IANCAS
Special Bulletin

Remembering

Dr. M.V. Ramaniah

A doyen of Radiochemistry in India

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Remembering Dr. M. V. Ramaniah : A doyen of Radiochemistry in India

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Dr. Ajit Kumar Mohanty

भारत सरकार
Government of India

अध्यक्ष, परमाणु ऊर्जा आयोग
व
सचिव, परमाणु ऊर्जा विभाग
Chairman, Atomic Energy Commission
&
Secretary, Department of Atomic Energy

MESSAGE

I am happy that Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) is bringing out a special issue on the Life and Scientific Journey of Dr. M.V. Ramaniah, the main architect of Nuclear and Radiochemistry programs of this Department as well as in India. His contributions to the Department have been well recorded.

Dr. Ramaniah after obtaining his MSc degree from Andhra University by research in the Chemistry of Thorium in 1949, worked in the field of Nuclear and Radiochemistry nearly a decade in different laboratories of United States of America. He had opportunities to work with pioneers in Nuclear Science like Prof. T. Moeller, Prof. A.C. Wahl, Prof. J. Kennedy and Prof. N. Sugarman. He was also associated with Prof. G.T. Seaborg. He obtained his PhD degree from Washington University in 1956 on the studies of mass distribution of deuteron induced fission of Thorium. Despite contributing significantly in the field of Nuclear and Radiochemistry in USA, his urge for working in his country brought him back to India. In 1957, he joined Atomic Energy Establishment at Trombay and became Head, Radiochemistry Division in 1965 and Director, Radiological Group in 1979. Some of his PhD students carried out research in the area of neutron induced fission of actinides such as mass, charge and kinetic energy distributions, and his work has been published in reputed journals.

Dr. Ramaniah was very particular about building world class R&D facilities, giving utmost importance to the chemical and radiochemical safety. He was instrumental in developing Radiochemistry Laboratory at BARC, Atomic Fuel Fabrication Facility at Tarapur and Radiochemistry Laboratories in Variable Energy Cyclotron Centre, Kolkata. In order to popularise nuclear science and its applications to society across India, he was instrumental in forming two scientific bodies namely Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) in 1981 and Indian Nuclear Society (INS) in 1988. He had served in many international bodies particularly as an Indian representative to International Atomic Energy Agency (IAEA). He was invited by IAEA for various specialist meetings due to his significant contributions, strict adherence to safety and understanding of the entire nuclear fuel cycle.

I take this opportunity to congratulate the IANCAS family for publishing this Special Bulletin consisting of reminiscences by the associates and colleagues of Dr. M.V. Ramaniah. I am sure this would be an inspiration to the present generation of nuclear scientists and technologists.

Ajit Kumar Mohanty

(Ajit Kumar Mohanty)

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MESSAGE

Dr. M.V. Ramaniah was a first-generation radiochemist in India who joined the Department of Atomic Energy during its formative years in 1957. Over a period of three decades until his superannuation in 1987, he, with utmost dedication and untiring efforts, nurtured the discipline of Radiochemistry and left an indelible mark on its growth not only within the Department, but was also instrumental in facilitating establishing this discipline in Indian Universities. Dr. Ramaniah had the privilege of working with famous Inorganic Chemist Prof. Therald Moeller at the University of Illinois in Urbana-Champagne and with doyens of Nuclear and Radiochemistry of his era like Prof. Arthur C. Wahl (with whom he earned his Doctoral degree) at the Washington University in St Louis, and Prof. Nathan Sugarman at the University of Chicago. He will always be remembered as one who considered the work as worship and work place as his first home. He along with young colleagues, initiated R&D work in the field of Nuclear Chemistry for Nuclear Fission and Nuclear Reaction studies using Apsara, CIRUS and Dhruva research reactors as well as using charged particle accelerator facilities at VECC, Kolkata and BARC-TIFR Pelletron at Mumbai. He successfully mentored future generation of Radiochemists who in turn steered key DAE research programs related to Nuclear Fuel Fabrication, Nuclear Fuel Reprocessing, initiating Radiochemistry Program at IGCAR for addressing fast reactor technology issues. Coordinating Nuclear Material Accounting activities had been his yet another signal achievement. Under his leadership, the Division played key role in demonstrating the suitability of mixed carbide fuel for FBTR, Kalpakkam and developing Neptunium process flow sheet as a part of nuclear fuel reprocessing in collaboration with Fuel Reprocessing Division. He was also entrusted with the responsibility of setting up of facilities for the fabrication of MOX fuel for thermal and fast reactors. Continuous operation of FBTR for about four decades and A3F facility at Tarapur for two decades is a glowing tribute to his dedication and sterling leadership. Dr. Ramaniah was very passionate about nuclear safety as well as nuclear safeguards. Many younger colleagues earned their doctoral degrees under his guidance who later headed and lead the Departmental programmes successfully.

Dr. Ramaniah was the principal architect of IANCAS (Indian Association of Nuclear Chemists and Allied Scientists), which is a vibrant professional body providing a common platform to Nuclear Scientists and Radiochemists from DAE as well as academic institutions. He was also the founding President of Indian Nuclear Society (INS), which is actively pursuing its objective of bringing Scientists, Engineers and Technocrats in government, private and academic institutions on one platform to discuss national plans on peaceful uses of nuclear energy.

I am delighted to learn that IANCAS is bringing out this special bulletin wherein his students, colleagues and family (of Dr. Ramaniah) are paying their tributes to one of the legendary figures of early years of DAE. I join them in paying my homage and wish them very best in this praiseworthy endeavor.

27.11.2024

(Vivek Bhasin)

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For Special IANCAS Bulletin
in honour of
Prof. Dr. M.V. Ramaniah

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München, 5 August 2024

Message of Appreciation in Commemoration of Professor Dr. M. V. Ramaniah

It is an honour and a pleasure for me to send this message of appreciation and recognition to radiochemists in India, commemorating the memory of Prof. Ramaniah of the Bhaba Atomic Research Centre (BARC), Trombay, Mumbai, India, who served the international journal Radiochimica Acta in the early phase of its development. The journal was founded in Germany by the Nobel Laureate Prof. Dr. Otto Hahn in 1962 to serve the publishing needs of the then fast developing field of radiochemistry. Dr. Ramaniah was chosen as an Advisor from India because he was one of the top radiochemists of the world at that time. He served in that capacity efficiently for about 15 years, i.e. till the journal was well established. In subsequent years, the collaboration between Radiochimica Acta and the radiochemists in India continued, with participation of its leading scientists as authors, reviewers, Guest Editors of special issues and as permanent members of the Editorial and Advisory Boards, in particular Professors Vijay Manchanda, Prasanta Mohapatra and Susanta Lahiri. Thus the legacy established by Dr. Ramaniah is continuing even after 50 years. For me, as the Editor-in-Chief of the journal for the last 29 years, it has been a great pleasure to maintain the excellent publishing relations with the radiochemists in India.

Another aspect of Prof. Ramaniah`s activities was establishing and nurturing international collaborations in research. It was partly through his initiative and contacts that cooperation between the Forschungszentrum Jülich in Germany, where I have been working for more than 50 years, and two radiochemistry research groups in India, namely Mumbai and Kolkata, were established. Some good cooperative efforts are continuing even today, especially in the areas of energy-related radiochemistry, nuclear data for applications, and accelerator-based radionuclides for medicine.

It is nice and befitting that a special Bulletin is being organised in memory and honour of Dr. Ramaniah. It is a distinct privilege for me to contribute to it by sending this message of appreciation as the Editor-in-Chief of Radiochimica Acta and as a senior radiochemist in Germany, still involved in international affairs. I wish his family and friends all the best.

Prof. Dr. Dr. h.c. mult. Syed M. Qaim
Advisor in Nuclear Chemistry, Forschungszentrum Jülich, Germany
Editor-in-Chief, Radiochimica Acta

Preface

Radiochemistry discipline is pivotal to the front end as well as backend of the Nuclear Fuel Cycle program of Department of Atomic Energy (DAE) and is one of the early Research and Development activities initiated at Trombay. Late Dr. M.V. Ramaniah served the department during 1957-1987 in various capacities including Director, Radiological Group, BARC. Most of the present generation Radiochemists did not have the opportunity to see Dr. M.V. Ramaniah in action. An attempt has been made in this special issue of IANCAS bulletin to bring home the journey of this doyen of Radiochemistry in India through the eyes of his associates and those who watched him closely as a guide, mentor, strict disciplinarian and as an assertive leader. There is unanimity among all of them that Dr. Ramaniah nurtured the Radiochemistry program as a parent from cradle to adulthood with his dedication and unwavering commitment. Undoubtedly, he was the principal architect of Radiochemistry Program in DAE from early sixties (after the departure of Dr. G.R. Hall, Dr. G.A. Welch and Dr. H.D. Sharma) and was singularly responsible for the installation of world class infrastructure, equipment and facilities needed to qualify as a Class A Radiochemical Lab for the first time in the country. In view of these capabilities, the laboratory served as a nursery to train the engineers and scientists from other Divisions of BARC, who steered the Fuel Reprocessing Program and Plutonium based fuel fabrication Program of the department in subsequent years. He was so passionate about his work that he treated his office as his first home. He also ensured 24x7 safe operations in the laboratory by insisting that scientific staff is available round the clock to monitor the functioning of services and facilities and avoid any untoward incident involving radionuclides. Dr. Ramaniah himself used to take a round of laboratory before he left for home for the day. Over the years due to his sustained efforts, Radiochemistry Wing of Radiological Lab (RLG) was considered as a model laboratory not only among professionals within the country but also among the overseas visitors. Though Radiochemists who worked closely with him are not around, yet the culture inculcated by him lives even today in the corridors of Radiological Laboratory.

Dr. Ramaniah published his work in most prestigious journals of inorganic as well as nuclear chemistry during his doctorate / post doctorate tenures. After his joining BARC, he pursued his research interests in neutron and heavy particle induced fission along with his associates like Dr. C.L.Rao, Dr. K. Rengan and Dr. Satya Prakash. Apart from the departmental strategic work, the major programs completed successfully under the leadership of Dr. Ramaniah were Processing of aged plutonium, Thermodynamic evaluation of nuclear fuels (including mixed carbide fuel for FBTR), chemical quality control (CQC) of Pu based fuels (including carbides, oxides, nitrides and alloys), Burn up studies of research / power reactor fuels and fabrication of sol-gel fuels. Dr. P.R. Natarajan, Dr. C.K. Mathews, Dr. B.D. Joshi, Dr. R.H. Iyer, Shri D.M. Chakraborty, Dr. D.D. Sood and Dr. M.S. Subramanian were his senior associates. In seventies, under his mentorship, Radiochemical Lab (RCL) was set up at IGCAR, Kalpakkam to carry out Radiochemistry Work for Fast Reactor Program and Radiochemistry Lab was set up at VECC, Kolkata to carry out Nuclear Chemistry work using heavy ions. With the availability of heavy ion beams at BARC-TIFR Pelletron facility in eighties, he ensured that a Radiochemical Lab is set up at TIFR for Nuclear Chemistry work. His dedicated and sincere attitude towards work impressed everyone who watched him closely. He was entrusted with the responsibility of setting up facilities to develop and fabricate alternate Pu based fuels in view of the termination of fuel supply agreement for TAPS-I and TAPS-II post PNE in 1974. A3F (originally referred to as D2) at Tarapur, fabricating MOX fuel for PFBR today is a testimony to his leadership. He was also responsible for setting up NUMAC for accounting nuclear material inventory in the departmental facilities including power plants and fuel fabrication / reprocessing /waste management facilities. Dr. Ramaniah worked as the convener of the safeguards committee of DAE and also as a Member of the standing advisory group on safeguards implementation appointed by Director General, IAEA during 1975-1983.

In the early eighties, Dr. Ramaniah realized the need to create a platform for close interaction of Radiochemists working in Universities/ Academic Institutes and National Laboratories. It was in 1981 during Radiochemistry and Radiation Chemistry Symposium held at BHU, Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) with its HQ at Radiochemistry Division, BARC was formed with Prof. B.M. Shukla as its first

President. Dr. Ramaniah along with Prof. H.J. Arnikar of Pune University and Prof. M.N. Sastry of Andhra University steered the activities of the IANCAS in subsequent years very deftly. Today, IANCAS has grown in many ways and is pursuing the objectives defined by its founders by publishing monographs and newsletters as IANCAS Bulletins regularly in the areas relevant to Nuclear & Radiochemistry, Applications of Radioisotopes and Allied Sciences. IANCAS National Workshops are being held in different Universities as well as academic and research institutions all over the country regularly. Both activities (IANCAS Bulletin and National Workshops) are being supported by BRNS, DAE. Several awards are bestowed every year on young and senior Nuclear and Radiochemists by IANCAS, which includes the prestigious Dr. M.V. Ramaniah Memorial Award for Life-time Achievement of an Outstanding Radiochemist.

After his superannuation in May, 1987, Dr. Ramaniah decided to carry forward his vast experience of IANCAS to set up a broader platform to promote all facets of nuclear sciences, engineering and technology in industry and academia. It may sound unbelievable but he literally knocked all possible doors in his mission to enrol members for this new society for two years. It was a tribute to his vision and sustained efforts that Indian Nuclear Society (INS) was inaugurated on January 19, 1988 by Shri J.R.D. Tata with Dr. Ramaniah as the founder Chairman. Today, INS has more than 5000 members and is actively pursuing the objectives of close interaction of professionals in nuclear industry with academicians and general public to disseminate information on safe use of nuclear energy for societal benefits.

This Special Bulletin on the life and scientific journey of Dr. Ramaniah contains 20 reminiscence articles by his associates and colleagues, two articles reprinted from INSA (Biography by Dr SS Kapoor) and from IANCAS Special Bulletin (on his completion of 60 years, Preface by late Dr. H. C. Jain) as well as a Photo Gallery (both professional and personal journeys). We would like to thank each and every contributor for sharing their reminiscences about Dr. Ramaniah for this special bulletin, mostly based on their own experiences. Special thanks to Dr. Lavanya Ramaniah for allowing us to peep into very rare side of Dr. Ramaniah as a parent and also sharing many photos printed in photo gallery. One name we all sorely miss is Dr. R. J. Singh (unfortunately, he breathed his last on May 14, 2024), who was one of the most trusted colleagues of Dr. Ramaniah throughout. We would like to thank Director, KMG, Head, SIRD, BARC and Archive Section of SIRD, BARC for making available some official photographs. Special thanks to Dr. Seraj A. Ansari, RCD for his help. Thanks to EC of IANCAS and BRNS, DAE for supporting the publication of this special issue of IANCAS Bulletin. We sincerely thank Dr. A. K. Mohanty, Chairman, AEC and Shri Vivek Bhasin, Director, BARC for their support and patronage.

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Disclaimer : Reminiscences of contributors are their own views. IANCAS / Editors cannot authenticate the contents of their articles in this special bulletin.

Contents

Dr. Anil Kakodkar

Chancellor, Homi Bhabha National Institute
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*Received Padma Vibhushan in 2009

Immediately after passing out of training school, I heard about Dr. M.V. Ramaniah as an accomplished nuclear chemist/radiochemist leading a large group of scientists working in mysterious radiological laboratories which had no windows. Some of my chemistry colleagues from training school had joined various programs at the radiological laboratories. This was a new and unique research infrastructure for nuclear, chemistry and metallurgical research involving radioactive materials. In a sense this provided an opportunity for kind of experimental research, no other laboratory in India could provide. These laboratories required special facilities and infrastructure. Building such facilities at the time they were built must have been a big challenge. In addition, all precautions to protect laboratory workers from radiation dose and the laboratory itself from spread of radioactive contamination, was necessary. As it is, any laboratory must nurture an ambience that sustains curiosity to explore new knowledge frontiers but at the same time enforce discipline that ensures that everything is done in a safe manner. Working with radioactive materials is significantly more challenging but that also opens a much wider research domain as compared to what would be the case when restricted to only stable nonradioactive isotopes. Dr. Ramaniah as a scientific leader not only provided leadership in creating such unique facilities and led the research programmes there, but also nurtured research ambience to benefit from expanded opportunity and at the same time inculcate the discipline necessary to ensure safety. I often used to hear from my batch mates about Dr. Ramaniah's leadership and the efforts he has been taking in nurturing a vibrant, disciplined, and responsible nuclear/radiochemistry research culture well integrated into DAE's mission programmes.

About 20 years later in mid-eighties, when I was included in a committee under his chairmanship to work out the details of India's 10,000 MWe nuclear power program, I had the opportunity to work more closely with Dr. Ramaniah. I learnt several things during this exercise. I got to know various challenges and opportunities across various dimensions of our atomic energy programme. More importantly, working very closely with Dr. Ramaniah was an important learning experience for me. This was the first time we were talking about such high ambition in DAE despite several visible constraints. Uranium resource was one such factor. I witnessed Dr. Ramaniah overseeing the fierce debates reconciling resource identification by AMD and acceptance of viable production potential by UCIL. Culmination of this discussion was the basis for 10,000 MWe PHWR programme that could be supported based on uranium available on Indian land mass as of that time and that would constitute the first stage of India's three stage nuclear power programme. While the ambitious time line of realizing this goal by the year 2000 did attract much skepticism and criticism despite the global slowdown caused by the Chernobyl accident and non-availability of Govt. budgetary resources, the committee report did trigger concrete actions to design and develop the larger capacity 540 MWe PHWR. Also, the discussion around uranium in the committee at that time, did prepare me well to deal with uranium shortages in early 2000 when the reactor programme started doing well and prevent NPCIL from sliding into red despite severe uranium supply constraints. Looking at the global existential challenge arising from climate change threat that we are

currently facing, and the inevitably crucial role of nuclear energy in meeting net zero emission target dates while also meeting energy needs of a 'developed India', it is now clear that Dr. Ramaniah's enthusiasm was well justified.

Report writing exercise with Dr. Ramaniah was also an experience. There seemed to be literally no limit to number of drafts he would go through before finalizing a text. For a person like me who has repulsion of reading one's own writing more than once, this was a patience game that I had to learn and that did benefit me.But it was setting up of Indian Nuclear Society (INS) that really brought me very close to him. Being a very active scientist himself, Dr. Ramaniah was well aware of the role professional societies play in nurturing broad based interactions among the scientific community interested in a particular discipline. He had been closely involved in societies like IANCAS right since the beginning. Having done the exercise on India's nuclear programme, Dr. Ramaniah took up the cause of INS, an idea that was in the minds of many but was not taking off, with great determination. I have experienced very closely his passion and perseverance in chasing the membership drive literally singlehandedly. He would repeatedly remind potential corporate and life members to apply and pay the fee. How so ever I would tell him about the embarrassment he was subjecting himself to, but he was clear; he used to say that I would keep chasing till I get an explicit 'no'. That was his commitment to the cause. He did succeed in setting up INS on a very stable and financially sound foundation. I was closely associated with him all through the formation of INS and worked as its Secretary under his Presidentship.

Talking about IANCAS, among its several activities, I must mention about their sustained engagement with universities in terms of strengthening their laboratories with nuclear instruments and experimental culture as well as awareness about societal applications of atomic energy.

Dr. Ramaniah has left behind a legacy that will keep contributing in the domains of nuclear chemistry and radiochemistry expanding their boundaries that receives global attention and would become a matter of increasing importance in our Atomic Energy Programme going forward.

My pranam to his revered memory.

Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with Mr. S. K. Sharma, Dr. Anil Kakodkar, Dr. V. K. Iya, Mr. A. N. Prasad, Mr. P. R. Roy, Mr. P. R. Dastidar, Mr. Sadhukhan and Dr. D. D. Sood.
Photo courtesy Dr. M. Lavanya

Shri R. K. Garg

Former Director, Chemical Engineering group, BARC
Former Chairman and Managing Director of Indian Rare Earths Ltd, Mumbai

I got acquainted with Dr. Ramaniah as early as 1957-1958 when both of us were working at South Site of the Trombay Establishment. All R & D activities were confined to the south site at that time. Only CIRUS civil work had started at the North Site. Of course we did not have any professional interaction since we were engaged in different type of activities. During chance meetings in canteen etc. we would exchange greetings. After shifting to the north site in the mid-sixties and with growth of BARC, we used to have interaction mostly during meetings.

Our close interaction was during 1977-1978 when IAEA organized the International Nuclear Fuel Cycle Evaluation (INFCE) study. In meetings with Director, BARC, we together finalized about our participation in that study and the strategy to be adopted by us. We had active participation in two of the eight working groups. Our participation contributed to the finding that spent fuel reprocessing was needed, especially for countries having low uranium resources.

In 1983-1984 our division was engaged in a strategic R & D project wherein we needed isotopic analysis of samples by mass spectroscopy. I approached Dr. Ramaniah whether he could help us in getting the analysis done in his laboratory. He readily agreed, called the concerned scientist and gave instructions to carry out the analysis on priority, as soon as the samples were received. This greatly helped in accelerating the work on the project.

In my interaction with him, I found him to be a competent scientist fully devoted to the task undertaken by him, very cooperative and a person of quiet nature. He also played a very active role at the launch of the Indian Nuclear Society (INS). I recall that he came to my office in IRE, on Queens Road in 1987-1988 to enlist me as a member.

I have great pleasure in contributing this brief write-up for the compilation being brought out by his colleagues who worked with him.

Dr. M. V. Ramaniah at a meeting with Dr. Raja Ramanna, Shri. R.K.Garg,
Shri. A. N. Prasad and others, Central Complex, BARC. Photo courtesy Dr. M. Lavanya

Shri S. K. Mehta
Former Director, Reactor Group, BARC

I feel privileged and honored to be invited to contribute in the compilation on the life and work of Dr. M. V. Ramaniah as a mark of respect and gratitude for his valuable contributions to our nuclear programme in general and Radiochemistry Program in particular. Though I had a limited professional interaction with him, my association with him had been technically very rewarding. Dr. Ramaniah was instrumental in setting up of various state of the art technical facilities for handling and investigating both theoretical and applied aspects of radiochemistry discipline, including basic nuclear physical properties of radionuclides; chemistry of radioactive elements and their compounds; the occurrence and behavior of natural and artificial radionuclides in the environment; nuclear fuel cycle; fuel development, radioanalytical methods; production and isolation of radionuclides and new applications of radioactive tracers. India has abundance of Thorium-232. It need to be converted to Uranium-233 to be used as fissile material. Under the guidance of Dr. Ramaniah in this context, the role of Molten Salt Reactors in the Indian Nuclear Power programme was studied in RCD. Dr. D. D. Sood was deputed to USA for this purpose. The Radiochemistry laboratory set-up under the guidance of Dr. Ramaniah was of international standing. Quite often I had the privilege of hosting visits of eminent scientists / visitors particularly from developed countries to BARC. Visit to Radiochemistry laboratory was always an important part. The scientific work being carried out and interaction with researchers in particular with Dr. Ramaniah always made an excellent impression and appreciation of quality of work and R & D activities being carried out.

FBTR was proposed to be set up in collaboration with France. Subsequent to PNE, this international collaboration was interrupted. Following that an alternative design and supply of the reactor fuel for the core had to be provided. DAE decided to use Pu enriched fuel. That needed considerable basic studies and developments. This technical support was provided by Radiochemistry group under the guidance of Dr. Ramaniah. Based on these inputs, the fuel fabrication of mixed carbide for FBTR and mixed oxide for PFBR were undertaken by Radiometallurgy Division. Subsequently, A3F was set up at Tarapur under the leadership of Dr. Ramaniah. Dr Ramaniah and his group participated in the assessment of post irradiated fuel at various burn up stages to arrive at the optimum fuel performance rating with safety margins. The Pu enriched carbide fuel has performed extremely well over four decades in FBTR. Dr Ramaniah played a key role in the nuclear safety assessment.

In Geneva during March-April 1987, there was a UN Conference for Promotion of International Cooperation in Peaceful Uses of Nuclear Energy (UNCPICPUNE). India participated in the conference. The DAE delegation was headed by Chairman, AEC, Dr. M. R. Srinivasan. Dr. Ramaniah, myself and others were part of the delegation. The deliberations of the conference was for two weeks and held in two parallel sessions, one was pertaining to the promotion of technical cooperation aspects. For that the Indian delegation was headed by Dr. Srinivasan during the first week and by Dr. Ramaniah during the second week. He also led the delegation during the concluding session. The other session wherein I participated and headed, was to update the Member States about the latest technical developments in the Nuclear Energy. At the end of each day of conference, the Indian team used to meet. The Indian Ambassador in Vienna also joined at times. Our main approach was that to Promote International Cooperation the developed countries, who also are mostly suppliers of Nuclear Power Plants and allied technologies, should support by sharing basic knowledge and training of manpower. Also developments pertaining to nuclear safety should be shared from time to time. During the final session of the

Conference Dr. Ramaniah very strongly presented our views which were appreciated by other developing countries. Dr. Ramaniah was also appreciative of the views that "Non-proliferation should not over-shadow the development of Nuclear Energy" in the developing countries. He also shared views of some of us that instead of imposition of full-scale safeguards, IAEA safe-guards to nuclear equipment and supplies should be considered. Further, the development of local infrastructure should be encouraged. Also there should be considerations for financing of the Nuclear energy and its applications and consideration for nuclear waste management.

On the administrative side, Dr. Ramaniah was very particular about the detailed deliberations on any subject without time constraints. He was particular about the drafting of minutes of the meetings particularly that of the technical inputs. This was being done during the period when computer based facilities were not readily available and it involved considerable efforts of redrafting and of course retyping. I had a chance to travel with him to Vienna for participation in our respective meetings. He will be using the travel time either preparing for the meeting, drafting of report (of the meeting attended) for briefing the authorities back home (a discipline he followed strictly) if not relaxing. At one stage, I understand that he suffered headaches and had to consume crocin tablets frequently. For this he was buying the tablets in bulk. Someone encouraged him to follow "Yoga". It seems to have worked wonders for him; so much so that he became a keen promoter of Yoga to his colleagues, friends and even the associates with whom he used to interact at the IAEA meetings. Dr. Ramaniah, on the suggestion of Dr. H. N. Sethna, worked in a dedicated manner for the formation of Indian Nuclear Society and was its founder President. The constitution, rules and the basic foundation laid down by him for the functioning of the Society has gone a long way in establishing the Society to the international status. I wish to express my humble gratitude to his contributions in the Nuclear Science and Technology and manpower development that led to number of experts in the specialized field of Radiochemistry. I cherish my association with him and pay my sincere homage to him.

