

## 70th Annual Meeting of Indian Academy of Sciences

The 70th Annual Meeting of the Indian Academy of Sciences (IAS) was held at Banaras Hindu University, Varanasi during 25–27 November 2004. There were about 200 participants including Fellows and Associates of the Academy.

T. V. Ramakrishnan in his presidential address on 'Many electrons together: strange new quantum worlds' described the novel collective phenomena that emerge when a large number of electrons come close to each other, as in solids; these phenomena have continued to challenge our understanding. As examples, he referred to (i) the fractional quantum Hall effect in which the transverse electrical resistance of the material is given by  $R_H = h/ie^2$ , where  $h$  is Planck's constant and  $e$ , the electronic charge,  $i$  a fractional number, (ii) high temperature superconductivity which harboured a metallic phase unlike any that were known previously, and (iii) colossal magnetoresistance in manganites.

The historical roots of the fractional quantum Hall effect go back to the previous century. In 1879, Edwin Hall of Johns Hopkins University discovered that when a magnetic field was applied perpendicularly to a thin metal sheet conducting an electric current, a small electrical voltage appeared that was perpendicular to both the sheet and the magnetic field. The observed voltage was proportional to the strength of the applied field. This was termed Hall effect in his honour. In 1980, the German physicist Klaus Von Klitzing found that the observed Hall resistance did not vary smoothly. Instead, it changed in steps independent of the properties of the material. He suggested that the phenomenon was the integral quantum Hall effect. Two years later, Stormer and Tsui while studying quantum Hall effect using extremely high quality gallium arsenide, found a new step in the Hall resistance. It was as if electrons, considered to be indivisible, had mysteriously split into new 'particles' with fractional charges. This anomalous effect was termed the fractional quantum Hall effect. Ramakrishnan gave a brief perspective on the facts that when a very large number of electrons interacted strongly due to their closer positions, strange collective phenomena emerged, that did not often make sense for the constituent electrons and required new paradigms. This was mainly because the electrons were the strongly interacting wave fields in the

extreme quantum limit, a regime where our physical intuitions could not reach. He outlined the ideas that the strong electron lattice interaction in the system of manganites led to two different states, namely localized polaron (an electron with locally distorted lattice), and an extended electronic state remaining in a coexistent state.

Ayurveda is the Holistic approach of therapeutics and ancient science of Indian medicine. It originated about 4500–5000 years ago during the period contemporary to the Vedas. In keeping with the growing popularity of the Ayurveda in the present-day society, a symposium was organized on 'A new look at traditional medicine'. While giving an overview on this symposium, M. S. Valiathan (Manipal Academy of Higher Education) spoke on the evolution of Ayurveda. The practice of medicine was faith-based in Vedic times and the *Atharva Veda* (BC 1500) had numerous hymns related to long life, illnesses, body organs, medicinal plants and procedures. During the time of the Buddha, medical knowledge and procedures advanced significantly and Takshashila became the seat of medical learning and training. Jivaka, the great practitioner of traditional medicine, was the physician of the Buddha. Although the counting of pulse, use of mercury, etc. did progress, the science suffered a period of stagnation after the 6th century. However, it remained as the sheet anchor of health care in India till modern medicines entered in the 19th century especially during the British rule. It is heartening that this ancient system of medicine is gaining popularity in many countries such as Thailand, Japan, China, Korea and even USA, and is being recognized as alternative/complementary medicine.

Ashok D. B. Vaidya (Bharatiya Vidya Bhawan's SPARC, Mumbai), speaking on the current status and reverse pharmacology of herbal and Ayurvedic products, lamented that the global confusion about terminologies used for remedies of plant/natural origin has potentially raised some legal and scientific issues. The Mashelkar Committee proposed intelligent differentiation amongst Ayurvedic drugs, natural drugs and nutritional supplements, with clear guidelines for approval and monitoring. Amendments to the Drug Act, according to the speaker, would hopefully put India in global leadership position *vis-à-vis* her-

bal/natural products. Since enforcement and monitoring the quality of thousands of patent Ayurvedic formulations manufactured by innumerable registered companies is far from adequate, he suggested for an establishment of a national task force for proper investigation.

