

Light, lattices and leadership: remembering Ramaseshan

Sivaraj Ramaseshan, scientist, teacher, and leader extraordinary, passed away on the morning of 29th December 2003, a little more than two months after his eightieth birthday. For some years, he had been less than his usual self, due to persistent and multiple illnesses, and the last two years were particularly trying for him, his close family, and large circle of friends, well wishers and admirers. But with this painful period over, it is time to remember what a remarkable 'usual self' the Indian scientific community could look to and indeed take for granted for half a century. No single writer can do justice to his achievements and influence. These span five academic generations, as measured by the birth of Ph D students. As with many large traditional Indian families, the generations overlapped since Ramaseshan's first research student joined him in the early nineteen fifties and the last passed out in the early nineteen eighties. Fittingly, both these were at the Indian Institute of Science.

Ramaseshan's B Sc (Honours) (1943) was from the Science College, Nagpur, an alma mater he shared with two distinguished physicist-brothers who followed him, Chandrasekhar and Pancharatnam. He joined his even more distinguished physicist-uncle C. V. Raman for doctoral work at the Indian Institute of Science and obtained his D Sc in 1951 – from Nagpur, since IISc did not award degrees at that time. He always openly acknowledged his admiration of Raman and his debt to him. Some of this rubbed off on his students because it was no mere parochial prejudice but based on many instances of Raman's insights and discoveries, many well ahead of his time. After 1948, when Raman moved to his own Research Institute, Ramaseshan continued to keep in touch with the group there on optical matters. An invited review, co-authored with G. N. Ramachandran on Crystal Optics for the prestigious *Handbuch der Physik*, was the pinnacle of this early optical period. He himself gave major credit for this achievement to Pancharatnam, who was doing a thesis with Raman at RRI as the review was being written. Light always illuminated his physics in later years as well. X-ray diffraction was not just a powerful tool but a fascinating phenomenon with its own physics and

subtleties. When Michael Berry's quantum 'geometric phase' was described in a journal club at the Raman Institute in 1985, he instantly and intuitively identified it with one of Pancharatnam's geometric results concerning polarized light – it took only a little calculation to check that he was right and this triggered off many generalizations and later developments.

Ramaseshan's period as a young faculty member at the Department of Physics at the Indian Institute of Science (1948–1962) marked his shift to crystal structure analysis with X-rays and his emergence as the founder and leader of a successful and influential school of crystallography. It could also be called the 'V' period since Viswamitra, Venkatesan, and Vijayan passed through the lab and went on to become well known and established at the Institute. He has movingly acknowledged how R. S. Krishnan oversaw the transition of this department from one centred on one strong individual – Raman – to many labs each with its own character, forming a whole greater than the sum of the parts, as indeed they do today. Anyone who knew Ramaseshan could not miss his love for this department and its deep influence on him. Incidentally, the other major school of crystallography which emerged, again from Raman and the IISc, was G. N. Ramachandran's, at Madras. Characteristically, Ramaseshan took great pride in the heroic exploits of this group and conveyed as much to his students. Much of this work was presented at an international meeting in Madras in 1964 and made a major impact. One of the major themes of his research was the understanding and exploitation of the 'anomalous scattering' phenomenon in X-rays (and later neutrons and electrons) – he fondly described it as 'the thin end of the wedge'.

Then followed a very important stay at the Polytechnic Institute of Brooklyn (1954–55), where he branched out into low temperature crystallography, under the influence of Isadore Fankuchen. His accounts of this period include interactions with Paul Ewald, the Bhishma of crystallography. The allusion is deliberate, because there was in him a strong streak of traditional reverence for great figures in physics, going beyond mere professional respect. This coexisted with

a completely modern spirit of scientific progress, since these feelings would not prevent him from improving on their work, or recognizing their mistakes and oversights. He has also described how he was exposed to medical and biological applications of crystallography in this period.

In 1962, he took over as professor and head of the department of physics at IIT Madras. In his relatively short stay there, he was able to initiate and encourage programmes in crystallography, guide students, and leave a lasting impression on his colleagues not only in physics but also in other departments like chemistry, aeronautics, and metallurgy. With his remarkable breadth and talents, and his charismatic impact on students, the IIT could well have become an academic niche in which he would have built up a strong department and training programme for physicists and engineers in India. Having heard his lectures to general and student audiences in Chennai in this period, I can testify to the excitement that they could generate for physics in general and for the research he carried out. The talks were carefully prepared and intensely delivered, with sharp sallies of humour, illuminating and insightful digressions into history and interconnections between different subjects, and generous acknowledgment of colleagues. As one got to know him better, it was clear that this was not just characteristic of his lectures but reflected his way of doing science.



His next long stay out of India was at Oxford, in 1964–65, in the world famous group of Dorothy Hodgkin, for whom again he had the deepest respect. This time, he had additional responsibilities since Dorothy Hodgkin herself was away for a significant part of his stay. The phase problem for large biological structures was of particular interest to him in this period, and he always kept track of new developments and encouraged younger colleagues in this important area.

