

Seventy-ninth annual meeting of the Indian Academy of Sciences*

The 79th annual meeting of the Indian Academy of Sciences (IASc) was held at Chandigarh for the third time (1979, 2002). This meeting coincided with the 125th birth anniversary of its founder, Nobel laureate C. V. Raman and the 150th birth anniversary of Ruchi Ram Sahni, a freedom fighter and educationist. To commemorate Sahni's birth anniversary, a postal stamp was released by the Government of India on 24 October 2013 at the Panjab University.

The meeting began with the Presidential address by Dipankar Chatterji, who explained how bacteria respond to stress, adapt to changes that occur in gene expression and also their various survival pathways. He pointed out that under nutritional limitations, bacteria adopt a highly conserved stress survival mechanism called stringent response, which is characterized by the synthesis of small nucleotide derivatives known as alarmones. The young bacteria show a nomadic lifestyle, which later transforms to a sedentary lifestyle with ageing. During this stage the bacteria behave collectively. Each bacterium then receives, responds and passes on the information to its neighbour through a cascade of signal transmissions, known as quorum sensing. Chatterji also discussed the role of DNA-binding protein from starved cells (Dps) synthesized under oxidative stress in *Mycobacterium smegmatis*.

In a special lecture, Girish Sahni (Institute of Microbial Technology (IMTECH), Chandigarh) spoke about the success story of developing India's first bio-therapeutic molecule, a protein-based clot buster. The clot-buster drugs such as tissue plasminogen activator (tPA), urokinase (UK) and streptokinase (SK) are all plasminogen activator drugs that have revolutionized the treatment of myocardial infarction in recent years. A two-step novel process for the purification of natural streptokinase from streptococcus was developed by IMTECH,

which has been successfully transferred to Cadila Pharmaceuticals, Ahmedabad and is being sold in the market since 2003 under the brand name 'STPase'. In 2006, US-based Nostrum Pharma was given a license to clinically develop it for commercial use. The efficacy has been tested on crab-eating monkeys. Sahni mentioned that India lacks affordable clot-busters, especially in rural areas. According to Infographic 2012 report, younger people are at risk of developing cardiovascular disease (CVD) due to change in lifestyle. According to World Health Organization (WHO), nearly 20 million people die of CVD worldwide, with 1 million from India. Sahni said if protein chemists and R&D groups align together with pharmaceutical companies, a global impact could be made by manufacturing affordable drugs or molecules. He estimated that therapeutic proteins will have a market share worth 100 billion US dollars and that the future of protein chemistry is an opportunity for India.

In another special lecture, Jayati Ghosh (JNU, Delhi) raised some important issues on whether India is prepared to: (i) productively employ the growing number of youth; (ii) provide skill; (iii) bridge the gender gap; (iv) increase women workforce participation and (v) take care of its elderly. Figures suggest that by 2020 an average Indian will be only 29 years of age compared to 37 years in China and the US, 45 years in Western Europe and 48 years in Japan. A significant rise has also been noticed in higher education. Unfortunately, tertiary education dominates in private institutions (90%) and half of it is offered through distance learning. She said it is important to have a regulatory framework to monitor incentivized education. The good news is that across South Asia women workforce participation has doubled, but recently women dropout rates are evident. With technological intervention, improved public health and nutrition, child survival rate has improved and the death rate has declined. Therefore, the number of women over 80 years is expected to increase by 2050. This makes it necessary to make changes in the social and political policies to address the needs

of the country's future elderly population. She concluded by saying that India like Thailand should learn from its rural health system, where rural doctors are paid higher wages than urban doctors.

