# New portal for scholarships, etc.

A portal detailing educational supports such as scholarships, fellowships, freeships and educational loans, etc. is launched recently by the Ministry of Human Resource Development (MHRD), Govt of India at the website **www.educationsupport.nic.in** to serve as a ready reference/single window source of information relating to scholarships, etc. available in India. First of its kind in India, the portal presents information on various types of incentives available from all sources such as educational institutions, universities, Ministries of Government of India, organizations, non-government sources and information about educational loans from various public and private sector banks. It also presents a number of external scholarships exclusively offered by MHRD for study abroad. It also deals with admission policy announcements, i.e. the facility of applying for scholarships online with the support of universities/institutions, etc. This facility enables applicants to know of the status of their applications for scholarships applied for also.

MEETING REPORT

# Mid-year meeting of the Indian Academy of Sciences*

T. V. Ramakrishnan, President, Indian Academy of Sciences, Bangalore, and M. S. Thimmappa, Vice-Chancellor, Bangalore University inaugurated the opening session of the 16th mid-year meeting of the Academy at Central College, Bangalore. In their opening remarks, both appreciated the joint efforts of the Academy and Bangalore University over the years in hosting major events in science, with large participation from schools, colleges and the university. They noted that 50 years of discovery of the structure of DNA was celebrated in 2003 during the mid-year meeting of the Academy at the Bangalore University. This year, marking 100 years of Einstein's famous discoveries (International Year of Physics), the Academy again chose Bangalore University as the venue for a full session on 'Lectures in Physics'.

The opening session, held in the afternoon of 7 July 2005, was attended by a large number of school and college students and teachers, apart from fellows and associates of the Academy. N. Mukunda (IISc, Bangalore), N. Kumar (RRI, Bangalore), J. V. Narlikar (IUCAA, Pune) and S. R. Ramaswamy (IISc) delivered the public lectures. Mukunda opened the session with a lecture entitled 'Light, space and time'. In his opening remarks, Mukunda described the evolution of temperature–frequency relationship from the work of Kirchhoff (1859), Wien (1893–96), Planck (1899), Rayleigh/Planck and Rubens (1900) and finally Einstein (1905). He explained the story of $E = h\nu$, i.e. the idea of photon, the particle of light, and dealt with the opposition to this idea of the particle nature of light by well-known scientists of that time (Millikan, de Broglie, Planck and Bohr) and its acceptance through the Compton effect (1923–24) and also by Dirac (1927). This was followed by a discussion on Einstein's work of bringing space and time together, leading to the general relativity theory. Mukunda explained how the modification of the Newtonian mechanism yielded the famous equation, $E = mc^2$. He also explained how a compounded knowledge of mathematics, physics as well as philosophy was essential for this discovery.

The second lecture by Kumar was on Bose–Einstein condensation (BEC) during the period 1924–95, in which he dealt with the quantum mechanically indistinguishable nature of classically identical particles, the explanation of Bose (Bose, S. N., *Z. Phys.*, 1924, **26**, 178) on correct counting of the indistinguishables (explanation of blackbody radiation (1900–01) hypothesis by Planck, and the origin of particles with integral spins. Kumar further informed that in 1995, Cornell, Ketterle and Wieman cooled dilute alkali gas of $^{87}$Rb atoms to nanokelvins in a trap, to obtain complete condensation, and thus created a near ideal BEC situation. Kumar termed this discovery to be of a new state of matter having implications in atom lasers, spectroscopy and interferometry.

Narlikar spoke about cosmology (understanding universe both in time and space) and explained the following: The first concept of cosmology was the Newtonian concept (1692), where the universe was considered as homogeneous, isotropic and static. The cosmological principle allows one to consider that the universe is same from all positions and directions when large galaxies are sampled. In 1917, Einstein applied the general theory of relativity and explained that distortion in the space around any matter is due to gravity and as a result the space derives a curvature. There has also been an approach to look at the universe where it is continuously expanding and the galaxies keep moving farther apart. This is the big-bang approach, where matter and energy that were densely situated together, exploded with 'a big bang', and the universe that resulted was hot and contained elementary particles. It started to expand and cool and organize to form various galaxies and stars. Narlikar explained the different cosmological theories starting from 1900 onwards and also the role of Einstein's cosmological constant and how it is revisited in modern cosmology. The present work in cosmology includes baryogenesis, dark matter, dark energy, etc. Narlikar concluded his talk with a message: 'Cosmology is still an open subject and there is need for some independent thinking'.