R. Kumar (Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore) spoke on the drugs from Indian medicinal plants. He stated that Indian medicinal plants, when combined with traditional wisdom, could yield universal botanicals, incorporating concepts of traditional system like Ayurveda, but would be validated through protocols appropriate to the accepting system. These fraction-based, molecularly-defined therapeutics with active molecules at low concentrations and operating through multiple mechanisms, were also adjuvants, prophylactics and agents of mop-up therapies. Kumar added that besides contributing to other systems of medicine, such preparations would enhance the credibility of traditional medicinal systems themselves.

'Tradition to transformation of Ayurveda, science and systems' was the topic of discussion of Bhushan Patwardhan (University of Pune). He defined traditional medicine as an evolutionary process and communities and individuals continued to discover new techniques that could transform practices. Modern drugs have their origin in ethnopharmacology and traditional medicine. Ayurvedic knowledge and experimental database could provide new functional leads to reduce time, money and toxicity—the three main hurdles in drug development. He suggested that by combining the strengths of Ayurveda and the power of science and technology, one could facilitate the desired transformation of traditions resulting in dynamic, evidence-based contemporary systems.

At the dawn of the new millennium we have entered a new era of genomics that can transform both biology and medicine. India, with one fifth of the world population, is a reservoir of genetic mutations and many cases of rare genetic disorders are found here. The symposium on 'Genetics and Health' was organized keeping this in view.

The first speaker of this session was N. Appaji Rao (Indian Institute of Science, Bangalore) on 'Consanguinity, endogamy and community genetics', in which he described his work for over ten years involving

more than 100,000 new born children of the South Indian population (where marriage among close relatives is common). The effects of consanguinity on the occurrence of inborn errors of metabolism were studied. Fertility, fecundity and post-natal fatality were not significantly affected in the consanguineous families, except in a few cases. The effects of endogamy on the gene pool composition and structure were also examined. STR analysis of autosomal markers indicated that despite consanguineous marriages over multiple generations, there was significant residual heterozygosity in the community.

Genomics is the buzzword of the 21st century, said R. M. Pitchappan of Madurai Kamaraj University. Speaking on 'Genomics, immunology and infectious diseases', he mentioned that it aims at investigating the whole genomic/functional molecular diversity in a global analysis, as if five blind men identifying an elephant: it is cost-intensive, labour-oriented and needs to be 'robustly' designed, the success may be 99.9%. This applies to infectious diseases as well: host genetic and genomic diversity and the resultant host immunological (repertoire, response) diversity decide the course of an infection. The pathogen diversity and epidemiology further skew this. He explained some of these points based on two of his studies on South Indian patients: (a) human whole genome scan to identify leprosy predisposing loci and (b) HLA high risk allele consensus peptides obtained by *Mycobacterium tuberculosis* whole genome scan in-silico, and their utility in the studies of pulmonary tuberculosis patients.

The next speaker, Chitra Kannabiran (L. V. Prasad Eye Institute, Hyderabad) spoke on transforming growth factor-beta induced (in short, Tgfb $\beta$ ) gene mutations in corneal dystrophies. Her lecture focused mainly on the Tgfb $\beta$  gene encoding an extracellular matrix protein keratoepithelin, expressed in the cornea and several other tissues. Mutations in this gene lead to autosomal dominant corneal dystrophies, popularly known as lattice and granular dystrophy, that are diseases characterized by progressive opacification of the cornea leading to visual impairment. She also added that examination of patients revealed that a majority had mutations at well-known hotspots for lattice or granular dystrophy while a few had novel mutations that were amyloidogenic.

