

Radicals in science: nature or nurture? Perhaps both!*

The 'Radicals in Science' workshop was held to mark the occasion when one of India's most celebrated astrophysicists, V. Radhakrishnan (popularly known as Rad) crossed a thousand moons. Interestingly, the event was named so because Radhakrishnan is a 'free radical' with an infectious enthusiasm that well surpasses his age.

The event was a get-together of well-known individuals from across the world, most of whom were friends and colleagues of Radhakrishnan. They sought to answer the question, 'How do radical ideas come to be?' They highlighted their connection with Radhakrishnan and the Raman Research Institute (RRI), Bangalore. RRI was steered by two prominent people – C. V. Raman who founded the institute and his son Radhakrishnan. If one looks back in time, Raman founded the institute in 1948 on a land gifted to him by the Government of Mysore in December 1934.

M. G. K. Menon, whose association with RRI is age-old, analysed the influence of nurturing individuals and institutions on science and society. He talked about how Raman had nurtured Homi J. Bhabha and Vikram Sarabhai, and how his influence on them furthered the shaping of science in India. Menon also mentioned how Radhakrishnan became the choice to lead RRI. The story goes like this: Sivaram Ramaseshan and Menon were members of the RRI trust. The first responsibility they undertook after Raman's demise was to find someone who could lead the institute. At that time Ramaseshan (who had discussed the possibilities with Raman during his last days) told Menon that the person who should come to RRI is Radhakrishnan. Menon suggested that Ramaseshan write to Radhakrishnan and persuade him to join RRI.

Radhakrishnan was trained at two of the world's best centres – California Institute of Technology (Caltech), USA and Australia's Commonwealth Scien-

tific and Industrial Research Organisation (CSIRO). In 1972 he joined RRI as its Director and continued till 1994. Owing to Radhakrishnan's leadership, RRI now has a large number of researchers and students working in a variety of fields, unlike in the early years. The interdisciplinary work that the institute carries out is the best tribute one could pay to its nurturers, said Menon.

During the workshop, attended mainly by the students and faculty of RRI, most of the invited speakers presented their contemporary scientific work. Other talks were historical in nature. A biographical sketch of the 'extraordinary

physicist' Robert H. Dicke was presented by Rajaram Nityananda (National Centre for Radio Astrophysics, Pune). The contributions of the first female radio astronomer, Ruby-Payne Scott, and those of John Bolton to radio astronomy in Australia were presented by Miller Goss (National Radio Astronomy Observatory, USA). Goss has also written Scotts' biography titled *Under the Radar*. G. Srinivasan (RRI, Bangalore) outlined the contributions of eminent scientists for whom he quoted Francis Bacon, 'They are ill discoverers that think there is no land, when they can see nothing but sea'.



The Raman Research Institute, Bangalore (courtesy: Raju Varghese, RRI).



V. Radhakrishnan (centre) at the workshop (with Rajaram Nityananda (left) and M. G. K. Menon (right); courtesy: Raju Varghese, RRI).

*A report on the 'Radicals in Science: Nature or Nurture' workshop held at the Raman Research Institute, Bangalore, during 9–11 August 2010.

Box 1.



V. Radhakrishnan (courtesy: RRI)

Here is a glimpse of what was said of Rad during the workshop:

'He is the ultimate free radical.' – Micheal Berry

'He has an interest in people, society. He is a radical.' – George Seielstad

'You have those rare individuals of excellence who seem to be able to defy most rules having to do with nurture and seem to come from almost nowhere (e.g. Ramanujan, Einstein, Radhakrishnan). But Einstein got an excellent education in physics at ETH-Zürich, and Rad had a family background, which provided him with the right genes and quite some scientific environment.' – Ed van den Heuvel

'I admire Rad's science and human qualities... During serious moments the astronomers look at serious things like singularities, black holes, etc. but in the lighter moments they like to play with snowflakes as Kepler did or as Rad does with catamaran sailing or on a hang glider flying into the sky.' – S. Ranganathan.

