TANJORE RAMACHANDRA ANANTHARAMAN

(25 November 1927 – 18 June 2009)

Biog. Mem. Fell. INSA, New Delhi **37** 149-168 (2010)

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TANJORE RAMACHANDRA ANANTHARAMAN
(1927–2009)

Elected Fellow 1972

INTRODUCTION

TANJORE RAMACHANDRA ANANTHARAMAN (affectionately known as TRA) was a towering giant in the Indian metallurgical field, for over five decades in the latter half of the twentieth century, both as a Teacher and as a Researcher. A major part of his career was spent at the Banaras Hindu University (BHU), where he was instrumental in setting up a world-class Metallurgical Research Institute which attracted worldwide attention. This remarkable accomplishment must be viewed in the milieu that prevailed in post-independent India. Research Centres in science were few and far between. Research in engineering disciplines was yet to make a beginning. Professor P Balaram has singled out two departments from the sixties: "We must not forget the remarkable engineering departments that grew within our university system; metallurgy in Banaras and chemical engineering at the University Department of Chemical Technology in Mumbai are two examples, which immediately spring to mind."

EARLY CHILDHOOD

TRA was born to Tangadurai Appaswami Ramachandra Iyer and Saradambal on 25 November 1927 in Tanjore, Tamil Nadu. His parents had seven sons and one daughter. Anantharaman was the sixth child. His father was the Principal of a Board School and had an influence in giving a strong academic orientation to TRA.

FAMILY LIFE

TRA married Margaret (also known as Hema) née Schäuffele from Stuttgart, Germany in 1958. They first met at Vinoba Bhave Ashram in India and were married by Vinoba Bhave in Sonora, Maharashtra, India. After her death in 1979, he married Priyamvada née Tripathi, a faculty member of BHU at that time in 1983 in Brussels, Belgium. He had two sons from his first marriage and a daughter from his second marriage. His elder son, Thomas Satyaprakash got IIT-JEE All India Rank No. 2 and completed his B. Tech in Electronics Engineering at IT-BHU in 1982. After completing his PhD degree he joined IBM's 3-member team which designed Deep-Blue, world's first supercomputer which eventually defeated Gary Kasparov in a Chess Tournament. Currently he is working at a private Biotech firm in Madison, Wisconsin, USA. The second son, Martin Premprakash joined IT-BHU for

mechanical engineering. He then left the institute and completed his study of mechanical engineering at Duisburg University, Germany with 1st rank. He did his PhD in mechanical engineering (with distinction) at the same university. Currently he is working at Delphi (an automobile components manufacturing company) at Stuttgart, Germany. TRA's daughter Karuna Pragalbha completed BS in 2009 from Notre Dame University, Indiana, USA, and is currently studying for an MD at Indiana University in Terre-Haute, Indiana, USA.

PROFESSIONAL EDUCATION

TRA's progress through school and college drew profound admiration with his brilliant academic record at the Madras University securing the first rank BSc (Hons) degree in chemistry He did his DIISc in Metallurgy from the Indian Institute of Science (IISc). He had attributed his switch over from becoming a Chemical or Extractive Metallurgist to a Physical Metallurgist to the effective teaching by Professor EG Ramachandran whom he described as 'mentor, friend and well-wisher'. Subsequently he was awarded the prestigious Rhodes scholarship, to perform research at Oxford University, based on his outstanding performance in his undergraduate studies. There he carried out his research under the supervision of JW Christian in the Inorganic Chemistry Laboratory and obtained his DSc (Oxon) in 1954. During this time the laboratory was headed by the famous metal physicist William Hume-Rothery. This association had a profound impact on his growth as a metallurgist. In 2004 Oxford University awarded him the ScD (Oxon).

