

S. Varadarajan (1928–2022)

Dr S. Varadarajan, a science visionary and one of India's most accomplished science administrators, who left an indelible impact on India's science and technology landscape and was an institution builder *par excellence*, passed away in New Delhi on 11 May 2022. In his departure, India lost an ardent and passionate spokesperson for India's science and technology and a deep friend, mentor and philosopher for a generation of Indian scientists. In his signature sartorial attire, comprising a suit and tie, he rode the post-Independent India's science and technology landscape like a colossus. Though diminutive in stature, he possessed a keen and piercing mind, deeply analytical, intensely logical, and able to ask simple questions that would perplex and confound men with a lot more knowledge and experience than him in any field. His knowledge was deep and broad, and his understanding of the role of S&T in nation-building was all-encompassing.

Varadarajan was born in Bangalore on 31 March 1928. His first degree, MA in Chemistry, was from Madras University. Thereafter he went to Andhra University, where he secured a second master's degree. At Andhra University, he came under the tutelage of T. R. Seshadri, whom he followed to Delhi University and obtained his Ph.D. in natural product chemistry under his guidance in 1952. His doctoral research dealt with the structure determination of several benzopyrones and retinoid natural plant products and a study of their biological effects. After his Ph.D., he proceeded to the University of Cambridge, where he was associated with Sir Alexander Todd as an 1851 Overseas Exhibition Fellow. He was also associated with D. M. Brown and pursued research leading to the synthesis of nucleosides, nucleotides and the structure of the ribonucleic acid (RNA) phosphate linkage, through the first cyclonucleoside and with iodine labelled heavy atom, and the first application of X-ray crystallography to this problem in the Laboratory of Lawrence Bragg. This work earned him a second Ph.D. from the University of Cambridge, UK, in 1956. Thereafter he proceeded to Massachusetts Institute of Technology (MIT), USA, as a Visiting Lecturer in Biology (1956–57). His work at MIT dealt with uniformly ^{14}C labelled *Thiobacillus denitrificans* and *Escherichia coli* deoxynucleotides, converted to triphosphates chemically

and isolated through the first use of lithium bromide as precursors for biosynthesis of DNA. Later he was a Beit Memorial Fellow in Medical Research in Addenbrooke's Hospital, Department of Radiotherapeutics, University of Cambridge (1957–59). He was also a Member at Pembroke College, Cambridge (1953–59).



Varadarajan returned to India in 1959. He decided to take a road less travelled, and contrary to the general practice of joining academia, he chose to join Hindustan Lever Limited (HLL) to set up their industrial R&D Centre in Andheri, Bombay. He built a world-class R&D facility, staffed it with some outstanding men and women and began research, development and commercialization of various products in the area of detergents, oils and fats, perfumery chemicals and nutrition. HLL R&D gained global recognition for its contributions to the company's business and India's industrial economy, based mainly on indigenous resources abundantly found in India. Along with the CIBA Research facility in Goregaon and Hoechst Research Centre at Mulund, the trio of institutions in Bombay heralded India's entry into the realm of industrial research. Varadarajan rose to become the Director of Research and a member of the Board of HLL.

In 1974, he was appointed the Chairman and Managing Director of Indian Petrochemicals Corporation Limited (IPCL) at Vadodra, Gujarat. IPCL was a public sector company that built India's first integrated petrochemicals complex. Commissioned in 1975, IPCL heralded the first large volume chemicals and polymer manufacturing in India, based on the cracking of naphtha.

With little prior operational experience, a team of young engineers, working under the leadership of Varadarajan, commissioned simultaneously sixteen plants (the mother ethylene/propylene plant and the entire downstream chemicals and polymer plants) in a record time of less than four months with seamless coordination and orchestration.

It was at IPCL that I first met Varadarajan as a young man of 29. Under his guidance, we built the first R&D facility in Vadodra devoted to the areas of polymer science, heterogeneous and homogenous catalysis, surface science, organic processes and analytical science. He also helped create a bioprocess group at IPCL R&D, a testimony to his vision that one day the chemical industry will be transformed by biology. His concern for employees was legendary. He built a modern housing township with all amenities for the employees. At a time when getting a cooking gas connection at home was an arduous task, he struck a business deal with IOC, whereby every resident of IPCL Township was provided with a gas cylinder. He understood that the way (then!) to men's hearts was through the woman's kitchen! He negotiated with the Gujarat government for land on which employees of the company could get a house built by the company and paid for by EMI's from their salaries.

During Varadarajan's tenure of about seven years as CMD, IPCL grew in stature as a respected profit-making public-sector company operating some of the most complex chemical manufacturing plants in India with safety and efficiency. Through his persuasive arguments, he convinced Verghese Kurien of Amul that flexible low-density polyethylene (LDPE) pouches are the best packaging solution for milk. Between 1976 and 1978, a team from IPCL, of which I was a part, worked with Amul Dairy to translate this vision into practice and shift from glass bottles to LDPE pouches. Today, as the world's largest milk producer, if pasteurized milk reaches every nook and corner of India, we must acknowledge Varadarajan's visionary role in the innovative packaging of milk. He also laid the foundations for the expansion of IPCL at Nagothane, Maharashtra and Dahej, Gujarat, with new manufacturing plants. IPCL also produced a generation of leaders in science, engineering, manufacturing and marketing who assumed leadership positions in private sector industries, government and national laboratories. Much of the credit for inducting and nurturing talent in IPCL must

go to Varadarajan, who firmly believed that when it comes to talent, India was second to none.

