No. 46 Patrika September 2007

Newsletter of the Indian Academy of Sciences

2007 Mid-Year Meeting

As has been the general practice, the 18th Mid-Year Meeting of the Academy was held on July 13 and 14, 2007, at the Indian Institute of Science, Bangalore. Those attending included 210 Fellows (90 from Bangalore), 5 Associates, 30 Teacher invitees (4 local) and many local students and the general public.


S C Lakhotia

On Thursday July 12, 2007, the day prior to the main meeting, two special activities were organized by the Science Education Panel for the benefit of the invited teachers: a pre-lunch symposium comprising 3 talks on selected topics in current life science research; and a post-lunch discussion session led by S C Lakhotia on the need and problems of science curricular reforms at college and university levels. In the evening a full meeting of the Academy's Science Education Panel, with representatives from INSA and NASI, was held. Academy President D Balasubramanian was also present.

The opening Special Lecture by G Sundararajan on "The indentation of materials to probe their mechanical behaviour" was an object lesson in classical physics of materials. It explained how conceptually simple methods indenting material samples with suitable indentors yields information, valid in certain domains, on hardness, plastic flow, stress-strain behaviour etc. In extreme conditions pressure induced phase transformations and dislocation dynamics are also accessible to study.


G Sundararajan


E D Jemmis

The second Special Lecture on 'A structural chemistry for boron' was presented by E D Jemmis. This is a field surprisingly still in the early steps of development

Inside...

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Forthcoming Events – 2007

Refresher Courses

Experimental physics
University of Kerala, Thiruvananthapuram
(22 October - 3 November 2007)

Lecture Workshops

Concepts in chemistry
Ramananda College, Bishnupur (WB)
(28-30 Sept. 2007)

Recent trends in physics
NGM College, Pollachi
22-24 Jan. 2008

compared to carbon chemistry. The speaker described the importance of icosahedral B_{12} as an important building block of elaborate structures, and significantly observed that 'A chemistry rivaling carbon is waiting to be explored and the list of applications of boron is sure to increase'. Particularly impressive was the large team of students and associates who over several years have worked on these problems under the speaker's leadership.


G Madhavan Nair

G Madhavan Nair's Public Lecture titled "Challenges in space exploration: Global perspectives and Indian initiatives' was a splendid survey of ISRO's efforts and accomplishments over about four decades. The contributions in the areas of communication, meteorology, disaster warning, remote sensing and resource surveys, are remarkable and praiseworthy. They are the fruition of Vikram Sarabhai's vision of the crucial inputs from space science to India's economic and social development in a wide variety of areas. In the process, both self-reliance and self-confidence have been achieved. Nair then outlined some avenues of work for the future – building cost-effective space infrastructure, planetary exploration projects including the Chandrayan – 1 mission, and some forays into the outer solar system. He also briefly mentioned ISRO's recent effort to set up a training establishment for young persons needed for ISRO's programmes in the coming years. The visuals from this Public Lecture are available at www.ias.ac.in.

The lectures by recently elected Fellows and Associates covered as usual a very wide spectrum of subjects. To mention just a few: Sanjay Jain spoke on self-organisation and collapse of complex networks; V Balaji on holonomy groups of bundles on algebraic varieties; Amitava Raychaudhuri on the Indian Neutrino Observatory; and Satheesh Chandra Shenoi on the reasons why the Bay of Bengal is warmer than the Arabian Sea.

Many participants and teachers commented on the high quality and intensity of the entire programme.

73rd ANNUAL MEETING THIRUVANANTHAPURAM

Scientific Programme

1 November 2007 (Thursday)

1800 – 1930 **Inauguration followed by presidential address**

D Balasubramanian, LV Prasad Eye Institute Hyderabad
Approaches to understand and treat eye diseases

1930 Cultural programme

2 November 2007 (Friday)

0930 – 1030 **Special Lecture**

ML Munjal, IISc, Bangalore
Towards quieter automobiles

1100 – 1300 Lectures by Fellows/Associates

1100 **Mythily Ramaswamy,** TIFR Centre, Bangalore
Symmetry of solutions of differential equations

1130 **Ashok Jhunjhunwala,** IIT, Chennai
What does it take for India to become a leader in wireless technology?

1200 **Chanda J Jog,** IISc, Bangalore
Lopsided spiral galaxies

1230 **A Ajayaghosh,** NIST, Thiruvananthapuram
Self-assembled molecular architectures with controlled size, shape and functions

1400 – 1700 **Symposium: Space sciences and applications – Current trends and future perspectives**
(Convener : R Sridharan)

1400 **K Kasturirangan,** NIAS, Bangalore
Evolution of space sciences in India

1430 **JN Goswami,** PRL, Ahmedabad
Frontier areas in solar system studies

1500 **BN Suresh,** VSSC, Thiruvananthapuram
Space transportation systems – What the future beholds

1600 **PS Goel,** Ministry of Earth Sciences, New Delhi
Earth from space

1630 **RR Navalgund,** SAC, Ahmedabad
Space – Touching humanity through applications

1800 – 1900 **Public lecture:**
Adoor Gopalakrishnan
Eminent Playwright, Thiruvananthapuram
Dance of the Enchantress – Documentary-cum-discussion

3 November 2007 (Saturday)

0900 – 1000 **Special lecture**

Sulochana Gadgil, IISc, Bangalore
Foretelling the monsoon

1030 – 1310 **Symposium: Re-emerging infections in India**
(Convener : CC Kartha)

1030 **CC Kartha,** SCTIMST, Thiruvananthapuram
Introduction

1035 **AC Mishra,** NIV, Pune
Chandipura encephalitis: Epidemiology and pathobiology

1105 **VA Arankalle,** NIV, Pune
Re-emergence of *Chikungunya* in India: Molecular analysis

1135 **YD Sharma,** AIIMS, New Delhi
Resurgence of malaria in India – Does genetic mutations in the parasite complement ecological causes?

1205 **PR Narayanan,** Tuberculosis Research Centre, Chennai
Current scenario of tuberculosis in India

1235 **V Raman Kutty,** SCTIMST, Thiruvananthapuram
A policy perspective on prediction and control of re-emerging infections

1305 **UC Chaturvedi,** Lucknow
Concluding remarks

1400 – 1500 **Lectures by Fellows/Associates**

1400 **Harkesh B Singh,** IIT, Mumbai
Organo-chalcogen and mercury chemistry: Role of intramolecular secondary interactions

1430 **Rahul Siddharthan,** IMSc, Chennai
What DNA sequence tells us about gene regulation

4 November 2007 (Sunday)

0900 – 1100 **Lectures by Fellows/Associates**

0900 **PN Rangarajan,** IISc, Bangalore
From vaccines to virogenomics

0930 **Sunil Bajpai,** IIT, Roorkee
India's northward drift and collision with Asia: Evolving faunal response

1000 **LS Shashidhara,** IISER, Pune
On the evolution of insect wings

1030 **Sandhya S Visweswariah,** IISc, Bangalore
Cellular communication: First and second messengers

1130 – 1230 **S Ramaseshan Memorial Public Lecture**

Lotika Varadarajan, Historian
New Delhi
Seafaring traditions of the Indian West Coast

ASSOCIATES 2007

Anandavardhanan, U. K.
Indian Institute of Technology, Mumbai
Areas of interest: Automorphic forms; representation theory

Ghosh Anil Kumar
Indian Institute of Technology, Kanpur
Robust and nonparametric statistics; pattern recognition; statistical computing

Jain Mukesh
University of Delhi South Campus, New Delhi
Plant genomics; biotechnology

Kavitha Telikepalli
Indian Institute of Science, Bangalore
Algorithms and data structures; computational complexity; efficient graph algorithms

Mukherjee Partha Sarathi
Indian Institute of Science, Bangalore
Nanoscopic molecular architectures; single molecule magnets; metal-organic framework

Mukhopadhyay Banibrata
Indian Institute of Science, Bangalore
Theoretical astrophysics; astroparticle physics; field theory in curved space time

