No. 42 Patrika September 2005

Newsletter of the Indian Academy of Sciences

2005 Mid-Year Meeting

The 16th Mid-Year Meeting of Academy was held at Central College on July 7 and at the Indian Institute of Science, Bangalore on 8–9 July 2005.

The year 2005 is being celebrated worldwide as the International Year of Physics. It is exactly a century since Albert Einstein's creative outburst in 1905, his year of miracles. As part of its Mid-Year Meeting, the Academy joined hands with Bangalore University and organized a half-day programme of special lectures on July 7th at the new Jnana Jyothi Auditorium located in the historic Central College campus in the heart of the city. The occasion was similar to the joint session during the 2003 Mid-Year Meeting celebrating the 50th anniversary of the discovery of the structure of DNA. It was heartening to see the near 1000–capacity auditorium completely full, with students and teachers from over 100 schools and colleges to whom special letters of invitation had been sent.

The programme was inaugurated by its Academy President TV Ramakrishnan and the University Vice-Chancellor, MS Thimmappa, who both expressed happiness at the spirit of co-operation between the two institutions. The four 45-min lectures were: 'Light, space and time' (N Mukunda); 'Bose–Einstein condensation: where many become one and there is plenty of room at the bottom' (N Kumar); 'Einstein and our understanding of the universe' (JV Narlikar); and 'Brownian motion then and now' (Sriram R Ramaswamy). There were lively question and answer sessions after each presentation. Brief accounts also appear in *Current Science* (10 August 2005).

D Chatterji

The Mid-Year Meeting proper was held during July 8 and 9, 2005. D Chatterji's special lecture on 'A tiny molecular machine and its architecture' described the functioning of RNA polymerase, a result of a 40-year effort from its detection in 1959 to its three-dimensional structure determination in 1999. Even the force exerted by this molecule – in purely physical terms – is

Inside...

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Forthcoming Events– 2005/06

71st Annual Meeting, Bharathidasan University, Tiruchirappalli
11–13 November 2005
(see programme on p. 2)

Refresher Courses

Foundation course in physics and chemistry of the earth
National Centre of Experimental Mineralogy and Petrology,
Univ. of Allahabad
(7–27 November 2005)

Physics of the atmosphere
Bangalore University/Indian Institute of Science, Bangalore
(14–25 November 2005)

Applied stochastic processes
Indian Statistical Institute, New Delhi
(5–17 December 2005)

Lecture Workshops

Einstein's legacy: A lecture workshop
St. Pious College, Hyderabad
(28–29 October 2005)

Experimental Physics
Maharani Lakshmi Ammanni College for Women, Bangalore
(4–7 November 2005)

T Ramasami

now measurable and is in the 10–15 piconewton range! The second special lecture by T Ramasami was on 'Collagen-based smart biomaterials'. This presentation covered the history of determination of collagen structure by GN Ramachandran, in which the Central Leather Research Institute (CLRI) played an important role. Ramasami reminded us of the basic properties of skin and the several remarkably effective products based on collagen for several medical purposes – ophthalmology, diabetic ulcers, burns and infected wounds – which have been developed at CLRI.

The public lecture on Friday, July 8th was by Kiran Mazumdar-Shaw of Biocon India on 'The need for shared vision between academia and industry'. This was very timely as the present era is strongly identified with genomics, biotechnology and bioinformatics. Shaw cited several examples of such shared vision in the West, and emphasized the importance of creating similar links in the Indian context. These bridges must be built as soon as possible and in her words the 'two sectors must complement rather than compete for research funding'.

The rest of the programme consisted of lecture presentations by newly elected Fellows and Associates on a host of topics covering many scientific disciplines. The Academy played host to 33 teacher invitees from different parts of the country.

71ST ANNUAL MEETING – TRICHY SCIENTIFIC PROGRAMME

Venue: Bharathidasan University

11 November 2005 (Friday)

0930 – 1100 Inauguration and Presidential address by **TV Ramakrishnan,** Banaras Hindu University, Varanasi **Transition metal oxides: Quantum many body physics meets solid state chemistry**

1130 – 1300 **Lectures by Fellows/Associates**

SK Sarin, G.B. Pant Hospital, New Delhi, **Portal hypertensive bleeding: Evolution of protocols and future options**

Amalendu Chandra, Indian Institute of Technology, Kanpur, **Hydrogen bond dynamics in aqueous solutions: *Ab initio* molecular dynamics study**

Subhasis Chaudhuri, Indian Institute of Technology, Mumbai, **Can we include the third dimension during image mining?**

1430 – 1730 **Symposium**
Physics and Chemistry of Materials
(Convener: **CNR Rao**)

AK Raychaudhuri, SN Bose National Centre for Basic Sciences, Kolkata **Phase separation in stained manganites films as probed by scanning probe microscope and 1/f noise measurements**

DD Sarma, Indian Institute of Science, Bangalore, **Electronic structure of oxide materials**

GU Kulkarni, JNCASR, Bangalore **Chemistry of nanomaterials**

S Natarajan, Indian Institute of Science, Bangalore **Open-framework materials — what is new?**

