No. 58

Patrika

September 2013

Newsletter of the Indian Academy of Sciences

TWENTY-FOURTH MID-YEAR MEETING

JULY 5 – 6, 2013

This year, the Mid-year Meeting of the Indian Academy of Sciences, Bangalore, was held between 5th and 6th July 2013 at the Indian Institute of Science. This was preceded by an interactive session held for teachers of under-graduate courses from institutions across the country. The aim of this session was to facilitate discussions on how science education in the country can be further improved, including the many different teaching methods adopted by teachers.

The talks covered varied topics from public health to solar cells and astrophysics to wireless communications and were delivered by the newly elected Associates and Fellows of the Academy. Special lectures by S. Sivaram and Deepak Pental and a public lecture by Jacob John were also organised as a part of this meeting.

The role of plastic in degradation of the environment is well-known and researchers worldwide are trying to find eco-friendly solutions to this problem. The meeting opened with a special lecture by **S. Sivaram** (NCL, Pune), whose talk focussed on the challenges encountered in developing a biodegradable form of plastic using aliphatic polymers.

Inside....

EDITOR

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Forthcoming Events

Seventy-Ninth Annual Meeting, Chandigarh — 8 – 10 November 2013

Refresher Courses

- Statistical Mechanics — 6 – 19 November 2013
  Homi Bhabha Centre for Science Education, TIFR, Mumbai
- Experimental Physics – LIII — 7 – 23 November 2013
  Indian Academy of Sciences Facility, Jalahalli, Bangalore
- Evolutionary Ecology of Plants and Animals — 11– 26 November 2013
  PSGR Krishnammal College for Women, Coimbatore
- Quantum Mechanics — 28 November – 12 December 2013
  Indian Institute of Technology, Roorkee
- Quantum Mechanics — 2 – 14 December 2013
  J.S.S. Educational Institutions, Suttur
- Theoretical Physics — 2 – 15 December 2013
  Assam University, Silchar
- Experimental Physics – LIV — 9 – 24 December 2013
  IISER, Pune
- Experimental Physics – LV — 9 – 25 January 2014
  University of Kota, Kota
- Experimental Physics – LVI — 11 – 26 February 2014
  Panjab University, Chandigarh

Lecture Workshops

- New Vistas in Topology and Analysis — 6 – 8 November 2013
  St. Joseph's College, Irinjalakuda
- Advances in Molecular Spectroscopy — 20 – 21 November 2013
  University of Calicut, Kozhikode
- Modern Trends in Chemistry — 20 – 22 November 2013
  Tezpur University, Tezpur
- Biowaves: The Pulse of Biology — 29 – 30 November 2013
  St. Xavier's College, Mumbai
- Trees of Life — 11 – 12 December 2013
  Jai Hind College, Mumbai
- Sense and Sensibility — 20 – 21 December 2013
  Sophia College, Mumbai
- Dynamical Systems — 26 – 28 December 2013
  PSGR Krishnammal College for Women, Coimbatore
- Excursions in Mathematics — 27 – 28 December 2013
  Jain University, Bangalore
- Fluid Dynamics — 7 – 9 January 2014
  Bharathiyar University, Coimbatore
- Fascinating Chemistry — 20 – 21 January 2014
  Malda College, Malda

The second special lecture, by **Deepak Pental** (University of Delhi South Campus, New Delhi), was on the use of transgenic crops which had drawn criticism and controversies globally. Pental's talk focussed on the advantages of using transgenic hybrids to improve crop yield and combat disease outbreaks. The speaker cited the example of mustard (*Brassica juncea*) which is grown on 6-7 million hectares of land in India and is often affected by diseases like stem rot, white rust and alternaria blight, for which no treatment have been found so far, leading to loss of yield. According to Pental, switching to transgenic plant varieties developed using new biological tools and markers, is a safe way to tackle this problem. Pental also mentioned the need to set up multiple plant breeding centres to help address problems such as the role of various genes and linkage drag that plant breeders face.

Application of the latest scientific research findings to the field of public health is not just important but a necessity. **T. Jacob John** (Vellore) in his public lecture spoke on India's long battle in fighting polio and reaping success. However, there have been a few reported cases of polio outbreak recently, which are vaccine-derived polio virus diseases. Studies conducted both by John and others have strongly suggested several advantages in using IPV over OPV. He stressed on how vaccine-associated paralytic polio is an effect of using oral vaccination. Several countries in Europe and also the USA have benefitted from switching over to IPV, and he highlighted the need for India to do the same.

With the current global energy crisis, research on solar cells have gained interest worldwide. Numerous scientific groups have been looking at making low-cost, high-efficiency solar cells by harnessing solar energy. **H. N. Ghosh** (BARC, Mumbai) in his talk highlighted the recent research advances in the making of dye-sensitised and quantum dot solar cells, and discussed the challenges in designing an energy efficient cell. **S. Baskaran** (IIT, Chennai) spoke of the advantages of domino reactions especially in the field of environment and gave us an insight of his research on domino-based strategies towards the stereo-selective synthesis of biologically active molecules. **S. Shankaranarayanan** (IISER, Thiruvananthapuram) spoke on higher derivative theories and quantum phase transitions and its implications on condensed matter systems and black-hole entropy. **Prahladh Harsha** (TIFR, Mumbai) spoke on communication complexity and its recent successes. **Amiya Kumar Pani**'s (IIT, Mumbai) talk looked at the ways in which traditional mathematics differed from the new framework followed today, its objectives and the need to have a relook on mathematical research as its done today.

The field of wireless communication has seen rapid growth during the past decade. Most of the devices for wireless communication, including mobile phones, at present, use one antenna to transmit and another to receive signals. Speaking on his area of research, **B. Sundar Rajan** (IISc, Bangalore) said using multiple antennas will enormously help increase both data rate and reliability. **Amol Dighe** (TIFR, Mumbai) spoke on particle astrophysics of neutrinos and how observing the nature of the neutrinos can help in studies related to supernova astrophysics. **T. K. Nayak** (VECC, Kolkata), in his talk on the Large Hadron Collider, discussed the discovery of quantum chromodynamics and the present understanding of its phase diagram based on data acquired from STAR and ALICE experiments. **M. Durga Prasad** (University of Hyderabad, Hyderabad) discussed, in his talk on the electronic structure perspective of the promoter modes in proton transfer reactions, the implications of electron donation into sigma orbitals on the rest of the vibrational degrees of freedom. **K. N. Raghavan** (IMSc, Chennai) delivered an interactive talk on invariant theory and standard monomial theory and explained the study of invariant functions and how it leads to the standard monomial theory with examples.

Debasis Chattopadhyay's (NIPGR, New Delhi) talk on protein kinases in plants discussed his research on CIPKs identified from the plant Arabidopis and their involvement in plant development and stress signalling, highlighting their role in transporting the plant hormone auxin. **V. K. Sharma** (JNCASR, Bangalore) spoke on the entrainment of fruit fly *Drosophila melanogaster* circadian clocks under natural conditions and focussed on his experimental research to study the behavioural responses of the wild-type strains of fruit fly to changes in natural light conditions. **Uday Bandyopadhyay** (IICB, Kolkata) spoke about a newly designed gastro-protective molecule SEGA of therapeutic potential against gastric ulcers caused due to consumption of non-steroidal anti-inflammatory drugs or pain killers. **Bhaskar Saha** (NCCS, Pune) delved into the subject of devising therapeutic strategies against protozoan Leishmania that infects macrophages.

Public health is a matter of great concern with the rapid global spread of epidemics and viral outbreaks. The rapid spread of the H1N1 virus and subsequently the H5N1 virus caused worldwide panic and India's capability to cope with epidemics was questioned. **A. C. Mishra** (NIV, Pune) in his lecture spoke on how the lessons learnt in the previous years and also new research on the influenza viruses have helped India to be better prepared to tackle and treat avian influenza and other such viral epidemics. Another matter of grave concern is the steep rise in the number of TB cases in India. With over 2.2 million cases of TB, the World Health Organization has placed India in the "high TB burden" category. **Soumya Swaminathan** (National Institute for Research in Tuberculosis, Chennai) raised her concern on the non-availability of biomarkers for tuberculosis that makes follow-up of recurrence or relapse cases difficult. She mentioned how failing to test for tuberculosis using the DNA PCR method had caused delays in diagnosis and treatment in children and also that around 5% of the tuberculosis patients in south India were also infected with HIV.

S. K. Pati's (JNCASR, Bangalore) lecture focussed on the transport in the DNA system and the magnetic interactions within a modified helix of the DNA with magnetic ions such as Cu^{2+}, Mn^{2+}, Ni^{2+}, Co^{3+} and Fe^{3+}. **B. J. Rao** (TIFR, Mumbai), in his talk titled on the spatial movements of chromosomes that facilitate their repairs, spoke on the non-random organization of chromosome territories in mammalian interphase nuclei.

N. V. Chalapathi Rao (BHU, Varanasi) spoke on his research on kimberlites from the Indian cratons relating to the spatial extent of Purana sedimentary basins and the origin of the Deccan flood basalts.

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SEVENTY-NINTH ANNUAL MEETING, Chandigarh

8 - 10 NOVEMBER 2013

Programme

8 November 2013 (Friday)
Venue: Panjab University

0930–1100 **Inauguration & Presidential Address**
Dipankar Chatterji, IISc, Bangalore
Stress management, the bacterial ways

1200–1300 **Lectures by Fellows/Associates**

1200 **Avesh K. Tyagi,** BARC, Mumbai
Rational design of new functional materials

1220 **Sourendu Gupta,** TIFR, Mumbai
Little bangs

1240 **Rajan Dighe,** IISc, Bangalore
Hormones, receptors and antibodies

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

1400 **S. A. Haider,** PRL, Ahmedabad
Meteoroid ablation in the Martian atmosphere: Observation and modelling

1420 **S. Gopalakrishnan,** IISc, Bangalore
Wave propagation in nanostructures

1440 **Jaya N. Iyer,** IMSc, Chennai
Tertiary classes – after Chern-Simons theory

1530–1730 **Symposium on Cyber Security and Privacy**

1530 **N. Balakrishnan,** IISc, Bangalore
Social media, analytics and national security

1600 **P. K. Agarwal,** Power System Operation Corporation Ltd, New Delhi
Security challenges for the power grid/smart grid infrastructure

1630 **Gulshan Rai,** ICERT, New Delhi
Cyber laws

1700 **R. K. Shyamasundar,** TIFR, Mumbai
Towards a science of cybersecurity

1800–1900 **Public lecture**
Jayati Ghosh, JNU, New Delhi
Demographic dividend or ticking time bomb?