Mukhopadhyay Pritam
Jawaharlal Nehru University, New Delhi
Supramolecular; materials chemistry

Senthil Kumar, P.
National Geophysical Research Institute, Hyderabad
Impact cratering; planetary geology; thermal evolution of planetary lithosphere

Subramanian Ganesh
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Dynamics and rheology of complex fluids; hydrodynamic stability; vortex dynamics

Suresh Babu, Surendran Nair
Vikram Sarabhai Space Centre, Thiruvananthapuram
Atmospheric aerosols; radiative forcing; climate impact

Thanikaivelan, P.
Central Leather Research Institute, Chennai
Leather science and technology; environmental science and technology; new materials design and development

Tripathi Vikram
Tata Institute of Fundamental Research, Mumbai
Theoretical condensed matter physics; strongly correlated electron systems; transport properties of granular metals; mesoscopic and nanoscale devices

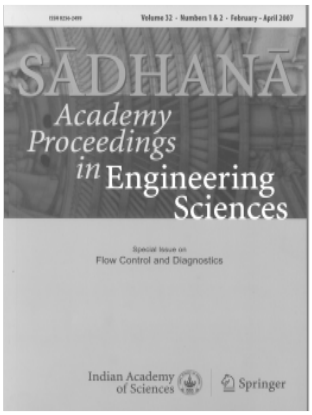
SPECIAL ISSUES OF JOURNALS

Flow Control and Diagnostics

Guest Editors : R Narasimha, TS Prahlad and Sajeer Ahmed

Sadhana, Vol. 32, Nos 1 & 2, February – 1 April 2007, pp. 1–154

Flow diagnostics and control have always been of great importance in fluid-dynamical technology, but in recent decades they have become particularly active and exciting areas of research. In September 1998, IUTAM sponsored an international symposium on flow control at Gottingen. Since then the great surge of interest has continued, for several good reasons. The first is the potential for control of turbulent flows revealed by the discovery of coherent structures in what generally had earlier been considered as motion with complete disorder. A second reason is the related development of the theory of nonlinear dynamical systems. Such systems are sensitive to small changes in initial conditions, and therefore necessarily also to small control signals if applied at the right time and place. Third, great advances have recently been made in the technology of sensors, actuators, computers and related systems, making it feasible to consider small active



control systems with a performance surpassing those that had earlier been available. Progress in MEMS and in nanotechnologies is unveiling ever newer possibilities. There is thus much interesting research being done in passive, active and hybrid methods of control; new experiments, computations and advances in the theory of control of continuous systems have all contributed to the excitement. And of course the potential benefits of turbulence management, to reduce or enhance drag, lift, heat transfer, mixing etc. as the application requires, are huge.

An Academy discussion meeting to consider these recent advances therefore seemed most appropriate. The meeting was organized in the pleasant environs of Orange County, Coorg, in February 2006. There were 27 participants including several from USA and UK. The four-day programme included 22 presentations in sessions that dealt with flow control, flow diagnostics and flow instability. Of these, the texts of 13 papers presented at the meeting are now published in this issue. The subject of the papers divides broadly into three areas: diagnostics, stability and control. The papers on stability are sandwiched between those in the other two areas, because an understanding of instabilities in the flow sought to be controlled has implications for both diagnostics and control.

Fluorescence spectroscopy

Guest Editor : N Periasamy

Journal of Chemical Sciences, Vol. 119, No. 2, March 2007, pp. 53–215

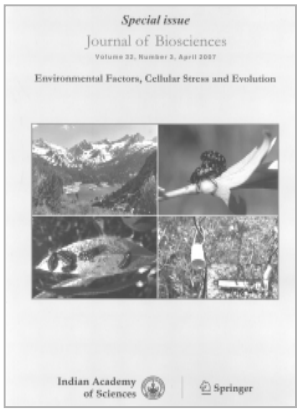
Publication of special issues devoted to active areas of current research in chemistry has been a regular feature of Journal of Chemical Sciences. Fluorescence is now so widely used in chemistry, biology and materials research that it was decided to bring out a special issue on 'fluorescence spectroscopy and its applications'.

There are just three properties that we measure in fluorescence: intensity, spectrum and polarization. The information obtained from these about the fluorescent molecules in a sample is straightforward, namely, concentration, identity of the emitting molecule and its spatial orientation. Fluorescence is highly sensitive to the immediate environment of the molecule, which makes it extremely useful in numerous applications in chemistry and biology, especially the latter. The time-dependence of these three fluorescence properties, when excited by an ultra-short light pulse, adds a new dimension to the understanding of the chemical kinetics and molecular dynamics of the excited molecule. This special issue contains eighteen articles dealing with many different aspects of fluorescence spectroscopy and applications in chemistry, which should be useful to both chemists and spectroscopists.

Environmental factors, cellular stress and evolution

Guest Editor : Subhash C Lakhotia

Journal of Biosciences, Vol. 32, No. 3. April 2007, pp. 429–628



For its survival and continuity, an organism has to be "in tune" with its internal as well as external environment, neither of which is ever static. Consequently, the organism and its constituent cells incessantly adjust their physiological milieu to remain in harmony with the dynamic environment. The adjustments involve long-term evolutionary adaptations as well as short-term responses to sudden changes. The sudden changes in environment are stressful to cells and since the nature of changes experienced by organisms are enormously varied, one may expect the cellular responses to be equally varied. Surprisingly, however, work carried out during the 1960s and 1970s revealed that the core response of individual cells to a variety of biotic and abiotic environmental stresses is remarkably conserved. For historical reasons, this cellular response has come to be known as the heat shock response.

Intensive studies of genes and proteins induced by cellular stresses have provided deep insights not only into some of the basic cellular processes like protein folding, gene regulation, cellular homeostasis ans so on, but have also stimulated biotechnological and clinical applications. At a more fundamental level of biology, it is clear that environmental stress factors have been key players in shaping organic evolution. However, research on the molecular biology of stress responses has often remained separated from that on the role of environmental (stress) factors in evolution and development. It is obvious that an integration of these diverse domains is essential for a comprehensive understanding of the biology of living organisms as well as for improvements in practical applications of our

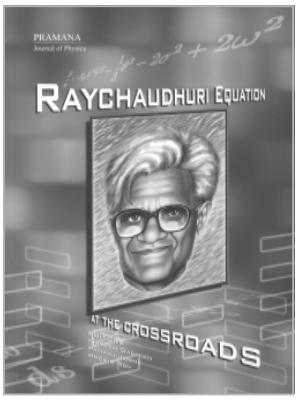
understanding of the stress responses. An international meeting was held at the Banaras Hindu University, Varanasi in October 2006 to provide an integrated perspective for understanding the roles of stress proteins and stress responses in cell. The twenty papers in this issue are based on the presentations at the meeting.

The articles provide succinct surveys of their chosen fields and should be of immense benefit not only to specialists but also to those generally interested in the broad area of stress biology. This special issue will have served its purpose if it catalyses the integration of stress responses with evolution and environmental factors.

Raychaudhuri equation at the crossroads

Guest Editors : Naresh Dadhich, Pankaj Joshi and Probir Roy

Pramana, Vol. 69, No. 1, July 2007, pp. 1–158



In 1953 something extraordinary happened at the Indian Association for the Cultivation of Science in Calcutta. Amal Kumar Raychaudhuri, twenty-seven years of age and employed ungainfully as a scientific assistant at the Experimental X-ray Section, made a startling theoretical discovery in General Relativity (GR). Without assuming any symmetry constraint on the underlying spacetime, he derived an equation which showed the unavoidable occurrence of spacetime singularities in GR under quite general conditions. Nearly a decade later, by global topological arguments utilizing the causal structure of spacetime and Einstein's equations, this result was given a complete mathematical generalization and proved rigorously in terms of a set of precisely enunciated theorems, now very well-known as singularity theorems, by Hawking, Penrose and Geroch. The equation of Raychaudhuri was the critical starting point for these theorems which held under more general conditions of which Raychaudhuri's conditions were a subset. Its import and significance were immediately recognized as was evident from the fact that Charles Misner could obtain a grant from NSF for an year's visit of AKR to the University of Maryland in 1964.

