

Patrika

Newsletter of the Indian Academy of Sciences

Guwahati Annual Meeting

The Academy held its 2003 annual meeting in Guwahati from 21 to 23 November at the invitation of the Indian Institute of Technology, Guwahati. This was the first time in sixty-nine years that the annual meeting was held in the north-east of the country. All the scientific sessions except a public lecture were held at the just-completed Senate Hall of IIT. Gautam Barua's brief welcome address was followed by the traditional introduction of Fellows and Associates, a hundred of whom were present at Guwahati. K Kasturirangan, in his presidential address on "Precision positioning: science and applications" talked about technologies



behind satellite-based navigation systems and about their use in scientific studies, military and civilian applications such as for land, remote sensing, geo-mapping, and in any application where the precise position in real time is to be determined.

The remaining programme of the three days was taken up by two symposia, two public lectures, two special lectures and 30-min presentations by eight new Fellows and Associates. The first symposium was on nanomaterials and nanoscience, a truly interdisciplinary area encompassing physics, chemistry, biology, materials science and engineering. There has been tremendous interest in this field in the last decade not only from the fundamental scientific point of view but also from possible technological applications in many areas. Significant progress has been made in recent years in developing new methods of synthesis of nanomaterials as well as new tools for characterization and manipulation. New understanding of size-dependent electrical, optical and magnetic properties of individual nanostructures and their assemblies is now emerging. There were five talks at the symposium. AK Sood (IISc, Bangalore) talked about carbon nanotubes which have potential applications such as nano-scale electronics,

Inside...

2004 Elections	
New Fellows	4
Honorary Fellows	6
Council for the triennium 2004–06	6
Associates – 2003	6
Raman Professor	7
Special issues of Journals	7
Public Lectures	8
Discussion Meeting	10
Refresher Courses	10
Lecture Series	14
Obituaries	16

EDITOR

N. Mukunda

Published by

Indian Academy of Sciences
Bangalore 560 080, India
Phone: (080) 2361 2546, 2361 4592
email: office@ias.ernet.in

This newsletter is available on the
Academy website at : www.ias.ac.in/patrika/

*To receive a regular copy of the
Newsletter, please write to the
Executive Secretary of the Academy*

Forthcoming Events

Annual Meetings

15th Mid-Year Meeting, Bangalore
2–3 July 2004

70th Annual Meeting, Banaras Hindu
University, Varanasi
19–21 November 2004

Refresher Courses

Experimental Physics
Bhavnagar University
25 October – 7 November 2004

Experimental Physics
University of Mysore,
1–15 November 2004

Plant Genetic Engineering
Madurai Kamaraj University,
7–21 December 2004

Animal Behaviour
Madurai Kamaraj University

Theoretical Physics
Changanassery

Physiology and Biochemistry
Goa University

sensors, actuators, hydrogen storage, field-induced emission and superstring polymer composites. Synthesis of nanomaterials, particularly using biological systems such as fungi, actinomycetes, and extracts from plant parts was discussed by Murali Sastry (NCL Pune). Tailoring properties of nanoparticles by tuning sizes due to quantum confinement effects were discussed by DD Sarma (IISc, Bangalore). Nanolithography was discussed by AK Raychaudhuri (IISc, Bangalore) in which he summarized the methods to make materials of sub-micron dimensions and the problems involved in making measurements on these objects. The last talk was by GU Kulkarni (JNCASR, Bangalore) who described studies to determine size-dependent electronic properties of metal nanocrystal and the synthesis and properties of free-standing nanocrystal films of gold, silver and copper, where the electrical behaviour of these films could be fine-tuned from metallic to insulating by varying the temperature during synthesis.

The second symposium on “Emerging trends in communication technologies” was jointly organized by Gautam Barua (IIT, Guwahati) and N Balakrishnan (IISc, Bangalore) and contained five talks: optical networks (KN Sivarajan, Tejas Networks, Bangalore), satellite and wireless communication (KS Das Gupta, SAC, Ahmedabad), connecting rural India with special emphasis on North-East (Ashok Jhunjhunwala, IIT, Chennai), the need for a change from voice telephony to broadband internet in rural or remote environments that needed community approach to defray costs (Bishnu Pradhan, IIT, Mumbai) and the challenges facing the North-East region, such as under-development and the tyranny of geography (Gautam Barua, IIT, Guwahati). At the end of the symposium, the message that came out was that those parts of the country that are not properly connected electronically will tend to stay away from the mainstream of growth, both ideologically and otherwise, causing a digital divide. States like Assam also pose a challenge to network designers and policy-makers, in view of the mountainous terrain. The focus of the symposium was to take a hard and close look at possible technology options that will make bandwidth available in abundance all over the country in general and for states like Assam in particular so that the nation can enjoy a uniform and sustained economic growth.

The first public lecture by Rakesh Sharma, the first Indian to journey into space, was entitled “Manned space flight and earth’s environment”. In view of the popular nature of this topic, the



Rakesh Sharma

lecture was arranged at the large Rabindra Bhavan in the centre of the city and there were over 1500 in the audience, many of them young school children. In his lecture, Sharma spoke of the technicalities and rigours of space-flight training, the wonders of space travel and looking at the earth through the windows of spacecraft. At the same time, he sounded a warning that mankind should

conserve non-renewable natural resources to prevent an ecological imbalance on earth. Pollution caused by affluent lifestyles of people was responsible for the ever-increasing degradation of the nature. The western countries have already adopted measures to protect the environment. This has resulted in the relocation of industries to the east because there are no environmental regulations in this part of the world.



HY Mohan Ram

HY Mohan Ram's (University of Delhi) public lecture on "Seeds and Civilization" highlighted the value and role of seeds in the origin of agriculture, the significance of determining the centres of primary diversity of economically important plants, and the romantic stories of plant introduction and their

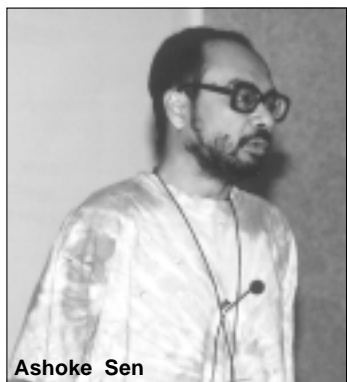
impact on civilization. An extended abstract of this interesting talk appears elsewhere in this issue.

The two special lectures were by J Gowrishankar (CDFD, Hyderabad) on "The love triangle between single-stranded RNA and double-stranded DNA: R loops and their consequences in bacteria" and by Ashoke Sen (HRI, Allahabad) on "The search for a unified theory". According to Gowrishankar, the R-loop



J Gowrishankar

has a three-stranded structure and is the physiological intermediate in plasmid replication and could occur during mRNA transcription, proving to be toxic if not dissipated. Ashoke Sen reviewed string theory which formed the basis for a unified theory of all matter and their interactions.



Ashoke Sen

The lecture presentations by new Fellows and Associates covered a range of topics. Dipankar Bhattacharya (RRI, Bangalore) on the magnetic fields of neutron stars, Probal Chaudhuri (ISI, Kolkata) on statistical learning in molecular evolution, Saraswathi Vishveshwara (IISc, Bangalore) on graph theory and biomolecular structure, SB Krupanidhi (IISc, Bangalore) on quantum well structures for infrared applications, A Samanta (Univ. of

Hyderabad) on fluorescence signalling of molecular environment, Shalivahan (ISM, Dhanbad) on electrical anisotropy of asthenosphere, RM Pitchappan (MKU, Madurai) on genomic diversity and disease susceptibility and finally V Purnachandra Rao (NIO, Goa) on the genesis of phosphorite deposits.

As part of the work of the Academy Panel on Women in Science constituted recently to look into the issues of women scientists, Indira Nath and Rohini Godbole convened a panel discussion at Guwahati in which members of the panel, Fellows of the Academy and others interested in this subject participated. Suggestions made and issues raised at this meeting will be considered by the panel.

A large number of teachers from the North-East region of the country attended the meeting as guest participants. An interactive session was held with these teachers to brief them about the activities of the science education panel.

Finally, a word about the excellent arrangements made at IIT, Guwahati for holding the annual meeting. Gautam Barua, Mihir K Chaudhuri and their colleagues did a wonderful job to make the stay of the participants most enjoyable.

Summary of Public Lecture by HY Mohan Ram on "Seeds and Civilization"

Flowering plants (angiosperms) have been the most successful plants on land since the Cretaceous period. A seed is a morphogenetic enigma, an ecological and physiological curiosity and a source of economic power. Activities stimulated by fertilization such as rapid growth of the embryo and endosperm come to an abrupt stop. This is in utter contrast to the condition in mammals where the young is born after attaining development. During maturation, the seed becomes dehydrated and all enzymatic activities are brought to a tentative halt. A seed is neither the beginning nor the end of a plant's life. It represents a state of suspended animation.

