

# INNOVATION TRAILBLAZERS

THE LEADERSHIP LEGACIES OF CSIR



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# **Innovation Trailblazers: The Leadership Legacies of CSIR**

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## FOREWORD

Institutions bear the imprint of their leaders. The Council of Scientific and Industrial Research (CSIR) is no exception. Tracing the evolutionary history of institutions is the task of the scholarly historian, one which is often made difficult by the absence of information. CSIR was born in 1942, amid a turbulent year, when the Second World War was raging, and Mahatma Gandhi had called for the British to Quit India. Its precursors were the Bureau of Scientific Research, 1939 and the Board of Scientific and Industrial Research (BSIR), 1940.

More than eight decades later, the early years of CSIR are fading from memory. In looking to the future, it is prudent to look back at the past. A beginning is made in this book, which assembles sympathetic portraits of the past leaders of CSIR, some of whom were in office for long periods while others had much shorter tenures. These 24 brief biographical sketches of Director Generals (DGs) of CSIR are authored by former colleagues, providing a glimpse of the men and one woman who have headed this flagship organisation in the country's scientific enterprise, which traces its origins back to the dramatic transitional years that preceded Independence.

By the late 1930s, the high point of the Bengal renaissance had passed, J.C. Bose was gone, P.C. Ray was nearing the end, C.V. Raman had moved to Bangalore and Meghnad Saha to Allahabad. S.N. Bose had completed his famous work. Much of the work for which Calcutta became justly famous was fundamental, the exceptions, of course, being P.C. Ray, who even at the turn of the century had recognised the importance of the chemical industry, and J.C. Bose, whose work set the stage for the first of the communication revolutions, that have transformed human society in the 20<sup>th</sup> century. Two research institutions, Indian Association for the Cultivation of Science (IACS), Calcutta (Kolkata) founded by Mahendra Lal Sircar (Sarkar) in 1876 and the Indian Institute of Science (IISc), Bangalore (Bengaluru), conceived by Jamsetji Tata in 1896 and born in 1909, stood as testimony to the recognition in India that the country's future development rested on its ability to absorb and exploit the fruits of scientific research. The colonial government was never disposed to invest resources in building scientific institutions, as exemplified by Lord Curzon's scathing comment on the proposal to establish IISc in the first decade of the last century: *"To start with polytechnics, and so on, is like presenting a naked man with a top-hat when what he wants is a pair of trousers"*.

In this environment, Meghnad Saha persuaded the President of the Indian National Congress, Subhash Chandra Bose, in 1938 to set up a

Planning Committee for Scientific Research under the chairmanship of Jawaharlal Nehru. Government support for organised science was launched with the birth of CSIR. Shanti Swarup Bhatnagar, the first DG, was an extraordinary builder of institutions, with laboratories across the country coming up in a few years. R.A. Mashelkar, one of CSIR's most charismatic leaders in later years, quotes C.V. Raman (1950), then an acerbic critic of the drive to establish National Laboratories: "*I think a new kind of effect is being displayed. I will call it, with great consideration, with trepidation, the Nehru–Bhatnagar effect. There was, for instance, a time when the chest of the government treasury was safely barred and locked and sealed against any demand from science. But now we see laboratory after laboratory coming up.*" In the decades that have passed, the laboratories have grown and contributed substantially to the growth of science and technology in India, even as science has transformed immeasurably over the last few decades.

In this volume, the reminiscences about CSIR's leaders provide personalised glimpses, albeit brief, of those who have shaped the organisation over the years. They are not scholarly historical assessments, replete with references, but personal accounts that often afford insights into qualities that hint at greatness.

My association with CSIR is a mere four decades, about half of its existence. Beginning with a stint on the Research Council of CFTRI, Mysore, in 1983, it has been my privilege to be almost continuously involved in diverse activities of CSIR. The extramural activities of CSIR in the 1960s and 1970s, along with those of the UGC, were crucial for the survival of academic science in universities.

In the years before the laboratories under the Department of Science and Technology (DST) and Department of Biotechnology (DBT) sprang into existence, and the IITs and IISERs mushroomed, CSIR represented much of the best in Indian science.

In December 1984, when the Bhopal gas tragedy unfolded suddenly, CSIR was thrust into the unenviable position of overseeing the safe conversion of large remaining stocks of toxic methyl isocyanate. This successful operation is an example of leadership under the most trying circumstances. S. Varadarajan, the then DG, was personally responsible, a story narrated very briefly by S. Sivaram in this volume.

By 1992, CSIR had completed 50 years of existence; building new laboratories was no longer a priority. The 1991 Budget had unleashed the genie of economic liberalisation. Many of us, for whom the flush of

youth lay behind us, were slow to recognise that the world around us was changing and changing fast. New and unfamiliar terms were beginning to appear on the horizon. Entrepreneurship, innovation, translational research and intellectual property would enter universal discourse. New world trade agreements were on the anvil. Research was needed to address practical problems with an urgency that had not been seen before in India. The creation of wealth, more simply put as patents that needed to earn money rather than spend it, was also on the scientific agenda. CSIR was at the centre of this transformation.

An old proverb states that “Opportunity maketh the man”. For CSIR, that man was a “dangerous optimist”, R.A. Mashelkar. From 1995 – 2006, as the longest-serving DG, his charisma and articulation placed CSIR at the centre of the advancing and burgeoning scientific enterprise. Ashish Lele’s portrait provides an appetiser for a more substantive analysis of CSIR’s adaptation to a changing environment. We must remember that adaptation is central not only to Darwinian evolution in nature but also to public institutions buffeted by economic and political change.

Less than two decades remain before CSIR marks a century of existence. The time is ripe to begin looking back at decades past and to tell the stories of the many scientists who helped the organisation navigate the period when science and technology exploded worldwide. The lessons of the past, both happy and unhappy, can be a valuable guide to the future.

Bengaluru  
September 2024

**Prof. P. Balaram**  
Former Director,  
Indian Institute of Science (IISc),  
Bengaluru



## PREFACE

The Council of Scientific and Industrial Research (CSIR) has a rich history, spanning over eight decades, defined by pioneering achievements and a steadfast commitment to advancing India's scientific and technological capabilities. As the current Director General of CSIR, I have both a privilege and a profound responsibility to carry forward the legacy of an institution that has played a central role in shaping the scientific landscape of the nation. This book, *Innovation Trailblazers: The Leadership Legacies of CSIR*, is a tribute to the 24 individuals who have led CSIR, guiding it through its numerous phases of growth, transformation, and excellence.

Each of these Director Generals has left an indelible mark on the institution, steering CSIR in ways that responded to the evolving needs of the country and the global scientific community. In compiling their profiles, this book provides glimpses of leadership qualities that defined their tenure and the broader context in which these leaders operated. The history of CSIR is a history of India's quest for self-reliance and innovation, and its Director Generals have been at the forefront of this journey.

The journey of CSIR began in 1942, amid World War II when India's scientific community was still in its nascent stages. The establishment of CSIR was a bold and visionary move, driven by the recognition that independent India would require strong scientific and industrial foundations to become self-sufficient and prosperous.

The first Director General, Dr Shanti Swarup Bhatnagar, is rightly hailed as the architect of CSIR. His leadership was instrumental in laying the groundwork for what has today become India's premier scientific organization. The establishment of national laboratories marked the early years of CSIR, the formulation of research strategies that would address the nation's immediate needs, and the nurturing of scientific talent that would serve as the bedrock for future generations.

Dr Bhatnagar's tenure was about laying physical infrastructure and envisioning a future where India could harness the power of science and technology for economic growth and social progress. His leadership set the tone for the organization, instilling a spirit of innovation, collaboration, and public service.

As India gained independence in 1947, CSIR's role became even more crucial. The subsequent Director Generals faced the challenge of aligning the institution's goals with the broader objectives of a newly independent nation. Each DG brought a unique vision, reflecting the

socio-economic priorities of their time. The profiles in this book capture these leadership transitions, highlighting how CSIR adapted to changing national needs while continuing to drive scientific discovery.

From expanding research in diverse areas to fostering international collaborations, the Director Generals during the post-independence years ensured that CSIR remained relevant and impactful. These leaders navigated the challenges of limited resources, rapidly changing global technological landscapes and the demands of a growing economy with foresight and determination.

Dr M. S. Thacker, who led CSIR during a critical period in the 1950s and early 1960s, oversaw significant industrial research and development growth. His tenure was marked by efforts to integrate science with the needs of India's industrial sector, laying the foundation for the institution's long-standing engagement with industry. Dr Thacker's leadership was instrumental in promoting collaboration between CSIR and various sectors, enhancing India's technological capabilities in critical areas such as chemicals and engineering.

Similarly, Dr M. G. K. Menon's tenure as DG saw a deepening focus on expanding CSIR's research into advanced fields. Dr Menon's ability to foresee the global shifts in science and technology helped ensure that CSIR remained at the forefront of scientific research during his time.

Dr S. Varadarajan, another distinguished leader, steered CSIR through the 1980s when India increasingly looked to science and technology as a driver of economic growth. His focus on fostering innovation and ensuring that CSIR's research had practical, real-world applications further solidified the organization's role as a key contributor to national development. Under his leadership, CSIR expanded its research portfolio and strengthened its ties with industries, ensuring that the innovations developed in the lab reached the marketplace and contributed to India's industrial growth.

As India entered the 21<sup>st</sup> century, its challenges became increasingly complex, requiring CSIR to evolve and expand its horizons. The subsequent Director Generals embraced this complexity, fostering innovation in emerging fields like genomics and renewable energy. Their leadership catalyzed the modernization of CSIR's research framework, integrating cutting-edge technologies and interdisciplinary approaches to address national and global challenges.

Dr R.A. Mashelkar's tenure is particularly noteworthy for his emphasis on intellectual property rights and indigenous innovation.

Under his leadership, CSIR became a global leader in patent filings, and Indian science was increasingly recognized worldwide. His efforts to democratize technology, ensuring it reaches the most vulnerable sections of society, remain a cornerstone of CSIR's mission.

Similarly, Dr Samir K. Brahmachari's leadership saw the emergence of AcSIR and the launch of the Open Source Drug Discovery (OSDD) program, a revolutionary approach to pharmaceutical research aimed at finding solutions to diseases that disproportionately affect developing countries. These initiatives reflect the evolving priorities of CSIR and its Director Generals—priorities that respond to the needs of the scientific community and society at large.

Today, as we stand on the threshold of new scientific frontiers, CSIR's role has never been more vital. The world faces unprecedented challenges—climate change, pandemics, energy security, and sustainable development. In this context, CSIR continues to be a beacon of hope, driving innovation that addresses national priorities and global imperatives. The legacy of the 24 Director Generals profiled in this book is a testament to the enduring spirit of leadership that has guided CSIR through decades of change and progress.

As the current Director General, I am deeply aware of the responsibility that comes with this role. It is a privilege to lead an institution with such a rich history and to build on the remarkable contributions of my predecessors. This book serves as a record of their achievements and an inspiration for future leaders, researchers, and innovators who will carry forward CSIR's mission.

*Innovation Trailblazers: The Leadership Legacies of CSIR* will offer readers glimpses of the vision, dedication, and perseverance that have shaped CSIR over the years. More importantly, I hope it will inspire the new generation to continue the pursuit of scientific excellence, to push the boundaries of knowledge, and to contribute to the betterment of society through science.

**Dr N. Kalaiselvi**  
Director General, CSIR



## ACKNOWLEDGEMENTS

The book *Innovation Trailblazers: The Leadership Legacies of CSIR* has been a deeply collaborative effort, and we are indebted to the many individuals who have contributed to this journey. This book would not have been possible without the guidance, encouragement, and support we received at every step.

First and foremost, we sincerely thank Dr N. Kalaiselvi, Director General, CSIR, for her visionary leadership and unwavering support in bringing this project to fruition. Her recognition of the need to document the contributions of the 24 Director Generals who have led CSIR since its inception was the cornerstone upon which this book was prepared. Dr Kalaiselvi's enthusiasm for capturing the essence of leadership, innovation, and legacy within CSIR inspired all involved in this endeavour. We thank the DG, CSIR for accepting the idea of such a book and consistently encouraging and supporting us throughout the process.

We are also greatly indebted to Dr Ram Vishwakarma, Distinguished Scientist, CSIR, for his invaluable role in shaping this project. His deep understanding of CSIR's history and his keen insight into the contributions of its leaders were instrumental in identifying the authors who could authentically capture the essence of each Director General's tenure. His efforts in assembling a group of esteemed contributors ensured that the profiles in this book were written with a personal touch. We are grateful for his commitment to this project and for his thoughtful guidance at every stage.

A heartfelt thank you to all the authors and contributors who took the time to delve into the lives and legacies of the Director Generals of CSIR. Their dedication to presenting an accurate and compelling narrative has been invaluable in shaping this book. Their contributions have brought to life the remarkable journeys of these leaders and the indelible impact they have had on CSIR and Indian science.

We also wish to extend our heartfelt thanks to Dr S. Sathiyarayanan, Head of Central Planning Directorate (CPD), Dr Rama Swami Bansal, Head of the International S&T Affairs Directorate (ISTAD), and Dr R. P. Singh, Former Head of the Innovation Management Directorate (IMD), at the CSIR Headquarters for their invaluable assistance in helping frame the roadmap of this book. Their early contributions in shaping the project's direction were pivotal, and we deeply appreciate their involvement.

A special thank you to colleagues in the Science Communication

and Dissemination Directorate (SCDD), CSIR HQ for their diligent efforts in scouring the archives and obtaining the invaluable pictures that enhance the narratives of this book.

We extend our most profound appreciation to the CSIR-National Institute of Science Communication and Policy Research (NIScPR) team for their outstanding work in designing and printing this book. The professionalism of the CSIR-NIScPR team has been instrumental in transforming this project into a polished publication, and we are grateful for their dedication.

Lastly, we thank the entire CSIR family for its constant support and enthusiasm for this project. CSIR's legacy is built on the collective efforts of its scientists, researchers, and staff, and this book is a tribute to all those who have contributed to its remarkable journey.

We are deeply grateful to everyone who played a part in this endeavour. We hope that *Innovation Trailblazers: The Leadership Legacies of CSIR* will serve as a lasting tribute to the visionaries who have shaped CSIR and as an inspiration for future generations of leaders and innovators.

**Dr Shikha Ambastha**

**Dr G. Mahesh**





# Shanti Swarup Bhatnagar

## *A Timeless Inspirator*

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**Raghunath A. Mashelkar, FRS**

*Former Director General*

*Council of Scientific & Industrial Research*

**S**HANTI Swarup Bhatnagar (SSB) was truly a timeless inspiration. He was a leader well ahead of his time, whom we all revere today as the beloved founding father of our CSIR.

Let's begin at the end.

SSB passed away on 1 January 1955. Pandit Jawaharlal Nehru paid a moving tribute to him.

“Dr Bhatnagar was a special combination of many things, added to which was a tremendous energy with an enthusiasm to achieve things... but for Dr Bhatnagar you could not have seen today the chain of national laboratories”.

Indeed, SSB was a ‘special combination’ of many things - a confluence of excellence in science, arts, languages, poetry, and literature. He built bridges. He was a bridge between colonialism and nationalism. He was a bridge between scientists, scientific peers and political leadership. In 1939, Sir J.C. Bose said, “Prof. Bhatnagar has provided a bridge of communication between scientists and industrialists. Nowhere are the beneficial effects of contact between university and industry better exemplified”.

SSB was born in Lahore on 21 February 1894 to Parmeshwari Sahai. His father died when he was just eight months old, and he was raised by his maternal grandfather, Munshi Pyarelal.

He was a young genius. As a 15-year-old, he published his first scientific work as a letter to the editor of the “Leader” on how to make carbon electrodes for batteries using molasses and carbon matter under heat and pressure.

SSB's inspiring life and work can be divided into three periods. First as a professor and a teacher (1921-35), then as a practitioner of applied industrial chemistry (1936-1945) and then as a leading science administrator and a pioneering institution builder (1945-55).

***“It is by the interchange of thought and work that the most fruitful results have emerged.”***

**— Sir Shanti Swarup Bhatnagar**



*1946: At CSIR's National Metallurgical Laboratory (NML), Dr S.S. Bhatnagar & Shri C. Rajagopalachari*

He received his DSc from the University of London in 1921. He joined Banaras Hindu University as a professor at the invitation of Pandit Madan Mohan Malviya. In 1924, he moved to the University Chemical Laboratory, Lahore, as its Director. A series of events led to his taking over the helm of affairs of CSIR. Let's trace the journey briefly.

In 1938, at the behest of Dr Meghnad Saha, Subash Chandra Bose, the then President of the Indian National Congress, created a National Planning Committee for Scientific Research under the Chairmanship of Pandit Jawaharlal Nehru.

This was followed in 1939 by setting up the Bureau of Scientific Research and then, in 1940, the Board of Scientific and Industrial Research (BSIR), with a budgetary allocation of ₹5.00 lakhs.

In 1941, Lord Linlithgow, the Viceroy of India, invited SSB to become the first Director of the Board.

On 14 November 1941, a resolution for the creation of CSIR was prepared by the Commerce Department and moved by Sir Arcot Ramaswamy Mudaliar. It was passed in the Legislative Assembly on 21 March 1942.

BSIR was then reconstituted as the Council of Scientific and Industrial Research (CSIR) and registered as a Society under the Societies Registration Act XXI, 1860.

It was on 26 September 1942 that CSIR was born as an autonomous body.

During 1946–47, SSB laid the foundation for the first of the five national laboratories, namely Central Glass and Ceramics Research Institute (CGCRI), National Physical Laboratory (NPL), National Chemical Laboratory (NCL), National Metallurgical Laboratory (NML) & Central Research Station, Dhanbad. Then followed the seven other national laboratories in rapid succession - thanks to what popularly



*1950: Left to Right: Dr K.S. Krishnan, Dr S.S. Bhatnagar, Shri Sardar Patel, and Dr S.P. Mookerjee during inauguration of the CSIR's National Physical Laboratory (NPL) building*

came to be known as the Nehru-Bhatnagar effect, a term coined by none other than Sir C.V. Raman himself, who remarked at the inauguration of Central Fuel Research Institute (CFRI).

“I think a new kind of effect is being displayed. I will call it, with great consideration, with trepidation, the Nehru-Bhatnagar effect. There was for instance, a time when the chest of the government treasury was safely barred and locked and sealed against any demand from science. But now we see laboratory after laboratory coming up.”

SSB was a true institution builder. Besides CSIR, he built so much else, much of it of a foundational nature.

SSB played a major role in not only creating the Tata Institute of Fundamental Research but also through CSIR, providing funding support to it in its formative years.

SSB was at the helm of affairs, occupying the position of a Secretary to the Ministry of Education, the Ministry of Natural Resources, and the Atomic Energy Commission, besides becoming the Chairman of the University Grants Commission.

SSB contributed to both fundamental science and applied scientific research. He was a pioneer in the physical chemistry of emulsions. He was the first to define the effect of electrolytes on the stability of colloidal solutions; he enunciated simple rules governing colloid stability. His hypothesis that all emulsifying agents (which we now term surfactants) with an excess negative charge will yield water-in-oil emulsions and emulsifying agents with an excess positive charge will result in oil-in-water emulsions is widely used even today.

He used magnetic susceptibility measurements to explore the properties of organic compounds, solutions, films and colloids. He proved the existence of ionic micelles by studying magnetic rotations of salt solutions with higher fatty acids in water and alcohol.

SSB maintained a fine balance of excellence and relevance throughout his life. India was then a poor country with rich natural resources. SSB applied science to create economic and social values from these natural resources.

He made fuels and lubricating oil from vegetable oils, jute and Shellac-derived containers for storing hydrocarbons, resins from bagasse

and jute, enamels and lacquers from Bhilawan nut, and cloth with a heat-insulating property of wool.

He followed up by creating cooperative research institutions focusing on value addition to our natural resources- like the Indian Jute Manufacturers Research Association, Calcutta, Indian

Rubber Manufacturers Research Association, Bombay and Textile Research Association, Bombay.

***“Failure does not baffle a scientist; it only creates in him the urge for a better planned and a more coordinated attack of the problem.”***

**— Sir Shanti Swarup Bhatnagar**

SSB’s messages and thoughts are timeless guiding lights today. When in doubt, we should simply turn to what SSB had opined on the issue. Let me give some examples.

First, there is often a debate on the distinction between the roles of fundamental research and applied research. SSB believed that there is only science and its application.

He famously said, “research can scarcely be divided into watertight compartments what is fundamental today may become very much of applied research in a very short time. Any artificial separation will render theory arid and practice petrified routine.”

Second, there are still (often uninformed) comments and debates about the role and place of national laboratories vis-a-vis universities. SSB was very clear on this.

In his convocation address of M S University of Baroda in 1951, SSB had said, “universities and national laboratories have complementary functions to perform. National Laboratories are not intended to supplant, but to supplement the work of individual or collective industrial concerns and universities in respect of research”.

Third, there are still debates on applied research having a lower status than pure basic research.

SSB was very frank when he commented on such a class distinction among the scientists. While addressing the Indian Chemical Society

in Calcutta in 1941, he remarked “I remember the days when we used to consider greasy, fatty, oily, cement, leather, textile, coal tar, paint and varnish chemists as something far removed from the realm of real chemistry, to be looked down upon by Pundits of Chemistry, who arrogated to themselves the self-styled title of pure chemists, almost implying that all others not of this kind are impure. In this age, even the pure chemist must soil his hands, although the spoils of academic reputation may be the privilege of the pure scientist”.

Fourth, India was late in waking up to the importance of a strong IPR. SSB believed in strong IPR. He himself was a holder of 29 patents. In 1945, he took a review of the patents held by Indians.

In 1946, SSB set up a Patent Expert Office in CSIR with the responsibility of ‘patent legislation and trusts’ under the supervision of K.N. Mathur, his former student.

It was 50 years later that CSIR established a formal Intellectual Property Management Division and created a formal IPR policy for CSIR, the first by any institution in India. Mashelkar committee (1993) on marketing CSIR’s knowledge base laid down the norms for sharing the benefits by individual scientists. This was just following the principles SSB had elaborated 60 years earlier about benefit sharing with individual scientists.

SSB had a big heart. He was generosity personified. When he put his personal earnings from licensing and royalties at the disposal of the university, Meghnad Saha had said, “India does not lack in men earning in millions; but if a few of these millionaires were guided by the fine example of a comparatively poor teacher like yourself her scientific and social progress would have been more rapid”. Later, SSB put his royalties at the disposal of the CSIR body.

Today, we have legislated 2% of the net profit of corporations for Corporate Social Responsibility. For SSB, his social responsibility showed up through his compassion, not through legal compliance.

There are three personal anecdotes with which I will like to end my tribute to SSB.

The first anecdote is about the Fellowship of the Royal Society, considered as one of the highest honors that a scientist can achieve in his

lifetime. SSB was India's first chemist to receive this honour in 1943. But there is something more to it.

When one is admitted as FRS, one signs in the original Charter book, which was created in 1663, a book in which legends such as Newton have signed. In the entire history of CSIR, only two other Director Generals have become FRS. One was Dr A.P. Mitra (1988), and another one was myself (1998).

Both Dr Mitra and I went to London to sign in the Charter book, but in the case of SSB, rather than him going to London to sign in the Charter book, the page that will form part of the Charter book travelled to him in Delhi.

Prof. Archibald Hill, FRS and Secretary of the Royal Society came to Delhi, carrying with him a parchment upon which he was empowered by Sir Henry Dale, President of the Royal Society, to take the signature of SSB, thus creating history in the Royal Society.

The second anecdote is about SSB's concern about India's weakness in IPR. He lamented, "weaker countries like India suffer, particularly as their scientific work is sometimes exploited even without acknowledgement."

SSB would have been proud to see how CSIR changed the game's rules worldwide about patents being granted without acknowledging India's traditional knowledge on which they were based. CSIR fought the wrong patent given by the USPTO on wound healing properties of turmeric, took the battle to WIPO and got traditional knowledge recognised for the first time in the International Patent Classification system. Eventually, it led to the Traditional Knowledge Digital Library, which forever eliminated biopiracy.

Here is the third anecdote.

I remember ending my Presidential speech at the Indian Science Congress on 3 January 2000, saying, "Next century will be the century of mind, and India will have the legitimate right to lead."

But ahead of his time as usual, the legendary SSB, way back on 6 April 1947, had said, "There are hardly any new lands which Indians can hope to exploit. The only new lands on which we may have our eyes must lie in the domain of mind. It is on these sources that we may have to

depend now and in the future for the means to maintain and raise our standard of living and to keep abreast amongst the best nations of the world.”

This timeless message by this timeless inspirator will continue to inspire generations to come.



### About the author

Dr Raghunath Anant Mashelkar, a world renowned polymer engineering scientist, is known for his transformative leadership as Director General of CSIR (1995-2006). He is one of the 3 engineering scientists from India to become FRS in 364 years of history of Royal Society. President of India honoured him with Padma Shri, Padma Bhushan & Padma Vibhushan, the only scientist from CSIR so far to have received all these 3 honours.







**M.S. Thacker**  
*A Visionary Institution Builder*

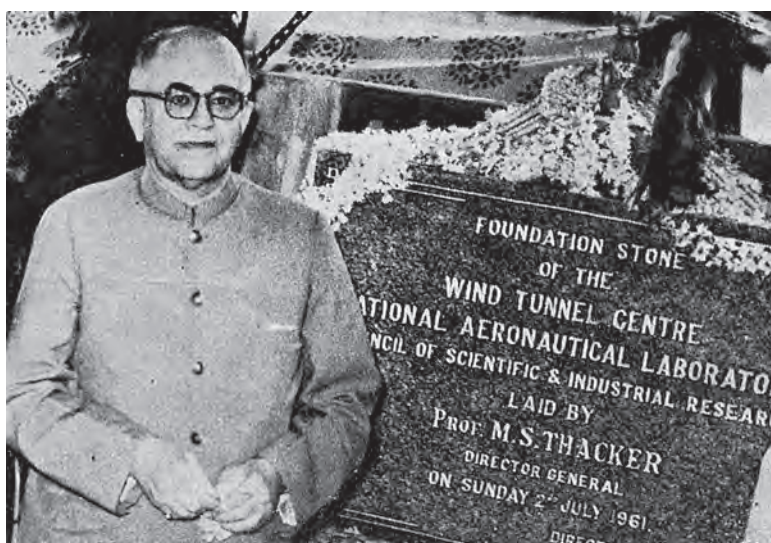
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**Ram Vishwakarma**

*Distinguished Scientist, CSIR, New Delhi and  
CSIR-Central Drug Research Institute (CDRI), Lucknow*

ONE of the key hallmarks of successful, sustainable and productive organizations, whether public or private, is the leadership identification and succession plan, particularly in their early and formative years. In this regard, and from the benefit of hindsight, it was truly remarkable how India, immediately after gaining its independence through a long struggle against colonial rule, identified and attracted remarkable individuals with expertise and vision to lead its scientific and technological institutions, such as CSIR, ICMR, ICAR, Atomic Energy Commission, INCOSPAR (later ISRO) and others – the drivers of the science-driven economy, industry and society. The CSIR was fortunate to have Sir Shanti Swarup Bhatnagar as its first Director-General (1942-1954), who laid a robust scientific and institutional foundation, resilient for decades to come. The successor of S. S. Bhatnagar was an equally gifted individual, M.S. Thacker – an Engineer-Scientist of remarkable capabilities and vision and the then Director of the Indian Institute of Science, Bangalore.