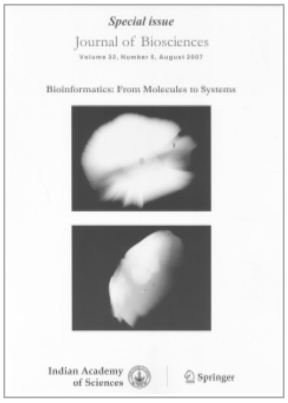
The Raychaudhuri equation has three aspects which are logically sequential. First and foremost, it is a geometric statement on the congruence of non-spacelike paths, including geodesics, in an arbitrary spacetime manifold. Second, on introducing the Principle of Equivalence, it becomes a statement on the congruence of the trajectories of material particles and photons in an arbitrary gravitational field. Finally, the use of Einstein's equations and of the energy conditions leads to the result that in a generally nonflat spacetime manifold there exist trajectories which are necessarily incomplete in the sense that they and their neighbouring trajectories inevitably focus into singularities at finite comoving times. The equation describes how trajectories behave during the course of their dynamical evolution, i.e. how they expand, reconverge, get distorted under shearing effects of gravitational fields and rotate under the influence of the energy density and matter fields present. The scope of the Raychaudhuri equation is very wide since it is a geometric statement on the evolution of paths in a general (not necessarily spacetime) manifold. For gravitational dynamics, it encompasses all spacetime singularities from the cosmological big bang to black holes and naked singularities that could arise in astrophysics from collapsing stars.

More than fifty years have passed since this powerful equation was written down. In this intervening half-century, it has influenced different types of research, not only in classical GR as well as in still incomplete theories of quantum gravity, but also in string theory and even in hydrodynamics. There is every likelihood that research involving the Raychaudhuri equation will take new directions in future. Just to illustrate this point, let us mention that in the currently fashionable Loop Quantum Cosmology, this equation is needed in a new avatar in the possible avoidance of the cosmological big bang singularity. Standing at the crossroads, it is an appropriate juncture to view this equation in perspective. To this end, essays were invited from several experts, working in different areas, whose current research not only derives inspiration from this equation, but in fact makes use of it in some way or the other. It was felt that, as a celebration of the golden jubilee of the birth of this amazing equation, publication of such a volume would be the best tribute that we can offer to the memory of its deceased creator. This special volume contains 12 articles on this topic including an article reminiscing AKR.

Bioinformatics: From molecules to systems

Guest Editor : Alok Bhattacharya

Journal of Biosciences, Vol. 32, No. 5, August 2007, pp. 807–1030



Bioinformatics is not a new discipline. It has been in vogue for hundred years, ever since the analysis of biological processes using mathematical or quantitative techniques was initiated. Computational models were developed in many areas, particularly in ecology, enzymology and metabolism, with reasonable success. Attempts could not be made to simulate actual real world systems due to a lack of computing power. In the last three decades we have witnessed an explosion in our ability to generate data in the area of nucleotide sequences and protein structure, simultaneous gene expression data for thousands of genes, protein-protein interaction data and so on. Fortunately, the computing power required to analyse such information has also kept pace.

Recently, bioinformatics has emerged as a discipline in which emphasis is given to curate, store and analyse large volumes of data. However, in order to comprehend biological processes and reactions, it is necessary to carry out large scale modelling and simulation. Attempts were made to develop computational frameworks to simulate large systems such as a cell; and rudimentary simplified cells or organs were modelled with some success. But it became obvious that methods were still not available to model all the complexities that exist even in simple bacterial cells. Bioinformatics today is the application of computational methods to understand the behaviour of a single molecular species or a large ensemble as in cells and tissues. This special issue entitled *Bioinformatics: From molecules to systems* is based on presentations made at *The International Conference on Bioinformatics for the year 2006* (INCOB 2006), which was held in New Delhi in December, 2006 an annual conference sponsored by the Asia Pacific Bioinformatics Network (APBIONET). The collection of articles reflects the diversity in the field. The articles range from analysing molecular interactions at the atomic level to systems-level simulations. The major areas covered by the articles are DNA regulatory site characterization, protein structure analysis and predictions, analysis of metabolic pathways, gene networks and microarray data analysis.

DISCUSSION MEETING

Structure and evolution of the lithosphere

Orange County, Coorg

February 19–22, 2007

Planet earth's lithosphere is a fragmented jig-saw set of its outer solid boundary layer, consisting of the simpler and larger (~70%) oceanic lithosphere and the more complex continental lithosphere. The former essentially constitutes the surface limbs of a convecting cell that mediate thermal loss from the interior eventually returning to the underlying mantle by gravitational foundering at their junctions with the lighter continents which they earlier rifted apart, and are nowhere older than 200 million years. The continental lithosphere, on the other hand, has remained buoyant for much of earth's history, incorporating in it the products and structures created during their successive processing from the primordial crustal materials. A knowledge of the lithospheric structure and its evolution, important as it is for understandinhg planetary processes, is also important for gaining insights into its ongoing dynamics. Much has been learnt in recent years about the lithosphere's thermal and mechanical state which provides a good vantage point for exploring some fundamental aspects of its structure and evolutionary processes.

The meeting was designed to systematically brain-storm some of the significant questions which can be more definitely examined today. The meeting held at Orange County was attended by 22 participants from various institutions in India and Dan McKenzie and Keith Priestley from Cambridge who have thought of some of the most revolutionary ideas we have about the subject.

The meeting started with talks by Keith Priestley and Dan McKenzie on the use of shear velocity of seismic waves that travel through the earth's litho-sphere to estimate the temperature in the earth's lithosphere. The question that was addressed in the talks was that if the shear wave velocity in a region is known, can we use that information to find the temperature in that region.

Two days were spent in discussing various aspects of the structure and evolution of the earth's litho-sphere. The talks by McKenzie and Priestley stressed

on the use of shear velocity waves to look at the structure, temperature and geometry of the lithosphere. The Canadian shield in North America and Eurasian shields were discussed in fair detail and it was pointed out that the Canadian shield goes all the way down to Gulf of Mexico on the basis of shear velocity observations. Some of the questions that concerned the Indian lithosphere included discussions on the lithosphere in the Dharwar Craton and discussion of the question: Is Tibet presently a shield in the making? The talks also pointed to a molten layer in the upper Tibetan crust resulting from high concentration of radioactive isotopes at that level which was the source of material involved in upper crustal channel flow from Tibet into the Himalaya. Keith Priestley discussed the issues related to surface wave tomography. He covered the factors affecting the sensitivity and resolution in tomography and showed how the higher modes provide good resolution over the upper mantle in surface-wave tomography. He also focused on using a physically-based regularization of the inverse problem and emphasized on the possibility to offset the shortcomings of ray theory by using a dense coverage of relatively shorter paths. He presented a new upper mantle model for the India-Tibet region with high wave-speed mantle lid extending to ~160 km depth beneath southern India, ~200 km depth beneath northern India, and ~250 km depth beneath central Tibet. Finally, he proposed that the lithosphere below Tibet is fully intact and has not delaminated; thus, the northern Tibet crust has not been exposed to the hot asthenospheric mantle.

The other intriguing topic discussed was related to melt generation and its separation from the source region in the upper silicate region of the earth. McKenzie led the discussion and pointed out that melt is generated within the earth by three general mechanisms: (a) decompression of hot material with little change in entropy, to the extent that it crosses its solidus; (b) by conductive heating at constant pressure, that leads to an elevation of the temperature so as to intersect the solidus; and (c) by the addition of volatiles, that causes the solidus temperature itself to decrease. By either of these mechanisms, melt is formed within the lower crust, or upper mantle. Melting initiates at points within system where the melting point is lowest – this corresponds to locations where four or more crystals of different phases meet. This leads to the development of discrete melt pockets at four (or more) phase junctions within the rock. Following melt generation, textural equilibration occurs between the solid phases and melt. The angle subtended by a melt phase at the junction of two solid phases is the dihedral angle. If this angle is less than 60°, the melt pockets become interconnected and melt extraction becomes possible. Since the accumulated melt is normally less dense than the matrix, it will tend to move upward and will consequently separate from the source. However, the questions related to this segregation process are: how much melt must accumulate before it starts moving, how quickly is this melt generated and how fast does it move to the surface (for volcanic rocks)?.

