No. 38 Patrika September 2003

Newsletter of the Indian Academy of Sciences

2003 Mid-Year meeting

The 14th Mid-Year Meeting of the Academy was held at Bangalore from 17 to 19 July, 2003. As a novel departure from previous practice the session was extended to 2½ days and the first day's session – lasting an afternoon – was arranged in the Bangalore University campus, to celebrate the 50th anniversary of the 1953 discovery by James Watson and Francis Crick of the double helical structure of DNA. This session was devoted entirely to presentations on various aspects of genetics, and was extremely well attended.

In a special lecture on 'Molecular medicine' inaugurating the session, G. Padmanaban IISc, Bangalore explained that the title signified using the body's own macromolecules as therapeutic agents to treat genetic disorders, cancers, cardiac myopathies etc. Several protein pharmaceuticals — insulin, interferons — are already being used in this way, and the proof of principle for such disease combating uses of genes is well established. However, there are important issues to be resolved before all this can become routine clinical practice — efficiency and sustained expression of gene delivery and resulting products, control of side effects, and addressing ethical problems that could arise out of misuse of these methods.

The other presentations in this session covered the story of 'cryptic genes' which remain silent during the lifetime of an organism (S. Mahadevan, IISc, Bangalore); genetics of drought–tolerant rice strains (A.R. Reddy, University of Hyderabad); the use of the domesticated silkworm *Bombyx mori* as a model for lepidopteran genomics and genetics (J. Nagaraju, CDFD, Hyderabad); the identification of an enzyme in the parasite *Leishmania donovani* producing kala azar (Pijush K. Das, IICB, Kolkata); and 'directed evolution' of proteins in the laboratory (Anand Ranganathan, ICGEB, New Delhi).

The next two days' sessions were held in the campus of the Indian Institute of Science and included two special lectures, one public lecture, and several presentations by recently elected Fellows and Associates. In his special lecture on 'Excitement in radiation research' J.P. Mittal (BARC, Mumbai) stressed the many years of basic scientific development in radiation chemistry methods at BARC leading to their present uses in diverse applications such as irradiation of foods and spices, sterilization of medical products, hygienization of municipal waste, and production of special polymeric materials. In all these cases, a thorough understanding of the basic molecular changes caused by highly ionising radiation has preceded their beneficial applications.

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Forthcoming Events – 2003/04

Refresher Courses:

- Physics (in association with Kerala State Council for Science, Technology and Environment)
  Cochin University of Science and Technology, Cochin
  8–22 October 2003
- Experimental Physics
  Goa University, Goa
  29 October–12 November 2003
- Earth Sciences
  Jawaharlal Nehru Technological University, Hyderabad
  3–15 November 2003
- Experimental Physics
  Saurashtra University, Rajkot
  3–16 November 2003
- Physics of the Atmosphere and the Ocean
  Indian Institute of Science, Bangalore
  1–12 December 2003
- Mathematics
  Berhampur University, Berhampur
  1–13 December 2003
- Frontiers in Inorganic Chemistry
  Indian Institute of Technology, Kanpur
  18–31 December 2003
- Lasers and Applications in Chemical Processes
  University of Madras, Chennai
  19–31 January 2004

Short Duration Lecture Programmes:

- Statistics in Theory and Practice
  St. Thomas College, Pala
  1–3 October 2003
- Nonlinear Dynamics and its Applications
  A.V.V.M. Sri Pushpam College, Poondi
  9–11 October 2003
- Frontier Lectures in Biology
  University of Mysore
  5-6 November 2003
- Frontiers in Chemical Sciences
  Sri Sathya Sai Institute of Higher Learning, Prasanthi Nilayam
  10–12 November 2003

Indira Nath's Public Lecture on 'SARS – 21st century virus connects the world' focussed on what has turned out to be the first global epidemic of the 21st century. It has been carried by air travellers worldwide, and it may not be the last such epidemic. This experience has demonstrated that we inhabit a global village, with diseases reaching across the globe in a matter of days. National boundaries are no barriers in such situations. The speaker stressed the need for co-operation between countries — exemplary in the SARS case — as the only way to combat and survive such epidemics. However, the psychological effects of such occurrences are enormous as well, affecting national economies, travel and tourism. The danger is, quoting from the speaker's abstract, that 'Health/disease is no longer an individual choice but is poised to become a political means to control nations'.

Ashok Sahni's special lecture on 'Dinosaurs of India: dead but alive' brought back briefly to 'life' these enormous creatures which roamed and lumbered across the earth up to some 65 million years ago. He described the discoveries of dinosaur remains — fossils, nests, eggs and even dung — in the Indian sub-continent over the past 170 years, and the need to preserve and protect them. This was a period when the Indian land mass was contiguous with Madagascar and South America. The speaker touched upon contrasting extinction scenarios, both volcanic and asteroid-impact related; and stressed that along with the dinosaurs about 65% of all life forms suddenly perished.

Both these special lectures and the public lecture led to considerable discussions and were extremely well received.

The rest of the programme for the two days was devoted to presentations by new Fellows and Associates based on their work. A report on this follows: U.K. Misra (Sanjay Gandhi Institute, Lucknow) reported on the continuing challenge posed by encephalitis, the common endemic prevalent particularly in South East Asia and the studies undertaken by his group during the last 15 years. S. Ramakrishnan (TIFR, Mumbai) discussed the observation of multiple transitions in $RE_5Ir_4Si_{10}$ compounds. A.K. Singh (IIT, Mumbai) reported the development of a new chromophore successful in caging immunoglobulin. Rahul Mukherjee (IIM, Kolkata) discussed a simplification of the Bose–Bush approach to study the existence of an orthogonal array with given parameters. Anurag Sharma (IIT, Delhi) in his talk on guided wave optics reported on one of the methods developed by his group, known as the collocation method, to solve the propagation equations numerically and reviewed the developments that have taken place in this area. Shobhona Sharma (TIFR, Mumbai) presented the details of a new approach to understand acquired immunity to malaria. This involved identifying some of the protective malarial antigens of the human malarial parasite. Rajiv V. Gavai (TIFR, Mumbai) unravelled the theory of strong interactions, viz quantum chromodynamics, with reference to the occurrence of quark-gluon plasma phase transitions which could have been significant to our universe after the big bang. G. Venkateswara Rao (VSSC, Thiruvananthapuram) enumerated the importance of finite element methods for understanding the accuracy of results and correlation between analysis and testing of complex structures in real-life engineering solutions.

Key attributes of novel, amorphous, alumina-based ceramics that exhibit metal-like plastic flow at temperatures below 1000°C were explained by Vikram Jayaram (IISc, Bangalore). These ceramics are useful in making cutting tools that are tough and wear-resistant. V. Chandrasekhar (IIT, Kanpur) works on transition metal chemistry dealing with phosphonates and stannoxanes. He reported on the synthesis of hexameric ferrocene assemblies like a wheel around a central core made up of a stannoxane framework. N.R. Jagannathan (AIIMS, New Delhi) presented a general overview of the basics, development and diagnostic applications of various methodologies of magnetic resonance imaging and magnetic resonance spectroscopy. Subrata Sinha (AIIMS, New Delhi) presented his studies on the biochemical aspects of different grades in human glioma, the commonest of all brain tumours that kills young adults. B.C. Das (Maulana Azad Medical College, New Delhi) reported on a novel and simple paper smear method for dry collection, transport and storage of cervical cytological specimens for rapid screening of human papillomavirus infections using a single-step DNA extraction procedure. The basic problems on topological and algebraic classification of principal bundles on algebraic varieties were briefly surveyed by Y.I. Holla (TIFR, Mumbai). The two other lectures were by T.K. Chakraborty (IICT, Hyderabad) on designing molecules based on sugar amino acids and G.V.R. Prasad (University of Jammu, Jammu) on biogeographic origins of late cretaceous biota of India.

2003 ANNUAL MEETING IIT, GUWAHATI

Programme

21 November 2003 (Friday)

0900–1030 Inauguration and Presidential address by
K. Kasturirangan, DOS, Bangalore
Precision positioning: science and applications

1100–1200 **Lecture Presentations by Fellows/Associates**

Dipankar Bhattacharya, RRI, Bangalore
The enigmatic superstrong magnetic fields of neutron stars

Probal Chaudhuri, ISI, Kolkata
Statistical learning in molecular evolution using distributions of DNA words

1330–1630 **Symposium on Nanomaterials and Nanoscience**

A.K. Sood, IISc, Bangalore
Introduction to the symposium and recent excitements in carbon nanotubes

Murali Sastry, NCL, Pune
New methods for the synthesis of nanomaterials

D.D. Sarma, IISc, Bangalore
Tailoring properties by tuning sizes

Arup K. Raychaudhuri, IISc, Bangalore
Playing with small objects: Nanolithography and its applications

G.U. Kulkarni, JNCASR, Bangalore
Size-dependent electronic properties of metal nanostructures

1815–1915 **Public Lecture**

Rakesh Sharma, Automated Workflow Pvt. Ltd, Bangalore
Manned space flight and earth's environment

22 November 2003 (Saturday)

0900–1000 **Special Lecture**

J. Gowrishankar, CDFD, Hyderabad
The love triangle between single-stranded RNA and double-stranded DNA : R-loops and their consequences in bacteria

1030–1230 **Lecture Presentations by Fellows/Associates**

Saraswathi Vishveshwara, IISc, Bangalore
Graph theory and biomolecular structure

S.B. Krupanidhi, IISc, Bangalore
Quantum well infrared photos detectors

Anunay Samanta, University of Hyderabad, Hyderabad
Fluorescence signalling of molecular environment

Shalivahan, ISM, Dhanbad
Electrical anisotropy of asthenosphere in a region of window to mantle

