



Science as a Way of Life – A Biography of C. N. R. Rao. Mohan Sundara Rajan. Prism Books Pvt Ltd, Bangalore. 2003. 170 pp. Price: Rs 235.

*Knowledge is not gained through one means alone
Whether that is talked of as
Science or Religion
Or the Intuition that integrates all,
Or Imagination, Emotion, or
Greater Reason;*

– from ‘Years of Pilgrimage’, a long poem by Tim Cloudsley.

Restlessness and impatience at mediocrity and sloth characterize C. N. R. Rao, who has strolled the science arena of modern India as a colossus. Although he has retired from official positions, he is very much at his research. His views and advice continue to be sought after for his rich experience regarding people and places. He is endowed with a critical but frank appraisal of people and events. What is the magic of this ‘dynamo’ behind the personality of Prof. Rao? What is the charging mechanism? And the chemistry of his brain?

The only qualification that I may possess for reviewing the book is, science is my profession (though not chemistry) I am not one of the large number of students or post-doctoral associates or collaborators in any work with Prof. Rao. However, from my student days at the Banaras Hindu University (BHU), Varanasi in the fifties, I had heard of Rao through my friends who were Ph D students of Prof. S. S. Joshi at BHU and thereafter from some of my colleagues at the Bhabha Atomic Research Centre (BARC). I wanted to know the persona of Rao, who remained an enigma to me. When the book was made available to me, I found it absorbing as it revealed various aspects of Rao’s life, career and personality. Mohan Sundara Rajan, the author of the book has to his credit a

large number of popular science books, including *India in Orbit*, translated into many Indian languages; he is a science communicator also.

The book contains 14 chapters followed by four appendices that list the large number of positions held by Rao, of his scientific collaborators – including graduate students, postdoctoral associates and other collaborators – and of medals, awards and other honours. Apart from as many as 33 honorary doctorates, the appendices list some 25 fellowships/memberships of a large number of Academies that have been conferred on Rao from all over the world. The fourth appendix lists 37 books authored by Rao. These are all phenomenal by any standard and awe-inspiring as they relate to erudition and excellence in one’s chosen career.

Chintamani Nagesh Ramachandra Rao was born to Nagesh Rao and Nagamma on 30 June 1934. They were well read; his father was working in the education department of the erstwhile Mysore State. Rao graduated with a B Sc degree from Central College, Bangalore, having studied up to secondary level in the vernacular Kannada. He was acquainted with modern Kannada literature of the pre-independence period and had come to be impressed by several men of letters and others like Jayaprakash Narayan, C. V. Raman and M. Visweswaraya. Rao acquired his M Sc (chemistry) degree from BHU with a high rank in 1953. Encouraged by J. C. Ghosh, Director, IIT Kharagpur, Rao proceeded to Purdue University, USA for his Ph D. The first few chapters of the book give a fascinating account of this early period of young Rao’s life.

Rao’s Ph D research work was with Robert Livingston at Purdue; Livingston gave Rao much encouragement and freedom to pursue independent research. Having obtained the Ph D degree, ‘a passport to research’, Rao moved in 1958 to University of California at Berkeley, a place noted for several famous chemists like Linus Pauling, G. N. Lewis, Joe Hildebrand and K. S. Pitzer. After his post-doctoral work at Berkeley, ‘driven by some sort of an inner compulsion, he decided to return to India in 1959’. He served as a lecturer at Indian Institute of Science, IISc, Bangalore for sometime. Contrary to his patriotic dreams of conducting first-class research in India, he found ‘conditions anything but encouraging’. The chapter on ‘The Raman effect’

goes on to detail the prevailing oppressive condition and inadequate infrastructure. In spite of these handicaps, Rao wrote his first book, a monograph on ultraviolet and visible spectroscopy during this period; the book was published by Butterworths, London. As Sundara Rajan puts it, this was a landmark in the scientific career of Rao: ‘the journey as a scientist had come out of dead-end’ and ‘the book marked a silver lining amidst the clouds of distrust and derision’. The chapter title refers to another ‘silver lining’ in the form of Raman who allowed Rao access to his personal library and laboratory. The first book was followed by a second one on infrared spectroscopy and many followed thereafter at regular intervals. It was during this period that the streak of self-confidence and extrovertedness in Rao, perhaps, helped him in meeting and indulging in scientific discussions with people like Satish Dhawan, S. Ramaseshan, Vikram Sarabhai and others.

