

## The Indian Academy of Sciences holds its Twelfth Mid-Year Meeting

The Indian Academy of Sciences (IAS) held its Twelfth Mid-Year Meeting, between 20 and 21 July 2001, at the Indian Institute of Science (IISc), Bangalore. A special lecture delivered by R. Chidambaram, Bhabha Atomic Research Centre (BARC), Mumbai on the topic 'Scientific objectives of Pokhran II – Design and realization' began the proceedings. He said that Pokhran II was to enable India establish and maintain a credible deterrent. He also said that the yields of the Pokhran II test were announced immediately after the test as the nuclear devices had performed exactly as planned and that they had confidence in their computer simulation capabilities and design methods used. The thermonuclear device had the design of a typical modern one wherein a fusion-boosted mechanism is employed to achieve an increased yield. The yield of 60 kilotonnes reported could only be obtained because the thermonuclear device had been successfully tested. With this success, Indian scientists are looking forward to designing thermonuclear devices of up to 200 kilotonnes or more, stated Chidambaram. Since Pokhran II, Indian nuclear scientists at BARC have carried out substantive research, said Chidambaram. In response to the recent report in *Current Science* (2001, **81**, 72–74) by Douglas *et al.*, challenging the yield claim made by Indian scientists from BARC, he said that seismologists would respond to this article shortly.

The secrets of the brain – as revealed by three different areas in brain research – were communicated through various lectures. The big challenge confronting the world, where the population is aging at a rapid pace, is the need to understand neurodegenerative disorders. Only very little is known of its pathogenesis. Vijaylakshmi Ravindranath (National Brain Research Center, New Delhi), gave an insight into neurodegenerative disorders like Parkinson's, Alzheimer's and motor neuron disease. These diseases, she said, afflict significant sections of the population and are termed neurodegenerative because of the progressive and irreversible nature of the disease in which nerves in the brain slowly die. Over the age of 65 years, one in 100 people have Parkinson's disease and eight in 100 are affected

by Alzheimer's disease. She spoke of research efforts in her laboratory that use animal models for identifying molecular mechanisms, which mimic the neuropathological features of the human disease. Future research in this area would help determine the pathway of neurodegeneration leading to a better understanding as to why selective regions of the brain are affected. Also, the role of specific cell population within specialized regions of the brain is to be established. When affected, such regions cause a selective loss of functions.

In his special lecture 'Neural basis of memory – New insights', P. N. Tandon (All India Institute of Medical Sciences, New Delhi), described memory, stating 'use it or lose it'. The mind needs exercise to work well and one can train the power of recall to prevent memory loss, no matter how old one gets. Although the brain tends to slow down with age losing roughly about 40 per cent of its efficiency over the course of life, it can stay mentally fit by presenting challenges on a daily basis. Tandon, with illustrative cases from personal clinical experiences, described the current state of knowledge and outlined the future direction of research in the study of memory. The present understanding of the formation of memory, he said, not only involves multiple anatomical regions but a complex set of cellular and molecular events. These involve neurotransmitters, second messenger pathways, post-translational modification of protein in the cytoplasm and regulation of gene expression in the nucleus. He further added that the neural substrate for short-term or working memory and long-term, implicit or associative memory has been localized to diverse regions of the memory.

Looking at sadness inside the brain, Vidita A. Vaidya (Tata Institute of Fundamental Research (TIFR), Mumbai), in her talk 'Stress, depression and hippocampal damage' highlighted the role of the hippocampus in the brain as the prime target of stress. There is an adaptive response to stress. However, if this goes awry, a maladaptive response to stress could lead to the precipitation of psychiatric disorders like depression. She added that under chronic stress, the hippocampus is damaged. In recurrent depression

hippocampus volumetric loss has been observed, suggesting contribution of similar mechanisms to this damage. She showed that there are indications of the possibility of antidepressant treatments that may help to prevent or reverse stress-induced neuronal atrophy and damage of hippocampal neurons through enhanced expression of growth, and survival promoting factors like the brain-derived neurotrophic factor (BDNF).

Clot-buster drugs such as streptokinase, used in the treatment of heart attacks and other circulatory ailments, are all presently imported. The Council of Scientific and Industrial Research has filed patents for second-generation clot-buster drugs, said Girish Sahni (Institute of Microbial Technology, Chandigarh) in his talk 'Challenges and surprises in the quest for designing an improved clot-buster drug'. He said that the know-how for the first indigenous industrial production of streptokinase to the Indian pharmaceutical industry has been successfully transferred and the drug is to be launched in the market shortly. This has been made possible by research into identification of a novel protein co-factor and its role in the proteolytic activation of blood plasminogen, crucial in dissolution of clots during treatment with streptokinase. Using unconventional but simple techniques such as peptide walking, etc. the identification of 'hot spots' or important sites where streptokinase interacts with plasminogen, its 'target' protein in the blood, helped in the development and design of novel protein-engineered streptokinase derivatives with improved clot specificity and time-delayed kinetics.

