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Patrika

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Newsletter of the Indian Academy of Sciences

2002 mid-year meeting

The 2002 mid-year Meeting, thirteenth in the series, was held in Bangalore on 5/6 July. About 200 Fellows and Associates attended the lectures at the Faculty Hall of the Indian Institute of Science. The meeting this year was extended to 2 full days, as against 1½ days hitherto, both to provide opportunities to a larger number of new Fellows and Associates to present lectures and to enable teachers attending the meeting from around the country a greater interaction with Fellows.

There were sixteen 30-minutes lecture presentations by new Fellows and Associates, two special lectures and a public lecture. The opening special lecture by S. Ranganathan (Indian Institute of Science) was on "Novel atomic configurations in metallics". A fine appreciation of this lecture appears in P. Balaram's editorial in *Current Science*, Vol. 83, No. 1, 10 July 2002. Ranganathan traced ideas and events covering several centuries in a grand and sweeping survey. He recalled Johannes Kepler's conjectures in the early 17th century on the forms of snowflakes, and on the space-filling problem. He touched upon the knowledge and technology of producing Wootz steel, originating in Karnataka; and how, in an unsuccessful attempt two centuries ago to understand the principles of its manufacture, the West discovered alloy steel instead. The seminal contributions of J. D. Bernal, William Hume-Rothery, Linus Pauling and more recently Roger Penrose to metallurgy in its various aspects were recounted. The revolution in thinking about possible crystal configurations, arising from Shechtman and co-workers' 1984 discovery of quasicrystals, has led to a crystal being defined as 'any solid having an essentially discrete diffraction pattern' rather than strict geometrical periodicity. Towards the end he also linked up to recent work on nanostructured materials approaching the domain of quantum effects. All in all a wonderful exposition. The second special

Q & A session during Ranganathan's lecture

Inside...

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Forthcoming Events —2002/03

SIXTY-EIGHTH ANNUAL MEETING
CHANDIGARH 8–10 NOVEMBER 2002
(programme on page 3)

REFRESHER COURSES

Theoretical Physics
University of Delhi, 1–15 Oct. 2002

Experimental Physics
IGCAR, Kalpakkam, 18–31 Oct. 2002

Spectroscopy, Chemical Reactions and Biology
Viswa Bharati, Santiniketan / S.N. Bose Centre, Kolkata,
21 Nov. –7 Dec. 2002

Immunology
University of Pune, 25 Nov.–7 Dec. 2002

Coding Theory, Cryptography and Discrete Mathematics
Panjab University, Chandigarh
2–14 Dec. 2002

Physics of Earthquakes
Tezpur University, 2–21 Dec. 2002

Reproductive Biology
Karnataka University, Dharwad
9–23 Dec. 2002

Molecular Genetics
Madurai Kamaraj University
27 Jan.–10 Feb. 2003

LECTURE SERIES

Chemistry
Gorakhpur University, 23–25 Nov. 2002

Mathematics/Statistics
St. Joseph's College,
Irinjalakuda 4–6 Dec. 2002

Organic Synthetic Methods
American College, Madurai
13–14 Dec. 2002


S.M. Chitre


K. Anji Reddy

lecture was on "Seismic sun and solar neutrinos", in which the speaker S. M. Chitre (University of Mumbai) aptly characterized the sun as the Rosetta stone of astronomy. He traced the manner in which, though inaccessible to direct observation, it has been possible to construct a reasonably detailed picture of the internal structure of the Sun. This is based on solving the relevant mathematical equations for mechanical and thermal equilibrium, matched to observable boundary conditions. Zones of convection and of radiative transfer of energy can be delineated. Signals from deep inside the sun come to us in the form of neutrinos, others are the more classical waves travelling through the solar body, involving many many modes and leading to the field of helioseismology. Add to these magnetic field effects and the sun is seen as a vast, complex and active object. It now appears that the solution to the long-standing solar neutrino puzzle has also been found with the recent Sudbury Neutrino Observatory results. The public lecture by K. Anji Reddy (founder of Dr Reddy's Research Foundation) was titled "Science for profit is profit for science". The main point made by Reddy was that both non-profit (or pure) science and the science carried out for commercial reasons are essential and can co-exist, and are in fact mutually dependent. If one can appreciate this fact, the apparent tension and cross-purposes of the two kinds of science will disappear to give way to a new and more healthy model of science that can also be more productive from the point of view of the taxpayer.

The lecture presentations by new Fellows and Associates covered their research work and dealt with such topics as (a) characterization of membrane raft in living cells; (b) intestine and post-surgical complications; (c) proton transfer reactions in proteins; (d) events regulating early development in plants; (e) experimental evolutionary biology; (f) discrete groups of semi-simple Lie groups; (g) high energy physics and precision measurements; (h) gravitational wave astronomy; (i) transport properties


Teachers' meeting in session

of one-dimensional systems; (j) adhesion instabilities in soft films; (k) chemistry of phosphorous-based systems; (l) classical co-ordination chemistry and bioinorganic chemistry; (m) planetology of Mars and Earth; (n) structure and tectonics of Indian Ocean, etc.

About 35 teachers from around the country attended the meeting as invitees. A full-day programme for the benefit of these teachers was arranged on 4 July, viz the day prior to the mid-year meeting. The programme included joint and subject-wise meetings of teachers with members of the Science Panel and invited Fellows, and visits to laboratories and institutions in Bangalore. The teachers generally appreciated the opportunity to participate in the meeting and interact with Fellows.

SIXTY-EIGHTH ANNUAL MEETING IN CHANDIGARH

Venue : Panjab University

Scientific Programme

8 November 2002 (*Friday*)

1000–1130 Inauguration and Presidential address by K. Kasturirangan
Recent advances in X-ray astronomy

1215–1315 **Lecture Presentations**
Murali Sastry: **New methods for the synthesis and assembly of nanomaterials**

Umesh Varshney: **Ribosome recycling, the fourth step of protein synthesis in bacteria**

1430–1710 Symposium : ***Quantum Computing and Quantum Information***

Anil Kumar : **Introduction and overview**

R. Simon : **Classical information theory**

Subhash Chaturvedi : **Quantum information theory**

K.R. Parthasarathy : **Quantum computations and algorithms**

Anil Kumar : **Experimental realizations of quantum computing**

1800–1900 **Public Lecture**
Mohan Maharishi: ***Rasa siddhanta* and its social significance**

9 November 2002 (*Saturday*)

0930–1030 **Special Lecture**
P.K. Kaw: **Collective modes in a strongly coupled dusty plasma**

1100–1300 **Lecture Presentations**
T.G.K. Murty: **Optical technologies for space imaging**

Sunil Mukhi: **The physics of branes**

K. Veluthambi: **Fine tuning of *Agrobacterium* Ti plasmid system for efficient plant genetic engineering**

Milind G. Watve: **Science where culture matters: A neoclassical approach to explore untapped bacterial diversity**

1430–1740 ***Symposium* :**
From Mantle to Monsoon: Himalayan Geodynamics and Climatic Change (*Convener* : Ashok Sahni)

Vinod K. Gaur: **Introduction**

A.N. Purohit: **Mountain biodiversity and climate change**

R.R. Yadav: **Climate variability in the Indian region: High resolution proxy records**

V. Rajamani: **Geochemistry of Ganga/Yamuna alluvium – Changing Himalayan provenance**

S. Krishnaswami: **Contemporary silicate weathering rates in the Himalaya: Impact on CO_2 consumption**

Peter Molnar: **From the mantle to the monsoon, manifested in the growth of the Tibetan Plateau**

1830–1930 **Public Lecture**
M.S. Raghunathan

10 November 2002 (*Sunday*)

0930–1030 **Special Lecture**
S.E. Hasnain: **Evolution of biology: Are we ready to play God?**

1100–1230 **Lecture Presentations**

Y.D. Vankar: **Carbohydrates: Much more than mere sources of energy. Synthesis of biologically important carbohydrate molecules**

S. Ramasubramanian: **Reflected Markov processes**

S.K. Satheesh: **Enhanced aerosol loading over Arabian Sea: Natural or anthropogenic**

2002 ELECTIONS

Fellows

K.A. Balasubramanian,
Christian Medical College and Hospital, Vellore
Sp: Oxidative Stress, Gastrointestinal Mucosa, and Pathophysiology

Sunanda Banerjee
Tata Institute of Fundamental Research, Mumbai
Sp: Experimental High Energy Physics

S.V. Dhurandhar
Inter-University Centre for Astronomy and Astrophysics, Pune
Sp: Gravitational Waves, General Relativity, and Theoretical Astrophysics