Rao rebelled against the laid-back, permissive attitude and the general acceptance of mediocrity when he moved to IIT Kanpur in 1963, accepting the position of an Associate Professor in the Department of Chemistry. As Sundara Rajan notes, to Rao ‘academic dreams to excel were more important than physical comforts; excellence, however, would remain in one’s wish-list, if not sustained by hard work. It has to be cultivated over years and the desire should come from within’. The IIT years saw, Rao as Head, Department of Chemistry; initiate programmes related to M Tech, Ph D and integrated M Sc and a new initiative in materials science. To him it was paramount that research was to go hand in hand with teaching programmes. IIT Kanpur came to be regarded as the best amongst all IITs thanks to the brilliant faculty gathered therein. At a very young age of 30, Rao was appointed a full-fledged Professor. Soon he was elected as a Fellow of the Indian Academy of Sciences, Bangalore. To be recognized by Raman had an ‘electrifying’ effect on Rao. Rao was invited to give a lecture at the Annual Meeting of the Academy at Ahmedabad in 1968, the session that celebrated the 80th birthday of Raman. Quoting M. G. K. Menon, Sundara Rajan notes ‘(Rao) was a dynamo on the stage fired by enthusiasm, waving his hands or jumping around and waiting to communicate to everyone his own sense of ex-

citement in science'. Even now, some 40 years later, one cannot but notice this characteristic excitement, which is almost contagious, that marks Rao's style.

In the above, I have tried to draw attention of the reader to only a few aspects of the early life of Rao from the book. They reveal a few stepping stones that have stood as landmarks in a successful scientific career. But how is a successful scientific career assessed? There is only one measure and that is by peer recognition of merit of one's works and publications in the form of admission to various academies, science societies, awards and citations. In addition, if some aspect or the other of one's work becomes a part of scientific lore over decades and sometimes over centuries, that indeed is an indelible mark left for future generations.

The later chapters in the biography dwell on Rao's life in later decades as floodgates of research got opened, as many books got written, and as innumerable honours began to be showered on him. Even as he declined the offer of Directorship of IIT Kanpur, his advice on various matters began to be sought by several institutions and organizations like CSIR, DAE, NCST and others. He travelled widely for pursuing advanced state-of-the-art research at many places, including a stint at Oxford and much later at Cambridge.

In 1976, Rao moved to IISc and started the Solid State and Structural Chemistry Unit and the Materials Research Centre somewhat later.

The book refers, at several places, to the supportive role played by Mrs Indumati Rao, wife of Rao. When they moved to Bangalore, 'the Raos decided not to get caught up in the never-ending circle of social parties and gatherings', which is difficult to practice as this author can vouchsafe. Rao was serious about his business, namely research in frontier areas of materials science. Rao was elected a Fellow of the Royal Society, London in 1982. The book does refer to the trials, tribulations and undercurrents at IISc as Rao's contributions got recognized at various quarters. In 1984, Rao was appointed as Director of IISc after Ramaseshan retired from the post.

