

## R. S. Krishnan

### *An obituary*

To move into a position vacated by a giant and then to effect a smooth transition to a new era is considered to be an extraordinary feat. Prof. R. S. Krishnan (1911–1999), who passed away on 2 October at a ripe age of 88 years, had achieved this distinction, in addition to his own personal contributions. He succeeded C. V. Raman in 1948 as the Head of the Department of Physics, Indian Institute of Science (IISc), Bangalore, and retired from that post in 1972 after nurturing the department into a fine center of contemporary solid state physics.

Rappal Sangameswaraier Krishnan was born near Palghat, Kerala on 22 September 1911. He completed his school education in Palghat, being consistently at the top of his class. Winning a small scholarship, he joined the St. Joseph's College, Tiruchirapalli, for his B Sc (Hons) degree in Physics, where also he obtained first rank. After completing this in 1933, he joined C. V. Raman as a research student in the newly started Department of Physics, IISc, Bangalore. The early batch of research scholars had, apart from R. S. Krishnan himself, persons like N. S. Nagendra Nath, C. S. Venkateswaran and others, all of whom rose to be leading members of the physics community, getting elected to various academies and winning various awards/distinctions in due course.

Krishnan's early studies were on the

scattering of light by colloidal solutions. In the course of these investigations,

he discovered the reciprocity relation between the intensity of the horizontally polarized incident light getting scattered with vertical polarization and the intensity of the vertically polarized incident light getting scattered with horizontal polarization, irrespective of the nature of the colloidal particles. This was called Krishnan's reciprocity effect and formed the basis for getting his D Sc degree from the University of Madras. In 1938 he was awarded the Overseas Scholarship of the Royal Commission for the Exhibition of 1851 and went to the University of Cambridge to work with J. D. (later Sir John) Cockcroft. There he was the first to observe the deuteron-induced fission in uranium and thorium. He returned to IISc in 1941, when the Second World War had already begun. H. J. Bhabha also returned from Cambridge at about the same time as the Reader of Physics in IISc and started work on cosmic rays and theoretical physics. With severe financial crunch due to the War, Krishnan, as a Lecturer of Physics (1942–1945), started work on the Raman spectra of crystalline materials. The use of the ultraviolet 2537 Å resonance radiation, using the mercury arc lamps made locally with fused quartz envelopes,

was an unusual and path-breaking experimental innovation. The source was powerful and in the scattered light the incident wavelength could be suppressed by the resonance absorption of the 2537 Å light by a small amount of mercury vapour. This development enabled Krishnan to record the second-order Raman spectra in diamond and in alkali halide crystals. The experiments triggered a series of investigations in many laboratories and provided the first confirmation of the lattice dynamics model of crystals. The Brillouin scattering from several crystals was

### On R. S. Krishnan

Sometime ago, I had to speak on the growth of physics in India immediately after independence. It was while contemplating on many of the important issues, the part you played came into perspective and I thought this may be a good occasion to mention it to you. In the lecture I said:

'Because of the policies government had followed just before and immediately after independence, one might have expected a set-back in the progress of science as the country would have had to wait for the newly trained young scientists who were sent abroad to return and establish schools of science. In the case of Physics and Applied Physics, this simply did not happen. In fact, Physics actually flourished magnificently. Vigorous schools of research in Pure and Applied Physics that too in new fields were set-up which produced internationally competitive scientific work. The tradition and momentum built up in physics in the country during the previous three or four decades came into play.

'The greatest contribution made by Raman to post-independence physics was not his science but the students he had trained and who had passed through his laboratories. One can mention the names of many of his students like S. K. Mitra, S. K. Banerjee, K. R. Ramanathan, L. A. Ramdas, K. S. Krishnan, S. Bhagavantham, K. Bannerjee, R. S. Krishnan, Vikram Sarabai, P. Nilakantan, P. R. Pisharoty, Anna Mani, G. N. Ramachandran, S. Chandrasekhar, A. Jayaraman and S. Pancharatnam. Many more could be added to this list.

'R. S. Krishnan was amongst the most outstanding experimenters of Raman's students. He is well known for the new effects he discovered in colloid optics. His work on the second order Raman Effect is nothing less than brilliant.

It was pity, however, that it became a subject of much controversy; not his experiments but their interpretation. His work on Brillouin scattering in diamond and the work he did with V. Chandrasekharan can only be described as monumental. Apart from his renown in his personal science I think the greatest contribution he made is when he changed the style in which physics was done in India. A clear break from the traditions set-up earlier.

'He had a knack of picking young scientists and encouraging them to start new things and make them work in almost independent groups. He courageously started such activities like dating of rocks, mass spectroscopy, ultrasonics, crystal dynamics and crystal properties, especially photoelasticity, paramagnetic and nuclear magnetic resonance and also X-ray crystallography. Many of these had never before been done in the country. By creating these semi-independent groups, Krishnan was in a sense (perhaps unconsciously) responsible for breaking the "GERHEIMRAT" system in which the Professor is supreme and all the members of the lab work for him. Unfortunately, this old system still persists at many places in the country, including at the Indian Institute of Science.'