There is nothing equivalent to a seed in the entire living world. It has three unique features: (i) it generally results from genetic recombination, (ii) it is the means of propagation, gene flow and perpetuation of the species, and importantly, (iii) it enables the plants to survive under extreme environments. No wonder seeds have inspired poets and philosophers in their quest for understanding life.

There is no clear-cut answer to the question why it took so long for humans to discover the seed and use it as the starting point for raising crops. Various theories have been put forth to explain the origin of agriculture which, according to our present knowledge, is around

2004 ELECTIONS

Fellows

10,000 years old. What prompted people to take up the deliberate sowing of seeds and harvesting of crops is not known. No other event has probably changed the course of human history and destiny as agriculture has. Even now, when we have landed on the moon and have successfully launched the spaceship voyager to explore Mars, we still depend on rice, wheat, maize and potato as our basic food crops.

Historically the old world and new world agriculture systems have been different and fairly well-advanced. However, due to lack of contacts, the crops and the methods of cultivation remained unknown. Out of the roughly 2,58,000 flowering plants, over 1000 are used for food in one form or the other. Of these 200 are commercially cultivated and 30 food crops have an annual production that exceeds 10 million tonnes.

Two thousand years ago plant products along with silk, gold, ivory, curios and artefacts were mainly traded across the old world by land routes. During the 'age of exploration' bold voyages and expeditions were undertaken not only to conquer new lands but also to introduce technologies, minerals, animals and food crops. To wrest the monopoly of the spice trade through the land route from the Arabs, the Portuguese set out to find India. Vasco da Gama landed in Calicut on May 20, 1498. When Christopher Columbus set sail from Spain in 1492, he speculated that his fastest route to collect gold and spices from the orient was west by sea. He had no idea that the island of San Salvador in the West Indies he reached in 1492 was the gateway to two unknown continents. Neither the inhabitants of this island nor Columbus whom they greeted, could imagine the enormous global consequences of the encounter that commenced that day.

Often unforeseeable, the original intentions of the voyages were to annex and exploit the riches of unknown lands. Today the purpose would be to manage and sustain the lives of humans and domestic animal in the shrinking world. We have to care and protect the resources of our planet which looks like a blue speck from outer space.

To botanists and agriculturists, exchanges and introductions of crops to the new world from the old world and vice versa and from one region to the other within the continents have been of tremendous significance, as the study of the centres of their diversity presents challenges for research and opportunities for application. Wheat, rice, millets, soybean, banana, apples, peaches, citrus fruits, lentil, grapes, chick pea, sugarcane and coffee were carried from the old world to the new world. Maize, potato, tapioca, sweet potato, pumpkin, kidney beans, red pepper, tomato, groundnut, cashew nut, pineapple, papaya, cocoa, cinchona and rubber are new world crops. These have now been grown on a larger scale in the countries of their introduction than in the regions of their origin.

The lecture highlighted the centres of primary diversity of important crop plants, the stories of their utilization, introduction and conservation.

Agrawal, Manindra

Indian Institute of Technology,
Kanpur

Areas of interest: Computational complexity theory, and computational number theory



Ahmad, Talat

University of Delhi,
Delhi

Igneous petrology (geochemistry)
and Himalayan geology



Bachhawat, Anand K

Institute of Microbial Technology,
Chandigarh

Microbial genetics, molecular genetics,
and microbial biochemistry



Bhakuni, Vinod

Central Drug Research Institute,
Lucknow

Protein folding and stability,
and molecular biophysics



Bhanu Sankara Rao K

Indira Gandhi Centre for Atomic Research,
Kalpakkam

Mechanical metallurgy, physical metallurgy,
and materials development



Chattopadhyay, Dhruvajyoti

Calcutta University,
Kolkata

Transcription, molecular virology,
and oxidative stress response



Chowdhury, Debashish

Indian Institute of Technology,
Kanpur

Statistical physics, condensed matter physics
(theory), and biological physics (theory)



Goswami, Sreebrata

Indian Association for the Cultivation
of Science, Kolkata

Inorganic chemistry, chemical reactions with
metal mediation, and polymetallic systems



Kant, Tarun

Indian Institute of Technology, Mumbai
Structural mechanics,
mechanics of polymer composites,
and finite element methods

**Radhakrishnan, TP**

University of Hyderabad,
Hyderabad
Materials chemistry,
and computational chemistry

**Kulkarni, Sulabha K**

University of Pune,
Pune
Surface physics, materials science,
and nanoscience

**Ramdorai, Sujatha**

Tata Institute of Fundamental Research,
Mumbai
Algebra, quadratic forms, number theory,
and Iwasawa theory

**Kumar, G Ravindra**

Tata Institute of Fundamental Research, Mumbai
Interaction of intense light with matter,
and nonlinear optical properties of novel
materials

**Shanbhag, Bhagyashri A**

Karnatak University, Dharwad
Comparative endocrinology and reproduction
(vertebrates), herpetology,
and animal behaviour

**Kumar, M Udaya**

University of Agricultural Sciences, Bangalore
Molecular basis of stress resistance,
physiology of water use efficiency in plants,
and canopy photosynthesis

**Sinha, Bikash C**

Variable Energy Cyclotron Centre and
Saha Institute of Nuclear Physics, Kolkata
Nuclear physics and high energy physics, quark
gluon plasma, and early universe cosmology

**Murthy, MVN**

The Institute of Mathematical Sciences,
Chennai
Particle physics phenomenology, and
quantum statistics (semi-classical methods)

**Tyagi, Akhilesh K**

University of Delhi South Campus,
New Delhi
Plant gene expression, genomics,
and biotechnology

**Nageswara Rao, G**

LV Prasad Eye Institute,
Hyderabad
Cornea, community eye health,
and eye care policy and planning

**Umapathy, Siva**

Indian Institute of Science,
Bangalore
Laser spectroscopy, photochemistry,
and ultrafast dynamics

**Palaniandavar, M**

Bharathidasan University, Tiruchirappalli
Bioinorganic chemistry, activation of
molecular oxygen, and structure,
bonding & electron transfer in small molecules

**Vrati, Sudhanshu**

National Institute of Immunology,
New Delhi
Molecular virology, vaccinology,
and biotechnology

**Pillai, M Radhakrishna**

Regional Cancer Centre,
Thiruvananthapuram
Tumour biology, molecular biology,
and drug development

**Yegnanarayana, B**

Indian Institute of Technology,
Chennai
Signal processing, speech and vision,
and artificial neural networks



Honorary Fellows

Griffiths, Phillip A

Institute for Advanced Study,
Princeton,
NJ



Livage, Jacques

Chimie de la Matière Condensée,
Université Pierre et Marie Curie,
Paris



Varadhan, Srinivasa SR

Courant Institute of Mathematical Sciences,
New York University,
NY



COUNCIL FOR THE TRIENNIUM 2004–2006

The outgoing Council held an election in December 2003 to constitute the Council for the next triennium 2004-2006. The composition of the new Council is as follows:

Ramakrishnan, TV

Banaras Hindu University, Varanasi – (President)

Kasturirangan K

Member of Parliament (Rajya Sabha) –
(Previous President)

Balakrishnan, N

Indian Institute of Science, Bangalore – (Treasurer)

Balasubramanian, D

LV Prasad Eye Institute, Hyderabad – (Vice-President)

Chandrasekaran, S

Indian Institute of Science, Bangalore – (Secretary)

Dattagupta, S

SN Bose National Centre for Basic Sciences, Kolkata
(Vice-President)

Goswami, JN

Physical Research Laboratory, Ahmedabad

Hasnain, SE

Centre for DNA Fingerprinting and Diagnostics, Hyderabad

Indira Nath

All India Institute of Medical Sciences, New Delhi

Kumar, N

Raman Research Institute, Bangalore

Kumar, R

Jawaharlal Nehru Centre for Advanced Scientific
Research, Bangalore – (Vice-President)

Indraneel Mitra

Bhopal Memorial Hospital and Research Centre, Bhopal

Mukunda, N

Indian Institute of Science, Bangalore
(Vice-President and Editor of Publications)

Nanjundiah, V

Indian Institute of Science, Bangalore

Ramasami, T

Central Leather Research Institute, Chennai

Rodrigues, Veronica F

Tata Institute of Fundamental Research, Mumbai

Sathyamurthy, N

Indian Institute of Technology, Kanpur

Sood, AK

Indian Institute of Science, Bangalore – (Secretary)

Sopory, SK

International Centre for Genetic Engineering and
Biotechnology, New Delhi

Sunder, VS

The Institute of Mathematical Sciences, Chennai

ASSOCIATES — 2003

Bhattacharya, Siddhartha

Tata Institute of Fundamental Research,
Mumbai

Area of Interest: Rigidity theory of
dynamical systems



Gadgil, Siddhartha

Indian Statistical Institute,
Bangalore
Topology



Ghosh, Saurabh

Indian Statistical Institute,
Kolkata
Statistical genetics



Goswami, Debashish

Indian Statistical Institute, Kolkata
Noncommutative geometry
and noncommutative probability



Mohanty, Bedangadas

Variable Energy Cyclotron Centre,
Kolkata
Experimental high energy heavy ion collisions



Nagendra, Harini

Ashoka Trust for Research in
Ecology and the Environment, Bangalore
Landscape ecology



Sheth, Hetu C

Indian Institute of Technology,
Mumbai
Igneous petrology, and volcanology



RAMAN PROFESSOR



Dr Robert Eugene Williams visited India as the twenty-first Academy Raman Professor in December 2003 and January 2004. As Director of the Space Telescope Science Institute from 1993 to 1998 he was responsible for defining the science programme and operation of the Hubble Space Telescope, whose

spectacular results have benefitted the international astronomical community.