One wonders how he was persuaded to leave IISc to come to CSIR to succeed S.S. Bhatnagar! Perhaps the nation expected much more from



*Foundation Stone of Wind Tunnel Centre in CSIR-National Aeronautical Laboratory (NAL) Bangalore laid by Prof. M.S. Thacker, Director General, CSIR in 1961*

him – the roadmap of the power infrastructure of the new India was to be laid down, among many other beginnings of great significance to the new country.

M.S. Thacker (Maneklal Sankalchand Thacker) was born on 3 December 1904 in Ahmedabad (Gujarat), the erstwhile Bombay Presidency of British India, to a business family of Sankalchand Dahyalal Thacker (Father) and Narmada S. Thacker (Mother). After completing his early education in Ahmedabad and Bombay, he went to the University of Bristol, England, for his graduation in engineering. In 1927, he completed his studies and joined the Electricity Department of Bristol City Corporation, becoming the first Indian electrical engineer to serve in that position. After working in Bristol for four years, he returned to India in 1931 and joined the Calcutta Electric Supply Corporation (CESC), where he remained in service until May 1947 (over 15 years). While doing his engineering job at CESC, he did not allow his research interests to fade. He continued his research and teaching activities as a faculty member at Bengal Engineering College, Calcutta (now Indian Institute of Engineering Science & Technology, Shibpur) and the Banaras Engineering College (now Indian Institute of Technology) of Banaras Hindu University, Varanasi.

In 1947, M.S. Thacker moved to the Indian Institute of Science, Bangalore, as a Professor in a newly created Department of Power Engineering. At the Institute, he made significant original contributions in the field of electrical engineering, notably in the design and development of new instruments for power supply systems, which was recognized by his election as a Fellow of the American Institute of Electrical Engineers – the first Indian to receive this distinction. Only two years after he joined IISc as a professor he was elevated to the position of director – the first engineer director of the institute. He succeeded Sir J. C. Ghosh as the Director of IISc and remained in that position until 1955 when he was appointed as the second Director-General of CSIR to succeed Sir S. S. Bhatnagar.

M.S. Thacker was DG-CSIR for seven years (1955 to 1962) and simultaneously occupied the position of Secretary at the then Ministry of Scientific Research and Cultural Affairs. After completing his term as DG, CSIR in 1962, the Government of India appointed him a Member of



*Prof. M.S. Thacker and Prof. Arcot Ramachandran at IIT Madras in 1958 during Indian Science Congress, where Prof. Thacker was the President*

the Planning Commission for a 5-year term until 1967, where he played a stellar role in nation-building in many capacities.

From the archival records available, his unique personal attributes and administrative and managerial acumen were the drivers for his success witnessed initially at CSIR and later at the Planning Commission. In the words of K. G. Krishna Murthi, who saw him in action and wrote his biographical memoirs, M.S. Thacker had the “ability to instil confidence in colleagues and others to get their willing cooperation, in getting things

done rather than doing oneself, good public relations and like”. It is noted in the records of the time that during the tenure of M.S. Thacker as DG, CSIR, the “Directors enjoyed a great deal of operational freedom and that provided Thacker more time to deal with Chief Ministers, Central Ministers and Secretaries and others who mattered” and this he did with “amiability and achieved a great deal in building up the infrastructure such as lands, buildings and other facilities”. In summary, he focused more on the macro issues of institution building, policy formulation, and forging industrial and international partnerships rather than getting into micromanagement.

His tenure as DG, CSIR was marked by an unprecedented growth of the organization as well as the consolidation of the roadmap laid down by his illustrious predecessor. He was instrumental in bringing about perhaps the largest expansion of the CSIR system (institutions, pilot plants, core engineering facilities and extension centres) – as many as 14 new research institutes/centres were conceptualized and established, and the existing ones flourished.

The new institutions included Central Mechanical Engineering Research Institute at Durgapur, Central Mining Research Station (later to become CIMFR) at Dhanbad, Central Public Health Engineering Research Institute (later to become NEERI) at Nagpur, National Aeronautical Laboratory at Bangalore, Central Scientific Instruments Organization at Chandigarh, Indian Institute of Petroleum at Dehradun, National Institute of Oceanography at Goa, National Geophysical Research Institute at Hyderabad and Central Indian Medicinal Plants Organization (later to become CIMAP) at Lucknow, and five Regional Research Laboratories (Hyderabad, Bhubaneswar, Jorhat, Jammu and Trivandrum). These five RRLs were later repositioned/ renamed as CSIR Institutes during the time of Dr Mashelkar.

Outside the CSIR system, M.S. Thacker was instrumental in the formation of several institutions/industry associations, including the Tea Research Association at Tocklai, the Cement Research Institute in Delhi, the Jute Research Association in Calcutta and the Wool Research Association in Bombay, and the Central Power Research Institute under the Ministry of Power (Govt. of India) and others. This unending list shows how foresighted and passionate he was in his vision for a new India.

In his other roles, initially as a Secretary to the Govt. of India and later as a member of the Planning Commission, he played an even more central role in laying down the roadmap and policy framework for technical education and research in India. In this regard, one of his major contributions was in the establishment of the five original Indian Institutes of Technology (Madras, Bombay, Kanpur, Delhi and Kharagpur) – the harbingers of the IT revolution in time to come - and several Regional Engineering Colleges across India. He was responsible for getting support and cooperation from the USA, UK, USSR and Germany during the early foundational phase of the IITs.

To encourage greater scientific exchanges abroad, he led in setting up key exchange programs such as the British Council Exchange Scheme, German Academic Exchange Program, and US-National Science Foundation Scheme, which covered the deputation of scientists. In this direction, three examples stand out:

1. A project at IIT Delhi where British Industry contributed equipment, facilities and experts.
2. The setting up of the Indo-Swiss Center for Instrument Technology at Chandigarh, with the support of the Swiss Foundation.
3. Embedded partnership of French Institute of Petroleum with CSIR Institute of Petroleum at Dehradun.

Under his initiatives, several Indian laboratories received funding from UNDP programs.

M.S. Thacker, in his role as a Member - Planning Commission, played even bigger roles for the country, as he chaired a large number of committees and experts' panels, which laid down the framework for almost all sectors of industry, education and research. Some notable examples are:

1. A path-breaking report on "Energy Survey of India Committee 1965" chaired by him, with Homi Bhabha as a member among other stalwarts, created a policy framework for energy and power sector for time to come.
2. The Thacker Committee (1959-1961) established the guidelines for the country's post-graduate engineering education and research.

3. An expert committee of ICAR, chaired by him recommended comprehensive rules and regulations for the Indian Insecticide Act 1968/1971, which led to the setting up of Central Insecticide Board and registration, formulation and approval guidelines.
4. The Machine Tools Committee of the Ministry of Heavy Industries chaired by him laid the roadmap for heavy engineering and manufacturing industries.
5. The UNESCO Advisory Committee on Research on Natural Sciences.

He presided over the UN Conference in 1963 on the Application of Science and Technology for the benefit of less developed areas.

M.S. Thacker was a prolific writer on science, natural resources and society, and some of his books and articles are still relevant and insightful. For example, he co-edited with B.V. Keskar, the then Union Minister of Information and Broadcasting, an authoritative book series, “India-The Land and People”, published by National Book Trust in 1971, a treasure trove of quality information. His article entitled “The Application of Science and Technology for Socioeconomic Development”, published in 1971 by the “Forum of Free Enterprise” set up by A. D. Shroff, a leading industrialist and co-author of the so-called “Bombay Plan”, gives us a perspective on the positioning of technology as a bridge between science and society. His prophetic article, “Grammar of Scientific Development”, based on his Presidential Address at the Indian Science Congress held at IIT Madras in 1958, should be on the reading list of scientists and policymakers. His other important books are “Science and Culture” and “Natural Resources and Their Planned Utilization”.

M.S. Thacker received a number of honours and recognitions, and it is not possible to list them here. Some of the key recognitions include: President of the Indian Science Congress and the Indian National Science Academy; Fellow of the American Institute of Electrical Engineers, Indian Academy of Sciences; Indian National Science Academy, President, Institution of Engineers; Member, Institution of Electrical Engineers (London); President, Indian Institute of Metals; Institute of Fuel (London); DSc/DEng (*Honoris Causa*) from a large number of universities. Finally, for his great service to the nation, he was awarded Padma Bhushan by the President of India in 1955.

In my view, S.S. Bhatnagar and M.S. Thacker gave vision and wings to CSIR to explore the “Endless Frontiers” of knowledge. I must say, the more I learn about M.S. Thacker, the more he reminds me of his American contemporary, Vannevar Bush, a great MIT engineer and Science leader who was the first Director of the National Science Foundation of the USA.

M.S. Thacker passed away in 1979 (age 75 years) after playing a pivotal role in the growth of Science and Technology in the first two decades of independent India.

### **About the author**

Dr Ram Vishwakarma is a Distinguished Scientist at CSIR, New Delhi and CSIR-CDRI Lucknow, after serving as the Director of CSIR-Indian Institute of Integrative Medicine (CSIR-IIIM), Jammu (2009-2020). Dr Ram is well known for his contributions to organic & medicinal chemistry, biosynthesis of Vitamin B12, glycobiology (GPI-anchors) and drug development. He conceptualized and led several pan-CSIR societal/ therapeutic/ industry mission projects, notably Aroma, Phytopharma and Antiviral missions; established translational centres (CSIR-Innovation Complex, Mumbai and Industrial Biotech Parks in J&K). He is a Fellow of the National Academy of Sciences of India, received the Sun-Pharma (Ranbaxy) Award, served as a KV Reddy visiting Chair Professor at IIT, Madras, advisor to the World Bank projects and served on the Advisory Boards of Pharma/ Biopharma companies/ institutions.





## **S. Husain Zaheer**

### *An Innovative Changemaker*

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**A.V. Rama Rao**

*Former Director, CSIR-Indian Institute of  
Chemical Technology (IICT), Hyderabad*

THE Central Laboratory for Scientific and Industrial Research (CLSIR) at Hyderabad was formed on 5 August 1944, by the government of Hyderabad under the Nizam, which appointed Dr M. Qureshi, the then Head of the Department of Chemistry at Osmania University, as its first Director. After independence and the formation of the Indian government, Nizam's Firman, on 11 June 1947, declared Hyderabad as an independent sovereign state. Political uncertainties in Hyderabad persisted until the Indian Army's "Police Action" in September 1948 and subsequent merger with the Indian Union. During this time, Dr S. Husain Zaheer was the Principal of the Government City College since 1946, and, on 28 November 1948, was appointed as the Director of CLSIR by General J.N. Chaudhuri, who was the Military Governor of Hyderabad.

Dr Zaheer was educated at Lucknow, Oxford, and Heidelberg. He believed that to use CLSIR as an agency for socio-economic development; scientists should work with mission and dedication. With this vision, Dr Zaheer recruited eminent scientists like G.S. Sidhu, K.T. Achaya, M.G. Krishna, P.M. Bhargava, and R. Vaidyeswaran from India and abroad. He also appointed women as scientists and emphasized the importance of operational research for managing scientific research. Additionally, he created pilot plants to scale up laboratory processes for industrial feasibility.

***“Science is a philosophy which is never perfect. Its law is progress. The point which yesterday was invisible, is its goal today and will be its starting point tomorrow.”***

**— Dr S. Husain Zaheer**

Significant scientific work and investigations took place at CLSIR around 1950, which included studies on the insecticidal properties of custard apple seed oil, castor oil, and cottonseed oil, as well as work on active carbons, coal carbonization, and synthetic drugs. The first synthetic drug developed by an Indian research laboratory during this period (1951) was Methaqualone by I. K. Kacker and Dr Zaheer, who



*Dr Zaheer with Pandit Jawahar Lal Nehru and Vijayalakshmi Pandit*

were researching new antimalarial medications. This drug proved to be an effective hypnotic sedative but was largely misused as a recreational drug.

Dr Zaheer invited distinguished scientists and public figures to visit the laboratories and sought their advice in building CLSIR. Prime Minister Jawaharlal Nehru and Education Minister Maulana Abdul Kalam Azad visited CLSIR on 25 September 1952. Welcoming the guests, Dr Zaheer praised Nehru for recognizing the importance of science for the country's development and said, "Not only as the Prime Minister of India, a prince among Patriots upon whom the mantle of the Father of the Nation has aptly fallen but also as one who has given full recognition to science and scientific methods and development of the country".

After a decade at the Osmania University campus, CLSIR acquired a 222-acre site for its new laboratory, which included various laboratories and an auditorium. Prime Minister Nehru opened the new CLSIR building on 1 January 1954. In his speech, Dr Zaheer highlighted the progress made despite financial and other limitations, stating that scientific research is a philosophy of progress. Referring to people

who were sceptical of scientific research, Dr Zaheer said, “Science is a philosophy which is never perfect. Its law is progress. The point which yesterday was invisible, is its goal today and will be its starting point tomorrow.”

Initially named "Central Laboratories" during the pre-independence era, CLSIR acquired a regional character after Hyderabad's merger with the Indian Union. Following the reorganization of Hyderabad state and the formation of the state of Andhra Pradesh on 20 February 1956, CSIR took over the assets and liabilities of CLSIR, renaming it the Regional Research Laboratory (RRL), Hyderabad, on 1 October 1956.

I joined CSIR–National Chemical Laboratory (NCL) in July 1960 as a Research Fellow in Prof. K. Venkataraman's group, who was then the Director of CSIR–NCL. After two years into my career, there was a vacancy for the post of Director General at CSIR. At NCL, we all felt that Prof. K. Venkataraman would be offered the position of DG because of his scientific distinction and exceptional contributions to chemistry. Contrary to our expectations, Prime Minister Pandit Jawaharlal Nehru appointed Dr S. Husain Zaheer without any formal selection process.



*Dr Zaheer with Dr Sarvepalli Radhakrishnan*

Dr Zaheer served as DG, CSIR from 1 September 1962, to 21 August 1966, and during this time, he aimed to transform CSIR into an instrument for social change and economic development through the application of science and technology, emphasizing indigenous technology. He introduced a five-year promotion system for scientists based on merit to incentivize creative activities. He believed in bridging the gap between science and society, fostering a scientific attitude and temper.

Dr Zaheer was honoured with the Padma Bhushan in 1972 for his contributions to science and technology.

### About the author

Dr A. V. Rama Rao is a prominent Indian scientist and former Director of the CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad. He is an outstanding synthetic organic chemist, institution builder, entrepreneur and inventor known for his pioneering research in the field of drug technology. His work has been recognized with several awards, including Padma Shri (1991) and Padma Bhushan (2016).







# **Atma Ram**

## *A Master Technologist*

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**Indranil Manna**

*Vice Chancellor, BIT Mesra, Ranchi  
President, Indian National Academy of Engineering,  
Vice President, Indian National Science Academy*

**O**BSTACLES rarely stumble visionaries, and Dr Atma Ram (1908-1983), the scientific luminary, is certainly one of them. Former Director General of the Council of Scientific and Industrial Research (CSIR), Government of India, Dr Atma Ram's journey is a testament to the unwavering commitment of an intellectual, scientist, and technologist, all combined into one, for whom the quest for knowledge and innovation mattered more than any hurdle.

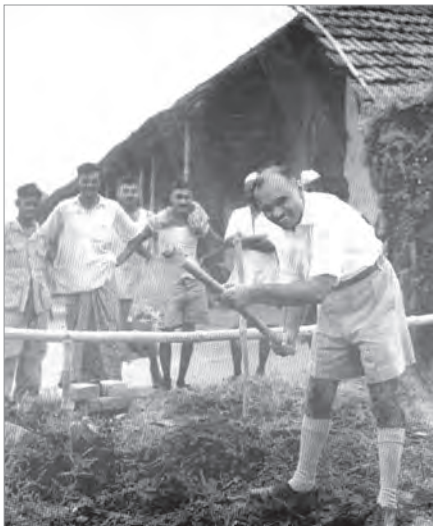
Atma Ram was born to a humble family in colonial times in Pilana, Bijnor, Uttar Pradesh. Given his filial circumstances, his initial years were anything but smooth sailing. Young Atma Ram did not hesitate to accept multiple odd jobs to overcome his financial predicament and fund his education. After his primary schooling, where he received an education in Persian, Arabic, and Urdu, he proceeded further along his academic journey. Pursuing a high school degree required him to walk several miles a day. Atma Ram endured and, through his perseverance, emerged as one of India's leading scientific and industrial minds.

Dr Atma Ram was truly a pioneer in glass and ceramics research in the country, which eventually culminated in successful industrial products in his lifetime and later. Undeterred by hindrances, he spearheaded the establishment of an institute dedicated to the specific ambit of research, which was the fourth in the chain of CSIR laboratories established after independence.

Young Atma Ram was resolute about his mission to translate knowledge into viable process technology and products. He did not allow a lack of funds or facilities to stand in the way. After graduating from DAV College, Kanpur, and earning his BSc degree with high laurels, his family insisted that he seek employment and help with the finances. However, young Atma Ram, buoyed by a nationalistic spirit and inspired by his teachers, was keen to continue his higher education and research trajectory. His continued excellence during his MSc and PhD at Allahabad University brought him on the radar of Professor N.R. Dhar, a celebrated academician of his time. As a research assistant under Professor Dhar, the gifted young scholar worked on the optical characterization of photochemical reactions, photooxidation, synthesis of formaldehyde, and its formation mechanism in the upper atmosphere. Dr Atma Ram was also privileged to receive partial mentoring from the eminent astrophysicist Professor Meghnad Saha.

Dr Atma Ram struggled to secure a job in the tumultuous pre-independence era despite his extraordinary credentials. However, in the early 1940s, he was accepted as a research assistant at the Industrial Research Bureau (IRB), which later evolved into the Board of Scientific and Industrial Research (BSIR) under the leadership of the legendary scientist Dr Shanti Swarup Bhatnagar. As BSIR was converted to an autonomous body of CSIR in 1942 with Sir Ramaswamy Mudaliar as President and Dr Bhatnagar as Director General, the latter swiftly recognized Dr Atma Ram's mettle. His groundbreaking work on developing indigenous fire extinguisher foam in wartime impressed Dr Bhatnagar. Dr Atma Ram's performance aided him in ascending the curve of his career, bestowing him prominence within CSIR.

Realizing the importance and widespread use of high-quality optical glasses as lenses in binoculars, cameras, microscopes, and visor glasses in the Second World War, Dr Meghnad Saha convinced CSIR to establish a new laboratory dedicated to melting and fabricating high-quality optical and speciality glasses. Calcutta was chosen as the venue as it was closer to the coal belt of Ranigunj and Jharia. Dr Atma Ram, already known as innovative and capable, was tasked with compiling a comprehensive report on India's glass and ceramic industry. Not only did he create a comprehensive report, but his meticulous planning and foresight earned him high praise from Dr Meghnad Saha. He was recommended to assume the coveted role of founding the Central Glass and Silicate Research Institute (CGSRI). The institute was later renamed the Central Glass and Ceramic Research Institute (CGCRI) in Kolkata, and Dr Atma Ram became its first Director.



*Leading by example – Dr Atma Ram in action at CSIR-CGCRI*

Though the work started in 1945, CGCRI was formally inaugurated in 1950 as the 4<sup>th</sup> Laboratory under CSIR. Dr Atma Ram demonstrated his utmost commitment to this institute's establishment and meaningful functioning. Under his guidance, CGCRI made noteworthy progress in glass and ceramic technology research, including developing optical glass for defence purposes. Dr Atma Ram paved the way for self-reliance in optical materials for the newly independent India by developing the technology and initiating its production at CGCRI. He fostered a fruitful connection between the industry and academia with innovative projects such as mica-based paints and insulating bricks, foam glass insulators, chemical porcelain, railway signal glasses, glass electrodes for pH meters, and spark plugs. To generate a more palpable real-time impact on society, he also worked on substituting imported selenium with copper to produce ruby red glass, which is vital for the bangle-making industry in Khurja, Firozabad, Uttar Pradesh. His significant contribution in this field is the development of highly homogeneous, optically clear, and corrosion-resistant lead glass sheets, blocks, and slabs for nuclear reactors. Under his rousing leadership, the institution developed an entirely indigenous technology for producing optical glass in India and has been meeting the nation's entire optical glass requirements since 1960. His journey from the realm of the underprivileged to the domain of prominence serves as an inspiring tale for young minds aspiring to be scientists and technologists.

A physical chemist by training, he employed his vigour to acquire innovative technical knowledge about glass and ceramics research. It often compelled him to travel to different parts of the globe. He was a member of an investigation team sent to Germany after WWII to inspect facilities working in the glass and ceramic domain. The organizers, i.e., the Allied Control Commission, gave Dr Atma Ram the honorary position of a uniformed officer. During the inspection, he was severely injured and had to be hospitalized for a long stretch. As a result of this trauma, he lost vision in one eye.

Nevertheless, this accident was not a deterrent that could throw him off his orbit. Surviving this ordeal, he continued to dedicate himself to research and development. He visited the National Bureau of Standards, USA, to usher in further growth for the optical glass-related research domain. His role as the Director of CGCRI was pivotal in the



*Dr Atma Ram taking charge as Director General, Scientific and Industrial Research, India, from his predecessor Dr S. Husain Zaheer on 22 August 1966 at New Delhi*

*Pictures Credit: 'Atma Ram Memorial Museum and Archives, CSIR-CGCRI, Kolkata'*

collaborative efforts of the Indian and the USSR governments to produce optical and ophthalmic glass.

Dr Atma Ram convinced the authorities to create or revise a policy through his cogent scientific arguments. His erudite correspondence with Dr Mahalanobis, an influential member of the Planning Commission, paved the way for the inclusion of refractories and glass technology as an important component of the industrial growth of India in the second five-year plan document.

In August 1966, Dr Atma Ram climbed a new height of his career when he was appointed the 4<sup>th</sup> Director General of CSIR, an institution to which he had laid the cornerstone with Dr Bhatnagar. His tenure was marked by momentous reforms and an emphasis on aligning scientific research with national needs. He stressed practical applications of scientific research to solve societal and industrial problems. He was unafraid to be a frontrunner and often an usher of difficult yet necessary changes to ensure holistic growth. He was also chosen to be the Chairman of the National Committee on Science and Technology (NCST) in 1977, where he served as prime consultant to the Prime Minister and the Union

Cabinet. His leadership roles protracted from serving as President of the Indian Science Congress in 1968 to the Indian National Science Academy (INSA) from 1969 to 1970. He was also allied with the Indian Science News Association and *Science and Culture* journal. He held several other prestigious positions, including President of the Indian Science Congress, President of the Institute of Chemists, and Vice-President of the National Institute of Sciences of India.

Furthermore, Dr Atma Ram was made the Honorary Fellow of the Indian Institute of Ceramics for his noteworthy and pioneering contributions in this field. He was also invited to be a Special Member of the International Commission on Glass. Additionally, he was elected as the Chairman of the prestigious UNIDO Group Conference on "More effective utilization of industrial research in developing countries," held in Copenhagen in August 1971.

Paying rich tribute to his contributions as a technology leader, Mrs Indira Gandhi, the then Prime Minister of India, on the eve of his retirement as the fourth DG, CSIR in 1971, observed, "Dr Atma Ram has brought distinction to India in the field of applied research over his long years of service for the cause of science."

Dr Atma Ram's pioneering work earned him numerous accolades. In 1959, he received the debutant Shanti Swarup Bhatnagar Medal for his contributions to physical and technological sciences. In the same year, he was awarded the Padma Shri. He also received an honorary doctorate from the Lenin Soviet Technological Institute. An *Honoris Causa* was conferred upon him by Banaras Hindu University, Andhra University in 1968 and Saugar University in 1971. All India Glass Manufacturers Federation bequeathed him a plaque of



*Dr Atma Ram receiving Padma Shri from  
Dr Rajendra Prasad, the President of India  
in 1959*

honour in 1964. He was recognized as an Honorary Fellow of the Society of Glass Technology, Sheffield, in 1966. Throughout his lifespan, he published over 200 original research papers in professional journals and filed 31 patents, proving in ample measure that he was both a researcher and technologist par excellence.

Dr Atma Ram passed away on 6 February 1983, in Delhi, at the age of seventy-four. A man of great intellectual stature, he believed in the philosophy of simple living and high thinking. He dressed in the most casual attire, often inciting curiosity in others. His trailblazing legacy is characterized by his outstanding work in industrial research in India. His endeavours laid the foundation for headways in glass and ceramic studies. His leadership helped shape the trajectory of CSIR and its multiple facilities across India. Dr Atma Ram's chronicle is one of steadfast dedication to science and technology, marked by his resilience in conquering personal and professional trials. He lives on in his pragmatic innovations that engendered tangible impact in the cross-sections of the nation.

### About the author

Prof. Indranil Manna, a former JC Bose Fellow, is currently the Vice Chancellor of BIT Mesra, Ranchi, and has served as the Director of CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata, from 2010-2012.

Prof. Manna received several awards for his contributions to science and technology. He is elected a Fellow of all the National Academies in India in Science (INSA, IASc, and NASI) and Engineering (INAE), and also of The World Academy of Sciences (TWAS) and Asia Pacific Academy of Materials (APAM). He is currently the President of INAE and Vice President of INSA.







# **Yelavarthy Nayudamma**

## *A Lasting Influence*

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**T. Ramasami**

*Former Secretary, Department of Science and Technology,  
Ministry of S&T, Government of India*

*Former Director General, CSIR*

**D**R Y. Nayudamma was born on 10 September 1922 in Yelavarthy, a remote Indian village. He graduated from a nearby school with limited infrastructure. He went on to Banaras Hindu University for higher education in industrial chemistry and was sent to the University of Leeds, UK, by the Government of India to acquire higher qualifications in leather technology. After a brief period, he moved to Lehigh University in the USA to work with Edwin R. Theis towards his doctoral degree. Serving India was his internal call.