9 November 2013 (Saturday)
Venue: CSIR – IMTECH

0900–0940 **Special Lecture**
Girish Sahni, CSIR – IMTECH, Chandigarh
Exploiting enzyme mechanistic insights for the design of improved clot buster (thrombolytic) therapy

0940–1020 **Lectures by Fellows/Associates**

0940 **G. Narahari Sastry,** IICT, Hyderabad
Cooperativity of non-covalent interactions

1000 **Madan Rao,** RRI & NCBS, Bangalore
Mechanics of information processing and computation in cells

1050–1300 **Symposium on Food and Nutritional Security**

1050 **B. S. Dhillon,** Punjab Agri University, Ludhiana
Innovations for adding value to agriculture

1120 **V. Prakash,** JSS Group of Technical Institutions, Mysore
Food and nutrition security from farm to folk

1150 **T. R. Sharma,** IARI, New Delhi
Plant genome analysis for accelerated gene discovery

1220 **Rakesh Tuli,** National Agri-Food Biotechnology Institute, Mohali
Safer GM crops: Opportunities for innovations

1400–1540 **Lectures by Fellows/Associates**

1400 **Souvik Maiti,** IGIB, Delhi
Interfering with interference: Targeting the RNAi pathway using small molecules

1420 **Sangita Mukhopadhyay,** CDFD, Hyderabad
PPE18 protein functions as a virulence factor during Mycobacterium tuberculosis infection

1440 **Bhim Singh,** IIT, New Delhi
Power quality problems and their mitigation

1500 **G. Mugesh,** IISc, Bangalore
Deiodination of thyroid hormones

1520 **Krishnendu Sengupta,** IACS, Kolkata
Junctions of topological insulators

1610–1730 **Business Meeting of Fellows**

1830–1930 **Public Lecture**
Shivshankar Menon,
National Security Advisor, PMO, New Delhi
Science and security

10 November 2013 (Sunday)
Venue: IISER, Mohali

0900–0940 **Special Lecture**
Anil Kumar, IISc, Bangalore
Quantum computation and quantum information processing by NMR: Introduction and recent developments

0940–1300 **Lectures by Fellows/Associates**

0940 **Subi J. George,** JNCASR, Bangalore
Supramolecular synthesis of functional materials

1000 **Sharad S Sane,** IIT, Mumbai
Combinatorics of block designs and finite geometries

1050 **Arun K. Pati,** HRI, Allahabad
Weak measurement and quantum correlation

1110 **Vijayakumar S. Nair,** VSSC, Thiruvananthapuram
Climate implications of soot on snow

1130 **Debashis Mitra,** NCCS, Pune
Host factors in HIV-1 pathogenesis and novel strategies targeting the virus

1150 **Thomas J. Pucadyil,** IISER, Pune
Reconstitution of membrane fission reactions

1210 **Kirti Chandra Sahu,** IIT, Hyderabad
Double-diffusive instability in viscosity-stratified flows

1230 **Sujit K. Ghosh,** IISER, Pune
Structural dynamism and functional studies of porous coordination polymers

ASSOCIATES – 2013

Sanjib Kumar Agarwalla
Institute of Physics, Bhubaneswar
Particle Physics, Dark Matter

Melinda Kumar Bera
Indian Institute of Science Education and Research, Nadia
Sedimentology, Sequence Stratigraphy, Stable Isotope Geochemistry, Evolution of Himalayan Foreland, Indian Monsoon

Neena Gupta
Indian Statistical Institute, Kolkata
Commutative Algebra, Affine Fibrations, Affine Spaces

Vishwesha Guttal
Indian Institute of Science, Bangalore
Theoretical Ecology & Evolution, Ecosystem Dynamics, Collective Animal Behaviour

Rajan Jha
Indian Institute of Technology, Bhubaneswar
Optical Sensors, Optical Fibre-based Devices, Plasmonics

Ulaganathan Mabalirajan
Institute of Genomics & Integrative Biology, Delhi
Allergy & Asthama, Mitochondrial Biology, Drug Discovery

Debabrata Maiti
Indian Institute of Technology, Mumbai
Organometallic Chemistry, Bioinorganic Chemistry, Synthetic Catalysis

Abha Misra
Indian Institute of Science, Bangalore
Graphene-based NEMS/MEMS Devices, Fuel Cells, Sensors & Actuators

Gopalan Rajaraman
Indian Institute of Technology, Mumbai
Applied Computational Chemistry, Molecular Magnetism, Catalysis

Aswin Narayan Sheshasayee
National Centre for Biological Sciences, Bangalore
Evolution of Genomics, Gene Regulation, Microbiology

Ranjani Viswanatha
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Nanomaterials, Spectroscopy & Electronic Structure, Magnetism

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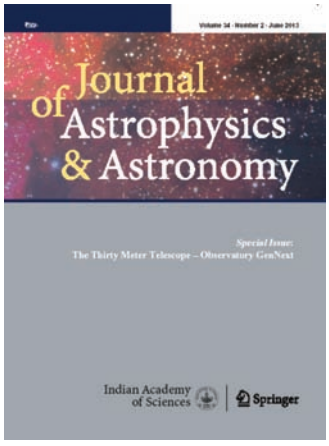
SPECIAL ISSUES OF JOURNALS

The Thirty Meter Telescope – Observatory GenNext

Editor: Ram Sagar, Aryabhatta Research Institute of Observational Sciences, Nainital

Journal of Astrophysics and Astronomy, Vol. 34, No. 2, June 2013, pp. 75 – 192



Optical Astronomy is as old as human civilization itself, since the human eye can also function as a telescope, a detector and an analyser. However, the importance, potential, and power of optical telescopes in discovering and deciphering the secrets of celestial objects was realized only about four centuries ago, when the Italian Astronomer Galileo Galilei turned a small optical telescope towards the sky and began analysing visual observations of planets such as Venus, Jupiter, Saturn, etc. These observations have revolutionized our ancient thinking that the Earth is at the centre of the Universe.

In fact, today we know that the centre of the Universe is not even in the solar system. This knowledge has been facilitated through observations with both ground- and space-based telescopes and their studied interpretations. Since the invention of the telescope, astronomers have augmented mankind's intellectual horizons, transporting our understanding of the Earth from that of a nonmoving centre of the Universe to one of several small planets around a typical small star in the outskirts of just one of billions of galaxies, all evolving in an expanding Universe in which planets are common.

The imperative need and relevance of building large optical telescopes was expressed by early astronomers. However, it was limited not only by financial resources but also by available technology. Today, technological developments in both electronics and computers have enabled the manufacturing of extremely large-sized optical telescopes to be economical and feasible. Globally, plans are underway to build three mega-sized (25 to 40 m aperture) ground-based modern optical and near-infrared optical telescopes.

Understandably, such projects are beyond the capabilities of any one nation. For example, the Giant Magellan Telescope, ~25 m in size, is led by a group of Universities in USA, Australia and South Korea, and the European-Extremely Large Telescope, ~39 m in size, led by 14 European countries and Brazil. The Thirty Meter Telescope (TMT) Project is led by a group of US institutions, namely, California Institute of Technology (CalTech); University of California and University of Yale. Other participating nations in the TMT Project are Canada, China, Japan and India. The TMT is a global effort in which all partners contribute to the design, construction, technology development, and scientific use of the Observatory. The TMT, like all telescopes with more than one-meter aperture size, is basically a reflecting telescope. But it will comprise of 492 hexagonal mirror segments, each 1.44 m in size and is planned for installation on the summit of Mauna Kea located in the island of Hawaii in the United States. Plate 3 (see page 80) shows an aerial picture of the TMT site on Mauna Kea alongwith the Canada–France–Hawaii Telescope (CFHT), and the Japanese Subaru and Keck Telescopes. The estimated cost of the TMT project is ~1.4 billion. With TMT, it will be possible to study the Universe as never before and find answers to many of the grand challenges of Science.

This special issue of the *Journal of Astrophysics and Astronomy* (Vol. 34, No. 2, June 2013) published by the Indian Academy of Sciences, aims to inform the learned Indian scientific community about India's participation in this multinational mega project and highlight its important technical aspects. The article by Gary H. Sanders, Project Manager of TMT, elaborates on the issues concerning participation of institutions and countries, the technological challenges present in the project, the key science programmes which TMT will enable as also the unprecedented gains in both light gathering power and angular resolution imaging capabilities of the TMT.

India's participation is at about the 10% (~140 million USD) level and will be jointly funded by the Department of Science and Technology (DST) and Department of Atomic Energy (DAE). The Indian activities are being coordinated by the India TMT Coordination Centre (ITCC), located at Indian Institute of Astrophysics, Bengaluru. B. Eswar Reddy, Director of this centre, in his article, shares salient details of the scientific justification and status of the technical participation of Indian astronomers as well as of Indian companies. India's proud participation in the TMT project is recognition of its growing stature in global multi-wavelength observational astronomy.

Photons collected by a telescope need to be analyzed to carry out frontline science. Back-end instruments mounted on a telescope are therefore extremely valuable. To realize its full scientific potential, TMT will be equipped with a suite of first-generation instruments. These details find description in the article written by Luc Simard, who heads the TMT instrumentation group. This article describes the capabilities and technical details of the first light science instruments. It also informs the reader about a diverse set of new instruments, now under study, that will bring additional workhorse capabilities to serve the scientific interests of a wider user base and also offer a wide range of opportunities to all TMT partners. Despite its extremely large size, the TMT will be a ground-based telescope. As a consequence, images of celestial objects formed by the TMT will be blurred by turbulences present in the Earth's atmosphere. These distortions can now be countered using a technique called adaptive optics (AO). The article by Brent Lee Ellerbroek, an expert in the field, provides a status on the TMT adaptive optics programme. The AO system uses a bright point source of light in the sky as a reference beacon to measure turbulences produced by the Earth's atmosphere. For TMT, China is to provide the *Laser Guide Star Facility* which will act as a bright star in the sky. The first light AO facility for TMT consists of the narrow field infra-red AO system and the associated Laser Guide Star Facility. This instrument is capable of providing diffraction-limited images in J, H and K photometric bands over 17–30 arc sec diameter fields. Progress in AO components prototyping, control algorithm development and system performance analyses are also presented in the article by Ellerbroek.

Considering the fact that vital diagnostics are present in the domain of optical astronomy, TMT can provide valuable complementary optical follow-up observations of extragalactic radio observations carried out by the Indian Giant Meter Radio Telescope, built and operated by NCRA-TIFR. C. H. Ishwara-Chandra articulates the value of such multi-wavelength observations in his article. Recent studies have proved beyond doubt that observations at optical wavelengths are essential to characterize and understand the sources detected in any other band of electromagnetic spectrum. Radio sources located beyond red shift of 5 require deep optical and near-IR observations with the capabilities of TMT. This aspect has been empha-sized taking a few science cases in radio astronomy. Sujan Sengupta delineates the importance of polarimetric observations taken with TMT in the case of exo-planetary systems discovered recently. The article suggests that even a low spectral resolution spectro polarimeter with a capability to detect linear polarization of 0.5–1% at the TMT would immensely help in understanding the atmosphere, specially the cloud chemistry of the self-luminous and resolved exo-planets. The contribution of TMT, equipped with modern first-generation back-end instruments, towards the understanding of front-line research problems in the area of the evolution of massive stars and high-red shift Universe using core-collapse supernovae and gamma-ray bursts have been effectively summarized by S. B. Pandey. The understanding of mechanisms and progenitors of these energetic events by TMT has been highlighted against the background of existing information on these objects. The TMT Infra-Red Guide Star Catalog (TMT-IRGSC) consists of stars as faint as J ~22 mag covering the entire TMT observable sky from +90 to –45 degrees in declination and is required for efficient planning and observing for this project. This important work is being carried out under the leadership of Indian astronomers. The methodology and technique used in generating this valuable catalog are detailed in the article by Smitha Subramanian *et al.,* which provides the status of this work.

India's participation in TMT will enable the Indian astronomical community to be involved with very exciting and pioneering astronomical research ranging from the study of exo-planets, to the origin and evolution of galaxies and black holes, to epochs close to the very origin of the Universe where recently high energy laboratory experiments were being carried out in Europe though on a small scale. Our involvement in TMT will catapult the Indian astronomical community into the forefront of optical and near-infrared astronomy and several key technologies related to the latest segmented mirror telescope such as edge sensor, segment support assembly, etc. would be transferred to India. This invaluable experience will help Indian industries and astronomers to develop our own 10-m or a larger segmented mirror telescope to be located on Indian soil. Besides astronomy, TMT will contribute to engineering and technology, international relations and workforce development. Given our strong theoretical background, strong quest for knowledge and our huge human resource along with the existing and upcoming multi-wavelength ground-and space-based observing facilities and international collaboration, India can certainly contribute significantly to the field of astronomy while advancing the country's indigenous technology development and growth of human resources.