N.R. Jagannathan
All India Institute of Medical Sciences, New Delhi
Sp: Biomedical NMR, and Structure & Conformation of Biomolecules

K.S. Krishna
National Institute of Oceanography, Goa
Sp: Structure and Tectonics of Continental Margins of India, Lithosphere Deformation of Central Indian Ocean, and Structure & Evolution of Volcanic Ridges of Indian Ocean

K.C. Kumara Swamy
University of Hyderabad, Hyderabad
Sp: Chemistry of the Main Group Elements, and Organophosphorus Chemistry

Satyajit Mayor
National Centre for Biological Sciences, Bangalore
Sp: Cell Biology, Biophysics, and Chemistry

S.V.S. Murty
Physical Research Laboratory, Ahmedabad
Sp: Early Solar System and Pre-Solar Processes, Cosmochemistry of Nitrogen & Noble Gases, and Mass Spectrometry

T.G.K. Murty
ISRO, Bangalore
Sp: Optical Engineering, Thin Film Technology, and Electro-Optical Instrumentation

S. Ramakrishnan
Tata Institute of Fundamental Research, Mumbai
Sp: Low Temperature Physics

S. Ramasubramanian
Indian Statistical Institute, Bangalore
Sp: Probability Theory and Stochastic Processes

K. Sankara Rao
Indian Institute of Science, Bangalore
Sp: Developmental Biology of Plants, and Plant Biotechnology

Murali Sastry
National Chemical Laboratory, Pune
Sp: Surface Physics, Hybrid Materials, and Nanomaterials.

Anurag Sharma
Indian Institute of Technology, New Delhi
Sp: Fibre and Integrated Optics, Gradient-Index Optics, and Applied Optics

Namita Surolia
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Sp: Molecular Parasitology, Biochemistry, and Molecular Biology

Y.D. Vankar
Indian Institute of Technology, Kanpur
Sp: Synthetic Organic Chemistry, Carbohydrate Chemistry, and Asymmetric Synthesis

Umesh Varshney
Indian Institute of Science, Bangalore
Sp: Molecular Biology, Protein Biosynthesis, and DNA Repair

K. Veluthambi
Madurai Kamaraj University, Madurai
Sp: Plant Biotechnology, Plant Genetic Engineering, and Plant Molecular Biology

T.N. Venkataramana
Tata Institute of Fundamental Research, Mumbai
Sp: Rigidity & Arithmeticity, Cohomology of Arithmetic Groups, and Shimura Varieties

Saraswathi Vishveshwara
Indian Institute of Science, Bangalore
Sp: Quantum Chemistry, Computational Biology, and Biomolecular Structure & Interaction

Milind G. Watve
Abasaheb Garware College, Pune
Sp: Wildlife Ecology & Animal Cognition, Evolutionary Biology, Computational Biology, and Microbial Diversity

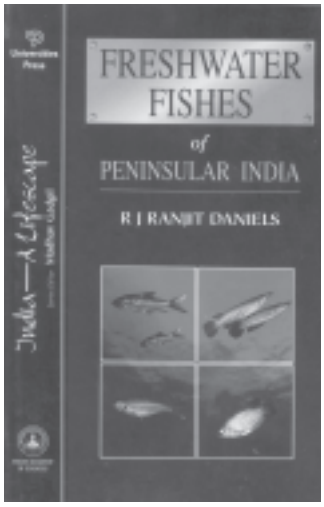
Honorary Fellow

Ahmed H. Zewail
California Institute of Technology, Pasadena California, USA
Sp: Ultra-fast Lasers and Electrons

SPECIAL PUBLICATION

Freshwater Fishes of Peninsular India

R. J. Ranjit Daniels, pp. 320, Rs. 290/-
co-published and distributed by Universities Press



This book represents the second fascicle to be published under Project Lifescape, the first one brought out in 2000 related to butterflies in Peninsular India. Freshwater fishes of India are probably better known to rural folk than to many of our professional biologists and students. This is because our textbooks rarely carry examples of our own species of fishes. While some biology text books include species that have been popular in fisheries and laboratory studies, a majority of the 750 species of freshwater fishes in India remain unknown to us. The literature available is too technical for students and non-specialists. Also, many of the standard reference books are not readily available in libraries and bookstalls; when available, the prices are usually unaffordable for the average Indian student. There is, therefore, a crying need for field guides written in a style accessible to both students and non-specialists. Our biology education could also greatly benefit from students undertaking first-hand studies of organisms in their own surroundings, addressing issues of scientific interest. This book is an attempt to provide such easily accessible information and to throw up ideas for field-oriented student projects.

A total of 75 taxa of fishes that commonly inhabit the freshwaters of peninsular India have been described in this book. Most of these are native Indian fish. A few species whose natural distribution lies outside peninsular India but are widespread due to introductions, aquaculture, and the aquarium trade have also been included. With the exception of a few taxa that are based on the early works of Francis Hamilton and Francis Day, the illustrations are based on published and unpublished photographs of live, freshly-killed and preserved specimens. The black-and-white illustrations included in the text depict the variations between the sexes, adults and juveniles. Around 50 taxa related to those described have also been illustrated.

SPECIAL ISSUES OF JOURNALS

Spectral and inverse spectral theory

Guest Editors: Peter D. Hislop and M. Krishna
Proc. Mathematical Sciences, Vol. 112, No. 1, Feb. 2002, pp. 1-256

This is the second special issue devoted to the *spectral theory of Schrödinger operators*, after the first one brought out by the journal in 1996, and is devoted to articles presented at the *Indo-US Workshop* held at Goa in December 2000.

The identification of the spectral types of Schrödinger operators is one of the main interests in this area. The spectral types of Schrödinger operators are studied for different families of deterministic potentials, random potentials, magnetic fields, and time-dependent potentials. Other issues of interest are the asymptotic properties of time evolution, the behaviour of eigenfunctions, and the finer properties of the density of states related to random potentials. The seventeen articles in this volume contain both original research results as well as review articles on the subject.

Indian language document analysis and understanding

Guest Editors: P. S. Sastry and M. Narasimha Murty
Sadhana, Vol. 27, No. 1, Feb. 2002, pp 1-126

Advances in information technology and the wide reach of internet are radically changing all spheres of activity in our society. Consequently, an increasingly large number of people are required to interact more frequently with computer systems. To make the man–machine interaction more effective in such situations, it is desirable to have machines capable of handling inputs in a variety of forms such as printed/handwritten paper documents, speech etc. The field of document analysis and understanding is concerned with developing techniques to facilitate computers to effectively handle (scanned images of) printed documents as input. Despite widespread use of computers, paper documents continue to be important and hence it is useful to have computer systems that can seamlessly integrate paper documents with other electronically created ones. There are also other important applications of document image analysis: e.g. public digital libraries may require many classical literary works to be processed and made available in digital form.

In a multi-lingual country like India, it is particularly important to develop computer systems that allow users to interact with them in Indian languages. Due to peculiarities of Indian scripts (and languages), solutions that work well for languages such as English, may not apply to Indian languages. Also, in the Indian context, many documents contain text of more than one script and hence recognition and segmentation of different scripts from a multilingual document is important. Thus issues such as recognition of scripts and characters in Indian languages, pre- and post-processing techniques tailored for Indian languages and user-friendly interfaces for better utilization of the output of document analysis systems, all need attention. This was what motivated this special issue.

This special volume contains eight articles, and constitutes a fairly representative sample of the state-of-the-art in this field today. Some of the papers deal with complete systems for processing printed documents in an Indian language. Such systems will hopefully reach a stage where they are routinely used in various applications. The techniques used should form a good basis for researchers to undertake work on processing of documents in other Indian languages. If this volume motivates design and development of systems for processing documents in every Indian language, the effort would have been worthwhile.

Formal verification of circuits and systems

Guest Editor : P. P. Chakrabarti

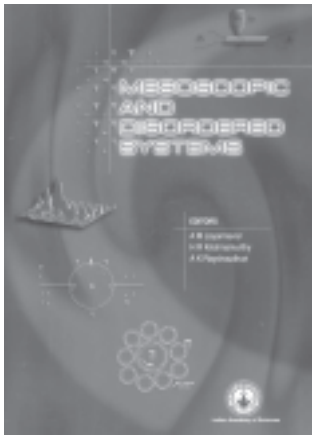
Sadhana, Vol. 27, No. 2, April 2002, pp. 127–250

The problem of validation and verification of correctness of present-day hardware and software systems has become extremely complex due to the enormous growth in size of the designs. Today typically 50–70% of the design cycle time is spent in verifying correctness. While simulation remains a predominant form of validation, exhaustive simulation is rapidly becoming infeasible. There is now a wider recognition of the need to include formal methods in the task of verification. Today formal verification is finding increasing acceptance in some areas, especially model abstraction and functional verification. Other major challenges, like timing verification, remain before this technology can be posed as a complete alternative to simulation. This special volume is devoted to presenting some of the different approaches that are major research issues in formal verification research today. The four articles present different flavours in the approach to formal methods in verification — algorithmic approach to timing analysis, algorithmic and logic-based model checking style of verification, an automata-theoretic approach to analysing timing properties of systems, and the assumption commitment method, a popular method to handle complexity of verification. While these do not cover all approaches being investigated today, they provide four important directions in verification search.