He joined Central Leather Research Institute (CLRI) in Chennai in 1951 and became the scientist-in-charge in 1958 at the age of 36. His entire professional service before becoming Director General of CSIR was also in CSIR. After serving a term of about 71 months as Director General, he returned to CLRI as the first Distinguished Scientist at the age of 55. He remains a role model for being a cause of change.

The manifold contributions of Dr Y. Nayudamma as DG, CSIR are memorable. Dr Nayudamma was the Director General of CSIR during a momentous period between 28 August 1971 and 27 July 1977. The Review Report of the Sarkar Committee submitted in 1968 contained many challenging recommendations, including structural reforms, refocusing of R&D priorities and transfer of CSIR laboratories to user ministries. It was a moment of crisis. The tasks of rebuilding the internal morale and external image were challenging. To his credit, the decision to transfer four laboratories made after his time had to be rescinded by the Government. Dr Y. Nayudamma converted the crisis of confidence into an opportunity by innovating.

Dr Nayudamma established polyclinics. He focused on the ability of CSIR to play solution designers to serve small and medium enterprises. He strived to democratize Indian innovations. The Industrial Policy of 1977 prioritized job creation by leveraging production by Small and Medium Enterprises. Dr Nayudamma connected the focus of CSIR to the

***“We have only two majorities in India- the young and rural poor. Every other group is a minority. Let us train the young to serve the rural poor”***

**— Dr Y. Nayudamma**

national aspirations and gained political support. He championed the seamless mobility of technical professionals across research and industrial enterprises. Internal morale and public image soared back. CSIR was in the news for good reasons.

One of the telling contributions of Dr Nayudamma as DG was to attract talent to CSIR. Dr R.A. Mashelkar, Dr Paul Ratnaswamy, Dr T. Ramasami, and many more were scouted by Dr Y. Nayudamma to serve CSIR. Three people he invested in held the office of DG, CSIR in later years. Many of his recruits became Directors of CSIR laboratories. His foresightedness in spotting talent was admirable. Dr G. Thyagarajan was appointed as the Director of the then Regional Research Laboratory, Jorhat, at the age of 40. This remains a hallmark of the visionary's decision-making.

CSIR expanded its research domains during his tenure. The Centre Cellular and Molecular Biology, Centre for Biochemicals (now CSIR-IGIB) and Regional Research Laboratory, Thiruvananthapuram (now CSIR-NIIST) were established. The scientific excellence extolled by the three institutions bears testimony to his commitment to scientific excellence and basic research.

Serving the cause of equitable development of India remained his commitment. He embarked upon a show-how experiment of CSIR on "Equitable and balanced development of Karim Nagar." CSIR might have short delivered on its project goals, but it conveyed a lasting message that it stands for "sustainable and equitable development." A revisit of the Karim Nagar project on "the long-term benefits of the show how experiment" might be in order. He saw in CSIR a vehicle for delivery of sustainable development goals and serving the cause of spreading economic freedom to rural India.

India's celebrated success through Green and White Revolutions demanded inputs from CSIR. CSIR delivered technology packages for agrochemicals. Milestones of CSIR in the service of India during the

***"Industry and research should move as closely as people in ballroom dance, hand to hand and cheek to cheek".***

**— Dr Y. Nayudamma**

1971-77 period include the Swaraj tractor and Mark II pumps developed by the Central Mechanical Engineering Research Institute (CMERI) under the leadership of Dr Suri as well as Technology for Amul Milk powder from buffalo milk developed by Central Food Technological Research Institute (CFTRI). The Titanium Anode technology of the Central Electrochemical Research Institute (CECRI) and the soft drink, 77, developed by the Central Food Technological Research Institute (CFTRI), are all examples of connecting research resources and competencies to national causes at times of need. Following the 1971 war with Pakistan, India needed technology for magnesium security. CSIR delivered the technology for magnesium production.



*Dr Y. Nayudamma as the DG, CSIR in the CSIR Society meeting 1976, Chaired by the then Prime Minister of India, Smt. Indira Gandhi*

The Sarkar Committee had recommended centralised decision-making for setting R&D priorities and limiting the functional autonomy of constituent laboratories as in strategic research. Dr Y. Nayudamma's belief that "when sensitivities were local, command could not be central for non-strategic research", made him delegate authority and empower constituent laboratories. A study of decisions of the Governing Body and the CSIR Society during 1971-77 would reveal historical governance measures taken in CSIR.

Dr Nayudamma found harmony with the political leaders in serving the technological needs of rural India in the 1971-77 period. At the Indian Science Congress meeting held on 3 January 1976, the then Prime Minister of India made a call to the Indian scientists to align their research priorities for serving the people of rural India. Dr Nayudamma aligned CSIR with the national aspiration. His statecraft earned the trust and confidence of the Prime Minister with benefits to CSIR.

Dr Nayudamma championed for right investments into industrial research. Investments into R&D by industries were estimated at ₹2735.6 lakhs, while the total budget of CSIR was at ₹1825.1 lakhs during 1971-77. Currently, 42% of national R&D expenditure is derived from industries. Public investments into CSIR for industrial R&D are now only a small fraction. His report culminated a) in the establishment of Science and Technology Entrepreneurship parks by DST and b) institutionalization of the Graduate Aptitude Test for Engineers. Banning the export of raw hides, skins and intermediates in 1972 proved a game changer for India. The Indian leather sector employs 4 million people, and India is currently a major exporter of mid- and high-priced leather products worldwide. His visionary thoughts triggered many desirable changes in the country's industrial environment.

When the celebration of new knowledge was the prevailing norm, he championed the relevance of knowledge and the use of technology for solutions to the country's social problems.

*"Science is like spreading water on a dusty floor. As the water spreads, islands of dust remain but eventually close up"*

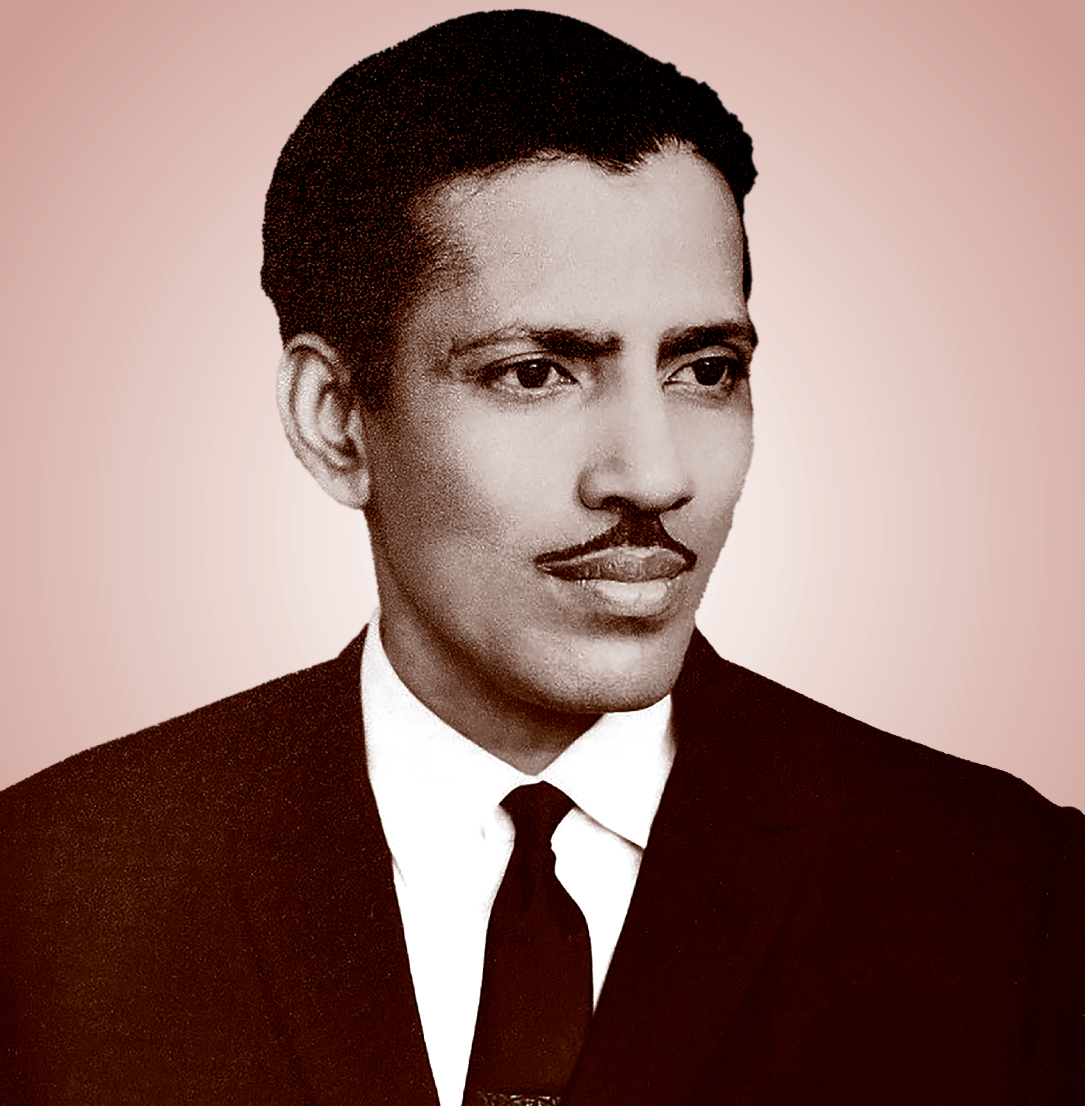
— Dr Y. Nayudamma

He extolled the values of excellence, relevance and convergence of knowledge through research and development. He added a human face to research in CSIR. When the history books of CSIR are turned, his persona of standing for positivity and speedy decisions is revealed by his initials, Y for Yes and N for Now.

### **About the author**

Dr Thirumalachari Ramasami is a renowned Indian scientist and administrator. He served as the Secretary, Department of Science and Technology, and the Director General, Council of Scientific and Industrial Research. He is a Fellow of several prestigious science academies. Among his numerous honors, Dr Ramasami was awarded the Shanti Swarup Bhatnagar Prize for chemical sciences in 1993, the President of India honoured him with the Padma Shri in 2001 and Padma Bhushan in 2014. The author was an undergraduate student of Dr Y Nayudamma.





## **Arcot Ramachandran**

### *An Institution Builder*

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**S. Srinivasa Murthy**

*Visiting Faculty, ICER/ IISc Bangalore  
(Formerly IIT Madras)*

PROFESSOR Arcot Ramachandran was born in Madras on 6 April 1923. He obtained his Honours degree in mechanical engineering in 1943 from the University of Madras. He then pursued his graduate studies on heat transfer at Purdue University, USA, under Professors Max Jakob and George Hawkins during 1945-49. On his return to India, Ramachandran joined as a faculty at the Department of Mechanical Engineering, Indian Institute of Science (IISc), Bengaluru.

At that time, however, very little research was being done in India in heat transfer, as there were hardly any graduate programmes in engineering. During 1950-67, Ramachandran established several graduate programmes in mechanical engineering and industrial management. In particular, he set up a school of heat transfer research, attracting several scholars and professors. Regarding basic research, he worked in pool and film boiling heat transfer, heat transfer from vibrating and rotating surfaces, free convection heat transfer, thermal entry length studies in annuli, and hydrodynamics and heat transfer in non-circular passages.

The needs of a developing nation led him to focus his attention on thermal power problems, such as using lignite as a fuel for power generation. He conducted extensive research on heat transfer problems related to production technology, such as solidification, thermal properties, and characteristics of metals and non-metals, which helped him gain international recognition.

Amid his illustrious professional career, Ramachandran was invited to take over as the Director of the Indian Institute of Technology at Madras (IIT-M) in 1967. During his tenure there, spanning a little over five years, he gave a major thrust to research by initiating and encouraging basic and applied research in many fields of science and engineering. With his charming personality and capacity to make quick and intelligent decisions, he moved significantly towards the growth of IIT-M as a leading research institution. In heat transfer, he established a new school of research at IIT-M. This school is now a recognized centre of excellence for research in heat transfer problems related to food processing, fluidized bed combustion, solar thermal systems, and refrigeration and air conditioning technologies.

Apart from being a great academician, researcher and administrator,

Ramachandran was a builder of institutions. As the founder-president of the Indian Society for Heat and Mass Transfer since 1974, he shaped the Society into an effective vehicle of interaction between the heat transfer community in India and abroad. With his insight into the similarity of problems of the developing countries, he was instrumental in founding the Regional Centre for Energy, Heat and Mass Transfer for Asia and the Pacific, which is the first regional centre of excellence in the field to be established in cooperation with UNESCO, International Centre of Heat and Mass Transfer, and the national government. He has been a delegate to the International Assembly for Heat Transfer Conferences and was a member of the Scientific Council of the International Centre for Heat and Mass Transfer.

His achievements attracted the attention of international organizations and the national government. In 1973, he was invited to assume the position of Secretary in the newly established DST and was later concurrently the Director General of CSIR.

This department was then responsible for planning and directing research and development in science and technology through a network of research laboratories, academic institutions, and industrial organizations in the private and public sectors. During his tenure, the first Science and Technology Plan was approved. His other noteworthy achievements include the establishment of the National Remote Sensing Agency, Ocean Science and Technology Agency, Science and Engineering Research Council, National Information System for Science and Technology and Central Electronics Limited – an industrial undertaking for manufacturing ferrites for electronic instruments and solar cells. He was the architect of the National Programme for Research and Development in Renewable Sources of Energy. During his tenure, the government also introduced fiscal incentives for research and development in industry.

Ramachandran played a leading role in engineering education at the undergraduate and graduate levels as chairman and member of various boards. He was Chairman of the Preparatory Committee for the United Nations Conference on Science and Technology for Development (1977-78). He was also Chairman of the UNESCO International Conference on Education and Training for Engineers and Technicians, the Association for Engineering Education in South and Central Asia, the UNESCO



*Prof. Arcot Ramachandran takes over charge as Director of IIT Madras from B Sengupto in the presence of C.V. Sethunathan, the Registrar, and S. Sampath, Professor in the Department of Electrical Engineering*

*(Photo Courtesy: IIT Madras)*

Expert Group on Environmental Aspects of Engineering Education and the ESCAP Experts Meeting on the Regional Centre for Transfer of Technology. Based on the recommendations of this group, the ESCAP Regional Centre for Transfer of Technology was established in Bengaluru in July 1978.

In October 1978, he was appointed as the Under-Secretary-General and Executive Director of the newly established United Nations Centre for Human Settlements (Habitat) with headquarters in Nairobi. He also had the additional charge of Administrator of the United Nations Habitat and Human Settlements Foundation. In six years, the Centre became fully operational and helped several countries in Africa, Asia, West Asia, Latin America and the Caribbean. During his tenure as the Under Secretary General at the UN Centre for Human Settlements, he proposed the introduction of World Habitat Day, which was accepted, leading to observing the first Monday of every October as a special day to remind

the world of sustainable progress with regard to the environment. He was also instrumental in the proclamation of 1987 as the International Year of Shelter for the Homeless, as a part of the Global Strategy for Shelter for 1987. During his tenure in 1990, the UN launched the Sustainable Cities Programme in 12 cities. He retired from the UN in 1993.

Ramachandran received many national and international honours for his outstanding achievements in professional and related fields of activity. He was honoured by Purdue University with an Honorary Degree of Doctor of Engineering and the Distinguished Alumnus Award. He was awarded an Honorary Doctorate from Stuttgart University (Federal Republic of Germany), University of Roorkee, Andhra University, Jawaharlal Nehru Technological University, Anna University, Indian Institute of Technology Madras and the University of Venice, Italy. The Institution of Engineers (India) elected him as an Honorary Life Fellow, and the Indian Institute of Science bestowed upon him the Honorary Fellowship of the Institute.

Ramachandran was a Fellow of the American Society of Mechanical Engineers, Institution of Mechanical Engineers (London), Indian National Science Academy, Indian Academy of Sciences and Indian National Academy of Engineering. He was a member of the editorial boards of several technical journals, including the *International Journal of Heat and Mass Transfer*. He was the Editor-in-chief of the *Regional Journal of Energy, Heat and Mass Transfer*. He has also received several awards: like Heat Transfer Memorial Award of the American Society of Mechanical Engineers (1986), the World Habitat Trophy, the Building and Social Housing Foundation of UK (1995), Shanti Swarup Bhatnagar Gold Medal (1998), Indian National Academy of Engineering Lifetime Achievement Award and Sir M. Visvesvaraya Lifetime Achievement Award in Engineering (1999), Padma Bhushan (Government of India; 2003) and World Federation of Engineering Organisations Award (2005).

Professor Arcot Ramachandran breathed his last on 17 May 2018 in Bengaluru at the age of 95 years. Until his last days, he closely followed the vast developments in the country in various fields of Science & Technology. As an exemplary educator, an accomplished scientist and an efficient administrator, Ramachandran has left an indelible mark in the realm of Science & Technology.

## About the author

Prof. S. Srinivasa Murthy is a distinguished academic and researcher in the field of heat and mass transfer, specializing on renewable and clean energy technologies. After nearly four decades at IIT Madras, he is now a visiting faculty at the Indian Institute of Science, Bangalore. He is known for his works on areas such as solar thermal energy, solid state hydrogen storage and refrigeration & air-conditioning. His contributions have significantly advanced research and education in the above areas.





## **M.G.K. Menon**

### *A Scientific Statesman*

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**Arun Kumar Grover**

*Sr. Prof. (Retd.), TIFR, Mumbai, and  
ex-Chairperson, Research Council,  
CSIR- National Physical laboratory (NPL)*

**C**OSMIC Ray Physicist, Dr Mambillikalathil Govind Kumar (M.G.K.) Menon, succeeded power engineer, Dr A. Ramachandran, as Director General of CSIR on 10 October 1978, while serving concurrently as Secretary of the Department of Science and Technology (DST) (1978-82). His predecessor was the first Secretary of DST (1973-78).

M.G.K. had served as the Chairperson of the Electronics Commission in the newly created Department of Electronics from 1970-78. He had accepted such a responsibility while serving as Director, Tata Institute of Fundamental Research (TIFR), Bombay, succeeding Dr Homi Bhabha, after his sudden demise in a plane crash on 24 January 1966. Bhabha submitted the final consolidated report of the Electronic Committee to GoI in December 1965.

Before his induction as DG, CSIR, M.G.K. was appointed an Adviser to the Defence Minister, and he later served as DG of DRDO (1974-78). At DRDO, his first initiative was to foster more collaborations between space and defence research. His close relations with his senior, Dr Brahm Prakash, and Abdul Kalam's regard for M.G.K. came in handy. M.G.K. was responsible for creating synergy between projects of national relevance in Electronics, Defence and Software.

Sir C.V. Raman ordained M.G.K. to pursue a career in physics. M.G.K. obtained his BSc from Jaswant Singh College, Jodhpur, at age 18 in 1946. After this MSc from the Royal Institute of Science, Bombay, M.G.K. travelled to Bristol in 1949 for a PhD under C.F. Powell. Powell received the Nobel Prize in 1950 for the 'development of the photographic method of studying nuclear processes and his discoveries regarding mesons'. M.G.K. used the same method innovatively to unravel several aspects of the 'Tau-Theta puzzle', which intrigued the globally engaged Cosmic Ray researchers and particle physics theorists.

M.G.K.'s work on nuclear interactions induced in nuclear emulsions exposed to a beam of slow Pions accelerated in Berkeley Cyclotron had attracted global attention as this confirmed the Bosonic character of Pions, as required for Yukawa particles.

M.G.K. submitted the thesis titled 'The Tau, Kappa and Chi particles' in October 1952. He was awarded the Senior Award of the 1857 Industrial Exhibition to continue his work at Bristol as a Postdoctoral fellow. Homi

Bhabha had received the same Fellowship in similar circumstances two decades earlier at Cambridge.

Bhabha was the rapporteur at the International Conference on Theoretical Physics in Japan in September 1953, where he and Bruno Rossi endorsed that Tau and Theta are the same. Its lifetime was measured to be nanosecond by M.G.K. and his collaborators. C.N. Yang quizzed Bhabha after his presentation at the conference. Three years later, C.N. Yang and T.D. Lee developed the theory of parity violation in weak interactions, which merited them the Nobel Prize in 1957.

Homi Bhabha identified the young rising star M.G.K. for induction, and he joined as a Reader at TIFR in December 1955 in preference to a Professor's position at a leading University in America.

At TIFR, M.G.K. was first assigned the responsibility of a team to indigenously develop large plastic balloons which could carry payloads up to the stratosphere. The US had imposed an embargo on sharing technical know-how on balloons developed for their Department of Defence. His team members were fabricating balloons with commercially available polyethene, which were white. Such balloons shattered like glass ongoing across Tropopause. Under M.G.K.'s leadership, the TIFR group overcame this problem by adding carbon black to the base material before extruding plastic films. The black plastic could absorb sunlight effectively, and such balloons passed through the Tropopause without cooling below the brittle point temperature of the plastic film. This was M.G.K.'s baptism in self-reliance. The TIFR Balloon group progressed to emerge as the National Balloon Facility at Hyderabad, which is globally used today.

M.G.K. had effortlessly permeated into all the domains of Bhabha's Cosmic Ray programme, comprising:

- i. Nuclear emulsion stacks exposed at high altitudes by R R Daniel, S Biswas, et al.
- ii. Detectors (cloud chambers and proportional counters) employed by B.V. Sreekantan and his team in Ooty and deep underground mines in Kolar Gold Fields (KGF), after his return as a postdoc from Bruno Rossi laboratory at MIT.



*1995: Prof. M.G.K. Menon at CSIR-CSMCR*

- iii. Electronic detectors and other payloads carried to high altitudes in Balloons.

M.G.K.'s PhD student at TIFR, P.V. Ramanamurthy, was amongst the pioneers of research on muons in KGF. M.G.K. and his collaborators had argued that the deep underground site at KGF was ideally suited for experiments to explore Cosmic neutrinos and limit protons' lifetime.

Prof. M.G.K. Menon was given charge in 1959 to oversee the Cosmic Ray Group, originally set up by Bhabha in Bangalore. M.G.K. received the SSB Prize in 1960. CSIR instituted this prize in 1957; initially, only one award was envisaged to be given annually. Sir K.S. Krishnan (KSK), FRS, the first Director of the CSIR-National Physical Laboratory (CSIR-NPL), was selected for the SSB prize in 1958. In 1960, SSB Prizes were given in four subjects; M.G.K. (TIFR) and Homi N. Sethna (DAE) were selected for Physics and Engineering, respectively.

M.G.K. was made a member of a CSIR committee in 1963 to study the Lord PMS Blackett Report on CSIR-NPL. Several leadership issues had cropped up after the sudden passing away of Dr K.S. Krishnan on 14 June 1961. No new Director could be appointed till the end of 1962. M.G.K. Committee, which included three students of Meghnad Saha, submitted their observations in April 1963. Prof. P.K. Kichlu of Delhi University, the first PhD student of Saha at Allahabad, assumed charge as Director, NPL in December 1963. He superannuated after a year on

reaching the age of 65. The then DG, CSIR again got back to Blackett. Prof. Ajit Ram Verma of BHU, an MSc student of Dr K.S. Krishnan at Allahabad, was appointed Director of NPL in 1965 and served till 1982. Incidentally, Blackett had facilitated Ajit Ram's travel to the UK in 1950 for PhD on request from Prof. D.S. Kothari.

During the tenure of the next DG of CSIR, GoI had to constitute a committee chaired by Justice A.K. Sarkar in 1968 to address the concerns in parliament on the functioning of CSIR. M.G.K., along with C.R. Rao and M.S. Swaminathan, was also a part of that committee.

M.G.K. was elected FRS in 1970, and C.V. Raman made him a member of the Governing Body (GB) of his Raman Research Institute (RRI). On the passing away of Raman on 21 November 1970, M.G.K. had to assume the chairpersonship of GB of RRI, and he persuaded V. Radhakrishnan, the Radio-Astronomer son of C.V. Raman in Australia, to return as Director of RRI.

Dr Vikram Sarabhai passed away in sleep on 30 December 1971, and M.G.K. was given charge of ISRO. M.G.K. convinced two of his distinguished colleagues at TIFR, Prof. Devindra Lal and Prof. Yash Pal, to move to Ahmedabad as Directors of the Physical Research Laboratory and the newly established Space Applications Centre, respectively.

As Director, TIFR, M.G.K. had responded to the call of PM after the 1971 war to participate in defence-related research, and he got started work on AREN (Army Radio Engineering Network) and ADGES (Air Defence Ground Environmental Systems) projects of DRDO.

In 1975, M.G.K. moved from Mumbai to Delhi by handing over the charge of TIFR to Prof. B.V. Sreekantan. Mr. J.R.D. Tata, the Chairman of the TIFR Council of Management, inducted M.G.K. into the Council as a co-opted Member. M.G.K. shouldered this responsibility till 2004.

In 1989, Prime Minister V.P. Singh inducted M.G.K. into his Ministry as Minister of State for Science and Technology and Education. The V.P. Singh Government lasted only a year. However, M.G.K. returned to the parliament as an elected member of Rajya Sabha (1990-96) from Rajasthan. Besides Meghnad Saha, who was elected to the first Lok Sabha, all other scientists in parliament have been nominated as members of the Rajya Sabha.

In addition to the SSB Prize and FRS, he received the C.F. Powell Medal (1978), C.V. Raman Medal (1986) and Abdus Salam Medal (1997). He and the Nobel Laureate Abdus Salam were admitted to the Pontifical Academy in 1981. The interaction between them nucleated the idea of establishing the World Academy of Science, TWAS, which came into being in 1983.

M.G.K. was elected to the Fellowship of several prestigious foreign Academies and received *Honoris Causa* degrees from numerous Universities. He was the first Indian to be elected as (i) the President of the International Council of Scientific Unions (ICSU) in 1986, which he served for two terms (1988-93), and (ii) the Chairman of the Cosmic Ray Commission C4 of the IUPAP (1972-75). He also served as the President of all three National Science Academies in India. GoI honoured him with Padma Shri (1961), Padma Bhushan (1968) and Padma Vibhushan (1985).

Dr C.H. Townes, Nobel Laureate (1964), had once surmised that M.G.K. could have had to his scientific credit a lot more at the US University, whose offer he had declined in preference to Bhabha's offer at his institute. Still, his decision ultimately resulted in important contributions to India and worldwide science and scientific statesmanship.

M.G.K. passed away at age 88 on 22 November 2016 in New Delhi.