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ACADEMY PUBLIC LECTURE

Type Ia supernovae and the accelerating universe

Brian P Schmidt, Nobel Laureate, Australian National University

20 August 2013
Indian Institute of Science, Bangalore

Type Ia supernovae remain one of Astronomy's most precise tools for measuring distances in the Universe. Professor Schmidt described the cosmological application of these stellar explosions, and chronicled how they were used to discover an accelerating Universe in 1998 – an observation which is most simply explained if more than 70 percent of the Universe is made up of some previously undetected form of 'Dark Energy'. Over the intervening 13 years, a variety of experiments have been completed, and even more proposed to better constrain the source of the acceleration. The lecture reviewed the range of experiments, describing the current state of our understanding of the observed acceleration and speculated about the progress in understanding Dark Energy.

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INAUGURAL JUBILEE PROFESSORSHIP OF THE INDIAN ACADEMY OF SCIENCES

Ashok Venkitaraman

University of Cambridge and the UK Medical Research Council

The Jubilee Professorship was instituted during the Platinum Jubilee Year of the Academy in 2009. One of the salient features is that the Jubilee Professor is expected to visit smaller towns and universities for delivering lectures, holding seminars and interacting with students, teachers and researchers or for scientific collaboration. The first Jubilee Professorship was awarded to Dr Ashok R Venkitaraman, University of Cambridge and the UK Medical Research Council, in 2012. Ashok R Venkitaraman holds the Ursula Zoellner Professorship of Cancer Research at the University of Cambridge, and is the Director of the Medical Research Council (MRC) Cancer Cell Unit there. He learnt and practised medicine at the Christian Medical College, Vellore, before completing his PhD at the University College London, and his postdoctoral work at the MRC Laboratory of Molecular Biology in Cambridge.

During his tenure as the Jubilee Professor, Venkitaraman delivered an Academy Public Lecture entitled “Cancer suppressor mechanisms that guard the human genome” on 2nd August 2012 at the Indian Institute of Science.

While in Bangalore, he was also able to meet and interact with the faculty and students from the Indian Institute of Science, the National Centre for Biological Sciences, St. Johns Medical College and the Mazumdar Shaw Cancer Centre in Bangalore.

During the period 5–22 August 2012 he made several visits to deliver lectures and meet interested faculty and students at smaller institutions, such as the Vellore Institute of Technology, the Amrita Institute for Medical Sciences, Cochin, and the School of Biological Sciences at Madurai-Kamaraj University, Madurai. These visits left a number of important impressions, which have been summarized in an interview published in *Current Science* (Volume 103, Issue 12, 25 December 2012).

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SUMMER RESEARCH FELLOWSHIP PROGRAMME FOR STUDENTS AND TEACHERS

The summer research fellowship programme (SRFP) for students and teachers has now become a major activity of the Academy under its science education initiatives. This programme is now jointly conducted by this Academy along with the Indian National Science Academy (New Delhi) and the National Academy of Sciences, India (Allahabad).

The following table gives information on the number of applications received and the number of fellowships offered and availed in 2013.

Subjects	Applications received		Fellowships offered		Fellowships availed	
	Students	Teachers	Students	Teachers	Students	Teachers
Life Sciences (incl. Agri. Sciences)	4872	287	610	38	532	22
Engg. & Tech.	11053	223	396	40	274	24
Chemistry	2314	165	331	62	263	45
Physics	2269	132	313	38	242	22
Earth & Planetary Sciences	916	25	179	11	144	07
Mathematics	865	52	125	13	96	06
TOTAL	**22289**	**884**	**1954**	**202**	**1551**	**126**
GRAND TOTAL	**23173**		**2156**		**1677**	

Many institutions in the country helped the programme by hosting summer fellows and providing them the necessary facilities such as laboratory support, accommodation, etc.

Table 1 gives information on the cities in which ten or more summer fellows were placed; and Table 2 lists institutions which hosted ten or more summer fellows in 2013.

Many institutions in the country have also been benefited by this programme as several of their own students and teachers were awarded summer fellowships to work at institutions elsewhere. Table 3 is a list of such institutions from where ten or more summer fellows were selected in 2013.

Table 1

Sl. No.	Cities (as hosts)	No. of SRFs
1	Bangalore	380
2	New Delhi	189
3	Hyderabad	169
4	Mumbai	168
5	Kolkata	136
6	Pune	80
7	Chennai	68
8	Thiruvananthapuram	61
9	Mohali	39
10	Bhubaneswar	29
11	Dona Paula Goa	21
12	Guwahati	21
13	Kanpur	20
14	Varanasi	18
15	Bhavnagar	17
16	Ahmedabad	16
17	Lucknow	16
18	Tirupati	15
19	Kharagpur	15
20	Allahabad	15
21	Durgapur	14
22	Karaikudi	14
23	Manesar	13
24	Dehradun	13
25	Nainital	12
26	Ropar	11
27	Mysore	10

Table 2

Sl. No.	Institutions (as hosts)	No. of SRFs
1	IISc, Bangalore	272
2	IIT, Mumbai	76
3	UOH, Hyderabad	54
4	BARC, Mumbai	52
5	IISER, Mohali	37
6	NCL, Pune	35
7	IIT, Chennai	31
8	IISER, Kolkata	25
9	IISER, Thiruvananthapuram	25
10	TIFR, Mumbai	25
11	NII, New Delhi	24
12	UOD (SC), New Delhi	24
13	CDFD, Hyderabad	22
14	NIO, Dona Paula, Goa	21
15	CCMB, Hyderabad	20
16	ICGEB, New Delhi	20
17	IIT, Guwahati	20
18	IIT, Kanpur	20
19	SINP, Kolkata	20
20	IACS, Kolkata	19
21	NGRI, Hyderabad	19
22	BHU, Varanasi	18
23	University of Calcutta, Kolkata	18
24	CSMCRI, Bhavnagar	17
25	JNCASR, Bangalore	17
26	UOD, Delhi	17
27	ISI, Kolkata	16
28	PRL, Ahmedabad	16
29	IIT, Kharagpur	15
30	NARL, Tirupati	15
31	NCBS, Bangalore	15
32	NCCS, Pune	15
33	NISER, Bhubaneswar	15
34	CMERI, Durgapur	14
35	JNU, New Delhi	14
36	CECRI, Karaikudi	13
37	IISER, Pune	13
38	NBRC, Manesar	13
39	ARIES, Nainital	12
40	Bose Institute, Kolkata	12
41	IIT, New Delhi	12
42	IMSc, Chennai	12
43	NIIST, Thiruvananthapuram	12
44	VSSC, Thiruvananthapuram	12
45	WIHG, Dehradun	12
46	IICT, Hyderabad	11
47	IIT, Hyderabad	11
48	IIT, Ropar	11
49	RRI, Bangalore	11
50	AIIMS, New Delhi	10
51	NPL, New Delhi	10
52	TIFR CAM, Bangalore	10

Table 3

Sl. No.	Institutions benefited by SRFP	No. of SRFs
1	IIT – BHU, Varanasi	51
2	University of Delhi, New Delhi	51
3	SASTRA University, Thanjavur	49
4	IIT, Roorkee	45
5	Pondicherry University, Puducherry	30
6	IIT, Kharagpur	29
7	NIT, Surat	29
8	IISER, Bhopal	28
9	University of Hyderabad, Hyderabad	27
10	NITK, Surathkal	27
11	University of Calcutta, Kolkata	27
12	NIT, Warangal	25
13	NIT, Rourkela	25
14	BITS – Pilani, Rajasthan	25
15	IISER, Pune	24
16	CUSAT, Cochin	24
17	University of Pune, Pune	23
18	Anna University, Chennai	23
19	IISER – Nadia, Kolkata	23
20	IIT, Kanpur	22
21	Andhra University, Visakhapatnam	20
22	IISER, Mohali	19
23	Jadavpur University, Kolkata	19
24	VIT, Vellore	19
25	MKU, Madurai	18
26	Bharathidasan University, Tiruchirappalli	18
27	IIT – Madras, Chennai	17
28	NIT, Tiruchirappalli	17
29	NIT, Durgapur	16
30	IIT – Bombay, Mumbai	16
31	NIT, Calicut	15
32	Thiagarajar College, Madurai	15
33	NISER, Bhubaneswar	14
34	RVCE, Bangalore	14
35	SVNIT, Surat	13
36	Presidency University, Kolkata	12
37	TNAU, Coimbatore	12
38	UM – DAE CEBS, Mumbai	11
39	BITS – Hyderabad, Hyderabad	11
40	PESIT, Bangalore	10
41	Central University of Rajasthan, Ajmer	10
42	IISER, Thiruvananthapuram	10
43	GBPUAT, Pantnagar	10
44	Tezpur University, Tezpur	10

This activity of the Academies has received enthusiastic response from both the faculty who acted as guides as well as the students and teachers who availed the fellowship.

As part of the Summer Fellowship Programme, a get-together was arranged for students and teachers in Bangalore on 21 June 2013 at IISc, Bangalore, and for those working in Delhi at the INSA premises. The Academy also arranged in Bangalore two popular lectures for the benefit of students and teachers. Rohini Godbole (IISc, Bangalore) spoke on 'The Story of Standard Model of Particle Physics and the Higgs Boson' on 13 June 2013 and Ajay Sood (IISc, Bangalore) spoke on 'Driven Soft and Granular Matter' on 21 June 2013.

A session on "Ethics in Science" was also organized for the benefit of the summer fellows in Bangalore on 21 June 2013. Ramakrishna Ramaswamy (University of Hyderabad) spoke on ethical practices in science publishing and Upinder S Bhalla (NCBS, Bangalore) spoke on "The privilege and responsibility of doing science".

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REFRESHER COURSES

Jointly sponsored by IASc (Bangalore), INSA (New Delhi) and NASI (Allahabad)

Two-week Refresher Courses continue to be another important segment of the activities of the Science Academies' programmes to enhance the quality of science education and teaching at the undergraduate and graduate levels. Refresher Courses aim at helping teachers to add value to their teaching and are designed to have direct relevance to the study materials covered in the graduate and undergraduate syllabi followed in universities and institutions in the country. The following courses were held during the last six months.

A. Refresher Courses in Experimental Physics

Five Refresher Courses in Experimental Physics were held during the period April to September 2013 under the direction of R. Srinivasan, who was instrumental in the conceptualisation and designing of the experiments. These experiments are useful for laboratory programmes at BSc and MSc levels and many universities in the country have adopted these experiments as part of their curricula. In order to conduct the Refresher Courses, a user-friendly kit containing several components has been developed and manufactured under licence by a company in Bangalore: M/s Ajay Sensors and Instruments. The experiments that can be done with the kit were listed in the earlier issues of *Patrika* including some of the new experiments that were added last year.

The following is a list of Experimental Physics Refresher Courses held with R. Srinivasan as the Course Director. These form course numbers 47 to 51 in this series.

1. XLVII. Sri Satya Sai Institute of Higher Learning, Anantapur (SSSIHL)

2 – 18 April 2013

Co-ordinator: Deepa Seetharaman (SSSIHL)

No. of Participants: 16 participants from Anantapur, Bangalore, Chennai, Mysore, Vijayawada.

Resource Persons: R Srinivasan, TG Ramesh, C Prathibha, Deepa Seetharaman, T Pramila, GVK Gayatri.

Special Lectures: Fundamental constants in physics (Dwaraka Rani Rao); Climate change and its impact on public health and agriculture (R Rama Krishna Reddy); Lasers and their applications (S Siva Sanakra Sai); Nano medicine (V Siva Subramaniyan).

2. XLVIII. Vidya Pratishthan's Arts, Science & Commerce College, Baramati (VPASCC)

14 – 29 May 2013

Co-ordinator: Mahesh Vedpathak (VPASCC)

No. of Participants: 30 participants from Ahmadpur, Akola, Dapoli, Daund, Indapur, Mumbai, Pune, Unnao.