During his stay in Bangalore, Williams interacted with the students and faculty of the Raman Research Institute, the Indian Institute of Astrophysics, the Indian Institute of Science, and the ISRO Satellite Centre, and delivered several lectures including an Academy public lecture. He also visited Pune and Mumbai and delivered lectures at the National Centre for Radio Astronomy, the Inter-University Centre for Astronomy and Astrophysics, and the Tata Institute of Fundamental Research.

SPECIAL ISSUES OF JOURNALS

Frontiers in materials science – Part II

Guest Editors: Baldev Raj and K Bhanu Sankara Rao
Sâdhanâ Vol. 28, Nos.3/4,
June/August 2003, pp. 359–864

In Patrika 38 (September 2003) Part I of a special issue on “Frontiers in materials science” was reported. Part II of this special issue was brought out as two combined issues of *Sadhana* (June/August 2003) and contained 26 articles on a variety of topics in materials science such as solidification cracking, steam turbine components, post-weld heat treatment, hydrogen embrittlement, laser processing of materials, biomaterials and tissue engineering in reconstructive surgery, biomimetics, bulk metallic glasses, computational materials science, thermomechanical processing of alloys, and teaching of materials science and engineering.

Precision machining

Guest Editor: VC Venkatesh
Sâdhanâ Vol. 28, No.5,
October 2003, pp. 865–974

This special volume is devoted to precision engineering. Recent progress in this field clearly indicates the transition

of precision technology to precision science. Merchant's new theory on the mechanics of metal cutting in 1944 heralded a new approach, moving away from the empirical work of Taylor (1906) that resulted in a new cutting tool material (high speed steel), the Taylor tool life equation $V T_n = C$, and the Taylor Gantt bar charts. Gene Merchant's theory was considered the start of a golden era in understanding machining. Merchant's contemporary Milton Shaw introduced new theories in the area of grinding, one of which is the size effect. Both Merchant and Shaw utilized Bridgman's work on large plastic flow and fracture to shape their theories. These are well presented in this volume, the size effect being explained in detail. Way back in 1961 Merchant predicted the imminent use of numerical control in machining that has changed manufacturing globally.

The papers presented in this volume report on various aspects of this field such as: size effect in metal cutting; precision grinding; free-form laser printer mirrors; diamond-coated tools made by plasma torch, microwave, and hot filament techniques; nano-finish grinding of brittle materials.

Proceedings of the Workshop on Quantum Chromodynamics

Guest Editors: P Jain, SD Joglekar and V Ravishankar
Pramana, Vol. 61, No.5,
November 2003, pp. 785–1054

Quantum chromodynamics continues to be an important area of research in high energy physics. Proper understanding of perturbative QCD is essential for interpretation of signals at future colliders. There is also considerable effort in the understanding of nonperturbative aspects of QCD. Facilities such as Jefferson Laboratory have already provided many new results in the medium energy aspects of QCD. Furthermore RHIC has also given considerable impetus to research in quark gluon plasma. Many of the results obtained at these experimental facilities have not agreed with cherished theoretical ideas.

The second quantum chromodynamics (QCD 2002) workshop was held at IIT Kanpur in November 2002. This was an international meeting and had several (theoretical and experimental) invited talks along with many contributed papers. The workshop covered many aspects of quantum chromodynamics including perturbative QCD, structure functions, quark gluon plasma, lattice QCD, topological aspects, chiral perturbation theory, effective field theories, applications to nuclear physics, spin physics and exclusive processes. This volume contains 14 of the invited talks presented at the workshop as also 17 contributed papers.

Emerging directions in chemical sciences

Guest Editors: GU Kulkarni, B Bagchi
and J Gopalakrishnan
Proceedings: Chemical Sciences, Vol. 115, Nos.5/6,
October/December 2003, pp. 319–806

This special issue of the *Proceedings* contains a collection of articles contributed by the participants of the



international conference on *Emerging Directions in Chemical Sciences* held in Bangalore during November 2003. The issue contains forty three articles on a myriad range of topics in chemical sciences, which lie at the frontiers of current international activity. The topics include: fullerenes as building blocks for nanoclusters, metal-

mediated chemical transformations, electrical conduction in nanostructured composites, mesoporous materials as catalysts for organic reactions, peptide design, synthesis of a variety of solids in various states of aggregation – single crystals, fine powders and thin films, nanomaterials, phase transitions, electron density distribution and aromaticity, and last but not the least, theoretical investigations of several interesting topics, as for example, multiphoton vibrational interaction in NO molecule, *ab initio* study of ferromagnetic perovskites, one-dimensional Bose–Hubbard model, magnetoresistance of manganites and free energy landscape of small proteins. The diversity and range of topics are indeed remarkable, and the guest editors believe that the special issue will be of use to many practitioners of chemical science.

PUBLIC LECTURES

Issues in planetary exploration

Jacques Blamont
French Space Agency (CNES), Paris, France
19 November 2003,
Raman Research Institute, Bangalore



If you would like to be included on the Public Lecture Mailing List please call the Academy office 080-2361 2546 or E-mail : office@ias.ernet.in

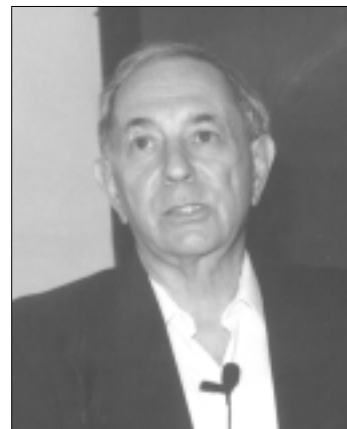
X-rays, synchrotron radiation, and the properties of matter: A continuing revolution

Martin Blume

The American Physical Society and Brookhaven National Laboratory, USA

1 December 2003, Raman Research Institute, Bangalore

An immediate scientific and public sensation followed the discovery of X-rays in 1895. It is indeed difficult to think of a major development in science since that time that has not been made possible or significantly affected by experiments using X-rays. In this talk the development of X-ray sources and the new uses



made possible by these sources were discussed and illustrated, and some considerations on the future put forward.

Scary: Does it frighten you?

Marshall Stoneham

Centre for Materials Research, University College London, London, UK

8 January 2004, Raman Research Institute, Bangalore



As scientists, we sometimes have to give views on matters of direct importance to the general public, as well as to ourselves. The issues may be those regarded as matters of life and death. Often, the reason our advice has been sought is a scare story, one of those threats that sounds

plausible, but may or may not be true. The story may be backed by statistics used in unconventional ways. The speaker discussed some of the contrasts between those things that frighten and those things that are actually dangerous, the parallels between statistics in science and in public perception, and the rules followed by successful writers of scare stories.

The standard model of cosmology, dark matter and dark energy: is it correct?

JP Ostriker

Princeton University, Princeton, NJ, USA

9 January 2004, Raman Research Institute, Bangalore

A standard model for cosmology has emerged, sometimes called the concordance model, which is apparently consistent with a broad suite of observations. The universe begins as a hot big bang, goes through an inflationary phase, and then follows a path that is well verified by current data. Ordinary baryons represent a small fraction



(~5%) of the critical density at the present time, dark matter of some unknown kind(s) is more abundant (~25% of the critical density) and a still more puzzling dark energy dominates the matter energy density (~70% of the critical density) with the total corresponding to the flat universe expectation: $\Omega_{\text{tot}} = 1$. Fluctuations in the gravitational potential at about the level of 10^{-5} obey an initial distribution that is nearly self-similar, with amplitudes distributed in a Gaussian random fashion about the mean. Structure grows initially via gravitational instabilities with energy feedback from stars and accreting black holes ("feedback") playing a minor role. Observations of the cosmic background radiation field and the distribution of galaxies are the two principal components in establishing this picture. But there are pieces of evidence that contradict the picture. Most difficulties are seen on small scales and may indicate either gross problems or only the need for relatively minor refinements of the model. But even if the picture is basically correct, our knowledge is woefully incomplete as we still have little or no understanding of the origin and nature of the dominant components of the universe.