Dr. H. N. Sethna introducing the scientists. Seen in the picture are Mr. P. K.Bhatnagar, Mr. S. K. Mehta, Mr. M. S. Ramani and Dr. M. V. Ramaniah.
Photo courtesy BARC Archives.

Dr. S.S. Kapoor

Former Director Physics and Electronics & Instrumentation Groups, BARC
Ex-DAE Homi Bhabha Chair Professor, BARC

I am happy that IANCAS is bringing out a compilation on the life and work of Dr. M. V. Ramaniah as a mark of gratitude and respect for his valuable contributions to the program of Radiochemistry in our department of Atomic Energy and in the country. I write this brief note as a mark of my respect for him as a person and for his valuable contributions to the field of nuclear science and technology. Dr. Ramaniah had worked for several years in the United States of America before he chose to return to India in 1957 in order to join the Atomic Energy Establishment at Trombay. When he was in USA this was a very exciting period for nuclear science and USA was quite the best place for pursuing research in this field. He had worked in USA in some of the most reputed research centres. For his doctorate degree he had worked with Professor Arthur Wahl, one of the co-discoverers of plutonium. As a part of his Ph.D. he investigated fission fragment mass distribution in the 9.5 MeV deuteron induced fission of Th-232. On returning to work in Trombay he continued to pursue his interest in the field of fission research and established a renowned nuclear chemistry group pursuing research in the area of fission process with radiochemical techniques. In the following years, Dr. Ramaniah's initial activity at Trombay centered around neutron induced fission of actinides using radiochemical techniques. Around 1965 when he became the head of the Radiochemistry Division he led basic and applied research in almost all frontier areas of nuclear and radiochemistry.

I joined in 1959 the fission physics section of the Nuclear Physics Division led by Dr. Raja Ramanna after passing out from the AEET training school. We were pursuing basic research in the nuclear fission process using physical techniques, and were investigating emission of prompt neutrons and gamma rays in the thermal neutron induced fission of U-235 at the APSARA reactor. The research team of Dr. Ramaniah was carrying out radiochemical studies to investigate fission fragment mass and charge distribution in the neutron induced fission of U-235 and other actinides. The research programs in nuclear fission pursued by his team with radiochemical technique were aimed to bring out a better understanding of the role of nuclear shell effects and of nuclear dynamics from saddle to scission in determining the mass and charge distribution in the fission process. Study of nuclear fission was a common link between us. Although I was much junior to him, he always encouraged me to meet him and his coworkers and discuss the latest developments in nuclear fission research.

On becoming the Director of the Radiological group at the BARC Trombay in 1979, he took up varied and challenging responsibilities in particular in the development of plutonium bearing nuclear fuels. It is difficult for me to recollect all his vast and important contributions to the development relating to nuclear fuels particularly those involving plutonium. As I recall, he was very active in the field of safety aspects of nuclear fuel cycle and had several responsibilities and assignments related to this. He also served as India's representative to the International Atomic Energy Agency (IAEA) on several assignments throughout his career. In recognition of his outstanding research and development work in nuclear and radiochemistry he was elected in 1980 a Fellow of the Indian National Science Academy, INSA.

In conclusion, I pay my respect to Dr. Ramaniah for his valuable contributions to the field of nuclear and radiochemistry, and for the encouragement and support I received from him during the period of my research work at Trombay.

Shri Johnson K. Samuel

Former Head Electronics Group, Radiochemistry Division, BARC

Radiochemistry Laboratories in the South Site of BARC (then AEET) located in a beautiful stretch of land between Trombay hills and the Arabian Sea was the only one of its kind in the nation exclusively designed to handle radioactive materials for research work in nuclear chemistry. The laboratory was a show piece for all visiting dignitaries. It was a comfortably air conditioned lab, rigorously maintained spotlessly clean. Dr. Ramaniah joined the Division as a nuclear chemist with high academic credentials from the University of Chicago, USA and I was posted in the Division with some interest in Electronic Instrumentation *(and very little knowledge in nuclear chemistry)* after completing one year as a second batch trainee in the BARC Training School in August 1959. I had the privilege of working under his supervision for many years from the day I joined until he moved out of his office in the RLG building on new, multiple assignments.

The Electronic Instrumentation & Maintenance group in my charge consisted of just 3 members to begin with and was assigned the job of maintaining the electronic instruments in the lab and to assist in meeting the instrumentation needs of the research workers. *(The staff strength grew at one stage to 12 members later in the new lab in North Site)*. Although we had only a supporting role to play, Dr. Ramaniah was able to instill in us a sense of importance of our work as indispensable for the research activities of Radiochemistry Division. The center of our activities was the "Counting Room" in the inactive area of the lab where radioactive samples were assayed. The "Counting Room" which featured an imposing 100 channel analyzer - 100 'dekatron tubes' with neon lights revolving at different speeds as visual display of a gamma ray spectrum - was also a tourist attraction! We were able to add more counting systems by fabricating some parts in our own workshop and by buying from outside sources.

As we moved to the spacious Radiological Laboratories in North Site, sophisticated equipments like Mass Spectrometers, Spectrophotometers, Diffractometers, Multichannel (4K channels) Analyzers, Emission and absorption Spectrometers, Electrochemical and Gas Chromatographic equipments, Elemental Analyzers, EPR, Infrared, Thermogravimetric Instruments etc. started arriving to supplement the activities of various sections of the Division and our work load increased tremendously. As these equipments were mostly imported from foreign countries, we had to learn the operation of each instrument, identify critical parts, procure and stock them so that the down time of each instrument was kept to the minimum. Each member of our group was assigned the job of studying the operation of a specific instrument and keeps it under his personal care so that the right person could be assigned to look into the problem as and when it arose. The procurement of spares had to be done very judiciously as there were severe restrictions with regard to expenditure in foreign exchange. Dr. Ramaniah managed to sanction additional staff for us under different project accounts even when there was a general cap on fresh recruitments.

Even though Dr. Ramaniah was a strict disciplinarian and a hard taskmaster, we had a very cordial and friendly relationship. He gave us complete freedom in carrying out our day to day activities. Funds were allotted liberally in the Divisional budget for stocking enough spare parts to keep all instruments running and for buying

new equipment needed for the lab. He showed his support for instrumentation needs by sending me on deputation for a year to AERE Harwell and Rutherford Laboratories in UK to work with their instrumentation groups and to acquaint myself with the state-of-the-art equipment in nuclear research. He also gave me the privilege to visit Electronic Corporation of India (ECIL), Hyderabad and discuss our requirements of nuclear instruments as ECIL was making efforts to develop and manufacture them indigenously. He extended all encouragement and support to develop new instruments on our own and showed his happiness and appreciation when such a job was done and put into practical use.

Dr. Ramaniah's far sighted and instrumentation oriented approach gave us immense support and freedom. Looking back, I consider it my honour and privilege to have such a great, forward looking leader in over-all charge. In spite of his ***tension-filled*** administrative position of running the Division and handling various other responsibilities, he generously granted me a ***tension-free*** working environment. I believe that is one of the reasons for my good health and a happy life even after retirement. I certainly enjoyed being an integral part of Radiochemistry Division under his leadership.

Shri J. K. Samuel in conversation with Dr. M. V. Ramaniah, May, 1987.
Photo Courtesy Dr. M. Lavanya.

Shri A. K. Anand

Former Director, Technical Coordination & International Relations Group, BARC
Former Director, Reactor Projects Group, BARC

For the first few years of our service in BARC, we mostly interact with our colleagues in the division for our work; though we do know about the organization set up of BARC within various groups, divisions and a few sections as well. Interaction with the colleagues from other divisions starts either due to some multi-disciplinary problem or if we reside in any DAE residential building. I started knowing Dr. Ramaniah, though indirectly, in 1969, when I shifted to Kenilworth after my marriage. He was a very senior Nuclear Chemist.If my memory is correct he was the head of the Radiochemistry Division.

As usual all the men folks used to take BARC transport and go to office and return late in the evening; the ladies had more interaction. Very soon Mrs. Ramaniah and my wife became friends; she started addressing my wife with her first name Meera. Mrs. Ramaniah was a very talented person and used to perform on stage, the Indian music and classical dance. I rarely met Dr. Ramaniah in some social gathering like flag hoisting or some children's sports event in the building.

A few years later, Ramaniahs shifted to their house in Saras Baug in Deonar but occasional interaction of Mrs. Ramaniah with other Kenilworth ladies along with my wife continued in some DAE/BARC/social functions. In 1980 we also moved to our own house in Vikram Jyoti, a walking distance from Saras Baug . Henceforth their interaction and socializing increased. Ramaniahs have a daughter Lavanya who has recently retired from BARC. Though I met Dr. Ramaniah in BARC some times during some functions/celebrations; Mrs. Ramaniah, at times with Lavanya, and my wife had their own occasional socializing, visiting each other's house and also some neighbors in Saras Baug and Vikram Jyoti, all of them being a part of the large DAE family.

My first real interaction with Dr. Ramaniah happened in 1988 when INS (Indian Nuclear Society) was launched in TIFR, the Chairman AEC was Dr. M.R. Srinivasan, chief guest was Dr. J.R.D. Tata and the first President of INS was Dr. Ramaniah. He visited us in Hall Number 7, a few days after the inaugural function and made us all, the members of INS.

Even after Dr. Ramaniah's death, Mrs. Ramaniah and Lavanya continued their friendship with my wife till my wife passed away. I did meet Mrs. Ramaniah in Saras Baug sometimes, during social functions. She expired a few years ago and I attended the 'condolence meet'. At times, Lavanya is still in touch mostly on the phone.

Shri D. S. C. Purushottam

Former Director Nuclear Fuels Group, BARC

An important project codenamed PEP, short for PRE EXPANSION PROJECT, was created in BARC by the DAE in 1978 with Dr. Ramaniah as the Director and Shri P.R. Roy, Head, Radiometallurgy Division as the Head of the project.

The Objective was to create a Facility for the production of an alternate fuel- MOX or Mixed oxide of Uranium and Plutonium, an indigenous substitute for the enriched Uranium oxide fuel supplied by the USA for the Boiling Water Reactors at Tarapur. At that time, there was likelihood of stoppage of supplies of fuel from the US as the sole supplier under bilateral safeguards agreement. This would have led to stopping of operation of the first Nuclear Power Reactors in the country. This was quite a challenging task to ensure the continued operation of the Reactors as the time available was rather short. It was necessary to develop not only the flow sheet but implement it for the production of MOX fuel expediously. Plutonium was to be sourced by the reprocessing of the TAPS spent fuel.

Dr. Ramaniah knew the nuances of the Safeguards agreements and could decide on the concerned policy matters. Using his international contacts, he facilitated visits to a couple of MOX facilities abroad with Shri Roy and discussions with scientists there. An understanding of process equipment for MOX fuel fabrication and potential suppliers of some critical items was very useful. However one had to navigate around the restrictive Nuclear Suppliers Group and his insights were important.

A decision was taken to do the project in 2 stages: Deeone would be set up with limited capacity, using available inventory of Enriched Uranium (available at NFC) and MOX to be fabricated at a facility to be set up at RMD. Special procedures were devised to expeditiously obtain glove boxes and equipments. Additional manpower was sought and recruited. Training programmes were arranged for the new staff to reduce the time needed to qualify and induct them in the chosen fields. This was also true for the Radiochemistry lab. In a scrambling mode, work was started. Dr. Ramaniah monitored the progress of Deeone regularly. He had practically no holidays. Once the facility was ready, a demonstration was undertaken to prove the line capacity using only Uranium oxide and the results analyzed. Dr. Ramaniah sat through the presentation and expressed his satisfaction and there was gain in confidence of achieving goal.

Simultaneously, work was initiated on Deetwo. This was a major job: construction of a building housing full-fledged MOX facility, integrating Radiometallurgy operations, Radiochemistry work, and scrap recovery operations, involving work of several divisions. The building civil, electrical, air-conditioning and ventilation works involved detailed design and execution by specialist groups. Block estimates were to be made and got approved. These groups were reluctant to prepare estimates prior to detailed design. Dr. Ramaniah had to persuade them to expedite this job and succeeded in obtaining preliminary block estimates. He succeeded in getting funds to start the work programmes without a detailed Project Report. This was very important at that point of time. The coordination of several Divisions was ensured as he personally attended many meetings. Some of these would start late in the evenings when he would be free from other schedules. It was normal to see

canteen providing snacks and tea at his meetings around 9 pm. Due to his deep commitment, he could motivate all involved persons to put in extra efforts.

Procurement of special equipments to be imported from limited suppliers abroad, needed special procedures including airlifting and in knocked-down condition. These were identified and permissions obtained. Some local fabricators needed persuasion to undertake jobs much against their commercial interests. A case in point is persuading the special gases division of M/S IOL to provide for trailerised supply of inert gas-hydrogen mixtures, an essential process requirement.

While all these efforts were in progress, diplomatic efforts were on to ensure the continued supply of Enriched Uranium oxide from the USA, as per contractual obligations. Efforts were successful in the location of an alternate supplier by early 1982. By then, as planned, the Assembly building was ready at Tarapur, along with some ancillary buildings. Detailed design of the MOX facility was ready and proper estimates were available and the process of obtaining financial sanction was in progress. The detailed estimate was more than the block estimates. This was justified appropriately by Dr. Ramaniah.

Dr. Raja Ramanna had returned to the DAE and some managerial changes were made in BARC. Mr. P R Roy was made in-charge of the project. There was a discussion of continuing with the construction work, as fuel supply for TAPS Reactors had resumed. Dr. Ramaniah supported continuation since a new facility would be available to undertake plutonium based fuel fabrication work, in future with PFBR programme at Kalpakkam. This helped in decision making and the work continued.

The personal qualities of Dr. Ramaniah were mainly instrumental for achieving the goals set. The dynamism, commitment, enthusiasm and determination were all the hallmarks of a great scientist and leader.

Prof. V. S. Ramamurthy
Former Secretary, Department of Science and Technology,
Government of India, New Delhi
Former Director, National Institute of Advanced Studies, Bengaluru

It was nearly sixty years ago that I came to know Dr. M. V. Ramaniah. He was then the Head of the Radiochemistry Division and I was a new member of the Nuclear Physics Division. For all our requirements of actinide targets, we were dependent on help from RCD.

My first meeting with Dr. Ramaniah was indeed very formal. I did not know then that Dr. Ramaniah had already made several important contributions in the area of nuclear fission, working with some of the pioneers including Therald Moellar at University of Illinois at Urbana-Champaign and Prof. A C Wahl a close colleague of Nobel Laureate GlennT Seaborg from University of California in Berkeley. Once he came to know that I was also interested in the same area of nuclear physics, he opened up and we had long scientific discussions on the subject. With Dr. Satya Prakash, my batch mate from the Training School and Dr. Manohar, couple of years junior to us, in the Radiochemistry division investigating fission process using radiochemical techniques, our interactions with RCD and Dr. Ramaniah grew stronger and we had no problem in getting any help from the Radiochemistry Division.

I had an opportunity to come to know Dr. Ramaniah a lot closer when both of us attended the 2nd IAEA Symposium on the Physics and Chemistry of Fission in Vienna in 1969. That being my first experience in an international meeting, I learnt a lot from him, both inside and outside the lecture hall.

I made an oral presentation of our work on fission mass distributions. The presentation was a disaster, I overshot the allotted time, I spoke so fast that the audience had a difficulty in following, the official translators actually gave up half way through. Dr. Ramaniah had a long discussion with me on this afterwards. With several years of experience in the western world, Dr. Ramaniah had a number of tips to offer to a debutant like me. Two of his advices stand out:

1. Never exceed 100 words per minute while making a presentation, particularly when you are addressing western audience
2. Never exceed one projection per minute, leaving enough time for the audience to absorb what you are trying to convey.

I have strictly followed the above advice by Dr. Ramaniah during my entire career.

I also learnt many things from him outside the lecture hall. Those were the days when life for a vegetarian, that too a teetotaler, was indeed tough in any of the western cities. I learnt from Dr. Ramaniah many survival techniques, restaurants where one gets genuine vegetarian stuff, free drinking water etc.

Dr. Ramaniah's foresight and leadership qualities in initiating several research programs, nurturing next generation leadership, creating facilities and creating Institutions are well known. Dr. Ramaniah remained one of my well-wishers throughout my career. My memories of Dr. Ramaniah are warm and will remain so forever.

Prof. Satya Prakash

Former Head, Nuclear Chemistry Section, Radiochemistry Division, BARC
Former Professor, Dayalbagh Educational Institute, Agra

The story of my association with Dr. Mangipudi Venkata Ramaniah began at the end of my stint at the Department of Atomic Energy's (DAE) Training School located at Cadell Road, Bombay in July 1964. All those who passed the training school with aggregate marks greater than 60% were interviewed by Dr. Ganguly who was then the Head of Health Physics Group at Bhabha Atomic Research Centre (then the Atomic Energy Establishment, AEET Trombay, Bombay) and was in-charge of the Training School for placement of trainees to different units of DAE and BARC.

When I met Dr. Ganguly, he asked me about which unit / division do I wish to work for? At that time, I knew only about the Chemistry Division and so I immediately opted for it. He looked at me with a smile and responded with an instant NO. He said you go to Radiochemistry Division at AEET. On 1st August, 1964, I reported to the Administrative Officer of the Division. Some four or five of us were sent to Radiochemistry Division which then had Dr. A.S. Ghosh Majumdar as it's Officiating Head. The previous Head Dr. H.D. Sharma had moved to the US. Here too we had a choice to make. We were told that Radiochemistry Division had two labs. One called Alpha lab dealing with alpha emitters radioactive work and the other lab was the Beta lab where work with beta emitters was being done. I opted for Alpha lab to which Dr. Ghosh disagreed. He opined that I should go to the Beta Lab. At that time Dr. M.V. Ramaniah was the head of Beta lab. How some things are destined and my destiny made me meet my mentor who in many ways shaped my working career and was responsible directly or indirectly in everything that I achieved at BARC in my 27 years of association. I had to wait for a year to meet him as he was away in Brazil as an IAEA (International Atomic Energy Agency) expert and so I reported to Dr. C.L. Rao who was then his deputy. Upon his return from Brazil, my real association with Dr. Ramaniah started.

I was asked to undergo training under Dr. R.S. Iyer for about 6 months to learn to handle radioactivity and its measurements. With him I worked on study of some isomer ratio and had my first research paper published in 1967. Later Dr. C.L. Rao asked me to look for some good research problem. After some search of literature, I opted for 'Recoil Ranges of Fission Products in Thorium metal and from that to obtain the kinetic energy distribution of fission products'.

In 1966, Dr. S.B. Manohar joined the Radiochemistry Division and was asked to join me and thus a future case of having a separate section for Nuclear Chemistry germinated. Both of us worked together most harmoniously for next 25 years. Hats off to Dr. Manohar for his camaraderie. Never ever there was any insubordination of any sort. His support and contribution to Nuclear Chemistry Section is very special. Our joint research work continued for 4 to 5 years. Our first paper titled Kinetic Energy Distribution in the Thermal Neutron Fission of ^{233}U and ^{239}Pu was published in the Journal of Inorganic & Nuclear Chemistry (JINC).

Dr. M.V. Ramaniah belonged to East Godavari District of Andhra Pradesh. About his personality I submit that he was an extremely honest, sincere and committed person. He would not tolerate lack of sincerity at work by anybody working under him. Given his own high personal moral standards, whenever he used to see any

slackness in work, he would come down heavily on them. It was the fear of his getting annoyed that kept many of us on our toes but then we acknowledge that it contributed in taking the best out of everyone in his team.

Dr. Ramaniah's Ph.D. guide was Prof. A.C. Wahl a close colleague of Nobel Laureate Glen T Seaborg from University of California. He worked on 'mass distribution in fission of several actinides.' After his return to India, he was selected to head the Radiochemistry Division of AEET. He had formed the Nuclear Chemistry Section of which he remained as Section Head; however most of the research and day to day work was looked after by me on his behalf. Subsequently when the Nuclear Chemistry Section was recognized officially by Bhabha Atomic Research Centre authorities, he in his true leadership spirit named me as the Section Head, a post which I held till I took voluntary retirement in June 1991 to join as Professor of Chemistry at Dayalbagh Educational Institute (Deemed to be University), Dayalbagh, Agra.

In years after 1975 many young scientists joined my group every year in the month of August after completing their Training School. Few young scientists would join Radiochemistry Division and Dr. Ramaniah used to very kindly allocate one or two of them especially the bright ones to our section. Eventually the group became quite large and probably later the largest in BARC. Several of my colleagues got our Ph.D. under him. I was lucky to be his first PhD student and Prof. A.C. Wahl was my foreign examiner. Dr. Ramaniah being happy with my work got me recognized as a Ph.D. guide at the Bombay University. Some of my young colleagues did their Ph.D. under me.

So much was his affection for me that many used to wonder why it was so. He would ensure I got my promotions every 3 years (the earliest one could have been recommended for promotion to next grade). Gradually I reached the Scientific Officer-G grade from which I took voluntary retirement in 1991.

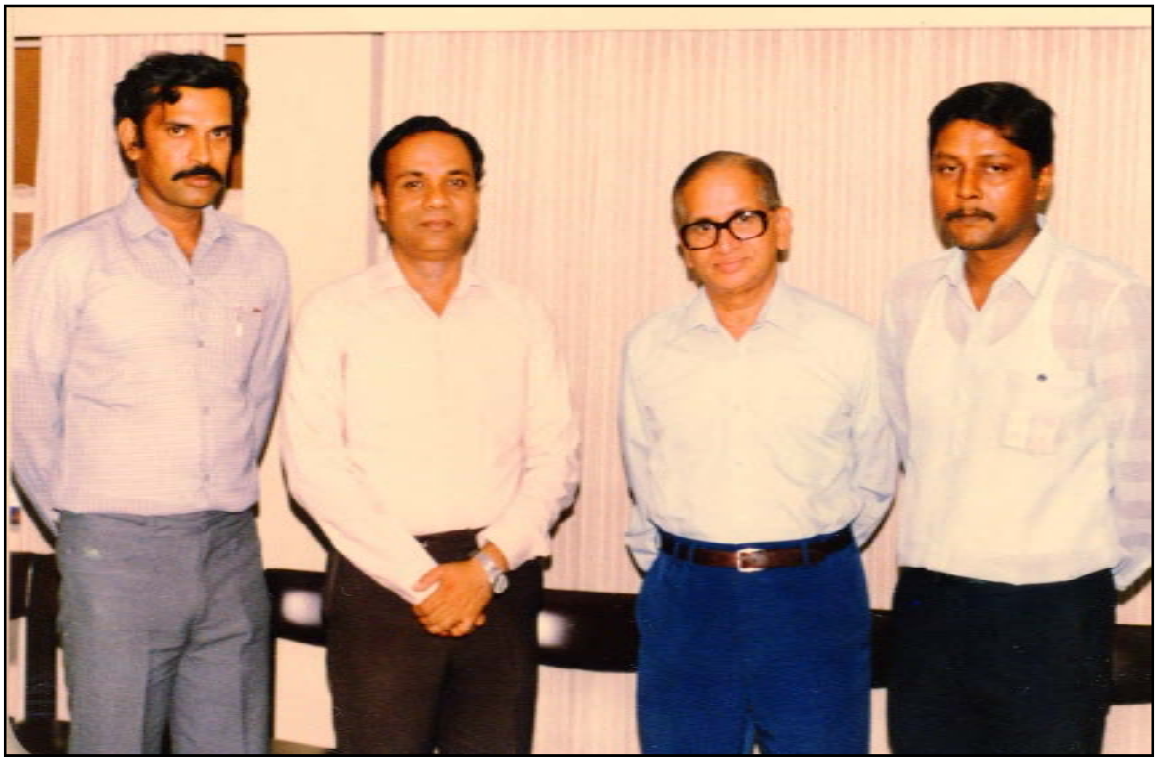
One of the major contributions of Dr. M.V. Ramaniah was of setting up the Variable Energy Cyclotron (VEC) Nuclear Chemistry lab at Calcutta. He ensured that the Nuclear Chemistry Section got two large Laboratories and also 3 or 4 scientific officers to be stationed permanently at VEC from BARC. Several of us would go 3 to 4 times a year to conduct our research work using Alpha particle beam that was available with good flux. When a pelletron facility came up at Tata Institute of Fundamental Research in Bombay he got one lab for nuclear chemistry section there too.

Scientific contributions of Dr. Ramaniah have been highlighted in the main text at several places. His early PhD work in USA was on fission of several actinides. Later on at BARC he was associated with all the research work of Nuclear Chemistry Group. He also encouraged to start new lines of research which resulted in our studies on Perturbed Angular Correlation, Positron Annihilation and development of several non-destructive assay techniques such as neutron well coincidence counter, fuel pin scanner, assay of fissile contents of spent fuel rods etc. Subsequent to the Pokhran experiment our section got work on determination of the yield of the nuclear device tested.

Dr. Ramaniah retired in 1987 and when I decided to quit in 1991 not only he but many others could not understand why I was quitting as I was doing well. But the reason was that I wanted to come back to Dayalbagh, Agra, which is the headquarters of the Radhasoami Faith of which I am a follower and also because I had decided to join as the professor and head of the Department of Chemistry, DEI.

I present an episode which characterizes Dr. Ramaniah's affection for me. Sometime in 1992 we went to Bombay and my wife and I went to meet him at his house. He excused himself for a short-while then happily walked back from his kitchen with a tray in his hand with Poha & Coffee that he had made himself for us. What made this kind gesture soulfully touching for me were his kind words: "*Dr. Satya Prakash you are the best person and the best scientist, I pray for your bright future*". His kind words happen to be my biggest achievement and award.

I also have to thank Dr. Ramaniah for giving my section some of the brightest minds. Without the valuable contribution of my colleagues like Dr. S.B. Manohar, Dr. A. Goswami, Dr. B.S. Tomar, Dr. P.K. Pujari, Dr. Tarun Datta, Dr. A. Ramaswami, Dr. A.V.R. Reddy and many others our Nuclear Chemistry Group would not have prospered and recognized as one of the best in BARC. Wishing them all the best and I pray for a blessed and happy life for Dr. Ramaniah's only daughter Dr. Lavanya Mahalakshmi.



