

## C. N. R. Rao

*A tribute on his sixtieth birthday by T. V. Ramakrishnan*

It is hard to believe that Professor C. N. R. Rao is sixty. The vigour, enjoyment and commitment with which he conducts his many lives, as a passionately dedicated researcher, an inspiring scientist and teacher, an author, a leader in Indian science, and not the least as a warm human being, are undiminished. It is easier to describe a natural phenomenon than to explain it (especially in the absence of a theory). This is what I shall try to do.

CNR is one of the few universalists in contemporary chemistry. The range of his contributions and their high professionalism disproves the common belief that breadth of interest and professional depth are antithetical and that their product is a constant. Perhaps it does depend on energy, commitment and a strong urge to understand the workings of nature! This was already apparent in the (very) young Rao, who as a PhD research student, worked on the structure of gaseous molecules by electron diffraction, spectroscopic studies of organic molecules, correlation of spectroscopic properties with reactivity, as well as crystal structure and phase transformation kinetics of the transition metal oxide  $\text{TiO}_2$ . In one of these fields, namely chemical implications of molecular spectra, he went on to make major early contributions. He recognized the structural chemistry of solids as a major subject about to be born; he assisted at the birth and nurtured it, till now it is one of the major concerns in chemistry.

CNR is one of the pioneers in solid state chemistry. The correlation between structure and chemistry; new families of compounds with unusual properties and strategies for realizing them; novel chemical routes for materials synthesis; phase transformations in solids; spectroscopy, chemistry and physics of solid surfaces; clusters and nanomaterials; solid state sensors and catalysts are some of the areas where he and his associates have made major contributions.

CNR's most sustained professional love, extending over more than 35 years, is perhaps oxides, once the ugly ducklings of solid state chemistry. This family of

compounds is electronically astonishing; some of the best insulators, magnets, ferroelectrics, metals and superconductors are oxides! They had however been largely left alone by chemists (and of course by physicists) because of their structural diversity or complexity, and incorrigible nonstoichiometry. Starting in the late fifties, and constrained mainly by facilities for synthesis and characterization, CNR and his colleagues have given us a good part of the present picture. For example, nearly a quarter of a century ago, at IIT, Kanpur, I began to learn from Rao that novel physical phenomena such as metal insulator transitions, variable range hopping, minimum metallic conductivity and high spin-low spin transitions are actually found in transition metals oxides which were being synthesized and explored by him and his associates. Many of these phenomena are still poorly understood. Around this time, in the early seventies, he also had the idea of looking at quasi-two-dimensional oxides on grounds that reduced dimensionality might lead to interesting effects. It indeed does, in  $\text{La}_2\text{CuO}_4$ , which was shown by Ganguly and Rao to be an unconventional antiferromagnetic insulator (Mott insulator). This is the parent compound of the first family of cuprate superconductors which are obtained on substitutionally doping  $\text{La}_2\text{CuO}_4$  with Sr.

Some of the material ground for high temperature superconductors had thus been prepared by this work on oxides. So, when the explosion came, CNR was quite prepared and within a few weeks his group had synthesized, isolated and structurally identified the best actor in the cuprate family, namely the 90K superconductor  $\text{YBa}_2\text{Cu}_3\text{O}_7$ . His group has made many significant contributions to high temperature superconductivity. A few early examples are: the metastability of the oxygen deficient compound  $\text{YBa}_2\text{Cu}_3\text{O}_{7-\delta}$  with  $\delta = 0.3$  to  $0.4$ , the relevance of Cu-O charge transfer energy for cuprate superconductivity, new families of Thallium-based cuprate superconductors and the synthesis of bismuth-based cuprate superconductors without superstructure modulation.

CNR has inspired nearly two generations of students, co-workers, and colleagues. His examples of enthusiasm for science, direct and clear insight, unremitting effort, phenomenal mastery of detail, and demanding professionalism have touched and shaped many lives. A good part of his day throughout his life has been spent in training students with great care and perception, from their first steps to the stage where they take off on their own.

