Raja Ramanna – A personal tribute

Raja Ramanna, India's most eminent nuclear physicist, passed away on 25 September 2004, early in the morning, at Mumbai after a cardiac arrest.

Raja Ramanna, son of B. Ramanna and Rukminiamma was born in Tumkur (Karnataka) on 28 January 1925. He had his early education at Bishop Cotton Boys' School, Bangalore and later graduated from Madras Christian College. He received his Ph D degree in physics from King's College, London University. He was a JN Tata scholar during that period.

I met Ramanna for the first time when he visited Banaras Hindu University (BHU), Varanasi, where I was a student of physics in 1956. He had come to the university for a Ph D viva and I was introduced to him by my professor, the late B. Dasannacharya. I remember Ramanna's visit to our laboratory and a talk at the Physics Department. After graduating from BHU, I appeared at the selection interview of the Training School of Atomic Energy Establishment, Trombay in 1957 and was selected as a trainee of the first batch. In that connection I had called on Ramanna at his Sargent House residence, Colaba to seek his advice as to what I should do, since I was on my way to BHU for my Ph D. He advised me to return to my hometown, Tumkur and await the official admission letter to the Training School; he suggested that I could take up Ph D programme at a later time. During this visit, he referred to his association with Tumkur and I felt happy to know that. The Training School has been the main avenue for recruitment and training of fresh graduates in science and engineering disciplines to DAE over the past 57 years; in fact most of the Heads of various units of DAE have been through the Training School. After graduating from the Training School, I was selected to join the Nuclear Physics Division, headed by Ramanna.

Around 1958–60, a handful of experimental physicists were working around the first nuclear reactor of the country, Apsara. Research at Apsara covered neutron scattering from solids, neutron thermalization and fission physics. I was associated with neutron scattering experiments with V. P. Duggal. Ramanna's group studied the fission process induced by thermal neutrons and charged particles. Fission research spanned studies of emission of prompt neutrons, gamma rays, X-rays and light charged particles like α-particles in thermal neutron fission of uranium nuclides. Extensive studies of fission fragment mass, kinetic energy and angular distribution and correlation amongst them, nature of asymmetric fission induced by charged particles

Raja Ramanna (Photo credit: *The Hindu* Photo Archives)

and thermal and fast neutrons were being carried out. The Indian Academy of Sciences, Bangalore dedicated a special issue of *Pramana* (1985, **24**, nos 1 and 2), edited by E. S. Rajagopal on Ramanna's 60th birthday. The dedication to this volume neatly summarizes the rich contribution of Ramanna to physics in general.

To give a flavour of the research involved in the late 50s and early 60s, I quote from an abstract of a paper entitled 'Emission of prompt gamma rays in the thermal-neutron fission of ^{235}U', published by Ramanna and coworkers in *Physical Review*: 'The angular distributions of prompt-fission gamma rays with respect to the direction of selected fission fragments in the thermal-neutron fission of ^{235}U have been studied for two different gamma-energy groups, using a gridded ionization-chamber scintillation-detector assembly and time-of-flight method to eliminate fission-neutron background. From the measured angular distributions with respect to the direction of the selected light and heavy fragments, (it has been observed) that the heavy fragments emit somewhat more gamma rays than the light fragments, showing existence of a significant anisotropy of emission of the gamma rays in the emitting-fragment system, suggesting the presence of significant angular momenta of the fragments correlated with the fission axis which also lead to an enhanced emission of the gamma rays'. S. S. Kapoor, R. Chaudhury, P. N. Rama Rao and others had been involved in these experiments.

Ramanna had worked on other topics like neutron diffusion and thermalization in moderators, and in later decades on theoretical studies concerning stochastic nucleon exchange process in the fission process, etc. There were debates concerning some of the investigations and conclusions of Ramanna, for example, binding energies of unstable nuclei (based on theory of discreteness and continuity). Instead of taking up a rigid standpoint, he preferred to give detailed seminars on his work and elicit comments from fellow-scientists. Anyone could make remarks without worrying that he/she may offend Ramanna. In other words, he had an open mind on all comments, pro or con. This open mind had resulted in many youngsters freely approaching him to inform him of their own work,

One of my indelible memories of the early period is a picnic of many young members of the Nuclear Physics Division with Ramanna to Elephanta Caves. Rarely has there been such free mingling of senior persons with one and all of one's staff. I remember Ramanna playing cards with my colleagues in a relaxed manner at the Elephanta Island.

On another occasion, we went to Waltair to attend the Low Energy Nuclear Physics Symposium by train, all the way from Mumbai to Waltair via Hyderabad. The train journey was memorable as we had a reserved bogie. The meeting had stalwarts like Swami Jnanananda and K. S. Krishnan discussing many physics issues. Ramanna continued to take personal interest in the symposia for years to come and his presence had a great influence on development of modern physics, including reactor physics, neutron

physics and solid state physics in our country.