From Left : Dr. A. V. R. Reddy, Dr. Satya Prakash, Dr. M. V. Ramaniah and Dr. Tarun Dutta
Photo courtesy Dr. M Lavanya

Dr. S. B. Manohar

Former Head, Radiochemistry Division, BARC

When Dr. Homi Bhabha was setting up Indian nuclear program with his broad vision covering all branches of science and engineering he included Radiochemistry as one of the important activities. To setup first radiochemical laboratory he sought support from two UK scientists viz. Dr. G.R. Hall and Dr. G.A. Welch who led the team. Dr. H.D. Sharma who had worked with Prof G.T. Seaborg took over the responsibility of Radiochemical Lab after the departure of foreign scientists. That time Radiochemistry and Isotope were the part of one lab. In 1965 these two labs were separated to form two independent Divisions. The Radiochemistry Division was led by Dr. M.V. Ramaniah and Isotope Division was led by Dr. V.K. Iya. At that time Radiochemistry division was having two radioactive labs, known as Beta Lab and Alpha Lab, and one Lab which included spectroscopy led by Dr. B.D. Joshi and X-ray Lab led by Shri D.M. Chakraborty. Starting from first batch of Training school many trained graduates started joining the Division. Dr. M.V. Ramaniah led the program for more than two decades and enlarged it to make it useful for almost all activities of the DAE starting from mining to reprocessing and waste disposal. First step was setting up radiochemical lab at RLG, similar facility for FBTR program at Kalpakkam. These facilities were useful to Chemical Engineers as well as to Radiometallurgists.

Dr. M.V. Ramaniah was closely associated with research in nuclear fission and nuclear reactions and for that he set up radiochemical labs at VECC Kolkata and subsequently at TIFR . He was mainly responsible of MOX fuel program and had set up a facility at Tarapur. Dr. Ramaniah's vision made him to setup the laboratory with state of art facilities in fields such as, analytical spectroscopy, mass spectroscopy, X-ray spectroscopy, and High temperature facility for fuel chemistry research, an electronics lab to support all these programs. He was also instrumental in setting up of nuclear material accounting cell and development of NDA program to assist it. For the research on trans-plutonium hot cells equipped with master salve manipulators for handling activities up to 10000 curies was set up at RLG as well as at IGCAR. In short whatever these facilities could do over last 67 years would not have been possible without the vision and hard work of Dr. M.V. Ramaniah.

Dr. S. B. Manohar felicitating Dr. M. V. Ramaniah during International Conference RON-BEC 100 held at BARC, February, 1996.
Photo Courtesy Dr. M. Lavanya.

Dr. M. D. Sastry

Former Head, Spectroscopy Section, Radiochemistry Division, BARC

Firstly I would like to thank Dr. P.K. Pujari and other active members for working on bringing out this book and for giving me an opportunity to reminisce my experiences with Dr. M.V. Ramaniah who played an important role in shaping up my scientific growth in BARC which started in 1973. These reminiscences are of a rather distant past being made by a nearly 82 year's old man; please bear with these realities.

I joined Radiochemistry Division of BARC on 3rd March 1973 after getting PhD in Physics at IIT, Kanpur and four year post doctoral experience in Canada and U.K. My research background was on electron paramagnetic resonance (EPR) studies of single crystals with transition metal (3d electrons) and rare earth impurities (4f-electrons) for crystal field and phase transition studies. I also had experience in Mossbauer investigations during my post doctoral work in U.K. I also had reasonable back ground in spectroscopy which I learnt at IIT, Kanpur as I was working in a spectroscopy oriented Physics group. I suppose that this background prompted Dr. M.V. Ramaniah, Head of Radiochemistry Division (RCD) and Dr. B.D. Joshi then Head of the Spectroscopy Section in RCD which was having activities in EPR and other solid state studies, in addition to the main activity of analytical spectroscopy of trans-uranium materials, to take interest in taking me.

To start working in physics/chemistry and spectroscopy of trans uranium elements/materials was definitely a great and exciting experience but not a simple one in spite of all the earlier work I had done. Dr. Ramaniah's vision and wide experience and Dr. Joshi's help made me overcome all the early obstacles.

Dr. Ramaniah was mainly a nuclear chemist with great vision and in-depth knowledge of material science of trans-uranium compounds and as the main leader he had responsibility and ambition to guide the people working in RCD. I, being from non-radiochemical/ nuclear background, was under their his close observation. His primary interest, more precisely the only interest, was research / development of actinide materials particularly of trans-uranium compounds. It is easy to find merits in such people with commitment but quite often difficult to live up to their expectations as they do not tolerate any deviation from their well defined goals. He clearly told me once, during my early stage in RCD, that I should take role in all activities of the Spectroscopy section and the work should be actinide based and the basic research (non-analytical) should also be in that direction. He further told that if it does not suit my interest I may seek transfer to other Divisions like Spectroscopy Division. I told him clearly that I had taken up the job in RCD with clear intentionof expanding my work to newer areas and conveyed that I have no desire for any transfer. Such a clear conversation with him brought a firm commitment in me to work where I have joined and stuck to that until my retirement in 2002 in spite of some other possibilities that came my way.

As my earlier experience in EPR investigation was on 3d based transition metals, and 4f based rare earths and radiation induced defects in solids, orienting myself to 5f electron based actinides was difficult as the signals are observable only close to 20K or lower temperatures and it was an added problem to work on radioactive materials. I brought it to the attention of Dr. Ramaniah as liquid helium facilities were not available. He told me clearly that it is my job to find the ways of circumventing such issues and find ways of working on actinides with existing facilities and open up newer areas. This made me think of ways of combining optical and

radiation induced methods with EPR and I started working on thermoluminescence of actinide doped solids for the first time and also detected EPR of U^{5+}, and also EPR and optical emission of Americium containing materials. Combination of EPR results with thermoluminescence and photo luminescence helped a number of my junior colleagues to complete their PhDs. The spirit and motivation of Dr. Ramaniah not to give up but tune oneself to look for newer avenues was indeed a great advice.

As mentioned earlier atomic emission spectroscopy is one of the vital areas in the assessment of nuclear fuel and other materials. I wish to bring a very interesting event in which Dr. Ramaniah played a very important role, which in my opinion current generation should be aware of. The sum and substance is that we cannot come to final conclusions about the experimental findings on any material unless you know every small step it has taken.

At a personal level I feel that I am extremely lucky to have known such a person who was completely devoted to the development of the place. He will be remembered with gratitude by all those who were his colleagues.

Dr. M. D. Sastry and Shri A. V. Jadhav with Dr. M. V. Ramaniah during a function at Training School Hostel, Mumbai, May, 1987. Photo Courtesy Dr. M. Lavanya.

Prof. A. N. Garg

Former Professor in Radioanalytical Chemistry,
Indian Institute of Technology, Roorkee &
Former Professor Emeritus, Nuclear Science and Technology,
Amity University, Noida

Though I had heard about Dr. M.V. Ramaniah as a Ph.D. scholar at IIT Kanpur, yet I first met him in February 1980 during Radiochemistry and Radiation Chemistry Symposium held at Andhra University, Visakhapatnam which I was attending for the first time as a faculty from Nagpur University. A group discussion followed at the end of Symposium and a proposal of establishing a professional body of nuclear and radiochemists was put up. As a young lad I had also put up my views which, I remember he appreciated very much. Later he enquired about my educational background and place of work. He seemed to be impressed by the kind of work on the Radiochemical separation of Zr and Hf in Lunar rocks, I had carried out during my Postdoctoral cum NASA Co-Investigator assignment at the University of Kentucky, USA. Next Symposium was held at the Banaras Hindu University (BHU), Varanasi and Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) with Prof. B.M. Shukla of BHU as first President was formally launched through relentless efforts of Dr. Ramaniah. Later he succeeded him as President for 1985-87. After superannuation, he still continued as Advisor and used to sit in Central Complex. During this time he started Indian Nuclear Society (INS) and became its Founder President for 1989-90. As I had known him as my well-wisher, I happen to have gone to meet him in his office, where he inducted me as a member of INS. Thus Dr. Ramaniah had the unique distinction of establishing two professional bodies, IANCAS and INS, both of which have bloomed into big organizations serving a large community of nuclear chemists, engineers and allied scientists. This speaks volumes of his organizational capacity besides many academic accomplishments attained during his tenure as Head, Radiochemistry Division and Director, Radiological group where he had established excellent radiochemical laboratory.

Around 1983, I got a BRNS project where I was asked to use facilities at BARC. Thus, I started visiting Radiochemistry Division for carrying out radiochemical and neutron activation analysis (NAA) work. I was specially introduced to him by Dr. Satya Prakash. At that time I was struggling to set up a Radiochemistry laboratory at Nagpur University. He not only permitted me to use all the counting facilities within the Division but also extended all cooperation in carrying out experiments using irradiations at the APSARA and CIRUS reactors by my student. For this we needed a vehicle to bring the irradiated samples to the Division, unwrap, decontaminate and count them using high resolution gamma spectrometry setup. For carrying out all this work, he and Dr. P.R. Natarajan, Head Radiochemistry Division extended all help to my student. Also Mr. P.P. Burte was deputed to help us in completing all the formalities needed in this matter. Around the same time in 1984 or so he sent me his student's Ph D thesis for evaluation. It was a matter of great surprise and pride for me as it was my first assignment of thesis evaluation and that too from such an eminent person. The work involved theoretical modeling of fission phenomenon. With a little skepticism and inhibition in my mind, I had gone through the thesis very carefully and pointed out some mistakes. After receiving my comments, when he first met me, he patted on my back and commented that I had read the thesis so critically and pointed out mistakes. My association with Radiochemistry Division which started around 1983 still continues though I am now no longer active after my

retirement from IIT Roorkee. During this long tenure of almost four decades, many division heads and group directors came and I got full cooperation from each one of them. Only for this reason and with generous grants from BRNS and two CRPs from the International Atomic Energy Agency (Vienna), I could contribute so much to the field of NAA and Radiochemistry. I had established High resolution Gamma Spectrometry set-ups first at Nagpur University and later at Indian Institute of Technology, Roorkee. Though I was never a part of DAE but for all academic purposes I was considered as a family member of Radiochemistry Division.

After his demise, all his research associates and well-wishers collected funds and established Dr. M.V. Ramaniah Memorial Lifetime Achievement award in his memory. This yearly award is given to a prominent worker who has contributed significantly to the field of Nuclear and Radiochemistry. I was fortunate to have been bestowed with this honor in 2011. Thus, I have the privilege of lifelong association with his name as a Radiochemist. Though I did not have a close or long association with Dr. Ramaniah but as I had known him, he was a hard task master, very punctual and dedicated worker and above all a great human being. Therefore, he wanted everyone else to be like him. In my opinion, he was a very kind hearted and helping person who always encouraged persons like me. He played a significant role in making me what I am today. I pay my respectful tributes to him.

Prof. V. K. Manchanda
Former Head, Radiochemistry Division, BARC
Former Professor, Deptt of Energy Science, SKKU, Suwon, South Korea

I am sharing my thoughts and moments of hope, despair and excitement (experienced during my limited interactions with Dr. M.V. Ramaniah) with the younger generation who missed an opportunity to work under his leadership. Idea is to let them peep into the persona of Dr. Ramaniah, a disciplinarian, taskmaster and the principal architect of Radiochemistry program in DAE. It will not be an exaggeration to say, what Bhabha was to DAE program of India, Dr. Ramaniah was to Radiochemistry program of DAE.

Dr. Ramaniah initiated his research career at Waltair in late forties on the Analytical Chemistry of thorium and zirconium in the chemistry lab of Prof. Bh SV Raghav Rao leading to his MSc (by research) in 1949. He pursued his research on Complex Chemistry of Actinides at University of Illinois, USA and published his work in JACS along with Prof. Therald Moeller in fifties. He subsequently joined Nuclear Fission groups of Prof. N. Sugarman and Prof. A.C. Wahl and co-authored publications with them in Physical Review and JINC respectively in early sixties. He was the first Asian on the Advisory Board of Radiochimica Acta, prestigious international Journal in the area of Radiochemistry in seventies and eighties (I was privileged to serve on this board in subsequent years). Apart from leading the Radiochemistry Programme in DAE, Dr. Ramaniah was the principal architect of several DAE programs like MOX Fuel Fabrication, NUMAC and Nuclear Safeguards. In addition, he was founding father of IANCAS as well as of INS. It was therefore one of my first conscious actions to adorn the office of Head Radiochemistry Division with his photograph when I had the privilege to sit there from June 2003 onwards. Let me start with few of my personal interactions with this father of Radiochemistry in DAE.

I joined Radiochemistry Division along with five batch mates in 1969. Those were the days when division was in transit from south site to Radiological Labs, type A radiochemical laboratory equipped with state of art facilities to handle large quantities of Pu and multi Curie level of beta gamma activity. In this lab, sophisticated instruments were installed inside glove boxes for carrying out work with alpha emitters, and state of art detectors and analyzers for the measurement of radioactivity. It was his vision to build a team of electronic engineers and technicians to ensure that downtime of these instruments remained minimum.

Dr. Ramaniah was a strict disciplinarian. Office was his first home. All of us from 12th batch were asked to report to Dr. Natarajan, a trusted group leader of Dr. Ramaniah for training in Pu handling at South Site. I was unhappy to learn after training, that I will have to report to Dr. Natarajan, another strict disciplinarian like Dr. Ramaniah on regular basis. After deliberating for few days, I gathered courage and approached Dr. Ramaniah with a request to place me in some other group. I would like to add that the image of Dr. Ramaniah was such that visiting his office cabin for me was like a lamb entering the lion's den. Dr. Ramaniah enquired about my training and on my request that I may be allowed to join another group, he sounded more like a mentor, to my pleasant surprise. He asked me to meet all group heads of the division (there were no section heads those days) and report to him with my three choices after three days. The truth was that I did not need three days. Dr. M.S. Subramanian who had just returned from Manchester University after completing his Ph.D. had struck me as a very accomplished scientist and a friendly supervisor. When I reported to Dr. Ramaniah about my choice, he

was furious and all hell was let loose. He grilled me on my choice. After interviewing me on fundamentals of Organic Chemistry, he cooled down and inquired about my Professors who taught me Organic Chemistry in Delhi University. Fortunately, he was familiar with many of them (they all belonged to Prof. T.R. Seshadari (FRS) group) and it helped a great deal. Important thing I learnt was that Dr. Ramaniah was not adamant and was ready to change his decision if situation warranted.

I was doing reasonably well in Dr. Subramanian's group and had few publications by 1971. However, on personal front, I used to miss my friends and relatives living in Delhi and wondered if I have to stay on in Mumbai for the rest of my life. One day, I gathered some courage to meet Dr. Ramaniah to request him to forward my application for writing UPSC (IAS) Exam. He was in no mood to accede to my request. However, to my surprise, he obliquely expressed satisfaction with my research work and asked me to register for Ph.D. under his supervision (he was one of the few guides in Chemistry in BARC at that time). It was like I have gone to him to permit me to climb a mango tree; instead he gave me some cherries in a plate. I did not know how to react. Reaction of some of my seniors added further to my confusion. After spending few sleepless nights, I decided to go ahead with my registration in mid 1971. He proved many of my cynical friends wrong when he allowed me to submit my thesis within four years (in 1975). As a novice, I never realized that he is not a coauthor in any of my publications and now when I look back, I can say without hesitation that Dr. Ramaniah had set up a rare precedent and was way ahead of time. PNE happened in 1974 and there was lot of pride and enthusiasm in the nation for this outstanding achievement of BARC. I dedicated my thesis to the team of scientists responsible for the successful PNE experiment after seeking the permission of Dr. Ramaniah who in turn sought the permission from his superiors. Dr. Ramaniah acknowledged the good work of his subordinates by his strong support though he was economical with words of praise.

Mod Lab canteen started in seventies. Once while walking to canteen, Dr. Ramaniah dashed against glass wall and was seriously injured and was hospitalized. Few months later, I too got involved in a minor accident with my two wheeler inside BARC campus, which resulted in physical scuffle. I was on the receiving end and had to undergo treatment. I decided to report this incident to Dr. Ramaniah. He immediately came out of his office and took me personally to Dr. A.K. Ganguli, our the then Group Director. What happened thereafter is not important. This incident showed that he cared immensely for the welfare of people around him.

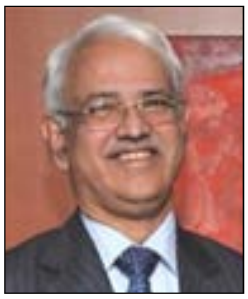
Post PNE, to thwart the intimidation from countries with advanced nuclear programme (who decided to walk out of international cooperation agreements), DAE decided to develop MOX fuels under the stewardship of Dr. Ramaniah. In deference to his wishes, I joined the section responsible for CQC of Pu based fuels in 1981 and was asked to work on high purity gas analysis at sub atmospheric pressure, an unknown area in the organisation at that time. It was a challenging task. I understand that the facility installed in Radiometallurgy Division in 1984 by our group continued to work for almost four decades. As Dr. Ramaniah was the Project in-charge of Tarapur facility for MOX fuel fabrication (known as A3F now), he used to visit Tarapur often. In one such trip, he met with road accident and was hospitalized for weeks. However, it did not deter him to visit the upcoming facility later. Prime Minister Shri Modi witnessed the initiation of core loading of PFBR on 4th March 2024. MOX Fuel for this reactor has been fabricated at A3F facility. It is in a way a tribute to the vision and dedication of Dr. Ramaniah who steered the fuel fabrication facility project from the beginning.

Many Radiochemists were sent for training to international laboratories (till late sixties). This programme was severally curtailed post PNE. I was privileged to avail the EOL to carry out Post Doctoral Work as Fulbright fellow at UTEP, Texas, USA during 1985-87 and it marked a fresh beginning in the division in this direction. While I was away from Mumbai, the division was bifurcated and to my surprise, I was transferred to the parent division and all my group members were a part of newly carved Fuel Chemistry Division. I was reminded of the partition of India in 1947 when many families (including my own) came to India from Pakistan as refugees and struggled everyday to make both ends meet. On my return from post doctoral assignment, I faced a similar

situation. These were most tumultuous days of my professional life. I did try to reach Dr. Ramaniah to seek advice. He was sympathetic but as he was due to retire soon, he was candid enough not to give me any false hope. I had no choice but to gather fragmented pieces of my research tools which were badly bruised and mutilated. I survived through perhaps the most challenging phase of my life by sheer determination. Soon Dr. P.K. Mohapatra joined me and after few years Dr. P.N. Pathak was part of our group. This group along with Ph.D. students worked on "Solution Chemistry of Actinides" with zeal in a dedicated way and soon turned out to be the most productive group in the division. This is acknowledged by the inclusion of our names in the list of selected scientists published by Stanford University and Research.com during last five years. I decided to touch on this period consciously to convey to my young colleagues, that they may find their professional journey sometimes uneven but it should not deter them to carry on with their work in mission mode with renewed vigour. You may not be able to change the direction of the wind but you can adjust the sails to reach your destination. Thanks to the legacy of dedicated leaders like Dr. Ramaniah, our department recognizes the merit in the long run.

Dr. Ramaniah conceived the idea of IANCAS along with Prof. Arnikar (Pune University), Prof. M.N. Sastri (Andhra University) and Prof. B.M. Shukla (BHU) and worked vigorously to make it a national body. Many of his students have nurtured the association over the years. During the 4 years of my close association with IANCAS, two new chapters were opened in Tarapur and in Khalsa College, Amritsar and Prof. B.C. Haldar Memorial Awards were instituted with the support of Prof. Z.R. Turel and other students of Dr. Haldar. It was indeed an honour for me to be bestowed with IANCAS Dr. M.V. Ramaniah Memorial Award in 2017. Post retirement, he was also instrumental in setting up a broad platform, Indian Nuclear Society in 1988, to promote Nuclear Science among Scientists , Technologists, Academicians and general public.

Friends, our best tribute to Dr. Ramaniah will be to explore new frontiers of Nuclear and Radiochemistry using accelerators and reactors and address new challenges at different stages of Nuclear Fuel Cycle as well as in Isotope Programme of the department. There is an urgent need to increase our interaction with the groups entrusted with the task of last mile delivery. Dr. Ramaniah has left an indelible mark on the vast canvas of plutonium related programs of DAE and his name will echo in the corridors of Radiological Lab for ever.



Dr. K. Raghuraman

Former Head, International Studies Division, Strategic Planning Group, DAE

Soon after completing my training in Training School in 1970, I joined the Trans-Uranium Group, of the Radiochemistry Division headed by Dr. M.V. Ramaniah. It was a tiny group of five headed by Mr. C.K. Sivaramakrishnan and Mr. A.V. Jadhav. We separated Pu-238 for the first time in India by irradiating ^{237}Np. After separation, and confirming through its alpha spectrum, we were thrilled to see the ^{238}Pu signature in the alpha spectrum. We ran to inform Dr. Ramaniah around 7 PM. We were expecting his appreciation. The first thing he asked us was whether we have taken enough precautions in the laboratory in handling it safely, as ^{238}Pu is around 280 times more active than Pu239. In spite of our repeated assurances, he rushed to the laboratory, summoned the health physicist to take air samples and ensure there was no contamination in the laboratory. He personally supervised to ensure that everything was safe. For me, though it was initially irritating, I witnessed how meticulously he went around personally ensuring that everything was safe and secure, setting before us an excellent example.

Since, in the other corner of the lab, we were also handling ^{241}Am (which has the same alpha energy as that of ^{238}Pu), he wanted us to take, then and there, the gamma spectrum to confirm the absence of ^{241}Am. In this process, he ensured that there was no cross-contamination and that the product was pure ^{238}Pu only. After that, he gave us a warm smile and said he would inform the higher authorities. I realized after 35 years, when I was associated with Risk Management in IAEA, that what he was practicing then was part of Risk Management. He would always take the worst-case scenario of the things that can go wrong and look for ways to mitigate it should it happen. His preparedness was amazing.

I would like to recall another association with him, in which I helped him to enroll life members for the Indian Nuclear Society (INS) in its formative days. He would drag me around lunch time in the first week of every month to SBI on the first floor of Central Complex. He would literally catch hold of both known and unknown persons and make them life members. I used to find this very embarrassing. But seeing his enthusiasm and commitment at that age, I would simply do my best. After a couple of months, when the membership grew to 300+, I went to him very happily and said, "Sir, we are exceeding the membership of other (professional) associations and we can stop our membership drive". He gave me such a look and said, "INS will be the mother of all such associations. It will exceed the importance of the American Nuclear Society." He then said, "*We should make at least 5000 life members*." My God! I simply sank! But what he said has come true.

Fortunately, I met him before leaving for my assignment in the Indian Embassy in Vienna. He was so happy and said that it was the right choice. For the first time, he addressed me by my name and said fondly, "*Raghu, remember that you're going to be an alternate to the Ambassador for all IAEA matters in the policy making organ. Read the documents very carefully, especially the fine prints and references*." This advice was so useful for several tough negotiations that I had, and in handling post-Pokhran diplomatic fallout.

This was the last conversation that I had with my respected Guruji.

Dr. V. Venugopal
Former Director, RC & I Group, BARC

I joined the Radiochemistry Division in 1971 after passing out from BARC training School from the 14th Batch. I came to Bombay to attend the BARC training School interview in August 1970 on a rainy day. I came casually to Bombay as BARC was providing third class train fare. The interview was conducted at Modular laboratories third floor in the Chemistry Division. I was selected after rigorous questioning for more than an hour in chemistry, physics and mathematics. After about 15 days of interview, I received a registered post informing me that I was selected and I have to join 14th Batch of training school by the end of July. All the trainees were accommodated in Brindavan building in Anushaktinagar. It was type VII building which had two rooms and a kitchen. I stayed there along with one Krishna Rao from Andhra University.

The new training school building at south site of BARC was inaugurated for the 14th batch training school. The inauguration was done by Director, BARC, Homi Sethna in the presence of Dr. Ramanna, Physics Group Director, Dr. A.K. Ganguly, (Health Physics group Director), Dr. Shankar (Head, Chemistry Division), Dr. Ramaniah (Head, Radiochemistry Division), Dr. Sankar Das (Head, Analytical chemistry Division), Dr. K.K. Damodaran (Head, Training School) and several other scientists. Several of them came to training school to teach various courses during our training. The chemistry lecture room was on the first floor corner. It was a rainy season and the greenery around was so beautiful. It was fully air conditioned and it was the first time in my life to enjoy such an air conditioned environment. Several Heads of Divisions connected to the courses came and gave introductory lectures. Dr. M.V. Ramaniah also came and gave lecture on the importance of Nuclear and Radiochemistry in the entire fuel cycle chemistry and informed us the Nuclear and Radiochemistry would be a 40 lecture course and Dr. C.K. Mathews and Dr. P.R. Natarajan would be giving lectures and Dr. S.B. Manohar would take tutorials. All trainees got introduced to him. That was my first introduction to Dr. Ramaniah. Dr. Ramaniah asked us to visit the newly built Radiological Laboratories (RLG) during the practical courses. During the courses and practicals on Radiochemistry, I came to know that Dr. Ramaniah is a strict disciplinarian and strict in following rules and regulations. Several courses were conducted during the course of training and it was strenuous to cope with weekly examinations. Out of close to 2500 marks for the entire course, I had scored more than 69 percent marks and became Scientific Officer, SC2 [SO(SC2)]. There were 14 chemistry trainees passed out from the 14th batch of training school. The vacancies were displayed on the notice board at the end of training. There were six vacancies for chemistry trainees for Space Program. Ours was the last batch where trainees were required for space research. Out of 14 chemistry trainees 7 were from south India and all of us have decided to ask for posting to space program. The placement interview was conducted in C-block auditorium in Modular laboratories. After placement interview the trainees were not allowed to interact with other trainees.

My turn to appear before the placement committee came after three or four chemistry trainees. I remember well that Dr. Ramaniah, Dr. Sankar Das and Dr. K.K. Damodharan (Head, training school) were present in the committee. Chairman of the placement committee asked me to select one of the vacancies. I replied, "*Sir, I am interested in synthetic organic chemistry and I prefer propellant research and hence interested in joining*

space programme." The chairman asked me to talk about my second preference for which I have not prepared my response. Dr. Ramaniah interjected and said, "You have scored 83 percent marks in Nuclear and Radiochemistry course" and asked me to join Radiochemistry division. The chairman agreed with Dr. Ramaniah and told me to join Radiochemistry division. Later, I came to know that Space department wanted all six chemists, otherwise they did not agree for less than six.