CNR is a major author in chemistry. In addition to writing out (usually long-hand) research work as it is completed, several kinds of scientific writings by him have made a difference. The first is reviews of nascent fields or of work done. For example, an early review on transition metal oxides helped to give the field an identity. The second is monographs on special areas, an early example being the book on *Ultraviolet and Visible Spectroscopy* (1961). A recent one is *Chemical Approaches to the Synthesis of Inorganic Materials* being published this year. Finally, he has edited and written textbooks at all levels, starting with *General Chemistry* (1971) and including the well-known *New Directions in Solid State Chemistry* (1986, with J. Gopalakrishnan). He was also the mainspring in NCERT's efforts to rewrite high school science textbooks, and contributed to it. All this speaks of a holistic concern with chemical knowledge and its diffusion that is all too rare among research scientists of distinction.

CNR is a remarkable builder of scientific institutions. He largely picked and encouraged the group of young scientists at IIT, Kanpur who made it a modern department of chemistry and have gone on to be among the leaders of chemical research and education in India (he was all of 30 years when he started this). At the IISc, he established a leading research group in solid state chemistry. And the last decade has been a period of sustained growth for IISc, in terms of new faculty, expansion of facilities and improvement of infrastructure, new educational programmes, financial well being, public perception, and even trees! Now his ener-



gies will be largely available for the Jawaharlal Nehru Centre for Advanced Scientific Research, which he conceived and brought into existence.

CNR probably knows more, professionally, about more Indian scientists young and old, than almost anyone. Their interests and contributions, their strengths and weaknesses are all of concern to him. This, coupled with his quick, sure and generally correct assessment of people as well as a realistic but activist approach make him uniquely effective.

As one of the leaders in Indian science, CNR has brought a great deal of sagacity and commitment to his role. He has led efforts to support quality science and scientists, as a good in itself. He has also made and generated detailed prag-

matic plans for technologies, present and future. He has furthered the growth of a large number of institutions and activities. He is forthright and clearly reads the bottomline. His observations on the overall poor performance of Indian science (even by rough measures such as the number of research papers published in good journals), on the lopsided and inadequate allocation of resources for science, on the lack of quality control and on the nearly total absence of good science education at an undergraduate level and its consequences, have always been coupled with feasible solutions. More recently he has clearly articulated the need, desire and capacity of the Indian science community to be an active partner in the knowledge and technology based,

internationally competitive economic regime that is emerging. In all this, he is a doer, a proposer of solutions and not just an analyser of problems.

The qualities of zest for life, instinctive kindness and helpfulness, respect for ability, and preference for substance over form coupled with a sharp intelligence and keen insight make him an unusual human being. He is steeped in his heritage, and is learning and growing all the time.

The first sixty runs tell a lot about the content and form of the century. We all look forward to it.

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### Special Interest Group on Medical Informatics (SIGMI)

Because of profound uncertainties involved in dealing with human beings and because medicine deals with vitalities of life where utmost care and speed are essential, the informatics needs of health sector are enormous. Medical informatics is a new technology which can significantly contribute to improve its efficiency. This is specially true for a country like India where plenty of scope exists to use information as an important resource to expedite decisions, to improve their rationality, and to be more effective in monitoring their impact. The technology can also help to achieve better utilization of our meagre resources.

In realization of importance of medical informatics in the overall development of health sector in our country, the Computer Society of India has taken initiative in forming a Special Interest Group on Medical Informatics (SIGMI). I am privileged to be its Convenor. Those interested in any aspect of medical informatics (health information system, hospital information system, databases on medical measurements and health indicators, literature bases, biostatistical computation, graphics, medical lessons, expert systems, networking for consultation, computerized equipments, etc.) and willing to contribute to the activities of the Group are invited to join the Group. For this, please write a brief on your past and current medical informatics activities and future plans, and mail to:

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