1400–1700 **Symposium on Emerging trends in communication technologies**

N. Balakrishnan, IISc, Bangalore
Introduction and overview:

Kumar N Sivarajan, Tejas Networks India Ltd, Bangalore
Trends in Optical Networks

A.R. Das Gupta/K.S. Das Gupta, SAC, Ahmedabad
Satellite and wireless communication prospects and the future

Ashok Jhunjhunwala, IIT, Chennai
Connecting rural India with special emphasis on North East

Bishnu D. Pradhan, IIT, Mumbai
From voice telephony to broadband Internet in the rural/remote environments - a reflection

Gautam Barua, IIT, Guwahati
The challenges in communication - A perspective from the North East

1830–1930 **Public Lecture**

H.Y. Mohan Ram, University of Delhi, Delhi
Seeds and civilization

23 November 2003 (Sunday)

0900–1000 **Special Lecture**

Ashoke Sen, Harish-Chandra Research Institute, Allahabad

Search for a unified theory

1030–1130 **Lecture Presentations by Fellows/ Associates**

R. Pitchappan, MKU, Madurai

Genomic diversity and disease susceptibility – Indian scenario

V. Purnachandra Rao, NIO, Goa

Towards understanding the genesis of phosphorite deposits

1145–1245 **Business Meeting of Fellows**

SPECIAL ISSUES OF JOURNALS

Computational materials science

Guest Editors: G.P. Das, V. Kumar, S. Ranganathan and U.V. Waghmare
Bulletin of Materials Science Vol. 26, No.1, January 2003, pp. 1–205

Computational materials science (CMS) is rapidly emerging as a powerful multidisciplinary branch of science that contributes towards a better understanding of materials. There is a broad spectrum of length scales that describe different systems and phenomena right from nano- to micro- to meso- to macroscopic levels. However, it is the interatomic interactions that hold the key for understanding the microscopic properties of materials. For electronic/ atomistic simulations of solids, surfaces, interfaces and clusters, first-principles electronic structure and molecular dynamics calculations based on density functional theory are being extensively used. It is the accuracy, reliability and most importantly predictive power of these simulation tools that can be exploited in designing novel materials whose properties can be tailored to suit the desired application.

The initiative for Asian Consortium for Computational Materials Science (ACCMS) was undertaken to consolidate the rich human resources and expertise available in the Asian region, and to promote collaborative research amongst member countries in the field of CMS. The first conference was organized by the Materials Research Society of India in Bangalore during Nov-Dec. 2001 jointly with the Jawaharlal Nehru Centre for Advanced Scientific Research and Indian Institute of Science. This international meeting brought together active researchers from various Asian countries, viz. Bangladesh, China, India, Iran, Japan, Korea, Singapore, Thailand and Vietnam. Some leading experts from Europe in the field of electronic structure were also invited to this meeting.

The conference witnessed excellent overviews of materials modelling and predictions of material properties using density functional tools. Several pioneers discussed state-of-the-art electronic structure methodologies and also the multi-scale modelling which combines the information about atomic-scale processes obtained from DFT with techniques suitable to treat longer length scales. Oxides, perovskites, borides, different alloys, clusters and nanostructured materials formed the subject matter of the conference. This special issue contains 33 refereed papers presented at the conference.

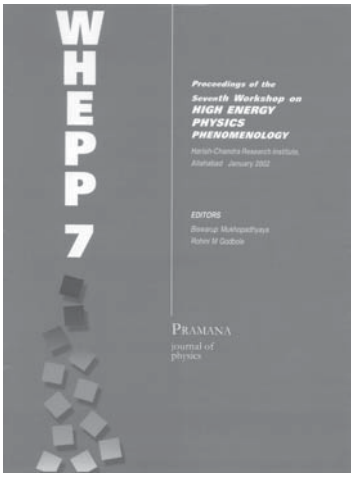
Functional analysis

Guest Editor: T.S.S.R.K. Rao
Proceedings: Mathematical Sciences, Vol. 113, No.1, February 2003, pp. 3–87

A national level conference on “Functional analysis and its applications” was organized by the Indian Statistical Institute, Kolkata in June 2001. This special issue of the Proceedings contains 7 papers presented at the conference.

Proceedings of the Seventh Workshop on High Energy Physics Phenomenology (WHEPP-7)

Guest Editors: B. Mukhopadhyaya and Rohini M. Godbole
Pramana, Vol. 60, No.2, February 2003, pp. 167–414



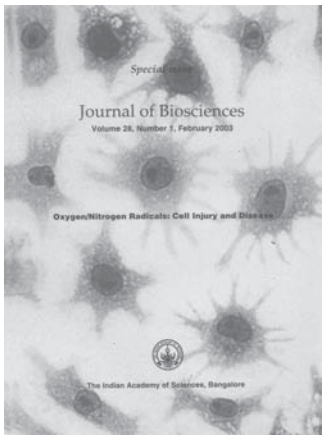
The Seventh Workshop on “High Energy Physics Phenomenology” (WHEPP-7) was organized at the Harish-Chandra Research Institute, Allahabad during January 2002. This special issue comprises most of the plenary talks delivered at the workshop together with several talks delivered in the four working groups and reports from the working groups on the projects undertaken there. Along the established tradition of the WHEPP series, the strongest emphasis in WHEPP-7 was on working group activities. A few focal themes were identified by each

working group, which acted as the pivots for the talks delivered and the problems investigated. The group reports present only preliminary results of the investigations. The success of WHEPP since inception lies in forming nuclei for new collaborations across India as well as on an international platform.

Oxygen/nitrogen radicals: cell injury and disease

Guest Editors: V. Vallyathan, R.K. Saxena and V. Castranova
Journal of Biosciences, Vol. 28, No.1, February 2003, pp 1–134.

Reactive nitrogen and oxygen radicals have been known for long to play an important role in immune defence mechanisms. Over the last few decades, evidence has also been accumulating for a central role for these radicals in normal cellular functions. The Nobel Prize in Physiology and Medicine in 1998 was awarded to Robert F. Furchgott, Louis J Ignarro and Ferid Murad for identification of nitric oxide as a crucial signalling molecule in biological systems.



The idea of putting this issue together took shape during the Third International Conference on Oxygen/Nitrogen Radicals: Cell Injury and Disease, held in Morgantown, West Virginia, USA in June 2002. At this conference several diseases including Alzheimer's, atherosclerosis, arthritis, diabetes, Parkinson's disease as well as disorders of the eye, heart, skin and lungs were discussed. The conference also had special sessions on molecular mechanisms involved in disease development, the value of dietary supplementation with antioxidants in the prevention of cellular damage leading to chronic disease, therapeutic modulations of disease, special *in vivo* techniques and the role of molecular studies in human risk assessment. It provided a forum for over 240 experts, representing 21 countries and numerous state and federal regulatory agencies, to discuss and synthesize this information. A general consensus amongst the participants was that it would be useful to publish selected presentations, thereby providing a wider dissemination of the information presented during the conference.

The focus of this special issue is on our current understanding of the pathophysiological and molecular mechanisms of disease development. Dissemination of new advances in this emerging important discipline will enhance interaction and exchange of information between scientists and further their common goal of disease prevention and amelioration.

This special issue contains 20 articles presented at the conference.

Frontiers in materials science

Guest Editors: Baldev Raj and K. Bhanu Sankara Rao
Sadhana Vol. 28, Nos.1/2, February/April 2003, pp. 17–358

Over the last few decades of the twentieth century, great advances were made in further development of established materials by improved and novel processing routes. It was also a period of discovery of a range of new materials such as high temperature superconductors, intermetallic compounds, conducting polymers, metal-matrix composites, ceramic-matrix composites, nanostructured materials, advanced ferritic steels, high nitrogen steels, directionally solidified and single crystal superalloys, functionally graded materials, biomaterials, intelligent and smart materials, to name a few. The new materials together with advances in processing methodology are competing with evolutionary progress in existing materials and processes. The purpose of this special volume was to reflect on the developments, over the last decade, in materials science and related technologies.

Tailored materials and innovative designs of products are the key drivers in many modern technologies such as communication and information technology, transportation, production engineering, environmental technology, nuclear, aerospace and defence, microelectronics and bioengineering. In each of these sectors, progress has been aided by a continuous development of capabilities. Research and development concerning advanced materials and processing has become an interdisciplinary activity necessitating synergy between materials scientists, metallurgists, design engineers and technologists. In the field of advanced materials, novel processing and material characterization methodologies are emerging. Tailoring the structure at the nano or even molecular level can be explored as a successful approach to materials processing when the homogeneity and the structural information of small volume elements could be scaled up to macroscopic component dimensions. The wide range of length scales of macro-, micro- and even nanoscale dimensions, extending over 8–10 orders of magnitude (nm-m), however, is a great

challenge to establish effective and affordable multistage processing and manufacturing technologies.

Based on the coverage and technical contents of the papers, the articles have been grouped into the following sections: (a) nanocrystalline materials; (b) mechanical behaviour of advanced materials; (c) development and processing of intermetallics, composites and ceramics; (d) recent advances in welding science and technology; (e) corrosion and surface engineering; (f) science and engineering of bio-materials; (g) testing and evaluation of advanced metallic and intermetallic materials; (h) computational materials science; and (i) teaching of materials science.

Viral evasion of host responses

Guest Editor: S. Jameel
Journal of Biosciences Vol. 28, No.3, April 2003, pp. 249–358

Besides being important pathogens of humans and animals, viruses are obligate intracellular parasites that require host functions to replicate and propagate. This intimate dependence, and the millions of years of co-evolution of viruses and their hosts, are responsible for elaborate attack, defense and counter-attack strategies. The small size of a virus necessitates a small genome. Conservation of sequence space demands a lean (and often mean) viral proteome in which every protein is essential. Some of these proteins often perform more than one function during the viral life cycle, features that make viruses ideal models for more complex living systems, namely vertebrates.