At this point, in the mid-nineteen sixties, something else seems to have stirred in him – a vision of the new and emerging discipline of materials science, as well as a vision of technologies needed for the nation's progress and how his science could contribute to them. In 1966, he moved, after his IIT colleague Valluri, to the National Aeronautical (now Aerospace) Laboratories in Bangalore – surely a leap in the dark for someone who had up to then functioned in the framework of established institutions. Here was a forty two year old academic, building a group in a new field from scratch, in a primarily technological setting. It is a measure of his stature that people from many different places took the plunge along with him and joined the group, pursuing problems which were important for the future needs of aerospace, but many of which they were exploring for the first time. Apart from classical metallurgy, other areas like composites, electrochemical machining and forming, trace analytical methods (to name a few), were initiated. He invited A. Jayaraman, then at the Bell Telephone Laboratories (but originally from the Raman stable!) to set-up a high pressure physics lab which came up in less than a year, with major technical inputs from NAL. Within a few years, the Materials Division was thriving. Perhaps most remarkably, he inducted research students and guided Ph D theses, at least four students being in 'pure' physics, with no trace of an application. Incidentally, this was very much an 'R' period, during which Ranganath, two Ramesh's, Rajaram, two Rajagopalans, two Ramanis (later becoming three), all working closely with him!

As one of the students, my first-hand acquaintance with him began in this exciting phase of his career. Since this period has been covered in a recent issue of *Current Science* (10 October 2003, vol. 85, p. 1082), a briefer description will suffice to give the flavour of his

leadership. Materials at NAL was an eclectic cocktail of solid state physics, crystallography, metallurgy, electrochemistry, optics, spectroscopy, and other things. Nor were we isolated from other divisions like structures, electronics, and aerodynamics either. (An electrochemical machining set-up once needed a turbulent flow and he suggested in a lighter vein that the best way to achieve it would be to design for laminar!) As students, we were encouraged to get involved in the problems being pursued, but gently reminded of the Ph D problem as well. Almost daily contact and discussion was the norm, as often as not in a group, with plenty of scope for cross-fertilization. His remarks were intuitive, insightful, incisive, and very positive, and following them up often led to something new and interesting.

Many acclaimed large research groups function in a 'many to one' culture but his was an exception, since there were direct interactions and contacts between any of the members, though as often as not his catalytic influence was present. Looking back now, I see how little formal structure there was, and hence how much depended on his light but sure touch. When I hear blanket criticism of CSIR labs in more 'academic' institutes, I remind myself that this was as academic an environment in its own way as I ever hope to see. Lectures, visits to and interaction with other places, and above all visitors, with whom there were invariably animated discussions, were all the norm. The visitors list would be a veritable who's who of science in India and the visitors from abroad included several (future) Nobel Prize winners. Long before the internet and globalization, the group at NAL did not need to feel isolated, thanks to Ramaseshan's efforts and stature.

After C. V. Raman's death in 1970, Ramaseshan devoted substantial time and energy to revitalizing the Raman Research Institute (of whose Trust he was a member from the beginning). He also plunged into giving a new broad base to the Indian Academy of Sciences and became deeply involved with its publications, serving as the founding editor of the new physics journal *Pramana*. The wide respect in which he was held in the community ensured that this venture could take off. After twelve years of work at NAL, his roots seem to have called back to him, first at the IISc and

then at the Raman Institute. After two years as Joint Director at IISc, he succeeded Satish Dhawan as Director for a short term of just three years (1981–84), in which he nevertheless initiated many changes and attracted bright young people, seeding new areas and programmes. He served as President of the Indian Academy of Sciences for a three-year term, 1983–85.

Based at the Raman Research Institute after retirement from IISc, he took up a crucial role in its growth, and also took up the major task of editing C. V. Raman's collected papers. In 1990 he found a new passion – this journal, *Current Science* – which had been in existence since 1932 but achieved a new stature in his care. His wide interests and equally wide circle of friends meant that as Editor, he could attract articles of a high standard on a wide range of topics to this journal. Its columns also became a lively forum for open discussion of policy issues among working scientists. It became and remains quite distinct from and independent of governmental departments and committees, institutional structures, or even the science academies (in spite of its symbiotic association with the Indian Academy of Sciences). His guidance during the crucial years after the revival and expansion of *Current Science* has set healthy traditions and ensured its stability in a changing environment.

Honours and distinctions came to him in due course but he wore them lightly. As his career moved from his own intense pure research, to guiding at the doctoral level, teaching at the undergraduate level, building up human resources in a new area, overseeing institutions, and then serving the scientific community, in some ways there was no fundamental change. He was not just willing but eager to learn new things, to teach, to discuss, to advise, and above all to do something constructive, in any context. Long after most formal duties and commitments had run their course, he remained intensely curious about much more than physics, reading prolifically and keeping many of us on our toes by his requests for explaining something new to him.

Just recounting his scientific achievements gives a very incomplete picture of what it was like to work with him. Informality, warmth and humour were characteristic of his style, and it was a pleasure to hear him recount events and

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incidents, scientific or otherwise. His memory for all these things was remarkable and he could always find an appropriate anecdote in any context. It took much more time to realize the deeper feelings that lay behind his good-natured approach, and the longer term goals and values that drove him. It is clear that Ramaseshan was one of a kind. We shall

not see his like again, but we are certainly heirs to his legacy which lives on in the people he touched, academically and otherwise, and the many institutions he served, not only in formal capacities. It is not an easy legacy to pin down, even in a few thousand words, and many of us will reflect on it in the years to come. For now, we have witnessed the passing

of an extraordinary scientist, teacher, and leader.

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