Ramanna had a lot of affection and concern for his younger colleagues. In 1961, when I was deputed to go to Atomic Energy of Canada Ltd at Chalk River, Canada to work with B. N. Brockhouse, Ramanna asked me to proceed to Chalk River after accompanying him and P. K. Iyengar to Vienna where they were going to attend the First IAEA Conference on Neutron Scattering. Several experts in the neutron scattering field were introduced to me by Ramanna at the conference and this made me feel at ease as this was my first visit to the West. Earlier on, I had asked Ramanna as to why I was not being deputed to the US like many of my other batchmates. He had told me that going to Canada would help me in the long run. I am glad that his observation was quite correct. I enjoyed working in Canada and many decades later, Brockhouse, with whom I had worked (Iyengar had worked with him even earlier), won a Nobel Prize in Physics; I treasure the association with Brockhouse, for it trained me in many aspects of science and life itself.

In the following years, Ramanna assumed greater responsibilities as Director of the Physics Group and then as Director, Bhabha Atomic Research Centre (BARC), Mumbai and my contacts with him became rather infrequent. However, he kept interest in the utilization of the reactors Cirus and Dhruva, where I was carrying out my programme of research.

In the 60s Ramanna was involved in the utilization of the Cirus reactor, design and development of Purnima – a zero-energy facility, research at van-de-Graff accelerator, establishing Reactor Research Centre (now called Indira Gandhi Centre for Atomic Research) at Kalpakkam, commissioning the Variable Energy Cyclotron at Kolkata and setting up the Centre for Advanced Technology at Indore and so on.

Ramanna's role in the design, development and testing of a nuclear device at Pokhran in 1974 is now a part of history. India conducted five underground nuclear explosions in May 1998 and established itself as a nuclear (weapon) power. The media have referred to Ramanna as the 'Father of India's Nuclear Test' and 'Dr Strangelove of India's Nuclear Weapons' Programme'. What was Ramanna's concept of nuclear deterrence and nuclear strategy *vis-à-vis* the Indian context? K. Subramaniam, the Defence Analyst who has interacted on nuclear issues with Ramanna has noted: 'though he (Ramanna) was converted to the strategy of deterrence in the early years of the nuclear age, it would surprise many people to know that he took very little interest in nuclear strategy. Once when Defence Minister C. Subramaniam asked him a question on nuclear strategy, he replied: "Sir, I am a physicist. That (strategy) is not my area". … For him, nuclear weapons guaranteed security in a dangerous world and that security is a prerequisite for development. As Minister of State for Defence, Ramanna in May 1990, spelt out for the first time the no-first-use doctrine. … He said in Parliament that India could not think of using a nuclear weapon first but would retaliate if an aggressor used it first'.

Ramanna occupied many prestigious positions. He was Director, BARC, (1972–78 and 1981–83), Secretary, Department of Defence Research, Government of India and Scientific Adviser to the Minister of Defence (1978–81), Secretary Department of Atomic Energy, Government of India (1983–87), Member/Chairman, Scientific Advisory Committee to the Director-General, International Atomic Energy Agency, Vienna (1986). After retirement from the Government, he was associated with Janata Dal and was a Minister of State for Defence, Government of India. (January–November 1990). He was elected to the Rajya Sabha in March 1990 and was again nominated to the Rajya Sabha in August 1997.

Ramanna was associated with science academies and other institutions, notably as Vice-President, Indian Academy of Sciences (1977–79), President, Indian National Science Academy, New Delhi (1977–78) and President, General Conference of the International Atomic Energy Agency, Vienna (1986). He had been Chairman of (i) Governing Council, Indian Institute of Science, Bangalore, (ii) Council of Management, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, (iii) Board of Governors, Indian Institute of Technology, Bombay (1972–78) and of (iv) Atomic Energy Commission. Ramanna had been conferred with many awards and honours: (i) Shanti Swarup Bhatnagar Memorial Award (1963), (ii) Padma Vibhushan (1975), (iii) Meghnad Saha Medal, INSA (1984), (iv) R. D. Birla Memorial Award (1985–86), (v) Honorary Degree of Desikottama (Doctor of Literature) by Visva Bharati 1993, (vi) Asutosh Mookerjee Memorial Award (Gold Medal), 1996 and (vii) D Sc (Honoris Causa) by several universities.