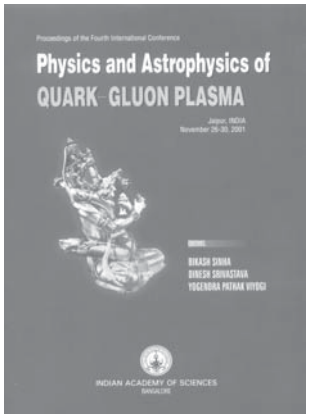
Many viruses are associated with one or the other disease. Following an acute infection, the clearance or persistence of viral infection will depend upon how successfully the virus is able to regulate the immune response and cell death (apoptosis) pathway of the host. We now understand that both of these pathways depend critically upon signal transduction. The study of host-virus interactions has yielded rich dividends in terms of basic biological information and intervention strategies. This special issue presents a collection of reviews by prominent workers in this area of research.

The immune response to viral infection consists of innate (non-specific) and adaptive (specific) defenses. The innate response, which is the first line of immune defense, is composed of natural killer cells, interferons and a complex set of serum proteins termed complement, which when activated destroy virus-infected cells and many virus particles.

This special volume contains nine articles which provide a glimpse into the fascinating world of viruses and their regulatory mechanisms in the quest for survival, replication and propagation.

Physics and Astrophysics of Quark-Gluon Plasma

Guest Editors: B.C. Sinha, D.K. Srivastava and Y.P. Viyogi
Pramana, Vol. 60, Nos.4/5, April/May 2003, pp. 575–1125



The search for quark gluon plasma, a deconfined state of strongly interacting matter, is one of the most notable examples of what the collaboration of international community of physicists can achieve in a very short time. To many it seems like yesterday when the proposals for building or modifying the present accelerators to produce relativistic heavy ions were being discussed. It also feels like yesterday when some of the largest experiments ever mounted in the history of nuclear physics like STAR, PHENIX, and ALICE were proposed, discussed and approved.

Yet the unfolding story of the success of the experiments has the uncanny markings of determinism, where events have proceeded with precision and inevitability of a well-made clock. This adventure has become possible due to the dedication of hundreds of accelerator physicists, computer personnel, some of the best engineers and technicians of the world, and a large body of students who carried out simulation, design, and development and whose outcomes were to be tested well after they were to finish their PhDs.

This series of International Conferences on Physics and Astrophysics of Quark Gluon Plasma, started in 1988 at a convenient interval of about four years and chosen to intersperse the much more frequent and regular series of quark matter conferences, played a significant role in building a vibrant community of scientists engaged in this front line area of nuclear physics. The earlier meetings were held at Mumbai, Kolkata and Jaipur. The present one was held in Jaipur in November 2001.

There were outstanding talks detailing the most interesting and exciting developments from the experiments at RHIC where almost all the signs of quark gluon plasma are

expected to be emblazoned across the data. The first signs of jet quenching, flow, large multiplicities, large energy densities, indications of electromagnetic radiations, strangeness equilibrations, etc. were presented. The results from CERN SPS spoke of consolidation of observations of J/Ψ suppression, medium modification of hadron properties, strangeness equilibration, flow, and electromagnetic radiations. The astrophysics talks covered strange stars, searches for dark matter, MACHOS, and consequences of quark hadron phase transition on the constitution of the stars. In brief, all aspects of quark hadron phase transition were covered in invited talks and in oral and poster presentations of a large number of contributions.

This special issue of proceedings in two successive issues of *Pramana,* contains 59 articles including invited talks and oral presentations.

Bay of Bengal Monsoon Experiment (BOBMEX) 1999

Guest Editor: D.R. Sikka
Proceedings Earth and Planetary Sciences, Vol. 112, No. 2, June 2003, pp. 129–312

Systematic studies on the Indian summer monsoon began in 1875 with the establishment of the India Meteorological Department (IMD). Almost a century later, between 1963 and 1979, several international field programmes were conducted to understand the role of the Indian Ocean in the monsoon. These experiments included the International Indian Ocean Expedition (IIOE) during 1963–65, Monsoon–73 in 1973, Monsoon–77 in 1977, and Monsoon Experiment–1979 (MONEX–79). Indian researchers played an active role in all these experiments.

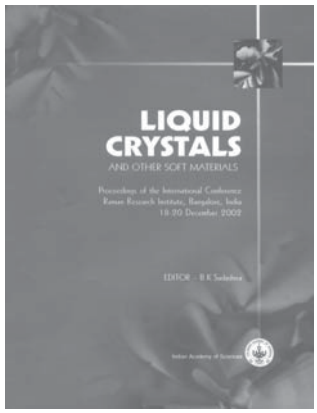
By the 1980s the atmosphere-ocean science community in India had sufficient infrastructure to conduct large scale ocean-atmosphere experiments on its own. This was possible because of the initiatives taken by several agencies in the country. The 'Monsoon trough boundary layer experiment' (MONTBLEX) was conducted during 1989–90 and the 'Land surface processes experiment' (LASPEX) in 1997–98.

The successful completion of these experiments motivated the science community to propose the formulation of the Indian Climate Research Programme (ICRP) in 1995. ICRP consists of different research components. One of these is process-oriented field observation programmes on the monsoon system. The first in the proposed series of experiments was the Bay of Bengal Monsoon Experiment (BOBMEX) implemented in two stages: BOBMEX–Pilot in 1998 and BOBMEX–1999 in 1999. BOBMEX focused on intraseasonal variability of organized convection in the atmosphere and on the role played by ocean-atmosphere interactions in monsoon variability. Special observational platforms like deep water meteorology-oceanography buoys, research ships, weather radars and satellites were used together with conventional meteorological observatories to collect data on the variability of the monsoon ocean-atmosphere system. The oceanographic data collected are available from the Indian National Oceanographic Data Centre, the National Institute of Oceanography and the meteorological data are available from IMD, Pune.

The results of BOBMEX–Pilot were earlier published in the Academy Proceedings (June 2000). A workshop was organized at the National Institute of Oceanography, Goa in February 2001 to discuss the results of BOBMEX-1999 where 30 papers were presented. This special issue contains 12 papers presented at the workshop.

Liquid crystals and other soft materials

Guest Editor: B K Sadashiva
Pramana Vol. 61, No.2, August 2003, pp. 189–481



To commemorate the silver jubilee of the discovery of the columnar phase at the Raman Research Institute, an international conference on "Liquid crystals and other soft materials" was held in Bangalore during December 2002. This special volume of the journal contains twenty five of the papers presented at the conference. The topics include liquid crystals and a few other areas of soft condensed matter including a plenary talk on 'from antiferroelectricity to ferroelectricity in smectic mesophases formed by bent-core molecules'.

The Bhuj earthquake, Gujarat, India, 2001

Guest Editors: Roger Bilham and S.K. Srivastav
Proceedings: Earth and Planetary Sciences, Vol. 112, No.3, September 2003, pp. 315–484

This special issue of the Proceedings is based on 16 papers presented at the International Conference on Seismic Hazard held at New Delhi during 2001 with particular reference to the Bhuj earthquake of January 2001. This earthquake of M_w = 7.6 was the third in 8 years to occur in the interior of the Indian continent,

and was one of the most devastating in India's history. Over 20,000 people were killed and a larger number rendered homeless followed by prolonged disruption of socio-economic activities.

The importance of the earthquake is that it was sufficiently large to be recorded throughout the world, and is the first $M > 7$ earthquake to have occurred in the mid-continent since the deployment of seismic networks in India. Its potential contribution to seismic hazard analysis in India is that it provides the quantification between felt intensity and magnitude needed to calibrate the numerous historic earthquakes in India that occurred before the availability of instrumental records. Its potential contribution to studies of the world's continents is that it is sufficiently large to have disturbed the lower crust, and thereby to provide a measure of the viscous properties of the mid-continent.

One of the difficulties with seismic hazard studies in India is that they have hitherto been based on empirical patterns of earthquake occurrence. Each succeeding earthquake has alerted seismologists to the potential in that region for shaking from future earthquakes. While this has resulted in regions of high seismic risk being assigned to the region bordering the Himalaya and also to the region of Kachhchh, both regions with a long history of damaging earthquakes, it has also resulted in isolated patches of seismic risk being manifest as "bulls-eyes" surrounding earthquakes in southern and central India. The basis for these isolated patches of seismic hazard is of course the tangible occurrence of recent earthquake damage. But it might also be possible to conclude that stresses in these isolated regions have recently been reduced, and that therefore they are now the regions least likely to experience a damaging future earthquake. In the presence of two orthogonal conclusions, it is best to err on the side of caution, as has been done. However, the low productivity of mid-plate earthquakes, and the long interval of time that presumably separates their recurrence, means that no simple patterns for the distribution of earthquakes will be manifest for possibly thousands of years.

An alternative approach to seismic hazard studies in India is to improve our understanding of the stresses and modes of failure of this mid-plate region. These stresses result from the forces of collision between India and southern Asia, from potential gradients caused by surface topography and erosion, from the loading of India by sediments deposited in the Arabian Sea and in the Bay of Bengal, and from the flexural effects of India's descent beneath the Tibetan plateau. The physics of these processes are fundamental to stressing the Indian plate, and since they are unique to India, presumably explain why India exhibits anomalously high mid-plate seismicity compared to neighbouring plates.