The last lecture of the evening was delivered by Ramaswamy, which was mainly

*A report on the 16th mid-year meeting of the Indian Academy of Sciences, Bangalore held during 7–9 July 2005 at Bangalore.

aimed at students. He explained how, with the aid of simple experiments, the Brownian motion in matter can be easily visualized. Delivering the lecture 'Brownian motion: then and now', with the aid of visual recording of experiments where colloidal particles (size $10^{-6}$–$10^{-4}$ cm) exhibited Brownian movement, Ramaswamy explained how diluted milk solution/dispersed pollen grains/other colloidal matter can be watched and how the particles exhibit random walk. These kinds of experiments have led to the derivation of Avogadro number and inference of mass and size of atoms. While concluding his talk, Ramaswamy explained how almost all branches of science and engineering and various facets of life are affected by Brownian motion.

The second day of the meeting, held at Indian Institute of Science (IISc), Bangalore began with a special lecture by D. Chatterji (IISc) on 'A tiny molecular machine and its architecture', in which a machine was initially defined as a combination of parts for utilization. DNA-dependent RNA-polymerase was chosen as the molecular machine where the function of the product protein depends on its structure. Chatterji explained how by targetting a particular subunit of an enzyme by an antibiotic, it could provide control over infectious organisms. Towards the end of the lecture, Chatterji spoke about some recent experiments in nanobiology, where he employed techniques such as those of Langmuir–Blodgett to organize DNA (large molecule) along with smaller molecules (e.g. arachidic acid). In this case, the action of a single molecule of RNA-polymerase during the process of transcription was studied. Following the lecture, there was a Decadal Vision Document release on Astronomy and Astrophysics by Ramakrishnan (Box 1).

The third session started with a lecture on magnetism by R. C. Budhani (IIT, Kanpur) entitled 'Antagonistic orders in tailored super-lattices of hole-doped Mott insulators'. He described the coexistence of superconductivity and magnetism, the two antagonistic quantum phenomena (observation of non-equilibrium superconductivity). Coupling between thin films of superconductors separated by thin film of ferromagnetic materials was discussed. Budhani further explained how the strength of interaction could be tailored by choice of the material and thickness of the film. There are thus more opportunities for fabrication of such devices and also for theoretical prediction of their behaviour.

Suresh Das (RRL, Thiruvananthapuram) spoke about photo-materials in his lecture on 'Photoresponsive liquid crystalline and luminescent materials'. His lecture began with the need for stable photo-responsive liquid crystals due to their potential applications in memory devices, optical computing, communications and display devices. Design, synthesis and characterization of chromophores and their organization were the main themes of this lecture. The system chosen for the purpose was the butadiene-based amphiphiles; these molecules were tuned to organize in solid state, to changes in heat and light. It was demonstrated that the development of rewritable imaging devices is possible with a proper choice of chromophore in the amphiphilic molecules.

In her talk, 'Kinetoplastid parasites – do they commit suicide?', Chandrima Shaha (NII, New Delhi) discussed the programmed cell death concept (PCD, or cell suicide) in case of unicellular organisms. For successful propagation of kinetoplastid parasites, rates of cell division/invasion/cell death need to be controlled. A link between changes in cytosolic $Ca^{2+}$ ion homeostasis and collapse of the mitochondrial function in the parasite was presented. It was pointed out that PCD could be a mechanism to control growth of unicellular organisms in response to limited resources and to maintain clonality and ensure propagation of cells which are fit.

The last lecture of the session, 'L-myo-inositol 1-phosphate synthase: evolutionary divergence and role in stress tolerance' was delivered by A. N. Lahiri-Majumder (Bose Institute, Kolkata). He spoke about the key enzyme L-myo-inositol 1-phosphate synthase (MIPS) in inositol (stress tolerance) and phosphoinositide biosynthetic pathways. MIPS was salt-tolerant and isolated from halophytic wild rice. He elaborated the role of this salt-tolerant MIPS protein in cellular metabolism in plants, when they were grown in saline environment.