Mr. Prasanna Venkatesan and Ms. Chaya (Chindarkar) were asked to join Radiochemistry Division. After the placement, the trainees were briefed about government of India rules and asked to fill various forms such as oath of allegiance and other forms by administrative officer. We were given introductory slip to report to respective division. So, with introductory letter I reported to RCD on 1st August afternoon.

Mr. Prasanna Venkatesan, Ms. Chaya and myself reported to the Radiochemistry Division at north site. Shri Mathai, PA to Dr. Ramaniah took our introductory letters and entered Dr. Ramaniah's room. After waiting for an hour we were ushered in. Dr. Ramaniah after describing the importance of RLG labs explained the once through ventilation system and daily expenses incurred in running RLG labs etc., and asked us to report to Dr. Satyaprakash to undergo training for a month and then decide on which group we will be allotted.

It was an exciting experience to work in RLG labs which were fully air conditioned. We were taken to Apsara reactor to irradiate steel coupon with nutrons, brought the irradiated sample in lead pot and directly counted in the newly installed Ge(Li) 400 channel gamma analyzer for ^{54}Mn activity. We had carried out separation of ^{131}I and ^{99}Mo from irradiated sample and estimated their radiochemical yield by counting. We also learnt handling plutonium in glove box, did counting of plutonium deposited steel planchets for alpha counting etc. At the end of one month Dr. Satyaprakash took us to Dr. Ramaniah who asked Mr. Prasanna Venkatesan to join Dr. Satya Prakash group. I was asked to go to South site laboratory for Molten Salt Breeder Reactor programme and to report to Dr. P.N. Iyer, as Dr. D.D. Sood was on deputation to Oak Ridge National laboratory (ORNL). Dr. Ramaniah informed me about the collaborative MSBR program with ORNL, and BARC was to determine the solubility of plutonium fluoride in molten salt LiF, BeF2 and ThF4. I hesitatingly mentioned to Dr. Ramaniah that the solubility determination is a thermodynamic problem and I found the subject difficult in training school. But Dr. Ramaniah told me that I was one of the chemistry trainees to pass in thermodynamics course in training school. I requested him to post me with Dr. Satya Prakash. After long explanation on MSBR programme, and the possibility of deputation to ORNL, Dr. Ramaniah asked Mathai to take me to South site S60 laboratory the next day. Ms. Chaya joined Dr. G.M. Nair in plutonium analysis group. This is how I started my career in Radiochemistry Division.

Next day I reported to Dr. P.N. Iyer at the old Radiochemistry lab at south site of BARC (S60). This laboratory was designed by United Kingdom Atomic Energy Agency (UKAEA), Harwell and commissioned in 1954 and design was published in an international journal. Dr. Iyer after explaining the PuF_3 solubility experiments, asked me to come for night shift next week onwards along with P.S. Nair for carrying out sampling of molten salts inside a glove box. We were chosen for the night time experiments because we were the two persons who were not married. Though I initially did not like to undertake thermodynamic work, later I felt that it was a blessing in disguise to work with Dr. Sood, Dr. Rajendra Prasad, Dr. Vaidya, Dr. K.N. Roy and Dr. Ziley Singh. During this period, I learnt Lathe operation, glass blowing and soldering which became helpful during my deputation to KFA, Julich. I started publishing several papers in international journals and carried out studies using Transpiration technique, Knudsen effusion cell measurements and calorimetry. During this period, I thoroughly understood all aspects in running a radiological facility, contributed to Pokhran peaceful experiment in 1974 and later Pokhran detonation in 1998.

Dr. Ramaniah asked me to come to meet him at RLG for my PhD registration. Earlier Dr. Sood and Dr. Vaidya registered for PhD with Dr. Ramaniah. He did not approve their PhD thesis immediately. Both of them had to extensively change their chapters. So I was hesitant to approach Dr. Ramaniah. Next day

I visited RLG and I requested Mathai that Dr. Ramaniah has asked me to come and meet him. By this time I had two Journal publications and hence took two copies of them with me to meet him. Dr. Ramaniah told me the importance of PhD for scientists as it exposes him to international journals and interaction with professors abroad to carry out post doctoral thesis which will benefit DAE. He glanced through my two journal publications wherein I have generated close to ten data points on vapor pressures of a component in a binary system. Then I carried out Gibbs Duhem integration to generate activity of the other component. Both the papers were published in Journal of Thermodynamics after vigorous scrutiny by referees. As thermodynamics was not his forte, he told me that the number of experimental points is not sufficient and compared my work with Dr. S.K. Patil thesis. He told me to discuss with Dr. Sood and meet him after a month. I told Dr. Sood that it was difficult for me to register for PhD with Dr. Ramaniah and requested him to permit me to register with him for PhD after he became a guide. Accordingly, I became the first student of Dr. Sood in 1989 and submitted my thesis in 1991 and was awarded Ph.D. from Mumbai University.

Dr. Ramaniah often used to visit S60 unannounced to know the status of solubility experiments. Dr. Sood and Dr. Vaidya used to brief him. Dr. Ramaniah, whenever he visited the laboratory, his pointed question used to be cleanliness of the laboratory and impressed on us the importance of working in that costly environment. Dr. Sood always defended us from the questioning by Dr. Ramaniah. Prasad used to argue with Dr. Ramaniah, whereas rest of us were afraid of answering him. Once Dr. Ramaniah asked me to carryout cleaning job from next day onwards, I told him that I will be going to my native place for my marriage from next week. He asked me "*who has sanctioned your leave?". I replied, "Sir, you have approved my leave*". Later Dr. Sood told me to go ahead with my leave and informed me that he will inform Dr. Ramaniah later.

I used to interact with Dr. Ramaniah for the preparation of quarterly reports on MSBR experiments along with OHPs for submission to Chairman, DAE. However, Dr. Ramaniah used to take plenty of time for preparation to meet chairman. Dr. C.K. Mathews was assigned the task of setting up a RLG lab at Kalpakkam IGCAR. Several trainees joined various sections in RLG, BARC to undergo training in handling radioactive materials. Prof. P.E. Potter from UKAEA visited IGCAR to give lectures of several phase diagrams on (U,Pu)-C-O, (U,Pu)-N-O and other alloy systems. We were asked to give talk on our work on FBTR fuel system. I gave a presentation on oxygen potential in oxide and carbide system based on Blackburn model. Dr. Ramaniah made the introductory talk on the studies to be undertaken. RCD carried out extensive experiments of U-Pu-C-(O) system and submitted that the fuel will perform its intended use successfully. FBTR became critical in 1985 and is still operating successfully with its intended 40 MW(th). It is due to the successful implementation of fabrication of fuel by RMD and its quality control by RCD and FCD. It was Dr. Ramaniah who foresaw the importance of chemical research on carbide and oxide fuels at BARC.

In 1987, I was deputed by Dr. Ramaniah and Dr. Sood to KFA Julich to work with Prof. Hilpert on Indo-German collaboration. They advised me the importance of the deputation and wished me well during deputation. In the same year Dr. Ramaniah retired from service. After my return I visited him in his house. He advised to keep the prestige of RLG high and appreciated my work at KFA. I understood that time that Dr. Ramaniah talked to us tough but he was good at heart and thought good for RLG, BARC and DAE. When I became Director, RC&IG, I went through CRs of many of the persons who had no good relations with him, but Dr. Ramaniah had not made any negative remarks.

In Anushaktinagar I used to meet Dr. Ramaniah often during 1988-90. During our conversation he used to brief me about the initial difficulties in setting up RLG. Later I met him when Dr. P.R. Natarajan passed away. Dr. Ramaniah is responsible for starting IANCAS and initiating IANCAS "*Nuclear and Radiochemistry Workshops*" at various universities, Institutes, and colleges. I was selected for two terms as President of IANCAS. I was fortunate to receive Dr. M.V. Ramaniah Lifetime achievement award by IANCAS.

Dr. Ramaniah's dedication to DAE program will always be remembered by Radiochemists in the years to come.

Dr. P. R. Vasudeva Rao

Former Director, IGCAR and Former VC, HBNI, Mumbai

I joined the Radiochemistry Division (RCD), BARC in 1973 from the XVI batch of BARC training school and was assigned to work with Dr. S.K. Patil. I worked in RCD until 1978, when I shifted to IGCAR, Kalpakkam. At that time, Dr. Ramaniah was already a very senior person, and I had, naturally, a lot of hesitation to meet him for anything. His image of a very serious person who can take anyone to task for not adhering to his standards made me even more diffident. I could, however, observe that he played a variety of roles in the department and also internationally, in addition to guiding the programs of Radiochemistry. Dr. Ramaniah was a Member of the Standing Advisory Group on Safeguard Implementation to Director-General, IAEA, Vienna (1975-83) and a number of UN bodies concerned with nuclear energy. He played a key role in the evolution of practices for control and accounting of nuclear materials in the country. He was very hard working. There were many occasions when I had to cross his office late in the evening while leaving for home, and I could see people waiting to see him. I could see that he took special interest in the activities of the nuclear chemistry section.

I must acknowledge the important role that he played in the fast reactor program of the department. Firstly, it was during his period of leadership that the chemical quality control of the fuel for FBTR was evolved, and I recall that a number of young chemists were recruited in the late seventies to be trained in chemical analysis of the samples received from Radio-metallurgy Division, where the fabrication of the fuel was carried out. Dr. Ramaniah co-authored a comprehensive review on analytical chemistry of fast reactor fuels that appeared in the Journal of Pure & Applied Chemistry in 1982. Many of the early recruits to the Radiochemistry Program at IGCAR, including me, spent their initial years at BARC and received their radiochemistry training. It is not therefore an exaggeration to say that a strong foundation for the radiochemistry activities at IGCAR was indeed laid at BARC under the stewardship of Dr. Ramaniah.

On a personal level, there were many instances when I could experience both his rigor and his emphasis on safety. One evening, I had to stay back (along with another colleague) to complete the preparation of some documents through cyclostyling (photocopying was not yet available at that time). Having made many copies, we had to cut the papers to size and staple them. The work went till late in the evening and since I had to catch the last bus to Andheri where I used to stay, we stopped the work at that stage and went home. The paper waste generated during our work remained strewn in the room, and we had planned to clean up the waste the very next day. To our great surprise, when we began the work the next morning, Dr. Ramaniah walked into the room (as part of his morning rounds in the lab) and saw the waste. I clearly remember the kind of dressing down that we received that morning. He pointed out how the paper waste constituted a fire hazard and should have been removed immediately. I cannot forget his question "will you have left the room in this state if this was your home ?"- after all, we spend over 8 hrs of our waking time in the lab and should it not be considered as our second home ? I have carried that message all through my life. There were other such occasions I had heard about from other colleagues, where he would walk into the lab, and point out how dust had collected on glove boxes and should be cleaned promptly ! I can vouch that it was his emphasis on safety and cleanliness that have helped the Radiochemistry community at BARC and also (through colleagues like me trained at RLG) at IGCAR to maintain an excellent record of safety.

In 1975, I registered for my Ph.D degree with Bombay University, with Dr. Ramaniah as my PhD guide. I started writing my thesis in early 1978; it went through several iterations; meanwhile, I was asked to shift to Kalpakkam (I was recruited for IGCAR, Kalpakkam). I had to leave Mumbai on Aug. 8th, and I had the onerous task of completing the thesis and submitting to Bombay University before departure. As luck would have it, I got the thesis copies and documents signed by Dr. Ramaniah in the morning of 8th and dashed to the University to submit the same before departing for Chennai!

Later, in 1979, I entered his room and met him for the last time, when I went to give my viva voce examination for the PhD degree. He was warm and supportive, and enquired about the work at Kalpakkam. I did meet Dr. Ramaniah later during the Nuclear and Radiochemistry symposia; I vividly recall the symposium at Waltair in 1980 wherein the proposal to form IANCAS was seriously deliberated and received overwhelming response. I consider myself fortunate that I had an association, albeit brief, with Dr. Ramaniah. I also consider myself most fortunate that I could receive an award, instituted in his name, from IANCAS.

I am immensely grateful to IANCAS for giving me this opportunity to share a few thoughts on Dr. Ramaniah.

Dr. K. L. Ramakumar

Former Director, Radiochemistry and Isotope Group, BARC

In the foreword to the seminal tome *Source Book of Atomic Energy* by Samuel Glasstone, Prof. Glen Seaborg aptly observed that when the subject of atomic energy was evolving and there was a need for making this subject easily comprehensible, the scientific community was very fortunate to have Samuel Glasstone addressing the issue very elegantly.

During the formative years of atomic research in India under the tutelage of Homi Jahangir Bhabha at the helm, on his request, a number of experts working abroad volunteered to join the nascent research establishment to lay the foundations of this exotic field in India. It was fortunate that Dr. M.V. Ramaniah was one among those pioneers. Under challenging circumstances, he nurtured the discipline with his single-minded dedication and commitment, oversaw its multifaced growth. Be it research activities in nuclear chemistry, programmes of chemical quality control, activities in actinide chemistry, he left his indelible mark and it is not exaggeration if one says the nuclear and radiochemistry programme what it is today in the Department of Atomic Energy is entirely due to his unflinching dedication and farsightedness. My reminiscences of Dr. Ramaniah include not only my personal interaction with him but also those of which I was a mute witness.

My entry into BARC was through 18th batch of training school. On August 1, 1974, my interview was held in training school in South Site. I distinctly remember one of the committee members asked me to distinguish between physical atomic weight and chemical atomic weight. While I was answering, one elderly gentleman entered the interview room and sat on an empty chair. From his stature he was commanding respect. After listening to my answer, he asked me to explain the nomenclature of atomic weights based on C-12. Later after my training I came to know he was Dr. Ramaniah, Head of Radiochemistry Division.

My next interaction with Dr. Ramaniah was during the placement interview after the training. At that time, we were asked for our favourite subject in the training school and not directly which Division or place. I mentioned my interest was in radiochemistry and I landed in Radiochemistry Division. Four of us from the batch joined the Division. Unlike the subsequent years when the placement was in a particular Section, we were asked to spend two months working in different groups (there were no Sections at that time) to get to know the work programmes. During that time the Division was entrusted with the responsibility of developing and standardizing a number of analytical methodologies to characterize Mixed carbide (U,Pu)C fuel for the upcoming FBTR at Kalpakkam. In addition, the Division was actively pursuing research activities in nuclear chemistry, actinide chemistry and X-ray and thermal studies, Spectroscopy, Mass Spectrometry and trans-plutonium elements.

Development of mixed carbide (U,Pu)C fuel was indeed an epoch making event in the annals of Department of Atomic Energy. During 1970's, while Radiometallurgy Section was to fabricate the fuel, Radiochemistry Division was given the responsibility of chemical characterization of the fuel with respect to a number of specifications. These include dissolution studies, homogeneity test, trace impurity (metallic and non-metallic) determination, thermodynamic and kinetic properties. Dr. Ramaniah, as Head was the central figure in coordinating these activities. When one walked in the corridors of Radiochemistry Division, there was a certain feeling of excitement, purpose and expectation from all. Dr. Ramaniah put in all his persuasive skills of convincing the

authorities in getting the necessary instruments and analytical equipments to meet the mandate. When the FBTR became critical in 1985, it was the culmination of the hard work and untiring efforts of all those under the able and competent guidance of Dr. Ramaniah. During the initial period, Dr. Ramaniah used to have fortnightly meetings to review the progress in the chemical quality control group and monthly colloquia by one of the active researchers. The issues were discussed threadbare. Dr. Ramaniah's commanding presence and his incisive analysis were somewhat putting us down. Even though it was less than two months since I joined the Division, I was given the responsibility of recording minutes of the meetings. In one such meeting, for some reason Dr. Ramaniah was so annoyed that he shouted at a senior colleague for the unscientific approach to a problem on hand and expressed his utter displeasure. In fact, the meeting ended abruptly. I prepared the minutes of the meeting moderating the contents and left the minutes in the Office for Dr. Ramaniah's perusal. I also showed another copy to the senior colleague and also the Group Head. They were a bit apprehensive that I would be taken to task for not enunciating what exactly happened in the meeting. Next day, I was called to see Dr. Ramaniah. As I entered, he asked me whether I wrote the minutes. I answered in affirmative. Even though he looked serious, I could espy a fleeting smile on his face. He approved the minutes and also sympathized with the colleagues working under challenging circumstances. I could see a completely different personality in Dr. Ramaniah, so human, understanding and amiable.

Another instance when this soft nature of Dr. Ramaniah came to the fore was during post-irradiation examination of Tarapur BWR fuel. Mass Spectrometry Section was given the responsibility to determine the burn-up of the fuel. As a part of that exercise, I used to construct isotopic correlations among the isotopic ratios of the fissile isotopes for checking the internal consistency of the data. For one of the fuel pins, the correlations constructed using the experimental data indicated initial U-235 enrichment to be 2.66% against the recorded figure of 2.1%. Dr. Ramaniah being a perfectionist went through the experimental data thoroughly and the methodology I used to construct the isotopic correlations and the basis for the same. Before reporting the results, he also advised that we should consult Theoretical Physics Section persons for their views. It turned out that our observations were indeed correct. The whole exercise brought out Dr. Ramaniah's quest for reliability in the results.

Another interaction with Dr. Ramaniah was when I requested him for permission to register for my PhD under his Guide ship. It was in the beginning of 1982 and an instrument spark source mass spectrometer was procured during the previous year. He desired that I should submit my work proposal without including any of the past activities I was involved in. Accordingly, I submitted the write up indicating that I would be using spark source mass spectrometer (SSMS) and thermal ionization mass spectrometer (TIMS) for my PhD work. While giving me permission, he had put two conditions: I should continue contributing to the routine mass spectrometric analytical services, and PhD work should be over by 1986 as he would be superannuating in early 1987. I registered for my PhD work in the month of April 1982 and in the month of October 1984, I submitted the first draft of the PhD thesis. Dr. Ramaniah went through the draft critically and expected me to find ways of using SSMS for hydrogen determination. In my thesis, I mentioned that even though SSMS is a multi-elemental analysis technique, it is not amenable to hydrogen analysis due to pre-dispersion in the analyzer. I was a little afraid that he might return the PhD draft, but he approved the draft. I heaved sigh of relief and in the month of January 1985, I submitted my PhD thesis to University of Bombay (now Mumbai).

Acting on his triggering query, I pursued relentlessly and with judicious manipulation of magnetic field during the operation of SSMS, I could develop 'two-level exposure technique' for the determination of hydrogen using SSMS and published it in an international journal towards end of 1986. I showed the reprint of the publication to Dr. Ramaniah. He beamed with pleasure, patted my back and complimented me for my doggedness to follow his suggestion. I always cherish that memory throughout my life.

Prior to joining the Department, Dr. Ramaniah's research activities were in nuclear chemistry. He brought his rich expertise and was instrumental in directing a small band of training school graduates to undertake research

in nuclear chemistry. Initial focus was on nuclear fission yields of a number of fission products in thermal neutron induced fission of U and Pu isotopes. From mass distribution studies, the activities were extended to charge distribution, angular distribution of fission fragments, high energy fission, charged particle induced fission. The importance of these activities was recognized by nuclear physics group and many inter-group collaborative research activities were initiated.

Dr. Ramaniah was well aware of importance and indispensability of collaborative research in atomic energy. During the early stages, when it was decided to initiate reprocessing research in the Department, three chemical engineers were advised to carry their preliminary research activities in Radiochemistry Division at South Site.

This was poignantly recalled in the Founder's Day Lecture in 2007 by Shri S.V. Kumar of Fuel Reprocessing Group. He fondly recalled Dr. Ramaniah's contribution and his suggestion for a Divisional colloquium on the solvent extraction studies for the benefit of Chemists pursuing research in actinides separations in the Division. Dr. Ramaniah was also instrumental in other collaborative research activities in developing Neptunium separation flow sheet in the PUREX process along with FRD.

When the 23rd IAEA General Conference was held in New Delhi in 1979, the administrative and coordinating abilities of Dr. Ramaniah came to the fore exemplarily. Dr. K. Raghuraman, my senior colleague, always used to say that perhaps for the first time the IAEA general conference was held outside IAEA Head quarters, Vienna and Dr. Ramaniah as one of the advisors to the leader of Indian delegation (Dr. H.N. Setna) effortlessly coordinated the visit of member delegates from more than 80 countries to BARC.

Another important milestone in the distinguished career of Dr. Ramaniah was the establishment of NUMAC Cell, DAE in BARC which could be called a fore runner of nuclear Controls and Planning Wing of DAE.

Othello in William Shakespeare drama with the same name, while speaking to Iago about his achievements, says that even his demerits speak of his status and greatness. Such was the personality of Dr. Ramaniah that whatever blemishes and short comings other spoke of him enhanced his standing and stature and this was very poignantly expressed by many senior colleagues long after his retirement. I remember vividly an instance during the first decade of this century, while commenting on the prevailing situation in RLG at that time, one senior colleague pointed out the need for personalities like Dr. Ramaniah to address the challenges.

Just as the French poet and novelist Victor Hugo observed "*Nothing is more powerful than an idea whose time has come*", I make another observation that even Mother Nature conspires to make the idea a success. Dr. Bhabha's idea of a developed India in atomic energy was fructified due to the eminent personalities like Dr. Ramaniah who through their dedication set themselves as beacons to successive generation of scientists.

Finally, I end this article with a stanza from H.W. Long fellow taken from his poem "A Psalm of Life". "*Lives of great men all remind us We can make our lives sublime, And, departing, leave behind us Footprints on the sands of time."* Dr. Ramaniah belongs to that genre of stalwarts who spontaneously and willingly partake their vision among others for a better tomorrow. The rich legacy left by them remains perennial and evergreen inspiring generations of Scientists.

Dr. A. V. R. Reddy

Former Head, NCS, RCD & Head Analytical Chemistry Division, BARC

Dr. M.V. Ramaniah, a multi-faceted nuclear scientist, had dedicated himself to nuclear science, particularly Radiochemistry (RCD). He joined RCD as a senior scientist, became its Head and later Director of Radio Chemistry group and strived to evolve various programmes of radiochemistry, fuel chemistry, reprocessing, nuclear chemistry and, health and safety. He has been a visionary and a builder of institutions. His dedication to the subject and the institution was second to none. His vision created two scientific associations, Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) & Indian Nuclear Society (INS) which have grown bigger and are meeting its objectives. Besides he is a connoisseur of music, dance and fine arts pertaining to Indian culture. By the time I joined Radiochemistry division (RCD) in 1977 he was an established scientist and Head, RCD. He was very particular for details, not only in scientific matters, but also in organization of symposia, personal health, etc. I feel privileged to write this article enumerating a few important interactions I had with him.

My first interaction with Dr. Ramaniah

After completing the 20th batch in Chemistry training, myself along with a few friends came to meet Head, Radiochemistry Division, in the second half of July, 1977 to know about the prospects in Radiochemistry Division, as a vacancy was shown to be filled from 20th batch. We were sitting in the Sofas near Security and chatting a bit louder and then we noticed an elder person walking across. He paused for a few seconds and asked what for we were there. I told him, "*We want to meet Dr. Ramaniah, Head RCD*". He had a trade mark smile, smiled and told "people call me Ramaniah" and started walking briskly to his office. Then we jumped off the Sofas and ran after him saying sir, sir, sir. He told sternly, "that is the office, come through office". That gave glimpses of his procedural discipline. Out of 8, 6 decided not to join RCD. I still told that "*I wanted to join*". No need to narrate the rest except that two of us met him and he explained ongoing RCD programmes. When we came out, other person also lost interest to join making my entry into RCD a bit easy.

Keen eye for safety

I was told to work in each section of RCD for 2 months to grasp the entire programme of RCD. Since I was keen to join Nuclear Chemistry, I chose to start from nuclear chemistry. Dr. AGC Nair was given the responsibility of training me in handling radioactivity. Within 2 weeks I pestered Dr. Nair and started working in fumehood, wearing gloves. After an hour I told "*Nair Saheb, my right hand appears to be wet*". Dr. Nair was coming towards me, then there was a booming voice "wait there only". Then we turned our head and noticed that Dr. Ramaniah was there and Dr. Nair murmured in my ear "*tumhara chutti ho gaya*". A few minutes later Dr. Ramaniah with soap solution bottle and torn shoe bags in one hand and a red tape in the other hand appeared. That picture of Dr. Ramaniah is etched eternally in my memory. He came near fumehood, put a red tape around the area, spread a polythene sheet, asked me to change my shoe bags and wash my hands. Then the great man started cleaning the floor along with Dr. Nair. Of course many seniors joined. My hands were checked, they were contamination free. He was about to leave telling that "don't repeat" and asked "how it happened". I could have kept quiet; instead I told that it was an accident. He didn't like my answer, but he moved away. I ran and caught his attention at the door and I told him "this gesture shown by you is so great I assure you sir that as long

as I am in Radiochemistry Division, I will train myself and help others particularly juniors in safety and discipline of handling radio activity". He smiled and went off.

His concept of working for PhD and working during late hours

I was about to complete my PhD as a CSIR research fellow before joining BARC training school in August 1976. I needed 3-4 months time to complete the Thesis work. I requested office for an appointment and, typical of him, I was given an appointment after 7 PM. I entered with lot of enthusiasm and explained what I have done and showed copies of one publication and a conference paper. Instead of going into details, he simply asked me "what is the cost of this laboratory and annual maintenance cost". I was disappointed and came out, and thought of not to continue with the PhD work that I was carrying in my university. I could realize later the implication of his question about judicial use of the laboratory space and facilities, and working for late hours.

He is keen to know details

It was in April, 1979 around 9 PM, Dr. Ramaniah entered RCD counting room. Myself and my colleague C.R. Venkatasubramani were so busy in following the decay of ^{221}Fr in MCS (multi-channel scaling) mode that we did not notice him until he told "nice". We turned back, explained him what we were doing as it was first time seeing live decay plot and he was pleased. Then our troubles started with a spate of questions. He asked questions like: (i) How did you ensure that there was no alpha activity contamination, (ii) How safely did you transfer the sample from lab to counting room, and (iii) What is the decontamination factor in your separation, etc. Of course we answered all and then he switched over to see the live plot while counting is on and suddenly he questioned "*why there is substantial background*?". I told him that it was not significant as the scale is in logarithm and quickly calculated and showed data. Yet he told "*you follow all safety precautions, take swipe samples regularly and report me tomorrow with the records*". He spent nearly an hour and left the counting room saying "good".