The difficulty with physical models is that they do not predict regions of future failure, merely distributed regions of enhanced stress. Clearly, a hybrid combination of physical insight and careful observation remains the only viable option to improved knowledge of future seismic risk, and the opportunity to discuss findings from the Bhuj earthquake provides an important step in this direction.

The articles in this special volume included the effects of flexure in imposing a stress system throughout India that is presumably fundamental to the earthquake process; strain changes that occurred in the 200 km region surrounding the Bhuj epicentre; the geographical distribution of ground shaking intensity based on eye-witness, media and ground truth accounts of the Bhuj earthquake; various aspects of aftershock activity that shed light on their space-time patterns and focal mechanisms; response of elevated water tanks and other masonry structures to intense ground shaking of the area, important aspects of specific site responses.

PUBLIC LECTURES

Three visualization systems based on graphics algebra

Leland Wilkinson
Northwestern University, Evanston, Illinois, USA
5 February 2003, Raman Research Institute, Bangalore

The Grammar of Graphics (Wilkinson: Springer, 1999) presents a mathematical framework for the generation of statistical charts and scientific visualizations. Three different systems based on this framework were presented in the lecture. The first, called nViZn, is a Java production library for producing interactive graphics on the web. The second, called visXML, is a library for generating production-quality graphics. The third, Dancer, displays streaming data. Dancer buffers streaming data (up to 20,000 events per second) in a way that allows real-time analysis and display of up to 20 frames per second in a 2D or 3D environment.

Bose Einstein condensation and quantum coherence

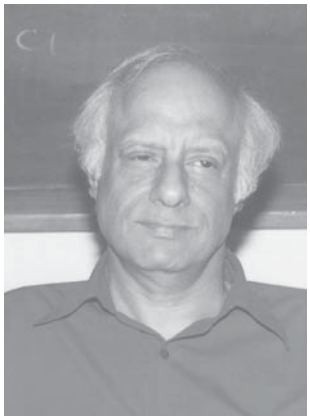
Philippe Nozieres
Institute Laue-Langevin, Grenoble Cedex, France
27 February 2003, Indian Institute of Science, Bangalore

Ever since it was discovered, Bose Einstein condensation opened again and again new physical vistas. A central issue came rather late: the role of quantum coherence that forces bosons to accumulate in a single quantum state, whose wave function becomes a macroscopic observable. Standard wisdom accumulated on a single example, liquid helium 4. The recent discovery of Bose condensation in metastable trapped atomic gases brings a revolution that offers a large variety of behaviours, thereby challenging theory. Is conventional Bose condensation the only fate of Bose liquids? What are its "enemies"? To what extent can one consider a pair of fermions as a boson? The talk looked back at these old problems: the legacy of Bose is still well and alive!

The rise and decline of modern science in India

Rajesh Kochhar
National Institute of Science, Technology and Development Studies, New Delhi
13 May 2003, Indian Institute of Science, Bangalore

The British could not have established an empire in India without the help of science and the natives themselves. This brought Indians into contact with modern science. There have been three nested stages of development in the advent and growth of modern science in India, each stage leading to the next and partly coexisting with it: (i) a colonial tool stage, (ii) a peripheral native stage, and (iii) an Indian response stage. India was the first country outside extended Europe to take to modern science, with J C Bose and P C Ray being the world's first non-white 'mainstream' scientists. The dazzle created by Raman's Nobel prize has blinded practitioners of science and analysts to the inherent shortcomings of the Indian pursuit of science which have been present from day one, even though the consequences are obvious only now. Indian science was not integrated into the Indian economy; it remained a middle-class intellectual activity; it was never self- assessing. Scientific activity in India has varied in step with the role which has been assigned to the middle class or which it has perceived for itself. One can distinguish between three phases in the 100 years of modern science in India: a nationalist (not national) phase (Raman), an international phase (Bhabha) and a globalization phase.



Atmospheric brown clouds: South Asian and tropical impacts

V. Ramanathan
Scripps Institution of Oceanography, University of California, San Diego, USA
28 July 2003, Indian Institute of Science, Bangalore

The Indian Ocean Experiment (INDOEX) provided one of the best and well-known evidences for how long range transport of man-made aerosols transforms the so-called urban haze into a regional and continental scale brown "cloud". The recently launched TERRA satellite not only confirmed INDOEX findings, but has also revealed the presence of widespread pollution haze layer downwind of many other continents.

This lecture summarized INDOEX findings on the South Asian haze and compared these with the impacts of anthropogenic haze in other parts of the world. It illustrated with model studies the unique vulnerability of the South Asian and tropical hydrological cycle to the radiative forcing by the absorbing aerosols within the haze layer.

SUMMER FELLOWSHIPS

Since the start of this programme in 1995, there has been a progressive increase in the number of applications received and the fellowships offered both to teachers and students. In 2003, summer fellowships were offered to 39 teachers and 109 students from all over the country.

The following is a subject-wise break-up of the fellowships offered:

Subject	Students	Teachers
Biology	54	14
Chemistry	16	15
Physics	14	6
Engineering	8	1
Earth Sciences	6	2
Mathematics	11	1
Total	***109***	***39***

These summer fellows worked with Academy fellows at the following places:

Bangalore	65
Calicut	2
Chennai	4
Dharwad	1
Dona Paula	2
Gandhinagar	1
Hyderabad	20
Kalpakkam	2
Kanpur	4
Kolkata	16
Lucknow	1
Madurai	1
Mumbai	10
Mysore	3
Nainital	1
New Delhi	7
Pune	7
Tiruchirapalli	1
Total	148

REFRESHER COURSES

Molecular Genetics

Madurai Kamaraj University, Madurai

27 January –10 February 2003

No. of participants: 18

Resource persons: V. Nagaraja, D.N. Rao, Dipankar Chatterji, Umesh Varshney, S. Mahadevan, (all of IISc, Bangalore) J. Gowrishankar, (CDFD, Hyderabad) R. Jayaraman, C. Rajamanickam, R. Pitchappan, S. Shanmugasundaram, K. Dharmalingam, P. Gunasekaran and M. Hussain Munavar (all of Madurai Kamaraj University).

The teacher participants were from Allahabad, Bangalore, Chennai, Coimbatore, Gorakhpur, Hyderabad, Kharagpur, Lucknow, Madurai, Malapuram, Mysore, Nasik, Tiruchengode, Tiruchirapalli, Vallabh Vidyanagar.

Extracts from the report by the course co-ordinator

Bacterial molecular genetics is hardly taught in detail in many places. In fact in today's scenario many people feel bacterial molecular genetics is an outdated discipline and only modern recombinant DNA technology and associated subjects are relevant. The objective of organizing this workshop was to emphasize the view that this is not true and bacterial genetics is indeed relevant even in today's context. In fact, it is well known that many concepts were understood at molecular level using only bacterial systems as model ones and even today the trend seems to be the same.

Every morning there were two intensive lectures where each resource person spoke on the topic of their choice relevant to bacterial molecular genetics. The topics covered include origins of bacterial genetics, mutations and mutagenesis, lateral DNA transfer (conjugation, transformation and transduction), fine structure mapping, genetics of DNA replication, mechanisms of regulation of gene expression, SOS and DNA repair mechanisms, translation and its regulation, RNA polymerase structure and function and biochemical regulation, stress response in *E.coli* and other organisms, informational suppression pertaining to suppression of missense and nonsense mutations, transposons, phage Mu and *in vivo* genetic engineering, genetics of gram positive organisms with special reference to *Streptomyces* and *Mycobacteria*, genetic manipulation in *Zymomonas mobilis*, pathogen diversity and disease susceptibility, chromatin structure and function with special reference to gene expression, and creating gene knockouts through homologues recombination.

The afternoon sessions were devoted to practicals, sometimes extending till mid-night depending on the experiment. The experiments covered during the practicals include MNNG mutagenesis and isolation of mutants, ampicilin enrichment of auxotrophs, phase lysate preparation and plaque assay, P1 transduction and genetic mapping of a mutation, bacterial conjugation (gradient transfer), construction of recombinant deficient derivatives of *E.coli,* transposition and isolation of insertions in the *lac* operon of *E.coli* and induction and assay of β-galactosidase. To enable the participants to

understand the experiments better, a hands-on laboratory manual was also prepared and distributed to the participants. Each participant received a copy of the following books: (1) Text book on Molecular Genetics; (2) Text book on Microbial Genetics; and (3) Instant Notes on Genetics.

Quantum Chemistry

University of Hyderabad, Hyderabad

16 February –2 March 2003

No. of participants: 25

Topics covered: Basic quantum mechanics, mathematical background, group theory, models of chemical binding, Hartree-Fock theory, spin dynamics, Huckel theory, qualitative molecular orbital theory, semi-empirical theories, molecular electrostatic potentials, post Hartree-Fock theories, density functional theory, molecular mechanics, molecular material design, drug design, approximate molecular orbital theory.

Resource Persons: E.D. Jemmis, M.V. Rajasekharan, M. Durga Prasad, T.P. Radhakrishnan, Kalidas Sen (all of University of Hyderabad), K. Bhanuprakash, G. Narahari Sastry, G. Madhavi Sastry (all of IICT, Hyderabad), and S.R. Gadre (University of Poona).

The teacher participants represented institutions from Aruvithura, Bangalore, Chandigarh, Chapra, Chennai, Cochin, Darjeeling, Goa, Gulbarga, Kottarakara, Kottayam, Mumbai, New Delhi, Palakkad, Parathodu, Sambalpur, Shillong, Shreeramnagar, Tezpur, Thrissur, Visakhapatnam, Vyasagiri, Warangal.

