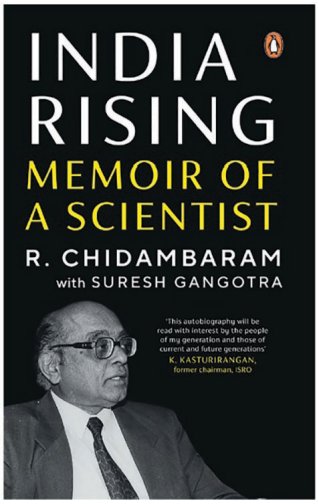

India Rising: Memoir of a Scientist. R. Chidambaram with Suresh Gangotra. Penguin Random House India, Imprint: Ebury Press, Daryaganj, Delhi. 2023. 240 pages. Price: Rs. 699.

At the beginning of 2020, when I finished reading two fascinating biographies, *From Temples to Turbines: An Adventure in Two Worlds* by V. S. Arunachalam, Former Scientific Advisor to Defence Minister and Director General, DRDO, and another *Fire and Fury: Transforming India's Strategic Identity* by Anil Kakodkar, Former Chairman AEC and Secretary DAE, I expected that sooner or later, the biography of R. Chidambaram would be released. Having enjoyed the privilege of a ringside view of the developments in the DAE, it was a delight to read his interesting memoir of 18 chapters spanning nearly 240 pages. The stories of Chidambaram, Arunachalam and Kakodkar are, in many ways, the history of the growth of indigenous technology for the country's defence. This growth has brought the country to a level where it can produce its own nuclear power plants and weapons, defence missiles, nuclear submarines, combat aircraft, and more.

Chidambaram was born in Chennai in 1936 and received his education in Meerut and Madras. He excelled in his studies, earning a first rank in the university upon completing his B.Sc. in physics with honours at the prestigious Presidency College in Madras. In 1956, he furthered his education by joining the Indian Institute of Science (IISc) in Bangalore. He obtained his M.Sc through research in 1958, focusing on analogue computers, and earned the Martin Forster Medal in 1962 for his doctoral thesis on the development of Nuclear Magnetic Resonance.

As a highly acclaimed scientist, he has made exceptional contributions to various fields of basic nuclear science and technology. He held the position of director at the renowned Bhabha Atomic Research Centre (BARC) and subsequently served as the Chairman of the Atomic Energy Commission for the Government of India. He was the Chairman of the Board of Governors of the International Atomic Energy Agency (IAEA) during 1994–95. His contributions to the design and execution of the two nuclear explosion projects at Pokhran are well known. He served the Government of India as Principal Scientific Adviser and the Chairman of the Scientific Advisory to the Cabinet for seventeen long years from 2001. He received numerous awards, including fellowships of several national and international science academies and India's 2nd highest civilian award – Padma Vibhushan.

In the first chapter, Chidambaram highlights the beginning of organized science in India in early the twentieth century. If independent India has made tremendous strides in several fields of science and technology, it is on the strong foundation laid by pioneers like C. V. Raman, M. N. Saha, S. N. Bose, P. C. Ray, P. C. Mahalanobis and many others. Several centres of excellence in research came up in the country soon after its independence, led by other scientists like Homi Bhabha, S. S. Bhatnagar, K. S. Krishnan, Vikram Sarabhai, S. Bhagavantam, and many others who drew great inspiration from the scientific legacy they inherited from the founders of science. In the next two chapters, Chidamabaram gives an interesting account of his early education and initial work in BARC on hydrogen bonding using neutron crystallography. While this work was progressing well with the acquisition of a computer and the development of innovative software, Chidambaram was suddenly asked by Raja Ramanna to work on building a nuclear explosion device. It was a tall order due to the paucity of literature on the subject in the public domain. He and his colleagues in the high-pressure physics group worked out the equation for the state of plutonium, which is still classified by all nuclear weapon states. Weapon design and construction also needed extensive studies on the metallurgical and physical aspects of the nuclear device. In the chapter on Pokhran-I, the book provides a detailed description of the technical challenges encountered during the execution of the Peaceful Nuclear Explosion (PNE) experiment project, as well as the test of the device. The chapter includes a lot of pre-test and post-test data related to the PNE experiment. In chapters 5 and 6, he discusses various modes of research at great length. He stresses the importance of mission-oriented research and development of indigenous hi-tech equipment. Basic research is the foundation on which evolving technologies like nuclear or space programmes can be built. He defines self-reliance as immunity against technology denial. He, however, suggests that one should not hesitate to import something of superior quality but less expensive if that is going to be integrated into a larger complex system. Research also plays an important role in what he calls country-specific research areas like prediction of monsoon, disease control, agriculture, etc. One important feature of the current research scenario is the important role played by supercomputers in areas like computational physics, chemistry or biology, requiring a huge network of laboratories across the world.

In chapter 7, Chidambaram presents extensive details regarding the second Pokhran program in which five nuclear tests were conducted in May 1998. This chapter includes a detailed account of the methodologies used for calculating the fission yields of the devices, and more importantly, answers the questions raised by a few eminent scientists doubting the success of the tests. Chidambaram is known for his quick wit. After the nuclear test, when the idea was proposed that India should maintain the option of nuclear capabilities, he likened it to prolonging one's eligibility for marriage until it was no longer feasible. The continual delay in pursuing nuclear advancements could result in losing the valuable knowledge and expertise required for such critical technology. For a country like India with the kind of neighbourhood it has, it is essential to possess retaliatory nuclear deterrence.