Resource Persons: R Srinivasan, TG Ramesh, JBC Efrem Desa, RT Sapkal, Manohar Nyayate, Sadique, Manohar Naik, Neeta Srivastava, Mahesh Vedpathak, KR Priolkar ,

Special Lectures: Nanomaterials and their applications (Suresh Gosavi); composites of metal oxide nanoparticles in glasses and the application of the same in practice (Bharat Kale); superconducting ferrites and other materials (R Nagarajan).

3. XLIX. Indian Academy of Sciences, Bangalore

6 – 21 June 2013

No. of Participants: 22 participants from Ahmedabad, Ahmednagar, Aizawl, Bangalore, Calicut, Chandigarh, Faridabad, Guntur, Indore, Kachchh, Katra, Khammam, Muzaffarnagar, Mysore, Sawangi, Tirunelveli.

Resource Persons: R Srinivasan, AV Alex, TG Ramesh, Seeta Bharati, Ranjani Ashrita, G Vinitha, Sarmishta Sahu.

Special Lectures: Arindam Ghosh (IISc, Bangalore) and KS Narayan (JNCASR, Bangalore).

4. L. Indian Academy of Sciences, Bangalore

6 – 22 August 2013

No. of Participants: 21 participants from 24-Parganas, Anantapur, Bangalore, Coimbatore, Dharbanga, Hyderabad, Jaipur, Kolkata, Kota, Kurukshetra, Malappuram, Mysore, Palpara, Tirupur, Tiruvannamalai, Thrissur, Vizhinagaram.

Resource Persons: R Srinivasan, Seeta Bharati, Elankumaran Kannan, AV Alex, Sarbari Bhattacharya, TG Ramesh, Sarmishta Sahu.

Special Lectures: PS Anil Kumar and KJ Rao (both from IISc, Bangalore).

5. LI. Barkatullah University, Bhopal (BU)

16 – 30 September 2013

Co-ordinator: Vikas Shelke (BU)

B. Felicitations

Refresher Courses in Experimental Physics is one of the success stories of our science education programmes and R. Srinivasan has been the prime architect of this entire programme. Started in 2001, so

far fifty-one courses have been held across the country. Nearly 1250 persons, mostly teachers, have so far been trained to do about forty experiments in mechanics, heat, electricity, magnetism, relaxation, lock-in amplifier, phase transitions, nonlinear dynamics and optics.

On the occasion of the Fiftieth Golden Jubilee of these Refresher Courses held in Bangalore in August 2013, a special function was organised at the Academy office in Bangalore on 16 August to express gratitude to R. Srinivasan, the faculty in Goa who assisted him in this effort right from the beginning and a number of resource persons who helped run these courses.

The President of the Academy (Dipankar Chatterji), the Chairman of the Joint Science Panel (N. Mukunda), office bearers of the Academy and staff attended this happy event.

C. Other Refresher Courses

6. Traditional and Modern Approaches in Animal Taxonomy

University of Agricultural Sciences, Bangalore (UAS)

15 – 29 April 2013

Course Director: M Sanjappa (UAS)

Course Coordinators: Ramakrishna & MD Rajanna (UAS)

No. of Participants: 22 participants from Ahmedabad, Andaman, Bagalkot, Baripada, Bhuj, Delhi, Dehradun, Dharwad, Indore, Kalyani, Kasargod, Kolkata, Padanakkad, Palyamkottai, Porto Novo, Ranchi, Sagar, Solapur, Shillong, Wayanad.

Resource Persons: K Muralidhar, MA Shankar, K Narayana Gowda, S Ramani, Seenappa, Ramakrishna, M Sanjappa, G Venu, Praveen Karanth, KP Dinesh, S Bhupathy, VV Belavadi, VA Viraktamat, RR Rao, Subramanyam, Sushil Datta, K Gururaj, K Rema Devi, Ramanjuni Gowda, Vijayakumar, NG Ravichandran, KN Ganeshaiah, MD Rajanna.

Topics of Lectures: Species and species concept; taxonomy and importance of Arachnids in the animal kingdom; biogeography of the world *vis-a-vis* India; faunistic diversity of India – an overview on invertebrates; fish diversity in India; taxonomy and taxonomic impediments; life and works of Linnaeus, the father of taxonomy and tercentenary celebrations; chromosomes as a taxonomic tool; role of molecular taxonomy as an aid to traditional taxonomy; Indian amphibians; reptiles, taxonomy and ecology; role of bioinformatics in taxonomy; introduction to entomology; external & internal morphology & development; use of identification keys and classification of insects; keying insects to order; introduction to ticks & mites; animal nomenclature; role of taxonomy in biotechnological research; role of nematodes; global conventions on biodiversity; birds and their role in the ecosystem; past, present and future of Indian taxonomy; role of behavioural science as a tool to taxonomy; faunal peculiarities in the Western ghats.

7. Quantum Mechanics

St Berchman's College, Changanacherry (SBC)

1 – 14 May 2013

Course Director: HS Mani (CMI, Chennai)

Course Coordinator: Jacob Mathew (SBC)

No. of Participants: 32 participants from Alappuzha, Angul, Bangalore, Bhubaneswar, Changanacherry, Coimbatore, Dindigul, Hyderabad, Pathanamthitta, Puthanampatti, Rajahmundry, Salem, Sindhudurg, Sivakasi, Talcher, Tiruchirapalli, Thrissur, Tumkur, Udumalpet.

Resource Persons: G Rajasekaran, HS Mani, KS Mallesh and Govind Krishnaswami

Topics: Principles of quantum mechanics and its applications to atoms; quantum theory of radiation; relativistic quantum mechanics.

Special Lectures: Neutrinos and the India-based Neutrino Observatory; Standard Model, Higgs Boson and what next? (G Rajasekaran).

8. Statistical Physics

Nehru Arts and Science College (NASC), Kanhangad

8 – 21 May 2013

Course Directors: Deepak Dhar (TIFR)/Chandan Dasgupta (IISc)

Course Coordinators: R Rajesh (IMSc)/KM Udayanandan (NASC)

No. of participants: 44 participants from Alathur, Anantapur, Calicut, Coimbatore, Kanhangad, Kannur, Karaikal, Kottayam, Kozhikode, Mattannur, Madurai, Palakkad, Payyannur, Periya, Rajapuram, Ratnagiri, Roorkee, Shimoga, Taliparamba, Thalassery, Thrissur, Tiruchirapalli, Tirupathi, Ujire.

Resource Persons: KPN Murthy, Deepak Dhar, Rajesh Ravindran, Chandan Dasgupta, Subodh Shenoy, PK Mohanty, Vishnu Mayya Bannur, Sumedha, Anuradha Banerjee.

Topics of Courses/Modules: Basic concepts of statistical physics; elements of probability theory and statistics; thermodynamics; quantum statistical mechanics; interacting systems and phase transitions; stochastic processes.

9. Modern Biotechnology: Concepts and Practice

Madurai Kamaraj University, Madurai (MKU)

15-29 May 2013

Course Director: G Marimuthu (MKU)

Course Coordinators: B Ashokkumar, P Varalakshmi and N. Sivakumar (MKU)

No. of participants: 22 participants from Bikaner, Chennai, Coimbatore, Courtallam, Dindigul, Erode, Krishnan Koil, Madurai, Mangalore, Mayiladuthurai, Pilayarpuram, Surat, Tiruchirapalli, Tirunelveli, Warangal.

Resource Persons: M Krishnan, K Thangaraj, S Mohanraj, C Adithan, GR Jayandharan, N Thajuddin, P Sundaresan, M Sundararaman, R Rengasamy, C Sankaranarayanan, P Malliga, K Veluthambi, A Palavesam, G Kumaresan, R Paramasivan, G Marimuthu, S Sudhakar, K Sundar, M Muniraj, SR Senthilkumar, K Chandra Raj, K Balamurugan, P Palanivelu, Saravanan Matheshwaran.

Topics of Lectures: Characterization of lipophorin in lepidopteran insect silkworm and its role in lipid transport to developing oocytes; recombinant strains and metabolic engineering for production of 3-hydroxypropionic acid; population stratification; pharmacogenomics and personalized medicine; AAV-mediated gene therapy; microalgae: biodiversity to biotechnology; molecular genetics of inherited eye diseases and gene therapy; potent toxins of marine cyanobacteria and its pharmaceutical potentials; biofuel production from microalgae; biotechnological applications of cyanobacteria; cyanobacterial defacement; gene silencing from transgenic plant with inverted T-DNA repeats; probiotics and prebiotics; genomics for diagnostics and targeted therapeutics; molecular diagnosis of vector borne diseases: special emphasis on dengue; clock gene polymorphisms; autofluorescence of stem cell and function of Riboflavin in regeneration; helminth infection modulates autoimmunity in mice; microbial association with insects; production of recombinant proteins in high density cultures; *Caenorhabdities elegans* as a model to study molecular changes during host-pathogen interactions; cloning, characterization and over-expression of a thermophilic fungal chitinase in *S. cerevisiae*; engineering sequence specificity of nucleases.

10. Foundation of Physics

Bengal Engineering Science University, Shibpur (BESU)

22 – 31 May 2013

Course Director: AK Mallik (BESU)

Course Coordinator: BK Guha (BESU)

No. of participants: 95 school students from 24 Paraganas (North and South), Durgapur, Hooghly, Howrah, Kolkata, Midnapore.

Resource Persons: AK Mallik, BK Guha, HC Verma, SS Sarkar, Joydeep Mitra, Partha Ghosh, Hiranmoy Saha, Bhupathi Chakrabarti, Birendrananth Das, Swapan Datta, Surajit Chakraborty.

Topics of Lectures: Newtonian mechanics and nonlinear dynamics; optics; quantum theory; electricity, magnetism and special theory of relativity; thermodynamics and statistical mechanics.

Special Lectures were given on: Solar photovoltaic cells (Hiranmoy Saha); fundamental particles (Partha Ghosh); importance of the works of Bohr and Mosley (Bhupati Chakrabarti).

11. Updates on Biology of Infectious Diseases

Haffkine Institute for Training, Research & Testing, Mumbai (HI)

22 September – 5 October 2013

Course Director: Tarala D. Nandedkar (NIRRH, Mumbai)

Course Coordinator: Nishigandha Naik (HI)

LECTURE WORKSHOPS

Jointly sponsored by IASc (Bangalore), INSA (New Delhi) and NASI (Allahabad)

1. Practice and Research in Disaster Management – Towards Better Worldliness

Dayalbagh Education Institute, Agra (DEI)

2 – 4 April 2013

Convener: Anand Mohan (DEI)

Co-ordinators: Sanjeev Swami/Sanjay Bhushan (DEI)

Participants: 150 participants (119 students and 31 teachers) from various colleges and institutions in and around Agra.

Topics of lectures: Natural disasters and sustainable development; man-made disaster and better worldliness; disaster management technology & application.

2. Neuro Psychiatry Diseases

Chennai Medical College and Research Centre, Irungalur (CMCRC)

4 – 5 April 2013

Convener: Usha Kant Misra (Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow)

Co-ordinator: N Prabhu (CMCRC)

Participants: 208 participants (33 teachers and 175 students/research scholars) in and around Irungalur.

Topics of lectures: Parkinson's diseases; nutrition and neurology; Alzheimer's and its management; dementia; molecular basis of memory and memory loss; delirium; neuropsychiatric aspects of traumatic brain injury. Panel discussions entitled "Issues and challenges of Parkinson's disease" and "Strengthening of learning and memory" were also held.

3. Modern Trends in Chemistry

Sikkim Government College, Gangtok

12–13 April 2013

Convener: Uday Maitra (IISc, Bangalore)

Co-ordinator: Bhaskar Chakraborty (Sikkim Government College)

Participants: 146 participants from Gangatok, Rangpo, Siliguri.