Extracts from the report by ED Jemmis

Quantum chemistry is considered to be one of the dreaded subjects in the M.Sc. programme in chemistry in most Universities. Many students look upon this as a final hurdle that they have to overcome, so that the course can be completed. This is a serious drawback, because a large percentage of research publications in experimental chemistry these days have a quantum chemistry component. Teaching of quantum chemistry has not changed in the country during the last 30 years. While the basics of quantum mechanics cannot change, advances in computer hardware and software have made numerical solutions to the Schrödinger equation practical, albeit many approximations. This helps in relating the equations to observables in chemistry. In addition, application of ideas based on symmetry, overlap of orbitals and perturbation theory has created a conceptual framework to think about chemistry. We reasoned that teachers would be more receptive to quantum chemistry if, in addition to formalistic treatment, numerical studies of specific problems and qualitative arguments to convert the outputs of programmes to 'understanding' are simultaneously provided. With this in mind, the present refresher course in quantum chemistry was planned.

Basic quantum chemistry, with all its mathematical background, is available in text books and also on the web in many courses; even worked out assignments and problem solving sessions, are seen. However, enough connection is not established in the minds of students between quantum chemistry and the rest of chemistry. Our emphasis in this course, therefore, was to teach the basics of quantum mechanics during the morning lectures and a hands-on session on the use of quantum chemistry on several experimental problems in chemistry in the afternoon. To achieve this, we considered laboratory components where participants would put to practice, with the help of PCs, quantum chemical methods that they learnt in lectures. Lectures on quantum chemistry and the mathematics background along with group theory were arranged, so that the relation between wave functions and symmetry of molecular systems are most optimally used in understanding chemistry. Attempts were made to show how the electronic structure methodologies developed are useful in designing molecules, materials and drugs. We also had some classes on molecular mechanics, often used in combination with semi-empirical and *ab initio* electronic structure theory.

The course started with a general mixer on 16 February, 2003 where we discussed the expectations and requirements of the course. The projected computational laboratory courses in the afternoon/ evening session already brought up the issue of familiarity with computers. The exactly solvable problems of quantum mechanics were covered in the first few lectures with the mathematical background as well as group theory parallely following. The concept of electron spin and its many implications in chemistry was introduced in between. Once perturbation and variation methods were proved, approximate ways in which quantum mechanics can be used in chemistry were introduced. The laboratory courses started by calculating the molecular orbitals of H_2 using a semi-empirical method, using programs installed on PCs made available to participants. The program used was taken from the chemistry CD developed by the Academy. There were several initial hurdles during computations. The biggest problem faced by participants was to specify the position of atoms in a molecule as an input to the programme! Once writing down the internal coordinates was mastered, the participants learnt to select a Hamiltonian and a basis set and to do calculations using the program. The output of the program were the wave-functions (which are the molecular orbitals) and energies. The program also included several Mulliken and other overlap

population analyses strategies, where the electrons in the molecule were partitioned to different atoms and bonds. The process of converting numbers or coefficients of atomic orbitals to conventional molecular orbital pictures of textbooks and publications, was tedious and took more time requiring additional laboratory lessons.

The response to this programme has been overwhelming. There were days when the laboratory was not closed until 11.30 p.m. The idea behind these laboratory courses was to make the teacher participants confident in using the programs given in the CD once they get back to their colleges and universities. The qualitative ideas that we teach such as the Walsh diagram for the geometric distortion of a molecule, influence of frontier orbitals on structure and reactivity and so on were drawn from the calculations and immediately compared with the morning lectures.

Emphasis was given to getting meaning out of molecular orbitals by giving several examples starting with water, CH_2, CH_3, CH_4 C_2H_6, $CH_3CH_2^+$, anomeric effect, hyper conjugation and other electronic structure ideas popular among chemists. Reactions such as 4+2-cycloaddition were studied using semi-empirical molecular orbital theory by each of the participants. They were encouraged to locate the transition state and through a frequency calculation establish the transition state as a true one. The participants also did calculations on inorganic complexes such as ferrocene, looked at the electronic structures, compared them to what would be obtained from a symmetry adopted linear combination method that they teach in group theory in the chemistry course. Electron correlations beyond the Hartree-Fock method were included in the programme in two lectures and density functional theory, which is now becoming very popular, was also introduced in two lectures.

Molecular and Developmental Genetics

Banaras Hindu University, Varanasi
2–14 July 2003

No. of participants: 15

Resource Persons: P. Maruthi Mohan (Osmania University, Hyderabad), M.M. Chaturvedi (Delhi University), K. Subramaniam (IIT, Kanpur), S.C. Lakhotia, Mercy J. Raman, R. Raman, J.K. Roy and Madhu G. Tapadia (all of BHU, Varanasi).

Extracts from the report by the course coordinator

The schedule of the course included one lecture of 90 min. duration followed by laboratory session of 8 to 9 hours on each day. For better interaction and to make participants work with their own hands, they were divided into 3 batches, each batch having 5 participants.

The lectures covered wide areas of basic, molecular and developmental genetics. The objective was largely to update the participants on the topics covered in their curricula. The following lectures were delivered:

The power of genetics; modern techniques in genetics and molecular cell biology (i) modern techniques in genetics and molecular cell biology (ii) neurospora – the model organism for genetic and biochemical studies; genetic understanding of body pattern formation; genetic basis of sex determination; genetic regulation of cell division cycle; conformational flexibility in DNA; signal transduction; *caenorhabditis elegans* – a model system for developmental and genetic studies; recombination and gene conversion and genetic basis of cancer.

Laboratory exercises

i) *Neurospora* culture and tetrad analysis

ii) *Drosophila* handling, identification of sex, setting up culture, observation of various types of mutants, observation of F2 progeny of specific crosses and interpretation of results, polytene chromosome preparation and observation of inducible puffs.

iii) Computer application in biology

iv) *In situ* hybridization on polytene chromosomes of *Drosophila*, studies on developmental gene expression by X-gal and immunostaining, observation of homeotic mutants

v) A. Air-dried chromosome preparation from bone marrow of mouse and study of different stages of meiosis in cells from grasshopper testis

B. Human cytogenetics: setting up and harvesting lymphocyte culture, G-banding, karyotyping

vi) Study of growth pattern of *E. coli* host, transformation of *E.coli DH5a* with desired plasmid, plasmid and genomic DNA extraction, agarose gel electrophoresis.

vii) Culturing *caenorhabditis elegans* and studying the different stages of development

viii) Restriction digestion and resolving the fragments on agarose gel

ix) Southern transfer, hybridization and detection by non-radioactive method

The following demonstrations were conducted:

i) SDS-polyacrylamide gel electrophoresis for proteins

ii) Polymerase chain reaction

The participants were given a complimentary copy of the book “Principles of Genetics” by Snustad and Simons (2003), John Wiley and Sons Inc.

Statistics, Probability and Stochastic Processes

S.N. Bose National Centre for Basic Sciences, Kolkata

4–21 August 2003

No. of participants: 5

Resource persons: K.B. Sinha, R.L. Karandikar, A. Dasgupta, Probal Chaudhuri, B.V. Rao and Rahul Roy (all of ISI, Kolkata); S.S. Manna and S. Dattagupta (all of S.N. Bose National Centre for Basic Sciences, Kolkata)

The teacher participants were from Chennai, Kolkata, Siliguri and Thane.

The speakers covered wide-ranging and inter-related topics of Probability and Statistics. Using these topics as base-material, selected themes on Stochastic Processes e.g. Markov Chains, Chapman-Kolmogorov-Smoluchowski equation, Gaussian Processes, etc. were also dealt with. The participants were given hands-on-experience on computers in the subject of Monte Carlo Simulations. Although the quality of lectures was high, the enthusiasm of the lecturers was somewhat dampened due to depleted participation.

The participants were given hands-on-experience on computers in the subject of Monte Carlo simulations.

LECTURE SERIES

Chemistry beyond tomorrow

St. Xavier's College, Mumbai

21 January 2003

Participants: 120 students and faculty from the chemistry department and colleges in Mumbai.

Speakers: J.P. Mittal (BARC, Mumbai); N. Periasamy (TIFR, Mumbai).

Lectures delivered: Excitement in chemistry; the core and frontier chemistry; some aspects of organometallic chemistry

Frontier lectures in Biology

University of Mysore, Manasagangotri

20–22 Feb. 2003

Participants: over 175 students and faculty members from the University and colleges in Mysore.

Speakers: K.P. Gopinathan, P.B. Seshagiri, V. Nagaraja, P.N. Rangarajan, D.N. Rao, U. Varshney and R. Gadagkar (all of IISc, Bangalore); S.K. Saidapur (Karnatak Univ, Dharwad); Amitabh Joshi and Maneesha S. Inamdar (JNCASR, Bangalore); Apurva Sarin (NCBS, Bangalore).

Lectures delivered: Genomics and biotechnology of silkworm; embryo biotechnology; biology of ageing; the dynamics of life: evolutionary biology today; how and why do cells commit suicide; embryonic stem cells and vascular development; replication process; DNA vaccines; ATP-dependent restriction enzymes; protein synthesis; evolution of eusociality and the evolutionary loss of eusociality.

Current trends in Mathematics

Madras Christian College (MCC)

February 21–22, 2003

Participants: Around 80 students and lecturers from colleges in Chennai.

Speakers: George Abraham, Rani Siromoney, K. Rangarajan, J.S. Cornelius, M.K. Viswanath and V. Rajkumar Dare (all of MCC, Madras); Kamala Krithivasan and R. Rama (IIT, Madras); P. Jothilingam (Univ. of Pondicherry); V.S. Sunder (IMSC, Chennai); R. Ramasubramanian (ISI, Bangalore);

Lectures delivered: History of mathematical astronomy; challenging problems which made NEWS; finite automata and digital images; two classical theorems in commutative algebra; petri net theory; current problems on flows; operator algebras; Brownian motion; group representations and 20th century mathematics; P systems with replicated rewriting; local w-languages.