The last day of the meeting was devoted to discussions and interactions amongst participants culminating in the formulation of future research plans to give a boost to research activities in this important field with the help of McKenzie and Priestley. VK Gaur led this activity and first-order proposals were discussed and presented by Anand Mohan, Talat Ahmad, D Mukhopadhyay, R Srinivasan, Saibal Gupta, SS Rai and RN Singh. The proposed work was divided into peninsular and Indian shield and the extra-peninsular Himalayan regions and involved carrying out work in various disciplines such as seismology, geochronology, petrology and geochemistry.

SUMMER FELLOWSHIPS

The 2007 summer fellowship programme was conducted jointly with the Indian National Science Academy (New Delhi) and the National Academy of Sciences, India (Allahabad). It was agreed between the three Academies that IASc will take the responsibility for running this programme. The Fellows of INSA and NASI will also guide the summer fellows and the total expenses will be equally shared.

Group photograph with summer Fellows 2007

The following table gives information on the numbers of applicants and the fellowships offered (in brackets) in 2007.

Subject	Teachers			Students		
	Male	Female	Total	Male	Female	Total
Chemistry	54(20)	16(4)	70(24)	341(35)	256(36)	597(71)
Earth & Planetary Science	8(5)	1(0)	9(5)	74(15)	57(13)	131(28)
Life Sciences	86(28)	56(13)	142(41)	991(78)	1008(98)	1999(176)
Mathematics	23(9)	5(3)	28(12)	93(12)	39(15)	132(27)
Physics	34(12)	9(2)	43(14)	322(30)	123(18)	445(48)
Engineering & Computer Science	24(3)	5(3)	29(6)	405(30)	123(11)	528(41)
	229(77)	92(25)	321(102)	2226(200)	1606(191)	3832(391)

REFRESHER COURSES

Topics in mathematics and physics

Ramakrishna Mission Vivekananda University, Belur Math
May 14–26, 2007

No. of participants: 32

Course Directors: A Sitaram (ISI, Bangalore) and Rohini Godbole (IISc, Bangalore)

Course Coordinator: MJ Mahan (Ramakrishna Mission Vivekananda University, Belur Math

Resource Persons : G Misra and A Sitaram (ISI, Bangalore), KB Athreya (Iowa State University), SC Bagchi and BV Rao (ISI, Kolkata), Sreerup Raychaudhuri (IIT, Kanpur), Rohini Godbole (IISc, Bangalore), Ram Ramaswamy (JNU, New Delhi), JK Bhattacharjee (IACS, Kolkata) and Debashis Ghoshal (HRI, Allahabad).

Topics covered in mathematics : Fourier series; connections with heat equation & wave equation; mean square convergence of fourier series; pointwise convergence; some applications to other branches of mathematics; fourier transforms; inversion formula; plancherel theorem; mathematical versions of the uncertainty principle; multidimensional fourier transforms; applications to problems of geometric analysis; laplace transforms; basic properties & connections with fourier transforms; introduction to wavelets; brief description of probability and conditional probabilities ending with Bose-Einstein statistics; introduction to discrete state; discrete time Markov chains including recurrence/ transience/limiting behaviour; ending with Chandrasekhar chain; Ehrenfest chain (of heat diffusion) and simple symmetric random walks in 1/2/3 dimensions; brief introduction to Brownian motion; existence/simple path properties without proofs; explanation as a Markov process/relation to the laplacian.

Topics covered in physics : 1) Application of fourier series and transforms in: (a) quantum mechanics and field theory: wave packets, momentum space representation; phase space; canonical quantization of fields; (b) optics: diffraction theory; coherence; holography; (c) electrodynamics: Maxwell's equations with sources; radiation theory; power spectrum; 2) anisotropy in the cosmic microwave background radiation; 3) fast fourier transforms; 4) applications of probability theory to physics: focus on difference equations; differential equations; dynamics and statistical mechanics; (a) dynamical systems – discrete and continuous; (b) chaotic evolution – discrete systems; (c) Hamiltonian systems – Poincare Birkhoff and KAM; (d) foundations of statistical mechanics; (e) discussion of chaos/attractors and measures.

The teacher participants were from Adipur, Bangalore, Berhampur, Burdwan, Chikmagalur, Coimbatore, Dewas, Ernakulam, Guntur, Iritty, Kendrapara, Kolkata, Manjeri, Midnapore, Navi Mumbai, Ongole, Pala, Paralakhemundi, Surat, Thiruvananthapuram, Trichy, Udgir and Warangal.

Advances in biophysics

Centre for Cellular and Molecular Biology, Hyderabad

May 25 – June 8, 2007

No. of participants: 31

Course Directors : Ch. Mohan Rao and Somdatta Sinha (CCMB, Hyderabad)

Resource Persons : Amitabha Chattopadhyay, Mandar V Deshmukh, Jyotsna Dhawan, K Guruprasad, Ch Mohan Rao, R Nagaraj, Anant Bahadur Patel, Nandini Rangaraj, Rajan Sankaranarayanan, Ram Rup Sarkar, Lalji Singh, Shashi Singh, Somdatta Sinha and Ravi Sirdeshmukh (all of CCMB, Hyderabad).

Extracts from report by Course Directors

Biophysics is an interdisciplinary science that uses concepts and methods from physical sciences and engineering to elucidate the workings of biological processes at molecular, cellular, and organismal level. The scale encompasses solving of protein structure or measuring the kinetics of interactions on one hand, to application of models and experimental techniques derived from physical sciences to larger systems such as tissues or organs on the other. The systems and methodologies used by biophysicists thus span a large number of disciplines, such as biology, chemistry, computer science, mathematics, medicine, physics, physiology, and neuroscience.

Biophysics often does not have separate departments of its own in colleges, and is primarily taught by biologists who have specialized in other areas of life sciences. Given the interdisciplinary nature of the subject, teaching biophysics to undergraduate and postgraduate students remains a challenging task. With the advent of new techniques to unravel intra-cellular processes at a very small and fast space-time scales, it becomes necessary for the teachers to acquaint themselves with the rapid developments taking place in the area.

The goal of the Course was to expose the biology teachers to the recent advancements in biophysics, so that they are able to transfer some of the excitements in biophysical theory and techniques through their teaching. The programme was designed to introduce the teacher-participants to the multi-faceted nature of biophysics with lectures, demonstrations and laboratory sessions.

The Course was divided into six modules to study structure, function of biological macromolecules and intracellular localization and processes. (i) spectroscopy (ii) high resolution microscopy (iii) nuclear magnetic resonance spectroscopy and imaging (iv) X-ray crystallography (v) proteomics and (vi) comparative protein modelling using bioinformatics tools and computational systems biology.

The morning sessions were devoted to theory lectures on the topic and the afternoon sessions were for laboratory demonstration of the relevant biophysical techniques. There were special lectures in the evening on nanotechnology, stem cells, quantum dots and emerging trends in biology.

Participants were from Allahabad, Bangalore, Bhopal, Coimbatore, Davangere, Durg, Gwalior, Hyderabad, Jaipur, Madikeri, Mahe, Mayiladuthurai, Nagaon, Namakkal, Nanded, Noida, Palakkad, Raipur, Rangpo, Rayagada, Sikar, Thiruvananthapuram, Tiruchengode, Vijayawada, Visakhapatnam.