In the remaining of his office tenure I had encountered such situations but as long as we give logical answers, all the time I found him satisfied. I was amazed that every time he sought details. So is the case whenever he attended nuclear chemistry section meetings as well as presentations in conferences. While he was hospitalised, he called us one evening for some help /coordination. Late A.V. Jadhav, Dr. S.B. Manohar and myself reached BARC hospital ward. We were astonished to see a list of 50 small & big jobs, and of course we could do all the jobs before treatment started. Sadly however, he left this world after 15 days.

He was a visionary and builder of institutions

I am sure many seniors might have covered this topic in the other articles. Suffice to state that A3F Tarapur is one of his contributions. Radiochemistry labs in BARC were the result of his vision. During the last week of his service, I sought an appointment to get a letter to facilitate RCD lab at TIFR, which I was looking after. He called me into his office, dictated a letter to PA and told me to check correctness of requirements. In another one hour, signed letter was with me and before handing over the letter he spoke to pelletron in-charge to clear it. From 1998 onwards till to date, the two rooms RCD lab in TIFR has been hub of our work with pelletron.

His vision on Nuclear Sciences and role of Nuclear Science Associations

Dr. Ramaniah always felt that carrying out R & D for the Departmental programmes was priority. Carrying out high impact basic Science is equally important, developing labs for expansion is crucial, above all cleanliness and safe practices are utmost important. He also believed that there was a need to have a forum to communicate with the general public about DAE programmes and for exchanging ideas among peers and younger generation about Nuclear and Radiochemistry. With that aim, he proposed to form an Association in the year 1980 in Vishakhapatnam symposium and his relentless pursuit resulted in founding IANCAS in 1981 in BHU, Varanasi. I am one of the first 25 founder members. Over the next one year he gave responsibility to seniors to register the

Association and increase the membership. Today IANCAS has about 2000 members and is one of the most popular Associations. After his retirement he was advisor to Chairman, Department of Atomic Energy and he took upon himself to provide a forum for Nuclear Scientists with global standards that resulted in the formation of INS whose membership canvas encompasses engineers, scientists, technocrats, entrepreneurs, environmentalists and established industrialists. Today it is one of the biggest global societies with defined programmes including an Annual Conference on a chosen theme.

As a tribute to his services IANCAS honored itself by instituting Dr. MV Ramaniah lifetime achievement award which is given every year to a person whose lifetime contributions to radiochemistry and isotope programs are significant. This award was instituted during the NUCAR-99, after his passing away, and it is gratifying to share with you that as a convener of NUCAR-99, I was one of the members to raise the funds and institute this award along with seniors and frame the procedure for selecting the awardee.

Dr. Ramaniah was a connoisseur of Fine arts

Dr. Ramaniah was very fond of Music, Dance and other Fine arts. During Radiochemistry and Radiation chemistry symposium held in my parent university Shri Venkateswara University, Tirupati, a Cultural programme "Shrinivasa Kalyanam", a Kuchipudi dance ballet by Dr. Vempati, Chennai was organized on the first day evening. All the scripts for Dr. Vempati were written by my teacher Prof. S.V.B. Sarma, a multifaceted artist himself. During dinner I was talking to Dr. Vempati and Prof. Sarma, and it caught the attention of Dr. Ramaniah. He joined us and explained about Kuchipudi dance and told me that "later sometime, we will bring this team to Mumbai". First Annual Conference of INS was held in 1988 in Mumbai. Four months before the conference, he called me and told that I should arrange Srinivasa Kalyanam ballet and added that I should bring Sankarabharanam fame heroine Manju Bhargavi. It was a difficult task but materialized. It was performed in Shanmukhananda Hall, Matunga, 3000 people attended and was a grand success. In the Second Conference he ensured to arrange another one, an Odishi Ballet, "Geet Govindam" by Shri Kelucharan Mohapatra. During 90s of last century he used to borrow videos & audios tapes from me to relax.

Dr. Ramaniah had never mixed office work with language or personal proximity. He never spoke to me in Telugu when he was in office. Like his dedication to office work, his principles & discipline had been exemplary. A great soul. His legacy is still alive in RLG , BARC.

Dr. B. S. Tomar

Former Director, Radiochemistry and Isotope Group, BARC

Dr. M.V. Ramaniah was the Director of Radiological Group which included Radiochemistry Division (RCD), Radiometallurgy Division (RMD) and Division of Radiological Protection (DRP), when I joined RCD in August 1982 after graduating from the 25th batch of BARC Training school. The vacancy under which I joined was for Variable Energy Cyclotron Centre (VECC), but Dr. Ramaniah assured that I will not have to go there against my will. This was my first interaction with Dr. Ramaniah.

Today the RLG culture, that we talk of in terms of camaraderie with the lab mates, cleanliness and radiological safety, we owe it to Dr. Ramaniah due to his strict disciplinarian nature. Being the founder of RLG, it was due to his vision that we have excellent class A radiological laboratory at Trombay campus established in 1967 for carrying out world class research in nuclear and radiochemistry. The camaraderie among the RLGians, arose due to condition that at any point of time, there have to be at least two persons present in the lab. The cleanliness in the labs was ensured, as Dr. Ramaniah would visit the labs every day at 1730 hrs and look for any lapses and ask for corrective measures promptly. I remember, once we were working in lab C-33A and in the same lab Dr. P.K. Khopkar one of the pioneering actinide chemists was also working in the fume hood and Dr. Ramaniah visited the lab at 1730 hrs and opened the door of the refrigerator. Dr. Khopkar, with gloves on, came to him to explain about the condition of the refrigerator, but Dr. Ramaniah, did not appreciate his coming to do so and asked him to continue doing what he was doing.

Dr. Ramaniah was the only PhD guide of Mumbai university till 1985, when Dr. Satya Prakash was recognized as PhD guide by the university and 10 of us, including, Satyen Das, Goswami, myself, Haladhara Naik, Pujari, Nair, and others registered for our PhD under his supervision. We have heard from our seniors that Dr. Ramaniah would read the manuscript of the PhD thesis very carefully and would not be satisfied till it meets his expectations.

Radiological safety was his top priority and he would personally check the gauntlets randomly some times during his lab rounds. The eatables in the labs were a big no no and hence those interested in tea/coffee and snacks necessarily had to visit the canteen where the camaraderie flourished further. For instance, the friendship among our lunch group of Drs. Manohar, Reddy, Ambi Pillai, Goswami, Pujari and myself continued till every one superannuated and that remains even today.

Dr. Ramaniah was a strict disciplinarian and hence expected all personnel to follow the rules and regulations of the radiological laboratory without any lapses. There was an impression that he would reprimand the personnel over even a small mistake, but I do not remember any incident when some person was reprimanded. Instead I found him caring particularly towards the younger researchers reminiscent of grandfatherly affection.

The fission group led by Dr. Satya Prakash was considered as a privileged group as Dr. Ramaniah supported the nuclear fission research from the point of view of man power to the laboratory facilities. The group had brilliant young scientists like Tarun Dutta, Ashok Goswami and others, expert radiochemists, such as, A. Ramaswami, A.G.C. Nair and others.. We had a Cf-252 source of fission products and used this source for research on fission product mass distribution, charge distribution, kinetic energy distribution, fragment angular momentum distribution, etc. Facilities were established wherever there was a source of neutrons (reactors) or

charged particles (accelerators). We were proud of getting the first 4096 channel multichannel analyzer (MCA) in the counting room C-16A and there would be a queue to using it as it was only one of its kind. We even learned making Basic computer programs using the computer which was a part of the MCA and used it for calculating activity from the count rate.

Dr. Ramaniah superannuated in 1987 and I was witness to the last 5 years of his illustrious career. He spoke less but very effectively. His vision to expand Radiochemistry led to the establishment of radiochemical laboratories at CIRUS, Dhruva, VECC and TIFR (Pelletron). Having worked with Prof. A.C. Wahl in the laboratory of Prof. Glenn T. Seaborg at University of California Berkeley, USA, he had the vast experience of working with Plutonium which was useful in building the excellent class-A radiological laboratory at Trombay.

He would invite the expert peers to review the work being done at RLG so as to get an outsider's view on the R&D at RLG. I remember Prof. P.T. Narasimhan from Chemistry Department, IIT Kanpur who taught me NMR spectroscopy during my stay there during 1979-1981, visited RLG on such a peer review meeting.

Though Dr. Ramaniah is not with us today, his legacy would be remembered and followed for the long time to maintain and sustain the culture of comradery, cleanliness and radiological safety required for a radiochemical laboratory. It would be a fitting tribute to this legend if the new generation of researchers followed his footsteps to maintain the high standard of R & D as well as safety culture.

Springs of Life

Dr. M. Lavanya

Formerly : Scientific Officer, Physics Group, BARC & Professor, Homi Bhabha National Institute

I would like first to thank Dr Pradeep Pujari and IANCAS for inviting me also to share my reminiscences in this tribute to my father. Of course, it's pretty much impossible for me to do justice in a few pages!

As far back as I can remember, I wanted to be a researcher. I guess that was because I knew, even as a little girl, how happy my dad was with his work. Though I had no clue as to what he did, I somehow knew it was something special, exciting and important. Early on in school, I had decided to study medicine, and then take up cancer research. But just a little later, I decided on pure science.

Ours was a very loving family, not just my parents, but also the extended family of cousins, aunts and uncles, and of course, doting grandparents. I had lots of friends and I would go off to play every day. I had many interests of my own, and a lot of freedom. Neither parent ever pushed me, and weren't even ambitious for me. What they did want was for me to be safe, secure and happy. Safety was a concern. They would ask me to be home before dark, and Dad would add that I should call and let them know if I couldn't make it for some reason. I almost never did, causing them many an anxious wait.

Dad (and Mom) were always very sweet to me. In fact, I don't remember ever being even shouted at, let alone beaten, by either parent. Yet, I was a very disciplined child. This changed when I entered my teens, and I went through all possible avatars, from a jeans-n-tee-shirt-swinging westernised kid to a jhola-chappal- kurta-pyjama socialist. There was a phase when I questioned everything under the sun. So, he had his good friend Dr. Emilio (Lopez- Menchero) speak to me, "You cannot reinvent the alphabet. There's not enough time in one life. You have to build on what others have done already." I had become a bit of a social activist and I would take social problems very personally. So, Dad brought me a picture of Goethe with the Globe on his shoulders and the inscription, "You are not born to carry the world on your shoulders !"
I guess I was always quite a handful, but Dad dealt with me delicately, with finesse.

Marvellous lazy Sunday afternoons when I was a child were often spent with Dad. He would stretch out on the sofa in the living room and we would listen to Western classical music on the big Philips radio (this either preceded or followed the Bournvita Quiz contest, 'Cricket with Vijay Merchant', and the like). This was also when he would teach me all sorts of stuff - playfully. I learnt the basics of German this way. He would give me the name of a country and I had to tell him the capital city! My interest in travel and adventure was probably kindled at this time. We would listen to world news and he would give me his take on world affairs, often an unbiased view. I remember the excitement when the first man walked on the moon. Dad got me lovely picture post-cards. He would also regale me with stories from his childhood, his time in America, and his travels everywhere.
Sometimes, he would get me to practise my Telugu, which myAmmamma had taught me, by reading from the Akashwani magazine we subscribed to. There was also a period when he made a rule that we would all talk only in Telugu at the dining table. I rebelled for a bit, but then it all worked out okay. Interestingly though, the first language I learned to speak was Portuguese! as Dad was on an IAEA expert assignment in Brazil at that time.

At meal times, also, there would be games ...he would quiz me with some arithmetic problems, like multiplying two huge numbers in my head! He himself could do all of that, almost lightning fast!
So, Nana was a lot of fun. He had a wonderful subtle sense of humour. We had a few favourites on TV, too, such as Here's Lucy- we thought my mother had shades of Lucy! About the Ph.D. degree, he would say with a wry smile, "(For a scientist), the Ph.D. is like a pair of trousers. If you have it, no one will even bother. But if you don't have it, everyone will notice!"
He taught me to cycle, holding me as I fell. Later, he taught me to drive our Fiat car, but still got me to enrol in a driving school, as their dual-control cars are safer for practising on busy roads.

Daddy was really very busy, but the time with him was fantastic quality time. My parents never really interfered with my life (they were always there ... but not there!) and Dad– though he religiously attended PTA meetings - probably didn't ever know clearly just which class I was in.Yet, it was uncanny how he always knew when I needed him. One early memory is illustrative.
One night, he came out of his room to the hall for a glass of water and spotted me at my study table in the corner, sobbing quietly. Of course, he came to me to find out why, what was the matter. It turned out I had a Hindi test the next day and I was totally unprepared. He talked to me a little more and finally figured out that I didn't know the Hindi alphabet! That was it! Dad asked me to forget about the test the next day. He then sat down in the wee hours of the morning to teach me the Hindi alphabet!
There was, of course, a deep lesson in this: get your fundamentals, the basics clear. The success will come - once you really understand (and enjoy) your subject.
Dad also taught me stuff like little tricks in maths, using which I could solve problems quickly. For the longest time, there was a ball-and-stick molecule-builder chemistry set at home which one could play with. Wherever I have excelled, I realized perhaps only later that it was the tableau my parents provided which made this possible.
Fast-forwarding through the years, to keep this at a reasonable length: Dad stayed keenly interested in all my fields of work – whether cosmology and field theory, nanomaterials and quantum dots, or *ab initio* simulations of systems. His comments were always insightful and his contribution invaluable, but never intrusive.
Further, both parents continued to support, protect and shield, but as always, I was allowed to make my own decisions.

Dad was an exceptional human being, possessed of stellar qualities. I sometimes look back and wonder at how privileged I was to have been associated with a person of that calibre.
First and foremost, he had absolute integrity. Highly principled, utterly honest and straightforward. He was a person of few words… but, direct. Sometimes, his straight-forwardness was even embarrassing.
He never ever gossiped. So, I grew up with absolutely none of that. Dad's philosophy in any case was, "Don't look at another's plate".
He was hugely talented, self-made, sincere and very disciplined. His work ethic and commitment to duty were outstanding. He was very soft-hearted and especially sensitive to those who were ill.He was a giver (who knew the art of giving – no strings attached, and the art of 'giving back') wanting to contribute to people around, to society (and of course to India, and to the world). Even when he cut fruit – which he did very skilfully – he would first hand over to everyone around before he had even a single piece. The birds and monkeys would often bite into the fruit from our garden trees. Dad, quoting his father, would say, "They are entitled to their share too"!
To me, also, he emphasized the importance of sharing, concerned that as an only child, I didn't have the opportunity to learn this naturally. So, I always shared, also my knowledge even in very competitive situations and environments. However, at one point this changed - I was very annoyed at someone's behaviour and refused to share what they asked of me. Of course, this bothered me a lot, and I told Dad later that I'd refused to share my knowledge. He didn't say a word. But the (searching) look he gave me said a lot.

Though incredibly busy at work, he took on social responsibilities as well. I remember, even when very young, him one-finger typing letters for improvement to various departments in Bombay. At practically all the places we

have stayed, he shouldered responsibilities on the Managing Committee and did yeoman service for the community. He also loved teaching. He loved to spend time with youngsters and has mentored and guided very many people, at work, in the family and outside, giving generously of his time and advice. Many of his protégés have scaled great heights in their professions.

He was a path-breaker in his time, an independent thinker. Enormously grounded, yet a visionary. A perfectionist. Brilliant, yet modest, self-effacing, and extremely low-key. He was courageous and could be adventurous. Despite being highly rooted in their own 'parampara', both parents were secular in outlook - above caste, religion, community and even nationality, and had friends across all these groups, as well as amongst the 'high' and the 'low'. And this is how they brought me up too. And, Dad maintained a cordial relationship with everyone, right up to the end.

Dad was fair. He had the ability to distance himself from a situation and see it objectively, from an unbiased perspective. He would recuse himself from a discussion if his interests were involved. By the same token, he didn't believe in or practice nepotism.

He had enormous patience and phenomenal focus and concentration. Yet he could be amazingly absent-minded too, especially when he was working on some problem. On one such occasion, he walked through the newly-washed and polished glass doors of a building at BARC! The glass door broke and gashed his hand, and he had to be rushed to the hospital!

Dad was multi-faceted, with many interests.

He enjoyed playing around with things technical - gadgets and machines, and had tool kits for everything.

He could spend hours on a holiday tinkering with the car, head under the bonnet, along with a friend, usually Mr (K J) Khan uncle.

With my mother, he shared a love of music – his favourites being Western classical and Carnatic music -and they had a wonderful collection. We would often attend classical music kacheris and dance performances at various sabhas. He also spent quite a bit of time tinkering with the recorders and gramophone player!

He was an ace photographer in an era when there was hardly any automation and sophisticated cameras were complicated to use. At family gatherings, he was more often than not found behind the camera than in front of it, and his photographs were often better than those taken by the hired photographers! He even filmed Amma's dance, which he would screen using a projector. It's ironic that the Rad Labs he spent his life in were out-of-bounds for photography, and there are few photographs recording important achievements, or even of the numerous visits by dignitaries to these strategic facilities.

Dad was a pretty good cook - having learnt by helping his mother as a youngster. He would treat his friends (here, and in America and elsewhere) and also family to vegetarian South Indian fare. "A good chemist should be a good cook", was a favourite remark. And, he would point out interesting phenomena such as the patterns that form in a boiling liquid!

Dad was deeply interested in philosophy and in the Upanishads. In his 50s, he learnt yoga - at the first classes conducted officially in Central Complex by Mr. Nimbalkar's Yoga Vidya Niketan - and practised it regularly, and got my mother and me to learn it too. He was very fond of walking (and cycling!) for exercise, and would take long walks, up to the hills. He often took me along, or other visitors – young or old – who were around during his walk time, and I've heard him recommend walking for health (as also yoga) to all his friends.

Dad spent much of the 1950s in the United States. During this period, he worked with several pioneers of Nuclear Science : Therald Moeller at the University of Illinois in Urbana-Champagne, Arthur Wahl and Joseph Kennedy at Washington University, St. Louis and Nathan Sugarman at the University of Chicago. Berkeley, Washington University and the University of Chicago were the key centres connected to the Manhattan Project at Los Alamos.

At Berkeley, nuclear chemistry research utilizing the high energy particles from the cyclotron was exciting. Here, plutonium had been produced for the first time by Glenn Seaborg, Arthur Wahl, Joseph Kennedy and Edward

McMillan in 1940. Certain areas of the Rad Labs were out-of-bounds for non-US citizens.
At the Washington University cyclotron, microgram amount of plutonium was produced. After the end of the war, Arthur Holly Compton was appointed Chancellor of Washington University, and he brought with him several scientists who had been working on the Manhattan project. Kennedy and Wahl, two of the four co-discoverers of plutonium, were a part of this team. It was with Prof. Arthur Wahl that Dad earned his Ph.D. degree.
At Chicago, Dad worked on the world's highest energy cyclotron at the time, often doing the 'graveyard shift'. Chicago was also exciting for many other reasons. Stanley Miller and Harold Urey had carried out the first experiments to synthesize organic compounds from inorganic constituents in an origin-of-life scenario. A copy of the 'Origin of Life' was on his shelf for quite a while. Also in Dad's collection was a (print) copy of Enrico Fermi's hand-written notes on Quantum Mechanics!
In fact, the books and courses that Dad studied during those years included both, a range of Chemistry, as well as Quantum Mechanics, Mathematical Methods, Thermodynamics and Statistical Mechanics – which would do a theoretical physicist proud!
Dad had a high regard for the Natural Sciences, because they deal with Nature and Natural Laws which are immutable, rather than man-made constructs which are ephemeral.
Dad had always been at the top of his class, and often taught his fellow students; this continued in the US as well. His confidence, and the ability to hold his own and earn respect, at international fora throughout, came undoubtedly from his enormous abilities, but also perhaps from his deep faith and roots in his own country.

Meanwhile, in Bombay, Dr Homi Bhabha was recruiting bright, talented young Indian scientists from all over the world to build up the Indian Atomic Energy programme. Dad had always been immensely patriotic. And so, in the winter of 1957, Dad left the United States to return to India to join the Atomic Energy Establishment at Trombay. The Radiochemistry Division (and the Rad Labs) became his first love and the people there his family. People from many other Divisions, including Radiometallurgy Division, Plutonium Plant, Isotope Division, etc. were also trained in the Radiochemistry Division. The Rad Labs contribute significantly to all aspects of the Nuclear Fuel Cycle. Over the years, Dad, as the Indian representative, also participated in several complex negotiations, such as the treaty on the non-proliferation of nuclear weapons (NPT), Safeguards, etc. at the IAEA and other international fora.

This is the Golden Jubilee Year of the Peaceful Nuclear Experiment (PNE) that India conducted at Pokhran in Rajasthan. 18th May, 1974 was a date that changed all our lives. There was a huge veil of secrecy over the entire program, so only a few public-domain memories are shared here.
I well remember the excitement, the quiet jubilation, the interviews on TV that I watched at our Malabar Hill home. Kids connect best with other kids. So, my most vivid memories of that day are actually of Mr Sethna's children! Sitting in a row on the sofa, and being asked by reporters, "How do you feel?" And them smiling broadly, "Very nice"!
Dr Homi N Sethna who was the Atomic Energy Commission Chairman at the time, organized a function at BARC, in which the especial contributions made by a few were graciously acknowledged. The beautiful silver medal that was presented to Dad at the time is treasured by us.
To explain the science to the public, Dad and a couple of others wrote popular level articles for the magazine, Science Today. The title: " How the Plutonium is obtained ".
Dr Raja Ramanna, who was then the BARC Director, gave a published interview later, in 1997, in which he said, "Several scientists (Dr Ramaniah, ... (a few other names)) had worked to the bone in order to bring the project to this stage."

I had the opportunity to witness, in a very small way, his style of working, when, as a consultant post-retirement, he was setting up the Indian Nuclear Society (INS). From the time he decided to take this up as a project, his enthusiasm and energy were to be seen to be believed! Starting with a working committee, and involving many others as well, to creating the motto (Anuhu Manava Sevartham) and emblem almost overnight, to registering as

members everyone they knew well (and not so well!), registering the Society with the Charity Commissioner, organizing the Annual Conference(s), inviting the Chief Guest and speakers etc., to organizing the technical and entertainment programs, to publishing the Newsletters, to getting space for the Society office, etc. etc. … the team did all of this, enjoyably and at breathtaking speed! Possibly, this is how they all researched, and worked at their projects: on a "war-footing", in the words of Dr Homi Bhabha.
Post-retirement, Dad also sifted through the original, voluminous Bhabha–Nehru correspondence during the years that Atomic Energy was being established in India, and compiled this in a slim booklet 'Nuclear India'.

One of the last things Dad said to me, with a smile was, "Life is sweet". Yet, he never clung on - to anything.
I realize now that he was sent here for a purpose, on a mission.
In his time, he was known as "The Plutonium Man".

Dr Ramaniah was a team player. He always said that anything he was able to do was because of his marvellous colleagues, who were partners in their joint achievements. I have wonderful memories of many of them, too numerous to write about here.
So, I close as I believe my father would want me to, with a line from the famous Thyagaraja krithi, as a tribute also to his very many amazing colleagues and friends, both, his contemporaries and those who have bravely carried the legacy forward: "Endaro Mahanubhaavulu, Andariki Vandanamulu".

UNIVERSITY OF CALIFORNIA

RADIATION LABORATORY
BERKELEY 4, CALIFORNIA

August 29, 1952

Mr. M. Venkata Ramaniah
357 Noyes Laboratory
University of Illinois
Urbana, Illinois

Dear Mr. Ramaniah:

I am glad that you have been accepted for graduate work in chemistry here. We are looking forward to your joining our nuclear chemistry group upon your arrival.

Sincerely yours,

Glenn T. Seaborg

GTS/db

Letter Courtesy of Dr. M. Lavanya, from the Personal Collection of Dr. M. V. Ramaniah

ARIZONA STATE
UNIVERSITY TEMPE, ARIZONA 85287
DEPARTMENT OF CHEMISTRY

May 8, 1983

Dear Ramaniah:

Your letter to Dr. Guest relating to my 70th birthday and retirement is included in a bound volume of letters presented to Mrs. Moeller and myself at the birthday party.

The sentiments you expressed therein are very much appreciated. I recall with much pleasure the period you spent at Indiana. Not only were you a remarkably productive and imaginative research worker, but also you were a fine colleague and a complete gentleman. I have been proud to call you my friend and to relish all of your accomplishments since you returned to India.

All of the best of wishes go to you from both Mrs. Moeller and myself.

Sincerely,

Harold Moeller

Letter Courtesy of Dr. M. Lavanya, from the Personal Collection of Dr. M. V. Ramaniah

Offi. : 22275 & 20641
IAF. : 22066/660
Resi. : 20205
Telex. 0352-204

अ. नागरत्नम्
निदेशक
A. NAGARATNAM
~~DIRECTOR~~
Emeritus Scientist

मद्देशासकीय पत्र सं०.....
भारत सरकार, रक्षा मन्त्रालय,
रक्षा अनुसधान तथा विकास संगठन
रक्षा प्रयोगशाला, जोधपुर
पिन कोड-342 001
D. O. No...DLJ/AN/87...
Government of India, Ministry of Defence
Deptt. of Defence Research & Development
DEFENCE LABORATORY,
JODHPUR-342 001

दिनांक
Dated 1 June'87

Dear Dr Ramaniah,

Thanks for your kind letter. Your outstanding and varied contributions in the atomic energy field will be long remembered by generations to come of Indian scientists. I have personally learnt a lot from your many-faceted personality - mastery of your own scientific specialisations, vast erudition encompassing a wide variety of disciplines, knowledge of our Shastras,deep commitment to our traditional values in life, spartan simplicity, humility and basic warmth and friendliness. I deeply cherish the privilege I have had of close association wit you.

For an active mind like yours, retirement is a misnomer. I am sure the scientific community and our country would continue to benefit from your wisdom and experience.

May I pray that God gives you many many decades of healthy, happy, purposeful life ?