The Universe of Hubble Space Telescope

Robert Williams

Space Telescope Science Institute, Baltimore

22 January 2004, Raman Research Institute, Bangalore

One of the largest scientific projects in history, the orbiting Hubble Space Telescope was developed by astronomers and NASA over more than twenty years. Immediately after its launch in 1990 it was found to suffer serious optical distortion. A historic servicing mission executed by NASA astronauts in 1993 corrected this problem, and the Hubble has been performing superbly since that time, with its beautiful images of the universe making it

one of the most important scientific tools of modern times, and known throughout the world.

The Hubble Telescope carries out a wide-ranging programme of observations by astronomers from all countries. During the past few years it has made important discoveries in a number of different areas which have advanced our understanding of the birth and death of stars, stellar explosions, planetary activity, black holes, and the formation of galaxies. The Hubble's greatest legacy may turn out to be the stunning views it has given us of the distant universe, providing a much clearer picture of the formation of the first structures in the universe after the initial Big Bang. The lecture illustrated the recent discoveries and servicing missions to the telescope, and described how the Hubble has changed the way we perceive the universe. Several spectacular photographs shown as slides enriched this lecture.

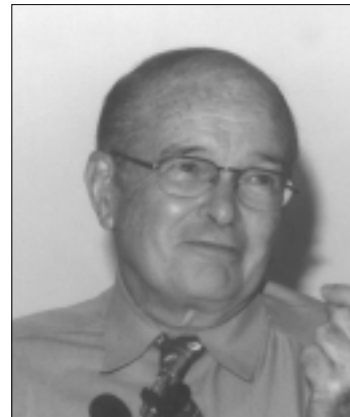
Forensic seismology: Earthquakes and atomic energy

Bruce A Bolt

University of California, Berkeley, USA

11 February 2004, Raman Research Institute, Bangalore

It is the business of seismologists to measure and study earthquakes, in order to understand their physics, to assist in building safer structures, and perhaps predict earthquakes reliably. Another and more recent business of seismologists is to monitor compliance



with nuclear test ban treaties. Of structures that earthquakes might affect, few prove as worrisome as nuclear power stations, otherwise promising sources of energy. Their seismic design safety is a major concern of seismologists, who use computer modelling and observations of strong ground-shaking to assess their response to earthquakes.

Like earthquakes, nuclear energy can be of great destructive potential and a Comprehensive Nuclear Test Ban Treaty has been drafted to deter the proliferation of nuclear weapons. Seismologists, by remote surveillance of underground weapons' tests, have now developed effective methods of discriminating between these and natural earthquakes.

The speaker who has been involved with the scientific side of safety in structural designing and in the monitoring of underground tests discussed both these topics.

What impact, if any, has feminism had on science?

Evelyn Fox Keller

Massachusetts Institute of Technology, USA
19 February 2004, Indian Institute of Science, Bangalore

A written version based on this lecture appears in the latest issue of the *Journal of Biosciences* published by the Academy (Vol. 29, No.1, March 2004, pp. 7–13).



Discussion Meeting

Cosmic Microwave Background Radiation

Orange County, Coorg
22–26 February 2004

The announcement of results from the Wilkinson microwave anisotropy probe (WMAP) is considered a watershed in contemporary cosmology and this discussion meeting was considered appropriate to get a set of people to discuss its implication. The meeting, attended by about dozen participants, discussed the recent developments in the study of cosmic microwave background radiation (CMBR). The meeting focussed on various aspects of the study of CMBR, from theoretical to observational, and the future prospects. The meeting began with an overview by T. Padmanabhan. K. Subramanian discussed the basic theoretical concepts behind the generation of CMBR anisotropy, and T. Souradeep dealt with various subtleties in interpreting the data. T. Seshadri and S. Sethi talked about polarization of CMBR, R. Srianand discussed the physics of the intergalactic matter and its relevance to the study of CMBR, J. Bagla discussed gravitational lensing of CMBR, and B. Nath reviewed the Comptonization of CMBR. S. Trivedi discussed the connections between string theory and cosmology and U. Yagnik talked about the mechanism of inflation which has important implications for the study of CMBR.

The meeting was fruitful as experts from different areas—from astrophysics to particle physics—gathered to exchange their ideas and is likely to foster collaborative efforts between various groups in the country working on different aspects of cosmology.

REFRESHER COURSES

Experimental Physics

Goa University, Goa
28 October–10 November 2003

No. of participants: 13

Course Director: R Srinivasan, **Course Co-ordinator:** PR Sarode

Resource persons: AW Joshi and VH Raybagkar (Sardar Patel University), AB Bhattacharyya (Noida), BA Dasannacharya (Mumbai), CS Sundar (IGCAR, Kalpakkam), R Srinivasan (RRI, Bangalore), RB Prabhu, PR Sarode, JAE Desa, and KR Priolkar and others (of Goa University).



The teacher participants were from Calicut, Chennai, Goa, Kannur, Kolkata, Madurai, Nagpur, Nuvem Goa, Tirunelveli, Trichy, and Trivandrum.

Extracts from the report on the course:

This course was aimed at exposing teachers to some new low-cost and simple experiments in addition to standard experiments in solid state physics. The teachers were required to build a few instruments necessary to carry out many simple experiments in physics.

The programme started with talks on the underlying physics of the selected experiments and projects. The participants were divided into two batches. While one carried out experiments, the other worked on their projects. The following experiments were developed by KR Priolkar and SM Sadique and their efforts were aided by Preeti Bhoje, Neeta Kole and Pratima Dhuri, students of the department: (1) measurement of the Stefan-Boltzmann constant; (2) study of the Wiedemann-Franz relation; (3) determination of dielectric constant and dipole moment of an organic molecule.

Project work and experiments:

Study of Hall effect; electrical resistivity of a semiconductor by the four-probe method; susceptibility of a paramagnetic solid; study of electron spin resonance; study of hysteresis loop; X-ray diffraction pattern of copper. The projects carried out by participants included a constant current source and dielectric constant

measurement circuit; A temperature controller and a sine wave generator using IC 8038.

Special lectures were arranged in the area of experimental physics. In his lecture AW Joshi (Sardar Patel University) talked about difficulties in learning experimental physics and wave diffraction. With VH Raybagkar (Wadia College) he demonstrated some simple mechanics and laser-based experiments. Participants were encouraged to get hands on experience during these demonstrations. AB Bhattacharyya discussed microelectromechanical systems (MEMS). Ameeta Chimulkar demonstrated the use of SPICE software for design and simulation of electronic circuits. Each participant was given a CD containing the software downloaded from the Internet public domain. CS Sunder spoke on the course conducted at IGCAR, Kalpakkam in October 2002. BA Dasannacharya shared his experiences of his scientific career in designing new instruments at BARC. RB Prabhu talked about the basics of magnetism to cover Guoy's balance and experiments on the B.H.Loop, resistivity and Hall effect. PR Sarode talked on electron spin resonance and X-ray diffraction experiments. JAE Desa spoke on the treatment of errors in measurements. SM Sadique spoke on the design and construction of dielectric constant circuit and sinewave generator while Efreem Desa covered design and construction of the constant current source and temperature controller.

Towards the end of the course R Srinivasan explained to the participants the basic concepts behind each experiment and talked on the philosophy of the experimental physics course and some aspects of designing new experiments in physics.

The participants, although small in number, showed keen interest and enthusiasm in completing the projects and performing the experiments. The project and experimental sessions extended late into the night on some days. The project kits developed by the participants were donated to their respective teaching departments for use.

Earth Sciences

*Jawaharlal Nehru Technological University,
Hyderabad*

3–15 November 2003

No. of participants: 13

Course Directors: U Aswathanarayana and KV Subbarao; **Course Co-ordinator:** B. Venkateswara Rao

Resource persons: U Aswathanarayana (Mahadevan Int. Centre for Water Resources Management, Hyderabad); KV Subbarao (IIT, Mumbai); B Venkateswararao and other faculty from JNTU (Hyderabad) ICRISAT, (Patancheru), Universities of Mangalore, Andhra and Pune.

The teacher participants were from Burdwan, Eluru, Gulbarga, Guntur, Hyderabad, Kurnool, Nagaur, Pune, Sagar, and Warangal.



Extracts from the report:

Geoscience instruction finds itself in a predicament today because of lack of students interested in the subject. The objective of the course was to broadbase geoscience education and the participants therefore included, besides teachers in geoscience, those from civil engineering, environment and economics. The themes were therefore chosen to address the twin objectives of broad-basing and employment orientation of geoscience instruction. Each lecturer was specifically asked in advance to indicate how teaching in his/her area of expertise could be so oriented as to lead to jobs. The topics thus included Internet-based geoscience instruction, linkage subjects such as geomorphology, meteorology, coastal resources management, land-use planning, remote sensing, agriculture, geophysical approaches, water resources management, soil resources management and mineral resources management.