OBITUARIES

Amar Nath Bhaduri (elected 1989) passed away at the age of 67 on 5 June 2003 at a South Kolkata nursing home after a brief illness. A dedicated professor of biochemistry for 20 years at the Department of Pharmacy, Jadavpur University (1966–1985), Bhaduri joined the Indian Institute of Chemical Biology (IICB), Kolkata in 1985 as scientist and later became the Director of

the Institute. Born in a respectable family at Shyambazar, Bhaduri had his early education from Scottish Church Collegiate School, Presidency College and Department of Applied Chemistry, University College of Science and Technology, Calcutta University. He went to USA for higher education, where he obtained his Doctor of Science from the University of Michigan, Ann Arbor and carried out his postdoctoral studies at Harvard Medical School. Bhaduri began his research career in the early sixties in Paul Srere's laboratory at the University of Michigan, where he made important contributions to the understanding of citrate metabolism in relation to fatty-acid biosynthesis. His work as a postdoctoral fellow at the Harvard Medical School resulted in an interesting finding on the effect of uridine nucleotides on an epimerase. During his early years as an independent investigator at Jadavpur University, Bhaduri discovered and purified a new enzyme galactose-6-phosphate dehydrogenase. Soon thereafter followed his important contribution on the regulation of the enzyme UDP-glucose-4-epimerase from *S. fragilis*. He not only discovered that the enzyme was allosterically activated by metabolically-related sugar phosphates, but also showed that the enzyme had allosteric kinetics in one direction and not in the other – an unusual property that may be of great importance in the regulation of galactose metabolism.

He also showed that the enzyme could be desensitized by heat to give hyperbolic kinetics. He further demonstrated that the enzyme could be inactivated by the dissociation of NAD and could be reactivated by the addition of NAD, a fact which he used for characterization of the pyridine nucleotide-binding site of this enzyme. Bhaduri's later work threw some light on the organization of the active site of this enzyme. He demonstrated the presence of conformationally vicinal sulfhydryl groups at its active site and also provided evidence for the possible involvement of sulfhydryl, arginine and histidine residues in its function. Bhaduri is one of the very few enzymologists in this country who studied an enzyme in-depth and so successfully. Bhaduri was not only a scientist and an academician; he served the Calcutta Municipal Corporation as a Councillor from North Kolkata in his earlier years after returning from the US. A person of great versatility with interests in music, literature and drama, Bhaduri was popularly and fondly known as Amar-da to everybody. As a talented man with great intellectuality and dedication to science, he made outstanding contributions to kala-azar research in the country. He was leader of the UNDP-sponsored coordinated programme of kala-azar research at IICB. A recipient of the Shanti Swarup Bhatnagar Award for excellence in science, Bhaduri was also honoured with fellowships from the Indian National Science Academy, New Delhi, and the West Bengal Academy of Science and Technology. He was a member of the Steering Committee of World Health Organization for parasitic diseases. As an honorary faculty member of Calcutta University and Jadavpur University, and as an Emeritus Scientist at IICB, he rendered valuable service by teaching postgraduate students and contributing his knowledge to scientific workers till the last day of his life. He is survived by his wife, a daughter, and a son.

Mukkattu Ramachandra Das (elected 1985) was born on 2 July 1937 in Tiruvalla in the Alleppey District in Kerala. After a master's degree in physical chemistry from the University of Kerala in 1958, he joined the Tata Institute of Fundamental Research in the chemical physics group as a Ph.D. student. In the early stages Das was interested in the applications of electron spin resonance to bio-molecules, a demanding task those days. After the completion of his thesis work in 1962, he went to Columbia University as a postdoc in the laboratory of George Frankel to study quinines and vitamins by novel ESR methods.

Returning to TIFR in 1965 and in 1966, he obtained his Ph.D. By then he was fired up about molecular biology and to pursue this new interest he shifted from the chemical physics group to the molecular biology group at TIFR. Here Das developed an interest in the replication and biology of oncogenic viruses. In 1968 he got a distinguished fellowship to work, once again, at Columbia University with Sol Spiegelman, where he did the most famous work of his career on the identification and isolation of the enzyme reverse transcriptase from murine leukemia viruses. The results were published as a series of three papers in *Nature* in 1970. Similar work, published a few days before Das's papers, from the labs of David Baltimore and Howard Temin, was awarded the Nobel Prize in 1973.

Das returned to TIFR in 1971 and began an ambitious project on the isolation of viruses from human milk that were potentially related to breast cancer. His collaborators were Dorab Dastur and Satyavati Sirsat. Their findings were published in *Nature* and the *Journal of National Cancer Institute*, however these leads could not be followed up and the viral etiology of human breast cancers

could not be proven. Based on his accomplishments in tumour virology in 1977, Das was offered the directorship of the Michigan Cancer Foundation in Detroit (a lab famous for providing the MCF-7 cancer cell line) where he worked for 2 years.

In 1979, while still in Detroit, Das got the opportunity that significantly changed the course of his scientific life. He was invited by Pushpa Bhargava, who was visiting Detroit in search of committed individuals, to set up the molecular biology group at the then upcoming Centre for Cellular and Molecular Biology (CCMB) in Hyderabad. Das accepted this offer, and worked at CCMB until 1994. In CCMB his contributions were in diverse fields, one of the most important of them being the characterization of a tumour specific transplantation antigen from a rat tumour cell line. Das with his colleagues worked on aspects of nucleic acid enzymology, oncogenes, and tumour cell heterogeneity. Towards the end of his stay in CCMB, Das developed a programme on the diagnosis of hepatitis C viruses.

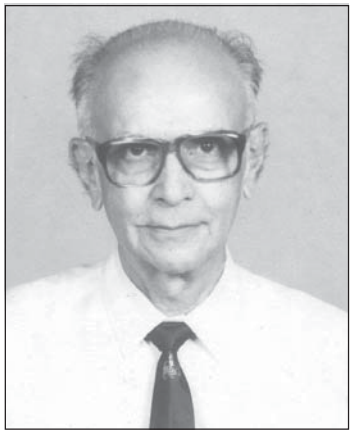
In 1994 he moved to Thiruvananthapuram to take up the directorship of the Rajiv Gandhi Centre for Biotechnology which he founded. He also served as the Chairman of the Kerala Science and Technology Programme. At the time of his death he was an INSA senior scientist and was about to start his study on the genetic diversity of the tribal populations of Kerala.

Das lived a scientifically full life, which began and ended in Thiruvananthapuram. He had his share of both successes and failures in this course but as a person he took them in his stride—a quality he developed through his interests in fine arts. He was an avid collector and reader of books and also had good knowledge about the world's painters and their works; he was very fond of wearing elegant tweed jackets of which he has left a large collection in his closet.

Das was elected to all the three national academies in the country and was the President of the Indian Society of Cell Biology. He was the recipient of the Hari Om Ashram Alembic Award (1983), the ICMR Sandoz Oration Award (1984) and the Sreenivasayya Memorial Award (1986).

He passed away in Thiruvananthapuram on 1 April 2003 leaving behind his wife Radha and two daughters.

Gopal Shankar Hattiangdi (elected 1963) was born in Bombay on 15 December 1921. He obtained his B.Sc., M.Sc. and Ph.D. and was also the recipient of honorary D.Phil. and D.Litt. His career started in University of Bombay where he was a research scholar from 1943 to 1945. He then went abroad to join the University of Southern California as a research assistant (1947-1948) simultaneously holding an assistantship at the



US Office of Naval Research. In 1948, he joined the US National Bureau of Standards and worked there for 2 years. Subsequently he returned to India and joined the Hindustan Lever Limited in Bombay as a chief chemist, became a senior technical officer until retirement in 1980. He also started a company known as Sharpedge Limited in Bombay and in later years founded an organization known as Vedic Workshop.

Hattiangdi is well known for his work on the properties and behaviour of systems of alkali and heavy metal soaps in organic solvents and for his X-ray diffraction and electron microscope studies of lubricating greases, soaps and soapless detergents. He has also made original contributions of merit in the fields of non-edible oils, utilisation of perfume-bearing materials and the nutritive value, vitamination and colouration of vanaspati. He published 32 research papers, 4 review articles, 5 monographs and one book. His monograph dealt with dietary fat and coronary heart disease, colouration of vanaspati nutritive value of heated oils and fats. He won the Samuel Hahnemann Medal of USA in 1964 and the Gold Maple Leaf Pin of 1990. He is the only Indian to translate the entire Rig-Veda from Sanskrit into English (1961-1985).

He passed away on 16 May 2003 in Mumbai leaving behind his wife Mira and a son and daughter.

Dharmaraja Krishnamurti (elected 1958) was born on 30 March 1929. He had his early education at St. Joseph's High School in Cuddalore and then did his B.Sc. (Honours) course in physics at the St. Joseph's College in Tiruchirapalli. He did his M.A. from the University of Madras in 1950. After working for a few months as a lecturer in physics in Hyslop College, Nagpur, he joined the Raman Research Institute (RRI) as a research scholar in December 1950.