Experimental physics

Anna University, Chennai

May 28 – June 10 2007

Course Director Prof. Srinivasan demonstrating an experiment

No. of participants : 28

Course Director : R Srinivasan

Course Coordinator : J Kumar

Resource Persons : R Srinivasan (RRI, Bangalore), JBC Efrem Desa, KRS Priolkar, SM Sadique (all of Goa University, Goa), J Kumar, R Dhanasekaran,

S Moorthy Babu, PK Palanichamy, K Baskar, SN Kalkura and R Jayavel (all of Anna University, Chennai).

Extracts from the report

The programme was designed such that the participants can concentrate on improving the experimental activities which are being carried out by the PG (physics) students. Towards achieving this goal ten experiments were given to the participants during the morning session. In the afternoon session the participants carried out project work to assemble lock-in amplifier, constant current source, etc. The participants assembled the components and the entire experimental set-up and the project related kits were brought and co-ordinated.

Participants working on a project

There was a special lecture every evening to introduce the participants to new developments in experimental physics. The participants were also introduced to the experimental facilities at the Crystal Growth Centre of the Anna University to carry out experimental project activities on crystal growth. A visit to the Indira Gandhi Centre for Atomic Research was also arranged.

The teacher participants were from Bangalore, Chennai, Coimbatore, Kurnool, Madurai, Perambalur, Pollachi, Pudukkottai, Thanjavur, Thiruchengode, Thirupattur, Thiruvananthapuram, Thiruvannamalai, Tiruchirappalli, Tumkur, Vellore, Warangal.

Mathematics and its applications

Central Mechanical Engineering Research Institute, Durgapur

June 9–14, 2007

No. of participants : 45

Course Director : JK Bhattacharjee, IACS, Kolkata

Course Coordinator : Gopal P Sinha

Resource Persons : JK Bhattacharjee (IACS, Kolkata), Somesh Chandra Bagchi, Rana Barua, Probal Chaudhuri, Alok Goswami and Palash Sarkar (all of ISI, Kolkata), Swapan Kumar Chakravarty (Howrah).

Extracts from the report

Science Education Programme for senior school students is an effort to inspire young, brilliant and talented minds in science and an endeavour for reversing the trend, which sees young minds drifting from the field of basic sciences. The main aim of this course was to create awareness and motivation towards the basic sciences especially in mathematics, and to inculcate a problem-solving approach in the young minds. The course provided the students a glimse of the captivating world of mathematics through discussions on the fundamentals and conceptual aspects of mathematics which are not discussed at the school level.

In his lecture JK Bhattacharjee emphasized on the development of the fundamental concepts of basic sciences especially in the field of mathematics and motivated the participants to take challenging careers in this field. J Basu introduced the teacher participants to the activities of CMERI and added that conducting programmes of this genre is a part of the mandate of CSIR for societal benefit. Palash Sarkar described to the students about the recent achievements of the Indians in the field of mathematics. He also shed light on the emerging areas of mathematics in which research and development is required.

The participants received two books on "What is mathematics" and "Mathematics and its history".

Participants were from different schools near Durgapur.

LECTURE WORKSHOPS

Physics of living matter

Aurora College, Hyderabad
July 19–20, 2007

Convener : LS Shashidhara (CCMB, Hyderabad)

Speakers : MRN Murthy (IISc, Bangalore), Srikanth Sastry (JNCASR, Bangalore), R Sankaranarayanan (CCMB, Hyderabad), Musti J Swamy (University of Hyderabad), Gautam Menon (IMSc, Chennai) and GV Shivashankar (NCBS, Bangalore).

Participants : 350 students and faculty from colleges in Hyderabad.

Topics of lectures : Protein structures; X-ray vision of biomolecules; biological membranes; machines at the molecular scale; genome organization and function within living cells.

Quantum mechanics, quantum field theory, group theory and tensors

Mar Ivanios College, Thiruvananthapuram
August 1–3, 2007

Convener : Diptiman Sen (IISc, Bangalore)

Speakers : N Mukunda and Diptiman Sen (IISc, Bangalore) and B Sathiapalan (IMSc, Chennai).

Participants : 150 students and faculty from Mar Ivanios and other local colleges

Topics covered : Group theory; quantum mechanics; quantum field theory.

Frontier topics in physics

CB Khedgi's Basaveshwar Science College, Akkalkot
August 10–11, 2007

Conveners : DG Kanhere and Sulabha K Kulkarni (University of Pune)

Speakers : Sulabha K Kulkarni and DG Kanhere (University of Pune), IS Mulla (NCL, Pune), BB Kale (C-Met, Pune), R Nityananda (NCRA, Pune), Milind G Watve (Abasaheb Garware College, Pune).

Participants : 120 students and faculty from the physics department and colleges in Solapur district.

Topics covered : Nanoscience and technology; nanoparticles; GMRT: beyond our universe; excitement in astronomy; opportunities and advances in life sciences and computers in physics education.

OBITUARIES

Chanduri Venkatasatya Kusumahara Baba – a great teacher, physicist, and above all a great human being – died on 5 December 2006 in Hyderabad. A few months before his death, he was diagnosed as having lung cancer. The death came quietly and he did not suffer for too long.

Baba was born on 2 October 1937. He was from the first batch of the Department of Atomic Energy Training School. After completing his training he joined SK. Bhattacharjee's group at Tata Institute

of Fundamental Research (TIFR) in 1958. His main area of research, in the early days, was nuclear spectroscopy using radioactive sources. He did several measurements of nuclear lifetimes, magnetic moments, beta-gamma angular correlations, conversion electron coefficients etc. Almost all the equipment needed was home built, including many valve-based electronic modules wired together by Babaji himself.

Baba visited Niels Bohr Institute twice, the first time in 1962–63 and then again in 1979–80. He spent two years at the Technical University of Munich from 1970, where he proposed and did a beautiful measurement of the difference of two g-factors in ^{210}Po using the perturbed angular correlation technique. After his return from Munich, he decided to shift to Bhabha Atomic Research Centre (BARC). This move helped start an accelerator-based nuclear spectroscopy programme at the Van de Graaff Laboratory, Trombay. In the late seventies and early eighties only a few experiments were done, due to problems with the 5.5 MV Van de Graaff. This, however, did not dampen his enthusiasm and he just took up different problems such as the assignment of a radiative decay from an isomeric excited state in the negative ion of Li, search for particle bound polyneutrons in the fission of ^{236}U, search for a difference in the radii characterizing the neutron and proton mean-fields using the beta decay of ^{209}Tl, search for the light axion in radiative neutron capture by protons at the 220 MW Tarapur reactor and in the Ml decay of ^{13}C, etc.

He often provided neat and simple solutions to problems. The horse-shoe magnets used in vacuum discharge gauges came to be known as *Baba Magnets*. Put at appropriate places on the beam line they helped steer the charged particle beam on to the target. Recently, nearly thirty years after his original innovation, they were also used to reduce the secondary electron background from the super-conducting RF cavity while making time profile measurements of the LINAC beam at TIFR. Baba also devised a simple technique to scan the excitation function in a nuclear reaction by ramping the reference voltage of the analysing magnet and hence the energy of the analysed beam from the Van de Graaff accelerator at Trombay. This trick reduced significantly the labour and systematic error in such measurements. Baba's own view was that it was not significant enough to write this up for publication. However, it was recorded in a paper by his colleagues and he was quite happy with a mention of his name in the acknowledgement. He later collaborated on high energy gamma ray experiments first at VECC, later at the TIFR Pelletron and finally at the Pelletron at the Nuclear Science Centre (NSC), Delhi, now known as Inter University Accelerator Centre (IUAC). At the NSC he suggested a solution to a problem that was encountered while using the large NaI(Tl) detector. The large crystal was viewed by several photo-multipliers whose recommended voltage for best energy resolution was not enough for the fast timing needed to discriminate against neutrons by time-of-flight. His idea of increasing the high voltage on the central PMT for good timing worked out very nicely.