With kind regards,

Yours sincerely,

(A.NAGARATNAM)

Dr. MV Ramaniah
44, Saras Baug
Devnar
Bombay-400 088

Letter Courtesy of Dr. M. Lavanya, from the Personal Collection of Dr. M. V. Ramaniah

Eastern Michigan University
Ypsilanti, Michigan 48197

June 2, 1987

Dr. M.V. Ramaniah
Director, Radiological Group
Bhabha Atomic Research Centre
Trombay
Bombay, India

Dear Dr. Ramaniah:

I heard from Dr. C.K. Mathews, during his recent visit to U.S.A., that you plan to retire soon. I wish you ALL THE BEST IN YOUR RETIRED LIFE. Do you plan to settle in Bombay?

I would like to convey my sincere thanks to you for intiating me in the area of radiochemistry and providing all the necessary help.

Sincerely,

K. Rengan

daw

Department of Chemistry
Room 225, Jefferson Science Building, (313) 487-0106, 7-0107

Letter Courtesy of Dr. M. Lavanya, from the Personal Collection of Dr. M. V. Ramaniah

MANGIPUDI VENKATA RAMANIAH

(1927 — 1997)

Elected Fellow 1980

DR MANGIPUDI VENKATA RAMANIAH belongs to that group of dedicated scientists who joined the Atomic Energy Programme in its inception and were responsible for establishing advanced facilities and research groups in various disciplines of nuclear science and technology. It is the foresight of such dedicated scientists that has led to the many successes of the Atomic Energy Programme in India. Dr Ramaniah initiated research programmes in the disciplines of Nuclear and Radiochemistry, and nurtured their growth in both basic and applied aspects. Together with his team of scientists, he made outstanding contributions in the areas of fundamental research in fission of actinide elements, solution chemistry of actinides, chemistry of plutonium-based reactor fuels, process chemistry, accounting and physical protection of nuclear materials and international safeguards.

The Early Years : Family Background Education and Scientific Research

Dr Ramaniah hailed from the village of Gangalakurru in the beautiful and fertile Konaseema region of the East Godavari District of Andhra Pradesh. He was born on May 14, 1927, to Sri MV Sarma and to Smt Mahalakshmi, the third child and eldest son in a family of seven children. His father was a landlord and an erudite Sanskrit scholar, a highly principled man with a love of learning and a command over several Indian languages. Trained by his father with strict discipline, in all aspects of life and work, the values that he imbibed early in life laid the ground for his remarkable character. The apple of his mother's and grandmother's eye, he also often helped them in their tasks. The young boy loved his childhood in the village amidst the fields and orchards, the religious atmosphere and the immensely rich cultural life. School was one of several activities, and yet, he excelled at it year after year, prompting the headmaster to urge his father to make sure that he pursued higher western-style education. Despite the young boy's own inclination towards Vedic study, his father sent him to the nearby town of Rajahmundry to pursue Intermediate studies. His

beloved grandmother accompanied him to keep house for him for a year, which spanned the wartime period in India.

From Rajahmundry, Dr Ramaniah went on to Waltair and to Madras to obtain a BSc (Honours) degree in Chemistry from Andhra University in 1948, standing first class first and winning the Sir SS Bhatnagar Prize. At Waltair, working first as a demonstrator and then as a lecturer in Chemistry in the department of Professor TR Seshadri, he began his research career with studies on thorium in the chemistry laboratory of Professor Bh SV Raghava Rao. He obtained his MSc degree by research in Chemistry in 1949.

Dr Ramaniah was to spend much of the next decade - the 1950s - in the United States of America. This was a tremendously exciting period and quite the best place in the world for Nuclear Science, which the young Ramaniah had decided would be his future field of research. During these years, he carried out research at several reputed universities, winning prestigious scholarships: the University Fellowship at the University of Illinois at Urbana-Champaign in 1952, the Rahammah Scholarship at Washington University, St. Louis, during 1953-54, and the University Fellowship at Washington University during 1954-56. During this period, he worked with several pioneers of Nuclear Science and Nobel Laureates: Therald Moellar at Urbana, Glenn T Seaborg at the Universtiy of California in Berkeley, Arthur C Wahl and Joseph W Kennedy at Washington University and Nathan Sugarman at the University of Chicago.

The first macro (microgram) quantities of plutonium had been produced at the cyclotron at Washington University during the war. After the end of the war, Arthur Holly Compton was appointed Chancellor of Washington University, and he brought with him several scientists who had been working on the Manhattan project at Los Alamos. Joseph Kennedy, who became Head of the Chemistry Department, and Arthur Wahl were two of the five co-discoverers of plutonium. It was with Arthur Wahl that Dr Ramaniah worked to obtain the degree of Doctor of Philosophy from Washington University in 1956. As part of his PhD work, Dr Ramaniah investigated the mass distribution in the 9.5 MeV deuteron-induced fission of thorium, analysing the results in terms of the peak-to valley ratio. The excitation energy of the compound nucleus enabled the understanding that the compound nucleus is ^{234}Pa formed by the deuteron tunneling through the Coulomb barrier and not ^{233}Th, that can result from the *(d,p)* reaction.

After his PhD, Dr Ramaniah moved to the University of Chicago where at the Enrico Fermi Institute for Neuclear Studies, he worked on the fission of uranium using cyclotron with the highest energy beam in the world at the time.

450 MeV, often doing the 'graveyard shift'. These studies led to estimates of the average kinetic energy cascade deposition energy and anisotropy of the fission products. At low cascade deposition energies, perpendilar emission of fragments was favoured. While at high deposition energies, forward-backward emission was favoured. The cascade deposition energy was calculated using Monte Carlo intranuclear cascade calculations from the recoil results for the formation of specific nuclide, and agreed with that obtained from an analysis of its excitation function.

The American experience was exciting and immensely rewarding and Dr Ramaniah enjoyed it thoroughly. But America was not 'home'. Idealism ran high in independent India, but the country was still receiving aid for food from the United States under the PL-480 programme. Dr Ramaniah had a fierce pride in his country's heritage and the formidable task of nation-building awaited him, as it did other brilliant and highly-trained expatriate Indians of the time. And so, in the winter of 1957, Dr Ramaniah chose to return to India, in order to join the Indian Atomic Energy Establishment at Trombay, near Bombay.

Architct of Nuclear and Radiochemistry in India

Homi Jehangir Bhabha was then scouting the world for the brightest scientific talents to work for the Indian Atomic Energy Programme. In all of the developed world, optimism that nuclear energy would provide a permanent and quick solution to the world's energy problems, ran high. Bhabha's call to his team of scientists was to work on a 'war footing' to achieve their goals. It was against the backdrop of this optimism and urgent need that pioneering scientists such as Dr Ramaniah began their work.

As Head of the Beta Laboratory from 1957-1965, Dr Ramaniah's initial activity centred around the neutron-induced fission of actinides using radio-chemical techniques. In 1965, he became the Head of the Radiochemistry Division at Trombay and, despite the meagre availability of resources at the time, initiated fundamental research in all the frontline areas of nuclear and radiochemistry. His excellent leadershp qualities and foresight resulted in establishing a school of nuclear and radiochemistry of international repute at Trombay.

Detailed investigations on the neutron-induced fission of actinides were carried out under his guidance at Trombay using radio-chemical techniques on various aspects, such as mass, charge and kinetic energy distribution and angular momentum of fission fragments using recoil catcher techniques, radiochemical separations and high resolution gamma spectrometry. These investigations

brought out the importance of single particle aspects such as the influence of the spherical/deformed nuclear shells and nucleon pairing, and collective aspects such as the influence of fragment deformation, dynamics of the late stage of the fission process and the role played by the potential energy surface of the fissioning nucleus on fission systematics.

The radiochemical studies of fission carried out by Dr Ramaniah and his associates during 1958-1987 contributed to a better understanding of this highly interesting and complex nuclear reaction. Extensive investigations on mass distribution showed that the one, two and three peaked mass distributions in low energy fission arise due to the relative contributions of the symmetric and asymmetric modes of fission, which in turn depend on the difference in barrier heights for these modes. It was also shown that this difference strongly depends on the neutron number rather than the proton number of the fissioning nucleus and further, the variation of this difference with mass number of the fissioning nucleus explains the observed variation in the peak-to-valley ratio with the fissioning nucleus. Results of kinetic energy distribution demonstrated the influence of the doubly magic shell at mass 132 on the total kinetic energy and kinetic energy deficit.

Results of studies on charge distribution and fragment angular momentum brought out the influence of 66 and 88 neutron deformed shells and further showed their dominant role when in phase with liquid drop energetics. It was also shown that the extent of variation of charge polarisation with mass asymmetry depends on the fissionability parameter due to the influence of the saddle point shape and dynamics of descent. Angular momentum studies provided estimates of fragment deformation and showed that odd Z fragments have high deformation due to the polarisation of the even Z core by the odd proton. Results of studies on medium energy fission have shown the influence of the saddle point properties on the charge distribution and fragment angular momentum due to higher excitation and shorter time of descent. These studies have thus contributed to a better understanding of the nuclear fission process, particularly concerning the late stage and have brought out the importance of the deformation energy surface, spherical and deformed nuclear shells, nucleon pairing and the dynamics of descent past the second saddle point.

On becoming the Director of the Radiological Group at the Bhabha Atoimc Research Centre (BARC) in 1979, Dr Ramaniah took up varied and challenging responsibilities. In this capacity, he played a key role in the development of plutonium-bearing nuclear fuels and radiological safety, in addition to directing

research in nuclear and radiochemistry. He was also the officer-in-charge of the Nuclear Materials Accounting Cell (NUMAC) which was responsible for the organisation and operation of a central accounting system for all nuclear materials being produced and used in all facilities in the Department of Atomic Energy (DAE).

Utilisation of plutonium in the Indian nuclear fuel cycle was a subject of special interest to Dr Ramaniah. In the area of fuel development, he was responsible for development work on the fabrication of plutonium based fuels and carried out important chemical investigations on the molten salt reactor concept utilising plutonium as a start-up fuel in the late sixties. He was instrumental in initiating a research and development programme on the wet route of fuel fabrication, viz., the sol-gel process, for which excellent facilities were established. He was responsible for the project on mixed-oxide (MOX) fuel for the 200 MW power reactor at Tarapur. In a short period, facilities were set up for producing this alternate fuel, and feasibility was established. Another area of interest to him, in which he brought out the crucial role of chemistry in the nuclear power programme, was the chemical quality control of plutonium-based fuels involving the determination of fissile isotopes, trace constituents, carbon, O/M ratio, moisture and absorbed gases. These studies were very fruitful for the characterisation of fuels for the Fast Breeder Test Reactor. Several non-destructive assay techniques for plutonium at various stages of the nuclear fuel cycle were also developed. He also made significant contributions in radio analytical and inorganic chemistry. One area of interest to him was the process chemistry of uranium, neptunium and plutonium, the findings of which were utilised in the reprocessing of irradiated fuel at Trombay and at the Power Reactor Fuel Reprocessing (PREFRE) plant. Dr Ramaniah was instrumental in the development of many methods for the precise and accurate determination of plutonium at several key points of the nuclear fuel cycle using mass spectrometry, alpha spectrometry and electrochemical methods. This also resulted in the contribution of a large volume of nuclear data on fission yields useful to nuclear technology. Apart from his research activities, Dr Ramaniah was instrumental in setting up large radiochemical laboratories for high level plutonium work, such as the radiochemistry laboratories at Trombay, at the Indira Gandhi Centre for Advanced Research (IGCAR) in Kalpakkam, the MOX plant at Tarapur, and at the Variable Energy Cyclotron Centre (VECC) in Calcutta, which paved the way for large scale applications of nuclear and radiochemistry in India. The research and development work carried out under his guidance led to the award of the degree of Doctor of Philosophy to more than 25 students.

Dr Ramaniah's duties included serving on several important committees: he was Chairman of the Working Group for reviewing design criteria for hot cells, standardisation of equipment, etc. from 1973. He was Chairman of the Physical Protection Committee constituted by the DAE during 1978-1984. During this period, the general philosophy and design of physical protection measures at different nuclear facilities of the DAE were worked out. He worked as Convenor of the committee constituted by the DAE in 1983 for the preparation of the Nuclear Power Profile, 1985-2000.

Dr Ramaniah was very active in the field of safety aspects of the nuclear fuel cycle. From 1975 to 1988, he worked as Convenor of the Safeguards Committee appointed by the DAE. The work of the Committee included various aspects of IAEA safeguards implementation. He served as Chairman of the Safety Review Committee of the DAE and also as a member of the Atomic Energy Regulatory Board (AERB). He also served as Consultant to the AERB for two years during 1988-1989.

Representative of India at the IAEA

Dr Ramaniah served as Indian representative to the International Atomic Energy Agency (IAEA) on several assignments throughout his career.

During 1963-1964, he worked as an IAEA expert in Radiochemistry at the Institute d' Energia Atomica at Sao Paulo, in Brazil, where he helped to establish a programme of research in radiochemistry and in the production of radioisotopes.

From 1975 to 1983, he served as a member of the ten-member Standing Advisory Group on Safeguards Implementation (SAGSI) appointed by the Director-General of the IAEA in 1975, for advising him on various aspects of international safeguards.

He also represented India at the IAEA on various other assignments: meetings of the Working Group-4 (dealing with reprocessing, plutonium handling and recycling) of the International Nuclear Fuel Cycle Evaluation (INFCE) during 1978-1979; meetings of the Expert Group on International Plutonium storage (IPS) during 1978-1982; meetings of Governmental representatives for drafting the International Convention on the Physical Protection of Nuclear Material under International Transport during 1978-79: and meetings on the

committee on Assurances of Supply during 1984-1985. In 1986, he participated in an international meeting for drafting two important international conventions, one on 'Early Notification of a Nuclear Accident' and the other on 'Mutual Assistance in the case of a Nuclear Accident or Radiological Emergency'.

Sometimes, even under difficult circumstances, Dr Ramaniah always met the challenge of presenting the Indian viewpoint with courage and competence, earning international respect for, and understanding of, India's position.

Academic and Related Activity

Dr Ramaniah enjoyed teaching and taught for several years: Chemistry courses at Andhra University, at Berkeley and at Washington Universities; Radiochemistry at the Institute d'Energia Atomica in Brazil, at IIT Powai, and at the BARC Training School; and Nuclear Chemistry at summer refresher courses for post-graduate chemistry teachers.

He also worked on the boards of several universities in various capacities: as PhD examiner for SV University, Tirupati, and IIT Kanpur; as chairman, member Board of Examiners for MSc in Chemistry at Andhra, SV, Osmania and Sagar Universities; as member, Selection Commitee for the selection of Faculty members at Andhra and Poona Universities; as member, Selection Committee for the award of scholarship by the Nizam's Charitable Trust for studies in Nuclear Technology; and as member, Board of Studies, SV University.

One of the many benefits of the Atomic Energy Programme in India has been the spur it has given to Indian industry. The latter was compelled to achieve quality control and maintain standards of excellence in the products that it delivered to the nuclear industry. Dr Ramaniah was one of the pioneering scientists who interacted with and encouraged industry in this regard.

The promotion of nuclear chemistry and radiochemistry and their applications to different branches of science and technology at educational and research institutions was a cause that was very dear to Dr Ramaniah. He conceived of the idea of a national forum, and worked for it and founded the Indian Association of Nuclear Chemists and Allied Scientists (IANCAS). It is because of his dedicated efforts and dynamic leadership that this Association has grown rapidly, and is working towards fulfilling his dream of nurturing the scientific temper in India. He was President of the Association in the years 1985-1987. As a member of the DAE Committee on Basic Research in Nuclear Sciences a

he worked for the cause of nuclear and radiochemistry. He was also the Founder-President of the Indian Nuclear Society (INS) and during his tenure from 1989 to 1990, he established a massive trust fund, and introduced the feature of an annual conference.

Distinctions

Dr Ramaniah served as a member of the editorial Advisory Board of the journal, the *Radiochemica Acta*, during 1965-1977, and was the first Asian to do so.

Dr Ramaniah was elected as a Member of the *Sigma Xi* Society in 1953. He was elected Fellow of the Royal Institute of Chemistry, London in 1965, of the Maharashtra Academy of Sciences, of the Andhra Pradesh Academy of Sciences and of the Indian National Science Academy in 1980. He delivered the Jolio-Curie Memorial Lecture at the University of Poona in 1992.

Family and Personal Life

Dr Ramaniah married Kum G Vasantalakshmi on May 18, 1959. She hailed from a highly educated and well-known family of Kakinada and was the daughter of Sri GB Rama Rao and Smt Kamalamani. An MA in Economics and accomplished in the fine arts, Smt Vasantalakshmi was also a very well-kown Bharata Natyam dancer of Madras. Their only child, Kamala Lavanya Mahalakshmi, was born in 1962. To his daughter, Dr Ramaniah imparted his own deep love of science, and his wonder at the magic of nature, and of life itself. Lavanya is now a well-established theoretical physicist working at BARC. With his wife, and with family members and numerous friends from different professions, Dr Ramaniah shared his excitement at the challenges and his pride in the achievements of the Indian Atomic Energy Programme, often inviting them to Trombay to see for themselves.

To family members on both sides, he was an unfailing source of support and help. To his brothers, to nephews on both sides and to several friends, he was a source of inspiration and generous guidance. He enjoyed the company of youngsters, challenging and stimulating them with questions and discussions. Several of those who availed of the benefit of his intense guidance and advice, have scaled great heights in their chosen professions.

PERSONAL QUALITIES

Dr Ramaniah was a man, with extraordinary qualities of character, of the heart and of the intellect, of the kind that one is only rarely privileged to be associated with. Deeply religious and intensely philosophical by nature, his spiritual convictions underlay all of his life and actions. A man of vision, with great breadth of perspective as well as depth of understanding, in many respects he was a trend-setter and far ahead of his times, who strived hard and spared no efforts in his own spheres of influence to improve the society and the country, so that it could hold its head high in the comity of nations.

Highly principled, he was straightforward and scrupulously honest in all dealings, financial, professional, and personal, even if this meant that he would be disadvantaged. Enormously self-disciplined, he kept his word, was dependable and stuck to time and schedules. A man of few words and often silent during discussions, he never hesitated to speak his mind if he felt the need to do so. Modest and unassuming, he did not seek honour or recogntion, keeping himself immersed in work with single-minded devotion. A perfectionist, methodical and systematic, he set the highest standards for himself and also for the people around him, and could be a tough task-master if necessary. Yet, he was humane towards fellow beings and very soft hearted, especially when it came to pain and suffering. Both from his early training under his father, and the time he spent in the United States, he had an unshakeable faith in hard work and in the dignity of labour, to the extent that he was uncomfortable having servants at home. He had a subtle sense of humour, a fine sense of fun, and an adventurous spirit tempered by a deep sense of duty and responsibility. He took his duties completely seriously, showing enormous courage, when required, in discharging them. He was unselfish, and always generous in sharing his knowledge and understanding in any field. He was just, and would not hesitate in admitting to a mistake when he realised it. He gave everything he had to a project that he undertook and would often get completely involved in the problem at hand, forgetting hmself totally. 'One can re-search even sweeping' he would say, and indeed research, for him, was an attitude to life.

A man of many talents, he had a vigorous enthusiasm for life and was interested in all aspects of it. He was a good cook. 'A good chemist must be a good cook' was his favourite saying, and he enjoyed experimenting, often coming up with recipes for his own version of tasty and spicy South Indian food. He could spend hours tinkering with and repairing machines and gadgets, an

was well-equipped for this with his own complete toolkits. Photography was a special interest, and he was a perfect photographyer. His taste in reading inclined towards finance, politics and philosophy, apart from science. Music was a favourite hobby, and he had an excellent collection of carnatic and western classical music; he also enjoyed classical dance performances. He liked plants and trees, and planted the garden at his Saras Baug home by himself. Himself childlike in many respects, he got along well with little children, sharing their fascination for the world around them. A complete vegetarian, he had a simple lifestyle; in his middle age, he began practising yoga and took a long walk daily, and advocated these enthusiastically to his friends. He had a rich fund of folk and sanskrit stories and proverbs, and he often drew from these in order to understand and face life in all its complexity.

Dr Ramaniah frequently stressed that the work that he undertook was possible only due to the enormous support that he received from all quarters. This brief biographical sketch is therefore incomplete, as it omits mention of the numerous distinguished colleagues with whom he was associated in various capacities in the course of his career; such an account would entail a much more detailed biography.

Dr Ramaniah passed away on May 22, 1997, a year after he was diagnosed with prostate cancer. He remained self-reliant in all his tasks right upto the end. He is deeply mourned and missed by his wife and daughter, family, friends and colleagues. The long and illustrious career of Dr Ramaniah, studded with numerous contributions and achievements, will ever remain a great source of inspiration and strength to his students, colleagues and admirers. They cherish with affection his dedication to work and his untiring efforts to take on newer and more challenging problems.

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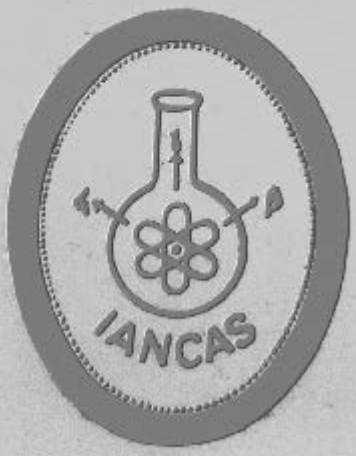

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THE NUCLEAR FUEL CYCLE

A Seminar organised at BARC, Trombay.

Bombay on May, 27 1987 to felicitate

Dr. M. V. RAMANIAH

President IANCAS and Director, Radiological Group, BARC

on his completion of 60 years.

INDIAN ASSOCIATION OF NUCLEAR CHEMISTS & ALLIED SCIENTISTS
(Regd No. MAH/232/1984 GBBSD)
C/o. Radiochemistry Division, Bhabha Atomic Research Centre, Trombay, Bombay-400 085.

DR. M.V. RAMANIAH - ARCHITECT OF NUCLEAR AND RADIOCHEMISTRY IN INDIA

Dr Mangipudi Venkata Ramaniah belongs to that group of dedicated scientists who joined the atomic energy programme at its inception and were responsible for establishing advanced facilities and reasearch groups in various disciplines of nuclear science and technology. It is because of foresight of such dedicated scientists that today we all can be proud of the fact that the atomic energy programme is one of the most successful scientific endeavours in India. Dr Ramaniah initiated research programmes in radiochemistry discipline and has been responsible for its growth in both basic and applied aspects. He made outstanding contributions in the areas of fundamental research in fission of actinide elements, solution chemistry of actinides, chemistry of plutonium based reactor fuels, process chemistry, accounting and physical protection of nuclear materials and international safeguards.

Born on May 14, 1927, Dr Ramaniah hails from Gangalakurru village in the Konaseema Region of East Godavari District, Andhra Pradesh. He obtained his M.Sc. degree from Andhra University, Waltair and subsequently served there as a lecturer in chemistry. He was awarded the degree of Doctor of Philosophy from Washington University, St. Louis, USA in 1956 and also carried out research in several reputed Universities like University of Chicago, University of California at Berkeley and University of Illinois. During this period he worked with pioneers of nuclear science like Glenn T. Seaborg, Joseph. W. Kennedy, Arthur C. Wahl, Nathan Sugarmann and Theralad Moeller.

Dr Ramaniah joined the Indian Atomic Energy Programme in 1957. His initial activity centred around the reactor neutron induced fission of actinides using radiochemical techniques. In 1965, he became the Head of the Radiochemistry Division at Trombay. With the meagre resources at that time, Dr Ramaniah initiated fundamental research in all the front line areas of nuclear and radiochemistry. His excellent leadership qualities and foresight resulted in establishing a school of nuclear and radiochemistry of international repute at Trombay. On becoming the Director, Radiological Group at BARC in 1979, Dr Ramaniah took up varied and challenging responsibilities. In this capacity he was responsible for the development of plutonium bearing nuclear fuels and radiological safety, in addition to directing research in nuclear and radiochemistry. He was also the officer-in-charge of the Nuclear Materials Accounting Cell (DAE). His meritorious contributions were recognised both nationally and Internationally. He was elected as Fellow of Royal Institute of Chemistry London in 1965 and as Fellow of Indian National Science Academy in 1980.

As a nuclear scientist, he made significant contributions towards the understanding of nuclear fission process, a most complex nuclear reaction by radiochemical investigation on low,

medium and high energy fission of a number of actinide isotopes. The extensive investigations carried out by him on nuclear fission of actinides ranging from ^{227}Ac to ^{252}Cf resulted in arriving at the systematics of mass, charge, kinetic-energy and fragment angular momentum. These systematics have been very helpful in delineating the importance of potential energy surface of fissoning nucleus, dynamical aspects such as mass and charge polarization and the role of fragment nuclear structure, fissility parameter and excitation energy of fissioning nucleus in the fission process.

Utilisation of plutonium in Indian nuclear fuel cycle has been a subject of special interest to Dr Ramaniah. In the area of fuel development, he was responsible for the development work on the fabrication of plutonium based fuels and carried out important chemical investigations on the molten salt reactor concept utilising plutonium as a start-up fuel in the late sixties. He was instrumental in initiating research and development programme on the wet route of fuel fabrication viz. sol-gel process for which excellent facilities were established. He was responsible for the project on mixed oxide (MOX) fuel Tarapur. In a short period facilities were set up for producing this alternate fuel and feasibility was established. Another area of his interest where he brought out the crucial role of chemistry in the nuclear power programme is the chemical quality control of plutonium based fuels involving the determination of fissile isotopes, trace constituents, carbon, O/M ratio, moisture and absorbed gases. These studies were very fruitful for the characterisation of FBTR fuels. Several non-destructive assay techniques for plutonium at various stages of the nuclear fuel cycle were also developed. He has also made significant contribution in radioanalytical and inorganic chemistry. One of the areas of his interest is the process chemistry of uranium, neptunium and plutonium, the findings of which have been utilised in the reprocessing of irradiated fuel at Trombay and PREFRE. Dr Ramaniah was instrumental for the development of several methods for the precise and accurate determination of plutonium at several key points of the nuclear fuel cycle using mass spectrometry, alpha spectrometry and electrochemical methods. This has also resulted in contributing to a large volume of nuclear data on fission yields useful to nuclear technology. Apart from his research activities, Dr Ramaniah has been instrumental in setting up large radiochemical laboratories for high level plutonium work such as radiochemistry laboratories at Trombay, at IGCAR Kalpakkam, MOX plant at Tarapur and at Variable Energy Cyclotron Centre Calcutta which paved the way for large scale applications of nuclear and radiochemistry in India. The research and development work carried out under his guidance led to the award of degree of Doctor of Philosophy to more than 25 students.