Mesoscopic and disordered systems

Guest Editors : A.M. Jayannavar, H.R. Krishnamurthy and A.K. Raychaudhuri

Pramana, Vol. 58, No. 2, Feb. 2002, pp 147–442



A small discussion meeting of physicists from around the world working in the general area of mesoscopic and disordered systems was held in Bangalore in December 2000.

The motivation was the intrinsic fascination of the field, which abounds in interesting and subtle physics issues. While on the one hand it is directly related to the fast emerging area of mesoscopic and nanoscopic devices, on the other, it leads to theoretical developments which have general application in a large number of other areas of condensed matter physics. This volume contains twenty-six of the talks presented at the meeting and the editors hope that the condensed matter physics community will find this volume of value.

Superconductivity and magnetism: Materials, mechanisms and devices

Guest Editors : R. Pinto, R. Nagarajan and A.K. Grover

Pramana, Vol. 58, Nos 5/6, May/June 2002, pp 715–1206

The phenomena of superconductivity and magnetism have remained at the centrestage of condensed matter science over the entire twentieth century. Once considered mutually exclusive, the two phenomena are seen to coexist and the interplay between them forms one of the most exciting aspects of present-day research in condensed matter physics and materials science. The discovery of superconductivity above the boiling point of liquid nitrogen in cuprates, colossal magnetoresistance in manganites, superconductivity and its coexistence with magnetic order in ternary alloys, quaternary borocarbides and boronitrides, superconductivity in fullerenes, etc. have all provided such an impetus to the field of superconductivity and magnetism since 1986 that the physics, chemistry, materials and devices aspects have become inseparable in the strongly correlated electron systems.

An international symposium held in Mangalore in September 2001 focused on some of the contemporary aspects of the above two phenomena. Several groups in India are actively engaged in magnetism and superconductivity, and many Indian researchers have made noteworthy contributions. For example, a variety of new materials, such as new superconductors, valence fluctuation compounds, heavy fermion systems, etc. have been discovered/identified in India. Important contributions such as superconductivity in thin films with the highest J_c and the lowest microwave surface resistance, Josephson junctions and SQUID devices of superconductors, etc. have been achieved. There is also a widespread interest in understanding the statistical physics of pinned vortices, which has bearing on the applications of high T_c superconductors and the CMR based composite devices. This special volume contains eighty of the contributions presented at the symposium divided into the following areas: strongly correlated electron systems, superconductivity, physics of vortex state, colossal magnetoresistance and other materials, and finally thin films and devices.

Quantum theory and quantum optics

Guest Editor : Rupamanjari Ghosh

Pramana, Vol. 59, No. 2, August 2002, pp. 163–432

The papers put together in this volume were presented at the second Winter Institute on “Foundations of quantum theory and quantum optics” held at Kolkata in January 2002. The

scope of the Winter Institute was quite broad and its aim was to play a proactive role in seeding and sustaining research collaborations in the emerging area of quantum mechanics, quantum optics and mesoscopic physics. The 34 papers included in the volume cover topics involving quantum entanglement and nonlocality, quantum tunneling, quantum teleportation, quantum computation, measurement and decoherence, stochastic quantum mechanics, formulation of a maximally classical and realistic quantum theory, fundamental light-matter interactions, etc.

Genome analysis

Guest Editor : Alok Bhattacharya

Journal of Biosciences, 1, Vol. 27, No. 1, Feb. 2002, pp 1–70

The last decade witnessed major changes that will affect the way in which much of biological research is carried out. Until recently, one could study only one or a few genes at a time and it took about three years even in well-equipped laboratories to understand the structure and function of a gene. It was not possible to rapidly work out how different gene-products interacted physically and functionally. The advent of high throughput sequencing methods and advances in computational techniques have made it possible to 'look' at the genome in its entirety. Along with improvements in sequencing technology, there have been major advances in the way the expression of genes is measured or mutations in genomes are mapped. High throughput methods allow one to analyse large numbers of genes within a short period. What does all this mean for the average biologist working in our country? Has he or she become redundant and been swept aside by the strong currents of high technology? Many of us feel helpless looking at the sheer scale of present-day research and are not sure how we can contribute significantly any more.

Despair, however, can quickly turn to enthusiasm if one realizes that the amount of information available today on the Internet can help anyone to conceive projects involving molecular tools. For example, full genomic sequences of a large number of organisms are already available, and a PCR reaction can result in the desired fragment. Databases and bioinformatics tools available on the Internet allow a researcher to find mutations, build three-dimensional structures of encoded proteins, get the relevant information and literature related to genes of interest, and so on. Genome sequencing projects eventually throw up lists of genes with predicted functions with different degrees of certainty. A list usually contains a sizable number of genes that have unknown functions. Traditional genetic and biological methods may have to be used to investigate and confirm the putative functions. This is particularly relevant for the vast majority of genes whose products do not work in isolation. After all, genetic circuits consisting of interacting gene products are the basis of cellular functions. Unfortunately, many organisms are not amenable to biological approaches and their genetic systems have not been defined (though their genome may have been sequenced). Exploitation of the genomic data in these organisms may not be feasible due to the lack of amenable systems to study the functions of their genes *in vivo*. Small laboratories can contribute significantly by developing genetic approaches such as methods for transfection, knockouts, expression blocking, etc. for different organisms. Judicious use of bioinformatics tools coupled with an insight into the biological properties of the system will help us to exploit genomic information. Any laboratory, however small or big, can contribute significantly.

This Journal supplement is a collection of papers on different aspects of genomics pertaining to analysis of genomes and application of genomic information in basic biology, diagnosis and clinical research. They give us a glimpse of what is going on in this area, mainly in India.

Conservation of biodiversity – the new consensus

Guest Editor: Sahotra Sarkar

Journal of Biosciences, Vol. 27, No. 4, July 2002, pp 299–435

When conservation biology emerged as an identifiable organized discipline in the late 1980s it was already apparent that it would have to draw its principles and practices from many different biological specialities including genetics, evolution and, especially, ecology. However, besides this single point of agreement, the practice of conservation biology diverged radically in different cultural and political contexts. In the North, particularly in the United States, humans were perceived as being essentially separated from nature, and their presence was taken to be the main reason for biodiversity depletion; human exclusion and wilderness preservation became major tenets of the new discipline. For many of these conservation biologists, the discipline's normative foundations were provided by "deep ecology", a doctrine of questionable intellectual cogency and considerable ethical dubiety. In sharp contrast, in the South, particularly in India and Latin America, biological conservation was viewed to be so closely integrated to cultural traditions in which the conservation of biodiversity was seen as part of the biocultural restoration of degraded habitats and the preservation of cultural practices that co-evolved in harmony with biodiversity. Over the years this view has been called human, liberation, or social ecology.

If in the North, in the United States, for instance, the pursuit of a science of biodiversity conservation was largely seen in continuity with basic rather than applied biological science, in the South, it was usually perceived to be in continuity with the social sciences. During the last five years, however, a synthetic consensus framework of conservation planning has emerged. Insights from each of the different traditions and insights gained from experience in the field during the last few decades have been integrated in this framework.

The papers collected in this Journal supplement reflect the new consensus framework of conservation biology and illustrate each of its aspects from different points of view. An effort has been made to include exemplars of all the major research programmes in conservation biology.

Several of the papers published here were presented at a workshop "Philosophical issues in biodiversity conservation", held at the University of Texas in Austin (USA) under the auspices of UT's Program in the History and Philosophy of Science.

SPECIAL SECTIONS PUBLISHED IN CURRENT SCIENCE:

Indus-I synchrotron: India's first synchrotron radiation source
Guest Editor: D.D. Bhawalkar
Vol. 82, No. 3, 10 Feb. 2002, pp 279–309

Recent advances in epilepsy
Guest Editor: Sanjeev V. Thomas
Vol. 82, No. 6, 25 March 2002, pp 664–731

Plasma applications
Guest Editor : P.I. John
Vol. 83, No.3, 10 August 2002, pp 225–290

Recent advances in silkworm biology
Guest Editor : J. Nagaraju
Vol. 83, No.4, 10 August 2002, pp 409–471

PUBLIC LECTURES

Distinguished scientists who visit Bangalore are invited by the Academy to deliver public lectures. Since January this year, several such lectures were arranged. A list of these follows:

The search for intelligent life

Arnold W. Wolfendale, University of Durham, UK
3 January 2002, Indian Institute of Astrophysics, Bangalore

This lecture was an attempt to find an answer to one of the great problems of the age, and one on which everyone has a view: "Are we alone?". The lecture, in a not too technical way, looked at the history of this question, and the science involved in present day searches.