There are several chapters in the book devoted to the days when Rao was administering the Institute, his involvement as member of the Science Advisory Committee to the Prime Minister (SAC-PM) Indira Gandhi and later as Chairman

of the SAC-PM when Rajiv Gandhi became the Prime Minister. Sundara Rajan notes that 'Rao preferred to function from the "corridors of power" without occupying seats of power'. Rao had to contend with bureaucrats and departments that set-up road-blocks to well-intentioned advice or proposals. Nevertheless, the SAC-PM proposed many new programmes and initiatives, supported the funding of science activities and paved the way for young people to take to science as a career. Documentation of national priorities for research and setting up of a new Centre for Development of Advanced Computers are notable achievements during that period. The book would be of interest to historians of science, especially as these chapters refer to the evolution of growth of science in our country.

Rao was selected to be a Member (Science) of the Planning Commission in which capacity he was responsible for chalking out a science and technology plan. Many of the dreams and action plans that he had chalked out came to nought after the tragic assassination of Rajiv Gandhi in 1991. Although Rao's opinions and advice were sought by several Prime Ministers later on, it was not the same response that he had received earlier. 'The pure joy of doing research, he found, had no match in any other calling'. At one time, Rao was entrusted with several responsibilities simultaneously, namely those of Chairman SAC-PM; President INSA; President ISCA; President IUPAC and Director IISc. However 'he did not bog down under the pressure of office'. A chapter entitled 'A chemist with a difference' dwells on the scientific forays of Rao in materials science in general and specifically in relation to his work on $hi-T_c$ superconductors, fullerenes and their derivatives, nanomaterials and nanotubes, etc. Rao retired as Director of IISc in 1994. Even when Rao was Director of IISc, the Government of India decided to set-up an autonomous Centre called Jawaharlal Nehru Centre for Advanced Scientific research (JNC-ASR) at Bangalore on the eve of the birth centenary of Jawaharlal Nehru, the first Prime Minister of independent India. Rao was appointed the President of JNCASR; he had to face much criticism, 'an inevitable professional hazard'. An entire chapter is devoted to the setting up and growth of JNCASR. Currently, Rao is associated with the centre as its Honorary President.

Other chapters in the book deal with Rao's role in the Third World Academy of Sciences, the several awards, rewards and honours that have come his way, and his views on science and other facets of life in general.

There have been several autobiographies by Indian scientists, and biographies of Indian scientists by Indian scientists during the last few decades. Autobiographies of Raja Ramanna (*Years of Pilgrimage*), of M. R. Srinivasan (*From Fission to Fusion*) and of Abdul Kalam (*Wings of Fire*) come to my mind. Along with the account of the important steps in the programmes in which the respective authors were involved, they provide a graphic 'portrayal of the people who made it possible and their extraordinary qualities as motivators'. As Abdul Kalam noted 'this story of (my life) is an account, I hope, not just of my personal triumphs and tribulations, but of the successes and setbacks of the science establishment in modern India, struggling to establish itself in the technological forefront. It is the story of national aspiration and of cooperative endeavour'. Perhaps these sentiments find, independently, echoes in all these autobiographies; this biography of Rao is no exception to similar thoughts. Among the biographies I am reminded of *Vignettes in Physics* penned by G. Venkataraman relating to C. V. Raman (*Raman and his Effect*), S. N. Bose (*Bose and his Statistics*), M. N. Saha (*Saha and his Formula*), and S. Chandrasekhar (*Chandrasekhar and His Limit*). These small books which Venkataraman referred to as 'some sort of "Junior Feynman Series"' are semi-popular science books, 'meant to be for fun and excitement', 'on diverse topics in physics which would stimulate interest, making at least some of our young students take up later a serious study of physics and reach for the Feynmann and the Landau classics'. They are interspersed with brief biographical sketches, boxed items, equations, figures and even correspondence. But they are essentially of people who are bygone and who have left their footprints of everlasting value. Then we have more detailed biographies: *Journey into Light: Life and Science of C. V. Raman* by G. Venkataraman and CHANDRA: *A Biography of S. Chandrasekhar* by Kameshwar C. Wali. The two books are written in two widely different styles. Venkataraman's book on Raman commissioned by two Indian Academies, is a

scientific biography, lucidly written 'somewhat at the level of *Scientific American*', including some technicalities meant for the specialists. There are copious quotes and notes included, which have enriched the book immensely.