G. Marimuthu (Madurai Kamaraj University, Madurai), presented details of experiments with the help of a video presentation related to bats, such as the Indian false vampire bat, *Megaderma lyra*, one of the common bats in India living in unused old buildings and temples, feeding on frogs. In his talk titled 'Echo-locating and listening modes of capturing frogs by the Indian false vampire bat', he showed real-time experiments of how the bat relies on the noise associated with the movement of the prey (frog) on a sandy floor. However, he said that the bat determines the palatability only after touching the prey. Using an

infrared noctovision sniperscope, he could demonstrate that bats skim the surface of the pond for several minutes in the dark to detect a frog and capture it. Bats were found to actively use their echolocatory powers as a result of which the frog, with its head out of the water, is ensured detection by the bat. In this way the bats employ a 'listening-in' method on the ground and 'echolocation' on the surface of the water to detect and capture a frog, Marimuthu added.

Superconductivity in the yttrium-nickel-boron-carbon (Y-Ni-B-C) system, the first quaternary system ever to exhibit superconductivity at elevated temperature ( $T_c \sim 12-15$  K) was discovered at TIFR, Mumbai in the last decade and laid the foundation for a new class of materials, the quaternary borocarbides. R. Nagarajan (TIFR, Mumbai) speaking on 'Quaternary borocarbide superconductors - The discovery and overview', dwelt on the interest that these materials have generated internationally and some important properties of this family of quaternary borocarbides.

In his talk 'Ionic solutions: From organic reactions to biomolecules', Anil Kumar (National Chemical Laboratory, Pune), described how Diels-Alder reaction, frequently used in the synthesis of six-membered rings in organic chemistry, can be accelerated in the presence of ionic solutions. Just as ionic solutions have special effects on kinetic profiles of the Diels-Alder reaction, reducing the need to use high pressures, a parallel can be drawn in the case of behaviour of biomolecules such as DNA using simple correlations, he stated. DNA molecules behave quite differently in the presence of an ionic environment, altering properties such as melting, etc. of a DNA duplex.

In order to obtain records of monsoon rainfall in India in ancient times from the present limitation of roughly 120 years, R. Ramesh (Physical Research Laboratory, Ahmedabad), has done intensive field collection of samples of stalactites, stalagmites and flow stones known collectively as speleothems, from specially selected caves in Orissa, Madhya Pradesh, North Karnataka and Uttar Pradesh. Back

in the laboratory, using stable oxygen isotope ratios of various layers of speleothems, palaeomonsoon data could be quantitatively reconstructed, said Ramesh. These could then be further compared to other global climate data sets such as ice core records from polar regions.

Research to find easy construction pathways to novel molecular arrays, photoswitches and energy transfer systems was elaborated by Bhaskar G. Maiya (University of Hyderabad, Hyderabad), while dealing with the topic of 'Multichromophoric molecular assemblies based on porphyrin building blocks'. Such assemblies, based on biomimetic porphyrinoid molecules have potential uses over a wide area, ranging from basic research to real-life applications.

'Living with earthquakes' the subject of a Public Lecture by Vinod K. Gaur (Indian Institute of Astrophysics, Bangalore), was topical. He said that the earthquakes of the recent past add credence to the fact that the Indian crust continues to exist in a state of high stress, at no time far from criticality. The big question is whether these are the last of a series, or only an intimation of enhanced stress environment preparatory to the occurrence of a stronger successor elsewhere, he added. Understanding plate tectonics would lead to a better handle on long-term stress loading that is preparatory to an earthquake. Also, looking at patterns to develop the physical reasons behind earthquakes is required for mitigating future disasters.

A presentation 'Resonating and non-resonating with electrons: Excitement unlimited' by S. V. Bhat (IISc, Bangalore), was based on observing electrons closely using electron spin resonance (ESR) and non resonant microwave absorption (NRMA). The former is used to pinpoint a chemical bond that is broken on irradiation of materials by energetic gamma and X-rays. It is found that, contrary to expectations, it is not the weakest bond that is broken, he said. NRMA, on the other hand, gives valuable information on the vortex dynamics in superconductors and is used for detecting and characterizing superconductivity in

high-temperature superconductors as well as the recently discovered superconductor, magnesium boride.

Ram Sagar (Uttar Pradesh State Observatory, Nainital), spoke on 'Star clusters'. These are groups of dynamically associated stars created from the same molecular cloud at the same time. These clusters are located at the same distance, have almost the same primordial chemical composition and move together through the star fields of their galaxy, he stated. He further described the distribution of stellar mass in young star clusters of our galaxy and nearby galaxies, from observations made using the Hubble Space Telescope.

The foundations of mathematics and a review of post-1970s ideas on the interaction between logic and geometry by several important mathematicians was brought through by Nitin Nitsure (TIFR, Mumbai), in his presentation 'Existence, truth, and proof: Modern foundations of mathematics'. Computational complexity was laid out in 'Algorithms and computational complexity' by Ramesh Hariharan, (IISc, Bangalore). He described how an 'approximation algorithm' could give a quick answer to an otherwise difficult problem, citing examples and surveying the results obtained.

Finally, one was taken to the skies, by Vijay V. Patel (Center for Artificial Intelligence and Robotics, Bangalore), who with the help of a video presentation gave insights into the 'Challenges in control law design for modern manned aircraft'. Patel explained how the control system of the aircraft provided the required stability, control and accurate navigation functions. Significant design and development efforts go into suppressing the pilot-induced oscillation (PIO) tendencies, he added. The design challenges in the development of its flight control system and the benefits of using a relaxed static stability aircraft were also discussed.

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