'Multi-tasking by small viral proteins' was the topic of Shahid Jameel (Interna-

tional Centre for Genetic Engineering and Biotechnology, New Delhi). In the quest for successful infection and replication of their genomes, viruses encode proteins that modulate the immune response, cell death (or survival) and intracellular signaling pathways. However as viruses are small and have limited coding capacity, it becomes imperative for a single viral protein to perform multiple tasks in the infected cell. Jameel presented results from the study on three such proteins—the Hepatitis E virus ORF3 protein, the HIV-1 Nef protein and the SARS virus X1 (orf3a) protein.

B. K. Thelma (University of Delhi), the last speaker of this session, spoke on 'Impact of single nucleotide polymorphisms (SNPs) in pharmacogenetics/personalized medicine—where are we?'. Complete sequencing of human genome due to technological advancements in recent years has led to identification of a large number of single base changes, known as single nucleotide polymorphism (SNPs) distributed throughout the genome. This discovery has revolutionized the science of pharmacogenetics, making it one of the major areas with significantly applied value in biochemical research. She addressed some of the important pharmacogenetic issues related to neuropsychiatric diseases like schizophrenia and neurodegenerative Parkinson's disease. She claimed that a large panel of SNPs has been genotyped in a series of candidate genes from the dopaminergic pathway (common to both the disorders) and their relationship to therapeutic response and adverse effect susceptibility has also been determined.

The meeting had on its programme two special lectures. The first was by Rajaram Nityananda (National Centre for Radio Astrophysics, Pune) on 'High ambitions at low frequencies: the GMRT and beyond'. Giant Meterwave Radio Telescope (GMRT) located near Pune is the world's largest radio telescope at meter wavelengths. It is one of the most challenging experimental programmes in basic science undertaken by Indian scientists and engineers. On completion GMRT would become the world's most powerful radio telescope operating in the frequency range of about 50–1500 MHz. Nityananda described the latest developments on GMRT in the context of relevant astronomical objects, physical processes, and observational techniques.

S. C. Lakhota (Banaras Hindu University, Varanasi), in his special lecture titled 'Non-coding DNA: junk, or a necessity for origin and evolution of biological

complexity', laid considerable stress on the 'central dogma of molecular biology'. This provided a formal basis to understand the flow of information from genes to phenotype. According to him, genetic differences between any two related species are mostly due to changes in the 'non-coding' DNA rather than in the protein coding genes.

Two sessions were devoted to lecture presentations by new fellows/associates of the Academy. Akhilesh Kumar Tyagi from the University of Delhi South Campus, spoke on 'Genetically anchored sequence of rice genome, gene discovery and functional analysis'. A part of the high quality and genetically anchored sequence of the entire rice genome was available in public databases and has been estimated to code about 50,000 genes. S. Umamathy of Indian Institute of Science, Bangalore, in his talk 'Capturing molecules in action by Raman spectroscopy', presented recent results from his laboratory utilizing Resonance Raman (RR) spectroscopy, covering time scales of femtoseconds to microseconds. Siddhartha Gadgil from Indian Statistical Institute, Bangalore, discussed results concerning symmetries of spheres. B. Yegannarayana of Indian Institute of Technology, Chennai, spoke on 'Person authentication from voice: The search for new features in speech'. He stated that though human beings effortlessly perform sophisticated pattern recognition tasks such as speech recognition, speaker recognition, signature matching, handwriting recognition, face recognition, etc., there are no simple ways of dealing with these problems with the existing signal processing techniques for feature extraction and mathematical models for pattern classification. He stressed the need for new methods of processing signals to extract features relevant for the task. M. V. N. Murthy of The Institute of Mathematical Sciences, Chennai, dealt with 'Fractional exclusion statistics: A generalized Pauli principle'. He discussed a 'generalized exclusion principle' proposed by Haldane. 'Carbon-nitrogen bond fusion reactions with metal mediation' was the topic of Sreebrata Goswami, Indian Association for the Cultivation of Science, Kolkata, in which he identified the key features of chemical transformations like transition metal-promoted aromatic amine fusion reaction that occurred with the formation of aromatic carbon-nitrogen bond(s).