On the other hand, Wali has stated that his book *CHANDRA* 'is not intended to be an appraisal of Chandra's scientific work, nor is it a scientific biography'. One may apply to this biography of Rao the words of Wali that 'it may be perceived as merely laudatory, more like a memorial to a living person than a biography'. One would like to see a personality 'presented as a living figure with all his human traits and faults, which every man possesses, however great his genius'. In this context, Wali has quoted what Kapitsa had said referring to Rutherford: 'I see that time has absorbed all his minor human imperfections and I can only see a great man with an astounding brain and great human qualities'. So shall be foibles of Rao, which are not mentioned by Sundara Rajan.

The biography under review is very readable and flows smoothly, annotated with quotes from many of Rao's colleagues, friends and well-wishers from all over India and abroad. There are a few minor corrections to be taken care of. Apart from that, the only lacuna is perhaps the omission of an Index. The book is not to be construed as a scientific biography, as it would be a formidable task to put together such a work based on a bibliography that has to take into account more than a thousand publications in national and international journals. The book under review has to be read by the young in their formative years for it gives an inkling to the joy of science, the grit and determination that goes to the making of a scientist and if one may say so, a blueprint for success in one's scientific career. I am reminded of an other book, *Advice to a Young Scientist* by P. B. Medawar, which is pedagogical. On the other hand, here is a book that provides the life story of one who serves as a model scientist, a science

administrator and a teacher – all rolled into one.

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Communicating in Style. Yateendra Joshi. The Energy Resources Institute, New Delhi. 2003. 250 pp. Rs 300.

In a recent interview to *The Scientist*, sociobiologist and well-known author E. O. Wilson said that writing is more difficult than doing research. Many Indian scientists will agree with him.

This book is meant to help researchers, academics, journalists and managers whose work involves writing project reports, research papers, conference presentations, newsletters, manuals, posters, web pages, etc. present their material in a simple and straightforward manner so that their readers can get the message without much strain.

The book started as an in-house manual on writing. The author has consulted many established style guides and made comprehensive searches of the World Wide Web. Several drafts were field-tested before TERI decided to offer Joshi's style guide to a wider audience.

While it may not match the *Chicago Style Manual* in sheer size and depth of coverage, or the cute little classic *The Elements of Style* by William Strunk Jr. in its canonical status, or the more recent punctuation guide *Eats Shoots & Leaves* by Lynne Truss in the number of copies sold, the TERI style guide is most welcome for it is written with Indian users in mind. It is full of practical wisdom. I

recommend this book to researchers and doctoral students, especially those whose English language training is inadequate – which means about 90% of Indian scientists and students, thanks to the overall deterioration in standards of teaching English in our schools and colleges. Increasing use of 'e-malese' and SMS messages on cell phones have an evil influence over the way we use language. In addition, given its foreign origin, in the current political climate, English may be looked down upon.

The book is organized well and Joshi has covered virtually every aspect of writing, editing and publishing that an author needs to know. The 13 chapters cover not only the basic elements of style, choosing titles (headings), nuances of grammar, abbreviations and acronyms, punctuation, capitalization, preparation of tables, figures and lists, and quoting work by others, but also writing letters, faxes and e-mails, making effective presentations, designing quality posters, and submitting papers to journals. The annexes cover different formats of giving references in scholarly work, spellings and dictionaries, typography, and the right way to present postal and e-mail addresses and telephone numbers. Throughout the book the author's text is on the right-hand side pages and all examples, excerpts from the literature and useful sources of information are given on the left-hand side pages.

Researchers and research students will find this book valuable as a source of ready reference.

In a future edition Joshi might want to write about the use of a thesaurus and alert his readers to the excellent style guide of *The Economist* and the outstanding book, *Words into Print* by Marjorie E. Skillin and Robert M. Gray.

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