### **About the author**

Dr Arun Kumar Grover is a renowned Indian scientist and academic, formerly the Vice-Chancellor of Panjab University, a retired Sr. Prof. of Tata Institute of Fundamental Research (TIFR), Mumbai and ex-Chairperson, Research Council, CSIR-NPL (2017-23). Known for his research in physics, particularly in condensed matter physics, he has made significant contributions to science and education, enhancing the academic and research landscape in India.





**G.S. Sidhu**  
*An Industry Connector*

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**J.S. Yadav, FNA, FTWAS**

*Director (Research), Indrashil University*

*Former Director, CSIR-Indian Institute of Chemical  
Technology (IICT), Hyderabad*

LATE Dr Gurbachan Singh Sidhu was a distinguished scientist who was conferred the Padma Shri for his contributions to the nation's advancement in Science and Technology. He served as Director General of CSIR from 5 May 1981 to 4 May 1984. It was the first time a scientist over 60 had been appointed to this position. The Government of India selected him because, at that time, a great deal was expected from the National Institutes functioning under the aegis of CSIR: searching for alternative fuels following the oil crisis, developing indigenous technologies to increase production, as well as achieving self-sufficiency in the development of appropriate intermediate technologies. Dr Sidhu was considered the right leader because he pursued these goals successfully during his three-decade research career.

During Dr Sidhu's tenure as DG of CSIR, the first Indian Scientific Expedition to Antarctica was launched with a 21-member team of scientists from various scientific organizations, including CSIR. Another achievement during his term was the dredging of poly-metallic nodules from the deep sea - a project that had attracted worldwide attention. On 29 August 1983, medallions of metals extracted from poly-metallic nodules were presented to the then Prime Minister of India, Smt. Indira Gandhi.

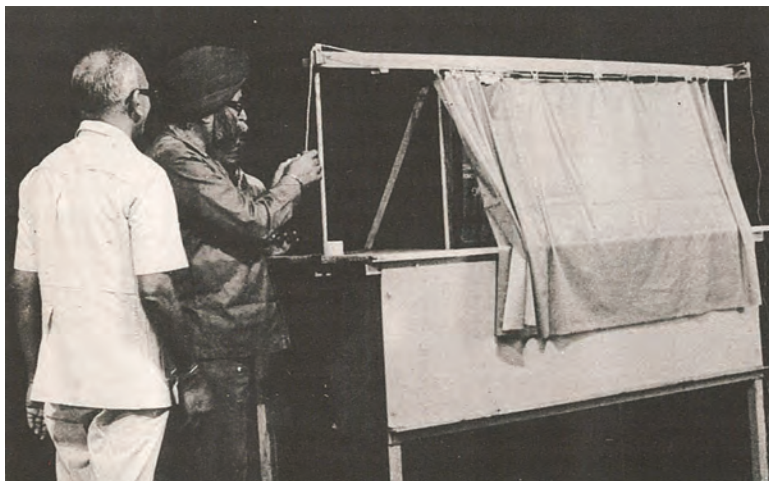
In addition to being the Director General of CSIR, Dr Sidhu served as Secretary, Department of Science and Technology, when the then Prime Minister held the Ministry of Science and Technology portfolio.

Before being elevated as DG, CSIR, Dr Sidhu was the Director of Regional Research Laboratories, Hyderabad (RRL(H)) from 24 June 1964 to 31 January 1981.

After being at the helm of affairs for close to two decades as Director of RRL, Dr Sidhu was named the Chairman of the National Research and Development Council.

Dr Sidhu had been a scientist in RRL(H) since 1949, almost since its inception, and had helped Dr Husain Zaheer and other colleagues to give it shape, form and direction.

For the first time, during Dr Sidhu's tenure as Director RRL(H), the initiative was taken to generate research funding from industries.



*Dr G.S. Sidhu, Director General of CSIR, declaring open CECRI's new corrosion research laboratory's building in 1983*

The significant infrastructural assets of RRL(H) were its carefully planned pilot plants. In keeping with the national needs and goals for self-sufficiency, it was necessary to take up long-term projects requiring significant investments, which would take long periods to bear fruit.

The industry, desirous of having quick returns, wanted to avoid investing funds in these projects. However, it was decided to continue these research projects. At the same time, it was considered beneficial to demonstrate processes on a pilot plant or prototype plant scale to wean the industry away from the easy option of importing technology and thus win its confidence and garner finances for the laboratory.

Thus, under the stewardship of Dr Sidhu, it was considered imperative to forge strong links with industry and to build, along with other R&D resources, a well-structured system for information and knowledge transfer to speed up development skills in the chosen areas that could face world competition and also to develop strategies for R&D which were in harmony with economic, social and political objectives of our society and nation.

It was recognized that dialogue with industry plays a vital role in the innovation process. This activity was, therefore, rightly chosen to



*To the President of India Shri Zail Singh, Dr G.S. Sidhu, Director General of CSIR, is explaining the work of Regional Research Laboratory (RRL)-Hyderabad on pesticides in 1983.*

receive utmost importance. It helped screen the research programmes and brought about an exchange of ideas on several problems needing solutions. Thus, new projects were born, new products were developed, and entrepreneurs were identified.

The national emergency during the Indo-Pak Wars of 1965 and 1971 had its impact on the research programmes as financial difficulties retarded progress. Specific new projects were undertaken while re-orientation was effected in some others. The laboratory manufactured sodium azide at an improvised pilot plant to meet the annual defence needs. More contracts with the industry resulted in the release of many processes for commercial exploitation. A new responsibility undertaken was to offer turnkey services to the industry. The appointment of RRL(H) for general technical consultancy to the manufacturing industry on an annual retainer basis was another feature introduced under

Dr Sidhu's leadership. Collaborative research schemes with other institutes increased, and leading business houses sponsored research projects. With an eye on the future, Dr Sidhu built the design and engineering group, considerably extended the scope and availability of analytical facilities for process development and expanded up-scaling facilities and other infrastructures. Another significant milestone during his tenure was establishing the Centre for Cellular and Molecular Biology (CCMB) in 1977. During almost two decades of administration of Dr Sidhu, RRL(H) grew from strength to strength and is today regarded as one of our premier national laboratories. It has since been renamed the Indian Institute of Chemical Technology.

Dr G.S. Sidhu was born on 4 July 1920 in Maujowal, Punjab. Though hailing from Punjab, Dr Sidhu had his school and college education in Lucknow, where his father worked. He did his BSc (Hons, 1939), and MSc (1941) in Chemistry, and PhD Organic Chemistry (1949) from Lucknow University under the guidance of Dr Husain Zaheer. The title of his thesis was "Synthetic Analgesics". He went to the University of Heidelberg in Germany for Post-Doctoral studies at the Institute of Chemistry of Woods and Polysaccharides, working with Prof. K. Freudenberg. Subsequently, he went to the Pregl Laboratory of the Medical Chemistry Institute of the University of Graz, Austria.

Dr Sidhu's research interests were Industrial Organic Intermediates, Drugs and Pharmaceuticals, Pesticides and Wood Chemistry. He helped develop management courses for R&D Scientists with the Administrative Staff College of India. He was associated with several educational institutions as a member of their board. He had the Directorship of many industrial organizations. He was an expert member of many Indian and foreign committees.

Dr Sidhu's contributions to the field of Industrial Chemistry have won him several prestigious awards, including the K.G. Naik Gold Medal in 1966, the FICCI award in 1975 and the Padma Shri in 1976. He has several research publications and patents to his credit. He had been associated with several professional bodies as a Fellow and was a member of the American, Indian, German and Swiss Chemical Society.

In 1954, Dr Sidhu married Mahijit Sandhu, a maths educator with an MA in mathematics. They raised a daughter, Sumeet, a son, Sanjiv and

a niece, Paramjit. After a successful career at Tata Consultancy Services, Sumeet serves pro-bono at Community Pure Water, a not-for-profit focused on safe water in rural India. Sanjiv Sidhu, a renowned software entrepreneur considered the father of modern advanced planning systems, is Chairman of o9 Solutions. Before o9, Sanjiv founded i2 Technologies in 1988. Paramjit took the research path, becoming a leading Toxicologist at IICT, and retired as Scientist Emeritus.

After Dr Sidhu retired as DG, CSIR and from his other distinguished public service appointments, he founded Sidhu Associates to continue pursuing industrial development as a consultant. He remained a leading Science and Industrial development consultant until he passed away on 11 July 2001.

### **About the author**

Prof. J.S. Yadav, former Director of CSIR-Indian Institute of Chemical Technology (IICT), Hyderabad, presently serving as the Director (Research) at Indrashil University, is a distinguished Indian chemist known for his contributions to organic chemistry and chemical research. Prof. Yadav is a towering scientist in Natural Products Chemistry, acclaimed worldwide for his contributions and professional accomplishments.





## **Prafulla Kumar Jena**

### *An Eminent Metallurgist*

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**B.K. Mishra**

*Former Director, CSIR-Institute of Minerals and  
Materials Technology (IMMT), Bhubaneswar*

*Former Director, Indian Institute of Technology (IIT), Goa*

PROFESSOR Prafulla Kumar Jena was a distinguished metallurgist who contributed substantially to metallurgy and scientific advancement in India. He was born on 27 December 1931 in Jajpur, Odisha. He completed his undergraduate degree in Chemistry with honours and a Master's in Physical Chemistry from Utkal University. He then pursued a PhD at Utkal University, earning his degree before obtaining an MS in Metallurgical Engineering from the University of British Columbia.

Prof. Jena's career started as a Metallurgist at the Bhabha Atomic Research Centre in Mumbai, and then he became a Professor of Metallurgical Engineering at Banaras Hindu University in Varanasi. He later served as Director of the Regional Research Laboratory in Bhubaneswar (now CSIR-IMMT), showcasing his leadership in scientific research. His international engagements included roles as a Senior Visiting Professor at Pontifical Catholic University in Rio de Janeiro, Brazil, and at Tohoku University in Sendai, Japan. He also held prestigious positions such as the Tata Chair of Distinguished Professor in Metallurgical Engineering at IIT Kharagpur and Director General at CSIR in New Delhi, further solidifying his global impact on metallurgy and scientific leadership.

In 1989, I had the privilege of meeting Prof. Jena during his visit to the University of Utah, where I was pursuing my PhD. I vividly recall spending an entire day with him until I bid farewell at the airport. He encouraged me to return to India after completing my studies to contribute to nation-building. Prof. Jena's profound dedication to science and visionary leadership left an indelible mark on me.

Back in India, I strengthened my bond with him, frequently inviting him to our laboratory during my tenure as Director. His unwavering encouragement and support for the growth of CSIR were always inspiring. Prof. Jena meticulously designed and developed RRLB, expanding its research scope and depth, modernizing its facilities, and building a skilled team.

When he assumed the role of Director in 1972, the laboratory was only eight years old, and he was tasked with transforming it into a world-class research facility. He established new departments that covered a wide range of fields, including Geology and Mineralogy,

Mineral Beneficiation and Agglomeration, Pyrometallurgy, Hydro and Electrometallurgy, Special Materials, Inorganic Chemicals, Aromatics and Medicinal Plants, as well as a central facility for characterization and chemical analysis.

Prof. Jena prioritized hiring top-tier talent, supported staff in pursuing advanced degrees, and equipped the lab with cutting-edge technology for scientific research. Moreover, he inspired scientists to secure significant projects. Notable among these were the Nickel project, the Deep-Sea Polymetallic Manganese Nodule project, the Complex-Sulphide project, and the Mines-to-Metals-Habitat project, all of which not only held special significance for him but also earned the laboratory recognition and acclaim. Over time, these departments thrived, evidenced by the growth of pilot-plant facilities, numerous publications, and patents.

Under Prof. Jena's leadership, RRLB flourished in nonferrous extractive metallurgy. He revolutionized facilities, recruited talented scientists, and championed research excellence. His foresight led to groundbreaking projects like the Nickel project and the Deep-Sea-Poly-Metallic Manganese Nodule project, elevating the laboratory's stature globally.



*Shri K.R. Narayanan, the then Union Minister for State for Science & Technology, Vice-President, CSIR discussing with Prof. P.K. Jena, on the R & D Project of RRL Bhubaneswar.*

With over five decades of dedicated research and development, Prof. Jena demonstrated a profound commitment to mineral resource conservation. He recognized the critical importance of minerals as non-renewable resources essential to industrial and socioeconomic growth and focused on their responsible utilization and preservation. His efforts involved comprehensive studies on upgrading low-grade and complex ores, extracting metals from lean reserves, and recovering valuable materials from industrial waste. This direct approach reflects a strong dedication to minimizing waste and optimizing resource efficiency.

To address the challenge of utilizing waste ore fines, Prof. Jena developed innovative agglomeration processes, including the briquetting of chromite fines and pan sintering of iron and manganese ore fines, which have been successfully commercialized. His outstanding research projects also encompass the chloride metallurgy of nonferrous ores, the extraction of valuable metals like nickel, cobalt, copper, lead, and zinc from various complex sources, and the preparation of nanoalloys and composites.

Prof. Jena's work on low-temperature chlorination of refractory metal oxides using carbon tetrachloride has been particularly acclaimed, underscoring his relentless pursuit of sustainable and efficient methods for mineral resource conservation. His contributions have advanced the field and laid the groundwork for responsible mineral resource management in India. Prof. Jena was also a trailblazer in India for developing metallothermic processes for extracting refractory metals like Niobium, Tantalum, Vanadium, Tungsten, and Molybdenum, many of which have been commercialized.

Beyond academics and research, Prof. Jena nurtured a lively campus life at RRLB, promoting cultural events and sports activities. His support for initiatives like the RRLB Staff Club's cultural evenings and the establishment of sangeet kendra enriched the lives of staff and their families. He also contributed to community welfare, spearheading developments like the RRL Dispensary and Departmental Canteen.

Prof. Jena's deep commitment to fostering scientific talent and initiatives earned him widespread recognition. He was particularly passionate about nurturing strong human relationships among scientists and staff. His influence was instrumental in creating the 'Pathani

Samanta' planetarium, the Institute of Physics, and the Science Park in Bhubaneswar. In 1999 he founded the Institute of Advanced Technology and Environmental Studies (IATES). The institute was established to provide technical services to various industries and to promote research and specialized training in critical areas such as environmental conservation, mineral resource management, waste management, water resource management, and afforestation.

In recognition of his exceptional contributions, the Government of India honoured Prof. Jena with the Padma Shri in 1977. His influence extended to hosting Prime Minister Indira Gandhi at RRL Bhubaneswar, where he presented her with coins crafted from metals extracted from manganese nodules, symbolizing his dual impact on science and national leadership.

Prof. Prafulla Kumar Jena's accomplishments stand as a testament to his profound impact as a metallurgist, educator, and visionary in science. His lasting influence inspires current and future generations, shaping the landscape of metallurgy and beyond with his pioneering contributions.

### About the author

Prof. B. K. Mishra is the former Director of CSIR-Institute of Minerals and Materials Technology (CSIR-IMMT) and Indian Institute of Technology (IIT), Goa. Prof. Mishra is renowned for his expertise in mechanical engineering and materials science, particularly in mineral processing and materials development, significantly advancing research and industrial applications.







## **S. Varadarajan** *A Crisis Conqueror*

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**Swaminathan Sivaram**

*Former Director, CSIR-National Chemical Laboratory (NCL), Pune*

*Honorary Professor and INSA Emeritus Scientist*

*Indian Institute of Science Education and Research, Pune*

**D**R S. Varadarajan, a science visionary and one of India's most accomplished science administrators, assumed office as the eleventh Director General of CSIR on 22 June 1984 and served till 27 June 1986. Dr Varadarajan was the Secretary to the Government of India, Department of Science and Technology (DST), before being appointed DG-CSIR and concurrently held the position of Secretary, DST, till 18 September 1984.

Dr Varadarajan was born in Bangalore on 31 March 1928. His first degree, MA in Chemistry, was from Madras University. At Andhra University, he came under the tutelage of Professor T.R. Seshadri, whom he followed to Delhi University and obtained his PhD in natural product chemistry 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 PhD, he proceeded to the University of Cambridge, where he was associated with Sir Alexander Todd and Professor D.M. Brown and pursued research leading to the synthesis of nucleosides, nucleotides, and the structure of the ribonucleic acid (RNA) phosphate linkage through first cyclo-nucleoside and with iodine labelled heavy atom, and the first application of X-ray crystallography to this problem in the Laboratory of Sir Lawrence Bragg. This work earned him a second PhD from the University of Cambridge in 1956.

He then proceeded to MIT, Cambridge, Massachusetts, USA, as a Visiting Lecturer in Biology (1956-57). His work at MIT dealt with uniformly  $^{14}\text{C}$  labelled *Thiobacillus denitrificans* and *Escheria coli* deoxynucleotides, converted to triphosphosphates chemically and isolated through the first use of lithium bromide as precursors for biosynthesis of DNA. He was a Beit Memorial Fellow in Medical Research at Addenbrooks Hospital, Department of Radiotherapeutics, University of Cambridge (1957-59) and a Member at Pembroke College, Cambridge (1953-59). His research experience overseas marks him as one of India's earliest chemical biologists.

Dr Varadarajan came to head the CSIR after having diverse experience in leadership positions in research and management in private and public institutions. Dr Varadarajan was associated with Hindustan Lever Limited from 1959 to 1974 and set up a world-class industrial R&D Centre in Andheri, Bombay (Mumbai). He and his team contributed to researching, developing, and commercialising various products, such as detergents, oils and fats, perfumery chemicals, and nutrition,

based on indigenous natural resources. Along with the CIBA Research facility in Goregaon and the Hoechst Research Centre at Mulund, the trio of institutions in Mumbai heralded India's entry into industrial research.

Dr 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 Baroda (Vadodara), Gujarat. IPCL was a public sector company set up to build the first integrated petrochemicals complex in India. Commissioned in 1975, IPCL heralded India's first large-volume chemicals and polymer manufacturing based on naphtha cracking.

With little prior operational experience, a team of young engineers working under his leadership simultaneously commissioned 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. This spectacular effort heralded India into the "age of petrochemicals." When I was 29, I first met Dr Varadarajan at IPCL. Under his guidance, we built the first R&D facility in Vadodara devoted to polymer science, heterogeneous and homogeneous catalysis, surface science, organic processes, and analytical science. Dr Varadarajan assumed the position of Chairman and Managing Director of Engineers India Ltd. (1975-78; 1981-82) and Bridge and Roof Co. (1978-83). As DG CSIR, he played a seminal role in creating two government departments: the Department of Scientific and Industrial Research in 1985 and the Department of Biotechnology in 1984.

Dr Varadarajan's tenure as the DG of CSIR saw some cataclysmic events in the history of India. Within five months of his assuming office, CSIR lost its President and India, its Prime Minister, a victim of a brutal assassination on 31 October 1984. Soon after that, on the evening of 5 December 1984, Bhopal became a household word, the site of the world's worst chemical disaster caused by the leak of methyl isocyanate from the manufacturing plant of Union Carbide Corporation. On 23 June 1985, the Air India flight, Kanishka, from Montreal to New Delhi crashed over the Atlantic, killing, among others, Dr Y. Nayudamma, the Founder-Director of CSIR-CLRI and the sixth DG of CSIR. This fatal crash, killing 329 passengers on board, was the world's deadliest act of aviation terrorism until the 11 September attack in 2001. On 4 December 1985, exactly one year after the Bhopal Gas Disaster, oleum leaked out

of Shriram Food and Fertilizer factory belonging to DCM in a densely populated area, Kirti Nagar, in Delhi, causing one death and harm to several citizens.

An account of Dr Varadarajan's contributions will only be complete with a mention of the stellar leadership he provided to manage the aftermath of the methyl isocyanate (MIC) gas leakage at Bhopal in December 1984. This was CSIR's finest hour and a testimony to the capacity and capability of CSIR to manage disasters of unspeakable proportions. Within a few hours of the event, Dr Varadarajan, at the request of the then Cabinet Secretary, was in Bhopal, putting together a team of expert scientists and engineers, myself included. His vast network of scientific and engineering professionals, borne out of his long years in industry, was effectively used. He called upon scientists from several CSIR Laboratories to manage specific activities at Bhopal. The CSIR labs provided critical analytical support to perform a forensic and root cause analysis of the disaster.

His leadership of "Operation Faith" to deactivate and decommission the now famous Tank 611 containing 42 tons of liquid MIC, which commenced on 16 December 1984, is legendary and now part of history. He 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  $\alpha$ -naphthol, the very process Union Carbide Corporation (UCC) was practising at Bhopal. Dr Varadarajan persuaded the Government to accept his proposition that this operation could be conducted with no additional risk. He was hands-on and supervised the operation to its conclusion.

I still remember vividly the 8 A.M. morning briefing at the BHEL Guest House in Bhopal, where Dr Varadarajan had set up a Camp Office, explaining our respective tasks before we dispersed and the evening 7 P.M. de-briefing of the day. We admired his clarity of thinking, attention to the minute details, and deep concern for our safety. The complexity of the task is best appreciated when one recognises that none of us assembled in Bhopal and were familiar with the chemistry, process, or manufacturing plant. We could not take the assistance of experienced managers and operators of the UCC plant as the investigative authorities denied them entry. The heroic efforts of Dr Varadarajan and his team have been chronicled by Professor D. Balasubramanian and Shri Shivaprasad Khened (<https://www.thehindu.com/scitech/science//article60637157.ece>; <https://khened.blogspot.com/2022/05/Drhtml>).



*Dr S. Varadarajan with the team of scientists from RRL-Bhopal participating in the scientific investigation related to MIC leak in Bhopal*

Dr Varadarajan, along with a team of scientists and engineers, authored the most comprehensive research findings of the cause of the disaster in a report submitted to the Government of India titled “Report on scientific studies on the factors related to Bhopal toxic gas leakage” in December 1985. This report contained the laboratory investigation of scores of scientists from CSIR laboratories who were mobilised to undertake studies related to the disaster. 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>). Sadly, for reasons not publicly disclosed, this report never received the kind of public attention it deserved. On the contrary, many reports authored by the so-called ‘independent’ experts in the USA, who never once visited the plant at Bhopal, were circulated widely to support the sabotage theory, vigorously propounded by UCC, to obfuscate the facts and escape legal liability. Sadly, despite the heroic efforts of the scientists of CSIR and others, the Varadarajan Committee Report has remained relatively obscure to this day.

Such was his reputation that the Government once again called on him to assist in the investigation when oleum leaked out of a factory

operated by DCM in Delhi in December 1985. There was great panic among the public at large since the memory of Bhopal was still fresh in everyone's mind. Through his many public statements, Dr Varadarajan calmed the citizens' nerves and helped the Government overcome the crisis.

Dr Varadarajan was a polymath whose knowledge spanned many different subjects and could draw on complex bodies of knowledge to solve specific problems. He possessed a keen and piercing mind, was deeply analytical, was intensely logical, and could ask simple questions that would perplex and confound men more knowledgeable and experienced than him. His knowledge was deep and broad, and his understanding of the role of S&T in nation-building was comprehensive. He could quickly grasp the significance of an idea and place it in the larger context of national development. The following story exemplifies Dr Varadarajan's prescience and quick decision-making.

It was the year 1985, Dr Roddam Narasimha had just taken over as the Director of National Aerospace Laboratories (NAL), and scientists in NAL's Fluid Mechanics Division were livid at the poor number-crunching power of NAL's Univac computer (<https://frontline.thehindu.com/other/obituary/obituary-the-disappearance-of-roddam-narasimha-tribute/article33431830.ece>). They met Narasimha to ask for more computing power. Narasimha immediately bounced the problem: "If you are unhappy with Univac, why don't you build your own fast parallel computer? I am sure we could put together one within a year ourselves." This required funding from CSIR. A mere ten-minute conversation was enough for Narasimha to convince Dr Varadarajan to sanction the ₹20 lakh needed for the project. NAL built India's first parallel computer, Flosolver, within a year. Flosolver was faster than the existing Univac by at least a factor of three. Thus, India's first parallel computer was born, which eventually led to the creation of C-DAC to build the first Indian supercomputer in the early nineties.

Addressing the gathering during the Silver Jubilee celebration of NEERI, Nagpur on 17 March 1985, Dr Varadarajan alluded to the "gigantic problems that will face the nation in the next fifteen years". He said that oil production would have to be increased from 39 to 95 million tons to meet the country's needs and coal production from 150 to 400 million tons. He envisaged that by 2000 there would be a massive conglomeration of cities with high population density, requiring "more energy, food and efficient transport system". In hindsight, we can only wonder in amazement at his ability to see the future as none could.

In retrospect, imagining that one man could pack so many eventful and impact-making activities in one lifetime is not easy. Dr Varadarajan was gifted with enormous energy, which he could transmit to others and propel them into action. He possessed a sharp intellect and 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. He was always full of ideas and had a childlike curiosity. Though his tenure at CSIR was short, he left an indelible mark on the institution.

(Note: I have extensively drawn on the Obituary I authored in Current Science on Dr S. Varadarajan in writing this article.

<https://www.currentscience.ac.in/Volumes/123/01/0109.pdf> )

### About the author

Dr S. Sivaram is an INSA Emeritus Scientist and Honorary Professor at the Indian Institute of Science Education and Research (IISER), Pune, India. Before this, he served as the eighth Director of CSIR-National Chemical Laboratory (NCL)

(2002-10). Dr Sivaram is a highly decorated scientist with numerous awards to his credit, including Padma Shri in 2006.







**A.P. Mitra**  
*An Advocate of Strong Scientific  
Ecosystem*

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**A.K. Srivastava**

*Director, CSIR - Advanced Materials and  
Processes Research Institute (AMPRI), Bhopal*

**P**ROFESSOR Ashesh Prosad Mitra (A.P. Mitra) is India's leading physicist who profoundly impacted atmospheric and ionospheric physics. He played a crucial role in establishing India as a prominent entity in atmospheric research and inspired scientists worldwide to establish a deep understanding of atmospheric and ionospheric physics.

Prof. A.P. Mitra was born in Kolkata (then Calcutta) on 21 February 1927. Growing up in an environment that fostered intellectual curiosity, Prof. Mitra developed a keen interest in science from a young age. He was fascinated by studying mathematics and physics since his schooling. He completed his BSc (Physics honours) in 1946 from Presidency College in Kolkata and continued his education at the University of Calcutta, earning an MSc (Physics) in 1948. Due to his great understanding of physics and excellent performance, he secured a gold medal in post-graduation. He took Physics lectures from exceptional teachers and scientists like Prof. Sisir Kumar Mitra (Prof. S.K. Mitra), Prof. Meghnad Saha, and Prof. Satyendra Nath Bose.