Stellar mass black holes

E.P.J. van den Heuvel (Academy Honorary Fellow), Astronomical Institute
Amsterdam, The Netherlands
4 January 2002, Indian Institute of Science, Bangalore

During the past one and a half decades the existence of stellar mass black holes in X-ray binary systems in the galaxy has become well established. At present about a dozen such systems are known. Several of them are the so-called "galactic micro-quasars" which on a much smaller scale show many of the properties observed in quasars and active galactic nuclei (AGNs): mass ejection in the form of bi-polar relativistic jets, apparent superluminal motions and copious X-ray emission. The masses of the stellar black holes in our galaxy are, however, only between 3 and about 20 solar masses, whereas those in quasars and AGNs are between a million and a billion solar masses. Strong evidence has been found recently that the formation events of stellar mass black holes are a particular type of supernova explosions, so-called "hypernovae" or "collapsars", which presumably mark the death of stars more massive than about 25 solar masses.

Some extensions of the binomial theorem and applications

Richard A. Askey (Academy Honorary Fellow) University of Wisconsin, Madison, USA
8 January 2002, Raman Research Institute, Bangalore

We all know the binomial theorem. However, some extensions of it found in the 19th and 20th centuries are surprising and have even more surprising consequences. Some of these were described, from how to refine the counting of lattice paths to how to explain the first derivation of the Rogers-Ramanujan identities. Ramanujan did some work in this area, including finding a formula which was missed by all of the great mathematicians who worked on elliptic functions in the 19th century. He could have done much more if he had learned a few things which were discovered in the late 19th century but not fully appreciated until after he died. For the scientific community, however, he left some things to find.

Current trends in the conservation of biodiversity

Ghillean T. Prance, University of Reading, UK
10 January 2002, Indian Institute of Science, Bangalore

The lecture discussed the roles of *ex situ* versus *in situ* conservation of biodiversity with an emphasis on the merit of *in situ* conservation. The important role of botanical gardens and seed banks was discussed with examples from the work of the Royal Botanic Gardens, Kew. Earlier work tended to focus more on single endangered species. The current emphasis on habitat and ecosystem conservation is likely to be much more effective. It is essential to maintain the web of interactions between the different elements of biodiversity, pollination, dispersal, mutualisms etc. The advantage of thinking in terms of biodiversity is that species, habitat and genetic diversity are all taken into consideration. Conservation today cannot be achieved without an equal emphasis on the sustainable use of biodiversity, and examples of the move to sustainability were given from experience. The Convention on Biological Diversity has had a considerable influence on current thought about conservation and its pros and cons were discussed in the lecture. The speaker felt that it is essential to bring on board those few countries that have not yet ratified the Convention.

The quantum-mechanical world view: A remarkably successful but still incomplete theory

Elliott H. Lieb, Princeton University, Princeton, USA
24 January 2002, Indian Institute of Science, Bangalore

This talk was about some important, unsolved problems of a mathematical nature connected with the quantum mechanical

many body theory. It centred on the stability of matter problem and how this is connected to the largely unsolved problem of quantum electrodynamics. The historical background and the present status of the subject were reviewed.

Does the everyday world really obey quantum mechanics?

Anthony J. Leggett, University of Illinois, Urbana, USA

25 February 2002, Raman Research Institute, Bangalore

Quantum mechanics has been enormously successful in describing nature at the atomic level and most physicists believe that it is in principle the "whole truth" about the world even at the everyday level. However, such a view prima facie leads to a severe problem: in certain circumstances, the most natural interpretation of the theory implies that no definite outcome of an experiment occurs until the act of "observation". For many decades this problem was regarded as "merely philosophical", in the sense that it was thought that it had no consequences which could be tested in experiment. However, in the last dozen or so years the situation has changed very dramatically in this respect. This lecture discussed the problem, some popular "resolutions" of it, and the prospects for meaningful experimental input.

Quantum information

Charles H. Bennett, IBM Thomas J. Watson Research Center, New York, USA

26 February 2002, Indian Institute of Science, Bangalore

One of the foundations of the information revolution is the robustness of digital information: its ability to be read, copied and transferred from one medium to another without degradation. But the information in microscopic bodies like atoms or photons, which obey the laws of quantum physics, is more delicate and cannot be copied or observed without disturbing it. Until recently these quantum effects were thought of mainly as a nuisance, causing small devices to be less reliable than their larger cousins, but now they have led to a profound generalization of our notions of what information is and what can be done with it, with applications to the art of designing unbreakable codes and vastly speeding up certain otherwise intractable computations.

J.D. Bernal: his legacy to science and to society

Alan L. Mackay, Birkbeck College, London, UK

3 April 2002, Indian Institute of Science, Bangalore

John Desmond Bernal (1901–1971) was born about a hundred years ago and it was considered appropriate to recall his personality and his contribution to science and society. He was the major founder of structural molecular biology. At the same time he worked tirelessly for the constructive application of science to the problems of society. He saw small science grow to big science under the demands of war and tried to arrange the application of science to the problems of peace. He contributed creatively to whatever held his attention.

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Crystallization of membrane proteins: Routes and achievements

Hartmut Michel, Max-Planck-Institute for Biophysics, Frankfurt-am-Main, Germany

22 April 2002, Indian Institute of Science, Bangalore

Despite the fact that 30–40% of all proteins from higher organisms are membrane proteins, experimentally determined structures are available for only 30 of them. In contrast more than one thousand structures of different water-soluble proteins are available. The disparity is caused by the amphipathic nature of membrane protein surface making membrane proteins difficult to handle and crystallize. The hydrophobic surface part of membrane proteins, in contact with alkyl chains of the membrane lipids in the native environment must also be covered in crystals, either by detergents or by lipids.

In type I crystals detergents surround the hydrophobic part of membrane protein in a belt-like manner. Such crystals can also be obtained as the crystals of water-soluble proteins by precipitating the membrane protein/detergent complex by salts or polymeric agents. In type II crystals the membrane proteins form two-dimensional crystals in the membrane phase. Type II crystals can be obtained using lipidic cubic phases. To obtain type I crystals varying the detergent is most important. Crystallization with fragments from specific monoclonal antibodies is an invaluable route towards obtaining well-ordered crystals when variation of the detergent and other parameters fails.

Recent successes at the speaker's laboratory include the structure determinations of several complexes involved in cellular respiration; cytochrome *c* oxidase from the soil bacterium *Paracoccus denitrificans,* the yeast cytochrome bc_1 complex, and a complex II-like fumarate reductase. Their crystallization, the structure determinations and the structures were presented as examples.

The big bang and the seeds of turbulence

K.R. Sreenivasan, Yale University, New Haven & University of Maryland, USA

8 July 2002, Indian Institute of Science, Bangalore

The existing observational data on cosmic background radiation (CBR) was presented and analysed to extract non-Gaussian features. The scaling exponents of CBR increments were shown to be the same as those of hydrodynamic turbulence. This remarkable similarity was interpreted in terms of primordial turbulence.

WORKSHOP ON ELECTRONIC PUBLISHING

In the last issue of **Patrika** we promised an account of a workshop on electronic publishing organized by the Academy in March this year. The idea of reviewing Academy's effort in electronic publishing originated after the second ICSU-UNESCO International Conference on Electronic Publishing in Science held in Paris in February 2001. It was clear that while Latin America had made admirable strides in electronic publication of scientific journals and a journal server had been set up that hosted several biomedical journals from a 'developing country' region, there were no similar initiatives from Asia.

At a subsequent Academy meeting of journal editors and invitees, this point was emphasized. It was then suggested that Academy, which was already making its journals available on the Internet, might organize a workshop for the benefit of other Indian journals and publishing organizations. The workshop was conceived with the help of Subbiah Arunachalam of the MS Swaminathan Research Foundation, Chennai. The Academy managed to get two excellent resource persons from abroad: Leslie Chan of the University of Toronto, Canada, and Bioline International, and Barbara Kirsop of the Electronic Publishing Trust for Development in the UK, who both had considerable experience in producing electronic versions of developing country journals, and were already working with Indian journals.