India unveiled its National Cyber Security Policy 2013 on 2 July 2013 to build a secure and resilient cyberspace for citizens, businesses and government. A symposium on 'Cyber security and privacy' was held in which the challenges faced by India were discussed. Supplemented with succinct examples, N. Balakrishnan's (IISc, Bangalore) talk highlighted the importance of cyber security and its impact on the security of a nation. He mentioned that though social media has a cascading effect on dealing with societal issues, it could pose a threat to national security. He further discussed the techniques for monitoring social media and trends in the use of analytics software to aid national security. Gulshan Rai (Indian Computer Emergency Response Team, New Delhi) emphasized the need to promote R&D on cyber security to secure e-governance services. He said though the government is self-sufficient to handle security issues, public-private partnership is a way forward to tackle cyber security. He said that India needs a DNS security and router protection to deal with malwares. The attacks on cyber space have exploded in a variety of ways. To tackle the challenge, R. K. Shyamsundar (TIFR, Mumbai) said cryptography is one of the building blocks of cyber security; there is a need to develop a scientific roadmap. P. K. Agarwal (Power System Operation Corporation Ltd, New Delhi) emphasized on the need to deal with cyber security issues emerging due to expansion of power systems. The expansion is a result of rapid changes in communication technology, GPS, signal processing and computer technology.

The second symposium was on 'Food security and national security'. The talk by B. S. Dhillon (Punjab Agricultural University, Ludhiana) focused on innovations for adding value to agriculture with special reference to northwestern India. He said that innovation in agriculture was the key to ensure food security,

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livelihood and a driver for growth, which could be done by improving the crops using technology. Climate variability is a challenge that blocks the road to crop improvement. The way out is to use conventional breeding and biotechnology. He said there is a need to reform the Agriculture Produce Marketing Committee (APMC) Act, bring changes in marketing methods, foster research collaborations and follow precision agriculture. V. Prakash (JSS Group of Technical Institutions, Mysore) focused his talk on malnutrition, a grave problem in India. He said that about 70,000 traditional foods were available earlier, which has now shrunk to 400. To address the problem, a nutritional intervention is required. T. R. Sharma (Indian Agricultural and Research Institute, New Delhi) discussed how next generation sequencing (NGS) technologies have enabled rapid identification of genes. For example, the rice genome information has been extensively used for the positional cloning and characterization of disease-resistance gene *Pi54* imparting resistance to rice blast. Rakesh Tuli (National Agri-Food Biotechnology Institute, Mohali) spoke about how new technologies can be used for a better yield and crop improvement. He said though productivity is increasing in India, production has reached a plateau. To increase productivity, GM crops can bring commercial success by creating awareness to overcome the fear regarding them. He said one of the reasons behind the delay in releasing crop plants was the inability of seed companies in India to tackle safety issues. Citing several examples, like the embargo on cultivating *Bt* brinjal in India and others, he stressed that India should make a decision based on its objective and need.

The second public lecture was delivered by Shivshankar Menon (National Security Advisor, Government of India). He stressed on the need to safeguard technologies to achieve better security system for the country. Before nuclear weapons, the main purpose was to win wars, but now the main contention is to avoid wars. He also spoke about cyber security as being a part of the national security and that India was fortunate to have the support of world-class scientists.

Lecture by Fellows and Associates of the Academy ranged from climate change, quantum computation, functional materials and therapeutics to the impor-

tance of protein chemistry. For example, Madan Rao (RRI-NCBS, Bangalore) spoke on how molecules on the cell surface are organized because of strong coupling with cortical matter, as there exists an interplay between the cell membrane and the cortex. His research looks at how the dynamics and organization of many cell surface molecules can be understood by their coupling to an active cytoskeletal layer. He also discussed the physical principles underlying the active composite cell surface that provide a natural language for discussing the mechanics of computation and information processing. Sujit Ghosh (IISER, Pune) spoke about the functional properties of porous coordination polymers that have been found to have a wide range of applications in gas storage, chemical separation, drug delivery, catalysis, chemo-sensing, etc. Arun K. Pati (Harish-Chandra Research Institute, Allahabad) presented his work on weak measurement and quantum correlation. Weak measurements cause small changes in quantum states, opening up new ways to manipulate and control them. According to Pati, weak measurement-induced quantum discord, known as 'super quantum discord', is larger than the quantum discord captured by strong measurement. Kriti Chandra Sahu (IIT, Hyderabad) spoke about instability due to double diffusivity in stratified viscous flows and discussed the results from linear stability analyses and direct numerical simulations. Krishnendu Sengupta (IACS, Kolkata) spoke on the surface quasi particles of topological insulators which obey Dirac-like equation. He also discussed the transport properties of junctions of the materials and the spin momentum locking of the Dirac quasi particles leading to a novel transport phenomenon. Sharad Sane (IIT, Mumbai) delivered a talk on combinatorics of block designs and finite geometries. Block designs are configurations useful in mathematical branches like coding theory and finite group theory. The focus of the talk was on classification theorems related to symmetric designs and quasi-symmetric designs. Bhim Singh (IIT, New Delhi) spoke on the major causes of power quality problems, such as reactive power burden, unbalanced loading, etc. and finding solutions to these by using custom power devices, power filters and improved power quality AC-DC converters. Vijay Kumar Nair's (Vikram Sarabhai Space