Then were two public lectures in the Annual Meeting. The first was by Montek Singh Ahluwalia (Deputy Chairman,

Planning Commission, New Delhi) on 'Globalization and science in India'. It was dedicated to the memory of late Sivaraj Ramaseshan, the editor of this journal for a long time. Ahluvalia said that India lagged behind in quality of science research despite having the third largest pool of scientific manpower. Research work was mostly restricted to a few institutions instead of at the Universities. There is therefore a need for a change in the working of the universities by introducing innovative methods. He emphasized the need to support new research. The private sector should support research and deve-

lopment, as public sector alone could not do the job. There was a vast global market for India-made generic drugs.

The second lecture was by Veer Bhadra Mishra (Banaras Hindu University) on 'The Ganga at Varanasi and the travail to stop her abuse'. The speaker drew attention to the fact that the pollution of Ganga is due to the industrial revolution and unplanned urbanization. Varanasi, situated on the banks of the river Ganges with a population density of 100,000 per square km in her denser parts, is largely responsible for polluting the river. Responding to the challenge posed by the polluters, a lone vol-

untary organization in Varanasi is carrying out a private-public venture on partnership basis to arrive at a technically appropriate and economical solution to remove the major pollution of the Ganges in Varanasi.

The teachers invited from various parts of the country met for a brief session where the science education activities of the Academy were discussed.

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## Recent trends in applied biology\*

During the last five years, products, processes and services in the field of biotechnology and bio-informatics in India have become a reality. The medical world has heavily depended on mute creatures used for experiments in laboratories. Millions of animals are killed to prepare medicine, nail polish, lipstick, floor polish and a number of other things. Keeping all these as the focal point, the seminar discussed various aspects of biotechnology and cruelty to animals. The technical programme was covered in two sessions to discuss various modern trends in biotechnology and alternative methods for laboratory experiments. About 300 persons from Tamil Nadu, Kerala, New Delhi, Gujarat and Mumbai attended the seminar. Three specialists presented their views on select topics. This seminar was supported by UGC, New Delhi.

In the first session, Nike Jukes (InterNICHE, UK) emphasized the need for developing alternative methods for laboratory experiments instead of killing mil-

lions of animals and highlighted points such as that all animals should have freedom to express full natural behaviour, be a part of the social structure and ecosystem, freedom from hunger, thirst, discomfort, pain, injury and distress. It is possible to meet the standards of teaching objectives of life science practical courses using humane alternatives that involve no harm to animals. Film and video models, mannequins and simulators and multimedia computer simulations are the possible alternatives. This approach is gaining momentum, supported by developments in technology and evolution of ethical thought. The alternative would have multiple positive impacts, as the students, teachers and animals would be benefited by it, he said.

In the second session, Achuth Sankar S. Nair (C-DIT, Thiruvananthapuram) spoke about the scope of bio-informatics. He elaborated upon the use of bio-informatics that is based on information technology for acquisition, storage, visualization, management, distribution and analysis of molecular biology data. G. M. Nair (TBGRI, Thiruvananthapuram) highlighted that modern biotechnology constitutes a growing range of techniques, procedures and processes. The confluence of classical and modern technologies enables creation of

new products and highly competitive processes in a large number of industrial and agricultural activities as well as in the health sector. This would provide the impulse to radically transform the competitiveness and growth potential for a number of activities and open up new possibilities. To increase agricultural productivity, in an environmentally sustainable manner, in the face of diminishing land and water resources is a highly challenging task. Knowledge-based approaches including crop genomics can provide powerful solutions and enhance food security, by improving local agricultural productivity, minimizing the use of chemical inputs such as pesticides and fertilizers, insulating crops against losses from diseases and pests, curtailing post-harvest losses including food spoilage, improving food quality and nutrition, increasing crop tolerance to stress factors such as drought and salinity problem, and through the production of value added products.

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