CAREER

Soon after his graduation TRA initially worked as a Research Associate at the Max Planck Institute for Metallurgical Research, Stuttgart, Germany for a period of two years from 1954 to 1956, where he came under the influence of eminent metallurgists like Konrad Schubert, Volkmar Gerold and Werner Koester on phase transformations in aluminium alloys. Returning to India he joined as an Assistant Professor in the Metallurgy Department at the Indian Institute of Science, Bangalore, in 1957 and stayed there till 1962. He initiated a major research programme on X-ray line profile. In 1962 he was appointed as Professor of Metallurgy, Banaras Hindu University (BHU), Varanasi, the post he served till 1987. At BHU, he was the Head, Department of Metallurgical Engineering. He also served as Dean, Faculty of Engineering and Technology and Director, Institute of Technology, Member, Executive Council, Rector and Acting Vice-Chancellor. Subsequent to his retirement in 1987 from BHU, he became the Director of Thapar Institute of Engineering & Technology (Deemed University) at Patiala where he worked between the years 1989 and 1992. He held the CSIR Emeritus Scientist position between 1987 and 1989 and again between 1993 and 1995. . He was the INSA Senior Scientist from 1995 to 2000.

The period between 1993 and 2000 was spent by him in New Delhi at the National Physical Laboratory.

TRA has been a frequent visitor to foreign laboratories. Even as an undergraduate student at IISc he made a short visit to Australia as Nuffield Scholar in Extractive Metallurgy in 1949. His extended periods of stays include three years from 1951 to 1954 in England and two years in Germany from 1954 to 1956. He has visited the following countries as a Visiting Professor or a Visiting Scientist: Germany–8 visits, USA–4 visits, UK–3 visits, Russia-2 visits, Belgium–2 visits, Japan-2 visits, France-2 visits, Switzerland 1 visit, China-1 visit and the Czech Republic–1 visit.

RESEARCH CONTRIBUTIONS

TRA's magnificent obsession was metallic structures—a key theme in Physical Metallurgy. He pioneered research in India on rapidly solidified alloys and metallic Glasses. He guided and supervised many graduate students working towards their PhD degrees. In the field of rapid solidification he designed newer techniques and many new metastable phases were characterized by him. Many major national projects on microstructural characterization, metallic glasses and rapidly solidified iron alloys were completed by him successfully. It speaks volumes about TRA's research abilities when one observes that in the year 1993 he had published a single author paper on " Identification of the Basic Unit Cell for Icosahedral and Decagonal Phases in Aluminium Alloys" in *Scripta Met Mater* (**28** 1555).

TRA has published more than 200 scientific publications in journals. He was imbued with the national spirit and published many of his papers in Indian journals such as *Proceedings of the Indian Academy of Sciences, Current Science* and the *Transactions of the Indian Institute of Metals*. He was the Co-Editor of the following proceedings of three International Conferences:

- Metal Sciences - the Emerging Frontiers (1978),
- Light Metals - Science & Technology (1985),
- Advanced Techniques for Materials Characterization (1989).

He has also edited a book on Metallic Glasses in 1984 published by Trans Tech Publications, Switzerland. In addition he has co-authored a book on Rapidly Solidified Metals: A Technological Overview in 1987 published by the publishers mentioned earlier. He also written a monograph in 1996 entitled *"The Rustless Wonder", "A Study of the Iron Pillar at Delhi"*, published by Vigyan Prasar, Government of India.

In his own words his contributions are in the areas of:

- Development of techniques for rapid solidification at cooling rates in the 10^4–10^8 K/s range.

- Estimation of cooling rates.
- Synthesis of new non-equilibrium phases
- Determination of crystal structures through X-ray and electron diffraction techniques.
- Study of microstructure and substructure.
- Construction of metastable phase diagrams.
- Theoretical approaches to predict formation of metastable phases, particularly metallic glasses and quasi crystals.
- Production and characterization of metallic glasses.
- Production and characterization of quasicrystals.
- Development of technology for production of soft-magnetic metallic glass tapes.

RESEARCH VISION

A crisis at IISc forced him to move to BHU in 1962. He deftly turned this crisis into an opportunity, as he went on to build a Centre for Advanced Metallurgy. This was basically unchartered waters. He conceptualized the steps in a brilliant fashion and executed them in a flawless manner. These included giving research a prominent place, attracting gifted faculty, motivating young students, building an infrastructure of equipment, attracting major projects, organizing major international events, links with overseas visitors From 1962 onwards several students came to BHU from IISc for their Mater's degree, stayed on to do their Ph D and became committed faculty members. Several, most notably P Rama Rao, P Ramachandra Rao, S Lele and KA Padmanabhan became research leaders in their own right. Many brilliant metallurgists gravitated to BHU just attracted by the powerful intellect of TRA. S Ranganathan, presently Professor at IISc, Bangalore, a Cambridge PhD, went to Banaras to do research in Metallurgy.