Baba was open to unconventional ideas about experiments suggested by other group members, the 17 keV neutrino search in the beta decay being one such. Indeed this was the first experiment that cast doubts about the existence of the 17 keV neutrino. After the Pelletron started operating at TIFR, he started a programme of studying heavy ion reactions around the Coulomb barrier. He moved back to TIFR in 1983. He was an active member of the TIFR collaboration with Pune University for the M.Sc. (Physics) programme during 1987–1989.

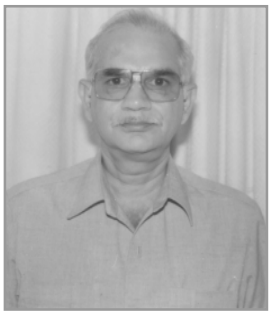
In the last decade after his retirement he used to spend time at NSC giving lectures on nuclear physics to the Ph.D. students there. He also lectured at several university departments. In his interactions with theorists, he contributed much to their understanding of experiments. He even collaborated on purely theoretical projects; this included such varied topics as neutrino physics and the quantum hall effect.

Baba had a pivotal role in most of the major projects in nuclear physics in the country. He was an active supporter of the on-going effort to build an underground laboratory devoted to neutrino physics. He did the early ground work with some colleagues at the Institute of Mathematical Sciences, Chennai where he was a regular visitor after his retirement from TIFR, to identify the site for locating the underground laboratory. The choice of the magnetized iron calorimeter detector as the main detector was also in no small measure due to him. Making a success of this project including the other planned experiments there, such as the neutrino-less double beta decay experiment (with the ^{124}Sn cryogenic bolometer), would be a fitting tribute to his memory.

Above all, Baba was a great human being loved by his colleagues, students and just about any one who got

to know him. He was vehemently opposed to the misuse of science; in particular, when nuclear tests and weapons were justified in the name of science and security. He enjoyed listening to music especially North Indian classical music, and maintained a large personal collection. He learnt to play the violin, but was hesitant to play it in front of others.

Baba leaves behind his wife Sukanya, a daughter (Prasanna) and a son (Srinath).



Ravinder Lal Kapur (elected 1977) was born on 7 July 1938 at Lahore in Pakistan to Mohan Lal Kapur and Vidyavati. After his schooling, he did his MBBS in Amritsar in 1960 and a Diploma in Psychological Medicine in 1965 from the All India Institute of Mental Health and Neurosciences (now known as NIMHANS) in Bangalore. He then left for England to work at the Department of Psychiatry in University of Edinburgh first as a commonwealth Medical Fellow (1966–67) and then as a Research Assistant (1967–70). During this period he completed his Ph.D from Edinburgh and the topic was a prospective epidemiological enquiry into factors related to failure and dropout amongst roughly 2000 students admitted to Edinburgh University in 1967. A number of social, psychological and academic factors were found to be related to wastage amongst the cohort and were combined to form two different kinds of prediction scales. One of the scales used the statistical technique of multiple regression and the other was based on a common sense unweighted procedure. Both the scales predicted the outcome with nearly 70% efficiency at given cut-off points. The multiple regression scale was also cross-validated.

Returning to India he joined the Kasturba Medical College in Manipal as professor and head of the Department of Psychiatry between October 1971 and September 1975. In 1975 he joined NIMHANS, Bangalore as a professor of community psychiatry and continued there until 1983 when he joined the Indian Institute of Science as a visiting professor. In 1987 he joined the newly founded National Institute of Advanced Studies (NIAS) again as a professor of the Department of Health and Human Behaviour and later as Deputy Director. He continued at NIAS until his end.

Kapur's research interests include psychiatric epidemiology, cross-cultural psychiatry, student mental health and evaluation of mental health programmes. His epidemiological training helped him to devise and conduct a four-year long cross-cultural study of mental disorder in collaboration with G.M. Carstairs. The aim of the study carried out in a village of nearly 10,000 population was to compare the frequency and patterns of mental disorder amongst three South Indian communities who lived in the same district but showed some striking differences in their way of life. Two of the communities were matrilineal and one was patrilineal. Before conducting the inquiry through a population survey a number of preparatory studies were carried out. One aimed at the development of a structural interview schedule suitable for the local context and testing of its reliability. Another was a socio-anthropological study on a participant-observer model to know more about the three communities. Attitudes of the communities towards modernization and towards the use of traditional healers for psychiatric problems were also examined. During the main survey every one with one or more symptoms was asked if he or she had consulted any one for the relief of symptoms. Social functioning of those with symptoms was compared with those without, through a specially prepared social functioning questionnaire. Finally an attempt was made to assess the degree of psychiatric need amongst those with symptoms with the help of a 'need scale' constructed on the basis of 'number of symptoms', 'consultation' and subjectively declared inability to cope and also as a book. The results of the above study were published in a series of papers.

His research interests then moved towards 'evaluation' and when acting as a temporary adviser to WHO mental health office in Geneva in 1974, he submitted a research proposal for evaluating low cost mental health programmes in developing countries.

Kapur founded the Department of Psychiatry in Kasturba Medical College as well as the Department of Community Psychiatry at NIMHANS. The latter involved evolving innovative strategies for community involvement in mental health. He did intensive research on the psychological and experimental aspects of yoga. At NIAS, he was engaged in understanding the psycho-social construct of violence in a multicentred study across the country and another study to elucidate the nature of creativity in Indian scientists. He was also involved in studying the large incidence of suicide tendencies among the student community in Indian Institute of Science and helped reduce such tendencies through a counselling mechanism.

Kapur received many awards. Murthy Rao Gold Medal for best performance in his D.P.M. examination; the first Marfatia award (1971); the Hari Om Ashram Alembic Award (1977), Poona Psychiatric award and Bhagwat Award of the Indian Psychiatric Society (1982) and Eminent Psychiatrist Award (1992–93). He was elected Fellow of the Royal College of Psychiatrists and the National Academy of Medical Sciences. His writings include a book "Great University of Kota" (Hogarth, 1976), two edited books "Mind approaches to its understanding" and "Psychotherapeutic processes".

Kapur passed away on 24 November 2006 while on a visit to Italy. He leaves behind his wife Malvika and they have a son and a daughter.

Pabitra Kumar Maitra (elected 1975), a pioneer in the field of yeast biochemical genetics, passed away after a brain haemorrhage in a Kolkata nursing home on 4 September 2007.

Maitra was born on 1 November 1932 in Mazda, a small town in the Nadia district of West Bengal. He attended school in Krishnagar in the same district. He obtained his Bachelor's, Master's and PhD degrees from Calcutta University during the period from 1952 to 1960. His doctoral research, under the guidance of S.C. Roy of the Department of Applied Chemistry, dealt mainly with the biochemical regulation of certain metabolic pathways of *Streptomyces olivaceous*. He then joined the Johnson Foundation, University of Pennsylvania, where he worked with Britton Chance and Ronald Estabrook on the bioenergetics and regulation of cellular metabolic pathways, with particular focus on baker's yeast *Saccharomyces cerevisiae* as a model system. During this period he developed sensitive flurometric assays for the enzymes and inter-mediates of the glycolytic pathway. These assays have since been used widely to monitor glycolytic reactions and their rates *in vivo*. A noteworthy out-come of these studies was the discovery of oscillations in this pathway.

After his return to India, Maitra joined the Molecular Biology Unit of the Tata Institute of Fundamental Research, as one of its first members, in 1963. Here, he and his colleagues, notably Zita Lobo (whom he later married in 1977), worked on the biochemical genetics of *Escherichia coli* and *S. cerevisiae*. His group made distinctive contributions to the field of bioenergetics, in particular to the understanding of glycolysis in its steady and oscillatory states. Early in his work he developed sensitive fluorometric techniques to monitor glycolytic reactions and used these techniques to study the steps that control the rate of glycolysis *in vivo*. His work led to the idea that certain reactions in this biochemical pathway may approach equilibrium although the total system supports a net flux. An interesting result of this work was the discovery of oscillations in this reaction sequence.