Chapter 8 describes the close interaction between India and IAEA. It is worth noting that India was one of the twelve founding members who drafted the Statute of the Agency and Homi Bhabha was the president of the First International Conference on the Peaceful Uses of Atomic Energy. India has been a member of the Board of Governors (BOG) since its inception, and Chidambaram had the distinction of being its chairman in 1994–95. India is not a signatory of the Non-proliferation Treaty (NPT) in view of its discriminatory nature. IAEA has the mandate and mechanisms to ensure

compliance of the signatories of NPT with nuclear safeguards. He gives an interesting account of how he carried out his function as the Chairman of the BOG without compromising the national interest.

In chapter 9, he elaborates on the role of science in improving the quality of life. Human Development Index (HDI) is generally defined by considering three parameters: life expectancy at birth, education index and gross national income per capita. According to Chidambaram, more appropriate parameters to define HDI are per capita electricity consumption and female literacy. While electricity consumption is connected to GNP, female literacy correlates inversely with infant mortality and birth rate. One of the most important contributions of Chidambaram as Principal Scientific Adviser (PSA) is his work on developing and disseminating technologies for rural development. He enabled the establishment of Rural Technology Action Groups (RuTAGs) centres at seven IITs and the University of Jammu. The long list of development works carried out by these centres within a short period mentioned at the end of this chapter is indeed awe-inspiring. To promote academia–industry interaction, he also set up the Core Advisory Group for R&D in sectors like machine tools, electronic hardware, etc. The next chapter delves into the obstacles women encounter when choosing a career in science. The author notes that although women tend to win between 60% and 70% of the prizes and awards in higher education institutions, the number of women pursuing scientific research is relatively low.

In chapter 11, he highlights the importance of interdisciplinary research with several examples, particularly the role of mathematics in biology, disease dynamics, space science, game theory, economics, neural networks, cyber security, etc. Chapter 12 deals with the works carried out under his guidance when he was the PSA. In fact, this chapter could have been part of chapter 9 or followed it immediately. Here are some of the significant programs identified and implemented during his long tenure of 16 years as PSA: Identification and mentoring Gifted Children, Science in Ayurveda, Advanced Super-critical Thermal Plant, Promotion of Industry–Academia Interaction, Nanoelectronics and National Knowledge Network (NKN). It is worth noting that NKN has myriad objectives, including establishing high-speed backbone connectivity for sharing information, promoting collaborative research work among national and international institutes, facilitating distance education in advanced science and technology, and creating an efficient platform for e-governance. The beneficial outcomes of all these initiatives in different sectors are illustrated with suitable examples. Chapter 13, the shortest in the book, deals with cyber security. With the ever-growing e-commerce and e-governance, cyber security has become challenging for the government. PSA facilitated the establishment of The Society for Electronic Transactions and Security (SETS), a centre of excellence in cybersecurity, to carry out R&D to develop a robust cybersecurity system.

During his extensive twenty-four-year tenure as Chairman of AEC and later as PSA, Chidambaram worked alongside six different prime ministers, regardless of their political affiliations, as well as numerous high-ranking government officials. Chapter 14 offers a fascinating glimpse into Chidambaram's interactions with these individuals. It is worth noting that politics has nothing to do with science, and the functioning of the PSA office was seamless despite the changes in the government. Chapter 15 is written by Ambassador D. B. Venkatesh Varma, who had held several key positions in the Ministry of External Affairs and has vast experience handling critical issues like CTBT, NPT and the Indo-USA nuclear deal. After the Pokhran tests in 1998, the USA imposed sanctions on India, and the supply of enriched uranium fuel to Tarapur reactors was under threat. The USA was willing to enter into a nuclear deal with India but on the condition that several Indian plants should come under IAEA safeguards. There was a concern that some of the elements of the proposed deal would impact India's strategic interests and the development of a fast reactor program. Venkatesh Varma provided a detailed account of the lengthy and complex discussions with multiple stakeholders to bring about this groundbreaking deal. He points out that Chidambaram was crucial in providing technical and moral support to the Indian negotiation team led by Kakodkar. In all these parleys, Chidambaram's clarity of thought and firmness of purpose facilitated building a national position that would serve its short- and long-term interests. In this context, Venkatesh Varma makes an interesting observation that Chidambaram is different from previous chairpersons of AEC, who stuck to their mandate of carrying out the technical and nuclear side of the program. But Chidambaram, a consummate diplomat, offered critical guidance to the government in handling international pressure.

The last three chapters of the book, contributed by Srinivas Laxman, a journalist, Suresh Gangotra, co-author of the book and his family members, throw light on his astonishingly multifaceted personality, his amiable nature, his fondness for sports and music, love for books and cinemas, and his views on religion, etc.

The book is indeed an absorbing personal reminiscence of a distinguished scientist who not only delivered on the mandate of the DAE but also relentlessly promoted the application of science and technology in myriad sectors of human development, which raised the country to be counted among the few nations well advanced in science and technology. It is fitting that Chidambaram has titled his memoir *India Rising*, as it delves into his personal story and professional accomplishments. This book will ignite the passions of aspiring researchers, scientists, science managers and science historians alike. An important lesson to take away is how crucial science is in advancing society through technology and the significance of having a strong sense of self-confidence and a grand vision when embarking on significant endeavours.

A. R. SUNDARARAJAN

#301, Rajalakshmi Apartments,
24th Main, J.P. Nagar 6th Phase,
Bengaluru 560 078, India
e-mail: arsundar@gmail.com

Edited by S. K. Satheesh and printed & published by the Current Science Association, Bengaluru 560 080.
Typeset by WINTECS Typesetters, Bengaluru and Printed at Printek Printers, Bengaluru (Ph: 2328 7763)