There were evening lectures on colloquia on geoscience topics, which are of public interest. These included international cooperation in teaching and research in geosciences, east coast gas deposits, paradigm of knowledge-driven economic development, ocean development, and geosciences, are large scale water transfers necessary?, how to use R&D in geosciences to create new jobs etc. A full-day field excursion related to water and soil issues in Kothapalli Watershed was organized. This joint programme of ICRISAT and the Andhra Pradesh government is known for effective implementation of various water and soil conservation works. Another full-day excursion was organized to the Robosand plant on the outskirts of Hyderabad to help the teachers understand environmentally sustainable, no-waste technologies in the mineral industries.

A roundtable discussion on "Natural resources management, geoscience instruction and jobs" was arranged which was also attended by Arun Nigavekar (Chairman, UGC, New Delhi), Umberto Cordani (International Union of Geological Sciences, Sao Paulo, Brazil) and Claudio Caponi (World Meteorological Organization, Geneva). Several decisions of far-reaching importance were made at the discussion for

consideration by UGC and other agencies. These included: how to make geoscience education broad-based and employment-oriented; possible curricular structures; co-ordination mechanisms; institutional mechanisms, and who pays for them; syllabus for UGC/CSIR/GSI etc competitive examinations; role of earth sciences in the newly proposed National Institute of Sciences, etc.

Experimental Physics

Saurashtra University, Rajkot
3–16 November 2003

No. of participants: 13

Course Director: MK Mehta, **Course Co-ordinator:** DG Kuberkar

Resource persons:

S K Malik (TIFR, Mumbai); A K. Raychaudhuri (IISc, Bangalore); R G Kulkarni (Shivaji University); M K Mehta (Ahmedabad) and faculty from Universities of Marathwada, Bhavnagar, Saurashtra, etc.



The teacher participants represented institutions from Amravati, Anantapur, Datia, Gondia, Gwalior, Junagadh, Nanded, Pune, and Rajkot.

Extracts from the report:

The refresher course was aimed at motivating physics teachers to improve their experimental skills and develop insight for designing and setting up of physics experiments in college and university laboratories. There were lectures on recent developments in physics and laboratory experiments in selected areas of condensed matter physics, nuclear physics and electronics. In addition emphasis was also on the design, building and testing of four experimental projects namely DC regulated power supply, constant current source, ON/OFF temperature controller, and high temperature tubular furnace.

A comprehensive laboratory manual and data book was given to all participants for understanding various aspects related to particular experiments conducted during the course. The experiments included in the laboratory work were:

Nuclear Physics: To determine the characteristics of G.M. tube and dead time of a G.M. counter; to study the intensity of gamma rays as they pass through different thicknesses of Al-foils and to determine the

linear absorption coefficient; to study gamma ray spectra using scintillation counting system.

Materials Science: Resistivity measurements by d.c. four-probe technique, determination of specific heat of graphite, Hall effect, determination of dielectric constant of solids.

Electronics: Combinational and sequential logic design by using analog to digital (ADC) & digital to analog converter (DAC), Characteristics of DIAC and TRIAC and their applications.

Physics of the Atmosphere and the Ocean

CAOS, Indian Institute of Science, Bangalore
1–12 December 2003

No. of participants: 16

Course Director: BN Goswami

Resource persons: R Narasimha (NIAS, Bangalore); Sulochana Gadgil, J Srinivasan, BN Goswami, RN Iyengar, GS Bhat, D Sengupta, R Nanjundiah, PN Vinayachandran, SK Satheesh *et al.*, (all of IISc, Bangalore) and PV Joseph (Cochin).



Teacher participants were from Agra, Bangalore, Bhopal, Chittoor, Cochin, Coimbatore, Gulbarga, Guwahati, Kanpur, Mangalore, Rourkela, Sambalpur, Silchar, Sitapur, Solapur, Trivandrum.

Extracts from the report:

As teaching of atmospheric and oceanic sciences is not widespread in the country, the philosophy of this course was to introduce important physical concepts and theoretical and observational tools to understand complex phenomena in the atmosphere and the ocean and to prepare background to develop models for prediction of weather and climate.

In his inaugural talk VK Gaur highlighted the feedbacks that lead to climate variability and importance of the global carbon cycle. The course began with some basics such as observing techniques by SK Satheesh and fundamentals of fluid mechanics by R Narasimha followed by observed state of the general circulation of the atmosphere by BN Goswami and the ocean by PN Vinayachandran and geophysical fluid dynamics by D Sengupta. This was followed by atmospheric thermodynamics and clouds by GS Bhat and atmospheric

radiation by SK Satheesh. With this background R Nanjundiah introduced the complexities of developing three-dimensional general circulation models for prediction of weather and climate. PN Vinayachandran introduced general circulation models of the ocean. They also highlighted the challenges in developing more accurate models for prediction of weather and climate. Synthesis of observations through large scale modelling was emphasized throughout. As statistical techniques are essential in bringing out physical signals of atmospheric and oceanic phenomena from large volume of atmospheric and oceanic data, two lectures were arranged by RN Iyenger on basics of statistical techniques used in Atmospheric and Oceanic sciences. Some special topics such as Indian monsoon and its variability by S Gadgil, El Nino and Southern Oscillation (ENSO), global warming, tropical cyclone (TC) and thunderstorms were also discussed in order to provide a flavour of interesting physical processes involved in some of the important and challenging weather and climatic phenomena.

The afternoon sessions were devoted to demonstrations and laboratory work. Some fluid dynamics movies illustrating some basic fluid dynamics processes (e.g. drag, vorticity etc) were shown to the participants. An introduction to principles involved in remote sensing techniques was given by J Srinivasan who also illustrated the usefulness of the Earth Radiation Budget Experiment (ERBE) data. Highly accurate with high spatial resolution sea surface temperature (SST) data obtained by the microwave imager on board the TRMM satellite as well as the surface wind measurements by the scatterometer on board the QuickSCAT satellite were demonstrated by D Sengupta. The participants were also given demonstration on actual running of atmospheric GCM's and oceanic GCM's. SK Satheesh demonstrated the working of the automatic weather station (AWS) stationed at CAOS and the radiometer used for measurement of aerosol. GS Bhat demonstrated certain unique properties of rotating fluids (e.g. Taylor columns) using a rotating table. He also demonstrated inter-tropical convergence zone (ITCZ) like phenomenon in the rotating table using a line heating.

Quantitative aspects of atmospheric and oceanic sciences were emphasized throughout the course. In order for participants to carry forward quantitative aspects of the training, they were given a book entitled "Meteorology for scientists and engineers" by Roland Stull and a hand held instrument to measure temperature and relative humidity and time. It is envisaged that the teacher participants will involve students in their respective places to maintain regular record of these important climatic variables. This is expected to not only provide good records of climatic data over a number of places but also enthuse some young students to get into this field.

Two special lectures on "New frontiers in meteorology" by RR Kelkar and "Physical basis for prediction of seasonal climate" by Jerome Vialard were arranged.

Mathematical Analysis and Applications

*Berhampur University, Berhampur
1-13 December 2003*

No. of participants: 30

Course Director: V Kannan, **Course Co-ordinator:** TC Panda

Resource persons: V Kannan (Univ. of Hyderabad); BV Rao and BS Dandapat (ISI, Kolkata); faculty from Universities in Utkal, Berhampur and Andhra and SAC, Ahmedabad.

The teacher participants were from Adoor, Aska, Berhampur, Bhismagiri, Bhubaneswar, Chikiti, Chirala, Cuttack, Ganjam, Hazaribagh, Hinjicut, Hyderabad, Khalikote, Mahuda, Nagpur, Puttur, Sriperumbudur, Vadlamudi, and Warangal.

This course was aimed at providing an up-to-date exposure of the latest techniques and mission mode developments in mathematics, and to create awareness and strong motivation among teachers and researchers. The topics covered included: Real analysis, conditional probability and Markov Chains, fuzzy logic, equivalences of axiom of choice and axiomatic set theory, differential equations, dynamical systems, mathematical modelling in meteorology and physical processes, turbulence, air pollution, satellite sensors and orbits for earth observations and applications in atmospheric sciences, remote sensing and geographical parameters, rough sets, and Banach algebra and symbolic calculus and real sequence.

Frontiers in Inorganic Chemistry

*Indian Institute of Technology, Kanpur
18-31 December 2003*

No. of participants: 17

Course Director: RN Mukherjee

Resource persons: R Murugavel (IIT, Mumbai); AJ Elias (IIT, New Delhi); S Goswami (IACS, Kolkata);



S Sarkar, PK Bharadwaj and RN Mukherjee (all of IIT, Kanpur).

The teacher participants covered the cities of Banda, Bangalore, Belgaum, Chennai, Dharwad, Jhalda, Kanpur, Mahishadal, Patiala, and Raja Rammohunpur,

The course was organized to enable participants to incorporate modern inorganic chemistry topics into the curricula of their respective institutions. Lectures at the course would hopefully demonstrate the strong interrelationship between different branches of modern inorganic chemistry.