TRA persuaded his colleagues to build in indigenous way simple equipment with contemporary status. These were Somnath Misra on Liquid Metal Calorimetry, S Ranganathan on Field Ion Microscopy and P Ramachandra Rao on Rapid Solidification. TRA himself guided the group on X-ray line breadth analysis including P Rama Rao, S Lele, RK Gupta and B Prasad. Other additions brought new strengths - VB Tare added solid electrolytes and KA Padmanabhan returned with superplasticity.

TRA had used the electron microscope at IISc— in fact the first to be installed in India. At BHU he dreamt a larger vision and set up a National Electron Microscope Facility. This is the forerunner of the many such facilities dotting the Indian landscape, manned often by his students of succeeding generations.

TRA was conscious of the new winds sweeping the metallurgical discipline. He strove to broaden its scope by founding the school of Materials Science and Technology at BHU. This was one of the first institutes to offer a postgraduate course in materials technology

TRA established collaborative links with leading universities in the UK (Oxford, Cambridge and Sheffield) and Germany (Stuttgart, Duesseldorf and Erlangen). Both young and senior researchers moved between these institutions imparting a momentum to research. Today such international exchanges are common place. But in the sixties and seventies it was a path breaking effort.

To quote from a citation conferring the Distinguished Alumnus Award of his Alma Mater at Bangalore in 1982, "Through his distinguished contributions to metallurgical education and research, by nurturing the Centre for Advanced Study in Physical and Mechanical Metallurgy at Varanasi and by inspiring generations of students, Professor Anantharaman has had profound influence on the growth of metallurgy in independent India. The primary credit for the outstanding profile of present-day Indian metallurgical research rightly belongs to him".

PHILOSOPHY

Science and technology need not necessarily lead to Richard Dawkins. Our religions have the resilience and sophistication to absorb the changes due to science and technology. They may even provide a fund of creative ideas to a thoughtful and incisive researcher. TRA was a strong believer in religious philosophy and gave many discourses on religion. He blended beautifully in both kinds of discourses, scientific and religious.

TRA had a deep interest in spirituality, religion and philosophy. He had published a book '*Erkenntnis durch Meditation* (knowledge through meditation)' in 1977 and he had also written another book '*Ancient Yoga and Modern Science*' in 1997 showing his deep interest in both science and philosophy.

TEACHING

TRA was concerned that there had been little change in the method of teaching or curriculum development. He felt that Indian professors just teach the subject, but are not involved in research and do not make the subject material interesting to students. His students recollect that he motivated them to do higher studies and research and TRA was more than just a teacher; he was inspirational and a broad thinker. In the minds of some students, he is one of those people who, transcended the modern versions of a Professor and gave the impressions of the true Guru; someone wise, visionary and inspirational.

POSITIONS HELD

1951-1954	Research Scholar, Metallurgical Chemistry Section, Inorganic Chemistry Laboratory, Oxford University, Oxford, England
1954-1956	Post-Doctoral Fellow, Max-Planck-Institut fur Metallforschung, Stuttgart, Germany
1956-1962	Assistant Professor of Metallurgy, Department of Metallurgy, Indian Institute of Science, Bangalore
1962-1989	Professor of Metallurgy, Director, Institute of Technology and Rector, Banaras Hindu University, Varanasi. Also Scientist at California Institute of Technology, Pasadena, California, USA
1989-1992	Director, Thapar Institute of Engineering and Technology, Patiala
1992-2001	Senior Scientist, Metals and Alloys Group, National Physical Laboratory, New Delhi