During 1963-64 he served as an International Atomic Energy Agency (IAEA) expert in Brazil where he helped in establishing radiochemical programme. Since June 1975, Dr Ramaniah worked as Convenor of the Safeguards Committee appointed by DAE. He also

served as a member of the Standing Advisory Group on Safeguards Implementation appointed by Director General, IAEA during 1975-83 for advising him on various aspects of International Safeguards. During the last 15 years he also represented India at IAEA at various international meetings like International Nuclear Fuel Cycle Evaluation, International Plutonium Storage and Committee on Assurances of Supply. He represented India for working out the International Convention on the Physical Protection of Nuclear Material under international transport.

Dr Ramaniah has been very active in the field of safety aspects of nuclear fuel cycle and served as Chairman, Safety Review Committee of the Department of Atomic Energy and also a member of the Atomic Energy Regulatory Board. In 1986 he participated in an international meeting for drafting two important International Conventions, one on "Early Notification of a Nuclear Accident" and the other "Mutual Assistance in the case of a Nuclear Accident or Radiological Emergency".

Promotion of nuclear chemistry and radiochemistry and its applications to different branches of science and technology at educational and research institutions in our country has been very dear to Dr Ramaniah. In order to achieve this goal, he conceived the idea of a national forum and worked for and founded the Indian Association of Nuclear Chemists and Allied Scientists. It is because of his dedicated efforts and dynamic leadership that this Association has grown rapidly. He is currently the President of the Association. As a member of DAE Committee on Basic Research in Nuclear Sciences also, he worked for the cause of nuclear and radiochemistry.

The long and illustrious career of Dr Ramaniah studded with numerous contributions and achievements will ever remain a great source of inspiration and strength to his students, colleagues and admirers. They cherish with affection his dedication to work and his untiring efforts to take on newer and more challenging problems and most sincerely wish him happiness and fulfilments in all his future activities for long time to come.

P R E F A C E

It gives me great pleasure in associating myself in bringing out this IANCAS Special Bulletin to honour Dr M.V. Ramaniah, President, IANCAS and Director, Radiological Group on his 60th birthday. The bulletin consists of the papers to be presented at the Seminar, "The Nuclear Fuel Cycle", being held on May 27, 1987 at B.A.R.C. to felicitate Dr. Ramaniah. With deep sense of gratitude, IANCAS thanks Dr M.R. Srinivasan, Chairman, A.E.C. for kindly agreeing to preside over the function and Dr P.K. Iyengar, Director, B.A.R.C. for inaugurating the Seminar.

The theme of the Seminar has been very dear to Dr. Ramaniah throughout his illustrious career in the Department of Atomic Energy. Stalwarts will present papers which deal with the entire gamut of the Nuclear Fuel Cycle starting from uranium exploration, production of nuclear materials, fuel fabrication, power reactor technology, reprocessing of the spent fuel, advanced fuel concepts and the safety aspects. The topic on uranium exploration will be expertly dealt with by Shri T.M. Mahadevan. The historical background, the availability of the uranium ores in the country, the assessed and anticipated reserves and the techniques employed in the exploration are discussed in the paper. The production of nuclear fuel materials, UO_2, U_3O_8, ThO_2 and other reactor materials like zircaloy and heavy water and the associated chemistry aspects have been elucidated in the paper by Shri T.K.S. Murthy. The fabrication procedures for PHWR, BWR fuels and reactor materials, the capacity and facilities available at A.F.D. and N.F.C. are excellently covered in the paper by Shri K. Balaramamoorthy et al. The technological know-how developed indigenously for power reactors and the capabilities of the Indian Nuclear Power Industry to meet the target of 10,000 MWe by 2000 A.D. have been expertly discussed by Shri K.V. Mahadeva Rao. The expertise developed in the country for the recovery of plutonium while reprocessing the irradiated fuel and the management of the nuclear waste generated in the process have been brought out in the paper by Shri A.N. Prasad. In order to improve the performance of the nuclear fuels, development work on the concept of advanced fuels has to be constantly pursued. The utilisation of plutonium in advanced fuels like carbides, nitrides and other alloy fuels and also sol-gel microsphere pelletization have been highlighted in the paper by Shri P.R. Roy and Dr. C. Ganguly. The safety aspects in the entire Atomic Energy programme, the related research and development work in radiological safety and environmental studies have been elegantly covered in the paper by Shri T.S. Iyengar and Shri S.D. Soman.

The Association expresses its grateful thanks to all the speakers for having kindly accepted the invitations, providing the texts of their talks in a short time and making the Seminar a success. Finally IANCAS would also like to acknowledge the wholehearted participation and contribution of various industries to the Seminar.

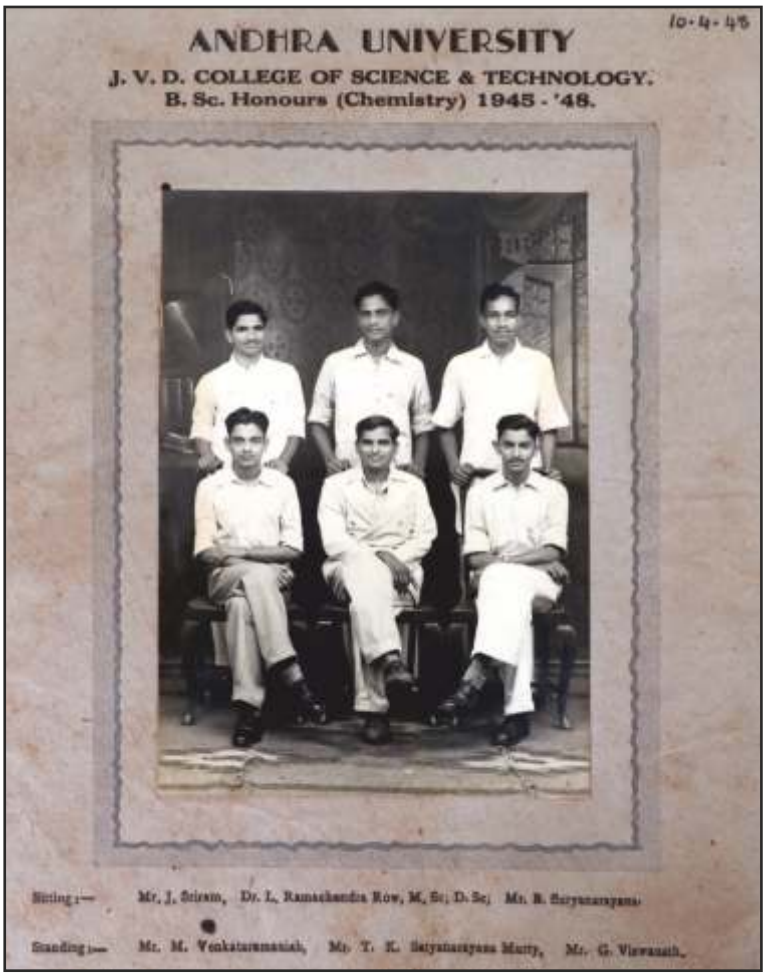
H.C. JAIN

Photo Feature

Footprints on the Sands of Time

Photographs Courtesy of
Dr. M. Lavanya
from the Personal Collection of Dr. & Mrs. M. V. Ramaniah
&
BARC Archives (where indicated)

Sri. M. V. Sarma and Smt. M. Mahalakshmi, parents of Dr. M. V. Ramaniah, Gangalakurru, 1981.

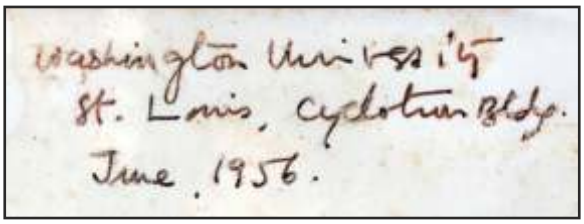


←

First from Left (Standing),
Mr. M. V. Ramaniah ,
1st rank holder B.Sc. (Honours),
Andhra University, Waltair, 1948.

→

Mr. M. V. Ramaniah, 'Ram' to friends.



Mr. M. V. Ramaniah at the Washington University Cyclotron Building, St. Louis, Missouri, June 1956. The first weighable sample (2.77 μgm) of Pu was produced here in August, 1942.

→

Dr. M. V. Ramanaih at the Enrico Fermi Institut for Nuclear Studies, University of Chicago, 1957.

Mr. M. V. Ramaniah with fellow graduates, Commencement, Washington University, St. Louis, Missouri, June 1956.

Dr. M. V. Ramaniah in conversation with the University Provost at his Commencement ceremony.

October, 1956.

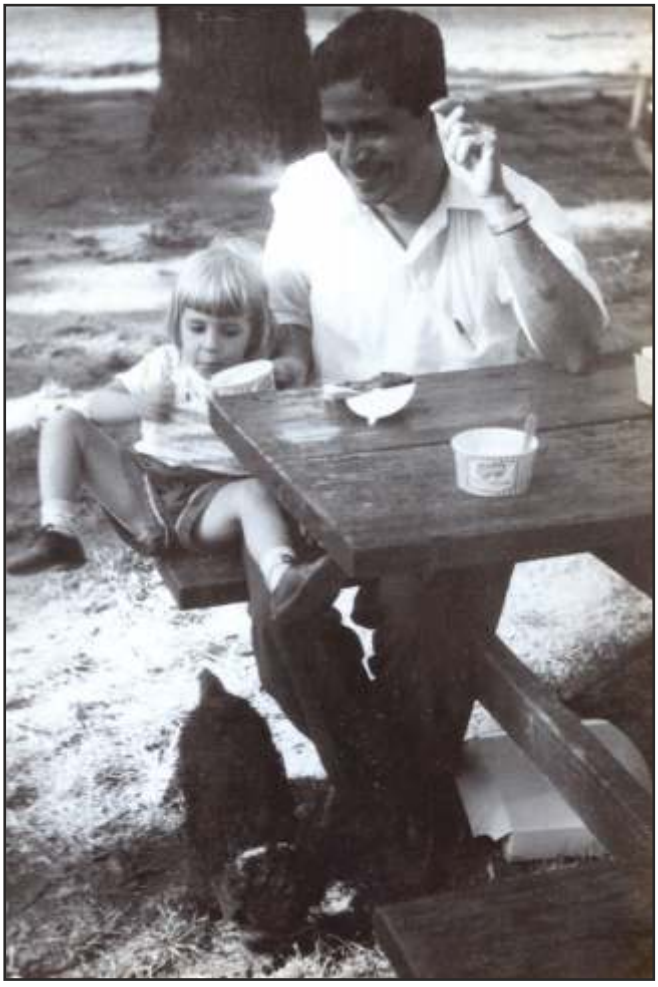
September, 1957.

Dr. M. V. Ramaniah in his laboratory, Enrico Fermi Institute for Nuclear Studies, University of Chicago.

Dr. M. V. Ramaniah at the Gordon Research Conference on Nuclear Chemistry, Meriden, New Haven, USA, 24-6-1957. Also seen in the pictures are Nobel Laureate Prof. Glenn Seaborg, Prof. Nathan Sugarman, Prof. V. Goldanskii (USSR), Prof. E. K. Hyde, Dr. Emilio Lopez-Menchero and Dr. Gerald Lange.

Dr. M. V. Ramaniah in informal discussions with colleagues, University of Chicago, September 1957.

Photographing the photographer!
Ram was more often found behind the camera than in front of it!



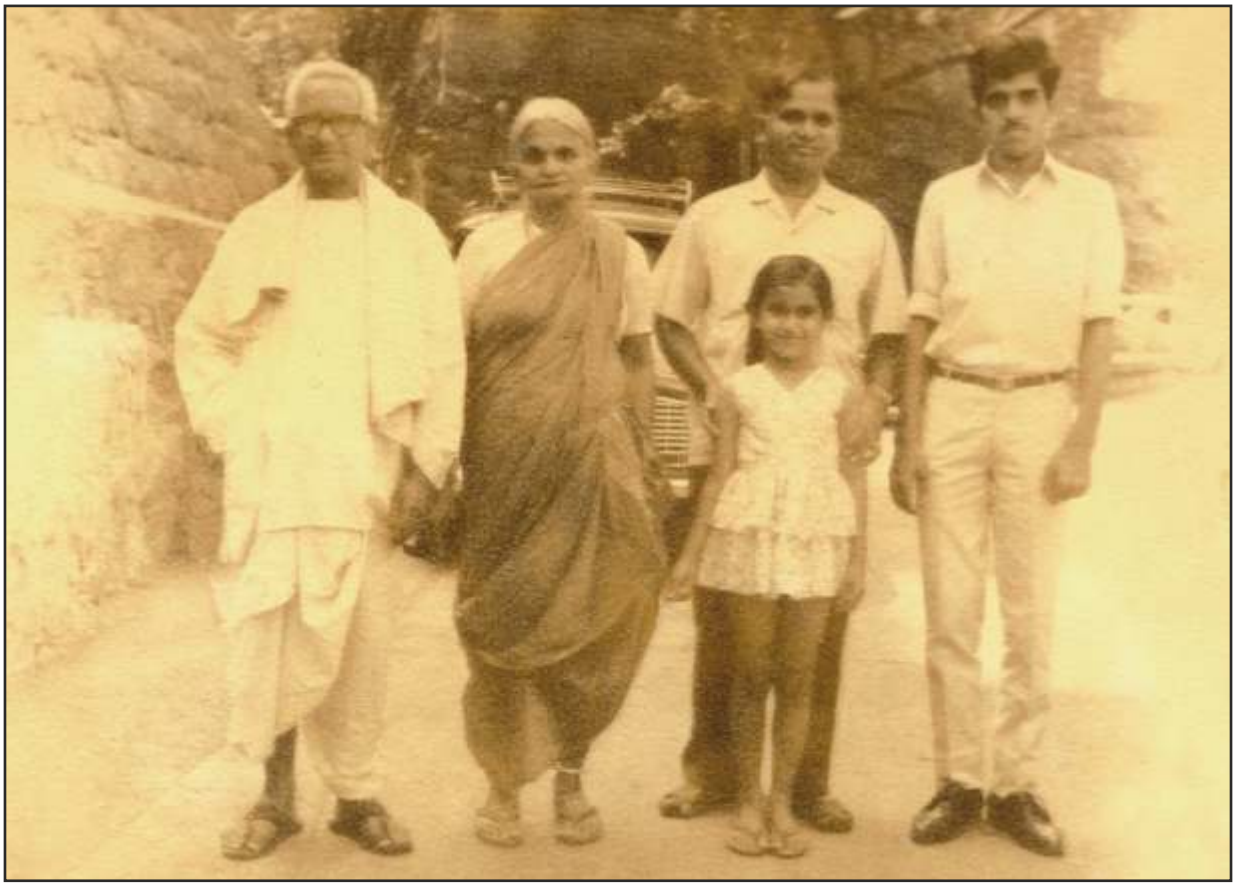
Ram at a picnic, Washington University, 1955.

Dr. M. V. Ramaniah with friends Dr. Emilio Lopez - Menchero, Dr. Hyde, Dr. Goldase, Massachusetts Institute of Technology (MIT), Cambridege, Massachusetts, 1957.

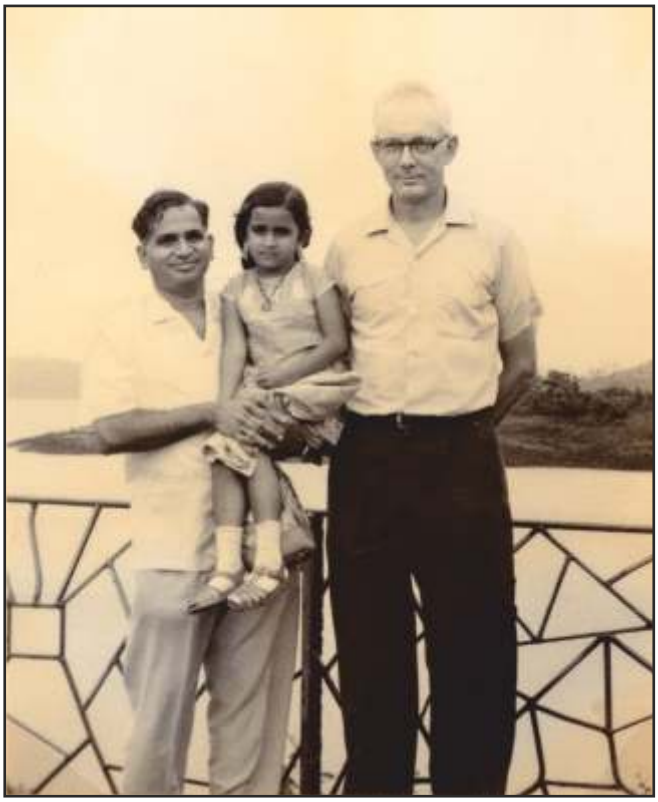
Dr. M. V. Ramaniah at his send-off party, University of Chicago, September 1957.

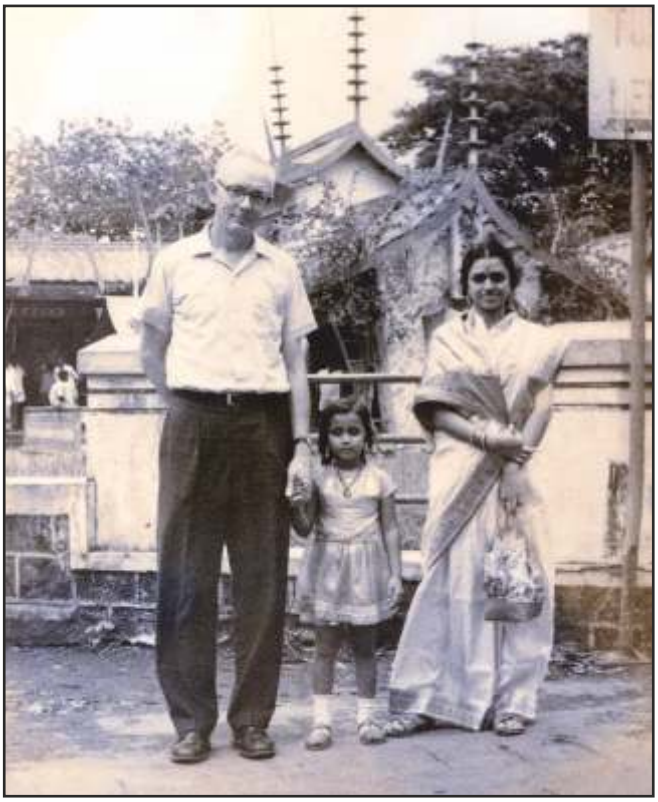
Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi, 1959.

Dr. M. V. Ramaniah and baby daughter Lavanya, with friends. Europe, 1964.

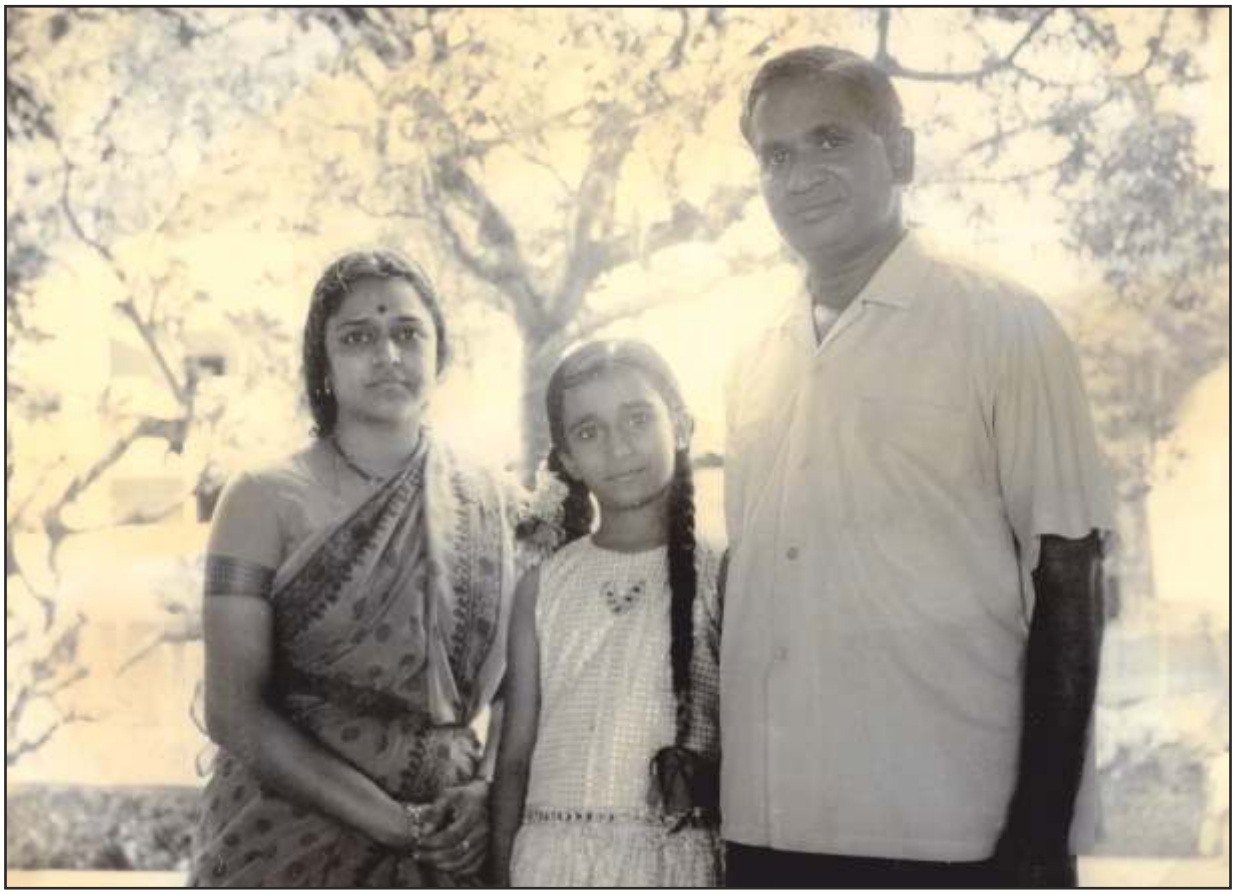


Dr. M. V. Ramaniah with parents, Sri. M. V. Sarma and Smt. M. Mahalakshmi, daughter Lavanya and nephew Ram, Kenilworth, Bombay.



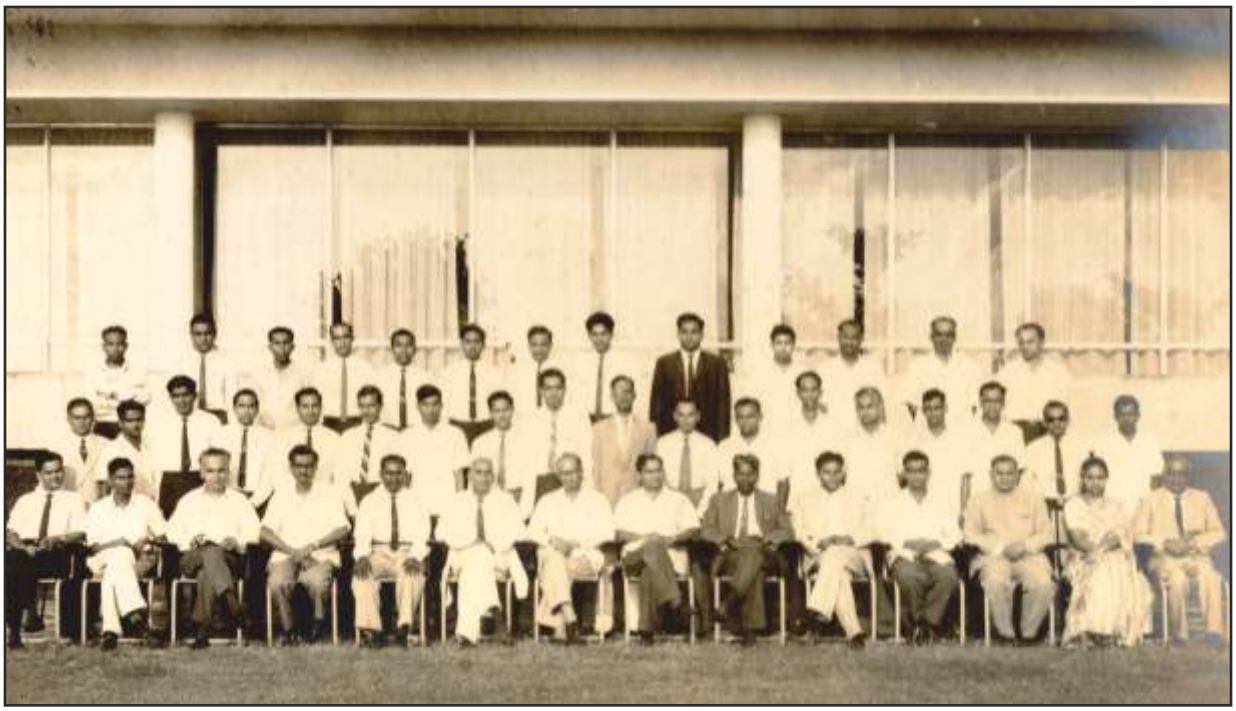


**Prof. Arthur Wahl, one of the four co-discoverers of Plutonium, during his visit to Bombay, 1967.
Seen here with Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi and their daughter Lavanya.
Dr. Ramaniah earned his Ph.D. degree with Prof. Arthur Wahl.**



Dr. M. V. Ramaniah with Mrs. M. Vasantalakshmi and Miss Lavanya, Malabar Hill, Bombay.

Dr. M. V. Ramaniah with Mrs. M. Vasantalakshmi and Ms. Lavanya, at a programme in Central Complex Auditorium, BARC, 1982. Seated next to Dr. Ramaniah, are Dr. P. K. Iyengar and Mrs. Seetha Iyengar.



GOVERNMENT OF INDIA ATOMIC ENERGY ESTABLISHMENT TROMBAY

The Fourth Refresher Course for University Teachers in Physics & Chemistry

(MAY—JUNE 1965)

SITTING (Left to Right):- Dr. C. L. Rao, Prof. R. R. Daniel, Prof. Yash Pal, Dr. R. Ramana, Dr. K. K. Damodaran, Shri A. S. Rao, Dr. P. L. Khare, Dr. M. V. Ramaniah, Shri K. S. Murthy, Dr. C. K. Mathews, Dr. A. S. Ghosh Mazumdar, Dr. V. A. Vyas, Mrs. K. S. Lokre, Dr. D. M. Desai.