The course started with a general mixer where the expectations and requirements of the course were discussed. Every morning there were three lectures (60 minutes) on various aspects of inorganic chemistry while in the afternoon practical sessions were held. In all lectures emphasis was on fundamentals. The following topics were considered by resource persons: Transition metal chemistry, bioinorganic chemistry, supramolecular chemistry, main group chemistry and organometallic chemistry. Special lecture topics included: Magnetism and absorption spectra of coordination complexes, variable-valence of transition metal ions, bioinorganic chemistry, EPR spectroscopy.

The practical sessions (2½ hours duration) demonstrated how a few simple inorganic chemistry experiments can be carried out in a college laboratory using bare minimum laboratory facilities. The experiments conducted include: extraction and identification of DNA from green peas, determination of calcium in milk powder by EDTA, preparation and photochemistry of tris (oxalato) iron (III), blue printing by photochemical reduction of tris (oxalato) iron (III), preparation of $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ and use of UV-vis spectroscopy for characterization, iodine in iodized common salt, preparation of acetylferrocene and its purification by column chromatography and characterization by IR and UV-vis spectra.

A book titled “General chemistry experiments” by AJ Elias was distributed to each participant.

Lasers and Applications in Chemical Processes

University of Madras, Chennai
19–31 January 2004

No. of participants: 21

Course Director: P Natarajan, **Course Co-ordinator:** P Ramamurthy

Resource persons: P Ramamurthy and P Natarajan (Madras University); PK Das and S Umapathy (IISc,



Bangalore); N Periasamy (TIFR, Mumbai); BG. Maiya (University of Hyderabad); PK Palanisamy (Anna Univ, Chennai).

The teachers were from Bhilai Nagar, Bhilai, Chennai, East Tambaram, Hubli, Kollam, Madurai, Pune, Trichy, and Visakapatnam.

The lectures covered the broad area of lasers, techniques, detection and applications in chemistry and also included fundamentals of spectroscopy including lasers, vision, photodynamic therapy and medical applications. There were three lectures of 90 min duration each followed by 60 min of demonstration practicals.

The participants were given books on “Laser fundamentals” by William T Silfvast, and “Laser technology and applications” by Mukunda Rao and a digital form of the resource and lecture materials.

LECTURE SERIES

Statistics in theory and practice
St. Thomas College, Pala
1–3 October 2003

Participants: 100 students and faculty from statistics, botany and zoology departments of colleges in Pala.

Speakers: AP Gore and SA Paranjpe (Univ. of Pune); T Krishnan (Systat. Software, Bangalore); S Ramasubramanian (ISI, Bangalore); *et al.*

Lectures delivered: Statistics of animal abundance estimation; statistics and design of experiments in forestry; statistical analysis of clinical trial data; crossover designs; statistics in business and management; index construction; Markov chain Monte Carlo; population dynamics in microbiology; statistical issues in the measurement of biodiversity; statistical sample survey on plantation crops.

Nonlinear Dynamics and its Applications

AVVM Sri Pushpam College, Poondi
9–11 October 2003

Participants: 140 students and teachers from Bharathidasan and other universities in Tamil Nadu.

Speakers: M Lakshmanan, (Bharathidasan University); V Balakrishnan and Neelima Gupte (IIT, Chennai); and others from IIT, Chennai, Universities of Madras and Tirunelveli, NIT (Tiruchirappalli), Pushpam College, etc.

Topics covered: Nonlinear dynamical systems; stability analysis; theory of solitons; local stability analysis and application to population models; logistic map and duffing oscillator; fractals and multifractals; linear and nonlinear oscillators; nonlinear electronics chaos and its characterization; computational methods and demonstration; nonlinearity in Bose–Einstein condensation.

Frontier Lectures in Biology

University of Mysore
5–6 November 2003

Participants: 250 students and faculty from University of Mysore

Speakers: G Padmanaban, Usha VijayRaghavan, MRN Murthy, AJ Rao, RR Dighe (all of IISc, Bangalore); Gaiti Hasan (NCBS, Bangalore); J Nagaraju (CDFD, Hyderabad); V Prakash (CFTRI, Mysore).

Topics covered: Malaria parasite biology; genetic regulators of the rice inflorescence and flower development pathway; TIM barrel proteins: cellular differentiation: glycoprotein hormones: IP_3 signalling in *Drosophila*; RNA interference-mediated baculovirus resistance in *Bombyx mori*; innovations in biology leading to career development.

Frontiers in Chemical Sciences

Sri Sathya Sai Institute of Higher Learning,
Prasanthi Nilayam
10–12 November 2003

Participants: Students and faculty from the chemistry department of Sri Sathya Sai Institute of Higher Learning

Speakers: P Natarajan (National Centre for Ultra Fast Processes, Chennai); S Chandrasekaran (IISc, Bangalore); BG Maiya (University of Hyderabad); R Ramaraj (MKU); T Ramasami (CLRI, Chennai) and others from Dr Reddy's Research Foundation, NCL, Pune and Sathya Sai Institute.

Topics covered: Chemistry of photochemical processes; Green chemistry; natural products in drug discovery; chemistry of tetrathiomolybdate; photoelectrochemistry; preparation of fascinating porous solids; supramolecular chemistry; determination of aldehydes and ketones in the atmosphere; science of human development; redox chemistry of chromium in industrial chemistry. There were also a few student presentations.

Life Sciences

Aurora's Degree College, Hyderabad
27–28 November 2003

Participants: About 300 students and faculty from universities and colleges in Hyderabad.

Speakers: D Balasubramanian (LV Prasad Eye Inst, Hyderabad); S Mahadevan and D Chatterjee (IISc, Bangalore); Ch Mohan Rao and U. Bhadra (CCMB, Hyderabad); J Nagaraju and J Gowrishankar (CDFD, Hyderabad); TP Radhakrishnan (Univ. of Hyderabad).

Topics covered: Decoding human genome; from double helix to gene regulation: the operon model protein folding; bacterial transcription; silk worm; gene silencing and RNA interference; renaissance of plastic age; the love triangle between SS RNA and DS DNA.

Biological Sciences: Now and beyond

St. Xavier's College, Mumbai
12–13 January 2004

Participants: About 150 students and faculty from St. Xavier's College.

Speakers: V Nanjundiah (IISc, Bangalore); Shubha Tole Sudipta Maiti and KS Krishnan (TIFR, Mumbai) and others from IIT, BARC, Mumbai.

Topics covered: Molecular to systems biology, development and social behaviour of a simple microorganism; humans as big flies; gal regulon of yeast; a paradigm for eukaryotic gene regulation; cell cycle progression: dynamic microtubules and cancer chemotherapy; new microscopes; making the invisibles visible in neurobiology; potions from poisons.

Quantum information theory

SB College, Changanacherry
26–28 January 2004

Speakers: R Simon (IMSc, Chennai), N Mukunda and AD Patel (IISc, Bangalore)

Current concepts in biological research

Bharathidasan University, Tiruchirappalli
27–28 February 2004

Speakers: S Mahadevan, DN Rao, D. Chatterji, P. Sadhale, U. Varshney, PN Rangarajan (IISc, Bangalore); N Gautham (Univ. of Madras).

Topics covered: DNA structure and transcription; regulation of protein synthesis; restriction-modification systems; gene expression and regulation in prokaryotes and eukaryotes; genomics and proteomics in drug discovery; expression profiling using microarrays; gene therapy; advances in developmental biology; and bioinformatics for biologists.

OBITUARIES

Moodalagiri Kushalrao Asundi

(elected 1975) passed away in Mumbai on 1 December 2003 due to cardiac arrest. Asundi was born on 1 May 1930 at Gadag in Karnataka. He obtained his B.E. in metallurgical engineering from BHU in 1953. He then joined the Department of Metallurgy at IISc Bangalore as a research student. In 1955 he joined the Metallurgy Division of the then Atomic Energy Establishment, Trombay wherefrom he retired in 1990 as the head of the Physical Metallurgy Division of the renamed Bhabha Atomic Research Centre (BARC).

In the first few years of his career he was responsible for evaluating the microstructure of uranium using optical metallographic techniques. One had to take a lot of precautions in handling this radioactive material and exercise care in electropolishing this highly reactive metal. Not only did Asundi develop an expertise in this but trained a vast number of people including physicists who joined his group and who did not know what a microstructure was.

In 1960 he went to the Imperial College of Science and Technology for his Ph D, which he obtained in 1963. He worked on Cu-Al bronzes under the guidance of DRF West.

Returning to BARC in 1963 as head of the Physical Metallurgy Section he was made responsible for



creating various facilities for carrying out basic and applied research in nuclear materials such as uranium, thorium, zirconium etc. His own research interests were in evaluating the interaction of interstitial and substitutional impurities in zirconium using internal friction techniques and in structure property correlations in nuclear materials. He assisted in the development of flow sheets for the manufacture of nuclear reactor components such as zircaloy-2 cladding tubes and pressure tubes and Zr-Nb pressure tubes. Another area of his expertise was in failure analysis investigations and he was involved in evaluations on the heavy water plant explosions at Baroda and Tuticorin, and Air India's *Kanishka* air crash in Ireland. He also worked on the development of metallic membranes for gaseous diffusion studies where he developed the membranes of the requisite quality. Development of plate type fuel element for the nuclear submarines was another activity where he devoted considerable effort.