It was decided to accommodate at least 40 participants and the initial plan therefore was to have two workshops, one in Bangalore and the second elsewhere. However, it was difficult to find a suitable venue elsewhere and we ended up holding both workshops in the Indian Institute of Science in Bangalore, at the Internet School facility of the Digital Information Services Centre.

The two workshops were held during 8 to 10 March and 13 to 15 March 2002 and were intended for editors/editorial support staff/computer support staff of Indian nonprofit science, technology and medicine journals and publishing organizations. The participants consisted of 10 from medical journals, three from INSA, two each from ICAR, CSIR, *Sankhya*, *Indian Journal of Physics,* Bombay Natural History Society, Geological Society of India, and one each from *Madras Agricultural Journal*, Indian Mathematical Society, Tata Energy Research Institute, *Bulletin of the Astronomical Society of India*, and the mathematics journal *Samasya.* The rest of the participants represented the journals of the Academy and *Current Science*.

The aim of the workshops was to address issues that relate to establishing electronic editions of journals in parallel with existing print editions, and to make participants aware of the rationale, economics, procedures and technologies of electronic publishing, and open archives. The workshop curriculum was prepared by Chan and Kirsop, who gave most of the presentations. Participants themselves came up with a few topics. Considerable time was devoted to hands-on sessions at PCs for creating a simple Web version of a journal paper, and for adding metadata elements to it. The workshops were enriched by presentations from G. Misra and V. Pati of ISI, Bangalore and D.P. Patil of IISc, Bangalore on topics relevant to mathematics and physics publishing, and by T.B. Rajasekhar, also of IISc, on metadata.

The overarching concern behind the idea of the workshops was the urgent need to increase visibility of Indian journals by making them available on the Internet in formats that take advantage of search and retrieval procedures. While that is not an easily achieved objective, the cooperative model that SciELO (Scientific Electronic Library Online of Brazil) adopted has apparently produced a measurable positive outcome. One can only hope that the Academy workshops will have played the catalytic role that was intended for them.

The Academy website has a section devoted to the workshops at http://www.ias.ac.in/epubworkshop/, including the curriculum and the presentations. The topic list mentioned above that participants came up with is a fair pointer to issues that one must address: Web journals and visibility, partnerships with institutions in developed countries, pre-printing workflow and document management, tools for electronic publishing, search engines, advertisements, copyright issues, XML, cost of website maintenance, access and control, archiving and long-term access, role of libraries, lack of electronic access in many regions, file formats and conversions, pricing and economics, persistence of print editions, and impact on subscriptions to print journals.

The Workshops were made possible by generous funding assistance from DBT, CSIR, and INASP (International Network for the Availability of Scientific Publications, Oxford). The International Development Research Centre (IDRC) in Canada and the British Council supported the travel of Leslie Chan and Barbara Kirsop.

SUMMER FELLOWSHIPS

Since 1996, as part of the activities of the Science Education Panel, summer fellowships are awarded to bright students and motivated teachers to work with Fellows of the Academy on research-oriented projects. Approximately 75 such fellowships to students and 25 fellowships to teachers are offered every year with travel and living expenses paid. While many institutions in the country offer summer fellowships, the distinguishing feature of the Academy programme is that it covers university and college teachers as well and the awardees are placed with Fellows working in institutions nationwide.

Announcements inviting applications are published in *Resonance* and *Current Science* and selections are made by subject-wise committees appointed by the Science Panel. The number of fellowships offered thus far is given below:

Year	Students	Teachers
1995	3	—
1996	12	—
1997	31	7
1998	33	8
1999	57	8
2000	69	10
2001	93	26

During the year 2002, 86 students and 29 teachers were offered summer fellowships. A subject-wise break-up of the number of applications received, fellowships offered/availed is given below:

Subject	Students			Teachers		
	Applns. received	Offered	Availed	Applns Received	Offered	Availed
Biology	412	50	37	55	18	15
Chemistry	198	22	20	29	5	5
Physics	131	15	12	15	7	5
Engineering	156	11	9	11	3	1
Earth Sciences	14	1	1	2	2	-
Mathematics	59	8	7	8	8	3
Total	**970**	**107**	**86**	**120**	**43**	**29**

The cities where the awardees worked are listed below:

Allahabad	1	Kharagpur	1
Bangalore	48	Kolkata	12
Calicut	1	Lucknow	2
Chennai	8	Madurai	2
Delhi	4	Mumbai	3
Dharwad	1	Mysore	6
Goa	1	Pune	7
Hyderabad	14		**115**
Kanpur	4		

Many informal enquiries reveal that this programme has been very successful and is gaining increased recognition and acceptance.

LECTURE SERIES

One of the activities of the Academy Science Education Panel is to arrange 2–3 day lecture programmes on carefully chosen topics at selected college and university departments in the country for local students and teachers. Speakers are mostly Fellows from nearby institutions.

Theoretical Physics

A three-day series in theoretical physics was organized at the C.M.S. College in Kottayam during January 14–16, 2002. The speakers included Arup K. Raychaudhuri, Diptiman Sen, Vasant Natarajan and Reghu Menon, all from IISc, Bangalore. The topics covered : Bose–Einstein condensation, nanomaterials, superconductivity, and molecular and polymer electronics.

Quantum Chemistry

A three-day lecture programme entitled "Quantum chemical calculations and their uses in teaching" was organized at the St. Joseph's College, Irinjalakuda in Kerala during February 18–20, 2002. The participants included college and university teachers and research scholars from all the southern states and the objective was to help teachers and students to familiarize themselves with recent advances in the field of quantum chemistry and to explore computer-aided methodology for teaching the subject. The speakers were K.L. Sebastian and E. Arunan from IISc, Bangalore and M.K. Mishra from IIT, Mumbai. The topics included variational method and molecular orbital theory, time-dependent perturbation theory and Hartree–Fock approximations, semi-empirical methods and ab-initio method of calculation, quantum mechanical approach to spectroscopic transitions and finally quantum chemical applications to molecular models. The lectures were interspersed with demonstration sessions where all the participants were provided with computer access.

In addition, a half-day lecture programme entitled "Current trends in life sciences" was held at the St. Xavier's College in Mumbai on 12 January 2002. There were five lectures on stress (Vidita Vaidya), genes in development (Veronica Rodrigues), drug design and structural biology (Anil Lala), gene therapy (Rita Mulherkar), and stem cells (S.G.A. Rao).

OBITUARIES

The Academy regrets to report the death of several Fellows in 2002. A summary of their life and work follows.

Moti Lal Dhar (elected 1975) was born on 29 October 1914 at Srinagar in Jammu and Kashmir. He obtained his B.Sc. (Hons) in 1936 and M.Sc. in 1937 securing a first class first rank in both degrees from the Panjab University. He got his Ph.D. from the University of London in 1940 and then joined the Drug Research Laboratory in Jammu and Kashmir, initially as an assistant chemist and finally as chief chemist and works manager until 1950 when he joined the newly established Central Drug Research Institute in Lucknow. Joining CDRI as a senior scientific officer, he rose through the ranks finally retiring as director of research and administration in 1974. In 1977, he was also the Vice-Chancellor of the Banaras Hindu University at Varanasi for a year.

His scientific work in medicinal chemistry covered organic reaction mechanisms, medicinal plants of India, chemotherapy of mycobacterial and protozoal infections including tuberculosis, leprosy, amoebiasis, filariasis and helmenthic disorders, neuro-muscular blocking, hypoglycaemic and hypotensive agents and fertility control.

He was elected to several other Academies such as the Indian National Science Academy (1960), Institution of Chemists (1955), and the Royal Institute of Chemistry, UK (1945). The Government of India honoured him with *Padma Shri* in 1971. He passed away on 20 January 2002.

Satish Dhawan, the President of the Academy during 1977–1979, passed away on January 3, 2002. With this, we lost a great figure in Indian science, engineering and education, an inspiring teacher and leader, a warm human being, a person of sterling character, humility and deep convictions. Several appreciations about him and his contributions have appeared in *Current Science* Vol. 82, pp. 225–228.

Dhawan was born in Srinagar on September 25, 1920. He obtained an unusual combination of degrees from Panjab University at Lahore: BA in Mathematics and Physics, MA in English literature and BE in Mechanical Engineering. After a year spent at Hindustan Aeronautics Limited, with the help of a government scholarship he went to the USA. He earned an MS in aeronautical engineering in 1947 from the University of Minnesota followed by a Ph.D. in Aeronautics and Mathematics from Caltech in 1951 under Hans W. Liepmann. Upon returning to India, Dhawan joined the Aeronautical Engineering Department at the Indian Institute of Science, Bangalore as a Senior Scientific Officer in 1951. In 1955 he became Professor and Head of the Department; and in 1962 at the young age of 42, he was chosen as Director of the Institute. His tenure as Director was to be the longest so far, for he retired 19 years later in 1981. He built the earliest wind tunnels, and was the father of experimental fluid dynamics research in the country.