During this period, A.P. Mitra cultivated such a strong interest in atmospheric science, with a particular focus on the ionosphere, that he devoted his whole life to understanding radio and space physics. He continued his research as a Research Assistant with Prof. S.K. Mitra to enrich his knowledge of ionospheric physics. He worked on a project "Ionospheric Investigations" sponsored by the Council of Scientific and Industrial Research (CSIR), India. During his tenure as a Research Assistant from 1949 to 1951, he completed his thesis on Ionospheric Physics.

Soon after thesis writing (but before submission), he was offered a Colombo Plan Fellowship at CSIRO, Sydney, Australia, to study Radio Physics with world-renowned astronomer J.L. Pawsey. While at CSIRO, he collaborated with renowned radio astronomer Alex Shain. He identified cosmic radio noise absorption as an innovative method for investigating the D- and F-regions of the ionosphere.

In 1951, the CSIRO organized the General Assembly of the International Union on Radio Science (URSI), also attended by Dr K.S. Krishnan, the then Director of the National Physical Laboratory (NPL), New Delhi, and Prof. S.K. Mitra. Due to his outstanding work, Prof. A.P. Mitra was offered the position of Secretary of the Radio Research Committee (RRC) at NPL, New Delhi, by Dr Krishnan.



*Prof. A.P. Mitra with Dr A.P.J. Abdul Kalam (then President of India),  
and other delegates of URSI 2005, New Delhi*

He promised to join RRC at NPL, India, after completing his foreign pre-assignments. Owing to his pioneering work on the discovery of cosmic radio noise technique and understanding of ionospheric D-region, Prof. Mitra was also offered the position of Visiting Assistant Professor and Visiting Associate Professor at Pennsylvania State University from 1952 to 1954. During that period, Nicolet and Mitra gave the concept of ionospheric chemistry. Prof. Mitra contributed immensely to enriching our understanding of the lower ionosphere, its photochemistry, and early D-region recombination coefficient reference models.

After returning to India in 1954, Prof. A.P. Mitra took over as the Secretary of the RRC at NPL, New Delhi. He established an Ionospheric Prediction Service utilizing an innovative approach to predict solar activity. His contribution to science, particularly atmospheric physics, is phenomenal. He made a significant contribution by investigating the diurnal and seasonal fluctuations of the ionosphere. He examined the ionosphere's changes during different times of the day and across various seasons, offering an in-depth insight into its variability. This research played a vital role in enhancing the precision of radio wave propagation models, which are essential for communication and navigation systems. Prof. A.P. Mitra also investigated the interaction between the magnetosphere and the ionosphere, which helped to improve understanding of geomagnetic storms and auroras.



*Prof. A.P. Mitra, Dr D. Massonnet (CNES France), and Dr A.P.J. Abdul Kalam (then President of India) during URSI 2005, New Delhi*

Prof. A.P. Mitra researched the propagation of very low frequency (VLF) radio waves in the Earth's atmosphere. His studies provided valuable insights into the behaviour of VLF waves and their applications in communication systems, particularly for long-range communication in remote areas. Prof. A.P. Mitra also significantly contributed to advancing India's space mission. He collaborated with the Indian Space Research Organisation (ISRO) on various initiatives, applying his knowledge in atmospheric science to enhance the development of space missions. His efforts were instrumental in increasing the precision of satellite communication systems by considering the impact of the ionosphere on radio wave transmission.

In 1972, Prof. Mitra received the esteemed Shanti Swarup Bhatnagar Prize for Physical Science, for the year 1968. Prof. A.P. Mitra established a centre on tropospheric research, CENTROP, to study Tropospheric Radio Communication at NPL. Subsequently, his team established the first Sound Detection and Ranging (SODAR) facility in India.

In 1982, Prof. A.P. Mitra was appointed as the Director of NPL, New Delhi, due to his exceptional work in radio and atmospheric physics. Prof. Mitra's aspirations transcended the confines of the laboratory and always lauded establishing a robust scientific ecosystem in India. His

leadership was instrumental in positioning India as a prominent entity in atmospheric science.

Prof. Mitra's esteemed reputation as a highly skilled and knowledgeable Director, along with his exceptional contributions as a scientist, had garnered the attention of the Prime Minister's Office. In February 1986, Prof. Mitra assumed the role of Director General of the CSIR, India, for five years.

In 1989, Prof. Mitra received the Padma Bhushan Award, recognizing his significant contributions to the field of atmospheric science. Prof. Mitra also became a Fellow of the Indian National Science Academy (INSA) and the Royal Society of London. As a leader, mentor, and visionary, Prof. Mitra significantly influenced the advancement of atmospheric science both in India and internationally.

On 3 September 2007, we lost Prof. Mitra, who dedicated his life to advancing the field of science for the nation's benefit. Although he has departed from us, his exceptional achievements and significant contributions to both Indian and international science in radio and atmospheric physics will forever be cherished. His influence and legacy can be seen in the work of many academicians, scientists, and researchers he mentored during his long and illustrious career, which will span many generations.

### About the author

Dr Avanish Kumar Srivastava is presently the Director of CSIR-Advanced Materials and Processes Research Institute (CSIR-AMPRI), Bhopal, India. His research interests include the characterization of nanomaterials using electron microscopy and the exploration of advanced materials such as graphene, metal oxides, magnetic, and biomaterials for various technological applications. He is a former President of the Electron Microscope Society of India (EMSI) and elected fellow of the Indian National Academy of Engineering, Indian Institute of Metals, and EMSI.







**S. K. Joshi**  
*A Nurturer of Institutions*

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**Venugopal Achanta**

*Director, CSIR-National Physical Laboratory (NPL), New Delhi*

PROF. Shri Krishna Joshi was born on 6 June 1935 in Anarpha village of Kumaon region of Uttarakhand, India. From a humble background, he studied at Allahabad University, where he completed his BSc and MSc (Gold Medallist) degrees in Physics. Just after completing his MSc in 1957, he was offered a lectureship in the Physics department of Allahabad University. While working, he also started work towards his PhD under the guidance of Prof. K. Banerjee on the diffuse X-ray scattering from organic crystals. He was awarded a PhD in 1962. From 1965 to 1967, he was a Visiting Professor at the University of California, Riverside. He returned to India and joined the University of Roorkee (now IIT, Roorkee), where he worked as a Professor from 1967 to 1986. After training as an experimental physicist for his PhD, he chose theoretical physics for his subsequent research. He guided 20 PhD students during his career.

His research focussed on the phonons and lattice vibrations in metals and insulators. In metals, as the phonon frequencies depend on the response of conduction electrons to the ionic motion, he proposed a phenomenological model incorporating electron response. He pioneered and significantly contributed to understanding the lattice dynamics of d-electron metals (e.g. copper and nickel) using a non-interacting s- and d-band model. He investigated the electronic band structure using the Korringa-Kohn-Rostoker method. The virtual crystal and the coherent potential approximation were used to calculate the electron states in several disordered binary alloys. With A. K. Rajagopal, he co-authored a chapter titled Lattice Dynamics of Metals in Solid State Physics, published in 1969 by Academic Press. Of significance could be that Charles Kittel was one of the other contributors to the book.

The year he joined CSIR-NPL coincided with the discovery of high-temperature superconductivity. While promoting the activity at CSIR-NPL, he significantly contributed to the field. He proposed a new variational method for the periodic Anderson model to study the ground state behaviour of heavy fermions and estimated the c-axis resistivity of high-temperature superconductors. At CSIR-NPL, he also started work on nanotechnology. Specifically, he investigated electron transport in mesoscopic single and double quantum dot systems.

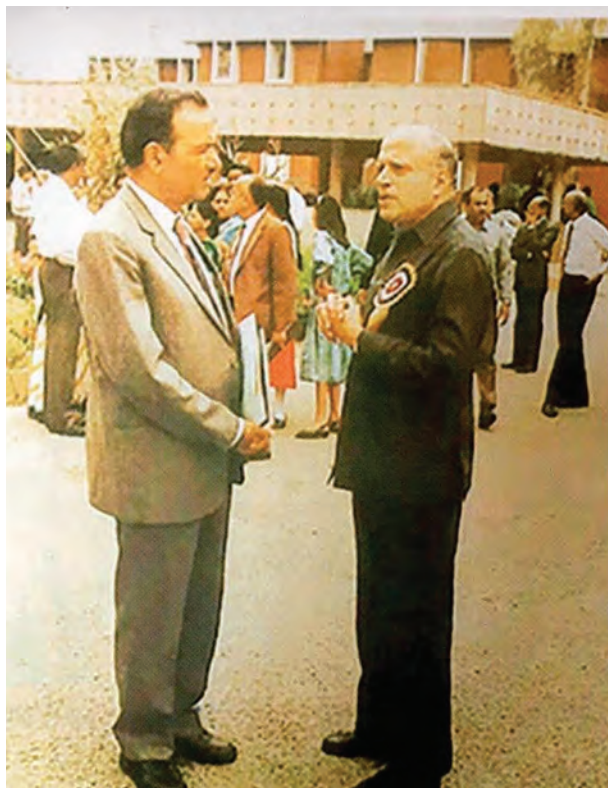
Prof. Joshi served as the 5<sup>th</sup> Director of CSIR-National Physical Laboratory from 1986 to 1991. Prof. Joshi's



*1999: Dr C.N.R. Rao, Founder President MRSI, Dr P. Rama Rao and Dr S.K. Joshi, Past Presidents MRSI, at RRL, Bhopal*

leadership and vision helped the institution. He reorganized CSIR-NPL and promoted the growth of leaders like Dr O. P. Bahl in Carbon materials, Dr Anil Gupta in Metals and Alloys, Dr Bindal in High Pressure, Dr Subhash Chandra in liquid crystals, Dr R. Bhattacharya in thin films, Dr B. K. Das in photovoltaics, and Dr P. K. Ghosh in Phosphors. He organized a low-temperature group into superconductivity under Dr A. V. Narlikar and cryogenics under Dr A. P. Jain. Materials groups were supported by the Material characterization division led by Dr K. Lal. The CSIR-NPL guest house and the student hostel were built during his tenure at CSIR-NPL. Another significant achievement of his time is the push to increase the Certified Reference Materials (CRMs) under the CSIR Trademark of *Bharatiya Nirdeshak Dravya* (BNDs).

Prof. Joshi served as the 14<sup>th</sup> Director General of CSIR from 18 April 1991 till his superannuation on 30<sup>th</sup> June 1995. After his superannuation, he continued at CSIR-NPL as a Scientist of Eminence. Prof. Joshi's scientific leadership is seen across the nation today in the new institutes of higher education like IISERs, NISER, and IITs, among others. As Chairman of their apex bodies, he nurtured major scientific institutions of the country including IIT Roorkee; Institute of Mathematical Sciences, Chennai; Institute of Physics, Bhubaneswar;



*1992: Dr S.K. Joshi, DG, CSIR & Dr M.S. Swaminathan, former DG, ICAR discussing during the CSIR Foundation Day celebrations*

Indian Association for Cultivation of Science, Kolkata; Recruitment & Assessment Center (RAC DRDO); Recruitment Assessment Board (RAB, CSIR); Visvesvaraya National Institute of Technology (VNIT, Nagpur); Inter-University Accelerator Centre (IUAC); and UGC-DAE, Indore. He was a member of the Scientific Advisory Committee of the Government of India and chairman of various selection committees for directors and vice chancellors of many prestigious institutes and universities.

Prof. Joshi's pioneering leadership enhanced the industry-academia interactions and brought national labs into the ambit of deemed

universities, e.g. TIFR and HBNI. Under his Chairmanship, the elite committee constituted by the Government of India established five DST-Centres of Higher Education Institutes, including the Panjab University, Chandigarh.

He was bestowed with the 3<sup>rd</sup> highest civilian award in India, i.e. Padma Bhushan in 2003, and before that with Padma Shri in 1991.

Prof. Joshi was an elected Fellow of the Indian National Science Academy (INSA), the National Academy of Science (NASI), the Indian Academy of Sciences (IAS), the Third World Academy of Sciences, and the Russian Academy of Sciences (Foreign Member).

He was honoured with several prizes including the Watumull Memorial Prize (1965), Shanti Swarup Bhatnagar Prize for Physical Sciences (1972), CSIR Silver Jubilee Award (1973), Meghnad Saha Award for Research in Theoretical Sciences (1974), Dr K.S. Krishnan Memorial Lectureship of INSA (1987), FICCI Award in Physical Sciences (1990), Goyal Prize in Physics by Goyal Foundation (1993), Dr Mahendra Lal Sircar Prize by IACS Calcutta (in 1994), C. V. Raman Medal of INSA (1999), and Kamal Kumari National Award (2011).

He was awarded a DSc *Honoris Causa* from Kumaun University in 1994, Kanpur University in 1995, Banaras Hindu University in 1996, and the University of Burdwan in 2005.

He served as Chairman of NABL and promoted the quality infrastructure within the country. Quality Council of India (QCI) launched the Prof. S. K. Joshi Laboratory Excellence Award in 2021.

Prof. Joshi played a major role in promoting Indian Science as an elected fellow and member of the academies. He was INSA's Secretary (1983 to 1986), Foreign Secretary (1989 to 1992), and elected President in 1993. He served the Indian Academy of Sciences (IAS) as Vice President from 1989 to 1991. Joshi was President of the Indian Physics Association (1989 to 1990) and President of the Materials Research Society of India. To honour his contributions, a Science Centre is named after Prof. S. K. Joshi at Devasthal, ARIES (Aryabhata Research Institute of Observational Sciences).

Prof. S. K. Joshi passed away on 15 May 2020 and is survived by his wife, Hema, and son Sanjay.

### **About the author**

Prof. Venugopal Achanta is presently the Director of CSIR-National Physical Laboratory (CSIR-NPL) in New Delhi, India. Dr Achanta served as Professor(H) at the Tata Institute of Fundamental Research (TIFR), Mumbai. He leads research in metrology, focusing on advancing measurement standards and technologies.





## **Raghunath A. Mashelkar** *A Legendary Scientist CEO*

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**Ashish Lele**  
*Director, CSIR- National Chemical Laboratory (NCL), Pune*

**K**NOWN for his transformative scientific research, technology leadership, and innovation management, Dr Raghunath Anant Mashelkar is a scientist of immense repute in India and across the globe. He seamlessly straddles excellence in engineering, scientific research, education, team building, administration, ideation, and providing inspirational and visionary leadership. He has played a crucial role in shaping India's science and technology landscape, fostering a culture of innovation, connecting education and research with industry, protecting traditional knowledge and creating strong yet balanced IPR systems.

Dr Mashelkar has been a vocal advocate for the importance of science and innovation in driving socio-economic development in India and globally. He is known for advocating "Gandhian Engineering", emphasising sustainable innovation rather than imitation and leveraging indigenous technology to address societal challenges.

As the longest-serving Director General (1995-2006) of the Council of Scientific and Industrial Research (CSIR), he enunciated "CSIR 2001: Vision and Strategy". This courageous attempt to draw out corporate-like R&D business plans for publicly funded R&D institutions transformed CSIR into a user-focused, performance-driven and accountable organisation. Widely recognised as the CEO of CSIR, he ushered in many initiatives, including the culture of 'Patent, Publish and Prosper', bold and innovative financial tools to incentivise industrial research, driving the idea of 'Saraswati to Laxmi' with a strong emphasis on global engagement, decentralisation of power and democratisation of operation. He almost single-handedly brought to the fore in India the importance of intellectual property protection by fighting and winning legal battles against U.S. patents in U.S. courts on Turmeric, Neem, and Basmati rice.

Dr Mashelkar was also instrumental in the genesis of the New Millennium Indian Technology Leadership Initiative (NMITLI), a bold special-purpose vehicle created to catalyse innovation-centred scientific and technological developments to attain for Indian industry a global leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private sector. Until 2019, NMITLI implemented 79 broadly networked projects in diverse areas.

agriculture, healthcare, engineering, energy, chemicals and information and communication technology. These projects involved 99 industry partners & 318 R&D groups from different institutions, and 1700 researchers.

As the Director of the CSIR-National Chemical Laboratory (CSIR-NCL) from 1989-1995, Dr Mashelkar skillfully and successfully navigated the laboratory through a difficult period of economic instability in India and transformed the institute into an “International Chemical Laboratory” by placing a strong emphasis on developing globally competitive and differentiated technologies based on original research and supported by international patents. He boldly decided to take a bank loan to modernise CSIR-NCL’s infrastructure and paid it back by increasing industry income in the laboratory. CSIR-NCL, which was involved only in import substitution research till then, began licensing its patents and providing high-quality knowledge-based services to large multinational companies such as General Electric, Proctor & Gamble, DuPont, Oxo, Polaroid and Cargil, to name just a few. At the same time, NCL continued to work with Indian companies to help them become globally competitive.



*Young Mashelkar brought back to India in 1976 by Dr B. D. Tilak, the then Director of CSIR-National Chemical Laboratory  
(Pic credit: <https://mashelkar.com/gallery/>)*

Looking back, it is interesting to note that in those years, CSIR-NCL won the contract of providing consulting services to China by beating the well-known global consulting company, Arthur D Little Inc. CSIR-NCL's transformation is a case study in the Harvard Business School's course on entrepreneurship in emerging economies.

A firm believer in the power of ideas, he introduced new initiatives like the 'kite flying' scheme for funding bright and bold ideas. He strengthened the Business Development Division to market NCL's technologies. He also created the NCL Research Foundation to acknowledge individuals' and teams' scientific and technological contributions.

For his wide-ranging and impactful contributions over the years, the President of India has honoured Dr Mashelkar with three of the highest civilian awards, namely Padma Shri (1991), Padma Bhushan (2000) and Padma Vibhushan (2014).



*Dr R.A. Mashelkar receiving Padma Vibhushan (2014) from the then President of India, Shri Pranab Mukherjee.*

*(Pic credit: <https://mashelkar.com/gallery/>)*

In addition to serving as the Director General of CSIR, Dr Mashelkar has also been Chairman of the National Innovation Foundation (2000-2018), President of the Global Research Alliance (2007-2017), President of the Indian National Science Academy (2004-2006) and the first and only non-English President of the prestigious U.K. Institution of Chemical Engineers (2007) in its 100-year history after its foundation.

Dr Mashelkar was the first Indian to win the most prestigious TWAS-Lenovo Science Prize (2018), the first Indian to be elected as a Fellow of U.S. National Academy of Inventors (2017), the first Asian Scientist to win the Business Week (USA) award of 'Stars of Asia' at the hands of George Bush (Sr.), and the first and only Scientist so far to win the JRD Tata Corporate Leadership Award (1998). In August 1997, Business India named Dr Mashelkar among the 50 path-breakers in post-independent India. He has been elected as a Foreign Associate of the U.S. National Academy of Engineering (2003), Associate Foreign Member of the American Academy of Arts & Sciences (2011), Fellow of the Royal Academy of Engineering, U.K. (1996), Foreign Fellow of Australian Technological Science and Engineering Academy (2008), Corresponding Member of Australian Academy of Sciences (2017) and Fellow of World Academy of Arts & Science, USA (2000). He has received 44 honorary doctorates from universities across the world.

As the Chairman of the Board of Directors of many companies such as Reliance Industries Ltd., Tata Motors Ltd., Hindustan Unilever Ltd., Thermax Ltd., Piramal Enterprises Ltd., Persistent Systems Innovation Council KPIT Technologies Ltd, Godrej Agrovet Ltd. etc, Dr Mashelkar has constantly promoted the culture of innovation. He conceptualised and chaired the New Energy Council of Reliance to guide the company's multi-billion-dollar investments in clean energy and advanced materials business. He was also a member of the External Research Advisory Board of Microsoft (USA), National Research Foundation (Singapore), and Corporate Innovation Board, Michelin (France).

Dr Mashelkar's connections with the national and international academic education and research community are deep and wide. He has been a visiting professor at Harvard University (2007-2012), Delaware University (1976, 1988), and Technology University of Denmark (1982). He has been Sir Louis Matheson Distinguished Professor at

Monash University for fifteen years (2007-2022). In India, he has been a Chancellor of the Institute of Chemical Technology (2010-2024), Assam University, Silchar (2003-2005), the Academy of Scientific and Innovative Research (2013-2016.), and Jio Institute (2020–till date). He has been the Chairman of Research Advisory Council, IITB-Monash Research Academy, (2014-till date), Chairman of the Board of Governors of IISER, Kolkata (2010-2014), IISER, Mohali (2010-2014), IIT, Gandhinagar, (2011-2014) and National Institute of Pharmaceuticals Education and Research, Mohali (2001-2005).

Dr Mashelkar has influenced India's science, technology and innovation policy by serving as a member of the Scientific Advisory Council to the Prime Minister of India and the PM's National Innovation Council. In addition, he has chaired 16 high-powered committees, popularly known in India as 'Mashelkar Committees' set up to look into diverse national issues, ranging from the drug regulatory system to National auto-fuel policy and higher education.

He is keenly involved in several societal and grassroots activities. Along with Prof. Anil Gupta, he has championed the movement of grassroots innovations in India over the past three decades and chaired the 'Corporate Social Responsibility' Committees of Reliance, Tata Motors, Godrej Agrovvet, etc. The Anjani Mashelkar trust he founded supports innovators in developing technologies for the less privileged.

He is known for his world-class scientific contributions to the rheology of complex fluids, non-Newtonian fluid mechanics, diffusional phenomena in structured polymeric systems, and polymer reaction engineering. His work in mechanistic analysis, synthesis, and breakthrough applications of novel stimuli-responsive polymers has received worldwide accolades. He continues contributing to fundamental research in collaboration with some of the finest intellectuals. His latest work on supramolecular therapeutics is as novel as it is impactful.

Amidst everything else, he is a prolific writer, public speaker, and mentor. His book, co-authored with Mr Ravi Pandit, titled 'Leap Frogging to Pole Vaulting: Creating the Magic of Radical yet Sustainable Transformation', won the Best Business Book of the Year award at the Tata Lit Festival 2019. His new book (2023), co-authored with Hersh Haladker, is a national bestseller and is titled 'Exprovement: Exponential

Improvement through Converging Parallels’. His mentorial capabilities can be witnessed by several of his students, who are leading top-notch research institutes and corporate industries across the globe.



*Dr Mashelkar receiving the Dadabhai Naoroji Memorial Award (2002) from Dr A.P. J. Abdul Kalam, the then President of India.  
(Pic credit: <https://mashelkar.com/gallery/>)*

### About the author

Dr Ashish Lele is the Director of CSIR-National Chemical Laboratory (CSIR-NCL), Pune. Dr Lele is a prominent researcher and scientist in Chemical Engineering. He has led many industry-sponsored research projects and several product development activities. He led the efforts to develop PEM fuel cell technology in a consortium of three other CSIR laboratories and three Indian industries. Dr Lele has received several prestigious awards, including the Shanti Swarup Bhatnagar Prize in Engineering Sciences in 2006 and the Infosys Prize in Engineering and Computer Science in 2012.







**V. Prakash**  
*An Eminent Food Scientist*

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**Sridevi Annapurna Singh**

*Director, CSIR-Central Food Technological  
Research Institute (CFTRI), Mysuru*

**D**R Vishweshwaraiah Prakash was born in Mysore, India, on 23 November 1951 to the academic professional couple Prof. K.N. Vishweshwaraiah and Smt. H. S. Gangamma. Dr Prakash earned all his degrees from the University of Mysore, India.

He obtained his BSc from Yuvarajas College (1967), MSc, and PhD (at CFTRI 1976) from the University of Mysore, Mysore. In 1976, he went abroad as a Postdoctoral Fellow at Baylor College of Medicine, Texas Medical Center, Houston, Texas, USA. He later moved to Brandeis University in Boston, USA, as a Research Associate and returned to India in 1980.

He joined as a Pool Officer of CSIR at CFTRI Mysore in 1981 and was appointed a Scientist at CFTRI in 1982. With his excellent research and outstanding ability to think innovatively, he vibrantly led a large group of students and colleagues working on proteins. He became head of the Department of Protein Chemistry and Technology at CSIR-CFTRI and rose to become Director of CFTRI at the young age of 43, a position that he held for 17 years and later appointed as the Director General, CSIR in 2007. He superannuated to occupy the position of Distinguished Scientist of CSIR.

Dr Prakash established excellent connectivity with industries and academia nationally and internationally in the unique chemistry and physics of the food and nutrition field. He was the Hon. President of IUFOST (Food Science and Technology) and Hon. Vice President of IUNS (Nutrition) (the two UN global ICSU affiliated organisations) — for the first time both were headed by an Indian Scientist. In these roles, Dr Prakash made a radical difference with a plant-based protein approach to fight undernutrition in children by adding value to agribusiness and policies for low-income countries and preventing food losses and waste.

He was the Chairman of the India Region of the European Hygienic Engineering Design Group (EHEDG), Germany. He is also an Adjunct Professor at Ramaiah University of Applied Sciences, Bangalore, India, and an Adjunct Professor at the Institute of Chemical Technology, Mumbai, India.

Dr Prakash's scientific contributions in the areas of Food Science, Food Technology, Chemistry and Biochemistry of Foods, Structural Biology and Biotechnology, Food Product Development, Food and



*Dr V. Prakash (Padma Awardee) receiving the “Doyen of Modern Indian Food Industries Award” from AFST (I) (2023) in memory of Dr M.S. Swaminathan*

Nutrition Biotechnology, Nutraceuticals, Food Safety and Nutrition are well known. His knowledge output includes over 200 scientific research publications, 25 books (14 more in the pipeline), 55 patents, and 987 addresses as chief guest, keynote and inaugural speaker, convocation address, etc.

He serves as chairman of many technical advisory boards, research councils, and research advisory committees, as well as chairman of many committees of various departments of the Government of India and various state governments. His keen interest in social nutrition endeavours and the regulatory angle of start-ups is well known. His close association with industry bodies takes him closer to home-grown industries and leverages them to take these industries to the next orbit of performance. As a regular contributor to leading professional journals, magazines, radio, TV and public talks, he reaches out to the public with the message of food science and nutrition for a healthy lifestyle.

He is a regular evaluator of projects globally for various countries. He is responsible for many planning documents, such as the Vision

for Food, Agriculture linked value addition for India in 2010 with the Planning Commission and the HLPE global document on Food Losses and Waste from FAO. He strives hard for innovative solutions to minimise food losses and waste, undernutrition, poverty and hunger globally and nationally in nutritional programmes and malnutrition endeavours. He was a Scientific Consultant to the Principal Scientific Adviser to Govt. of India until 2017. Also, he focuses on the cost-effectiveness of such processes by promoting traditional foods and traditional wisdom based on ancient Indian practices of Ayur Science, which relates to sustainable food-based approaches for a healthy lifestyle. He does this at different levels with affordable, adaptable, and acceptable science and technologies for farmers and consumers.