Topics of lectures: Selected reagents for transformation addressing selectivity in organic synthesis; introduction to biophysical chemistry; drug design by enzyme inhibition; weak hydrophobic interaction and its strong outcome; introduction to computational chemistry; carbohydrates; molecules which "break" rules.

4. Skill Development & Career Orientation: Biotech, Pharma, Medicine, Informatics

Government Degree College, Kullu

a. 9 – 11 May 2013

b. 11 – 13 May 2013

Convener: Asha Chandola Saklani (Apeejay Satya University, Gurgaon)

Co-ordinators: Dhaneshwari Sharma/Atul Kathait (Government Degree College)

5. Frontiers in Life Science

North-Eastern Hill University (NEHU), Shillong

21 – 24 May 2013

Convener: SK Saidapur (Dharwad)

Co-ordinator: BBP Gupta (NEHU)

Participants: 80 participants from various institutions in and around Shillong.

Topics of lectures: Biology: the past, present and future prospects; epigenetics; concept of natural selection; genetics and genomics of speciation; Darwinian medicine; evolution of reproductive strategies; Interventions for healthy aging; pollination biology; biodiversity crisis; carnivorous plants; biomonitoring through biodiversity indices. A panel discussion on "Science Education & Research" was held.

6. Biology 21st Century

SRN Adarsh College

24 – 25 May 2013

Convener: V Nagaraja (IISc, Bangalore)

Co-ordinator: Vijaya B (SRN Adarsh College)

Participants: 167 participants from institutions in and around Bangalore.

Topics of lectures: Metagenomics: a revolution in biology; multiple growth polarity during leaf growth and its control by a microRNA; epigenetics and cancer: role of microRNAs and DNA methylation in brain tumour development; bacterial pathogenesis – how can a pathogen establishes itself in a host; small RNA for all seasons; visible and invisible messages: how do plants communicate with animals; advances in human genetics; two burning problems of the HIV-AIDS research today; traditional, modern and futuristic vaccines.

7. Recent Advances in Materials Science

Payyanur College, Payyanur

24 – 25 June 2013

Convener: TP Radhakrishnan (University of Hyderabad)

Co-ordinator: KV Sujith (Payyanur College)

Participants: 180 participants from about 12 colleges, universities and institutes in Kerala.

Topics of lectures: Polymers; atoms, natural or man-made; nanites; folding and aggregation profiles of α, $\beta^{2,3}$ hybrid peptides; electons, photons, phonons: SASER and phoniton; size matters: materials at the nanoscale; interfering with interference for nanoscale patterning – the challenges and the journey through Maser to Spaser; diverse reactivity of anthracene-methanamines and sulfides with electron deficient acetylenes; electrical energy storage: materials challenges and prospects; topochemical reactions.

8. Galois Theory, Finite fields & Cryptography

NASI & IIIT, Allahabad

24 – 26 June 2013

Convener: Satya Deo (HRI, Allahabad)

Co-ordinator: Niraj Kumar (NASI, Allahabad)

Participants: 200 participants from various colleges and institutions in Allahabad, Mathura, New Delhi, Roorkee.

Topics of lectures: Introduction to finite fields; Galois Theory: geometric constructions; cryptography; solvability by radicals; geometric constructions; mathematics.

9. Mathematics: Aspects, Prospects and a bit of History

The Institute of Mathematical Sciences (IMSc), Chennai

1 – 2 July 2013

Convener: KN Raghavan (IMSc, Chennai)

Co-ordinator: S Vishnu Prasad (IMSc, Chennai)

Participants: 80 participants from various colleges and institutions in Chennai.

Topics of lectures: Nuclear safety and the mathematical quantification of risk on the spectrum of the Laplacian; from linear algebra to robotic arm design via Groebner bases; shapes and geometry of surfaces; determinant and permanent; analysis, transcendence and arithmetic; using online resources to learn mathematics; history of mathematics in India. A panel discussion on "Prospects of careers involving mathematics" was held.

10. Quantum Mechanics and Statistical Mechanics

Maharani Lakshmi Ammani College for Women, Bangalore (MLACW)

11 – 13 July 2013

Convener: G Srinivasan (Bangalore)

Co-ordinator: Sarmistha Sahu (MLACW)

Participants: 145 participants from various colleges and institutions in Bangalore.

Topics of lectures: Crisis in classical physics; Maxwell-Boltzmann distribution; waves of particles; applications of Maxwell-Boltzmann statistics to the thermal energy of the sun; Fermi-Dirac statistics; waves and interference; probability waves; quantum stars; statistical physics. Several demonstrations were also held by the Resource Persons as part of the Workshop.

11. Frontier Areas in Physics

St Xavier's College, Kolkata

19 – 20 July 2013

Convener: DN Bose (St. Xavier's College, Kolkata)

Co-ordinator: Subhankar Ghosh (St. Xavier's College, Kolkata)

Participants: 60 participants from different colleges in West Bengal.

Topics of lectures: Standard model and beyond; symmetry and its application to physics; growth and characterization of low dimensional structures; selected topics in statistical physics; nanoelectronics.

12. Advances in Chemistry

Madurai Kamaraj University, Madurai (MKU)

26 – 27 July 2013

Convener: R Ramaraj (MKU)

Co-ordinator: S Sivakumar (MKU)

13. Advances in Chemistry

Gandhigram Rural Institute, Gandhigram (GRI)

6 – 7 September 2013

Convener: R Ramaraj (MKU)

Co-ordinator: Abraham John (GRI)

14. Microbial Genomics

Maharani's Science College for Women, Bangalore (MSCW)

19 – 20 September 2013

Convener: DJ Bagyaraj (Bangalore)

Co-ordinator: Kavitha B (MSCW)

Topics of lectures: Evolution in the microbial world; restriction-modification systems in *H.pylori*; metagenomics – a revolution in microbiology; chromosome organization in *saccharomyces cerevisiae*; transcriptional control in *E.coli*: how much RNA polymerase; mechanism of protein synthesis; bacterial genome evolution; translational control of cellular genes by internal initiation.

15. Life Sciences

S.B. Arts and K.C.P. Science College, Bijapur (SBAKCPSC)

19 – 21 September 2013

Convener: SK Saidapur (Dharwad)

Co-ordinator: MS Mulimani (SBAKCPSC)

Topics of lectures: Seeds: the biological enigma; genetics today; floristic diversity in India: inventorization, conservation & bio-prospection-priority agenda for 21st century; glycolysis: its importance & ramifications; globalization of plants; current problems in taxonomic teaching & research in India; genetically modified crops;

introduction to epigentics; evolution and human health; different types of jaundice & their management; bio-fuel technology.

16. Advances in Chemistry

Alagappa University, Karaikudi (AU)
20 – 21 September 2013

Convener: S Natarajan (IISc, Bangalore)

Coordinator: P Manishankar (AU)

17. Frontiers in Biology

Kristu Jayanti College, Bangalore (KJC)
23 – 24 September 2013

Convener: K Somasundaram (IISc, Bangalore)

Co-ordinator: AL Calistus Jude (KJC)

Topics of lectures: Microbiology and cell biology; biochemistry; molecular reproduction, development and genetics.

18. Recent Advancements in Animal Research

Bethune College, Kolkata
27 – 28 September 2013

Convener: Aparna Dutta-Gupta (UOH)

Co-ordinator: Rahul Kumar Datta (Behtune College, Kolkata)

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The Repository is at http://repository.ias.ac.in. Repository content can be viewed by year, by subject (sectional committee name), and by Fellow name (names as in Academy Year Book).

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HINDI WORKSHOP

The Indian Academy of Sciences jointly with Raman Research Institute had organized Hindi Week celebrations during 10 - 13 September 2013. Various competitions in areas such as essay writing, singing and dictation writing, etc., were organized. On the concluding day, a special lecture by Professor Mallikarjun B, Director, Central University of Karnataka, Gulbarga, was arranged. He spoke on 'Linguistic Landscape of India'.

Prizes were distributed to the winners of the various competitions held during the event.

OBITUARIES

Adusumilli Srikrishna
(elected 1994)

Adusumilli Srikrishna, Professor of Organic Chemistry at the Indian Institute of Science (IISc), affectionately called ASK by his colleagues and admirers, passed away suddenly due to a cardiac arrest on 20 January 2013 at Anantapur, Andhra Pradesh, while attending to official work.

Srikrishna was born on 1 January 1955 at Gudivada, Krishna District, Andhra Pradesh. He had an excellent academic record, and obtained his BSc degree from ANR College, Gudivada, in 1973 and MSc degree in Chemistry in 1975 from Andhra University, Visakhapatnam. In 1975, he joined the University of Hyderabad to work with Goverdhan Mehta, and obtained his MPhil (1976) and PhD (1981) degrees in synthetic organic chemistry. Srikrishna belonged to the first batch of students to join MPhil and had the distinction of being the first PhD awardee of the University of Hyderabad. His PhD thesis dealt with 'Triquinanes – synthesis and transformations'. While working for his PhD, Srikrishna unravelled the triquinane motif hidden in Cookson's cage dione that paved the way for total synthesis of several triquinane natural products like coriolin, hirsutene, capnellene, etc. In 1982, he proceeded to USA for postdoctoral work, initially with Philip Eaton at the University of Chicago (1982–83) and later with Gilbert Stork at Columbia University (1983–85). At both places, he richly contributed to the total synthesis of complex molecules of contemporary interest.

Srikrishna joined the Department of Organic Chemistry, IISc, Bangalore, in June 1985, as a Lecturer and was promoted to Assistant Professor (1989), Associate Professor (1994) and Professor (1999). He also served the Department as the Chairman during 2003–2005.

Srikrishna, a brilliant and creative organic chemist, carved a niche for himself in the realm of organic synthesis. His contributions in the area of natural products synthesis, particularly total synthesis of terpenoids, were outstanding. During the early stages of his career, Srikrishna studied radical reactions for the synthesis of complex natural products. Subsequently, he extensively and ingeniously, harnessed the abundantly available 'chirons', R- and S-carvones for the enantiospecific construction of complex natural and unnatural products. More than a hundred publications on the total synthesis and approaches towards the total synthesis of complex natural products from this innocuous monoterpene amply illustrate the original thinking and the craftsmanship with which he transformed this simple entity to complex natural products.

Endowed with an exceptional ability to infer the spectroscopic details of organic compounds, Srikrishna displayed a special talent in applying this technique to unravel some of the enigmatic rearrangements and reactions. He had an uncanny ability to visualize reaction pathways in terpenoid chemistry. His inquisitiveness coupled with his innate ability to solve intricate NMR problems was an instant draw to students to flock to his course on the topic. It was a regular feature for students, colleagues from the department and practitioners from other laboratories in India to seek his counsel for solving their own NMR spectral problems.

A strong advocate of synthetic organic chemistry and a prolific author of published research work, Srikrishna published 290 papers in journals of national and international repute. Some of his research papers are now part of textbooks/monographs of organic synthesis. He guided about 28 doctoral students and several postdoctoral fellows. Almost all of his research students occupy prime positions in academic institutes and industries of repute. He received many awards and recognitions, including the INSA medal for young students (1987), Dr S. H. Zaheer Young Scientist Award (1993), B. M. Birla Science Award (1994), Shanti Swarup Bhatnagar Prize (1997), R. D. Desai Commemoration Medal (1996), A. B. Kulkarni Endowment Lecture (1998) and Prof. S. Swaminathan Endowment Award (2002). He was also DST J. C. Bose National Fellow. Srikrishna was elected to the Fellowship of all three science academies of the country. He was a member of the Editorial Board of the *Indian Journal of Chemistry*

and *Proceedings of the Indian National Science Academy*.