In its initial stages, RRI had no laboratory or electricity. C. V. Raman carried out his experiments in optics using sunlight reflected through a mirror. Perhaps, the first paper of Krishnamurti was theoretical, on the evaluation of the elastic constants of diamond in terms of its force constants, using a force field that took into account interaction of each carbon atom with its first, second and third neighbours, by the so-called static or deformation energy method. Later, he derived the same by the 'dynamic' or long wave method, but found that the two expressions were different. Using a general force system, he found that the deformation energy contains 45 independent constants, which appeared in different combinations in the two methods. RRI had a large collection of minerals like feldspar, moonstone, labradorite, jade, limestone, tourmaline and opal, that exhibited beautiful optical effects. Raman published dozens of papers on these. Krishnamurti made several contributions to the optics of stratified media, their birefringence, the iridescence of potassium chlorate crystals and generally, the reflection colours of minerals. The passage of light through a mineral brings to light the optical heterogeneities, local fluctuations in its composition as well as in its birefringence. Raman and Krishnamurti found that light falling on the rear surface of pearl does not travel through it but around it, following the laminations of its structure. A pearl owes its beauty and brilliance to this effect.

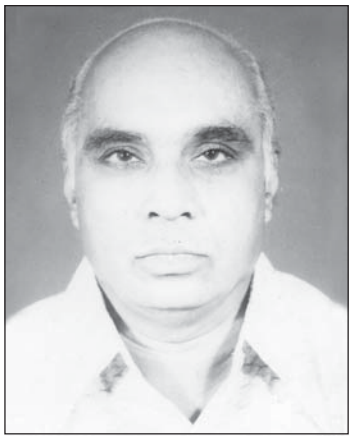
Krishnamurti obtained his Ph.D. in physics from University of Madras in 1955 for his work in optics; later he worked on infrared and Raman spectroscopy of crystals and obtained the D.Sc. degree from the same university in this subject in 1961. Lasers came in as a tool for Raman effect studies only later.

Krishnamurti joined the physics department of the University of Mysore in 1961 as a reader in physics and made significant contributions to this newly started department in its teaching programmes as well as in organizing the laboratory. In Mysore, his interests shifted to liquid crystals. His investigations on the birefringence of liquid crystals and their molecular orientational order were published. He retired as professor of physics from the Mysore University in March 1989.

He was elected a Fellow of the Indian Academy of Sciences in 1957. He was also a recipient of the Raman centenary medal in 1988.

During the first week of May 2003, he was hospitalized with colon cancer. Though a surgery was performed, it could not save his life. He passed away on 14 May 2003 at the age of 74. He is survived by his wife and three children.

Perurmadom Ramaiyer Mahadevan (elected 1973) was born on 20 May 1928 in Cochin, Kerala. He was one of our leading biologists and the earliest in discovering the power of a multi-disciplinary approach to investigating biological phenomena, be it the cell wall of a fungus or the complex pathogenesis of a human disease, leprosy.



PR obtained his M.Sc. from Banaras in 1955 and an M.A. from Princeton, where he also obtained his Ph.D. His research career can be thought to have begun during the sixties when he started his doctoral thesis. Subsequently he went on to join the Nobel Laureate E L Tatum at the Rockefeller University, an experience and contact that he cherished and maintained even after his return to India. It was during this period that he used Neurospora crassa as a model to understand the basic phenomenon of morphological changes that fungal species undergo both *in vitro* and *in vivo*. Fungi are notorious for changing shape from thread like filaments to branching ones as well as becoming rod like, circular or conoid. The changes in shape are observable at microscopic as well as colony level when they grow in culture media or in the tissues of plants or animals. He was particularly interested in the genetic regulation of the enzymes of this fungus that would influence the cell wall constituents and thereby permit the fungi to take on different shapes. In a landmark discovery he showed that a single gene was the dominant regulator for the enzyme aryl ß glucosidase and altered the ratio and composition of the cell wall polymers. Later on while working in India he also showed the relationship of other enzymes to cell wall constituents and their effects on the morphology of the fungal colonies. He also demonstrated the localization of the structural polymers in the cell wall which were responsible for the morphological changes. More significantly he established a chemical method for studying the cell wall constituents which began to be used routinely by other laboratories.

During the mid sixties he returned to India to lead a group in Biochemical Genetics and Molecular Biology in the Biomedical Division at the Bhabha Atomic Research Centre (BARC). During the next 7 years his group continued the cell wall studies, and went on to show the level of genetic control and how hydrocytic enzymes were associated with hydrolysed the cell walls at the branching points. PR concluded that the distribution and hydrolytic activity of these enzymes were the determining

factors for the total pattern of branching and appearance of the fungus. Of interest and significance was the demonstration of the presence of long lived mRNA and the presence of an inhibitory protein that regulated transcription in the Neurospora species. These studies encompassed the finest biochemical and genetic approaches of that time to understand a basic problem that had long fascinated microbiologists.

In 1972, he joined the Indian Drugs and Pharmaceuticals Ltd. (IDPL) in Rishikesh. He was perhaps attracted by the challenge to build new laboratories in a public sector undertaking and bring new knowledge into the area of antibiotics and fermentation technology. It was during 1972-1978 that PR contributed his knowledge for improvement of antibiotic strains and helped to make improved microbial products. He applied genetic approaches to industrial fermentation technologies and thereby helped to create better strains and improved methodologies for tetracycline and streptomycine production. It is a matter of history that the early pioneers in chemical engineering and industrial microbiology provided India with cheaper drugs and antibiotics which helped to revolutionize health care. The trials and tribulations of PR in these early years can be easily imagined when one realizes that he was isolated in a scenic but poorly connected town far from the academic environments that drive research. Yet he was happy because he was involved in a challenging job both academically and managerially. Moreover he made the transition from esoteric research to one with practical application with ease and grace.

The next phase in Mahadevan's career was to give him a lasting identity in the field of leprosy and bring him back to Bombay. The Godrej Foundation decided to institute the Foundation for Medical Research whose mandate in the early years was to understand the scientific basis for leprosy and thereby contribute to its elimination. This mandate was both brave and laudatory as India had a third of the world's population of leprosy patients. The stigma attached to the disease was horrendous, drugs were scarce but Dapsone had been found useful. PR's knowledge of microbiology made him an appropriate leader in research. Those were heady days. N H Antia, a famous plastic surgeon devoted himself to the treatment and investigation of deformities and had excellent clinical understanding of nerve damage which is the bane of leprosy. The team of Antia and Mahadevan soon attracted brilliant anatomists, neuropathologists and young researchers from India and abroad to this small but beautifully planned institution at the Sea Face Corner at Worli. With his team of the naïve and wise PR drew attention to biochemical defects in the host cells of leprosy patients that may explain the lack of immunity in the worst affected patients. He showed that there were abnormal changes both in the cell membranes as well as inhibitory factors that were in the cell lysates of macrophages, the very cells that harbour the organism. PR was instrumental in screening new drugs being developed in UK laboratories. Another major contribution of his group is in the understanding of nerve damage caused by the leprosy bacillus which is the only infectious agent that appears to reside in the Schwann cells. Organised nerve cultures were developed wherein leprosy bacilli would be maintained.

His penchant for biochemical approaches drew him naturally to investigate the make up of the leprosy bacillus. The cell wall was his main target. He always maintained that human tissue derived bacilli were more appropriate than the armadillo derived ones which were being studied by the western laboratories because of the ease in obtaining large amounts of bacilli. PR was able to hone in on a subunit of the cell wall which he felt would have potential as a vaccine. Unfortunately due to his moving away from FMR this work did not achieve the expected impetus.

Once again PR moved back to R&D in Industry, this time to the Malladi Research Centre in Chennai. He began building new laboratories, energizing young people and influencing industrialists to invest in R&D. Unfortunately, Malladi R&D unit ran into financial problems when the founder died. Unbelievably PR invested his personal meager earnings during this period to tide over the temporary problem. Once the tide had turned, PR was ready to move again. His last move in the year 2001 was to start R&D in a little known new venture called Mannya Biotech in Hyderabad. It was here that he had the first mild heart attack. Though it was treated early he does not appear to have recovered and complained of weakness and physical debility. During the searing summer of 2003, he was admitted twice more to the hospital and breathed his last on 27 April 2003. He leaves behind his wife Sita, 2 sons and 2 daughters.

Bhyravabhotla Radhakrishna Murty (elected 1975) was born in Gudivada in Andhra Pradesh on 4 April 1928. He had his early education in Madras obtaining a B.Sc. in Agriculture from the University of Madras. In 1956, he secured a first rank in the Associateship examination of the Indian Agricultural Research Institute (IARI) and subsequently got his Ph.D. in 1960 from Cornell University working on genetics and biometry. His research career started in the Central Tobacco Research Institute, Rajahmundry as a research associate (1948-54). He worked for three

years at the Brookhaven National Laboratory at Upton (1958-60) and returned to India as biometrical geneticist at the Indian Agricultural Research Institute (1961-68). He took over as the all-India crop co-ordinator in 1967 for the Indian Council of Agricultural Research and served in this position until 1974 when he was appointed as Director of the IARI's Nuclear Research Laboratory in Delhi. He continued in this position until superannuation in 1991.

Murty is distinguished for his contributions to the assessment of genetic divergence in biological populations by multivariate analysis and its relationship with the breeding system for classification of large world collections of cereals, oilseeds and grain legumes on genetic criteria. He was the first to establish the one-to-one correspondence of the statistical distance measures and the components of genetic variation; the work was carried out to its logical conclusion by actual selection and evolution of superior lines which were released in Brassica, coarse grains and linseed.

His work on disruptive selection in Brassica resolved the existing controversy about the magnitude of divergence, change of linkage phases and release of variability available for selection. This resulted in the release of a Brassica camprestris variety with nearly 80% yield increase over the best strains available so far.

He made outstanding contributions to our understanding of the mechanisms of wide adaptation in cereals, oilseeds and legumes. His studies altered the present breeding procedures in crop improvement.