The fourth session of the meeting began with a lecture on 'Tuning intermetallic electronic coupling in polyruthenium systems via molecular architecture' by G. K. Lahiri (IIT, Bombay). He brought out the fact that the mixed valent polynuclear ruthenium compounds can be designed using a variety of strategies. The spacers and ancillary ligands used in these systems can be altered in a manner so as to obtain molecules where the metal centres act independent/dependent of each other (as demonstrated by both electrochemical

**Box 1.** Vision Document on Astronomy and Astrophysics.

The mid-year meeting of the Academy saw the release of the *Decadal Vision Document on Astronomy and Astrophysics* by the President of the Academy, T. V. Ramakrishnan. This is the first in a series of vision documents in various areas of science proposed by the council of the academy, where survey, assessment of contribution from Indian scientists, and prioritized recommendations for new initiatives of different sub-areas are given major considerations. This vision document, which was compiled over a period of two years by G. Srinivasan, is a brain child of K. Kasturirangan (the then president of the Academy) and is the result of in-depth discussions and recommendations of several panels focusing on the special branch of astronomy/astrophysics. The Astronomical Society of India was also involved in the preparation of this document. The document has nine chapters. It begins with an executive summary (describing the aim of the project), with the second chapter describing the present revolution in astronomy. Chapters 3–8 are devoted to discussions on different areas of astronomy/astrophysics, namely solar physics, optical and IR astronomy, radio astronomy, high-energy astronomy, theoretical astrophysics, gravitational and particle astrophysics. In the last chapter, seventeen recommendations have been made. In this document the necessity of public outreach has been stressed upon (knowledge accessibility of the ongoing activities and opportunities for students in astronomy/astrophysics). The generation of such a document in any subject is expected to catalyse discussion among scientists to define thrust areas in the subject and prioritize them, and hence the acceptance by funding agencies is expected to be followed.

and theoretical studies of such systems). Such molecules are expected to have a decisive role in molecular electronics based on polymetallic systems.

A. H. Chokshi (IISc) in his lecture entitled 'Role of interfaces in mechanical properties of polycrystalline materials' explained how grain boundaries (internal interfaces) define plasticity. The use of superplastic zirconia ceramic having 1000% ductility or more has applications in aircraft as well as automobile industry. He also discussed the validity of scaling relationship in coarse-grained materials to the nanocrystalline range.

In the lecture on 'Electrical conductivity imaging of frontal Himalaya: geodynamic implications' B. R. Arora (Wadia Institute of Himalayan Geology, Dehra Dun) presented results on measurements carried out using electromagnetic techniques in the Indo-Gangetic plains. The presence of fluid leads to high conduction zone. Thus increased seismicity can be predicted. Periodic reactivation of the trans-Himalayan conductor (THC) in response to strains accumulated during the locking intervals of the Indian–Eurasian plates leads to increased seismicity in a zone from Himalayas and extending towards Delhi. He concluded that temporal changes in the conductivity can predict seismicity and thus earthquakes.

In the lecture entitled 'Towards an aerosol climatology for India', K. Krishnamoorthy (VSSC, Thiruvananthapuram) explained that both natural as well as anthropogenic aerosols affect several biospheric processes such as water cycle and monsoon. Typical measurements were carried out in South India in both coastal as well as arid locations over an extended period; similar measurements were also carried out at off-shore locations to study the movement of aerosols (atmospheric black clouds, ABCs) from one area to another. The talk dealt with results of the measurements as well as future efforts in aerosol research by ISRO. The last lecture in this session was by P. N. Pandita (NEHU, Shillong) on 'Low-energy implications of supersymmetric grand unification'. According to him, the idea of grand unification is one of the most compelling theoretical models, which goes beyond the standard model. He discussed some of the implications of supersymmetric grand unification for the spectrum of superpartners of the standard model particles, which will be probed experimentally at the upcoming Large Hadron Collider.