His contribution to mid-day or noon meals right from his research days is a long-standing commitment to his love and compassion for food-deprived children coming to school. Today, the noon meal in India is one of the world's most extensive school lunch programmes, offering a lasting impact on more than 12 crore children in 11.20 lakh schools across the country. It's a massive mission in India, and lakhs of people have contributed to its success.

He also was able to show how scientific organisations can help during natural disasters. In 2004, when Tsunami struck on the East Coast of India, CSIR-CFTRI supplied packed and sterilised food to more than half a million stranded and displaced people within the first ten days of disaster.

Dr Prakash's priority has recently been outreach and awareness of local food science solutions to global problems, including climate change and food insecurity. He addressed the Global Conference of Climate Change Scientists on Actions Needed for Sustainable Food by 2050 Future Earth Programme in Montreal, Canada, in December 2023.

His contributions as Chair to Nutraceuticals Regulation of India were game changer in the US \$400 Billion Global Industry, and it removed India's shackles to emerge as a global player. His scientific contribution to the basmati patent victory for India, Regulations for Beverages and Bottled Water, and committee recommendations for establishing FSSAI are a few game changers in this country one has seen. Most recently, in Mysore, India, he was Crowned as the 'Doyen of Modern Indian Food Science and

Technology’ by Dr Somnath, Chairman of ISRO in the AFSTI, once in 5 years Congress at Mysore.

He has received innumerable national and international awards, including the Padma Shree (2004), Shanti Swarup Bhatnagar Prize for Science and Technology (1996), Rajyothsava Award of Karnataka and several Lifetime Achievement Awards from various organisations like FICCI, IUFoST, AIFPA, KSTA and many organisations abroad. Dr Prakash is former Chair of the Panel on Nutraceuticals and a Member of the Scientific Committee of FSSAI, Government of India, New Delhi. He is a fellow of the Indian Academy of Sciences, National Academy of Sciences, National Academy of Engineers, National Academy of Agricultural Scientists, Karnataka Science and Technology Academy in India Roy, al Society of Chemistry, UK, IAFoST, Canada and Institute of Food Technology, USA.

Dr Prakash has excelled in tennis, table tennis, shuttle badminton, basketball, and cricket. He served as President of the CSIR Sports Promotion Board for three consecutive terms from 1998 to 2006. Dr Prakash is an ardent yoga practitioner and has a keen interest in classical Karnatak music, as well as instrumental music.

### About the author

Dr Sridevi Annapurna Singh is the Director of the CSIR-Central Food Technological Research Institute (CSIR-CFTRI) in Mysuru, India. Dr Singh is the Chairperson/ member of institute governing councils, taskforces, national committees, of the DBT, FSSAI, DST, and university boards of studies. Dr Singh is an Honorary Fellow of the Karnataka Science and Technology Academy.







**M.K. Bhan**  
*A Doyen of Biomedical Research  
and Innovation*

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**Renu Swarup**

*Former Secretary, Department of Biotechnology,  
Ministry of Science & Technology, Government of India*

**D**R Maharaj Kishan Bhan, an eminent researcher, a well-acclaimed clinician, an able administrator and above all, a perfect human being — there are different ways in which he is fondly remembered. We lost a titan of Science & Technology and Biomedical research on 26 January 2020. The country lost a valuable treasure, a born leader who had exhibited his skills in the different fields he contributed to. His valuable contributions will always stay etched in our scientific journey.

Born and raised in Srinagar (J&K), the young Maharaj Krishan Bhan grew up in an environment of curiosity and exploration. He developed a very inquisitive mind, a trait that was a key factor in his becoming a visionary leader. After his initial education in Srinagar, he moved to Pune to join the Armed Forces Medical College, where he got his MBBS degree. He attained his MD (Paediatrics) from the Post Graduate Institute for Medical Education Research (PGIMER), Chandigarh. His medical profession became his lifelong passion, and his contributions to child health and nutrition are today valued and remembered. His post-doctoral research and faculty position at All India Institute of Medical Sciences (AIIMS) focused on diarrheal diseases and child nutrition.

Dr Bhan was a visionary leader, and his biggest asset was his zeal for continuous learning. This gave him the strength and the confidence to outperform in each task and responsibility he took on. From starting his career as a trained Pediatrician to becoming a successful faculty and clinician-researcher, he took on an important role of becoming a science administrator in the Government as Secretary to the Government of India, Department of Biotechnology - a position he occupied for eight years from 1 March 2004 to 30 November 2012. These eight years were very important in the growth trajectory of Science & Technology in the country, specially Biotechnology and Biosciences, and Dr Bhan's visionary leadership has left an indelible impression in different spheres of S&T. During his tenure as Secretary to the Government of India, he also held charge of DG, CSIR and Secretary, DSIR for two months from 5 January 2007 to 6 March 2007. His contributions have been well recognised and awarded — the Shanti Swarup Bhatnagar Award for Excellence in Science & Technology in 1990 and the Padma Bhushan in 2013 for his contributions to public service.

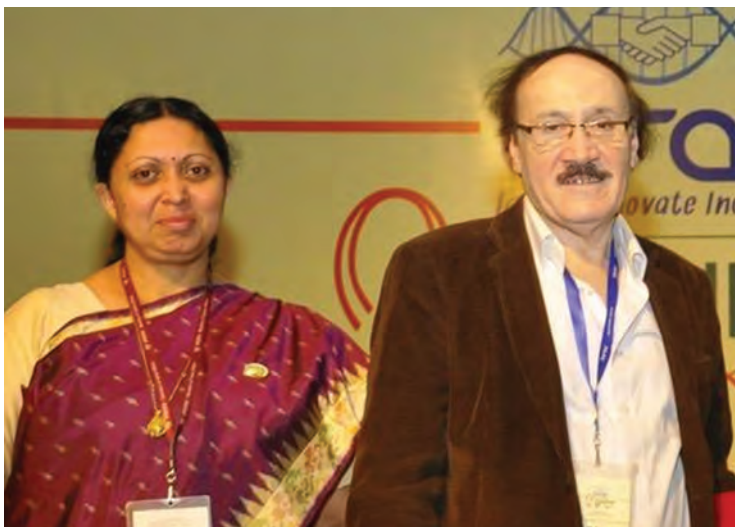
Dr Bhan is remembered very respectfully by the scientific community for his immense contributions to building a strong, robust research and innovation ecosystem in the country. His very inclusive and humble nature was a crucial personality trait that helped him build strong partnerships and collaborations. The most outstanding example of his successful research collaboration is the development of the Rotavirus Vaccine - the first indigenously developed vaccine which was introduced into the Universal immunisation programme. The making of this vaccine exhibited his unique traits of leadership - a curious researcher, a team player bringing together academia, industry, NGOs, international organisations and all relevant stakeholders, a learned personality and most importantly, a doer who delivers difficult tasks by overcoming challenges and finding the right solutions.

The journey of Rotavirus. Vaccine - or Rotavac as it is available today - began in 1985 when Dr Bhan, or “Raj”, as he was affectionately called by his friends, identified a weakened strain of Rotavirus in a newborn child that was not causing the disease. This strain was called 116E. He worked closely with Dr Roger Glass, NIH, who, at that time, was also characterising strains of Rotavirus that were not causing the disease. He then worked tirelessly to develop the first vaccine, collaborating closely with NIH and all stakeholders, including industry. This was the first successful Industry-Academia partnership, which resulted in a cost effective vaccine being made available for child immunisation.

Dr Bhan’s deep understanding of how the components of a translation value chain work was a key factor in building a vibrant innovation and translation ecosystem in the country. He was a strong institution builder, and during his tenure, the Department of Biotechnology set up THSTI, InSTEM, NABI and the Bioclusters at NCR and Bengaluru. He was also responsible for providing visionary leadership for the setting up of the first Public Sector Company, the Biotechnology Industry Research Assistance Council (BIRAC), which has today been a game changer in the setting up of a strong Biotech Startup and Innovation ecosystem involving industry, academia and international organisations. Dr Bhan also built many new models of partnership with international organisations — the DBT Wellcome Trust Alliance for Biomedical Research career fellowships, the Stanford India Biodesign programme for building an ecosystem and nurturing innovation in biomedical

devices, the partnership with Gates Foundation for the Grand Challenges India programme for promoting deep tech research and social innovation across biotech sector and many more such collaborations.

I have personally been very fortunate to have had the opportunity to work very closely with him for many years. While I had known and interacted with him since he was involved with DBT during his position as a clinical researcher at AIIMS, my working with him began on 1 March 2004 when he assumed charge as Secretary of DBT. As soon as he assumed charge, within two days, he led an official delegation for a UNCTAD meeting in Rio de Janeiro, of which I was a member.



*Dr M.K. Bhan with Dr Renu Swarup, on her assuming the charge as Secretary, Department of Biotechnology*

During those seven days, observing his working style and understanding his thought process and response to critical international collaboration matters was a learning experience. After that, I worked with him on many new initiatives, major missions, and policy matters. The one thing that always stayed with me was his openness to new revolutionary ideas and his enthusiasm to start something new, even if it meant taking a risk and understanding that it would yield high rewards. Discussing new ideas with him was always encouraging because he was always

supportive and came up with new and exciting suggestions that added so much more value to the concept. He gave his full support to take these forward till we could achieve a logical conclusion. Because of this, we could launch many new and interesting initiatives. Each new initiative was a wonderful learning experience, and it was a pleasure to observe him to understand the nuances of good leadership. I continued to receive his encouragement and guidance until he was with us, and I shall always cherish it. I fondly remember the good wishes and blessings I received from him when I took over as Secretary of the Department of Biotechnology. The most cherished moment for me was when he came to congratulate me in the Office of Secretary the next day of my joining. The one time when he was most missed was during COVID-19. His vast experience in public health management would have added value to the COVID-19 management strategy.

Dr M.K. Bhan is not amongst us today. Still, his guiding light to the scientific and biomedical research fraternity, especially the younger generation, will be with us forever. He has set the benchmarks high and established deep, strong foundations, which we should strive to continue to strengthen.

### About the author

Dr Renu Swarup is the former Secretary of the Department of Biotechnology (DBT), Ministry of Science and Technology, Government of India, where she worked for over 30 years. She was also Chairperson of the Biotechnology Industry Research Assistance Council (BIRAC) and briefly held additional charge of the Secretary, Department of Science & Technology – the first woman to do so. Dr Swarup featured on the list of BW's Most Influential Women of India in 2019. In acknowledgement of her immense contribution to microbial diversity research, a newly discovered microbial species – *Natrialba swarupiae* – was named in her honour by the National Centre for Cell Science.







## **T. Ramasami**

### *A Governance Role Model in S&T*

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**B. Chandrasekaran**

*Distinguished Scientist, CSIR and Former Director,  
CSIR-Central Leather Research Institute (CLRI), Chennai*

**B**ORN in Srivilliputtur of Tamil Nadu, Thirumalachari Ramasami had an illustrious early education which kindled his passion for seeking truth in whatever he learnt. He chose the path of science to shape his life and sought truth in everything.

TR, as he is popularly known, joined a prominent tannery soon after obtaining his Bachelor's degree in leather technology. The young TR revealed his innovative qualities and leadership abilities early enough at the tannery by increasing productivity 12-fold. He then completed his Master's degree in Leather Technology at the University of Madras in 1972 and a Doctor of Philosophy in Chemistry at the University of Leeds in January 1976.

His doctoral research was on the aqueous chemistry of Chromium (III) under the guidance of Professor A.G. Sykes. His doctoral work elicited some fundamental aspects of chemistry which form textbook content. After a brief stint as a scientist at the CSIR-Central Leather Research Institute (CLRI), TR, on the advice of Dr Sykes, joined Ames Laboratory in the USA to work on energy research. Later, he joined Dr J.F. Endicott at Wayne State University, Detroit. His work on electron transfer phenomena is a hallmark of his originality.



*Hon'ble Minister S&T, Dr Jitendra Singh presenting the IULTCS Merit Award 2021 to Dr T. Ramasami*

He established a school in chromium chemistry at the CSIR-Central Leather Research Institute. He pioneered in demonstrating that a) chromium(III) is not always inert as was believed, b) stabilised unusual oxidation states of chromium, c) gave a new explanation for the implication of Chromium(III) in glucose metabolism and d) demonstrated the chromium(III) induced apoptosis of human lymphocytes. His thought leadership earned him global peer recognition, and he went on to develop several innovative products and processes for chromium-based industries.

In the early 80s, CSIR sought leaders to shape leather research in India. Dr Ramasami was invited by the then DG, CSIR, to join the CLRI leadership team. He returned to India in 1984 and joined CSIR-CLRI as a senior scientist. It coincided with the new leadership change at CLRI, with Dr G. Thyagarajan assuming Directorship. Dr Thyagarajan, Dr Ramasami and Dr K.V. Raghavan brought developmental strength, and the trio made transformational changes in CSIR-CLRI during 1984-95. The role of TR as a designer and Dr KVR as a developmental Engineer in the modernisation of CLRI through World Bank assistance, the introduction of CAD/CAM techniques in footwear and leather products, UNDP-assisted National Leather Development Program, TNO collaboration in environmental technologies, technology forecasting of Indian leather 2010, drafting of Leather Technology Mission and many more left a strong imprint.

In 1996, Dr Ramasami, as a natural leader, assumed the Directorship of CSIR-CLRI. Almost concurrent with Dr Ramasami assuming directorship of CSIR-CLRI, the tannery sector in Tamil Nadu faced a significant crisis. The Supreme Court passed an order to close down 400 tanneries. Thanks to his leadership, the CSIR-CLRI teamed up with CSIR-NEERI and provided “Do Ecology Solutions” to all 764 functional tanneries within nine months. Technology intervention averted an industrial catastrophe, saving about 250,000 jobs and Rs 6000 crore turnover. TR’s delivery of extraordinary values for human efforts through innovative deployment of R&D solutions revealed an unmatched leadership at crisis moments.

In 1995, he drafted the CSIR-CLRI vision for 2005. Setting superordinate goals and synergising self-actualised people are his

hallmarks. The single-point agenda for Vision 2005 was to attain CLRI global leadership. He invested in people. He believed in the power of inspirational leadership. Several of his students have emerged as leaders in different domains, some becoming Directors of CSIR laboratories. His leather school at CSIR-CLRI is globally renowned.

During the directorship of Dr Ramasami, CSIR-CLRI became the first Indian R&D establishment to deliver a Leather Technology Mission (LTM). The successful implementation of LTM, which delivered all stated outputs without any time and cost overrun, is widely acclaimed.

Dr Ramasami attributes the success of CSIR-CLRI to:

- a) clear articulation of principles,
- b) evidence-based decision-making,
- c) transparency on governance,
- d) positioning of a balanced performance-reward relationship,
- e) recognition of performance without scope for internal jealousies and
- f) open communication.

In the transition of India from a supplier of finished leather and other processed intermediates to a reliable supplier of finished and branded products, synergy between research and industry was necessary. TR led the transition, teaming up with industrial leaders from different parts of India. The practice of Zero Liquid Discharge in the Tannery sector in Tamil Nadu bears testimony to his art of persuasion.

By bestowing the Merit Award 2021 on Dr T Ramasami based on the unanimous nomination of 7 European nations, the International Union of Leather Technologists and Chemists Societies is a recognition of his global leadership in leather research. He remains the only Indian awardee.

A non-linear and growth-focused sector like science has to redress cultural dichotomies with bureaucracy. The role of communication across cultural divides in the delivery of good governance is crucial. He calls for synergy between science leadership and civil servants. He believes that the formation of entities like the Science, Engineering Research Board (SERB) and the establishment of the National Research Foundation



*Dr T. Ramasami receiving Padma Bhushan Award during his Additional Charge as DG CSIR*

(NRF) are for ensuring good governance with process integrity without defeating the purpose of research.

Dr Ramasami was able to practice synergy with civil servants for good governance both at DST and CSIR during his tenure. During his tenure as Secretary of DST, the department launched 74 new schemes and programs, including INSPIRE. He earned the respect of the bureaucracy and the trust of political leaders. The leadership of science is bridging to redress interfacial tension between linear and non-linear processes. He championed process intensity in governance for the sustainable development of Indian science.

Dr Ramasami remains a champion for the planned development of the Indian science landscape. He speaks for Public-Private Partnerships for R&D and clean energy, innovative audit methods for science, laying leadership pipelines, rightsizing the Full-Time Equivalent R&D professionals and collaborative excellence for resource optimisation of research. He is a credible policy professional. Science, Technology and Innovation Policy 2013 bears his stamp. He champions new policy paradigms for R&D in the low resource setting.

Dr Ramasami has left a lasting impact on Indian science. He holds the record for the maximum number of extensions in the service to the Government of India. His legacy continues to inspire young researchers

in India. In short, his career is a testament to good governance and the rise of India as a knowledge power. Selflessness is his signature. With an unwavering commitment to scientific excellence and a visionary approach to leadership, Dr T. Ramasami's contributions elevated India's research and also has left an indelible legacy of innovation and transformative impact for generations to come.

### **About the author**

Dr B. Chandrasekaran is presently a Distinguished Scientist at CSIR - Central Leather Research Institute (CLRI), Chennai. He served as the Director of CSIR-CLRI from Feb. 2016 to April 2019.

Dr Chandrasekaran has made significant contributions to leather science and technology. His work currently involves various aspects of leather processing, including sustainability for leather and products sector, greener and cleaner processing, International S&T cooperation and organisational excellence. The author was a research student of Dr T. Ramasami.





## **Samir K. Brahmachari**

### *A Big Science Visionary*

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**Anurag Agrawal**

*Dean, Biosciences and Health Research,  
Trivedi School of Biosciences, Ashoka University, Sonapat  
Former Director, CSIR-Institute of Genomics and Integrative  
Biology (IGIB), New Delhi*

PROFESSOR Samir Brahmachari (SKB to all who know him), Director General of CSIR from 2007 to 2013, presided over a remarkable phase of growth and impact beyond CSIR. This was the time when the research capacity of CSIR was used to plant academic seeds, such as the Academy of Scientific and Innovative Research (AcSIR), an institution of national importance, now the largest academic institution for doctoral research in India. While this was just one of many significant initiatives during his tenure, it exemplifies the qualities of foresight, passion, and energy that made him a great leader. From multiple accounts of his life, these have been his defining qualities. Praise and criticism, depending on who one speaks to, were just different perspectives on whether these qualities were to the right degree or in excess.

“This one would turn the institution upside down” was the fear of a member tasked with determining whether a mid-career SKB should be given the reins of the then-staid Centre of Biochemical Technology (CBT), his entry point into CSIR. Indeed, within a few years, CBT was replaced by the fast-growing CSIR-Institute of Genomics and Integrative Biology (IGIB), which I had the pleasure of leading during the COVID-19 pandemic.

I can say without hesitation that CSIR-IGIB’s contributions during that time could all be directly traced to SKB’s vision and mentorship two decades ago. The young scientists he recruited and personally led in that phase referred to themselves as the “Lagaan team”. “Yes, we can” was his defining motto - and most importantly, the team believed even when others did not.

SKB’s journey from a curious and sensitive child to a leading scientist and visionary Director, compiled in a tribute on his 60<sup>th</sup> birthday, illustrates a life dedicated to advancing scientific understanding and application. As per SKB’s brother, a single-minded focus on his pursuit was an attribute of Samir’s personality from childhood, as was his sheer determination and refusal to accept failure. He had his heart set on studying science at IISc but barely missed a first division, which was required. He was denied an interview, and he stood outside the interview hall for three consecutive days, as long as the interviewers were present, eventually convincing them to give him a chance. The rest, as they say, is history.



2013: The President of India Shri Pranab Mukherjee launching “India Science & Technology” Volume 2. Shri Jaipal Reddy (the then) Minister of Science & Technology and Vice President, CSIR presenting the book to the Hon’ble President. On extreme left is Prof. Samir K. Brahmachari.

As a PhD student at IISc, SKB exhibited exceptional intellectual vitality and a deep commitment to scientific exploration. Joining the newly created Molecular Biophysics Unit (MBU), he worked under eminent mentors, delving into the complexities of collagen biochemistry. His sharp analytical skills, creative approach to problem-solving, and ability to engage deeply with a wide range of complex scientific issues made those around him sure he was going places; the only question was where. A strong nationalistic streak and his life mate, Vani, kept him in India, starting the next leg of his journey as a faculty member at MBU.

During his tenure as a faculty member, SKB foresaw the profound impact of genomics on modern biology and medicine. This ability to predict future trends in science (and other matters) was complemented by his dynamic teaching style and dedication to research, which inspired a generation of students and researchers. Numerous prestigious awards, including the Bhatnagar Prize, followed. However, he wanted more than



*2008: Dr A.P.J. Abdul Kalam at NPL during the 32<sup>nd</sup> Krishnan Memorial Lecture; on his right is Dr S.K. Brahmachari*

the individualistic scientific pursuit style of the institute; he wanted to sow the seeds of 'big science' with large, motivated teams working on common goals to advance the frontiers.

When advised that such dreams would only materialize with a new institution, he did precisely that. His move to CBT, followed by its transition to IGIB, is a remarkable story of conviction and courage. He always has a burning desire to see his students, colleagues, and Indian science flourish on the international stage, where we had previously been bit players.

I first met SKB when I was visiting IGIB in 2005. It was a memorable meeting where he spoke about his need to leave the comfortable cocoon of the professorship at IISc to establish something new and essential for Indian science. It was clear from our initial conversation that he was different: a visionary with the conviction and courage to convert visions to brick and mortar. Since I was transitioning back to India from the United States, I decided to work with him if the opportunity arose, and soon enough, it did.

I joined CSIR-IGIB in 2007, when he was still the Director but was soon to become the Director General of CSIR. The few months of our overlap at IGIB were an exciting period where I saw how he inspired people to be all they could be and perhaps more than they could have been elsewhere. More than a mentor, he was a profoundly involved senior family member with the family's interests at heart.

Many things can be said for his accomplishments as DG, CSIR. While his most significant surviving contribution is AcSIR, his most extensive vision was a program called Open Source Drug Discovery (OSDD). AcSIR was a pragmatic and strategic consolidation of CSIR's research capacity towards research training, leveraging existing infrastructure, research talent, and resources, thereby reducing additional costs typically associated with establishing a new educational institution.

OSDD was a dream. A ground-breaking effort to make drug discovery more collaborative, cost-effective, and open to a broader scientific community, including researchers, students, and professionals worldwide. This initiative targeted diseases ignored mainly by major pharmaceutical companies due to low market incentives, such as tuberculosis and other neglected tropical diseases. By leveraging the open-source model, OSDD facilitated the sharing of data and resources, significantly reducing the costs associated with drug discovery and allowing for a more democratic and transparent research process. While it is difficult to call the Indian OSDD effort a success, becoming inactive before yielding any crucial new drug, it was also not a failure. It is simply an idea whose time is yet to come.

To end, I will recapitulate some things I learnt from him that merit repeating, even if partially covered above:

1. We are all only as good as the people we work with.
2. Open sharing of knowledge and resources makes everyone better.
3. Nurturing young people is the only way to ensure the continuity of innovative research.
4. Looking forward with a purpose bigger than oneself is necessary to build institutions.

Whether or not we have his foresight, passion, energy, and planning skills, we can all imbibe these values.

### **About the author**

Dr Anurag Agrawal is the Dean of Biosciences and Health Research at Trivedi School of Biosciences, Ashoka University, Sonapat. He is a former Director of the CSIR-Institute of Genomics and Integrative Biology (CSIR-IGIB), Delhi. Dr Anurag Agrawal is a physician-scientist who focuses on the interface of biology, medicine, and data. His specialisation includes lung disease and physiology, and he has spent a significant amount of time imagining the medicine of tomorrow, with synergy between human expertise and machine learning.





## **Paramvir Singh Ahuja**

### *A Cross-Disciplinary Expert*

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**Sanjay Kumar**

*Chairman, Agricultural Scientists Recruitment Board  
Department of Agricultural Research and Education  
Former Director, CSIR-Institute of Himalayan  
Bioresource Technology (IHBT), Palampur*

**D**R Paramvir Singh Ahuja was a tall personality in plant biotechnology and a bright academician whose scientific career was marked by a persistent quest for knowledge and keenness to innovate. He held the distinction of being a national scholarship holder. Invaluable experiences at institutions like the Plant Breeding Institute in Cambridge, UK, and the Nuclear Research Institute in Julich, Germany, enriched his doctoral studies. This exposure to international scientific excellence laid the foundation for his impressive career, which flourished with postdoctoral research as an NSERC Fellow at McGill University in Montreal, Canada, and a subsequent visiting scientist position at Ohio State University, USA.

Dr Ahuja's career began with a firm grounding in practical plant breeding at Punjab Agricultural University. After completing his MSc, he joined the Indian Council of Agricultural Research (1977-1980), where he focused on developing salt-tolerant varieties of wheat and forage leguminous crops vital for sustainable agriculture. This early focus on practical applications foreshadowed his lifelong commitment to research with a real-world impact.

Driven by a voracious intellectual curiosity, Dr Ahuja sought further knowledge through a Commonwealth Scholarship to pursue his PhD under the guidance of Prof. E.C. Cocking at the University of Nottingham, UK. He made pioneering contributions to the field, achieving the previously challenging feat of regenerating cell suspensions and protoplast cultures in monocots. This pioneering research opened new avenues for plant improvement through genetic manipulation.

Dr Ahuja's collaborative spirit extended beyond his doctoral studies. He forged a fruitful partnership with Prof. U. Zimmerman, a pioneer in protoplast fusion, and even co-developed a cell fusion machine with Prof. Peter Mansfield, a renowned figure in MRI development. These collaborations exemplify Dr Ahuja's commitment to cross-disciplinary research and his ability to translate cutting-edge science into practical tools.

Dr Paramvir Singh Ahuja's visionary leadership and profound expertise were instrumental in shaping the landscape of Indian biotechnology. He was a driving force behind the development of the Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP),

Lucknow, beginning in 1983, marked the inception of a transformative era. Subsequently, he propelled the CSIR-Institute of Himalayan Bioresource Technology (CSIR-IHBT), Palampur, to global prominence, serving as a scientist and Head of the Biotechnology division from 1993 to 1998 and later assuming the role of Director from 1998 to 2014.

Beyond his institutional roles, Dr Ahuja's influence extended widely. He was a pivotal member of numerous prestigious research councils, scientific advisory committees, and government task forces, contributing significantly to the nation's scientific policy. His exceptional capabilities were further recognized through additional responsibilities as Director of CSIR-CIMAP and CSIR-NBRI.