AWARDS AND RECOGNITIONS

- Kamani Gold Medal of the Indian Institute of Metals (IIM) in 1960.
- National Metallurgists' Day Award of the Union Ministry of Steel and Mines in 1964.
- Shanti Swamp Bhatnagar Prize of the Council of Scientific and Industrial Research (CSIR) for Engineering Sciences in 1967.
- Federation of Indian Chambers of Commerce and Industry (FICCI) Award for individual Initiative in Science and Technology in 1972.
- Homi J Bhabha Award for Applied Sciences by the University Grants Commission (UGC) and Hari Om Trust in 1974.
- VASVIK Award in Materials Science in 1978.
- Nehru Fellowship of the Jawaharlal Nehru Memorial Fund (JNMF) during 1979-81.
- Election as President of the Indian Institute of Metals (IIM) in 1979.
- Bhatnagar Medal of the Indian National Science Academy (INSA) in 1982.
- Distinguished Alumnus Award of the Indian Institute of Science (IISc) In 1982.
- Tata Gold Medal of the Indian Institute of Metals (IIM) in 1983.
- Materials Science Prize of the Indian National Science Academy (INSA) in 1987.
- Eminent Teacher of Metallurgy Award on the occasion of the Golden Jubilee of the Department of Metallurgy, Bengal Engineering College, Howrah in 1990.
- Outstanding Teacher of an Engineering Institution - National Award conferred by Indian Society of Technical Education (ISTE) and Uttar Pradesh Government in 1991.

- IIM Platinum Medal, the highest conferment of the Indian Institute of Metals, in 1996.
- Professor GP Chatterji Memorial Award of the Indian Science Congress Association (ISCA) in 1997.
- Distinguished Services Award of the Department of Metallurgical Engineering, BHU, Varanasi, on the occasion of its Platinum Jubilee in 1998.
- Dr. BC Roy National Award for "Eminence in Philosophy" in 2001.
- First-Ever "Lifetime Achievement Award in Metallurgy," instituted by Union Ministry of Steel and Mines in 2004.
- In recognition of his numerous contributions to the Science of Metals as teacher and researcher, Professor TRA has been elected Fellow of the Indian Academy of Sciences (1964), the Indian National Science Academy (1972), the Institution of Metallurgists, London (1968), Indian National Academy of Engineering (1987 – its Foundation Year) and the American Society for Materials (ASM International) (1990). He is Honorary Member of the Indian Institute of Metals, Ehrenmitgleid (Honorary Member) of the Deutsche Gesellschaft fuer Metallkunde (German Society for Metals) and Corresponding Member of the Royal Belgian Academy of Overseas Sciences. In 1989 he became the first Afro-Asian to be conferred the highly coveted Sorby Award of the International Metallographic Society for his life-long work.

LAST DAYS

His son Dr Thomas Anantharaman describes the last days of his father: "TRA's unfortunate 18 month final illness started the week after his 80th birthday. My father had been suffering for over 5 years from diabetes, but was otherwise in good health and mentally sharp on his 80th Birthday. During a routine MRI procedure using anaesthesia (to rule out stroke) he unexpectedly went into a coma for several days and woke up with severe memory loss due to brain damage, the exact cause of which was never determined. In May 2008 I picked him up from India to come live with me in Madison, USA. On Jan 2 2009 he suffered a heart attack. He recovered enough to return home from the hospital but his heart finally gave out on June 18 2009 with me at his bedside."

EULOGY

A sense of sacrifice and 'let us do it' spirit were dominant in the air particularly amongst persons like TRA brimming with excellence soon after Indian independence. They definitely had a dream and worked hard towards realizing it under trying circumstances. Attracted by TRA many younger people stayed back in India to work in the area of research and contributed mightily to the development of Metallurgy and Materials Science. A rare combination of talent, intellect, positive

attitude towards life, extraordinary self confidence and above all grace, all in good measure were what TRA was made of. When one studies the life of TRA, the overwhelming impression is of an almost childlike inquisitiveness and pleasure in exploring the nature and structure of the world around him scientifically and philosophically.

ACKNOWLEDGEMENTS

The author wishes to thank Professor S Ranganathan for providing information from various sources. He is also grateful to Professor P Rama Rao, Professor P Ramachandra Rao, Professor C Suryanarayana and members of TRA family for a critical reading of this article

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