The evening public lecture on the second day was delivered by Kiran Mazumdar-Shaw (Biocon India, Bangalore) on the topic 'The need for shared vision between academia and industry'. She spoke about different eras of technology and called the decade of 2000 as that of genomics/bio-/information technology. Intellectual asset creation was stated to be essential, for which several ways of encouraging academia–industry interaction were suggested. She gave a number of examples from Western academia–industry interactions to substantiate her suggestions. The national innovation *mantra* according to her is 'high value innovation development at the lowest cost'.

The first session of the third day started with a special lecture by T. Ramasami (CLRI, Chennai) on 'Collagen-based smart biomaterials'. He demonstrated how an in-depth understanding of the basic science of skin could be employed for development of a series of life-affecting tools. The lecture began with a historical note on collagen structure and G. N. Ramachandran, and continued with applications in repairing collagen for non-cosmetic purposes such as wound/burn healing and eye lens preparation. The contribution of CLRI to skin repair via commercial medicines such as Kollagen, NeuSkin and Biofill as well as enhanced tissue culture growth demonstrated the industry–academia collaboration.

The last session of the meeting had lectures by V. Shankar (IIT, Kanpur), S. K. Kulkarni (University of Pune), G. C. Mishra (NCCS, Pune) and S. Ramdorai (TIFR, Mumbai). The first of these talks entitled 'Stability and dynamics of fluid flow past deformable solid media' by Shankar dealt with theoretical studies based on linear stability analysis for the Newtonian fluid flows through deformable tubes/channels. The effect of deformable solid layers on interfacial instabilities in multilayer flows of both Newtonian and

**Box 2.** Science education initiative of the Academy.

The mid-year meeting of the Academy had a meeting of the Science Education Panel (SEP), a panel set by the Academy for the advancement of education and issues pertaining to it. The members of SEP had a discussion meeting with college teachers of various science disciplines on the forenoon of 7 July 2005, on different aspects of undergraduate/postgraduate education in Indian universities. The guest teachers held a discussion on issues such as syllabus modernization and free availability of computer-aided education tools through the Academy (~ 60 teachers were present). Efforts to popularize the initiatives of the Academy at an all-India level were also discussed. Following a common meeting, a discussion in four subject committees (physics, chemistry, mathematics and biology) was conducted where the teachers interacted with SEP members. In all these discussions, the main focus was related to initiatives of the academy such as summer fellowships (for both teachers and students), refresher courses and lecture workshops.

The discussions with teachers were followed by a SEP member meeting, which was attended by 24 (members + invitees) scientists. The meeting was chaired by Mukunda and the members included fellows/associates of the Academy from various science disciplines. Following the welcome and introduction of the attendees, the meeting proceeded with a review of the activities completed during 2004–05, including summer fellowships (44 teachers and 202 students were offered fellowships compared to figures of 37 and 167 respectively for 2003–04), refresher courses (11) and lecture workshops (14). It is gratifying to note that the increasing Governmental budget support has enabled the Academy to carry out its initiatives substantially.

Five new proposals for refresher courses and lecture workshops for the following year were discussed and approved. The meeting also had extensive discussions on: (i) the need for improving statistics education and application of statistics to real datasets; (ii) improvement of earth sciences education and awareness about the subject at the pre-university level; (iii) improvement of biology education and need for study of integrated biology courses.

viscoelastic liquids was dealt with. In this connection, a new type of instability was predicted for viscoelastic fluids. Kulkarni spoke on 'Surface-engineered small particles', especially dealing with synthesis of a variety of materials with specific size and shape. She spoke about how physico-chemical properties can be tuned by changing the size (in nanoscale), choosing materials such as silica, alumina, polymers, zinc oxide and titanosilicate.

Mishra spoke about the interaction between B cells and $CD8^+$T cells in the lecture entitled 'Differentially activated B cells acquire different capacity to activate $CD8^+$T cells'. A mechanism of B cell surface TGF-b1-mediated hyporesponsiveness leading to reduction of immune response of $CD8^+$T cells was discussed. In the last presentation, Ramdorai spoke about 'Elliptic curves and number theory'. She posed a number of questions related to elliptic curves and discussed the tools which would provide answers to these questions. She also gave references to ancient mathematics and how some of the questions of number theory were realized much earlier.