For all his achievements, Srikrishna was an extremely modest and simple individual with strong convictions and principles. His dedication, discipline and integrity towards the pursuit of science were impeccable. He had a reputation as a great speaker. He used to visit even remote colleges and universities in the country to interact with the faculty and students. He had a soft corner for students coming out of universities and colleges located in rural/semi-urban settings. A most sought-after mentor for research work, Srikrishna inspired many young scientists to better their research careers. In his untimely demise, Indian science has lost a stalwart and scientists have lost a distinguished friend and colleague.

Besides being passionately involved in the pursuit of chemistry, he also had a humane side, less known to many. He deeply yearned for educational facilities for the less privileged and had personally supported the higher education of quite a few indigent but deserving students.

Srikrishna leaves behind his wife and two daughters, besides a host of friends, colleagues and admirers.

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Mahendra Singh Vardya
(elected 1972)

Mahendra Singh Vardya, a well-known astrophysicist, passed away on 20 January 2013 in Mumbai after a brief illness at the age of 80 years.

Vardya was born on 22 February 1933 in Fatehpur (Uttar Pradesh). After his initial education, Vardya started his professional career with a BSc in 1951 and MSc in 1953 from Banaras Hindu University, Varanasi, and a PhD from the Yale University, USA, in 1959. He worked closely with L. H. Aller at the University of Michigan and R. Wildt at the Yale University, who were stalwarts in the area of stellar atmospheres. He was then at the Physics Department, University of Delhi from 1960 to 1962.

After spending several years in USA at the University of California, Berkeley, and the Joint Institute for Laboratory Astrophysics, Boulder, and also in The Netherlands at the University of Utrecht, Vardya joined the Tata Institute of Fundamental Research (TIFR), Mumbai, in 1966 to start the Theoretical Astrophysics Group. At that time, TIFR was very active in the areas of radio and X-ray astronomy, and there was a need to develop a theoretical group to supplement the above experimental and observational activities. Vardya took up this challenge, and in just a few years he was primarily responsible for building a growing group of young astrophysicists at TIFR, who were well-known experts in their own fields. His effort in building the Theoretical Astrophysics Group is highly credited, and the Group is well reputed in India and abroad.

As astronomy and astrophysics became a major activity and study in India over the subsequent years, Vardya played a key role in establishing the Astronomical Society of India (ASI). When the members of the Society later wanted to start a journal in astronomy and astrophysics, Vardya, on account of his vast experience, was entrusted with its development as the first editor. With his tireless effort, the *Bulletin of the Astronomical Society of India* came into existence and is now a well-recognized journal worldwide.

During his research career, Vardya was invited to visit various astronomical centres around the world for scientific interaction and collaboration. This included the time spent at the Goddard Space Flight Centre, NASA, Maryland, USA. He was elected a Fellow of the Indian Academy of Sciences, Bangalore, (1972) and of the Royal Astronomical Society, London.

Among his many accomplishments, Vardya was internationally known for his fundamental contributions in the area of stellar atmospheres, which plays a crucial role in the overall structure of a star. For late-type main-sequence stars, the convection zone has to be represented by better models. This requires knowledge of various basic thermodynamic quantities for neutral and ionized gas. He developed computational techniques relating to various thermodynamic and statistical mechanical properties and functions.

Vardya was the first to construct hydrogen–helium adiabats with the inclusion of molecular hydrogen. Based on this work he calculated better models that were used in the study of the march of molecular abundances in late-type stars. These studies elucidated many earlier problems, and his results were widely used by others. He was the first to propose the idea of pressure dissociation and its importance. This affects the abundance of molecular hydrogen, and may be important in models of late-type main-sequence stars and in white dwarfs.

A problem known as missing solar opacity referred to the difference in observed flux in the Sun in the UV region compared to the calculated flux. Vardya proposed molecules to be the source of missing solar ultraviolet opacity. He also showed the importance of opacity arising out of negative ions. He was associated in a detailed study where the forbidden absorption nebular and auroral lines of oxygen were identified in the spectra of a large number of G and K stars, mostly giants and interpreted in terms of nucleosynthesis in the galaxy.

Vardya enjoyed deep affection and esteem from his colleagues. He was a kind-hearted and approachable person. His valuable advice was sought at every stage, both within and outside TIFR, on any aspect connected with astronomy and astrophysics. He also gave unselfishly of his time and expertise to convey the excitement of astronomy and astrophysics to all those interested in the subject.

His helpful nature and jovial spirit will be greatly missed. He is survived by his wife, a son and a daughter.

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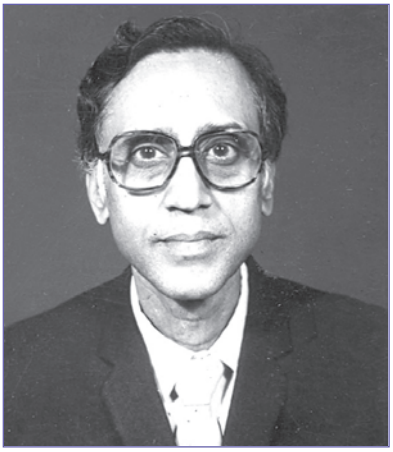

Palliakaranai Thirumalai Narasimhan
(elected 1971)

We record with profound sorrow the passing away of P. T. Narasimhan at Sunnyvale, California, USA on 3 May 2013.

Palliakaranai Thirumalai Narasimhan – PTN to his friends, students, colleagues and admirers in India, Jim to his colleagues in the West – was a phenomenon in the Indian academic and scientific research scene. Born on 28 July 1928 in Cuddalore (New Town), Tamil Nadu, PTN's early academic career was at Madras Christian College, where he obtained his MSc degree (by thesis) in 1951. He then joined the Indian Institute of Science (IISc) for his doctoral studies under the guidance of R. S. Krishnan. After obtaining his doctoral degree, he worked as an ICI postdoctoral fellow at IISc during 1955–1956. His research at IISc Physics Department included numerous investigations on molecular dipole moments of organic molecules, as well as a molecular orbital treatment of pyrazines. It is noteworthy that his work at IISc included studies on the temperature dependence of dielectric constants of ionic crystals and diamond; dealt with infrared intensities and the chemical bond; and offered an extrapolation method for complex data. This body of work was published in 13 research papers in the *Journal of the Indian Institute of Science*, *Current Science*, the *Proceedings of the Physical Society*, etc. This was followed by postdoctoral years at USA, especially with Max T. Rogers at the Michigan State University. Rogers was keen on developing new experimental techniques to garner insights into molecular structure. The research work of Narasimhan and Rogers on nuclear magnetic resonance (NMR) was published in top-ranking journals including the *Journal of Chemical Physics*, the *Journal of the American Chemical Society* and the *Journal of Physical Chemistry*. Subsequently, between 1958 and 1961, PTN served as an Assistant Professor at Michigan State University, University of Illinois and Columbia University. While at Columbia, he had many fruitful discussions with Martin Karplus on the generalized valence bond theory of nuclear spin–spin couplings in molecules.

PTN returned to India in 1962 and joined as Assistant Professor in the Department of Physics at IIT Kanpur. However, he soon moved to the Department of Chemistry – and the rest, as they say, is history. Joining the Department as Associate Professor, he became full Professor in 1965 and subsequently Senior Professor. It is here that the famous 'tri-umvirate' of Chemistry, P. T. Narasimhan, M. V. George and C. N. R. Rao, brought in a paradigm shift in the way chemistry was taught and practised in the country. In particular, physical chemistry was then dominated by research in electrochemistry, chemical thermodynamics and kinetics. Narasimhan

and Rao brought in expertise in the field of magnetic resonance, solid state chemistry and theoretical chemistry. Fully supported by the founding Director of the Institute, P. K. Kelkar, the three professors built the Chemistry Department at IIT Kanpur to national and international prominence. The culture and tone of the department resulted in chemistry flourishing at their hands, and at the hands of younger colleagues including D. Balasubramanian, A. Chakravorty, D. Devaprabhakara, G. Mehta and S. Ranganathan, to name but a few, who excelled both in teaching and research.

Narasimhan was passionate about magnetic resonance and theoretical chemistry. He brought to both these areas perspectives that have been unique on the Indian scene and made him a pioneer. In his experimental research, he believed in developing scientific instrumentation, while in his theoretical undertakings he never allowed mathematics to reach a point where it might distract from the physical perspective.

With his research group at IIT Kanpur, he pioneered the development in India of dynamic nuclear polarization at X-band, both in terms of home-built instrumentation and chemical applications. Another important research area of his was nuclear quadrupole resonance (NQR) spectroscopy, culminating in home-built phase-locked super-regenerative oscillator-detectors and a home-built pulsed NQR double resonance system. The high resolution Nuclear Magnetic Resonance (NMR) of small molecules dissolved in liquid crystalline media, and the investigation of alternating line width effects in electron spin resonance (ESR) were other major undertakings of his group. PTN carried his fondness for working with scientific instruments to the point of reviving dead commercial spectrometers – the days spent reviving an A60D that had been given up being one example.

A considerable body of quantum chemical research also emerged from PTN's group. His contributions to theoretical chemistry led to ushering in the era of computational chemistry in India, although he was a firm believer in gleaning physical in-sights through computational methods. A good deal of code development was undertaken by his group, both within semi-empirical and *ab initio* frameworks.

He mentored over 20 Ph D students, encouraging each one to be an independent researcher and published over 200 research papers during his 26-year stint at IIT Kanpur. In the classroom, he was a natural teacher, and his course on Chemical Binding at IIT Kanpur has been the stuff of legends, fondly remembered to this day by acolytes across the country – themselves learned professors today.

It follows naturally that PTN built an awesome reputation and received a series of accolades from the Indian science establishment, including the Shanti Swarup Bhatnagar Prize, Fellowships of the Indian National Science Academy, New Delhi; the Indian Academy of Sciences, Bangalore; and the National Academy of Sciences of India, Allahabad. He served in several positions, such as Founder Member and secretary of the Association of Magnetic Resonance Spectroscopists (AMRS) of India, and Member of the first Editorial Board of *PRAMANA – Journal of Physics*, published by the Indian Academy of Sciences, Bangalore. PTN also served as a Council Member of the International Society of Magnetic Resonance, Chicago. He received the Sir C. V. Raman Award and Hari Om Ashram Trust Award established by the University Grants Commission. PTN was the moving force behind the establishment of one of the earliest magnetic resonance imaging (MRI) facilities in India, at the Institute of Nuclear Medicine and Allied Sciences, New Delhi. His reputation was by no means confined to the shores of India. He had close working relationships with leading magnetic resonance researchers and theoretical chemists of continental Europe, UK, USSR and USA. Indeed, despite not being given to *seeking* visibility, he unfailingly attracted a fan following wherever in the world he lectured or researched – or gave his Carnatic music concerts!

To the surprise of many, he chose to resume his research in the USA after his 'retirement' from IIT Kanpur in July 1988. He continued his work at the Huntington Medical Research Institute in Pasadena, California on novel applications of magnetic resonance in biology. Subsequently, in 1993, he moved to the Biological Imaging Center of the Beckman Institute at California Institute of Technology, from where he contributed significantly to biomedical NMR and to NMR microimaging. A list of publications in his 'second innings' of research includes development of methods for small animal brain mapping, as well as several applications. He formally retired from the Beckman Institute in 2009, after being engaged in research in the USA for about 21 years after 'retirement' from IIT Kanpur. In August 2011, IIT Kanpur honoured themselves by making him an Institute Fellow, in recognition of his lasting contributions to the institute.

Music was always close to PTN's heart. He was an accomplished violinist and flutist who gave recitals in India as well as several performances abroad, especially in the USA after 1988. In addition, he played host to top classical musicians and dancers during their visit to Kanpur. Many of us fondly remember the performances of Bhimsen Joshi, Lalgudi Jayaraman, Ustad Amjad Ali Khan and several SPIC-MACAY programmes. Many a time, there were dinner outings to the Kwality Restaurant at the Mall Road in Kanpur and also dinner meetings at his residence.