Asundi was made a Distinguished Alumnus of BHU in 1973 and was recipient of the National Metallurgists Day Award of the Ministry of Steel, Govt. of India in 1974.

He leaves behind his wife Lakshmi and two sons, Ravi and Jai.

Asok Ghosh (elected

1982) was born on 20 January 1927 at Jamalpur, now part of Bangladesh. He passed his M.Sc in Zoology from University of Calcutta in 1948 and obtained a second Masters degree in anatomy from the McGill University in Canada. In 1955, he was awarded the Ph.D degree of University



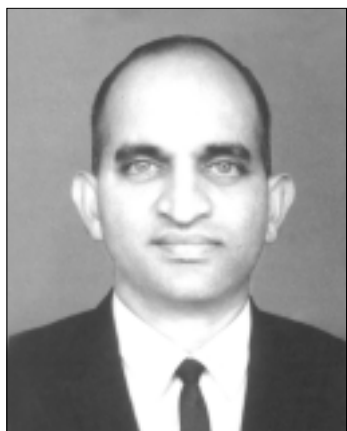
of Calcutta. He started his research career as a lecturer in Zoology in Bangabasi College, Calcutta (1950–52) and for a brief period (1953–55) worked at McGill University and at the University of California in Davis. On returning to India he joined the Bengal Veterinary College, Calcutta (1955–56) as an Assistant Professor of Histology. In 1957, he joined the University of Calcutta as a lecturer in Zoology, became a reader in 1971 and subsequently took over as the Sir Nilrattan Sircar Professor of Zoology. In 1992 he continued in the University as CSIR emeritus scientist.

Ghosh's research contributions in avian endocrinology are internationally recognized. His studies on the distribution pattern of the avian medullary hormones added significantly to our knowledge of taxonomic endocrinology. He proved that in birds, as a contrast to mammals, norepinephrine (NE) appears to be an equally active

glucose-enhancing hormone compared to epinephrine (E). An almost parallel effectiveness of both NE and E as pressor hormones has also been recorded in the avians. His contributions on the polysaccharide cytochemistry of the avian adrenal medulla and the heat protective action of NE merit mention. Besides his findings on the avian adrenal medulla, Ghosh also significantly contributed to our understanding of cytomorphic zonal concept in the bird interrenal, avian neurosecretion and ecologic adaptation, cytophysiology of the bird pancreas and the hormonal control of the uropygial gland. His research publications number over 250.

Ghosh was a fellow of all the three national academies in India and presided over the zoology section of the Indian Science Congress in 1975. The other recognitions that he received include: UGC National Lecturer (1977), the Hari Om Trust Award, the JC Bose Award of UGC (1979) and the JG Law Medal of the Asiatic Society (1984).

He passed away on 29 September 2003 leaving behind his wife and a son.



Shrinath Seshagiri Kalbag (elected 1974) was born in Bombay on 23 October 1928. He did his B.Sc from the Royal Institute of Science in 1948 and an M.Sc in Chemical Engineering from the University Department of Chemical Technology in Bombay in 1952. He obtained his Ph.D from University of Illinois in 1955 on a thesis

related to fatty acid esters of sugars and related compounds. He returned to India in 1956 to join CFTRI, Mysore as a senior scientific assistant and later as senior scientific officer. During this period he was involved in designing and commissioning of a large variety of unit operations equipment and process development, particularly of evaporators, driers and centrifuges, and plant for processing of fruits and vegetables, tubers and oilseeds. He was also involved in integrated processing of groundnut for separation of fats, protein and carbohydrate.

In 1963 he joined the Hindustan Lever Research Centre in Mumbai as the head of the engineering group. Here he was responsible for process development and transfer of processes to manufacture chemicals, detergents, oils and foods. He led a team that transferred over 25 processes from laboratory to commercial manufacture involving capital investment of over Rs. 10 crores.

In 1983 he left Hindustan Lever to involve in something that became a passion for him. This was to do with our

educational system, its inadequacies and the changes necessary to make it relevant to our villages. When his ideas had crystallized sufficiently, he set up an institution known as *Vidnyanashram* or *Vigyan Ashram* at a place known as Pabal, which is a village 60 kms from Pune. This Ashram teaches its boys and girls simple workshop technology including steel working, welding, house construction with mostly locally available materials, healthy cookery, nutrition, hygiene and sanitation, poultry and dairying, simple pathological tests like urine and blood tests, mechanical and electrical maintenance, the use and maintenance of computers and finally business and entrepreneurial skills. Its alumni have set up small businesses and service industries and have become useful and respected members of the village community. Over the last 20 years, under his guidance *Vidnyanashram* has developed and sold household steel furniture, earth resistance meters for finding and mapping water tables underground, geodesic domes for housing and storage, preserved foods like partly dehydrated groundnuts and quick cooking chicken meat, etc. But what outshines all other achievements is the invention and development of "Mechbull" a cheap and simple tractor with ploughing, threshing and water pump attachments. It can be constructed and maintained by the ultimate user. Kalbag developed a computer course on CD-ROM disks, which interactively teaches even a school boy the basics of a computer, its assembly and maintenance, as well as the use of common software like Windows, etc. At the time of his passing away he had just launched an Internet service to provide wireless Internet connections using WLL technology so that the newly computer literate villagers and industrial units in the area would have affordable and reliable Internet services. His dream was to make advanced technology available to every villager who wanted it.

He was the recipient of the GD Parakhe award, the Natu award, and the prestigious Jamnalal Bajaj award. He passed away on 30 July 2003 leaving behind his wife Mira and a son.

Rajagopala Natarajan

(elected 1981) passed away on 2 December 2003 at Chennai after a brief illness. A dedicated marine biologist, he served as the Director of the Centre for Advanced Studies (CAS) in Marine Biology, Annamalai University for about 20 years



(1968–88). At the invitation of the Anna University, he also established the Ocean Data Centre, in Chennai (1988–91). He was also an invited visiting faculty of the MS Swaminathan Research Foundation, Chennai.

Born on 9 July 1930 in an orthodox middle class family of the holy town Chidambaram, he was educated in Government School. At Annamalai (1946–62), he was trained by the renowned hardcore Zoologists, RV Seshaiya and P Govindan in embryology and genetics. Later he bloomed into an excellent malacologist at the University of Michigan, Ann Arbor (1963–67). In 1968, he returned to Annamalai, when under Seshaiya's leadership, a department of marine biology was being carved out of the zoology Department. During its formative years, CAS Marine Biology had the immense benefit of his leadership, drive and dynamism.

As a teacher par excellence, he organized the postgraduate course in marine biology and recruited students all over India. He was the first Indian to bring a Colombo PL480 project for marine biology. He established linkages with many foreign institutions.

Natarajan pioneered studies on the molluscan taxonomy and resolved many complicated species by adapting morphometry and chemotaxonomy. His contribution to marine microbiology focused on the isolation of actinomycetes from marine sediments, besides surveying the east coast for the occurrence of *vibrio* and *coliforms*, as a measure of bacterial contamination.

As a pioneer in marine biology, he played a key role in the formation and establishment of the National Institute of Oceanography and Marine Biology Institutions in many coastal Universities. In 1984, the Government of Tamil Nadu honoured him with an award for his contribution to Environmental Sciences.

Natarajan is survived by his wife Mangalam, two sons and two daughters.

Balasubramanian

Ramamurthi (elected 1972) was born on 30 January 1922 in Madras. He had a brilliant academic career. A Johnstone gold medallist as the best outgoing student, he obtained his MBBS in 1943 and MS from Madras University and FRCS from Edinburgh in 1947. He started his career at the Madras Medical College (MMC) as an



assistant to the Professor of Operative Surgery (1945–48), and gradually rose to the ranks of Assistant Professor of Orthopaedic Surgery (1945–48), lecturer (1951–57), reader (1951–57) and professor of neurosurgery, and for a brief period as the principal until his retirement in 1978. For some time he was also concurrently the head of Department of Institute of Neurology and Neurosurgeon at the Government General Hospital in Madras.

A pioneer in setting up the science of brain surgery in India, he initiated training and research in this field. He successfully conducted research in many aspects of brain surgery, neurophysiology, and neurology, depth surgery of the brain, treatment of pain, behavioural disorders and involuntary movements by stereotaxic surgery, physiological effects of brain injuries, pituitary tumours and acoustic neurinomas. Old-timers at MMC could not accept this youngster's claims to neurosurgical skills since they contradicted the then prevailing theory that operations on the brain were almost uniformly fatal. To overcome this he strove to develop the goodwill and confidence of not only his patients but his colleagues as well. He began developing the physical requirements of a neurological department. In 1962, a chance opportunity to treat a dignitary enabled him to invite Dennis Williams and Laurence Walsh who helped him to start a stereotactic surgery unit enabling a wide variety of stereotactic operations. His department became a national referral centre and patients requiring stereotaxy flocked to Madras. The experiences thus gained from large number of operations have been recorded in several papers of Ramamurthi and his colleagues. Similarly the electrophysiological studies carried out from cortical and depth recordings have been well documented. He published over 200 research papers and delivered 120 special lectures at various fora.