In 1972, Dhawan became the Chairman of the Indian Space Research Organisation and in the following decade he directed the Indian space programme through a period of extraordinary growth and spectacular achievements such as the launch of Indian satellites on Indian rocket vehicles, and pioneering experiments on remote sensing and satellite communications.

In his years as Director of the IISc, the Institute grew greatly in faculty and student strengths and initiation of many new areas of research. He was instrumental in bringing in talented young faculty in many fields, and also getting G.N. Ramachandran, E.C.G. Sudarshan and C.N.R. Rao to the Institute. Both Ramachandran and Rao had earlier been in IISc. Quoting from Yash Pal's appreciation "his role in making the Indian Institute of Science a great centre of learning and research has been seminal. It is during his time that the Institute developed its unique personality and its breadth. Without his lateral vision the Institute would have been no more than an excellent institute of technology. He made it into a place that attracted talent of a wide range, where people might have been recognised in terms of the departments to which they belonged but the boundaries were kept porous. Even deep social concerns soaked in"…..

And about his contributions to ISRO, quoting again from Yash Pal. "It was Satish Dhawan who gave the management sinews to the Indian space program. ……. Solidity combined with human goals is a character that ISRO owes largely to Satish Dhawan. I do not know another example in the country that can match what this remarkable man gave to the country. Above all were his strength of character, probity, concern and honesty of purpose".

Satish Dhawan was elected to the Academy in 1970 and served in the council for 21 long years. His term as President (1977–79) was a period of intense growth in the Academy. The "role of the Academy" which is reproduced in the year book was drafted by a committee that he chaired. This document set the tone for a clearer picture of what the Academy should strive for and stressed the need for concrete proposals to translate science into action. By an amendment of the statutes, the fellowship of the Academy was enlarged to elect nearly 200 new fellows in just two years. The Academy Proceedings, published since 1934 in two sections, were split into several theme journals. New journals in materials science, engineering science, and astronomy and astrophysics were added. Dhawan initiated the moves that eventually resulted in the Academy taking over from the Haldane Trust the *Journal of Genetics*. Independent editorial boards were constituted for the first time to run the journals thus paving the way for the involvement of a larger number of fellows in the activities of the Academy. The Academy discussion meetings on topical scientific themes was another new activity started during his period. Dhawan wanted the Academy to play a greater role by taking up issues that affected science and humanity. The proposed government moves to reorganize CSIR in 1977, the Narmada dam controversy, and the Silent Valley project were some of the issues that he took up for discussion in the fellowship.

He was Fellow of the U.S. National Academy of Engineering and Distinguished Alumnus of both the IISc and Caltech. Dhawan has been widely honoured in India and abroad for his contributions to science and technology. A grateful nation awarded him the *Padma Bhushan* in 1971, *Padma Vibhushan* in 1981, and the Indira Gandhi Award for National Integration

in 1999. The citation for the latter said in part. "The award goes fittingly to one of our foremost scientists, teachers and nation builders, Prof. Satish Dhawan, who has made multidimensional contributions to scientific education, research, policy formulation and implementation and is deeply concerned with the solution of national problems through the use of science."

He leaves behind his wife Nalini, two daughters and a son.

Triloki Nath Khoshoo (elected 1961), an eminent environmentalist, passed away on 11 June 2002, after a prolonged illness. Born on 7 April 1927 at Srinagar, Kashmir he obtained his B.Sc. (Hons) in 1945 and M.Sc. (Hons) in 1946, both in botany from the Punjab University in Lahore, followed by a Ph.D. from the Panjab University in Chandigarh in 1958. He began his career as a senior lecturer in botany at the Panjab University in Chandigarh (1948–62) and became the head of the post-graduate department of botany in the University of Jammu and Kashmir (1962–64). He joined the National Botanical Research Institute as assistant director (1954–74), becoming deputy director (1974–76) and finally its director (1976–82). From 1982 to 1985, he held the position of Secretary to Government of India, Department of Environment and in 1985 was redesignated as the CSIR distinguished scientist until 1990 before joining the Tata Energy Research Institute as a Jawaharlal Nehru Fellow from 1991 to 1993.

Khoshoo was a renowned teacher, brilliant researcher, and a well-known R&D administrator. As a scientist, he did outstanding work on cytogenetics as related to plant evolution and improvement and in environmental management. In his studies on genetics of forest trees, he proposed new hypotheses to explain the peculiar genetic architecture underlying their evolutionary diversification. His work helped forest geneticists and tree-breeders to chalk out breeding methodologies for this economically and environmentally important group of plants. His work on the experimental analysis of dynamics and statics of the evolution in polymorphic wood and vegetable, minor fruit and medicinal plants was regarded as one of the most original pieces of work. In the mid-sixties to seventies, he worked on non-agricultural economic plants, particularly ornamental and subsidiary food plants and established a flourishing school of research in Lucknow. He was able to manipulate genes, chromosomes and genomes for increased novelty and productivity and perfected breeding methodology for F1 hybrid seed production of triploid marigolds, tree flowering colourful hybrid verberas, new tropicalized cultivets in amaranths, bougainvilleas, chrysanthemums etc. Using elegant cytogenetic techniques, he worked out the genetic mechanisms underlying transformation of small and wild into large cultivated types during the process of domestication of ornamental and subsidiary food plants.

As NBRI director, he also helped restructure its R&D set-up by initiating high-level research programmes, especially on pollution-tolerant plants for land-scaping polluted areas, aerobiology of allergenic plants, man-made forests, and biomass production on marginal land using high-density and short-rotation firewood, alcohol, petroplant and rubber-yielding plants at the unique biomass research centre at Lucknow. As the environment secretary, he was responsible for policy planning and management of environment in the country's botanical and zoological surveys and natural history museums. He brought about many innovations in the areas of heavy metal toxicity, rural fuels, air pollutants and plants, biotechnology of waste management, ethnobiology and tissue culture and seed biology as a conservation strategy. Meaningful programmes on eco-development of watersheds and acelogically degraded areas, environmental education centres of excellence and many other programmes brought together scientists, technologists, ex-servicemen, governmental and non-governmental organizations, students and villagers alike. He was one of the architects of the Ganga Action Plan.

Khoshoo was the recipient of many honours and awards like the Prince of Wales Gold Medal (Panjab University), the ICAR Rafi Ahmed Kidwai Medal, the Birbal Sahni Gold Medal (Indian Botanical Society) and the UN Sasakawa Environment Prize. He was a fellow of all the three national academies and the general President of the Indian Science Congress (1985–86), the President of National Academy of Sciences (1985–86), the Indian Society of Genetics and Breeding and the Bioenergy Society of India. The Government of India honoured him with Padma Bhushan in 1992. He leaves behind his wife Mohini and two sons.

The passing away of **Kuruvakkat Kochu Govind Menon** (elected 1975) is another disappearance from the Indian scientific terrain of a vanishing species, carrying traits characteristic of the pre- and neo-independence period of science in India as regards idealism, marks of travails as well as excitement born out of achievements, success with satisfaction, and setbacks with stoicism. Born on 19 September 1927, in Chittur of Palghat to a Nair family of traditional teachers and scholars in the classical rural mould of the period, he developed an everlasting ethos of identity with the best in the true traditional mores in a true cultural sense, while integrating it with the best underpinning of rational principles of scientific enquiry throughout his life.

Menon was educated at Madras and Bombay Universities, and obtained his Ph.D. in biochemistry from the University of Toronto in Canada. He did his post-doctoral work at many leading centres in US during the golden age of biochemistry. Between 1942 and 1947, he worked at the Haffkine Institute in Bombay and for a year in 1959 at the Patel Chest Institute in Delhi and for a short while at the Central Leprosy Research Institute at Chingalpet before joining the Hindustan Lever in 1962. For the next decade and a half, Menon led its research centre with distinction putting together teams in chemistry, biology, toxicology, agriculture and importantly, engineering sciences, comprising superlative talent and potential. He was the head of the biology division and later in 1974 became the director of research. After his retirement in 1987, he served as principal scientific adviser to the National Dairy Development Board and Chairman of the scientific advisory committee of Tea Research Association, and director of research, Assam Tea Company until 2001.