'Looks like not only the ether but fluids other than ether namely air and water, and sometimes their combinations fascinated Rad, as is seen in two of his papers – From square sails to wing sails and Locomotion: Dealing with friction. These show that Rad has a personal equation with air and water.' – R. Narasimha

Ed van den Heuvel (University of Amsterdam) said, 'the only factor one can influence (on a personal or government level) is 'nurture' (including the creation of new job and funding opportunities)'. Bob Frater (Macquarie University, Sydney) in his talk, 'Why is it so?' discussed the role of education, the ability to see the 'big picture', mentoring and the importance of the 'right nature to absorb nurture' in generating ideas.

In his lecture entitled 'What goes down must come up', George Seielstad (University of North Dakota, USA) narrated the story of the 300 ft long Green Bank

Telescope that collapsed after 26 years on 15 November 1988 due to lack of maintenance and how the 100 m long Robert C. Byrd Green Bank Telescope was built from its wreckage. Marshall Cohen (Caltech) described the genesis of the 1000-ft Arecibo Dish. Thomas Phillips (Caltech) traced the invention of the Hot Electron Bolometer and the SIS detectors – techniques for millimetre and submillimetre-wave detection for astro-

nomy. The existing fundamental theories of the physical world were challenged by C. S. Unnikrishnan (Tata Institute of

Fundamental Research, Mumbai), for which he was criticized and appreciated equally. Ramanath Cowsik (Washington University) talked about work done by his group on developing a low-noise oscillator to achieve isolation of vibrations. Joseph Samuel (RRI) gave a talk about the interface of cosmology and soft condensed matter physics. S. Ranganathan (National Institute of Advanced Studies (NIAS), Bangalore) described the advent of quasicrystals. B. V. Sreekantan (NIAS) traced the discovery of cosmic rays and highlighted the role of cosmic ray research in ushering in the era of high energy physics, elementary particles physics and ultra-high energy astronomies. Ron Ekers (CSIRO) elaborated on the search for ultra high energy neutrinos.

The functioning of science, particularly astronomy and the search for undiscovered Einsteins was outlined by Ray Norris (CSIRO). Micheal Berry (University of Bristol, UK) talked about 'Hamilton's diabolical singularity' and Vinod Gaur (Indian Institute of Astrophysics, Bangalore) about the different theories explaining plate tectonics and the associated scepticism. Wireless technology in India, and what India needs to become a leader in the technology were highlighted by Ashok Jhunjhunwala (Indian Institute of Technology-Madras, Chennai). Roddam Narasimha (Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore) talked about Ludwig Prandtl's invention of modern fluid dynamics and its growth in Göttingen in the early 20th century. M. Muthukumar (University of Massachusetts, USA) talked about polymer crystallization and the complexity involved in organization of polymer strings.

'What are the ways of doing science? There are thousand ways of doing it – through education, teamwork, imagination, curiosity... even war, ignorance, and thinking while in a bathtub!', said Peter Shaver (European Organization for Astronomical Research in the Southern Hemisphere). Shaver described instances of remarkable discoveries, such as that of the waggle dance of honey bees by Karl von Frisch and of extrasolar planets by Wolszczan. Bernard Burke (Massachusetts Institute of Technology, USA) highlighted the stream of innovation and development in the field of radio astronomy.

Among others who attended the workshop was Kausalya Ramaseshan (wife of late S. Ramaseshan). Miller Goss, a

friend and colleague from early days when Rad was at CSIRO, talked about him at an evening function on behalf of John Brooks, as Brooks could not attend the workshop. Goss and Brooks have been with Radhakrishnan on sailing expeditions too!

In addition to having headed RRI and carrying out cutting-edge research, Radhakrishnan continues to pursue his interests in sailing and gliding. His presence in the institute can be sensed with the 'Double Trouble' glider and boat models that reside in the RRI workshop.

He is a source of inspiration for the young and old alike.

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MEETING REPORT

Frontiers in atmospheric sciences*

The dissemination of contemporary developments in atmospheric science, meteorology and climatology is important in decision-making with regard to climate change and natural hazards, and to meet the information requirements of personnel in related institutions. In this background, a refresher course on 'Frontiers in Atmospheric Sciences' was organized.