STANDING (Left to Right): 1st Row — Dr. S. D. Ambegaokar, Prof. S. S. Kulkarni, Dr. B. K. Sharma, Shri A. K. Pandya, Dr. K. S. Srivastava, Shri N. B. Goswami, Shri A. K. Gupta, Shri H. P. Sinha Shri S. P. Sangal, Dr. F. A. Siddiqui, Prof. V. C. Upadhyaya, Prof. H. M. Shah, Prof. G. N. Navaneeth, Prof. S. S. Sangal, Dr. V. R. Sastry, Prof. S. S. Solanki, Prof. V. V. Agashe, Prof. K. P. Joshi.

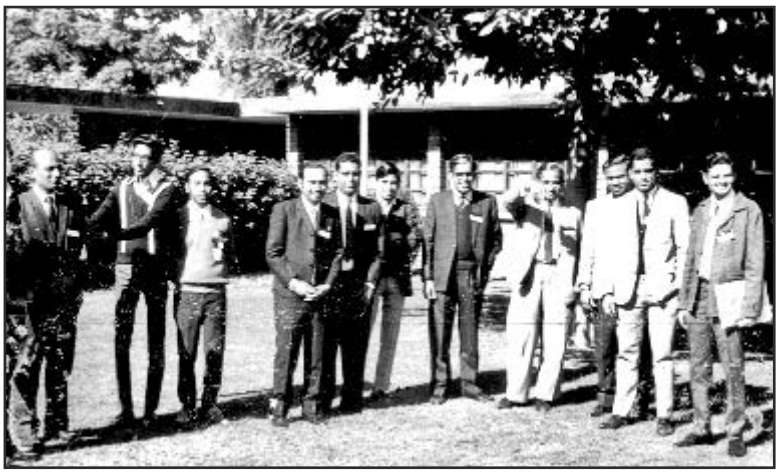
STANDING (Left to Right): 2nd Row — Shri N. N. Kakde, Shri U. M. Bhatt, Shri Kurian Varughese, Dr. S. P. Banerjee, Shri S. P. Agrawal, Shri A. K. Jain, Shri O. P. Bhargava,* Dr. J. P. Sharma Shri S. Srinivasan, Shri J. C. Mohanakrishna, Prof. S. P. Sinha, Dr. S. V. Soman, Dr. Y. G. Kher.

The 10th Refresher Course in Nuclear and Radiochemistry
Bhabha Atomic Research Centre, Bombay, May 1 - June 8, 1979

1st row sitting 1-10 — Y. Yagnasubramanian, R.K. Iyer, M.S. Chadha, M.V. Ramaniah, M.D. Karkhanawala, R.M. Iyer, R.H. Iyer, N.B. Mulchandani, S. Gangadharan, Satya Prakash

2nd row standing 1-19 — B.B. Patil, H.C. Jain, N. Sampathkumar, A. Ramaswamy, G.T. Bhandage, C.P. Shinde, A. Nageswara Rao, B. Keshavan, R.R. Roy, K. Gnanasekharan, A.S. Upyal, D.K. Hazra, V.S. Srinivasan, Ramesh Astik, S.K. Patil, J.N. Srivastava, Iswar Singh, S. Sugasan, S.G. Marathe.

3rd row standing 1-9 — V. Chakraborty, M. Raman, S.D. Manohar, C.K. Sivaramakrishnan, M.S. Sataragi, R.J. Singh, Keshav Chander, S.D. Bhalalkar, S.M. Shah.



DAE Symposium at AMU, Aligarh :
From right to left :
Dr V.K. Rao, Dr R.H. Iyer, Dr Satya Prakash,
Dr M.V. Ramaniah, Dr P.R. Natarajan,
Dr V.K. Manchanda, Dr P.N. Iyer,
Dr A.G.I. Dalvi, Dr R.T. Chitnis and others

DAE Symposium at AMU, Aligarh:
From Left to right : Dr R.T. Chitnis,
Dr K.S. Venkateswarlu, Dr S.K. Patil,
Dr P.R. Natarajan, Dr M.V. Ramaniah,
Dr P.N. Iyer, Dr R.H. Iyer and Dr A.G.I. Dalvi

Dr. M. V. Ramaniah at the Symposium on
High Temperature Chemistry,
BARC, 21-1-1982.

Dr. M. V. Ramaniah at the
A. P. Akademi of Sciences,
Hyderabad, National
Science Day, 28-2-1987.

Dr. M. V. Ramaniah delivering a talk at the IAEA Interregional Training Course on Radiation Protection, BARC, Bombay. Photo courtesy BARC Archives.

Dr M. V. Ramaniah, Director Radiological Group, BARC chairing the discussion session on Organization of Radiation Protection, Dr. U. Madhavnath, Division of Radiological Protection, Rapporteur. Reprinted from AERB Newsletter, Vol. 2 (1986).

Dr. M. V. Ramaniah at the "Atoms for Peace, Power and Prosperity" Seminar, I.I.Sc. Bangalore, 12-8-1988.

Dr. M. V. Ramaniah at the National Workshop on Nuclear Chemistry and Isotope Applications, Institute of Science, Bombay, October 1986. Also seen in the picture are Prof. Z. R. Turel and others.

Dr. M. V. Ramaniah with fellow delegates at the IAEA Research Council Meeting on C1-4 for Nuclear Facilities, TIFR, Bombay, 12-12-1984.

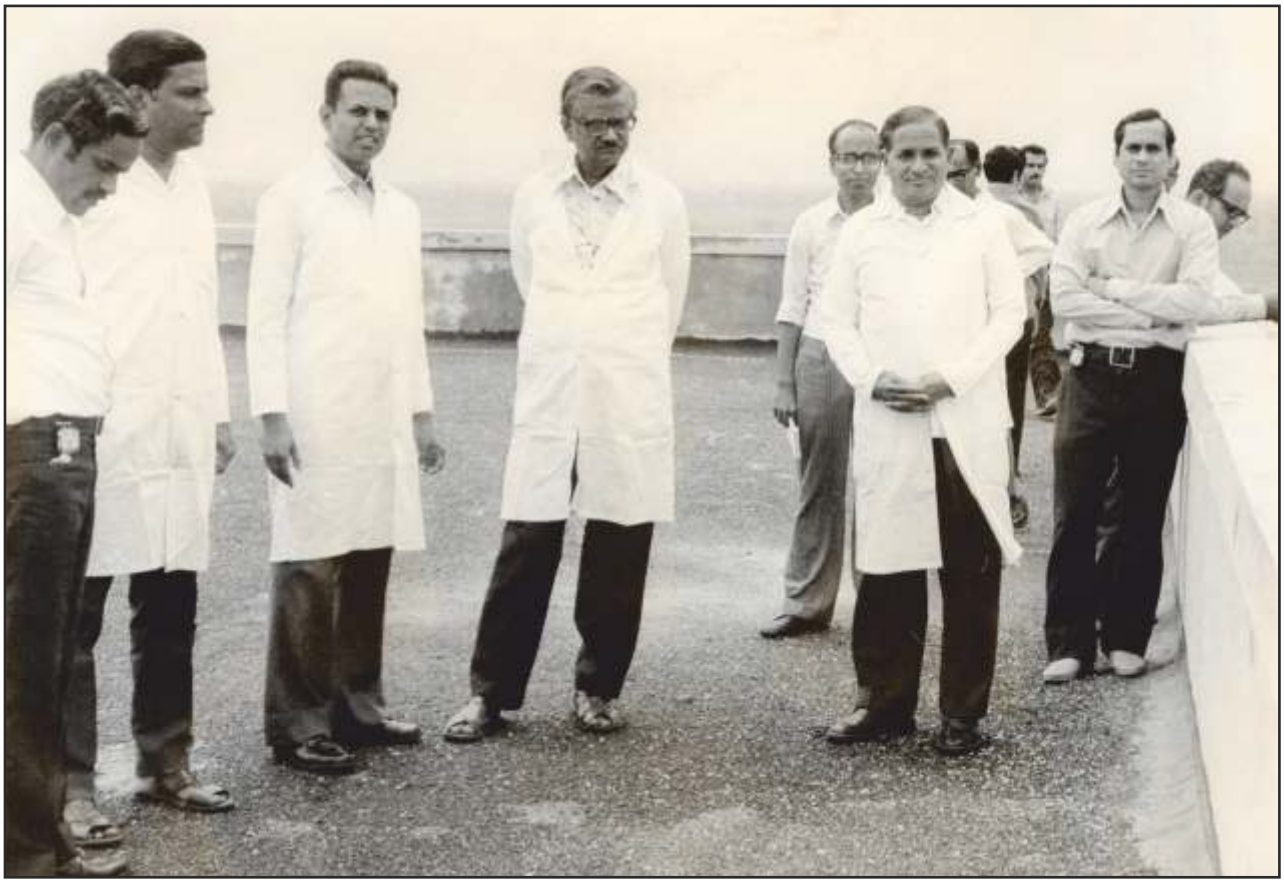
Dr. M. V. Ramaniah with Mr. P. R. Dastidar and Mr. Syed Fareeduddin.

Indo-French Seminar on Nuclear Energy, Air India Lecture Hall, Bombay, April 1, 1985.
Seen in the pictures are Dr. M. V. Ramaniah, Dr. Raja Ramanna, Dr. Vendrez and Dr. M. R. Srinivasan.

← Dr. M. V. Ramaniah with Dr. Raja Ramanna and others, BARC Labs., Bombay.

Dr. M. V. Ramaniah with Dr. Raja Ramanna, Mr. G. V. Nadkarni, Dr. P. K. Iyengar and others, 1985.

Dr. M. V. Ramaniah with Dr. Raja Ramanna at the Apsara Reactor, BARC.
Also seen in the picture are Shri P. N. Krishnamurthy, Shri A. N. Prasad and others.



Dr. M. V. Ramaniah with Dr. Raja Ramanna, Mr. A. N. Prasad and others.

Dr. M. V. Ramaniah at a meeting with Dr. Raja Ramanna, Shri. R.K. Garg, Shri. A. N. Prasad and others, Central Complex, BARC.

Dr. M. V. Ramaniah with Dr. Raja Ramanna, Mr. K. T. Thomas, Mr. P. N. Krishnamurthy and others.

← Dr. M. V. Ramaniah with Dr. H. N. Sethna, and Lady and Lord Walter Marshall at the Lab.

→ Lord Marshall, Dr. M. V. Ramaniah, Mr. Sunderrajan and others at the Lab.

← Dr. M. V. Ramaniah with Lod Walter Marshall, Mr. P. R. Dastidar, Mr. K. T. Thomas, Mr. S. Fareeduddin and Dr. P. K. Iyengar.

Visit of Lord Walter Marshall of Goring, Chairman of the U.K. Atomic Energy Commission to BARC, April 1980.

Dr. H. N. Sethna introducing scientists to Dr. Hans Blix. Dr. M. V. Ramaniah, Dr. P. K. Iyengar, Dr. V. K. Iya and others are seen in the picture. Photo courtesy of BARC Archives.

Dr. M. V. Ramaniah with Dr. H. N. Sethna, Mr. P. R. Roy and the visiting delegation at the lab.

Briefing Room, Central Complex
Picture at left : (1st row) Mr. V. N. Meckoni, Dr. M. V. Ramaniah, Mr. H. C. Katiyar and Dr. P. K. Iyengar (2nd row).
Picture at right : Dr. R. Ramanna (1st row) and Dr. M. V. Ramaniah and Dr. V. K. Iya (3rd row).

Visit of Dr. Hans Blix, Director General of IAEA, to BARC, Bombay, 13-12-1982.

Dr. H. N. Sethna introducing the scientists.
Seen in the picture are Mr. P. K. Bhatnagar,
Mr. S. K. Mehta, Mr. M. S. Ramani
and Dr. M. V. Ramaniah.
Photo courtesy of BARC Archives.

Visit of Mrs. Margaret Thatchers, Prime
Minister of the U.K., to BARC.
Dr. M. V. Ramaniah seen on his way to a seat at the
C.C. briefing room. Also in the picture are
Dr. P. K. Iyengar, Dr. V. K. Iya and Shri P. R. Dastidar.
Photo courtesy of BARC Archives.

Central Complex Briefing Room, 1984.
Seen in the picture (front row) are
Shri P. R. Roy, Mr. S. K. Mehta, Dr. N. Satya Murthy,
Mr. Chalappa, Mr. B. P. Rastogi, Dr. M. V. Ramaniah,
Dr. V. K. Iya, Dr. R. Chidambaram,
Dr. K. S. Venkateswarlu and others

BARC colleagues at Central Complex, 8th floor.
Seen in the picture with Dr. M. V. Ramaniah
are Mr. K. T. Thomas, Dr. V. K. Iya,
Mr. C. Ambasankaran, Mr. P. R. Dastidar and
Mr. P. N. Krishnamurthy.

Dr. M. V. Ramaniah with Dr. Jal Patel, Former Physician to the President of India.

Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with Mr. V. P. Naik and Dr. Jal Patel.

Maharashtra Chief Minster Shri V. P. Naik's 'At Home', Independence Day, Bombay, 15-8-1967.

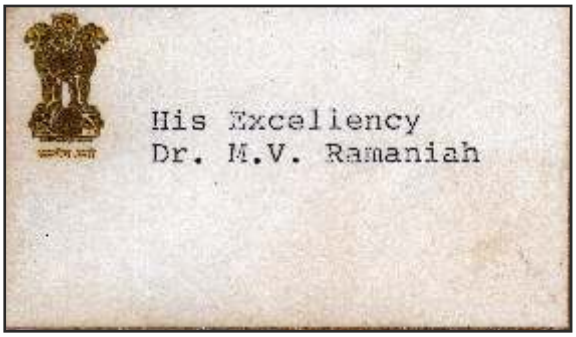
Dr. M. V. Ramaniah explains technical details in the BARC labs. to Mr. Nurul Hasan, Union Minister of State for Education, Social Welfare and Culture, August 1981.

←

Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi and their baby daughter Lavanya with friends at a conference, Sao Paulo, Brazil, 1964.

Dr. M. V. Ramaniah with delegates at an international conference.

Geneva, February 1987.



Representative of India at the International Atomic Energy Agency (IAEA).

Vienna, 1979-1980.

**International Fuel Cycle Evaluation (INFCE) Meeting in Tokyo, Japan, 19-5-1978.
Dr. M. V. Ramaniah and Lord Walter Marshall of Goring, U. K. Atomic Energy Chairman
are seated 5th and 4th from the right, respectively.**

Dr. M. V. Ramaniah at a Meeting of the Standing Advisory Group on Safeguards Implementation (SAGSI), 1982.

Dr. M. V. Ramaniah delivering his talk at the 5th Pacific Basin Nuclear Confernce, Seoul, S. Korea, 1985.

←

Dr. M. V. Ramaniah at an International Meeting, Vienna, 1971.

Dr. M. V. Ramaniah and Mr. A. N. Prasad in discussions with colleagues.

Dr. M. V. Ramaniah, Dr. M. R. Srinivasan and Dr. A. K. Ganguly in discussions with colleagues, 13-12- 1982.

Dr. M. V. Ramaniah and Dr. M. R. Srinivasan welcoming Mr. J. R. D. Tata.

Dr. M. V. Ramaniah with Mr. J. R. D. Tata, Dr. M. R. Srinivasan, Mr. A. N. Prasad and others.

Inaugural function of the Indian Nuclear Society, Homi Bhabha Auditorium, TIFR, Bombay, 19 -1-1988.

Dr. M. V. Ramaniah with Mr. J. R. D. Tata, Dr. M. R. Srinivasan, Dr. P. K. Iyengar and Dr. M. Kannan Iyer.

Inaugural function of the Indian Nuclear Society, Homi Bhabha Auditorium, TIFR, Bombay, 19-1-1988.

Dr. M. V. Ramaniah at a conference in C C Auditroium BARC along with other senior colleagues Photo courtesy BARC Archives.

C. V. Raman Lecture, I.I.Sc. Bangalore, 27-11-1989. Seen in the picture along with Dr. M. V. Ramaniah are Dr. V. S. Vankatavaradhan, Dr. M. R. Srinivasan, Dr. P. Rodriguez, Dr. R. Chidambaram, Dr. B. A. Dasannacharya, Mr. C. V. Sundaram, Mr. Soni and other colleagues. Photo courtesy BARC Archives.

Felicitation by the Trombay Council, Central Complex, BARC, May 1987. Dr. M. V. Ramaniah responds to colleagues. Also seen in the picture are Dr. R. M. Iyer, Dr. P. K. Iyengar and Dr. M. S. Chaddah.

←

Felicitation by colleagues from Tarapur, May 1987. Mr. L. K. Jha presents a bouquet to Dr. M. V. Ramaniah.

→

Felicitation by the Safety Review Council, May 1987. Dr. M. V. Ramaniah responds to colleagues.

Inaugural function, Seminar on the Nuclear Fuel Cycle in honour of Dr. M. V. Ramaniah, Central Complex Auditorium, BARC, May 27th, 1987.
Dr. M. V. Ramaniah with Dr. A. V. Jadhav, Prof. H. J. Arnikar, Dr. P. K. Iyengar, Dr. M. R. Srinivasan and Dr. D. D. Sood. Photo courtesy BARC Archives.

Prof. Z. R. Turell felicitating Dr. M. V. Ramaniah Photo courtesy BARC Archives.

Dr. M. S. Chaddah, Mr. S. D. Soman, Mr. C. V. Sundaram, Mr. P. R. Roy, Mr. R. K. Garg and other colleagues in the audience.

Mr. A. N. Prasad, Mr. T. K. S. Murthy, Mr. S. M. Sundaram, Dr. R. M. Iyer, Mr. P. R. Dastidar, Mr. N. S. K. Prasad and other colleagues in the audience.

Seminar on the Nuclear Fuel Cycle in honour of Dr. M. V. Ramaniah, Central Complex Auditorium, BARC, May 27th, 1987.

Dr. M. V. Ramaniah and Mrs M. Vasantalakshmi with Mr. T. K. S. Murthy, Mr. P. R. Roy and Mr. S. D. Soman.

Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with Mr. S. K. Sharma, Dr. Anil Kakodkar, Dr. V. K. Iya, Mr. A. N. Prasad, Mr. P. R. Roy, Mr. P. R. Dastidar, Mr. Sadhukhan and Dr. D. D. Sood.

Felicitation function for Dr. M. V. Ramaniah, Central Complex Auditorium, BARC, May 28th, 1987.

Felicitation function for Dr. M. V. Ramaniah, Central Complex Foyer, BARC, May 28th, 1987.
Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi greeting colleagues.

Seated : Dr. P. R. Natarajan, Mrs. Natarajan, Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi, Dr. D. D. Sood, Mrs. Sood and Ms. M. Lavanya.
Standing : Dr. P. M. Mapara, Dr. Seshgiri, Dr. Venkataramani, Dr. V. Natarajan, Dr. Satya Prakash, Dr. A. V. R. Reddy, Shri P. S. Srinivasan and Shri. A. V. Jadhav.

Seated : Mrs. Jayadevan, Mrs.Samuel, Mrs.Sivaramakrishnan, Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi, Mrs. Swarup, Mrs. Nagar and Ms. M. Lavanya.
Standing : Dr. N. C. Jayadevan, Shri. J. K. Samuel, Shri. C. K. Sivaramakrishnan, Dr. R. Swarup and Dr. M. S. Nagar.

Family Get-together with the Radiological Group, Training School Hostel, Anushakti Nagar, Mumbai, May 29th, 1987.

Seated : Mrs. Sastry, Mrs. Ramaswami, Mrs. Malathy Raghuraman, Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi, Mrs. Vaidya, Mrs. Bhargava and Ms. M. Lavanya.
Standing : Dr. M. D. Sastry, Dr. A. Ramaswami, Dr. Raghuraman, Mrs and Dr A. Ramanujam. Dr. V. N. Vaidya and Dr. V. K. Bhargava

Seated : Mrs. Smita Manohar, Mrs. Aggarwal, Dr. M. V. Ramaniah. Mrs. M. Vasantalakshmi, Mrs. Jain, Mrs. Chitambar and Ms. M. Lavanya.
Standing : Dr. S. B. Manohar, Dr. S.K. Aggarwal, Shri Kavimandan, Dr. Keshav Chander, Dr. Sarabjeet Singh, Dr. H. C. Jain and Dr. Chitambar

Family Get-together with the Radiological Group, Training School Hostel, Anushakti Nagar, Mumbai, May 29th, 1987.

Dr. Tarun Dutta, Mrs. Geeta Dutta, Dr. M. V. Ramaniah, Mrs. M. Vasantalakshmi, Mrs. and Dr. S. G. Kulkarni and Ms. M. Lavanya.

Dr. Tarun Dutta, Dr. P. M. Mhapara, Dr. S. K. Aggarwal and Dr. M. V. Ramaniah

Family Get-together with the Radiological Group, Training School Hostel, Anushakti Nagar, Mumbai, May 29th, 1987.

Dr. S. B. Manohar, Dr. A. V. R. Reddy, Dr. A. Ramaswami, Dr. A.G.C. Nair, Shri. S. P. Dange, Mr. P. K. Pujari and others are seen in the picture.

Mrs. M. Vasantalakshmi being felicitated by Mrs. Anita Pujari.

Dr. M. V. Ramaniah being felicitated by Mrs. Anita Pujari.

Dr. M. V. Ramaniah, Dr. A.V.R. Reddy and others are seen in the picture.

Family Get-together with the Nuclear Chemistry Section, Radiochemistry Division, Training School Hostel, Anushakti Nagar, Bombay, May 24th, 1987.

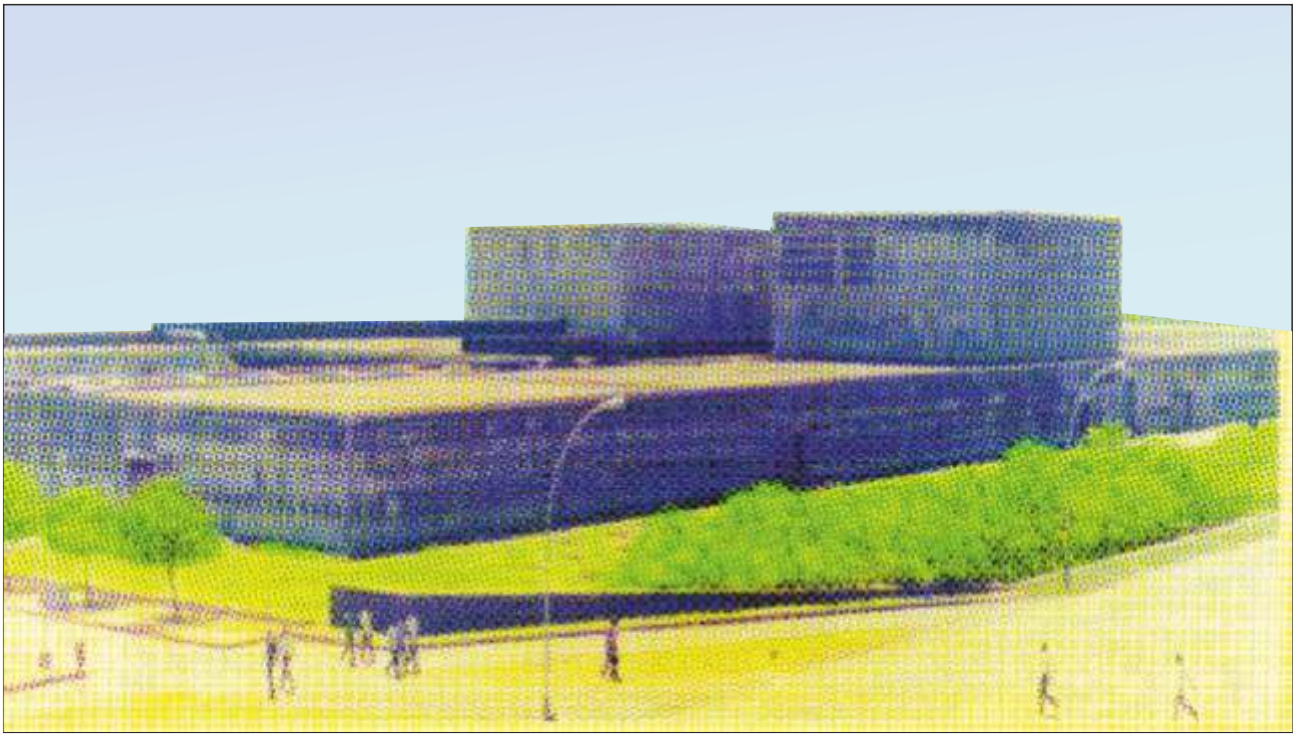
Dr. M. V. Ramaniah as Chief Guest for the Republic Day at the Atomic Energy Central School, 1976. He is accompanied by Mrs. M. Vasantalakshmi.

Dr. M. V. Ramaniah with members of the BARC Colony Residents' Association, Tarapur, 15th August, 1982.

Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with 'Padmavati' in the dance ballet 'Srinivasa Kalyanam", Shanmukhananda Hall, 19-1-1989.

Fun time! Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with their grand-niece Sagarika and grand-nephew Keshav, as Dr. M. Lavanya looks on. Saras Baug, Bombay, 1995.

Sitting From Left : Dr M. D. Karkhanawala, Shri P. R. Dastidar, Shrimati Vaidya, Shri S. Fareedudin, Shri Vaidya, Dr V. K. Iya, Dr P. N. Krishnamurthy, Dr M. V. Ramaniah Standing : Dr M. S. Chadda, Shri Batliwala, Shri M. P. S. Ramani, Dr G. B. Nadkarni, Dr Narasinghrao, Shri M. S. Chalappa, Dr R. Chidambaram, Shri R. K. Garg, Shri R. Rao, Dr S. D. Soman, Shri A. N. Prasad, Dr Shankar Das, Dr K. K. Mehta, Dr K. K. Damodaran, Dr V. A. Pethe, Dr K. G. Vohra, Dr Narasimhan, Shri S. M. Sundaram and others.



Radiological Laboratories, BARC, nurtured by Dr. M. V. Ramaniah, where golden years (1967-1987) of his professional life were spent.

Dr. M. V. Ramaniah and Mrs. M. Vasantalakshmi with Pandit Jawaharlal Nehru.