After retiring from government service, he started another neurosurgical centre in the Voluntary Health Services Medical Centre at Chennai.

He was intensely committed to maintaining high standards of postgraduate medical education and served as President of the National Board of Examinations for many years. Many honours came to him. He was President of the Neuroscience Society of India, Association of Biomedical Scientists in India, Society for History of Medicine, and National Academy of Medical Sciences. He was an honorary brigadier of the Indian Army, honorary surgeon to the President of India and Honorary President of the World Federation of Neurosurgical Societies. The Government of India honoured him with *Padma Shri* and *Padma Bhushan*.

He passed away on 12 December 2003 leaving behind his wife, Indira, an obstetrician and gynaecologist, and two sons.

Sivaraj Ramaseshan, a

past-president of the Academy, passed away at Bangalore on 29 December 2003. Born on 10 October 1923 in Calcutta, Ramaseshan took his M.Sc degree in physics from Nagpur in 1943. He then joined the Indian Institute of Science to work with CV Raman in optics, mineralogy and



crystallography and obtained his DSc degree from Nagpur University in 1949. In 1945 he became a member of the IISc faculty where he initiated researches in magnetic resonance and X-ray crystallography. For a brief period during 1954–55 he taught and worked at Brooklyn Polytechnic in US as a visiting scientist on low temperature crystallography. In 1962 he moved to IIT Madras to organize the teaching and research at the Department of Physics. In 1964 Dorothy Hodgkin invited him to Oxford where he worked for two years before returning to India in 1966 to join the National Aeronautical Laboratory in Bangalore. At NAL he organized the first materials science laboratory in India and initiated research and development in high pressure science, fibre reinforced composites, electrocomposites, electronic materials, novel methods of fabrication, failure analysis etc. In 1979, he rejoined IISc as Associate Director (1979–80) and finally became its Director (1981–84). Retiring from IISc in 1984, he joined the Raman Research Institute as Professor Emeritus.

Ramaseshan's researches covered a number of fields in physics and materials science and in these either by himself or with his students, he discovered many interesting and unexpected effects. He proposed, for the first time, laws that govern cleavages in crystals which he was able to verify by observations on diamond. With R. Nityananda, he developed a theory according to which natural or stress-optic birefringence is caused by each of the dispersion frequencies of the substance splitting into two by the anisotropic distribution of atoms; experiments strikingly confirmed this theory. He predicted that pressure can induce liquid crystallinity in some normal liquids. Along with GS Ranganath, he showed that stress can induce optical activity in certain optically inactive crystals; that polarized neutrons can display the phenomenon of "optical activity" when traversing helimagnetic crystals. Ramaseshan, with TG Ramesh and V Shubha searched for and succeeded in determining the critical point in the solid isostructural transformation of SmS. With NV Mani, Ramaseshan discovered the

icosahedral coordination – the Platonic solid which Linus Pauling did not include in his list. An elegant method of separating the partial structure factors in a liquid was proposed by him and TG Ramesh, which is now used universally, especially in the case of technically important liquid alloys.

Ramaseshan pioneered the multiwavelength method of solving the phase problem of X-ray crystallography and proved (with K Venkatesan and NV Mani) its practicability. With the advent of tunable synchrotron X-ray sources this technique has been revived and has become commonplace. Ramaseshan proposed that neutron anomalous scattering by special isotopes can be fruitfully used to determine structures of very large molecules like proteins. He was involved in many firsts (at least in India): setting up with G Suryan the first paramagnetic resonance experiments (1950); establishing the first materials science and technology laboratory in the country (1966); designing and fabricating the first ever FRP nutation damper for the Indian satellite (with PS Goel and RV Ramani); making porous FRP tubes for desalination (with RV Ramani). He and AV Ramani were mainly responsible for selecting novel materials and the fabrication processes (an ingenious application of materials science) for the first Indian heart valve prosthesis.

Besides his scientific contributions, Ramaseshan has been associated with the growth of many important research institutions. He played a key role in the growth of Raman Research Institute after the passing of its founder in 1970. At IISc he was responsible for starting 12 centres of excellence and initiated many novel schemes. He played an important part in establishing the ASTRA Research Centre in India. He also helped set up an exceedingly fine research laboratory for building materials for an industry, and a factory to manufacture biodevices.

Ramaseshan was elected a Fellow of this Academy in 1955 and became a member of the Council in 1968. Between 1968 and 1988, he occupied the positions of President (1983–85), Vice-President (1971 – 79) and Editor of Publications (1977–82). This was a period of extraordinary growth in the Academy with Ramaseshan taking overall responsibility in its activities. The fellowship rose from around 200 in 1968 to nearly 600 in 1988. The publication activity was considerably expanded. The Academy *Proceedings*, published in two sections, were split into several theme journals. He was instrumental in starting the new physics journal, *Pramana*, in 1973 after countrywide consultations. This was followed by

starting of other journals in engineering sciences, materials science and astrophysics and astronomy. The Academy revived the *Journal of Genetics* earlier published by the JBS Haldane family. Editorial boards were constituted for each of the journals headed by a chief editor.

As general editor of publications, Ramaseshan helped formulate the publication policies of the Academy. Formal refereeing procedures were introduced, printing and production standards improved, and efforts made to increase journal circulation. Bringing out special publications of topical interest became a regular feature. Additional staff, better working environment, improving Academy finances and many other measures were all due to Ramaseshan's personal involvement.

As other Fellows were able to slowly take over many of his responsibilities in the Academy, Ramaseshan began to involve himself in reorganizing *Current Science*. With considerable help from P Balaram, he was able to transform the journal to what it is today.

Ramaseshan is the recipient of several awards: Bhatnagar award (1966), CV Raman award (1988) and centenary medal (1993), IISc Platinum Jubilee award, Padma Bhushan, Vasvik award for materials science (1980) and G N Modi award (1996).

He leaves behind his wife Kausalya, and three daughters, Arati, Sita, and Tara.

Ayyagari Sambasiva

Rao (elected 1974) was born on 20 September 1914 in a small village in Andhra Pradesh. He obtained his M.Sc in physics from Banaras Hindu University, where he subsequently carried out research work as a faculty member for six years. In 1946, Rao was selected for the prestigious Tata scholarship to successfully pursue his Master's degree in electrical engineering from Stanford University in US. On return, Rao was invited by Homi J Bhabha to help him in conducting certain experiments on cosmic rays at TIFR, as similar experiments, conducted elsewhere, were not conclusive. His very first experiment was



successful and he was offered the job of a reader in TIFR. In 1953, he joined the Atomic Energy Establishment, Trombay (now BARC) and was entrusted with the task of designing and building the control and monitoring systems for Asia's first nuclear reactor, *Apsara*. Commissioned in 1955, *Apsara* became critical on 4 August 1956 within 12 months of the start of the project.

The success in the field of reactor electronics further continued with the installation of the control and safety system for the second, 40 MW heavy water-based reactor *Cirus* and with design, fabrication, installation and commissioning of the entire electronics system for a third research reactor, *Zerlina* and the radiation monitoring system for the plutonium plant at BARC. As part of the programme for radiation protection in the country, Rao organised a nation-wide network of monitoring stations and laboratories for determining the levels of environmental radioactive contamination resulting both from nuclear explosions and other radiation activities. The Health Physics, Electronics, and Reactor Control Divisions and the Directorate of Radiation Protection of BARC owe their inception and growth to his vision and guidance.

As the Director of Electronics Group at BARC, Rao initiated and carried through design, development and engineering programmes on a broad spectrum of electronic materials, professional grade electronic components including semiconductors, industrial, nuclear, medical and test electronic instruments, analog and digital computers and servo systems. He established a production facility to carry out pilot production of some of the components and systems for which there was a rapidly growing general demand in the country.

Rao was in the Committee along with Homi Bhabha, Vikram Sarabhai and S Bhagavantam which prepared a comprehensive report aimed at achieving self-reliance in electronics so as to put India on par with the developed countries, modernise Indian industry through new technology and open up vast employment opportunities for Indian scientists and engineers. This resulted in the setting up of the Electronics Corporation of India in 1967. Rao served as its Managing Director until 1978. ECIL was primarily set up to produce a variety of electronic components and systems, which were developed at BARC.

Rao was conferred many awards including the Padma Bhushan (1972) and the Shanti Swarup Bhatnagar Award (1965). Rao passed away in Hyderabad on 31 October 2003.