Its main objectives were to: (i) bring together individuals and organizations interested in teaching climatology, atmospheric science and meteorology, (ii) dissipate knowledge on some important frontline topics such as climate and climatic change, palaeoclimate, global warming, atmospheric pollution, weather forecasting, climate forecasting, weather modification, physics and dynamics of tropical clouds, thunderstorms and global electric circuit, and (iii) introduce atmospheric science in the graduate/post graduate curriculum in research and development institutes in India.

The course was inaugurated by Madhav Gadgil (Indian Institute of Science (IISc), Bangalore) who delivered a lecture on 'up above the world so high!'. He focused upon the evolution of living beings with regard to climate change. Sulochana Gadgil (IISc, Bangalore) gave four talks on understanding and predicting the Indian monsoon. She explained the biotic responses on the eve of monsoon,

physical mechanisms behind the initiation of monsoon, intraseasonal and inter-annual variations in monsoon rainfall and associated phenomena, factors related to large-scale and large-area coverage of monsoon rainfall through the phenomenon of the Inter Tropical Convergence Zone (ITCZ) and drought related to human impact. Processes responsible for interannual variations in rainfall such as the El Niño Southern Oscillation (ENSO) and the Equatorial Indian Ocean Oscillation (EQUINOO) were described in detail. She also highlighted the importance of monsoon with regard to the gross domestic product and agriculture.

B. N. Goswami (Indian Institute of Tropical Meteorology (IITM), Pune) delivered talks on 'our climate' and 'present and future of Indian monsoon in a changing climate'. In the first lecture, he spoke on how to distinguish between weather and climate, and the principles of global weather parameters. This was followed by an explanation of the principles of monsoon system and the complexities in monsoon prediction including human induced forces. He said that the recent change in climate (particularly since the 1980s) is attributed to human impact as a consequence of increase in greenhouse gases such as carbon dioxide, nitrous oxide and methane. Climate modelling studies support these observations.

R. Krishnan (IITM, Pune) spoke on the 'dynamics of atmospheric general circulation models (GCM) and modelling'. He first explained the principles of GCM and boundary conditions. Other parameters required for GCM are atmospheric circulation and dynamics in tropics, temperate and polar regions including

monsoon system. In the second part, he discussed the different approaches for modelling.

Krishna Kumar (IITM, Pune) lectured on 'ENSO–monsoon linkages' and 'impact of climate change on India's monsoonal climate'. He gave an overview of the developments with respect to the ENSO phenomenon, from the initial contributions made by Sir Gilbert Walker in the 1920s till recent years. He then focused on the ENSO–Indian monsoon linkages – stronger El Niño events tend to decrease monsoon rains, causing droughts in India; however, not all El Niño events result in droughts.

The fundamental principles which change the radiation balance of the earth, that in turn change climate, were explained by G. Pandithurai (IITM, Pune). He outlined the effect of atmospheric aerosols on incoming solar flux to the earth's surface (through scattering and absorption), which would alter the water budget for the hydrological cycle. Pandithurai also emphasized the importance of anthropogenic aerosols with regard to size, life time and rain yielding capacity.

J. R. Kulkarni (IITM, Pune) talked about 'the cloud aerosol interactions and precipitation enhancement experiment (CAIPEEX)'. He highlighted the significance of air-borne monitoring in the troposphere for understanding the nature of aerosols and their microphysical properties, and clouds over different parts of India. This type of investigation would be useful for cloud seeding, particularly during drought conditions.

A series of lectures in different fields of atmospheric electricity, viz. 'global electric circuit – the classical concept', 'physics of lightning, electrical structure

*A report on the two-week refresher course on 'Frontiers in Atmospheric Sciences' organized at the Indian Institute of Tropical Meteorology, Pune, during 14–25 June 2010. The course was jointly funded by the Indian Academy of Sciences, Bangalore, the Indian National Science Academy, New Delhi and the National Academy of Sciences, Allahabad.