*Excerpted from a lecture by S. Ramaseshan on the Growth of Physics in India after Independence.*

In a letter to R. S. Krishnan on his 80th birthday Ramaseshan wrote:

'You chose V. S. Venkatasubramanian (VSV) to work on the dating of rocks. The work you and he did was truly path breaking. The first mass spectrometer was built in the Physics Department under your guidance (and not in Bombay). With VSV and E. S. Raja Gopal, ultrasonic research came of age and elastic constants (of solids also) were determined using the most modern techniques. Your encouragement of Suryan, who was so full of ideas in those days, was truly phenomenal. The first paramagnetic resonance and nuclear magnetic resonance set-up was done in the Physics Department. Indeed, modern electronics really entered into physics because of you in your department. The remarkable work of R. Srinivasan, his theoretical and experimental acumen is something you and all of us can be proud of. I think Chidambaram, under your inspiration, became one of the best, in India in instrumentation and he produced notable science in many fields.

'I remember how you egged me on to finish my doctoral thesis and persuaded me to change from magneto-optics (and paramagnetic resonance). When G. N. Ramachandran left, you "picked me" and said that you had decided to put me "in charge" of X-rays and said "Try to build a group worthy of this department". I am personally very thankful to you for this decision of yours. Students who came out of this group attained world renown; Viswamitra, Venkatesan, Vijayan and N. V. Mani (who died) and also *their* students. I flatter myself in thinking that your experiment in this regard was not too unsuccessful.

also studied, in particular the subtle new phenomena which occur in the scattering from birefringent and optically active crystals. Krishnan was made an Assistant Professor in 1945 and was appointed to be the Professor and Head of the Department in 1948, when Raman retired from that post.

In the post-war period, Krishnan energetically developed the department into an active school of research in crystal physics. G. N. Ramachandran and S. Ramaseshan, who had earlier started their work with C. V. Raman, made outstanding contributions to crystal optics, thermo-physical properties of crystals and X-ray crystallography. Newer colleagues like P. S. Narayanan, G. Suryan, P. T. Narasimhan and V. S. Venkatesubramanian started in the early fifties to open out new areas like nuclear geochronology, magnetic resonance, dielectrics/ferroelectrics and ultrasonics. Studies on semiconductors were added soon as also work on low temperature physics and theoretical solid state physics. The department attracted very good students from all over India,

who got imbibed into the spirit of building and developing one's own apparatus or experimental facilities. Though the hierarchical ladder of the student/assistant, Lecturer, Assistant Professor and the all-powerful Professor was the norm in those days, Krishnan gave considerable freedom to the younger colleagues to grow on their own, training them not only in research but also in administrative responsibilities. It is therefore not surprising that several persons of this period made names for themselves later on, both as distinguished Professors of Physics and also as Directors of various institutions. In spite of a temporary cloud arising out of an unfortunate litigation against IISc in 1961/1962, Krishnan continued to be very active in the department till his formal retirement in 1972.

Soon after superannuating from the services of the IISc, Krishnan became the Vice Chancellor of the University of Kerala, Thiruvananthapuram (1973–1977), where he tried to link the University with the work being done in the Space Research Center (now called Vikram Sarabhai Space Center). He then returned to Bangalore and

undertook the collection, annotation and editing of the scientific publications on Raman Effect under a DST sponsored programme (*Source Book on Raman Effect*: First volume, pre-1937 period, second volume, 1937–1948, and third volume, 1948–1961 the beginning of the laser revolution). These volumes and the earlier book on *Crystal Physics*, including in addition crystal physics property data, have been widely used by many scholars. Krishnan published over 220 papers in scientific journals and over 60 students had taken their Ph Ds with him. He was elected, among others, to the Fellowship of the Indian Academy of Sciences in 1944, to the National Institute of Sciences, India (now called Indian National Science Academy) in 1950, the Institute of Physics (UK) in 1953 and the American Physical Society in 1955. He had travelled widely in India and abroad not only in his personal professional capacity but also as a member of many national committees/delegations. Among the many awards and medals he had received, the Sir C. V. Raman Centenary Medal and the IISc Platinum Jubilee Alumni Award probably gave

... .. procedure and satisfaction.

In his personal life, Krishnan was simple, strict and religious. He had his likes and dislikes about which he made no pretenses. He belonged to the earlier era of scientific research and administrative procedures and yet he

succeeded in making a smooth transition to the new age. He was active and in good health till about a year ago when his health began to fail. He is survived by his wife, who had been a pillar of strength to him for more than six decades, his two sons and three daughters. His family,

colleagues and students are all pained with his passing away.

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