Varadarajan assumed many important positions in the public sector and government after his term at IPCL. He was the CMD of Engineers India Ltd (1975–78; 1981–82) and Bridge and Roof Co. (1978–83). He worked as Secretary to the Government of India (1982–88) in the Department of Science and Technology (DST) and was Director-General, Council of Scientific Industrial Research (CSIR), Vice Chairman, National Biotechnology Board, and Chief Consultant Planning Commission of India (1986–88). Varadarajan was a Founder Member of the Oil Industry Development Board. He was invited to be a Member of the Oxford Energy Policy Club, St Anthony's College (1976–83). He served as a member of the Governing Councils of Indian Institute of Management, Ahmedabad (1974–92), National Council of Applied Economic Research (1976; 1984), Indian Institutes of Technology, Indian Institute of Science, Jawaharlal Nehru University and Banaras Hindu University. He was a Trustee of the Indira Gandhi National Centre for the Arts. He served for eleven years as Chairman of the National Commission of Science Museums and assisted in establishing several Science Museums from 1975 to 1986. He was a Member of the Public Enterprises Selection Board (1985–88). He was associated with international negotiations for the establishment of the International Centre for Genetic Engineering and Biotechnology in Delhi and Trieste and the formation of the Indo-French Centre for Advanced Scientific Research in Delhi. He was associated with the task of revision of National Generally Recommended Dietary Allowances for Nutrition. He served as the Chairman of Development Library Network DELNET from 1995 and was a member of the IUPAC Committee on Chemical Research Applied to World Needs (CHEMRAWN). Special mention may be made of the leadership he provided to work on the environmental effects of petroleum refinery on Taj Mahal (1974–76, 1994–95) and to assess the status of semiconductor grade silicon technology in India (1981–83) and create manufacturing facilities for silicon at IPCL, Vadodara. Sadly, his plans were aborted in 1984, a heavy price that the country is paying to this day.

No account of the life and work of Varadarajan will be complete without a men-

tion of the stellar leadership he provided to manage the aftermath of the methyl isocyanate (MIC) gas leakage at Bhopal in December 1984. Within a few hours of the event, he was in Bhopal, putting together a team of expert scientists and engineers, myself included, and supervised the 'Operation Faith' to deactivate and decommission the now-famous Tank 611 containing 42 tonnes of liquid MIC on 16 December 1984. It was decided that the safest way to deactivate MIC was to re-commission the plant and convert the remaining MIC in Tank 611 to carbaryl by reacting with α -naphthol, the very process Union Carbide Corporation (UCC) was practising at Bhopal. Varadarajan had to convince the government that this operation could be conducted with no additional risk and, hands-on supervised the operation to its conclusion. The complexity of the task is best understood when one recognizes that none of the experts assembled in Bhopal had any familiarity with the process or the manufacturing plant, and the experienced managers and operators of the UCC plant were denied entry into the plant by the investigative authorities. Varadarajan and his team's heroic efforts have been chronicled by D. Balasubramanian (<https://www.thehindu.com/sci-tech/science/article60637157.ece>). Varadarajan, along with a team of fifteen scientists and engineers, authored the most comprehensively researched findings of the cause of the accident in a report submitted to the government titled 'Report on scientific studies on the factors related to Bhopal toxic gas leakage' in December 1985. This report remains, to this day, the only authoritative scientific record of what transpired on the fateful night of 3 December 1984, written by Indian scientists and engineers (<https://bhopalgasdisaster.files.wordpress.com/2014/12/csir-report-on-scientific-studies-december-1985.pdf>).

Varadarajan had the rare distinction of serving as the President of the Indian National Science Academy (INSA) (1996–98), Indian Academy of Sciences, Bangalore (1980–82) and Indian National Academy of Engineering (1992–95). It was during his tenure at INSA, that the present permanent building of INSA was built at Delhi. Generations of scientists who have enjoyed the comfort of staying at the INSA Guest House must thank him for creating this excellent facility.

Varadarajan was elected Fellow of the Academy of Sciences for the Developing

World (TWAS), National Academy of Sciences (India), Allahabad, National Academy of Agricultural Sciences of India, All India Management Association, and Jawaharlal Nehru Centre for Advanced Scientific Research. He was bestowed the INSA CV Raman Medal, the INSA Medal for Promotion and Service to Science, and the INAE Lifetime Contribution Award in Engineering. The President of India conferred on him the coveted civilian award, Padma Bhushan.

In retrospect, it is not easy to imagine that one man could pack so many eventful and impact-making activities in one lifetime. Varadarajan was gifted with enormous energy, which he could transmit to others and propel them into action. He possessed a sharp intellect, a telescopic vision and was an astute manager of people. He thought big and had the rare ability to see both the forest and the trees. He was a caring person, large in heart and generous to the core. Many of us who have been recipients of his hospitality can attest to the spirits and food that was generously laid out for us. Varadarajan, however, preferred the former to the latter! Many fellows of INSA will remember seeing him at the entrance of the building after meetings, personally inviting everyone to go to his home in Feroz Shah Road for an evening of animated conversation and delicious food. He never missed attending a meeting of the INSA or IASc, late into his age, to meet friends young and old.

Varadarajan was married to Lotika, a renowned ethno-historian and a prolific author with scholarship spanning several disciplines, such as trade and knowledge exchange in pre-colonial and colonial textile technology, maritime technologies, cartography, museology and Indian ethnological heritage. She passed away in 2017. Varadarajan is survived by his sons, Raghavan and Madhavan. He also leaves behind a host of professional colleagues and friends whose lives he deeply touched and substantially enriched. I consider myself fortunate that I came to know him in the formative years of my professional life and had many opportunities to work with him closely, both at the company and national levels. I truly feel blessed to have received his mentorship.

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