Maitra and his collegues studied the induction of the enzymes involved in glucose utilization and the metabolites that regulate these enzymes, They have shown that the apparent constitutive synthesis of glycolytic enzymes results from the presence of endogenous inducers and have identified the key metabolites involved in the induction process in yeast and bacteria. Later they isolated genetic mutants defective in the structural genes for several glycolytic enzymes opening a new approach to the study of glycolysis. Maitra along with S. L. Chakrabarti investigated the effect of ribosomal mutations on the fidelity of translation. Their work showed that mutations in ribosomes led to changes in the structure and kinetic properties of enzymes synthesized on these ribosomes. Maitra's work on glycolysis also led to the discovery of a new glucokinase in yeast.

Maitra is thus a leading expert in the field of glucose metabolism. He is a member of International Cell Research Organization's panel of experts of Energy Metabolism and a member of the editorial board of the Journal of Molecular and Cellular Biochemistry.

After superannuation from TIFR Maitra settled down at Pune working at the Agharkar Research Institute. Even though he spent only a relatively short period of time at the Agharkar Research Institute, he is remembered there even today for having completely rejuvenated the student community at that institute. He was a remarkable guide to his students, both academically and otherwise, and inculcated in them a philosophy of practising science that was strikingly different from what appears to be the norm in Indian science today.

Apart from science, Maitra was passionate about other good things in life – sports, particularly football (he was diehard supporter of the Mohun Bagan Football Club of Kolkata), Hindustani classical music, Bengali folk music and Rabindrasangeet, literature and of course, food and Bengali sweets. He would

often announce seminars on the applications of glycolysis to human life and serve rossogollas that he had carried for the entire department all the way from Kolkata!

Rangaswamy Narasimhan (elected 1966), considered the father of Indian computer science research, passed away on 3 September 2007. He was born on 17 April 1926 at Madras. After his schooling, he obtained his B.E (Hons) degree in telecommunications engineering in 1947. In 1949 he received his MS in electrical engineering from CalTech (Pasadena) and then proceeded to the Indiana University in USA for his M.A and Ph.D in mathematics in 1953 and 1954 respectively.

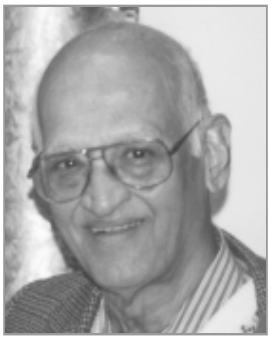
He joined the Tata Institute of Fundamental Research (TIFR) in 1954 as a research fellow and worked on the logical and system design of TIFRAC, the first digital computer to be designed, built and operated in India. A three-year stint at the university of Illinois as a visiting faculty member (1961–64) enabled him to work on the development of computational techniques for processing pictures in digital computer. He also developed a model for visual data processing. Returning to TIFR in 1964 as Associate Professor and Head of the Computer Group and CDC-3600-160A computer installation, he became a full professor in 1966 and Senior Professor in 1973. He was also designated as Director, National Centre for Software Development and Computing Techniques which was set up in TIFR with assistance from UNDP. This Centre was renamed National Centre of Software Technology (NCST) which became the cradle for not only ERNET, the choice gateway of several academic and research institutions, but also the promotion of Internet domains in the country. NCST – certified courses in software, the epitome of quality education, was much sought after by the industry.

At TIFR Narasimhan made important contributions in the field of pattern recognition using computers. He was able to formulate a linguistic model for pattern analysis and description – and to devise a specific algorithm based on this model for the processing of bubble chamber data and other pictures.

In the late sixties, as an offshoot of the recommendations of a three-man sub-committee, constituted under the Bhabha Committee, with Narasimhan as chairman, a national company was set up to address computer manufacture and maintenance in the country. Narasimhan was drawn into these early efforts to set up the Computer Maintenance Corporation later renamed CMC Limited and was the natural choice to be the first chairman. Narasimhan was on a sustained quest, over two decades, of developing a meta-theory of behaviour. This led him to deep research in the areas of computational modelling of behaviour, modelling language behaviour, first language acquisition, artificial intelligence in the study of agentive behaviour among others. This covered a wide range of subjects from picture processing to natural language theory to linguistics to behavioural sciences to formal mathematics. He was the first to discover an analogy between formal grammars of natural languages and the formal structures underlying picture processing. He assisted policy formulation for computer and software industry, often from behind the scenes. Other than pure research, he was also keen on how IT could be deployed to serve the bulk of the population. While he acknowledged the beneficial role of government, to the extent they were catalytic and constructive, he also encouraged the industry and the academia to jointly set up a private society to evolve and articulate their stand on the industrial and academic aspects of design, manufacturing, services and applications of computers. His campaign resulted in the setting up of the Computer Society of India in 1964 and served as its founder-President from 1964 to 1969.

Narasimhan was also interested in the role of science and technology in socio-economic change and development. To give a creative direction to early education of children, he investigated the language behaviour environment that a child is exposed to in the very early stages (9 months to 3 years) of first language acquisition. This led to an important ethological study of language acquisition behaviour. Such first language acquisition was found to have close links to the orality-literacy contrast. He showed that pre-literate oral language behaviour differs from literate language behaviour and that the former, and not the latter, has correlations with genetically prewired behaviour. Further, he showed that language acquisition in the two cases bears an analogy to the differences between connectionist AI and rule based AI, the former defined to include non-literate modes of functioning which cannot be reduced to a 'puzzle-solving' mode. He wrote a thought-providing book on this at the age of 77. These studies have revealed new paradigms for nursery and primary education of children.

Narasimhan was elected to all the three national science academies of the country, was recipient of Padma Shri (1976), the Homi Bhabha Award (1976), the Om Prakash Bhasin Award (1988) and the Dataquest Lifetime Achievement Award (1994).



Kumbakonam Viswanatha Ramanathan (elected 1975) passed away on 8 March 2007. He is well known for his pioneering efforts to establish in India a viable research and development effort in the area of semi-conductor electronics. The group he established and headed for several years at Tata Institute of Fundamental Research (TIFR) Mumbai was acknowledged to be among the leading ones in this area in India. As the Chief Executive of the Semi-conductor Complex of the Government of India, he pioneered the growth of that young institution from 1976 to 1980.

Ramanathan was born in Kumbakonam (Tamil Nadu) on 17 July 1926 and studied first at the Thiruvadumarudur High School and then at P.S. High School in Mylapore, Chennai. He studied at the Presidency College, Chennai to graduate in 1945 as B.Sc (Hons) student in physics. The rules that existed then at the Madras University meant that this degree automatically became an M.A. after a specified time. It was common those days for such physics graduates either to opt for IAS or some technical services, since very few research opportunities existed. All India Radio was one of the attractive technical services since it was a government service and Ramanathan joined AIR in 1947 and worked until 1958 as a technical assistant, first in Chennai, later in Dharwar and then on to New Delhi. When the gates of the US universities opened for Indian students for science after the world war Ramanthan went to US for graduate studies. At the University of California, Los Angeles, he was awarded the MS (Applied Physics) in 1960. After completing the course requirements for a Ph.D. degree, he joined the MTS, TRW Systems (California) and in 1962 moved to be a staff scientist at the Hughes Research Laboratories. At that time the Electronics Commission of India was active in promoting semi-conductor research and Ramanathan joined TIFR in 1964 with a mandate to set up a state-of-the art semiconductor research laboratory. The Solid State Electronics Laboratory at TIFR was then one among the very few labs in India to pioneer research and development effort for advanced work on unit processes for integrated circuits and train young graduates in this important field. During his tenure at TIFR, he was seconded to the Semi-conductor Complex of the Government of India, Chandigarh from 1976 to 1980. He retired from TIFR in 1983 but continued his involvement in this area as a visiting professor or as a visiting scientist at the University of California (Los Angeles), IBM Research (New York), Rensselaer Polytechnic Institute (Troy, NY), University of Florida (Gainesville), Australian National University (Canberra) and Indian Institute of Science (Bangalore).