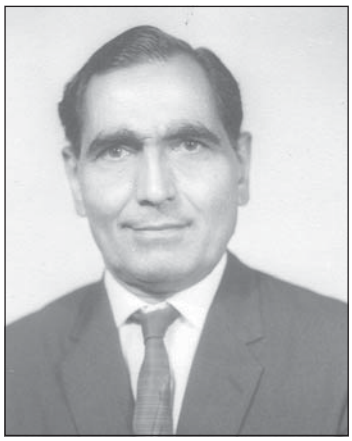
His theoretical-statistical studies on components of association, factor analysis and cumulant analysis have been useful in the genetic analysis of cereals, particularly wheat.

Murty authored 110 research publications and 3 monographs on sorghum, pennisetum and tobacco. Over 30 students received the Ph.D. degree under his guidance.

Murty gained several academic distinctions to his credit. He was elected a Fellow of the Indian National Science Academy and the Royal Statistical Society and President of the Indian Society of Genetics and Plant Breeding. He received the Shanti Swarup Bhatnagar award in 1973.

He passed away in New Delhi on 16 May 2003. He is survived by his wife Venkataramalakshmi and two daughters.

Jamnadas C. Patel (elected 1956) passed away on 11 May 2003 in Mumbai. He was born on 2 August 1908 in Karamsad town of Kheda District Gujarat, in a poor family. He learnt, very early in life, the lessons of self-reliance, hard work and persistence. As there was no one to look after the household, he was married early at the age of 14 years. He used to relish working on the family farm and gained a lifelong robustness by looking after the farm animals. His premedical college education was at Vadodara, where he developed some lifelong friendships. Before he joined Grant Medical College at Mumbai, he had also contemplated on the options to be an engineer or a forest officer. High marks at the Intermediate Science level exams had opened up all these options for him. His choice of medicine augured well for modern medicine in India, at a critical juncture in pre-independent India.



Patel obtained his B.Sc. degree in physiology, so that he could obtain a fellowship for Ph.D. in physiology at University College, London. He was India's first internist with a Ph.D. degree in the basic medical sciences. He passed MRCP (London) in the year 1936. On his return from England, he had a one-year assignment at J.J. Hospital and at St. George Hospital, both in Mumbai. He was a great patriot, and when he got an opportunity to work at the Indians-initiated King Edward VII Memorial (KEM) Hospital in Mumbai he found his home base.

From 1941 to 1967, he pioneered several specialities and clinical researches at KEM hospital. As early as 1955, he started a speciality of diabetology, that later flowered into a postgraduate centre of excellence in endocrinology and metabolism due to the efforts of M. K. Dhirwani, S. D. Bhandarkar and Padma Menon. His emphasis on diet control in diabetes mellitus, as early as in the 50s, has now become a mainstay in the therapy of the disease. He truly exemplified that a well-balanced,

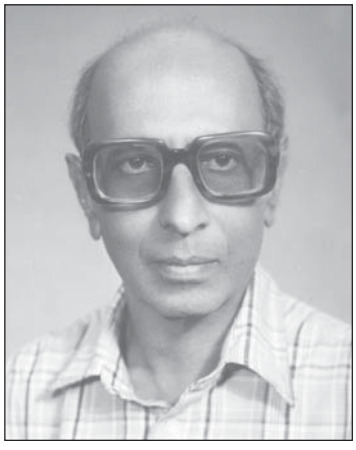
low caloric diet can lead to an active and long lifespan. He was on the expert committees on diabetes of several national and international organizations.

Patel's work on tetanus prophylaxis was path-breaking. His use of robust designs of clinical trials and epidemiological methods impressed many of his students.

Tetanus immunology and critical care of patients received much attention after his pioneering work. His endeavour to get tetanus prophylaxis incorporated in the public health care system led to a significant saving of human lives in India. Patel also pioneered haematology and clinical drug trials with new drugs at Seth G.S. Medical College, Mumbai. He headed the Haematology Unit of ICMR, that later metamorphosed into the National Institute of Immunohaematology and Dr J.C. Patel Postgraduate Department of Haematology. Many scientific contributions have emerged from these centres.

JCP also pioneered another field in India. He was one of the first physicians to be a Medical Advisor to Glaxo Laboratories. He was the founder President of the Association of Medical Advisors to the Pharmaceutical Industry. This association pioneered pharmaceutical medicine in India. He had also served as a Medical Officer with Burmah Shell, and later Hindustan Petroleum, until April 2003. JCP was also associated as a consultant with Bombay Hospital from 1950 to 1998, with Singhania Hospital and S.L. Raheja Hospital for diabetes (1984–2003).

Suresh Krishnarao Pradhan (elected 1986) a distinguished organic chemist, passed away at the age of 72 on 23 May 2002 in the USA following a heart attack. He was born in Nagpur on 6 September 1929. After graduating from the University of London (M.Sc., 1954), he joined Sir Derek Barton's group (Glasgow University and Imperial College, London) for his Ph.D. degree. His Ph.D. thesis (1958) was entitled 'Structure of limonin'. Pradhan's lifelong interest in the structure of natural products and reaction mechanisms can thus be traced to the influence of Barton early in his research career. His other major preoccupation – the chemistry of steroids – obviously stemmed from his post-doctoral association with Ringold at UCLA (1961–62), followed by a two-year stint (1962–64) at the Worcester Foundation for Experimental Biology. Between 1959 and 1961, he was at the National Chemical Laboratory, Pune. This was the period when he brought his experience with limonin to bear on the structure elucidation of the neem bitter principle, nimbin. Back in India in 1964, Pradhan spent two years at the Shivaji University, Kolhapur, and was later associated with the Regional Research Laboratory, Hyderabad for about five years. From 1970 until his retirement in 1989, he was the professor of Pharmaceutical Chemistry at UDCT, Mumbai.



Pradhan's research spanned four major areas: structure elucidation of natural products, stereoselective synthesis of drugs, investigation of reaction mechanisms and the discovery of new reactions. In all these efforts, he made full use of the latest developments in theoretical chemistry and analytical methods involving modern instruments. In a significant contribution to alkaloid chemistry, Pradhan proved that atisine was a mixture of two rapidly interconverting configurational isomers. It was in his mechanistic investigations, however, that Pradhan exhibited the full power of his intellect. He was particularly interested in single-electron transfer reactions, and the application of Frontier Molecular Orbital Theory to the prediction of the product structure and stereochemistry in such reactions. For this purpose he found that the steroidal skeleton offered the ideal template. He was the first to introduce naphthalene sodium as an alternative single electron transfer reagent to generate ketyl radical-anions from ketones. This reaction was utilized to achieve the Stork reductive cyclization. The mechanism of this reaction established by Pradhan involved the novel postulate that the radical anion attacks the triple bond as a radical. Pradhan next turned his attention to the mechanism of reduction of enolizable saturated ketones by alkali metal in ammonia. Taking advantage of the fact that naphthalene sodium does not reduce such ketones, Pradhan established that dianion formation is the rate-determining step in metal–ammonia reductions. He thus provided proof for the mechanism postulated earlier by Barton for this reaction. Pradhan went further: he explained the stereochemistry of such reductions by suggesting that the direction of pyramidalization of the intermediate radicalanions is governed by Frontier Molecular Orbitals. Pradhan then showed that other electron-transfer reactions were also subject to FMO control. A new reaction discovered by Pradhan was the cyclization of 1,5-dioximes using sodium borohydride. The product is an *N*hydroxypiperidine formed via a nitrone intermediate. The stereochemistry of the product was established by converting it to an *N*-chloro compound and studying

the NMR. At UDCT, Pradhan was interested in developing asymmetric syntheses of some common drugs. An excellent example was his synthesis of the antibiotic chloramphenicol. During his research career, Pradhan received several honours and awards. He was also a Fellow of the Indian National Science Academy. Pradhan is survived by his wife and two daughters.

Torbjorn Caspersson (elected 1963), who was born on 15 October 1910 in Motala, Sweden gained his M.D. from Stockholm University in 1936. He then joined the staff of the Nobel Institute and served as professor of medical cellular research and genetics for 33 long years from 1944 to 1977. In 1977 he was appointed professor and head of the medical research and genetics department at the Karolinska Mediko-Kirurgiska Institute in Stockholm.

Caspersson is considered to be the father of cytometry and modern analytical cytology. He developed the first generation of microspectrophotometers and micro-

fluorometers and introduced the concept of quantitative analysis of the cell. His seminal observations during 1940s and 1950s about the localization of DNA and RNA within the cell provided a foundation for further discoveries revealing mechanisms of DNA replication and transcription by Watson, Crick, Kornberg, DeDuve, Palade, Porter and other Nobel Prize winners. Chromosome banding, introduced in the late 1960s by Caspersson, revolutionized the field of cytogenetics and was the beginning of molecular cytogenetics.

He passed away nearly six years ago on 7 December 1997 but it was only recently that this was made known to the Academy.

BUILDING

When the HMT Limited was disposing of some of its land in Bangalore, the Academy along with the Raman Research Institute bought a piece of land in 1997. It is situated in Jalahalli, about 8 kms from the Academy and about 5 kms from IISc. Part of this land was used for constructing a small building. The plinth area of the building is about 1600 square metres consisting of a basement, ground floor plus two floors. The facilities created include 24 guest rooms, a lecture room, office space, storage, kitchen and dining room.

The Academy had been looking for additional building space on account of increased activities in recent years including the Science Education programmes. The modest guest house in the campus has been found inadequate to take care of our needs particularly for housing students and teachers visiting Bangalore for taking up Summer Fellowships, Mid-Year Meetings, Refresher Courses, etc.

The building was made functional by the President of the Academy K. Kasturirangan on 3 May 2003 at a simple get-together at which many Fellows and others were present.

The procurement of the land and the completion of the building was made possible due to the assistance of the Director and staff of the Raman Research Institute.