Centre, Thiruvananthapuram) talk examined the effect of black carbon on snow in the Himalayan region. He showed how snow darkening caused due to deposition of soot and dust on snow cover, reduces the reflecting power of snow, accelerating seasonal snow melting leading to floods in the foothills and the plains. S. A. Haider (PRL, Ahmedabad) discussed the similarities of the ionosphere of Earth and Mars. Earth's ionosphere has three layers, *S*-, *E*- and *D*-, while that of Mars is composed of *F*, *E* and *S* layers. The *F*-layer is produced by UV radiations and X-rays. Around 100 organic and inorganic compounds are known in the Mars' atmosphere. He mentioned about future missions to Mars, of which India's first *Mangalayan* was launched on 5 November 2013, which is expected to reach the Martian atmosphere in September 2014.

Japanese scientist Nario Taniguchi was the first to use the term 'nanotechnology'. Later, in 1991 carbon nanotubes (CNTs) were discovered. CNTs have applications in different areas because of the remarkable properties they exhibit, such as (i) enormous stiffness, (ii) high thermal conductivity, (iii) better electrical property, (iv) low density, (v) high temperature resistance and (vi) propagation of waves at the density of hertz. S. Balakrishnan (IISc) delved into the history of nanostructure modelling and wave propagation. He said that understanding wave propagation in these structures is necessary to design next-generation nano devices such as nano electro mechanical systems, nano opto mechanical systems, nano resonators, etc. Anil Kumar (IISc) spoke on the theoretical aspects of quantum computation and quantum information processing and the challenges faced in its experimental aspects. He spoke in detail of the recent developments in the field, including the experimental proof of the quantum no-hiding theorem, using nearest neighbour Heisenberg *XY* interaction to entangle a linear chain of three-qubits, to study the frustration dynamics in a quantum Ising spin system in a triangular configuration and the use of genetic algorithm in NMR QC. Narahari Sastry (Indian Institute of Chemical Technology, Hyderabad) spoke on how a pair of non-covalent interactions mutually influence each other's strength, through computational and structural analyses. He also spoke on the concept of cooperativity

in hydrogen-bonded clusters and aromatic clusters, in addition to explaining the effect of cation- π interaction on hydrogen-bonded clusters and π - π clusters. Avesh Tyagi (Bhabha Atomic Research Centre, Mumbai) spoke about functional materials, a new class of materials that are being developed that have wide applications. Inducing functionality and stabilizing these materials is a problem that researchers are now trying to address. He mentioned that using combustion method and vacuum heating in a reduced atmosphere, a range of materials like CeCrO_3 could be synthesized. CeCrO_3 is used to degrade rhodamine, a toxic dye.