His scientific contributions involved preparation of a plague vaccine using casein hydrolysate instead of blood agar; demonstrated biosynthesis of lecithin from phosphatidyl ethanolamine through vitamin B12 and methionine, formation and metabolism of malonyl CoA through transferase, enzyme from pig heart, formation and metabolism of malonaldehyde CoA, enzymic carboxylation of butyryl CoA, and synthesis of glutaryl CoA, demonstration of increased ketogenesis by deacylation of aceto-acetyl CoA in diabetes, metabolism and

utilization of acetoacetate in human skin, mass production of nutritive foods in nutrition intervention programme, development of the concept of "shadow nutrients" indicating the possibilities of the use of lipoic acid in the treatment of diabetes; and of taurine in human infants for better health; and choline in very old people for better retention of memory. Some of his work on nutritional biochemistry and micronutrients are considered to be ahead of their time and their relevance and importance have been appreciated only recently.

Menon was a scientist with a rare combination of qualities. His frequent quotes from Malayalam and Sanskrit classics appropriate to situations on the one hand, and irreverence for dogmatism and authority without substance in endeavours of the mind on the other, were a curious blend in him lending both colour and substance to his words and deeds.

He passed away in Chennai on 5 April 2002 leaving behind Tara, his wife, a former scientist colleague of his, daughter Mala and son Anil. A very large circle of friends and colleagues in India and elsewhere will miss him.

Nishtala Appala Narasimham (elected 1966) was born on 15 August 1922 in Parlakimidi, Orissa. He obtained his BA in Physics in 1942 from Andhra University, Waltair standing first-class first in the university; and his M.Sc. in Physics in spectroscopy in 1945 from the Banaras Hindu University, Varanasi with a first class. To pursue Ph.D, he had to take up a teaching job as lecturer in physics first in Visakhapatnam and later in Bijapur from 1947 to 1949. When a research scholarship became available at BHU, Narasimham joined to work with R.K. Asundi for his Ph.D which he obtained in 1952. One of the problems on which he worked for his thesis was the quantitative determination of the intensities of the first and second positive bands of the N_2 molecule produced in electrical discharges used in the studies on the Joshi effect (popularly known as the opto-galvanic effect).

After his Ph.D, Narasimham proceeded to USA and Canada for post-doctoral research work first for a year at the University of Wisconsin, Madison and later to work with J.R. Nielsen at the University of Oklahoma, Norman till 1955. During this period he carried out very significant work on the infrared and Raman spectra of fluorinated benzene molecules. In 1955 he obtained the prestigious National Research Council of Canada (NRCC) postdoctoral fellowship which provided him with a unique opportunity to work with the Nobel Laureate, Gerhard Herzberg at Ottawa. In collaboration with Herzberg, he discovered the spectra of the astrophysically important molecular ions, PH^+ and $P2^{+,}$ and subsequently carried out high-resolution spectroscopic studies on them. His life-long association with Herzberg played an important role in shaping Narasimham's scientific career. While at Canada, Homi Bhabha happened to visit the NRCC laboratories at Ottawa where he met Narasimham and asked him to join the Atomic Energy Establishment at Trombay (AEET), later renamed the Bhabha Atomic Research Centre. Narasimham joined the spectroscopy section at AEET in 1957. With a dedicated group of workers, Asundi and Narasimham developed and standardized several spectrographic methods for the analysis of reactor fuels, heavy water and other reactor materials. This contributed in a large measure to the successful implementation of the atomic energy programmes in our country.

Realizing the importance of basic and applied research for technological development, Narasimham took up the responsibility of setting up the spectroscopy research laboratory virtually from scratch. In atomic spectroscopy, studies of high resolution spectra of rare earth atoms using interferometric techniques, uranyl and rare earth ions in crystals and X-ray spectra were taken up. In molecular spectroscopy, studies of infrared and Raman spectra of polyatomic molecules, high resolution electronic spectra of diatomic and polyatomic molecules and of free radicals in the vacuum ultraviolet, near ultraviolet and visible regions were taken up. His discovery of the rare instance of dissociation by rotation in the $c^1\Pi$; state of NH merits particular mention. The spectroscopy section became an independent division of BARC in 1966 and Narasimham was appointed its head. Realizing the need to develop indigenous knowhow for optical instrumentation he helped to set up the optics laboratory in the division. The expertise thus generated became useful in designing and setting up the vacuum spectrometer and reflectors used in the vacuum ultraviolet and optical beam-lines at the Synchrotron Radiation facility, INDUS-I, at Indore.

After retirement from BARC in 1982, he continued his researches at BARC as an INSA senior scientist until 1987. Narasimham was then associated with the Indian Institute of Astrophysics at Bangalore where he spent a major part of his time setting up the 2.3 m telescope at Kavalur. He was also deeply interested in the diffuse interstellar molecular spectra and the interpretation of their origin.

Narasimham was elected to several Academies, including the Indian National Science Academy (1971), was President of the Physics Section of Indian Science Congress (1975), Chairman of the Indian National Committee of IUPAP (1975–81) and member of the International Committee on Atomic and Molecular Physics and Spectroscopy (1981–87). He received several awards including the C.V. Raman birth centenary medal (1988). He passed away on 8 April 2002 leaving behind his wife Kamala and son Prasad.

Ram Chand Paul (elected 1974) was born on 20 October 1919 at Shakargarh, now in Pakistan. He graduated in Chemistry in 1934, obtained his M.Sc. (chemistry) in 1940, and his Ph.D. in 1947, all from Punjab University in Lahore. In addition, he secured a Ph.D. and an Sc.D. from Cambridge in 1954 and 1968 respectively. His career in Lahore began as a demonstrator (1940–48), lecturer (1949–54) and reader (1954–58). In 1958 he joined the Karnatak University in Dharwar as a professor and head of the Chemistry Department for 2 years and later shifted to the Panjab University in Chandigarh in the same position in 1959 until 1974. He became the vice-chancellor of the Panjab University in 1974 and continued in this position until 1985.

Paul is internationally known for his research in the field of non-aqueous solvents, then a new field in India, and synthetic inorganic chemistry. He worked on the chemistry of Uranium and other elements, and his group standardized the solution chemistry of a large number of solvents such as acid halides, amides, and strongly protonic acid media. He published over 400 research papers. He helped modernize the chemistry curriculum at school and college levels under the sponsorship of NCERT and COSIP. He was a Fellow of the Indian National

Science Academy, the National Academy of Sciences, and the Royal Society of chemistry.

He passed away on 16 February 2002.

Guruvayur Subramanian Ramaswamy (elected 1974), born on 3 October 1923, had his early education in Trichur and moved to the then College of Engineering, Guindy from where he took his B.E. degree with Honours in 1944. He received his M.S. and C.E. degrees in 1948 from the California Institute of Technology. On his return he was appointed professor and head of the Civil Engineering Department at Annamalai University when he was only 26 years. After serving the university for about 8 years, he joined the Central Building Research Institute (CBRI), Roorkee in 1956 as the Head of the Structures Division. During his tenure that lasted for nearly 9 years, he carried out spectacular R&D projects that earned him universal acclaim and several awards. The technology developed by GSR and his team of scientists for a unique cost-saving flooring scheme involving the use of concrete funicular shells has been adopted in the construction of thousands of buildings in India and abroad. It was due to his efforts that the currently popular twisted concrete reinforcing steel bars gained acceptance in the country in the early seventies.

In 1965, he founded the Structural Engineering Research Centre at Roorkee whose headquarters was later moved to Madras in 1974. As Director of SERC and coordinating Director of CSIR campus, he initiated pioneering research in a number of disciplines in structural engineering which made him and SERC well known in national and international circuits. His far-sighted vision enabled the setting up of several advanced laboratories and facilities including the tower testing station at Pallavaram which is among the best in the world.

GSR authored several books which have become reference books on the respective topics. His latest book on space structures was recently released in UK. He had immense interest in literature and fine arts. He was a prolific writer and a great orator. He chaired several committees constituted by state and central governments. Even a few hours prior to his passing away on 9 March 2002, he was preparing notes for his next technical book. He leaves behind his wife, a daughter and two sons. With his passing away, the scientific world and the structural engineering profession have lost an outstanding and eminent scientist-cum-consultant.

Potukuchi Suryaprakasa Rao (elected 1943) was born at Rajahmundry on 1 September 1914. He had his early schooling and intermediate course at Rajahmundry and his B.Sc. (Hons) in Chemistry in 1935 from Andhra University in Waltair securing a first class first rank. He then joined the same university for carrying out research in Organic Chemistry under T.R. Seshadri and obtained his M.Sc. (Hons) in 1936. He was then appointed as a lecturer in 1937 and working on flower pigments, he obtained his D.Sc. in 1940 from Andhra University. In 1945, he joined the Forest Research Institute, Dehra Dun as an assistant chemist and became the head of the department of chemistry and minor forest products in 1956. In 1960 he was appointed the Director of the Forest Research Institute in Bangalore, in which position he continued until retirement in 1973. After retirement he took up a teaching assignment at the Sathya Sai Institute of Higher Learning near Bangalore.