Dr Ahuja's research portfolio stands as proof of his innovative spirit. His pioneering contributions to plant biotechnology, particularly in genetic engineering, plant tissue culture, and genomics, have left an enduring legacy. A seminal achievement was the creation of transgenic plants as early as 1988-1993 through protoplast fusion in *Hyoscyamus muticus*, *Hyoscyamus albus*, *Atropa belladonna*, and *Nicotiana tabacum*. His expertise extended to developing micropropagation protocols for various endangered medicinal plants, including *Picrorhiza*, *Valeriana*, *Rheum*, and *Aconitum* species. Notably, he also played a pivotal role in creating a somaclonal variant of *Cymbopogon winterianus*, leading to the release of the widely cultivated CIMAP BIO-13 variety.

A dual commitment to research excellence and practical application marked Dr Ahuja's leadership at CSIR-CIMAP. As Head of the Plant Tissue Culture Department, he transformed it into a centre of global repute. His research into reproductive biology and tissue culture of medicinal and aromatic plants led to establishing a gene bank and the successful conservation of endangered species through artificial seed technology.

At CSIR-IHBT, his visionary leadership modernized the tissue culture laboratory and successfully transferred tissue culture-raised bamboo and tea plants to the field. His research led to the development of transgenic tea with reduced caffeine content and the creation of stress-tolerant transgenic Arabidopsis and potato plants.

The impact of Dr Ahuja's work extended far beyond the confines of the laboratory. His expertise in characterizing Indian tea germplasm

and his commitment to bioprospect novel plants earned him widespread recognition. He played a pivotal role in promoting stevia and other medicinal plants as commercially viable crops, thereby contributing to the diversification of Indian agriculture. His dedication to promoting rural development led to the dissemination of critical technologies to remote Himalayan regions, fostering sustainable livelihoods and improving the lives of rural communities.

Dr Ahuja's multifaceted contributions have indelibly shaped the country's biotechnology trajectory. His visionary leadership, coupled with his scientific acumen, have created a lasting impact on both the research landscape and the socio-economic development of the nation.

Dr Ahuja's academic prowess is reflected in his prolific research output, with over 200 publications and several patents credited to his name. His dedication to advancing agricultural science and technology is further underscored by the numerous awards he received throughout his career. He actively participated in scientific societies, holding life memberships in several organizations and fellowships in prestigious academies like NAAS, NASI, and INSA. His guidance nurtured numerous PhD and MSc scholars, many of whom have gone on to become prominent scientists.

Dr Ahuja's tenure (8.05.2014 - 31.12.2014) as the Director General of the Council of Scientific and Industrial Research (CSIR) was instrumental in positioning CSIR for more significant innovation, commercialization of technologies and enhanced societal impact. His exceptional leadership and administrative acumen were influential in steering the organization towards its ambitious scientific goals.

Before assuming this pivotal role, he served as the Chairman of the Recruitment and Assessment Board (RAB) of CSIR.

He led the formation of a High-Powered Committee to revamp the CSIR Scientists Recruitment and Assessment Promotion Rules (CSRAP-2001) and redesign the Performance Mapping of Scientists (PMS). He oversaw the development of a new PMS system that emphasized technology development, knowledge generation, human resource development, intellectual property, and economic product development.

Dr Ahuja was crucial in successfully launching the Broadband Confocal Microscope, a product developed under the CSIR-New Millennium Indian Technology Leadership Initiative (CSIR-NMITLI) program. This project was the prime example of a successful public-private partnership, aligning with the government's "Make in India" strategy. During Dr P.S. Ahuja's leadership as Director General of CSIR, India unveiled its first indigenously constructed research vessel, R V Sindhu Sadhana. This milestone significantly elevated India's oceanic research prowess and paved the way for global scientific partnerships.

Under Dr Ahuja's visionary leadership, CSIR embarked on a series of strategic initiatives to address national challenges and foster innovation. His emphasis on research excellence, technology transfer, and public-private partnerships propelled CSIR to new heights. He created an environment encouraging creativity and collaboration among scientists, leading to discoveries and technological advancements.

Dr Ahuja's legacy at CSIR is marked by his firm commitment to scientific integrity, his ability to inspire and motivate researchers, and his strategic vision for India's scientific landscape.

Dr Paramvir Singh Ahuja's passing on 22 January 2017 was an immense loss to the scientific community. His legacy as an inspiring institution builder, selfless scientist, and visionary leader continues to inspire future generations of researchers and innovators. His contributions to plant biotechnology, agricultural science, and the advancement of India's scientific landscape will be remembered for years.



*2014: Celebrating seven decades of IICT's service to the nation with Shri Venkaiah Naidu, Vice President of India; Dr Jitendra Singh, Minister of State, S&T; Dr P.S. Ahuja, DG, CSIR, and other dignitaries-releasing the 70 Years IICT Souvenir*



*Dr Jitendra Singh, Hon'ble Minister S&T, dedicating to the Nation the indigenously built Research Vessel (Ship) "Sindhu Sadhana" acquired by the CSIR-National Institute of Oceanography, at Marmugao Harbour, in Goa on 13 July 2014, with Dr P. S. Ahuja, DG CSIR.*

Dr Ahuja's life and work serve as an example of inspiration, reminding us of the power of human intellect and the importance of pursuing knowledge for the betterment of society.

## About the author

Dr Sanjay Kumar, a distinguished scientist, currently serves as the Chairman of the Agricultural Scientists Recruitment Board (ASRB) under the Department of Agricultural Research and Education, Ministry of Agriculture and Farmers Welfare, Government of India. He previously held the position of Director at the CSIR-Institute of Himalayan Bioresource Technology (IHBT) in Palampur. Dr Kumar has made seminal contributions in carbon capture, enzyme technology, adaptation biology, and the study of secondary metabolism in Himalayan plants. His innovative scientific initiatives have led to the development of entrepreneurship and improved livelihoods for communities and youth through the sustainable cultivation of high-value crops and the production of value-added products.





**Madhukar O. Garg**  
*A Translational Specialist*

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**Anjan Ray**

*Former Director, CSIR- Indian Institute of  
Petroleum (IIP), Dehradun*

I HAVE several abiding memories of Dr Garg, but one of the most enjoyable was an accidental encounter on an overnight train where he regaled me with accounts of the most recent innovations at the CSIR-Indian Institute of Petroleum, Dehradun, which he headed for over a dozen years before he assumed charge as Director General, CSIR at Delhi in February 2015.

What came across consistently during our chats was his abundant energy, remarkable attention to detail, passion for excellence and ability to work to a punishing schedule. Add to this an inquisitive nature, coupled with a razor-sharp intellect, these made him a standout leader, albeit an exacting one - less than tolerant of mediocrity and not at all of indolence.

Dr M.O. Garg pursued his undergraduate studies in chemical engineering at the Laxminarayan Institute of Technology, Nagpur. A Master's degree at the Indian Institute of Technology (IIT), Kanpur, showcased his academic excellence with a perfect 10-point cumulative grade point average. At the University of Melbourne, his passion for research and innovation flourished during his doctoral studies. His peers speak of his systematic problem-solving approach and ability to think outside the box. His PhD dissertation on droplet coalescence behaviour in extraction columns, under the guidance of globally acknowledged solvent extraction engineering expert Prof. Henry R.C. Pratt, laid the foundation for his lifelong focus on separation processes in industrial chemistry applications at large scales.

After completing his MTech at Kanpur, Madhukar began his professional journey with Engineers India Ltd (EIL), India's largest public sector process engineering company. He had an 18-year career at EIL, during which he also completed his PhD - was marked by several advancements in process and design thinking, driving step changes in efficiency, output and economic value of client projects, particularly in solvent extraction techniques and pinch analysis for heat integration as applied to the refinery and petrochemicals sector. After a short stint at KTI (now known as TechnipFMC after various mergers and acquisitions), Dr Garg moved to CSIR-IIP in 1998. Major technical milestones during his career include the Aromatics extraction unit at BPCL, Mumbai in 1982, cited as an example of the first large indigenous technology ever commercialised in India. A technology conceived during his tenure at



*Dr M.O. Garg being greeted and welcomed at a CSIR event by Dr Anjan Ray*

CSIR-IIP – bio-jet fuel – moved into the field demonstration stage after his superannuation and culminated in the use of CSIR-IIP-produced sustainable aviation biofuel powering a fly-past at India’s Republic Day Parade in 2019.

Translational research and field deployment of technologies were among the hallmarks of Dr Garg’s 18-year stint at CSIR. He also had the networking skills and capability-led confidence to call upon any level of stakeholder leadership, be it the company’s executive head, a senior bureaucrat or the State’s Chief Minister. He pushed for world-class infrastructure and debottlenecked pain points, such as a vexing power outage issue at CSIR-IIP, which he addressed creatively by inviting a state-owned utility to set up a 33kVA power station with three massive transformers at one corner of the campus. Five kW out of the 130 kW solar panel capacity he installed on campus was devoted to the Director’s Bungalow that he occupied, underscoring his commitment to sustainability.

I was employed back in 2007 by a multinational company, and we needed to evaluate a facility offered by CSIR-Central Building Research Institute (CSIR-CBRI), Roorkee, to carry out some trials. After several attempts to reach the CBRI landlines, I called Dr Garg on his mobile to ask if he had the phone number of the Director of CBRI so that I could air my frustration. A hearty guffaw greeted me, “Anjan, you’re speaking with him”. I was unaware till that moment that Dr Garg was holding additional charge at CSIR-CBRI (he did so for about two years starting

July 2007) - and was making a tangible difference to the industry-institute interaction activities.

He kept punishing hours for himself, often returning to the office late at night after dinner, and his refining technology colleagues, in particular, speak of his vast reserve of innovative ideas. Despite his busy schedule and administrative commitments, he would visit his favourite laboratories often and sometimes personally supervise the activities during experimental runs. His former colleagues often remarked on his ability to lead by example, always willing to get his hands dirty and work alongside his team. A couple of years ago, when visiting with him at Reliance Industries Limited (RIL) Jamnagar Refinery, which he joined as President (R&D) in 2018, how well he knew every operator and worker by name, just as he knew every valve and line and vessel of the Benzene Recovery Unit that he and his team at IIP designed, erected and commissioned in partnership with RIL in 2016. It was a first of its kind for India, as every process unit before this at RIL Jamnagar had been built with technology from foreign licensors.

Dr Garg's extraordinary industrial research track record includes 26 Solvent extraction-based technologies developed and commercialised, 16 breakthrough technologies in refining and petrochemicals, 15 successful implementations of Pinch Analysis and 8 path-breaking developments in simulation and modelling. He has 44 Indian and 23 international patents to his credit and is the author of 97 peer-reviewed papers, besides 198 papers in proceedings of prestigious conferences.

Dr Garg is also strongly committed to education and capacity building in the next generation. He has been an outspoken advocate for improving the quality of STEM education in India. He has walked the talk about the need to ignite curiosity and creativity in young minds. He strongly supported infrastructure enhancement at the Kendriya Vidyalaya on the CSIR-IIP campus in Dehradun. Building on his early exposure to teaching at the University of Melbourne, he initiated two post-graduate programs at CSIR-IIP. He expanded the flagship training courses offered by the Institute to the refining industry. In all these courses, Dr Garg continues – even today – to deliver several highly acclaimed and appreciated lectures. To quote one of the stream leaders of SABIC after one of his lectures: “Dr Garg has the heart of a teacher

along with great practical knowledge, a combination which is rare and valuable.” After superannuation from CSIR and before joining Reliance in a leadership role, Dr Garg taught courses and guided MTech students in Chemical Engineering at IIT Bombay for one year.

In 2015, Madhukar O. Garg was appointed Director General of the Council of Scientific and Industrial Research (CSIR), India’s premier research and development organisation. His appointment was a testament to his vast experience, technical acumen, and visionary leadership. At CSIR, Garg oversaw various research initiatives across various scientific disciplines. Groundbreaking innovations and strategic initiatives marked his tenure at CSIR. One of his most significant contributions was his emphasis on translational research – bridging the gap between laboratory research and real-world applications. To this end, he accelerated the industry adoption of several technologies during his tenure, believing that it was more important to ensure that CSIR-developed technology was commercially deployed than to set tough licensing and royalty criteria that might discourage clients from partnering with CSIR constituent laboratories. He also believed that the true value of scientific research lay in its ability to address societal challenges and improve the quality of life for people. He strongly encouraged the CSIR-800 technology development programme for rural and disadvantaged populations.

Given his impatience with mediocrity and confidence in his capabilities, it is perhaps unsurprising that colleagues and subordinates admired Dr Garg for his technical prowess and administrative acumen. Still, many also feared his incisive and direct style of critical feedback and disfavour of dissent. He had the remarkable ability to clearly understand the precise capabilities of his colleagues and leverage them effectively for his purposes and the organisation. He raised the bar on assessment promotions, creating sharp distinctions between those he considered performers and non-performers. At the same time, he consistently led from the front, positioning himself as the public face of his organisation, a leader where the buck stopped.

Leading an organisation as vast and diverse as CSIR was challenging. Dr Garg faced numerous obstacles, from budget constraints to bureaucratic hurdles. However, his tenacity and problem-solving skills helped him navigate these challenges reasonably effectively

during his short tenure as DG, CSIR. He was adept at finding innovative solutions and leveraging partnerships with industry and academia to advance CSIR's mission. Under his guidance, CSIR achieved significant scientific breakthroughs and made substantial strides in making science accessible and relevant to the common man.

At a personal level, people remember Dr Garg as a leader capable of conceiving and communicating compelling visions of the future beyond the foreseeable horizon. His co-workers in the process engineering and simulations area refer to him as an encyclopaedia of extraction, separation and heat integration technologies. A bon vivant, many anecdotes abound of his entertaining conversations over his favourite beverage and piping hot, fresh-from-the-kitchen home-style Indian food. He has been widely travelled and enriched by interactions with thought leaders worldwide, in his formal career stints and in various influential national committees, including those of the Centre of High Technology and the Bureau of Indian Standards. On the other hand, he is known to be a devotee of Sai Baba and respectful of Indian traditions; in one narrative by a former colleague, Sai Baba was instrumental in helping him regain his lost bag in London.

His journey from a curious young boy to the helm of one of India's most prestigious scientific organisations is a story of passion, perseverance, and astute people management at all levels. His ability to blend technical excellence with a deft ability to navigate last-mile issues in technology commercialisation, regulatory frameworks, and collaborative negotiations have been defining characteristics of Dr M.O. Garg's career.

### **About the author**

Dr Anjan Ray was the Director of the CSIR-Indian Institute of Petroleum (CSIR-IIP), Dehradun, from November 2016 to April 2023. Dr Ray has three decades of experience in the Chemical and Energy sectors and an active interest in media, education, heritage and environmental conservation. His professional interests have spanned fields as diverse as biofuels, surfactants, oleochemicals, adhesives, pharmaceuticals, water treatment, energy efficiency and renewable energy policy.





**Girish Sahni**  
*A Pharmaceutical  
Biotechnology Pioneer*

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**Shekhar C. Mande**

*Distinguished Professor, Savitribai Phule Pune University, Pune  
Former Secretary, DSIR, Ministry of S&T, Govt. of India, and  
Former Director General, CSIR*

**D**R Girish Sahni was born on 2 March 1956. After his initial education in Chandigarh, he obtained his PhD in biochemistry from the Indian Institute of Science (IISc), Bengaluru. He did his post-doctoral training at the University of California, Santa Barbara, CA, USA; Rockefeller University, New York, USA; and Albert Einstein College of Medicine, New York, before joining CSIR-Institute of Microbial Technology (IMTECH), Chandigarh, in 1991, where he rose to become its Director in 2005.

At CSIR-IMTECH, Chandigarh, Dr. Sahni's work focussed on protein engineering, molecular biology, and biotechnology, with pioneering contributions in protein cardiovascular drugs, especially 'clot busters' and their mode of action. His group developed the technology for India's first indigenous clot buster, natural streptokinase, licensed to Cadila Pharmaceuticals Ltd., Ahmedabad, and recombinant streptokinase, licensed to Shasun Drugs, Chennai. In a true sense, he pioneered the field of pharmaceutical biotechnology in India with close Industry-Academia interactions. His team also developed India's first bio-therapeutic molecule, Clot-specific streptokinase. This drug has been patented worldwide and is licensed to a US Pharma company.

He took over as the Director General of CSIR in 2015. He recognised the need to reorganise CSIR to the extent possible for its mandate of "Best of science for societal benefit". This was amidst the challenge of limited resources from the Government and Industry. Moreover, the difficulty of translating scientific discoveries into marketable technologies that the industry could use was apparent in CSIR. The newly elected Government had also explicitly called upon CSIR to reorient its policies so that technology and licensing could become significantly more important thereon. The 'Dehradun Declaration' had just been made when he took over as the Director General. On his accounts, in an early one-to-one meeting with the President of CSIR, Hon'ble Prime Minister, Shri Narendra Modi had conveyed this feeling to him as the Director General of CSIR and particularly mentioned that CSIR should put greater emphasis on converting its large patent base into industry-specific projects.

Dr Sahni knew that CSIR had a strong base in technological innovations rooted in excellent science in its history. His primary challenge in 2015, therefore, was to reorient the organisational goals in

the light of the Government of India Policy— that is, fundamental science must promote converting it into early-stage discoveries/patents/know-how. He approached this to consider the low-hanging fruits of lab/PIs in technologies downstream and put these on a fast-track basis on a strong lab-to-market pathway. This required a major reorientation of CSIR's resources, efforts and, most importantly, mindset towards translational research and technological outcomes as end goals.

Dr Sahni's approach benefitted from his own personal research as a CSIR scientist from 1991 onwards, during which he gave a balanced emphasis to fundamental science and its applications. This resulted in some remarkable basic insights into disease processes and mechanisms in blood coagulation biochemistry. But importantly, this work also led to patents and technologies—some of which were licensed and successfully developed as pharma products (clot busters) with good market penetration by major companies.

When he began his tenure as the Director General, the team at CSIR Headquarters analysed the “Low Hanging Fruits” from the various research projects of the preceding few years, prepared a “Most-Probable-to-Succeed” shortlist, and launched Fast Track Translational projects (approx. 140 in number) across the CSIR labs with a strong inter-institutional and multidisciplinary linkage basis after a competitive peer review.

The results were spectacular, with nearly 50-60 high-quality technologies ready for out-licensing to industry within two to three years, especially for medium-and small-scale industries.

CSIR then oriented its 38 institutes into eight thematic pillars so that easy cross-flow within verticals and horizontals could be catalysed.

- Aerospace, Electronics, Instrumentation & Strategic Sectors;
- Civil Infrastructure & Engineering;
- Ecology, Environment, Earth & Ocean Sciences and Water;
- Mining, Minerals, Metals and Materials;
- Chemicals (including leather) and Petrochemicals;
- Energy (conventional and non-conventional) and Energy devices;
- Agri, Nutrition & Biotech; and
- Healthcare.

The institutes under CSIR could now vigorously collaborate under different thematic pillars to create a positive synergy oriented towards time-bound delivery in many Mission-oriented programs and fundamental science.

A few examples of such programs and missions that were launched and pushed forward vigorously in his tenure were:

1. Phyto-Pharmaceutical Mission: making traditional medicine scientifically validated products that can also be internationally competitive.
2. Mission on Drug intermediates to support the pharma industry in coping with cheaper Chinese drugs/drug intermediates.
3. Aroma Mission focused on making the Indian aroma industry globally competitive on one hand and training the farmers to grow the best of the aromatic plants/varieties developed by CSIR to create unique aromatic plant material for necessary processing by the industry.
4. Mass Housing Mission, to develop and provide advanced construction technologies utilising regional resources.
5. Microfluidics and AI Mission to develop advanced diagnostics for affordable health care and testing of contaminants in milk and food products.

This brought about much-needed enthusiasm within the organisation, and the result was that various institutes shifted gears from “pure principal investigator-oriented research” to cross-collaborations and interdisciplinary research so that CSIR was now no longer a mere conglomeration of 38 institutes but could also synergise with each other to produce tangible outcomes to solve real-life problems on a faster scale.

The second challenge was related to resources and funding. Under Dr Sahni’s leadership, CSIR took steps to bring more extramural funds

“*CSIR is committed to deliver technology for common man, solving their day to day problems and thus improving their quality of life*”

— Dr Girish Sahni

from industry and non-CSIR Governmental agencies like DST, DBT, DAE, DRDO, etc, towards targeted research. With these efforts, CSIR succeeded in diversifying its resource base across Government agencies, industry, and the private sector. Together with the reorientation of research programs focused on developing technologies and raising extramural resources, this brought CSIR closer to societal problems, which could now be addressed by developing appropriate technologies.

The drive to raise extramural support yielded rich results, with more than 30 per cent of grants over the regular Government CSIR grants. However, most of these were from the industry for CSIR's technology/IPR, specialised services, and know-how! For example, before Dr Sahni's tenure, for every Rs 100 that was received from the Government, more than ₹15 (>15%) came from the non-government sector. By the end of Dr Sahni's tenure, more than Rs 30 (30%) came from non-CSIR sources. Therefore, the move to bring the industry closer to CSIR started showing good results.

During Dr Sahni's tenure, CSIR also launched the CSIR Innovation Fund for ₹400 crore from its industrial earnings to support early-stage translational research, particularly in areas where venture funds from market-friendly sources are not easier to attract but are nevertheless very important for the upliftment of sections of society at the bottom of the societal pyramid. An innovation complex in Mumbai has been made using these funds.



*Hon'ble Prime Minister, Shri Narendra Modi, visited CSIR-CDRI in June 2017, welcomed by then DG, CSIR, Dr Girish Sahni*

Dr Sahni's tenure, therefore, marked closer CSIR-industry interactions. Moreover, CSIR was now poised to work on translational projects that could benefit society.

He remained an active researcher till the very end, which unfortunately came soon enough and suddenly. On the afternoon of 19 August 2024, the scientific community received the shocking news of Dr Girish Sahni's sad demise. He was sixty-eight.



*Dr Girish Sahni at the Diamond Jubilee celebrations of CSIR-NEERI on 8 April 2018*

### **About the author**

Dr Shekhar Mande is a prominent Indian scientist and academician known for his contributions to the fields of molecular biology and biotechnology.

Dr Mande was the Director General of CSIR and Former Secretary, DSIR, Ministry of S&T, Govt. of India, from October 2018 till his superannuation in April 2022. He also served as the Director of the National Centre for Cell Science (NCCS) in Pune, and is presently a Distinguished Professor in the Savitribai Phule Pune University, Pune. In addition to his research, Dr Mande has been involved in science policy and administration, working to enhance the research environment in India.





## **Ashutosh Sharma**

### *A Mega–Science Champion*

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**Sandeep Verma**

*Indian Institute of Technology, Kanpur*

*Former Secretary, Science and Engineering Research Board, DST*

*Govt. of India*

**P**ROFESSOR Ashutosh Sharma is an Institute Chair Professor in Chemical Engg at the Indian Institute of Technology at Kanpur, a former Secretary of the Department of Science and Technology (DST), Government of India (January 2015-August 2021) and elected President of the Indian National Science Academy (2022-25).

Born in Ajmer, Rajasthan, on 22 August, 1961, Prof. Sharma changed eight schools in the first eleven years of schooling because his father was a rather upright civil engineer in Rajasthan government service. This was his early introduction to the importance of diversity in learning and negotiating change. He stood 2<sup>nd</sup> in the Rajasthan Board's high school examinations in 1977.

Sharma received his PhD from the State University of New York at Buffalo (1988), working with Prof. Eli Ruckenstein, a US Medal of Science winner; his MS from the Pennsylvania State University (1984) and BTech. from IIT Kanpur (1982). He was a research faculty member at the School of Medicine, SUNY Buffalo, before joining IIT Kanpur in 1990. He has been a full professor (1997), the only Institute Chair Professor (2007), the Head (2003-05) of Chemical Engineering, and the founding PI & Coordinator of the Nanosciences Centre and Advanced Imaging Centre at the Indian Institute of Technology at Kanpur.

Prof. Ashutosh Sharma is a visionary academician and technologist who made exceptional contributions in the interdisciplinary domain of nanoscience and nanotechnology, specifically in soft nanofabrication, patterns and instabilities of soft viscoelastic interfaces and ultrathin films, meso-patterning of polymers, carbon, ceramics and hydrogels, biosensors, wetting, adhesion and functional and nanomaterials. His work has broadly impacted fundamental and applied science and engineering, particularly in nanoscience and technology.

His research contributions have been widely recognized by the inaugural Infosys Prize in Engineering and Computer Science; Shanti Swarup Bhatnagar Prize in Engineering Sciences; TWAS Prize in Engineering Sciences from The World Academy of Sciences (TWAS), Trieste, Italy; the Friedrich Wilhelm Bessel Research Award of the Alexander von Humboldt Foundation and the UNESCO Medal for Development of Nanoscience and Nanotechnologies, and the Lifetime Achievement Award of the Indian Institute of Chemical Engineers,



*Prof. Ashutosh Sharma, then DG, CSIR, delivering welcome address during 77<sup>th</sup> CSIR Foundation Day Celebrations in September 2018*

to name a few. Prof. Sharma is an elected Fellow of TWAS-The Academy of Sciences for the Developing World Indian National Science Academy, Indian National Academy of Engineering, Indian Academy of Sciences, and National Academy of Sciences, India. He is a recipient of the Distinguished Alumni Awards of IITK and SUNY Buffalo and has over six DSc *Honoris Causa*, including from Jadavpur University, SUNY Buffalo, and others.

Prof. Sharma is credited with the creation of the Centre for Nanoscience and Advanced Imaging Centre at IIT Kanpur and many other initiatives in the Institute, which later became flagship destinations for quality research in interdisciplinary sciences. He has been serving as an Associate Editor of *ACS Applied Materials & Interfaces* journal since 2013, in addition to his close involvement as a member of the Editorial Boards of *Chemical Engineering Science*, *Journal of Colloid and Interface Science*, *Canadian Journal of Chemical Engineering* and *Nanomaterials and Energy*.

From 9 January 2015 to 31 August 2021, Prof. Sharma was Secretary to the Government of India, heading the Department of Science and Technology (DST). He was also given additional charge

of Director General, Council for Scientific and Industrial Research—cum—Secretary, Department of Scientific and Industrial Research, on 24 August 2018. During that time, he worked on solving a rather vexing problem of delay and stoppage of some fellowships and presided over its 77<sup>th</sup> Foundation Day, announcing the Shanti Swarup Bhatnagar prizes. He has been a Member of Research Councils of CSIR-NPL, Delhi, CSIR-IICT, Hyderabad, CSIR-CECRI, Karaikudi, CSIR-NIIST, Thiruvananthapuram and CSIR-CGCRI, Kolkata, of which he is also currently the Chairman.