Hormones play an important role in the regulation of reproduction and overall physiology. They are of interest to

protein chemists, said Rajan Dighe (IISc). The antibodies against hormones and their receptors are pivotal to probe the mechanism of hormone action at both physiological and molecular levels. The receptor antibodies help in elucidating the mechanisms of activation of glycoprotein hormone receptors and can have applications in cancer immunotherapeutic. Souvik Maiti (Institute of Genomics and Integrative Biology, Delhi) explained the *in vitro* screening method using DNA-based molecular beacon to identify inhibitors of miR27 from a library of 14 aminoglycosides. Further, screening of the library revealed that streptomycin had the inhibitory capacity to silence miR-21 oncomir by structural perturbation of the dicing process, making it a potential anti-cancer agent. Debashis

Mitra (National Centre for Cell Science, Pune) said that 30 years after the discovery of HIV, a vaccine is yet to be developed. His group has been able to identify and characterize few novel HIV-1 inhibitors that may functionally block the proteins inside the cell that enhance virus replication. The on-going study may take two years to complete. He said that these specific inhibitors may help solve the mystery of drug resistance in HIV patients. He said though 27 FDA-approved inhibitors exist, none has been developed further. These inhibitors can keep the virus away, but the virus tends to rebound once they are withdrawn.

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MEETING REPORT

Thermophiles–2013*

The 12th International Conference ‘Thermophiles–2013’ was organized by the Archaea Centre, Institute of Microbiology, University of Regensburg, Germany. During the inauguration Michael Thomm (Chairman, Organizing Committee) explained how the Archaea Centre originated and also about its activities. Karl Stetter gave an account of the expeditions to high-temperature geothermal environments in Iceland and oceanic thermal vents for collection of samples followed by isolation, characterization, identification and discovery of novel hyperthermophilic bacteria and archaea. Stetter and co-workers have described several new genera and species of thermophilic bacteria and archaea, and developed an excellent facility for the preservation of microbial cultures, studying their physiology, biochemistry and molecular characteristics, and unique facility for large-scale cultivation of hyperthermophiles in specially designed fermenters. The conference proceedings

consisted of invited lectures, and oral and poster presentations.

R. K. Thauer (Max Planck Institute for Terrestrial Microbiology, Germany) spoke on the early evolution of C-1 metabolism. Flavin-based electron bifurcation has been shown as the mechanism of coupling endergonic and exergonic redox reactions in anaerobic archaea such as *Methanopyrus kandleri* and bacteria like *Moorella thermoacetica*. Van der Oost (Wageningen University, The Netherlands) presented the work on DNA-guided DNA interference by prokaryotic argonaute. Argonaute is a key enzyme of RNA-guided RNA interference pathway in eukaryotes. The argonaute in prokaryotes such as *Thermus thermophilus* functions as a host-defence system on DNA-guided DNA interference.

Jennifer Littlechild (University of Exeter, England) explained how they produced thermostable biocatalysts from thermophilic bacteria and archaea, and bacterial genomes and metagenomes for different industrial applications. Recombinant thermostable enzymes such as dehydrogenases, hydrolases and transferases, halogenases and dehalogenases have been produced and tested for various bioconversions. She further added

that the current Framework 7 grant HOTZYME and ERA-1B grant THERMOGENE holders are now studying new hydrolase and transferase enzymes respectively. N. Morant (University of Bath, UK) reported the discovery of a unique DNA polymerase (Tin DNA pol I) from thermophilic marine anaerobic bacterium *Thermodesulfator indicus*. The enzyme displays strand displacement at 65°C and thermostability up to 95°C for several minutes. The enzyme has been found to be useful in heat-denaturing loop-mediated isothermal DNA amplification (HD-LAMP) method for the rapid and on-site detection of nucleic acids.

G. Diemer and co-workers (Portland State University, USA) discovered RNA-DNA hybrid virus from metavirome of Boiling Springs Lake, a high-temperature acidic lake. This could be due to recombination between DNA and RNA viruses. Such a recombination was considered not to occur in nature. Lossouarn *et al.* (Bretagne Occidentale University, Plouzane, France) reported the discovery of bacteriophages that infect thermophilic bacteria of the order Thermotogales. The viruses belong to Siphoviridae. While Edmann *et al.* (University of Copenhagen, Denmark) observed complex CRISPR

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