The meeting, which was attended by about 250 participants, concluded with an address by S. Chandrasekaran (IISc), Secretary of the Academy. In the sidelines of the meeting, events such as the release of a Vision Document on Astronomy and Astrophysics (Box 1) and an interactive session on Science Education Initiative of the Academy (Box 2) also took place. Now it is time to look forward to scientific deliberations and related events during the forthcoming 71st annual meeting of the Academy in Tiruchirapalli during 11–15 November 2005.

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MEETING REPORT

# The fluid earth*

The most consequential dynamical processes of the earth system are mediated by fluid flows. These include not only the obvious wind and ocean currents or river, lava, geyser and debris flows, but material flows beneath the outer thin, colder, brittle lid of the earth, which set the basic conditions for planetary evolution: distribution of land and sea, topography, volcanic and earthquake regimes, climate and glacial cycles, and evolution of mineral and hydrocarbon resources as well as of life forms among others, such as the earth's magnetic and gravity fields. Indeed, rightly intuiting this fundamentally fluid nature of the earth, Newton, in the 17th century, interpreted its equatorial bulge to be the result of a rotating fluid sphere, and proceeded to calculate its ellipticity, a figure remarkably close to the currently accepted value.

This view of the earth remained eclipsed for a while between the late nineteenth and mid-twentieth century by the inference that apparently the earth was not only solid up to great depths, but had a rigidity greater than that of steel, as required by the propagation of seismic waves and investigations of earth tides, both involving short-term periodic stresses. Meanwhile, conceptual advances in our understanding of solid-state creep and subsolidus convection in the earth's mantle, together with evidences of sea-floor spreading and application of Euler's conditions for rigid body motion of spherical caps already formulated over a century ago, helped reinstate the viscous fluid-like behaviour of the earth's mantle, in a new and more elaborately defined form with the recognition, in the 1970s, of plate tectonics. This unique thermodynamic engine evolved in the solar system by planet earth for the transfer of its internal heat, predicated by its special endowments of just the right mass and just the right distance from the sun, provides the fundamental geodynamical framework which is believed to account for virtually all terrestrial phenomena known or observed today. Inevitably, thereafter, fluid dynamicists set to address the problems of the ubiquitous two-phase flows in the earth system[1,2], as an analogue for a host of geological processes both at high and low Reynolds numbers. These analytical developments basically exploiting the conservation laws of mass, momentum and energy in advecting fluid regimes, and further refined since, now enable scientists to set bounds on critical geophysical conditions such as the amount of melt fraction required to separate it from the residual solid phase, before it can become a potent dynamical agent. This fraction, assumed by geologists for over a century to be ~10%, was thus shown to be no larger than ~2–3% on fluid dynamical considerations, a figure now also confirmed by ion probe studies of the geochemical composition of melts trapped in olivine crystals beneath axial spreading centres. 'Geological fluid dynamics', a term voiced by Herbert Huppert of Cambridge University, continues to demonstrate its illuminating potential in refining our understanding of critical earth processes: high Reynolds number flows as in the flow of atmospheric particles, sediment, and crystallization in magma chambers (Figure 1), as well as those of low Reynolds numbers such as melt generation and movement, sediment compaction, metamorphism and reservoir engineering. In the process it has also led to a better comprehension of how low-viscosity fluids react with high-viscosity ones to alter the chemistry and thereby the rheology of

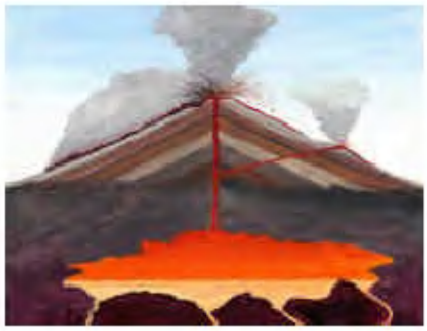

**Figure 1.** Magma conduit in cross-section.

*A report on the Discussion Meeting of the Indian Academy of Sciences, Bangalore held in January 2005.