In his personal life, Narasimhan was supported devotedly by his wife Leena Narasimhan for over 50 years. His children Nalini, Vikram and Nandini are all doing very well in their chosen careers.

PTN was very pleasant and gentle in his approach to his students, well aware of their limitations. Smilingly and steadfastly, however, he insisted all along that the student should develop scientific prowess on his – or her – own, be it in magnetic resonance, or theoretical chemistry, or both. In time, this approach greatly helped his students find their feet quickly as independent researchers in their chosen areas of work. At a personal level, his handwritten letters to each one of us at least once a year, long after our graduation, remain cherished.

Having been diagnosed with lung cancer by September 2012, he had elected not to pursue any major medical treatment and expressed a desire to say his goodbye to the people who were an important part of his life. Many of his close associates talked to him on the phone. His voice, though feeble, was calm. He made enquiries about our work and families. PTN had been a brave fighter all along, whether fighting for an academic cause, maintaining high standards in scientific research or in his illness. To his PhD students, he was much more: a friend, philosopher and guide.

His students feel privileged to have been associated with PTN, a scientist and an artiste, a man with great personal charm and ready wit. He will be remembered for his outstanding contributions to teaching, to the development of scientific instrumentation and to insightful researches into magnetic resonance and theoretical chemistry, with chemical and biomedical applications.

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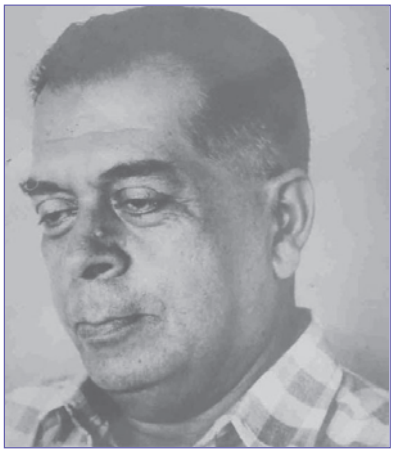

Sasanka Chandra Bhattacharyya
(elected 1975)

The illustrious career of Sasanka Chandra Bhattacharyya (31 August 1918–19 May 2013) touched several institutes and many individuals and left an indelible mark on all of them. He was one of the founding fathers of the Department of Chemistry at the Indian Institute of Technology Bombay (IIT Bombay). His association with the department had only been for a brief period of a little over a decade (1966–1977), during which his example influenced the trajectory of the department. He moved to IIT Bombay from National Chemical Laboratory (NCL), Pune, where he was heading a group of about 100 researchers, with the purpose of shaping the young Chemistry Department at IIT Bombay in its infancy, as it had come into existence just a year ago in 1965. Along with Bhattacharyya came several of his research colleagues and co-workers, who too joined the rank of the Chemistry Department as faculty and staff members, and on whose collective shoulders the department grew from strength to strength. A true pioneer that he was, Bhattacharyya brought in the culture of research to the newly born department by raising sponsorship grants, including that of securing the first US-funded research grant to IIT Bombay, which till then was functioning with Russian aid that came in kind rather than cash. The PL-480 funds were used to support research as there were hardly any funds available from the Institute for this purpose. In addition to leading a large research group, Bhattacharyya was an able administrator with great trouble-shooting abilities and led the Chemistry Department not only as a Head but also the Institute as a Deputy Director till 1977, when he moved to Bose Institute, Kolkata as Director.

Bhattacharyya obtained his Bachelor's degree (BSc) in 1938 from the University of Calcutta and his Master's degree (MSc) in 1940 from the University

of Dacca. He obtained his PhD degree in 1944 by carrying out doctoral research under the mentorship of P. C. Guha at the Indian Institute of Science (IISc), Bangalore, while being registered as a doctoral degree student at the University of Dacca. He obtained a second PhD degree under the supervision of B. Lythgoe, FRS, in natural product chemistry and analytical chemistry from Cambridge University in 1949. In his professional career, Bhattacharyya was honoured with almost all of the awards in chemical sciences that our country had to offer at that time, including that of being the third recipient of the much coveted Shanti Swaroop Bhatnagar Award in 1962. In his remarkable research career, Bhattacharyya worked in the area of natural products guiding 93 doctoral students and publishing over 250 research articles. He emphasized the completion of a body of work before publication and one often saw a spate of papers on a particular aspect appearing back to back, even if with different co-workers, after he was satisfied that the work was complete. Thus *Tetrahedron* (1967, **23**) carried 11 papers from his group.

One of the areas of activities of Bhattacharyya was the isolation, characterization and structure determination of the odorous constituents of essential oils and plant extracts. In this pursuit, he undertook extensive studies of several essential oils and plant extracts such as vetiver oil (*Vetiveria zizanoides* L.), sandalwood oil (*Santalum album* L.), costus root oil (*Saussurea lappa*), agarwood oil (*Aqui-laria agallocha* Roxb.) and plant roots extract of *Selinum vaginatum* C.B. Clarke. He was involved in the isolation and structure determination of over 100 natural products, especially terpenoids and furo- and pyrano coumarins.

Bhattacharyya's contribution is deeply entrenched in the Chemistry Department at IIT Bombay and still motivates the current generation of researchers even after 36 years of him leaving the Institute in 1977. He is fondly remembered by his students, colleagues and co-workers as a visionary bestowed with uncanny administrative abilities and unparalleled problem-solving skills and at the same time filled with compassion for everyone around him. He was a legendary orator who could captivate his audience at ease and at will. Like a true veteran captain of many voyages, he steered the young and inexperienced department looking for guidance to the shores of prosperity, where the department finds itself today. A rare mix of all of these virtues made him a towering, larger-than-life persona who stood tall among his peers and a true representative of the class of leaders of his time.

Bhattacharyya's past students always recall the warm hospitality they received at his home, thanks to his wife (who passed away in 1999). That she was an equal partner in looking after his students' well-being is witnessed by numerous anecdotes. During the Indo-China border conflict the nation was faced with severe resource shortage and the Government appealed to the citizens for contributions to the PM's National Defence Fund. Prof. and Mrs Bhattacharyya donated all their gold ornaments and medals in response to the appeal. The then Prime Minister, Jawaharlal Nehru, personally acknowledged their generous contribution. It is obvious that this was no ordinary couple. Bhattacharyya is survived by a son and two daughters. His rich legacy continues to inspire scientists.

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Narasimhiah Seshagiri
(elected 1974)

In the passing of Narasimhiah Seshagiri, India has lost one of its most versatile and eminent scientists. Born on 10 May 1940 at Satyamangalam in Coimbatore district of Tamil Nadu, he received his early education in Bangalore, graduating in engineering from the University College of Engineering in Bangalore in 1961. After receiving his PhD degree from the Indian Institute of Science, Bangalore in 1964, he joined the Computer Group of the Tata Institute of Fundamental Research (TIFR) in Mumbai in 1966.

The plan at TIFR was to start activities in the field of systems science. He soon made a positive impression with his exceptional competence in applying mathematical techniques for quantitative analysis in problems involving physics and economics. It gave him opportunities of working in many diverse fields.

Use of mathematical techniques for national planning was keenly pursued in several countries including India. His mathematical skills brought him in contact with top scientists and gave him an opportunity of making a significant contribution at the national level. With the establishment of the Department of Electronics, M. G. K. Menon appointed him the director of the newly created 'Information, Planning and Analysis Group' (IPAG) in 1971. The IPAG publications were very useful for the Indian industry as it provided important and timely information on government policies and plans and the state of electronics development and the industries.

His five productive years at TIFR gave him visibility at the national level. He had a great innate capacity in applying mathematics to a physical phenomenon. Among his important contributions in various fields are optimization of the satellite links for ISRO, optimizing bus schedules for Bombay city's bus transport, optimizing techniques for power planning and generation, modelling developing economies, analysing protein structure, etc. Not so well known is his work on the derivation of Maxwell's equations. He showed that Maxwell's equations and Lorentz transformations are equivalent. This was taken note of by K. Demys in 'The Mathematical Heritage' by C. F. Gauss, pp. 163–164. Apart from these studies, he successfully guided a number of students for their PhD degrees. He had several high quality publications in peer reviewed journals.

A unique feature of the Department of Electronics was the Technology Development Council (TDC) which gave significant funds for projects undertaken by the academic and R&D institutes. Seshagiri was keenly interested in computer education. Under his leadership TDC supported many projects that helped universities in strengthening their research capabilities and student training programmes. It also helped in upgrading, expanding and spreading computer education. For example, the popular MCA programme was launched with his initiative which became an important source for generating skilled manpower on a large scale. This must have been a major contributor to the success of the software industry in India. He was a great supporter of indigenous technology development and industry with focus on self-reliance. In fact, the concept of IIIT was originally conceived by Seshagiri in the late 80s and early 90s, though it never took off.

His real impact making contribution to national development came with the establishment of the National Informatics Centre (NIC) in 1975. The timing happened to be just right. Computer and communication technologies were undergoing a major transformation with rapid advances in integrated circuits, availability of powerful minicomputers, the digital conversion of telecommunications and the arrival of small satellite earth stations. Data communication was competing with telephony and separate rules were made for dealing with data communication, taking it out of the stranglehold of telephone administrations (all over the world). He foresaw this and made a plan for a nationwide data communication network for interconnecting government and public service offices. Special efforts and innovations were required for the fullest utilization of the limited capabilities of the most advanced equipment available in mid-seventies. With his great personal appeal, he succeeded in putting together a team of bright young engineers, the best that were available in India at that time and who later became leaders in the field. He helped the creation of an infrastructure and environment where young members were able to make their best contributions. Experience at TIFR was perhaps very useful for this purpose. This large nationwide organization has played a key role in the computerization of administration and operations of the government and utilities of the country. This also helped the process of national integration.

Interconnecting far-flung offices covering the whole country was the biggest challenge. Data communication and networking facilities that were then avail-able were very limited (and expensive), providing at best 2400 bps in the most favourable conditions. Fortunately at that time a company (Equitorial) set up by Edwin Parker, a professor at Stanford University, provided a neat solution to exactly match NIC's requirements, *viz.,* small compact low-cost earth stations with less than a metre wide dish and capable of two-way communication at 9.6 kbps. Seshagiri saw a great opportunity here and set up a nationwide network of Very Small Aperture Terminals (VSATS). A local company was set up jointly with ITI for assembly and manufacture of these terminals for this purpose.

His other important and pioneering contribution was the setting up of satellite-based export processing zones in different states that helped local companies to have data communication facilities with large corporations overseas for providing software development services. This was crucial in making India a global leader in the business of outsourcing of software services.

Seshagiri was the recipient of various awards, including the prestigious Padmabhushan Award, Asiad Jyothi Award, Om Prakash Bhasin Award and Karnataka Rajyostava Award. He was elected to the fellowship of the two national science Academies of the country (IASc, Bangalore in 1974; NASI, Allahabad in 1988) and the Indian Academy of Engineering (1998).

A great thinker and analyst, he was one of the brightest scientists. His national level contributions were no doubt outstanding and exceptional.

His death is a great loss for electronics technology development in India. In his passing, India has lost a pioneer who steered the IT act for the Government of India and set up the NICNET – the nationwide data network – which has been the IT backbone of the Government of India.

He passed away on 26 May 2013 and leaves behind his wife, a son, a daughter and two grandchildren.