Ramanathan worked in all aspects of physics of semiconductors and devices and technology with reference to integrated circuits. During the early stages he was involved in the original patent disclosure of TTL, devised dielectric isolation by chemical means, and developed a method for depositing SiO_2 on integral silicon oxide to increase the yields. Characterizing these circuits resulted in better mask designs yielding three patents. He also worked on discreet *p-n-p* design and fabrication, on the mechanism of filamentary switching in chalcogenide glasses, and the Mott prefactor problem in hydrogenated amorphous silicon. He investigated the thermal stability of MOS devices, deep levels in silicon and their gettering, properties of ion implanted oxides, XPS measurements on the effect of implanted chlorine in thermal oxides, hot electron and hole instability in thermal oxides, and modelling of three dimensional structures made by laser annealed polysilicon.

At TIFR, his group established the facilities for diffusion, ion implantation, photo resist, CVD for polysilicon deposition, epi reactor, plasma etching, plasma deposition, e-beam evaporation, and cw laser for laser annealing. Characterization equipment such as IV, CV, DLTS, four point probe, Dektak etc. were established. Computer aided tools like CAD for mask pattern generator, SUPREME and MSINC were developed. His group worked intensively in the area of large scale integration (LSI) and very large scale integration (VLSI). The TIFR effort, besides establishing an outstanding facility for fabrication of novel semiconductor devices, made substantial contribution to the basic understanding of semi-conductor device processes. The main fallout from the TIFR's R&D effort is: (a) the TTL (gold doped) version and the Schottky TTL developments were subsequently transferred to manufacturing units, and (b) along with his coworkers a facility for R&D

and manufacture of LSI devices was established at the Chandigarh Semiconductor complex.

After TIFR, his research on solid phase epitaxy of silicon helped build a molecular beam epitaxy system to study strained layer superlattices. The area of low energy (> 1000 eV) reactive (oxygen) ion beam synthesis of oxides of transition metals like Cr, Cu to produce very thin films was studied. The transport properties, the structure, the oxidation state, the morphology etc were studied by Squid magneto-meter, X-ray diffraction, transmission electron diffraction, XPS and SEM and the composition of the films by nuclear back scattering. It was found that the energy, the flux, and substrate temperature had a phenomenal effect on the composition and structure. These studies show the existence of a new, as yet unidentified, phase with unusual properties and resulted in patent disclosures.

Ramanathan shares four patents: original patent for co-inventing the TTL computer circuits (1962); deposited oxide (1962); dielectric isolation by chemical etching (1962) and low energy ion beam synthesis (1986).

Ramanathan's contributions to solid state electronics were recognized by awards such as Vasvik and a gold medal for original contributions to solid state electronics in 1986. He was a member of the committees of the Government of India which went into several aspects of semiconductor electronics. He was also a consultant to UNIDO in Vienna.

Ramanathan was a multifaceted person. He is rare among scientists in that he held license as a full pilot for a single-engined plane. He was fond of Carnatic music and on the whole enjoyed life. He was friendly and ever keen to share his views with others.

He settled down in Chennai since 1995. He leaves behind his wife Radha, a son and two daughters.

Udai Narain Singh (elected 1975) was born on 1 January 1931. After his schooling, he graduated from the University of Calcutta and then had his early training in physical chemistry at the Banaras Hindu University (1952–54) and university of Pennsylvania (1956–57). He obtained his Ph.D from the university of Chicago in 1963 and worked for a brief period at the McGill Montrial General Hospital between 1963 and 1965. In 1966 he joined TIFR, Mumbai and worked there for 20 years. In 1986 he moved to the university of Delhi.

After his early interest in physical chemistry he changed over to biophysics and biochemistry. Among his early contributions in this area was the development and application of a quantitative analytic method for the evaluation of isotope incorporation data in animal cells. He used this approach to demonstrate the precursor product relationship between nuclear and cytoplasmic RNA. Subsequently this approach proved to be of general applicability to a variety of problems such as the replication of viruses and maturation of ribosomal RNA.

At TIFR he worked on different aspects of synthesis of RNA and protein. During this period he developed a stochastic model of protein synthesis on labile templates which provides a framework for co-ordination of transcription, translation, and degradation of messenger RNA in microorganisms. This model provides the rational basis for a variety physiological phenomena such as the size distribution of poly ribosomes and the rapidly labelled RNA, distribution of nascent peptides, and the temporal relationship between the synthesis of enzymes and its mRNA.

Singh and his students investigated the biogenesis of ribosomes in *E. coli* using a quantitative immuno-chemical technique. His work led to the suggestion that the ribosomal proteins in *E. coli* are synthesized in a coordinate manner and the free proteins in the pool function as a positive control element in the synthesis of ribosomal RNA. He has shown that the genes for 16 S and 23 S ribosomal RNA are contiguous and involve a common initiation site.

Singh passed away at Varanasi on 31 December 2006. He remained a bachelor.

Veeravalli Venkata Ranga Varadachari (elected 1974) was born on 1 July 1925 in an orthodox family in Gutala, a small village on the banks of river Godavari in Andhra Pradesh. After completing his primary and secondary education , VVR obtained his B.Sc (Hons) degree in physics in 1948 from the Andhra University and the M.Sc degree in meteorology and oceanography in 1949 with a second rank from the university. On completion

of this course, VVR worked as a member of the teaching faculty in the Department of Meteorology, and Oceanography of the Andhra University before proceeding to the Florida State University in Tallahassu (USA) on a research fellowship. At Florida he worked with Seymour L. Hess in the Department of Meteorology, which was then an US Air Force advanced training centre in meteorological forecasting.

VVR returned from Florida in 1956 with an MS degree in fluid dynamics. Back at Andhra University, he continued his career as a teacher at postgraduate level in meteorology and oceanography to make significant contributions to teaching, planning and organizing oceanographic cruises in the seas around India, and formulation of marine science programmes in several Indian Universities having postgraduate courses in physical oceanography and meteorology. Varadachari made significant contributions to oceanography in India. His main contributions are in the areas of physical and dynamical aspects of upwelling along the Indian Coast line, ocean currents, water masses, submarine canyons, wave refraction and littoral currents along the Indian coast line, circulation in the seas around India, coastal oceanography and coastal zone management, particularly on problems of beach erosion, mud banks along the Kerala coast, rip currents, harbour sedimentation, bar formation near river months, dispersal of effluents in the nearshore environment, and the role of oceans and ocean variables on the Indian Southwest monsoon. His basic researches triggered applied researches and led to several sponsored projects in coastal oceanography.

VVR joined the National Geophysical Research Institute (NGRI) at Hyderabad in September 1962 and shortly thereafter moved to Cochin as Senior Scientist with Oceanographic Research Wing (ORW) of NGRI. He was a leading Indian Oceanographer to participate in the International Indian Ocean Expedition (1961–65). On completion of the expedition, the ORW under NGRI became the nucleus for the formation of the National Institute of Oceanography (NIO) in January 1966. VVR shifted his place of work from Cochin to Goa, and continued to serve NIO till his retirement in July 1985. He formulated research programmes in physical oceanography, as Head of the Physical Oceanography Division of NIO right from its inception in 1966, and in various aspects of marine sciences, as the Director of the Institute from 1981 to 1985. He provided logistic support for the first scientific expedition to Antarctica.

VVR was elected a Fellow of all the three national Academies of the country, and a founder Fellow of the Indian Geophysical Union. He served as a Member Secretary of the Indian National Committees for Scientific Committees on Oceanic Research (SCOR) and was elected Vice-Chairman of the Joint SCOR/IOC committee on climatic changes and the Ocean (CCCO). He represented India in many international conferences of the Intergovernmental Oceanographic Commission and contributed to the preparation of the document on 'Ocean Sciences for the year 2000' published by IOC/UNESCO. At NIO, under his directorship VVR played a key role in organizing the four Indian scientific expeditions to Antarctica from 1981 to 1984, and NIO received the status of "pioneer investor" in the survey of "polymetallic nodules" in the Indian Ocean.

Varadachari was married to Kamala who passed away leaving two sons and four daughters. Subsequently, he married Radha who also predeceased him.

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