

Ramamurthy Balasubramaniam (1961–2009)

Ramamurthy Balasubramaniam (fondly known as Bala) was born on 15 April 1961 in Salem, Tamil Nadu to R. S. Ramamurthy and R. Savithri. He did his schooling at Holy Cross Matriculation School at Salem. He obtained his Bachelor of Technology from the renowned Metallurgical Engineering department in the Institute of Technology, Banaras Hindu University (BHU), Varanasi in 1984. He won the N. P. Gandhi Gold Medal from the Department of Metallurgical Engineering, BHU and the Vidya Bharathi Award from the Indian Institute of Metals. He received his PhD from Rensselaer Polytechnic Institute (RPI), Troy, USA in 1990 for his dissertation on 'The role of hydrogen in the stress corrosion cracking of a binary aluminum–lithium and a ternary aluminum–lithium–copper alloy'. He joined the faculty of Materials and Metallurgical Engineering at Indian Institute of Technology (ITI), Kanpur in 1990 as Assistant Professor and became a full Professor in 2001. Balasubramaniam's illustrious career was cut short by his untimely demise on 9 December 2009. He had every gift except one of long life.

Bala's research interests included material–hydrogen systems, environmental degradation of materials, structure–property correlation in advanced materials and Indian archaeometallurgy. He established a state-of-the-art laboratory to facilitate corrosion research at IIT Kanpur. He was successful in developing ceramic reinforced metallic coatings and such coatings exhibited superior tribological properties. His recent research has also large national relevance in terms of safety concern for millions of citizens travelling on Indian Railways. One of his most recent research projects was on Corrosion Prevention of Rails and was funded by Indian railways under their Technology Mission on Railway Safety. Lately, his research interest was in the area of nanostructured coatings on metallic substrates.

In the area of Indian archaeometallurgy, he had in a very short span of time established himself as India's leading archaeometallurgist. His first and perhaps best known major study was on the Delhi Iron Pillar. Despite extensive research on the pillar over the last century, many questions remained unan-

swered. His pioneering research on the corrosion resistance of Delhi iron pillar attracted worldwide attention. Using multiple characterization tools, his research answered a long-standing question as to why iron pillar at Delhi has the unique corrosion resistance property. In his book *The Story of the Delhi Iron Pillar*, Bala used his experience in corrosion science and metallography to formulate the first convincing mechanism by which a corrosion-resistant surface could have developed in the open atmosphere. He proposed the formation of a protective passive film on the pillar surface and the chemistry of this film was



consistent with high phosphorus content of the iron that was used several centuries ago to build the iron pillar. Not only that but Bala gave a full account of the construction of the pillar and the complex wrought top. He also gave a detailed account of the likely original location and history of the pillar, thereby displaying a deep knowledge and understanding of India's history, culture and philosophy. He drew on epigraphy, astronomy, metrology and several other disciplines to bring fresh insights into this ancient and impressive object.

A second major area, where he made magnificent contribution, is related to cannons. This resulted in *The Saga of Indian Cannons*. From an archeometallurgical point of view, the book, for the first time, presented the massive and wonderful forge welded iron cannons and cast bronze cannons of medieval India. Indian innovations in cannon technology like shaturnal (cannons fired from back of camels), composite cannons (of inner wrought iron bore and outer bronze casting) and bans (battlefield rockets)

offer sufficient proof of Indian ingenuity in science and technology, thereby providing rare glimpses into the country's rich military and metallurgical heritage. His paper on saltpeter manufacturing in medieval India is a notable contribution.

A third area was wootz steel, where his attention turned to several facets of this legendary material. These included the gift to Alexander, the etymology of wootz, Hinduwani and pulat, detailed recording of the locations of smelting sites in the Deccan including Kona-samudram, the ethnography of the smelting communities, the metallographic examination of the steels that they made. Here again he brought out the influence of phosphorus.

In recent years the history of Indian metrology attracted his attention. He came about with the bold hypothesis that Angulam was the probable measure used from the days of Mohenjodaro to the Taj of the Mughals. His ability to come out with new insights into ancient technology is unparalleled. He coupled this with an intensive study of Indian and Persian literature and offered significant evidence for this startling possibility that India used a single measure of length over millennia. It was clear that this is path-breaking work and he had embarked on a new journey of discovery tragically cut short.