Ramanna was instrumental in establishing the National Institute of Advanced Studies (NIAS) at Bangalore after his retirement from DAE. The institute, the brainchild of J. R. D. Tata, was created 'to conduct advanced research in multidisciplinary areas and also as a forum to bring together administrators and managers from industry and government, …academic community in natural and social sciences'. The institute, with Ramanna as its founder-Director, was involved in a variety of studies, including those on consciousness, energy, gender, history and philosophy of science, international and strategic studies, sociology and social anthropology. Ramanna was Director of NIAS from August 1987 to December 1989 and again from 1991 to June 1997. He held the position of Director-Emeritus of the institute from 1997 till the end. On my settling down at Bangalore after retirement, he made me an Associate of NIAS. So on a few occasions I used to meet him at the institute.

Ramanna had interests in a variety of topics, music to philosophy. Regarding philosophy he noted, 'In recent years I have been interested in the philosophy of science. This approach to knowledge has been neglected and is only now becoming an essential part of science. The fact that the various components of science like Physics, Chemistry, Biology have merged into one, makes a philosophical approach inescapable, as it used to be in the past, and in fact the old name for science is Natural Philosophy. It is indeed an anomaly that many of the Doctors of Philosophy as fabricated in our Universities each year, know little of philosophy as an integrated approach to knowledge'. It is obvious that his interest in philosophy extended beyond the realms of science per se. The above quote is from an article entitled 'A few moments with Paramacharya' by Raja Ramanna (see Raja Ramanna kamakoti_org.htm). The article reveals Ramanna's way of thinking, his expression and his views; truly the article has captured some vignettes of his personality. This juxtaposition of science and philosophy seems to have interested him again and again. However, he shunned blind acceptance of religious rituals and was a rationalist. In a seminar on

scientific temper held recently, he said, 'Our entire educational system works in an atmosphere of conformity, and non-questioning and obedience to authority. Teachers do not supplement the knowledge with proof nor ask students to try and independently prove whatever they are taught' [http://www.hindu.com/thehindu/mp/2003/02/26/stories/200302260380100.htm].

Many eagerly sought Ramanna's opinion and advice on education and other policy matters. Recently, he had headed Karnataka's Education Task Force.

Ramanna was a connoisseur of music, both Western and Indian. He was well versed in playing on the piano and viola. He is said to have started playing on the piano at a young age. After 1987, he was actively involved in setting up the Bangalore School of Music and served as Chairman of its Advisory Board.

Ramanna had a sense of humour, subtle and enjoyable. Even amidst strong and divergent opinions, he had the knack of disarming arguing persons by his light-hearted comments.

Ramanna, apart from his publications in *Science*, authored two books: (i) *Years of Pilgrimage – An Autobiography*, Penguin Books India Pvt Ltd (1991) and (ii) *The Structure of Music in Raga and Western Systems*, Bharatiya Vidya Bhavan (1993). In addition, he has rendered into English, *Mukundamala of Kulashekhara Alwar*, a publication of the Gandhi Centre of Science and Human Values of Bharatiya Vidya Bhavan, Bangalore (1997). Although this work was published as recently as in 1997, interestingly, the Introduction to this translation by Ramanna dates back to 1974, the year which saw him leading the Pokhran-I test. Ramanna wrote in the Introduction, 'It is unfortunate that many of the gems of ancient poetry are so much associated with the ritualisation aspect of religion that their beauties are available only to a few who belong to the associated sect or caste and who in turn consider them as their sole property. This great *Bhakti* poem … is usually associated with the *Vaishnavite* sect; the sect itself was in the nature of a Hindu reformist movement which rose to its zenith of influence under Sri Ramanuja… It was a reaction against the agnosticism of the Buddhists and the intellectualism of *Advaita*…'. He continues: 'Social conditions have changed in the last thousand years and while we may have lost sight of the worldly problem referred to in the poem in the original sense, the greed for money and aimless seeking of ephemeral pleasures of life are so much around us, that the word "worldliness" [free translation of *samsara* by Ramanna] can be interpreted as to refer to these ills'. One would wonder if Ramanna had implied this broad vision whenever he referred to his own interest in yoga, because a yogi is said to be aware of the ephemerality of all that is associated with this life, as stated in the other classic poem *Bhaja Govindam* or the greatest epic-poem *Bhagavad-Gita*. Concluding the Introduction, Ramanna notes: 'Whatever be the thoughts contained in this inspiring poetry, it brings out the fact that no human activity reaches its full glory without "*Bhakti*", whichever way one interprets the word'. In this one sentence he seems to have encompassed many a concept like *Akaamya-akarma* (performing every action as a duty without seeking fruits of action), if not *Sharanagati*.

Ramanna has left behind his wife, Malati Ramanna, son Shyam and daughters, Nina and Nirupa.

Ramanna's life-long achievements 'symbolize the time-honoured traditional belief that science, philosophy, poetry and music are not water-tight compartments but merge with each other, bringing a sense of fulfillment, in the ultimate transcendental fusion'.

I pay my humble homage to Raja Ramanna, who was a well-wisher and a mentor to me.

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