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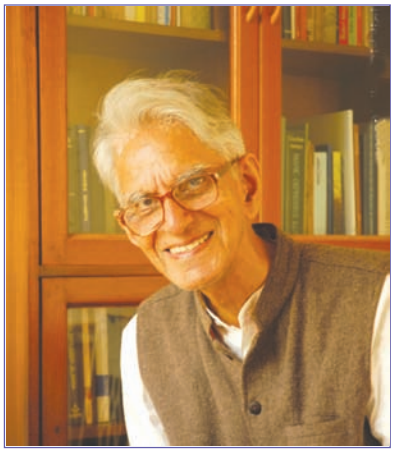

Obaid Siddiqi
(elected 1968)

Colleagues of Obaid Siddiqi in TIFR and NCBS had frequent and largely similar encounters with him. Walking alone with eyes to the ground, apparently deep in thought, he would abruptly look up and trap you in a brilliant, unwavering gaze before proceeding into an unhurried but penetrating conversation on music, art, science, people or politics. His sophistication was simple and unostentatious as were his broad interests. He spoke to directors and students, with almost equivalent levels of engagement and interest.

Around Siddiqi, always 'Obaid' to his students and colleagues, it was impossible not to realize that the beauty of pursuing the truly interesting and original, even with its risks of failure, hugely outweighed success from solid, incremental advancements. He lived his life and did his science based on these simple, heartfelt principles. He transmitted the excitement of big questions together with a liberating lightness of spirit that made these seem accessible. He was particularly drawn to the amateur and the novice. To them, he was a source of both the intellectual inspiration and sympathetic support crucially required during the too-often lonely process of scientific inquiry.

In the 1970s, friend Seymour Benzer (1921-2007) was a natural draw for Obaid, particularly when the interests of both shifted from molecular genetics to neurogenetics. The study of *Drosophila* mutants with strikingly visible and memorable defects in nervous system function, fit beautifully with both Benzer's and Siddiqi's whimsical approach to science. These were the primary focus of Obaid's science from the mid 1970s, when he went on the first of three visiting professorships to Benzer's laboratory in California Institute of Technology.

His first work in neurogenetics focused on fruitfly mutants that appeared normal at room temperature, but abruptly paralysed when shifted to higher temperatures. The paralysis reversed when the animals were shifted back to room temperature. Captivated by the simplicity and exactness of these mutant phenotypes, Obaid showed how electrical recordings from single muscle fibres in genetic mutants could be used to identify the likely molecular targets of the mutations and the mechanism of paralysis. In doing so, he provided the impetus for path-breaking studies of Drosophila neural excitability mutants, particularly by young Benzer postdocs Chun-Fang Wu and Barry Ganetzky, who went on to provide the first glimpse of important classes of ion channel genes, now known to be involved in human epilepsy and heart disease. On his return to India, Obaid suggested to his new PhD student, Veronica Rodrigues (1953-2010), a similar neurogenetic approach to understand the mysterious processes of smell and taste perception.

Using still relevant behavioural assays that they devised, Obaid and Veronica isolated and characterized the first collection of genetic mutants with defects in smell or taste in Drosophila. When presented with the Birla Award for his work on taste and smell, he unhesitatingly presented a cheque for half the prize to his star student (who in turn quietly refused to cash it). As a consequence of these pioneering studies, the

broad field of neurogenetics, though severely set back by the recent loss of both Obaid and Veronica, still remains one of India's internationally recognized strengths today.

Obaid effortlessly built a biological research community in TIFR. He invited talented scientists to join his unit paying scant attention to their CVs. He cherished the diversity of styles and individuals around him, and would ensure that the administration respected the centrality of their research and supported their needs. Rarely was Obaid authoritarian or annoying. When, convinced that he knew best, he would speak rapidly, brook no interruption, and when particularly moved his voice would rise in volume and he would shake his finger in emphasis. Yet such times were truly rare. In subsequent conversations, Obaid's views would lose their rigidity and he never grudged anyone a contrary position.

The combination of intellectual interest, institutional vision and collegial concern allowed Obaid to recruit to TIFR and NCBS, a legion of scientists (initially including Pabitra Maitra (1932-2007) and Padmanabhan Babu with fiercely independent styles and temperaments. But Obaid contributed subtly and unobtrusively to their success. To small conferences, workshops and meetings held around TIFR in molecular biology, genetics, neuroscience and neurogenetics, he attracted all major stars and intellects in each field and treated them with attention and kindness, but no particular deference. Comfortable being treated like friends and grateful for a gentle and dignified introduction to India, most came more than once. And so it came about that all members of TIFR to lesser or greater degrees found themselves included in an exclusive freemasonry of outstanding scientists. In these rarified intellectual communities, TIFR faculty and students not only gained access to the best minds and best thoughts in the field, but also discovered that they could themselves aspire to greatness. Thus, association with Obaid opened many doors and greatly expanded TIFR's scientific worlds.

Obaid Siddiqi passed away on 26 July 2013 in tragic circumstances. He was born on 7 January 1932 in Basti in Uttar Pradesh to M. A. Qadeer Siddiqi and Umme Kulsum. He received his early education at Aligarh Muslim University (AMU). He obtained his Ph D from the University of Glasgow in 1961. He started his academic career as a lecturer in AMU (1954-57) and then moved to IARI, New Delhi as a research scholar (1957-58). He then continued his post-doctoral work at the University of Pennsylvania. In 1962, he moved to India and set up the Molecular Biology Unit at the Tata Institute of Fundamental Research (TIFR) in Mumbai. Thirty years later, he moved to Bangalore as the founding director of the TIFR National Centre for Biological Sciences.

His contributions to science and institution building have been recognized widely. He was an elected member of the Royal Society, London (FRS), the US National Academy of Sciences, The Third World Academy of Sciences, all the three Science Academies of India and the Maharashtra Academy of Sciences. He served on the Council of the Indian Academy of Sciences for 18 long years (1974-91) and was its President (1986-88) and Vice-President (1983-85). He also held positions of responsibility at the Indian National Science Academy, the US National Academy of Sciences and the Third World Academy.

He has been honoured with the *Padma Vibhushan*, *Padma Bhushan*, Bhatnagar Prize, INSA Golden Jubilee Medal, Birla Samarak Kosh National Award, Goyal Foundation Prize, INSA Aryabhata Medal, Bhasin Foundation Prize, Science Congress Plaque of Honours, BC Roy Award for Biomedical Research and Firodia Award for Basic Sciences.

Siddiqi has held visiting professorships at Yale University, the Massachusetts Institute of Technology, the California Institute of Technology and Cambridge University. He was twice Sherman Fairchild Distinguished Scholar at Caltech and was a life member of Clare Hall, Cambridge. He was conferred the honorary degree of D Sc by AMU, Banaras Hindu University, Jamia Hamdard, Kalyani University, IIT Bombay, Jamia Millia Islamia and the Central University of Hyderabad.

Siddiqi is survived by his wife, two sons, two daughters and his grandchildren.

G. Madhavan
Indian Academy of Sciences and Current Science Association

Prosad Kumar Das
(elected 1975)

Prosad Kumar Das, former Deputy Director General of Observatories (Planning), Meteorolgical Office, New Delhi, passed away on 14 January 2011.

Born on 20 May 1926, Dr Das obtained his MSc degree from the University of London and his DPhil degree from the University of Calcutta.

Dr Das was Emeritus Scientist, CSIR, from 1990 to 1993, and Senior UNDP Professor from 1983 to 1985. He served as Director General of Meteorology, Government of India (1978 to 1983), WMO Consultant to the Government of Malawi (1983), Member of the Executive Committee of the World Meteorological Organization (1979), and Director of the International Management Centre for Monsoon Experiment (1979 to 1980). He was a Fellow of the Indian Academy of Sciences, Bangalore, Indian National Science Academy, Delhi, and Royal Meteorological Society, London.

Dr Das was an authority on atmospheric research and meteorology. He specialized in numerical modelling in atmospheric sciences. At Massachusetts Institute of Technology, USA, he developed a model for monsoon circulation for India. Later, he developed a model for computing storm surges for the Indian coastline, and made an analytical study of mountain waves associated with a circular mountain.

He had many papers in Indian and international technical journals, and some of his works have been quoted in text books. He has also authored a book, *The Monsoons* (National Book Trust, India).

In honour of his work, he was awarded the KR Ramanathan Medal by INSA in 1993, and the IMO Award by the World Meteorological Organization in 1983, and the Gold Medal, Indian Meteorological Department Biennial Award in 1963 for his paper on mountain waves.

He is survived by his wife, one son and a daughter and their families.

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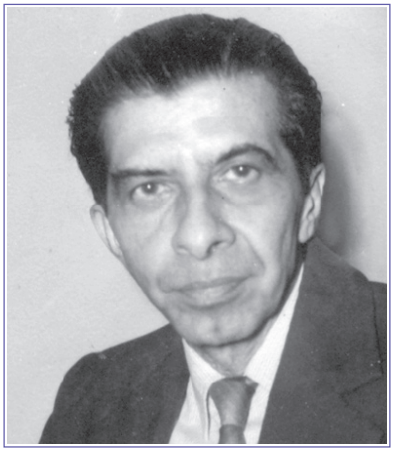

Erach Hormasji Daruwalla
(elected 1974)

Erach Hormasji Daruwalla, ex-Director of the Institute of Chemical Technology and Research Advisor to the Bombay Textile Research Association, passed away on 17 March 2012.

Born on 24 October 1923, Daruwalla obtained his BSc and MSc degrees from the University of Bombay and his PhD degree from the University of Manchester. He worked as a Reader in Technology of Dyeing and Printing from 1953 in the University of Bombay and continued there as Professor of Textile Chemistry from 1960, and was Director of the Bombay Textile Research Association from 1969 to 1971. After 1971 he served as Research Advisor and Consultant.

Professor Daruwalla had made valuable contributions in the fields of researches connected with "Chemistry of Cellulose", "Physico-Chemical Studies in Dye-Polymer Interactions" and "Photochemistry of Dyes and Polymers". He was internationally recognized for his researches in "Physical Chemistry of Dyeing" and was visiting scientist to several countries. He was recipient of Dr K.G. Naik Gold Medal awarded by M.S. University of Baroda for his valuable contributions to industrial research. He was the inventor of a novel process of dyeing with vat colours, a process

which has been patented in India and several other countries abroad, and widely used in the textile industry.

He has left behind his wife, two daughters and their families.

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Tansukh Harshadray Rindani
(elected 1960)

Tansukh Harshadray Rindani, former Chief Executive Director, Jaslok Hospital and Research Centre, Mumbai, passed away on 24 October 2012.

Born on 17 April 1917, Dr Rindani obtained his MBBS, MD and DSc degrees from the University of Bombay.

Dr Rindani was Medical Director and Director of Research at Jaslok Hospital, Mumbai, from 1972 to 1982 and then from 1988 to 1991. He was Professor of Physiology (1952 to 1964) and Dean (1964 to 1972) of the National Medical College in Mumbai. He was also Visiting Scientist at the Institute of Experimental Medicine and Surgery at Montreal. He was a Fellow of the Indian Academy of Sciences, Bangalore; National Academy of Medical Sciences, India; All India Institute of Diabetes; and a Member of the Association of Physiologists.

Dr Rindani's area of interest was the phenomenon of stress, endocrinology, and physiology. His work included biochemical, morphological and cytochemical studies.

He had around 40 papers in Indian and international journals. He authored a book on *Seach for New Drugs* in 1972 (Marcel Dekker).

In honour of his work, he was awarded the Moos Gold Medal by the University of Bombay in 1965 and the Jugatram Dave Oration (1964) and SL Bhatia Oration in Bombay.

He is survived by his wife, three daughters and their families.

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Shanthi Bhaskar

Shanthi Bhaskar, who served the Academy since 1975, tragically passed away on 29th September 2013 as a result of a grievous road accident.

Our deepest sympathies to the bereaved family.

We at the Academy will always remember the kind-hearted and soft-spoken Shanthi.

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