He currently also serves as Chairman of the Life Sciences Research Board, DRDO (2023-2027) and Chairman of the Governing Council of the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad (2023-2027) and a former Chairman of Board of Governors of IISERs at Tirupati and Berhampur. He was the Chair of Science 20, S20/G20 in India's presidency of G20 in 2023.

Based on his long association and insights in all aspects of S&T and innovation, he conceived and implemented several new programs in DST, in its statutory bodies—SERB and TDB, and in the Survey of India, that focus on technologies, innovation, structure and processes related to national development and priorities. His vision and foresight helped initiate several new pathbreaking programs related to S&T infrastructure and capacity building in strategic areas, supported startup ecosystems and inculcated innovation at many levels of research endeavours. He was instrumental in creating opportunities for women researchers for weaker sections of society and ushered in a new concept of Scientific Social Responsibility.

Emphasis on advanced manufacturing strategies, waste-to-wealth opportunities, solar energy, industry-academia cooperation and international collaborations were visibly scaled up during his tenure. He conceptualized and created the National Mission on Cyber-Physical Systems, with a hub-and-spoke model, which connected top institutions, startups and researchers through new governance and financial structures. This important national mission integrated technological advances in cyber-physical space with multisectoral requirements such as agriculture, energy, robotics, and cyber security, to name a few. Prof. Sharma's tenure also initiated the National Supercomputing



*Prof. Ashutosh Sharma, then DG, CSIR, with student awadrees during 77<sup>th</sup> CSIR Foundation Day Celebrations in September 2018*

Mission and several new initiatives in Renewable Energy, Sustainable Development, Intelligent Machines, Climate Research, and Quantum Technologies while admirably employing S&T interventions for the COVID-19 crisis as a test of India's technology readiness for the future.

A small sample of some of the schemes and programmes with the greatest connects and potential impacts were:

1. SATHI Centers for industrial R&D support.
2. A policy and guidelines on Geospatial data liberalizing and democratizing surveying and mapping.
3. Concept and implementation strategy for Scientific Social Responsibility to connect our science, scientists and infrastructure to a wide cross-section of society.
4. A Policy on S&T Infrastructure.
5. AWSAR for scientists to write popular science stories.
6. MANAK to scout and mentor the top 50,000 innovative ideas from 5 lakh schools.
7. VAJRA to attract the top global science and scientists for collaborative research in India.

8. National Missions on the futuristic needs of the country—Cyber-Physical Systems, Quantum Technologies and Supercomputing and several more, including schemes on clean energy, manufacturing and waste processing.
9. Several schemes for women empowerment in S&T, such as KIRAN and Vigyan Joyati.
10. An end-to-end scheme for innovation and startups—NIDHI.
11. A national postdoctoral scheme to provide the best PhD students research opportunities in India, etc.

Prof. Sharma said that “today science and technology has become part and parcel of every person’s life, the future is going to be much more dependent on S&T, and it will impact everything. We looked at technology from a technology point of view 50 years ago, but today, we are looking at technology through the lens of society, and people are at the centre. The future lies in the convergence of technologies, and the drivers of technology are needs, demands, wants, and desires of the mind”. Consequently, according to Prof. Sharma, “the future processes of science and technology would shift from being tool-centric to problem-centric; it would involve creativity by connecting the dots, intuition and common sense, convergence, negotiating change and invention to innovation”.

His visionary leadership was marked by a tremendous focus on strengthening and developing science, technology and innovation, new programs for gender equity in S&T, exploring futuristic research initiatives such as geospatial and quantum technologies and the creation of technology innovation hubs, with an increase in the overall quantity of publications, number of startups and multiple innovation programs. S&T programs of high societal and MSME impact, such as NIDHI, SATHI, and MANAK, further added to the repertoire of DST and doubled the financial support to the ecosystem, leveraging energy and passion for good science across the country at all levels.

Prof. Ashutosh Sharma has led the Indian S&T programs and policy from the front and steered through the turbulent times of the pandemic, bringing out indigenous and innovative solutions to society, touching the lives of 1.4 billion Indians through science-driven ease of living.

His vision and contributions to international mega-science projects have further propelled India's position as a pre-eminent nation delivering quality S&T and breakthrough research.

As a steadfast champion of science in service of the public good, he vigorously advocates for India's scientific advancement, serving as a role model to young engineers aspiring to make a difference.

Prof. Sharma's other interests are philosophy, art, and poetry.

### About the author

Prof. Sandeep Verma has been working at Indian Institute of Technology Kanpur since 1997. His research interests include chemical neuroscience, new antibiotics, and microfluidic devices. With over 250 publications and several patents, his work has been recognized by Shanti Swarup Bhatnagar Prize, Distinguished Alumnus Award of Banaras Hindu University, Society of Materials Chemistry (BARC) Gold Medal, CRSI Silver Medal, and Swarnajayanti Fellowship, to name a few. He is an elected *Fellow* of Indian National Science Academy, Indian Academy of Sciences, National Academy of Sciences, and Indian National Academy of Engineering. He is an Associate Editor of *Chemical Communications* (RSC, UK). He served as Secretary, Science and Engineering Research Board, Department of Science and Technology (2019-2022). At present, Prof. Verma is leading Gangwal School of Medical Sciences and Technology, at IIT Kanpur.







## **Shekhar C. Mande**

### *A Scientific Mentor*

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**Rakesh Mishra**

*Director, Tata Institute for Genetics and Society (TIGS), Bangalore*  
*Former Director, CSIR-Centre for Cellular & Molecular Biology (CCMB), Hyderabad*

DR Shekhar Mande is not only a distinguished scientist and leader in science but also possesses a rare dedication to supporting teaching and mentorship in Indian universities—a virtue critical for nation-building. His commitment reflects a deep passion for fostering scientific temper and valuing India’s cultural heritage, which enriches the nation’s unique civilisation. I had the privilege of meeting Shekhar during our overlapping tenures at the Molecular Biophysics Unit of the Indian Institute of Science, Bangalore. He is a person of simplicity, charm, and friendliness, leaving a lasting impression on all who encounter him. I have been fortunate to maintain direct contact with him throughout my career in the country. Working under his leadership as the Director of CSIR-CCMB was an immensely positive and enthusiastic experience, characterised by aiming high. This period provided an invaluable opportunity to closely observe Dr Mande’s qualities as a person, a leader, and a nation-builder.

Dr Mande boasts a robust academic and scientific background that has fueled his illustrious bioinformatics and structural biology career. Holding a Bachelor’s and Master’s degree in physics from Nagpur University, he later earned his PhD in Molecular Biophysics from the Indian Institute of Science (IISc), Bangalore, where he explored the intricacies of protein structure and function. Dr Mande gained international exposure at Rijksuniversiteit Groningen, The Netherlands, and the University of Washington, Seattle, USA, where his work underscored his ability to integrate theoretical insights with experimental data. These pioneering approaches continue to shape global bioinformatics and structural biology. This multidisciplinary training laid the foundation for Mande’s expertise in applying computational methods to unravel complex biological processes, leading to groundbreaking contributions. His academic trajectory underscores a deep-seated passion for integrating physics with biology, driving advancements that bridge theoretical insights with practical applications in scientific research and technology development.

Returning to India in 1995, Dr Mande made substantial contributions across various premier research institutions. As Director of the National Centre for Cell Science (NCCS) in Pune, he led initiatives that significantly advanced cell biology, molecular biology, and biotechnology research. Under his stewardship, NCCS expanded

its research scope and infrastructure, driving innovations in stem cell research, cancer biology, and regenerative medicine.

Before his role at NCCS, Dr Mande held pivotal scientific positions at the Centre for DNA Fingerprinting and Diagnostics (CDFD) in Hyderabad, where he spearheaded genomics, bioinformatics, and molecular genetics research. His efforts focused on developing computational tools and databases for DNA fingerprinting, genome analysis, and forensic science applications, significantly enhancing the institute's capabilities.

Before joining CDFD, Dr Mande served as Scientist C at the Institute of Microbial Technology (IMTech) in Chandigarh, pioneering research in microbial genomics and biotechnology. His contributions included the discovery of novel microbial enzymes and pathways with implications for industrial processes and environmental sustainability.

Dr Mande has demonstrated a steadfast commitment to advancing scientific knowledge and technological innovation throughout his career at these prestigious institutions. His expertise in computational biology, bioinformatics, and molecular biophysics has been instrumental in addressing critical challenges in healthcare, agriculture, and biotechnology, influencing and inspiring the scientific community in India and globally. Dr Mande's exceptional work has garnered accolades and awards, setting high standards in every organisation he has served and elevating the lives of countless researchers and colleagues fortunate enough to collaborate with him.

As the Director General of the Council of Scientific and Industrial Research (CSIR), Shekhar Mande has spearheaded numerous transformative initiatives and achieved significant milestones, consolidating CSIR's role as a pivotal institution in India's scientific and industrial landscape. Mande has championed initiatives to promote innovation and entrepreneurship within CSIR, fostering a culture of technology transfer and commercialisation of research outcomes. Under his leadership, CSIR has strengthened its engagement with industry, leading to numerous collaborations and partnerships that have translated scientific discoveries into practical applications.

Mande also encouraged interdisciplinary research within CSIR, facilitating collaborations across scientific domains to address complex

challenges. This approach has led to groundbreaking healthcare, agriculture, materials science, and environmental sustainability research outcomes. He prioritised strategic initiatives aimed at addressing national priorities and societal challenges. This includes research programs focused on clean energy technologies, affordable healthcare solutions, water management, and sustainable agriculture practices, aligning CSIR's research agenda with India's developmental goals. Under Mande's leadership, CSIR has strengthened its international collaborations and global engagement, enhancing its visibility and impact on the global stage. Collaborative research projects with international partners have facilitated knowledge exchange and access to cutting-edge technologies and expertise.



*Dr Shekhar Mande, during the test flight of HANSA NG aircraft of CSIR-NAL*

For CSIR to stay competitive internationally, Dr Mande has overseen significant investments in infrastructure development and capacity building within CSIR laboratories, modernising research facilities and enhancing scientific capabilities. This has positioned CSIR as a leader in research and development infrastructure in India. Dr Mande understood the value of fundamental science and domain-specific niche creation in CSIR laboratories and built research support programs to strengthen this part of the organisation. Overall, Shekhar Mande's tenure as Director General of CSIR has been characterised by visionary leadership, strategic planning, and a relentless pursuit of scientific excellence and innovation,



*Hon'ble Minister S&T, Dr Jitendra Singh spearheading meeting for COVID-19 mitigation technologies in August 2021, along with Dr Shekhar Mande, DG, CSIR*

contributing significantly to India's scientific advancement and socio-economic development.

Dr Mande's tenure as DG, CSIR also coincided with the global pandemic, which was a tough test for anyone in decision-making and leadership positions and more so if a person is heading the largest R&D organisation in the most populous nation in the world. During the COVID-19 pandemic, Shekhar Mande, as the Director General of CSIR, played a pivotal role in leading CSIR's efforts to combat the virus and mitigate its impact. Under Mande's leadership, CSIR laboratories actively engaged in research and development to develop diagnostic kits, vaccines, and therapeutic interventions for COVID-19. In most of these efforts, CSIR contributed to the fight against the pandemic. CSIR facilitated technology transfer and collaboration with industry partners to scale up the production of essential medical supplies such as personal protective equipment (PPE), ventilators, and sanitisers. This collaborative approach helped in meeting the healthcare demands during the pandemic. Hand in hand with these highly science-based efforts, Mande and CSIR actively engaged in public outreach and education campaigns to disseminate accurate information about COVID-19, preventive measures, and vaccination. Shekhar Mande's proactive leadership and CSIR's scientific contributions during the COVID-19 pandemic underscored their commitment to leveraging scientific expertise for public health emergencies, contributing significantly to



*Dr Shekhar Mande with the author of this section, Dr Rakesh Mishra*

India's pandemic response and preparedness efforts. To make all this happen, visionary thinking, strategic leadership, a deep understanding of various scientific fields, collaboration, and nurturing innovation and adaptability are needed. Dr Mande rose to the occasion and demonstrated exceptional resilience and perseverance in this long battle, maintaining the high morale and positivity of the entire CSIR. Because of these leadership qualities, Dr Mande made extraordinary contributions to the fight against the pandemic with the scientific excellence of CSIR.

Leading and mentoring his research team, networking with collaborators, leading research institutions and the largest research organisation in the nation – Dr Mande has left his footprint – a vibe of positivity and nation-building – wherever he has been. And he continues to do so.

### **About the author**

Dr Rakesh Mishra is a former Director of CSIR-Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad. Presently he is the Director of the Tata Institute for Genetics and Society (TIGS), Bangalore. Dr Mishra is well known for his work in genetics and molecular biology. Dr Mishra has over three decades of experience as a researcher and an administrator. He is a J.C Bose fellow, elected fellow of Indian National Academy of Sciences, Indian Academy of Sciences, National Academy of Sciences and AP Academy of Sciences and a lifetime member of the Proteomics Society, India.





**Rajesh S. Gokhale**  
*An Exemplary Chemical Biologist*

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**Vinay K. Nandicoori**

*Director, CSIR- Centre for Cellular & Molecular  
Biology (CCMB), Hyderabad*

IT is both a pleasure and privilege, while also a daunting task, attempting to sum up Dr Rajesh Sudhir Gokhale's achievements in just a few words. Dr Gokhale serves as Secretary of the Department of Biotechnology (DBT) and Director General of the Biotechnology Research Innovation Council (BRIC). Rajesh served as Director General of the CSIR from 1 May to 6 August 2022.

I first met Rajesh in 1989 when I was a freshman at IIT Bombay, Mumbai, where he was a year ahead of me, pursuing an MSc in Biotechnology. Before studying for a Master's in Biotechnology, Rajesh graduated from the University of Delhi with a Bachelor's in Chemistry. His background in chemistry equipped him with strong basics that played an important role in his becoming one of the best chemical biologists of our time.

After completing the Master's program at IIT Bombay, Rajesh joined the Indian Institute of Science, Bangalore, to pursue his PhD. Under the supervision and mentorship of Prof. Padmanabhan Balaram, he worked on stabilizing thymidylate synthase using protein engineering strategies. In addition to publishing his research in several international journals of high repute. Rajesh is an excellent sportsman who found time to play several sports, including tennis, cricket, and badminton, which, in his own words, "is a great leveller and crucial to maintaining balance in life."

After acquiring his PhD, Rajesh moved to Dr Chaitan Khosla's laboratory at Stanford University, USA, to pursue postdoctoral research, where he employed protein engineering to understand modular polyketide synthases and secondary metabolite biosynthesis. After a successful three-year stint with Dr Khosla's group, Rajesh returned to India in 1999 to establish his research group at the National Institute of Immunology (NII), New Delhi. He made *Mycobacterium tuberculosis* (Mtb), the causative agent of TB, the centre of his investigations. Mtb harbours a very thick, impenetrable cell wall containing complex lipids.

At NII, Rajesh's group carried out pioneering work on the lipid metabolism of this wily pathogen. Their ground-breaking work uncovered the importance of fatty acyl AMP ligases in Mtb and other bacterial systems, delineating their role in the biosynthesis of lipid components of the cell wall. His group has identified two novel metabolites in Mtb, which significantly modulate the infection process.



*Dr Rajesh S. Gokhale along with Dr Shekhar Mande and Prof. Ashutosh Sharma, while taking additional charge as Director General, CSIR and release of CSIR Vision 2030*

In addition, his group has carried out important work on the chronic autoimmune skin condition Vitiligo, focusing on how metabolic imbalance drives the disorder. More than 25 students have completed their PhD under his supervision, and as many as 200+ students have been trained in his lab.

The large body of work from Rajesh's years in laboratory research has been published in frontline international journals such as *Nature*, *Nature Structural and Molecular Biology*, *Nature Chemical Biology*, *Molecular Cell*, *JACS*, and *PNAS*, to name a few. His group's research has significantly advanced our understanding of these diseases. The research has been highly recognized through several awards, such as the Shanti Swarup Bhatnagar Prize (2006), the National Bioscience Award for Career Development (2009), and the Infosys Prize (2013). He has been a Wellcome Trust Senior Research Fellow, a Swarnajayanti Fellow, and a Howard Hughes Investigator, and is an elected Fellow of the three Science Academies of India.

In March 2009, Rajesh took over the reins of the CSIR-Institute of Genomics and Integrative Biology, holding the position of its Director for seven-and-a-half years. During his years at CSIR-IGIB, in addition to his twin research passions in Tuberculosis and Vitiligo, he co-founded a biopharmaceutical company, Vyome Biosciences. As the Director of IGIB, Rajesh initiated new research programs by recruiting young, talented faculty and spending considerable time interacting with and mentoring IGIB students. His efforts pushed forward the establishment and growth of the IGIB South Campus. In addition, he played an essential role in the Indian consortium Open Source Drug Discovery (OSDD), aimed at identifying effective novel therapies for tropical diseases such as tuberculosis.

Rajesh returned to the National Institute of Immunology in October 2016 to continue research in his passion: tuberculosis. He served as the Director of the National Institute of Immunology from June to September 2021 before taking a position at IISER Pune. He subsequently took over the reins of the Department of Biotechnology as its Secretary in November 2021.

Although tuberculosis is primarily a disease that impacts the lungs (pulmonary TB), almost 15% of TB patients suffer from extra-pulmonary tuberculosis (EPTB). In addition, the sequences of the genomes of Indian clinical TB strains remain largely unknown.



*Dr Rajesh S. Gokhale with Dr Vinay K. Nandicoori*

As the Secretary of DBT, Rajesh launched the Data-Driven Research to Eradicate TB (DARE2ERAD) program to holistically understand the aetiology of the disease and work towards its elimination. His creativity and capacity to see the larger picture and think big is evident from some of the organizations and programmes he has been instrumental in setting up as Secretary, DBT, including establishing BRIC and the i3c-BRIC-RCB PhD programs. He has played a prominent role in the recent BioE3 initiative, the Honourable Prime Minister launched.

I was fortunate to be associated with Rajesh at different stages of our lives, first as students at IIT and IISc and then as colleagues at the National Institute of Immunology. One of the first things I noticed about Rajesh in my earliest interactions with him was his boundless energy and infectious enthusiasm; after all these years, he still radiates the same vitality. His ability to assess and accept people's strengths and weaknesses is reflected in his dealings with others.

One encounters few people who impact one's way of thinking and influence one's life trajectory. Dr Rajesh Gokhale's positive energy, optimistic outlook, ever-striving attitude, out-of-the-box ideas and the ability to take them forward, and thoughtful demeanour, which often leads him to go the extra mile to help others, make him one of them.

### About the author

Dr Vinay K. Nandicoori is the Director of the CSIR-Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad. He is a well-known molecular biologist and has been a Scientist at the DBT-National Institute of Immunology, New Delhi. Dr Nandicoori's research interest extensively spans molecular signalling networks in *Mycobacterium Tuberculosis*, the micro-organism that causes TB. He is an elected fellow of the Indian Academy of Sciences, Indian National Science Academy and National Academy of Sciences, India.







**N. Kalaiselvi**  
*The First Woman Director  
General of CSIR*

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**Vijayamohanan K. Pillai**

*Chair, Chemistry and Dean (R&D), Indian Institute of Science  
Education and Research (IISER), Tirupati  
Former Director, CSIR-Central Electrochemical Research  
Institute (CECRI), Karaikudi*

**I**T gives me great pleasure to write about a few personal experiences of Dr Nallathamby Kalaiselvi's leadership, persona, and her remarkable contributions to CSIR so far.

Dr N. Kalaiselvi worked closely with me for about 7-8 years when I joined CSIR- Central Electrochemical Research Institute (CECRI) as its Director. She epitomises excellence, as visible as many exquisite verses in the Song of Life, as a loving mother, caring wife, able administrator, compassionate leader, passionate teacher, committed scientist and many other attributes. She has carried out many important national mission-mode and lab-centric projects admirably. It is no wonder that more and more responsibilities come to such visionary leaders as they "climb the ladder of limitless excellence" using the prophetic words of another former DG, CSIR, Dr R. A. Mashelkar.

It is often said that crisis brings unknown latent talents in individuals, which is all the more true for a leader like Dr N. Kalaiselvi. I have witnessed several incidents demonstrating an uncanny combination of skill sets like abundant grit, fierce determination and absolute commitment to agreed goals, no matter what happens.

Dr Kalaiselvi had a humble beginning. She studied in a Tamil medium school in a rather obscure village near Ambasamudram in Tirunelveli District of Tamil Nadu. Being studious, she completed her education with laurels. She began her career as a lecturer and joined CSIR-CECRI as a scientist in November 1997.

She has a natural propensity to adapt to difficult situations and her hardworking nature made a lasting impression on me. Therefore, as Director of CSIR-CECRI, I did not think twice when we were considering a leader from CSIR-CECRI to coordinate a National 12<sup>th</sup> Five Year Plan project, Multifunctional Electrodes and Electrolytes for Futuristic Technologies dubbed "MULTIFUN" by CSIR involving seven laboratories and many diverse themes, all linked to the preparation, characterisation and applications of Multifunctional Materials.

MULTIFUN was an unprecedented project for a lab like CSIR-CECRI. Thanks to Dr Kalaiselvi's efficient coordination and networking capabilities, MULTIFUN was graded excellent by the sectoral monitoring committee. I remember how she unleashed the full potential of each team leader through inspiring and fearless discussions.



*Dr N. Kalaiselvi receiving the Materials Research Society of India (MRSI) Bronze Medal from Dr Sundararajan, President of MRSI in 2014 for the work on Battery Materials*

I never thought selecting her was a harbinger of her innovative leadership. Naturally, a project of this stature is a springboard for leveraging her innate potential, facilitating a network of many active scientists in different laboratories. Later on, whenever I could not attend MNRE and other line ministry meetings on renewable energy, I deputed her with confidence, and she never once disappointed me.

Not even in my dreams had I thought that I was involved in mentoring a future DG. Still, in hindsight, I feel very content in selecting the right individual who provided enormous help not only in Battery Chemistry and Electrochemistry but in the general administrative framework – from the committee on sexual harassment to the grievance committee of student matters.

Before becoming DG, CSIR and Secretary, DSIR, Dr Kalaiselvi was pillar of support to CSIR-CECRI. Her tenacity and ability to make sacrifices for institutional goals are amazing. Being one of the most agile minds of the present era, it is no wonder she has aspirations to create breakthrough technologies, especially energy technologies. She has an uncanny ability to challenge your thinking, expose you to new ideas,

sharpen strategies, move forward undeterred by obstacles, and is driven by a strong passion to succeed in developing technologies aligned with National Missions.

Her ardent love for students was instrumental in attracting many good students to a remote place like Karaikudi. She can write very well in the vernacular about many complex science themes in a simple manner, understandable and even entertaining to school children, and this made her successful as an editor of *Ariga Ariviyal* – a monthly Tamil science magazine published by a social organisation. She also has an extremely gentle and compassionate human side, which I came to know when my wife was hospitalised for a few days.

Her research priorities include filling the missing links like supply-chain disruptions, ore beneficiation, ensuring the raw materials purity and costing, rapid-prototyping, providing incentives to second-life batteries, integrating battery recycling with manufacturing to augment the electric mobility, etc. This vision is commensurate with her strong expertise in Li battery technology since her group has done outstanding work on high-performance cathodes, electrolyte formulations and composite anodes for Lithium and beyond Lithium batteries and supercapacitors.

As an active scientist working in the cutting-edge areas of batteries, Dr Kalaiselvi has had several international collaborations with countries like Australia, the USA, France, South Korea, etc.



*Recognition to Dr Kalaiselvi as “India’s Most Inspiring Women Engineer/ Scientist” for 2014 by Engineering Watch*



*Hon'ble Minister of S&T and Vice-President, CSIR, Dr Jitendra Singh, with the newly appointed DG, CSIR, Dr N. Kalaiselvi, on 8 August 2022*

Her world-class R&D activities are revealed in a couple of hundred papers/patents that she authored with the help of a dozen doctoral students.

Being the first female Director General of CSIR, armed with more than a decade's background in Batteries and Materials Electrochemistry engineering, the battery scientist, Dr Kalaiselvi is very keen to redefine the Li and Na battery manufacturing ecosystem in our country, facilitating a robust end-to-end product-development process, especially in Li-ion, Sodium ion and next-generation solid-state rechargeable batteries. This is extremely important for India since our sustainable future depends on the establishment to meet the required battery capacity demands. India's ambitious aim to install 50% of the Renewable Energy Capacity by 2030 requires about 100 GW of battery storage, and there are formidable challenges intimately linked with our climate policies and carbon mitigation strategies. India has become the second most solar energy producer globally, and our green hydrogen and EV initiatives have just started to produce the desired results.

Science is the only hope to eradicate human miseries, which could be achieved only with more budgetary support. Leadership matters a lot, and many of us do hope that leaders like Dr Kalaiselvi, as a strong Director General and one of the Science Secretaries to the Govt. of India, could enhance the value and prestige of scientific Departments especially of CSIR (with its strengths and weaknesses) so that science in this country will make a stronger societal impact in the years to come without impoverishing fundamental research.

### **About the author**

Prof. Vijayamohanan K. Pillai is presently the Chair, Chemistry Dept. and Dean (R&D) of the Indian Institute of Science Education and Research (IISER), Tirupati and also serving as Honorary Faculty in the Department of Chemistry, IIT-Madras, since 2017. Prof. Pillai was the Director of CSIR - Central Electrochemical Research Institute (CECRI), Karaikudi during 2011-2019. He has been awarded with several prizes in academia including the JC Bose Fellowship of the Dept. of Science & Technology, Govt. of India, in 2020, Silver Medal by the Chemical Research Society of India (CRSI) in 2019 and MRSI Medal.



## About Book

The book — *Innovation Trailblazers: The Leadership Legacies of CSIR* — celebrates the remarkable leadership of the twenty-four (24) Director Generals who have led and shaped the Council of Scientific and Industrial Research (CSIR) since its inception in 1942. This publication provides glimpses of their vision, scientific contributions and brief legacy of these exceptional leaders who have significantly influenced the scientific landscape of CSIR in its more than eight decades of existence.

The profile of each Director General has been authored by an eminent scientist who has served or is holding S&T leadership position.

## Editorial Team



**Dr Shikha Ambastha** is a Scientist with the Science Communication and Dissemination Directorate (SCDD) at CSIR Headquarters, New Delhi. Dr Shikha Ambastha is a Ph.D in Engineering from Indian Institute of Science, Bengaluru. She has been associated with CSIR for the past fourteen years in multifaceted domains of robotics, sensing and science communication.



**Dr G. Mahesh** is a Chief Scientist heading the Science Communication and Dissemination Directorate (SCDD) at CSIR Headquarters, New Delhi. Dr G. Mahesh has more than 25 years of experience in CSIR.