His early research work was mainly on flower pigments and later shifted to the chemical and utilizational aspects of several forest products like dyes, drugs, essential oils, fatty oils, carbohydrates, proteins, tannins etc. Amongst his contributions are the development of tamarind kernel powder industry in the country to get over the problem of shortage of cereal starches for sizing and finishing in cotton and jute textile industries. At Bangalore he directed his attention to the study of diseases of sandal, a plant of great economic importance to India. The spike disease in this plant was shown to be mycoplasmal in nature and methods for its possible control making use of antibiotics were worked out. Rao was thus a unique combination of a forest chemist and a forest physiologist with a good knowledge of forest pathology.

Among the honours he received were fellowships of Indian National Science Academy (1968), Royal Institute of Chemistry, London (1952), and Indian Academies of Wood Science (1968) and Horticultural Science (1974). He was a founder member of the Tree and Wood Chemistry Group of the International Union of Forestry Research Organization.

He spent the last few years of his life with his daughter-in-law as his wife and three of his sons and a daughter predeceased him. He passed away in Bangalore on 9 January 2002.

Cecil John Saldanha (elected 1980) was born in Mumbai on 27 December 1926. After obtaining his two year intermediate course in Madras in 1945 with distinction he completed his Licentiate in philosophy from the Gregorian University of Rome in 1952, B.Sc. in botany from University of Bombay in 1954, Licentiate in theology from Institute Sup. De Theologis, Paris in 1959 and finally a Ph.D. in taxonomy in 1964 from Bombay. He spent his entire research career from 1964 at the St. Josephs College in Bangalore as vice-principal, principal, professor and head of the department of botany and finally as director of the Centre for Taxonomic Studies.

Saldanha is distinguished for his work on angiosperm taxonomy and floristics. His monographic study of the Scrophulariaceae, and his studies of south Indian orchids are notable. His “flora of Hassan district of Karnataka” is an outstanding piece of work. He published a new and handy tool for plant identification which was called ‘A punched card key to the Dicot families of south India.’ The Hassan flora project involved intensive exploration, determination, description and nomenclature of over 1700 species. His research work also included conservation of the bamboo resources of Karnataka, the flora of Bannerghatta national park near Bangalore, and ecological survey and biosphere reserves of the Western Ghats.

His field work included exploration of the Western Ghats from Surat in Gujarat to Kanyakumari in Tamilnadu, field studies in Nilgiri and Palni Hills, deciduous vegetation of the Deccan plateau, exhaustive collection and determination of cyperaceae of south India, fern collections, and field studies on bamboos as raw materials for paper industry.

In his later years he was deeply interested in issues related to environment and development. This took him to the Andaman, Nicobar and Lakshadweep islands to study the flora, a task entrusted to him by the Island Development Authority of the Planning Commission. He was the recipient of the Karnataka Government Rajyotsava Award for ecology and the Pitamber Pant national fellowship for ecology of the Government of India.

He passed away in Bangalore on 7 April 2002. As a Roman Catholic Jesuit Priest, he remained single.

Parimal Kumar Sen-Sarma (elected 1984) was born in Calcutta on 1 April 1929 and had his early education in Calcutta obtaining his M.Sc. in 1951 and Ph.D. in 1965. His research career started at the Forest Research Institute in Dehra Dun where he joined as a research assistant in 1951 slowly rising through the ranks to become the director of biological research from 1980 to 1987. He also served as the director of wood science and technology in Bangalore (1973–76) and as dean of Birsa Agricultural University, Ranchi (1987–91).

Sen-Sarma has made outstanding contributions on the taxonomy, biology, ecology, physiology, laboratory testing and control of termites. Several new taxa of termites have been discovered and described by him. Conclusions on phylogenetic affinities based on morphology between genera of Nasutitermitinae have also been confirmed by biochemistry of frontal gland secretions. Research on the ecology and digestive physiology of wood destroying termites not only resulted in better understanding but also generated new facts. Research on anatomy and affinities of elephant louse is still the standard work in this field. He also initiated research on temporal polyethism in Indian termites.

He passed away at Noida on 29 July 2002 leaving behind his wife Aparna, two daughters and a son.

Suresh Kumar Sinha (elected 1983) was born at Bulandshahar District in U.P. on 18 July 1934. He was educated in a residential school at Anoopshehar, received his B.Sc. degree from Agra University in 1955; did M.Sc. botany with specialization in cytogenetics and plant breeding from the same university securing a first class in 1957. He was appointed as lecturer in DAV College, Kanpur where he completed his Ph.D. on mineral nutrition aspects of linseed. The desire for learning plant biochemistry took him to University of Alberta in Canada, where he obtained a second Ph.D. in 1964 in a record 18 months. His outstanding work on glycine-serine conversion in plants is a textbook item in plant biochemistry. He continued as a post-doctoral fellow at the same university before returning to India in 1965 to join the Indian Agricultural Research Institute (IARI), New Delhi. He joined the Central Tuber Crop Research Institute, (CTCRI) Trivandrum as a plant physiologist in 1966 and worked on tuber crops until 1969 when he rejoined IARI as a senior plant physiologist at the Division of Plant Physiology. He served IARI eventually becoming its Director (1991–1994), and retired as the ICAR National Professor (1995–99).

As a plant physiologist Sinha tried to integrate the disciplines of physiology, genetics, biochemistry and breeding in the analysis of research problems. At CTCRI, his group had only an oven, microscope and an old spectronic 20. He started research on the mechanism of tuberization, source-sink relationship and cyanide content in tapioca, an important crop in south India. This helped in relating starch deposition with root development, highlighted the importance of leaf area for tapioca productivity and helped characterize the breeder selections for edible purposes. These were new findings for this crop and are included in books on tuber crops. At IARI Sinha initiated research on the mechanism of heterosis, a phenomenon which has revolutionized agriculture.

Sinha received several awards such as the JJ Chinoy Gold Medal (1979), FICCI (1983), SM Sircar Memorial Award (1984), VASVIK Award for Research in Agricultural Science (1985), OP Bhasin Award for Research in Agricultural Science (1988), Birbal Sahni Medal (1989) and the Jawaharlal Nehru Fellowship (1991), to name only a few. He occupied several important positions like the President of Agriculture Section, Indian Science Congress Association (1986–87), President of Agriculture Society of India (1986), Secretary General, International Congress of Plant Physiology (1988) and President of the Society for Plant Physiology and Biochemistry. He was elected to all the leading national academies in the country.

Sinha was a kind, warm hearted, simple person and believed in the inherent goodness of mankind. He passed away on 17 March 2002 leaving behind his wife and three daughters.

Robert Hanbury Brown was born on 31 August 1916 in Aruvankadu in the Nilgiri Hills of southern India. After his schooling, he graduated from the London University with honours in Electrical Engineering. At the age of 19, he published his first scientific paper on the use of cathode ray tubes to measure the distribution of light from lamps. After doing his post-graduate diploma in telecommunications, he joined the Air Ministry in 1936 at the Bawdswey Research Station working in the team that was developing airborne radar. In 1942, he joined the British Air Commission at Washington DC as assistant head of combined research group working in the development of radar systems for the Allies during the second world war at the Naval Research Laboratory. In 1945 he became the principal scientific officer at the Telecommunications Research Establishment in Malvern to take charge of research on navigational aids for aircraft. After two years, he partnered Sir Robert Watson-Watt to work on marine radar and radar for airports. In 1949 he joined the Jodrell Bank Experimental Station of the University of Manchester to work on radio astronomy. For the next eleven years he was involved in the development of radio intensity interferometer, correlation between photons in coherent beams of light, pilot model of optical stellar intensity interferometer, measurement of angular diameter of *Sirius*, and installation of full-scale stellar interferometer at Narrabri in Australia. In 1964 he joined the University of Sydney as professor of astronomy, a position he held until 1981, and was concurrently the director of the Narrabri Observatory in New South Wales.

Among the several recognitions he received include the fellowships of the Royal Society and the Australian Academy of Sciences, the Holweck prize of the French Physical Society, the Eddington Medal of the Royal Astronomical Society, the Lyle Medal of the Australian Academy of Sciences, and the Hughes Medal of the Royal Society of London. He became a Companion of the Order of Australia in 1985.

He was elected an Honorary Fellow of the Academy in 1975 and a year before came to India to take up the first Raman Chair of the Academy. The Academy brought out a volume entitled “Photons, Galaxies and Stars” containing a selection of his scientific papers.

He passed away on 16 January 2002 leaving behind his wife Heather, two daughters and a son.