Most inspiring aspect of his career is that despite his busy schedule related to research activities, he never compromised on his teaching and research at IIT Kanpur. He had adapted the famous text book by Callister on *Materials Science*. He kept a meticulous record of his courses and has taught more than two thousand students. He was bestowed with the inaugural Distinguished Educator Award (2009) from Indian Institute of Metals (IIM) in November 2009. An even more befitting acknowledgement of this commitment to teaching and his exemplary teaching skills is there in the tributes paid by his students on the IIT Kanpur obituary pages. In their outpouring of grief, the fact stands out that they were inspired by his teaching and the lucid and incandescent style he brought to his lectures.

Bala was a prolific researcher and has published about 275 research papers in various refereed journals. He has autho-

red a number of books on diverse subjects. In 2007, he organized a major international conference 'METALLO 07' in the honour of his guru, T. R. Anantharaman at IIT Kanpur. The proceedings were published in special issues of *Journal of Materials Science and Transactions* of Indian Institute of Metals. Apart from publishing numerous papers in international journals, Bala published extensively in Indian journals, such as 14 papers in *Transactions of the Indian Institute of Metals*, 19 papers in *Current Science* and several thematic issues in *Indian Journal of History of Science*. Several of his figures adorned the cover page of these journals. In addition, Bala served on the editorial board of a number of academic periodicals including the *International Journal of Corrosion*, *The International Journal of Corrosion Science*, *Engineering and Technology*,

Transactions of the Indian Institute of Metals, *Kolkata*, *The Open Corrosion Journal*, *The Collection Indologie, Paris*, *The Journal of South Asian Archaeology*.

In recognition to his outstanding contributions in the field of metallurgy, materials science and archaeometallurgy, Balasubramaniam received a number of awards, including Young Scientist Award from the Indian National Science Academy (1993), Alexander von Humboldt Foundation Research Fellowship (1996), Materials Research Society of India (MRSI) Medal (1999), Metallurgist of the Year Award (1999) from the Ministry of Steels and Mines, Government of India. In September 2009, Balasubramaniam became the first occupant of the B. B. Lal Chair at IIT Kanpur. He was a member of the National Commission for History of Science.

Apart from academics, Bala was an enthusiastic sportsperson and an avid cricketer. He had a great passion for both Indian and Western music. Bala was adept at playing the western classical guitar and was an ace drummer too.

He had every gift except one of long life.

He is survived by his wife Gaitri and two daughters, Gowri and Gargi.

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Sukumar Biswas (1924–2009)

India lost one of its leading solar physicists when Sukumar Biswas passed away on 16 November 2009. He had the unique distinction of having worked closely with two of the leading physicists, who built major scientific research institutions in independent India – Homi Bhabha and Meghnad Saha.

He was born on 1 July 1924 in Jalpaiguri in West Bengal. All through his school and university education, he was a distinguished student. After graduating from Calcutta University, he continued his interests in physics with Meghnad Saha in Calcutta. When Hopper of the University of Melbourne offered him to work with him for his second Ph D he accepted the offer and distinguished himself in Australia with his research in nuclear physics. When Bhabha started the Atomic Energy Programme, Biswas moved to work with him in Mumbai. He was with the Tata Institute of Fundamental Research almost from its start until he retired as Senior Professor in 1989. Then, he continued there until 1992 as Emeritus Professor.

His research career spanning more than four decades resulted in several

unique contributions. Using the nuclear emulsion techniques, his earlier contributions to discovering new particles are well known to experimental particle physicists. Later on, when he went to work in Minnesota, he turned his attention to cosmic ray composition studies



using nuclear emulsions. He was a member of the group which detected nuclei heavier than helium in cosmic rays. After his return to TIFR, he worked on the composition of cosmic rays using nuclear

emulsions. His contributions to the heavy primary cosmic ray work brought new laurels to India in this field. He then went on to interpret the propagation of cosmic ray nuclei. One of his major achievements is the development of space borne detector *Anuradha* to detect solar cosmic ray composition. This was his last contribution to cosmic ray research.

Biswas received several honours including the fellowship of the three science academies in India and the American Physical Society. He was one of the earliest to get the UNESCO Fellowship. His *Anuradha* experiment fetched him the NASA Public Service Group Achievement Award. He was the recipient of C. V. Raman Award in 1984. He had the distinction of becoming an academician of the International Academy of Aeronautics.

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