AK Ganguli, Indian Institute of Technology, Delhi, **Chemistry of oxide materials**

1830 – 1930 **S Ramaseshan Memorial Public lecture**
CNR Rao, JNCASR, Bangalore, **Science for our future: Personal reflections on doing science in India**

12 November 2005 (Saturday)

0900 – 1000 **Special lecture**

KV Subbarao, University of Hyderabad, Hyderabad, **Volcanic poisoning and mass extinctions**

1030 – 1300 **Symposium**
Genomic Landscape and Structure of the People of India
(Convener: **Partha P Majumder**)

MLK Murty, University of Hyderabad, Hyderabad, **Archaeology of modern humans (*Homo sapiens sapiens*) in India: Prehistory, cultural diversity and migrations**

K Thangaraj, Centre for Cellular and Molecular Biology, Hyderabad, **Genomic approaches to reconstructing the Indian population histories**

Partha P Majumder, Indian Statistical Institute, Kolkata, **Genomic diversity and structure of ethnic India: Lessons from haploid chromosomes**

Mitali Mukerji, Institute of Genomics and Integrative Biology, Delhi, **The Indian human genome variation initiative: Overview and first results**

V Nanjundiah, Indian Institute of Science, Bangalore. **Genomics and our past : Where are we and where do we go from here ?**

1430 – 1600 **Lectures by Fellows/Associates**

DP Kasbekar, Centre for Cellular & Molecular Biology, Hyderabad, **Dominant suppressors of repeat-induced point mutation**

Shankar P Das, Jawaharlal Nehru University, New Delhi**, Heterogeneity in supercooled liquids**

Subhabrata Chakrabarti, L.V. Prasad Eye Institute, Hyderabad, **A molecular genetic perspective on primary congenital glaucoma in India**

1730 – 1830 **Public lecture**

V Shantha, Cancer Institute, Chennai, **Cancer causes and prevention**

13 November 2005 (Sunday)

0900 – 1000 **Special lecture**

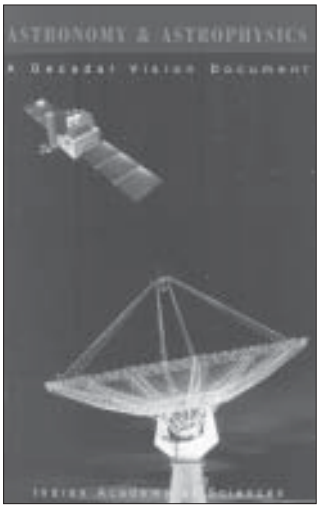
RK Shyamasundar, Tata Institute of Fundamental Research, Mumbai**, Computer science: Scientific and engineering fascinations and challenges**

1030 – 1130 **Lectures by Fellows/Associates**

VA Raghunathan, Raman Research Institute, Bangalore, **Organization of cholesterol in model membranes**

M Radhakrishna Pillai, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, **Human papillomavirus associated cervical cancer in India**

VISION DOCUMENT FOR ASTRONOMY AND ASTROPHYSICS



The Academy brought out a Decadal Vision Document on Astronomy and Astrophysics. This document is intended to project the possibilities and imperatives in an area of strong tradition and great strength in India.

The Document was formally released on 8 July 2005 by T V Ramakrishnan, the President of the Academy at the IISc Faculty Hall in the presence of Fellows and invitees who attended the Mid-Year Meeting of the Academy.

The following briefly gives the genesis of the document, its contents, and the recommendations that it contains.

A couple of years ago, the Council of the Indian Academy of Sciences decided to commission a series of ***Vision Documents.*** The first of these was on *Astronomy and Astrophysics.* The Council was of the view that this was the right moment to critically survey and assess the contributions made by the Indian astronomers and astrophysicists, as well as make a prioritized set of recommendations for new initiatives for a comprehensive growth of different areas of contemporary astronomy and astrophysics.

This document is the result of in-depth discussions by several panels, each of which focused on a specific branch of **astronomy.** The recommendations of these panels were subsequently discussed at a special meeting of the *Astronomical Society of India.* This formed the input to a special committee set up by the Academy to draft this vision document.

It begins with an Executive Summary of the recommendations for the future, followed by a semi-popular account of the present revolution in astronomy. The subsequent chapters deal with different areas of research in contemporary astronomy and astrophysics. Each chapter is self-contained with a historical introduction, a summary of the significant achievements in the past, current areas of scientific research, a survey of the existing observational facilities and recommendations for the next major initiatives in that area. The final chapter lists a series of recommendations for the future.

Some of the important recommendations

❑ **New Initiatives in astronomy from space**

The Academy Committee has recommended two modest instruments that could go piggy back on the Remote Sensing Satellites that are periodically launched by Indian Space Research Oganization. These are (i) a small solar coronograph, and (ii) a near infrared spectrophotometer.

❑ **New Technology Initiatives**

Keeping in mind the central role of detector technology in the presently unfolding revolution in astronomy, the committee has strongly recommended a set of new R&D initiatives.

These include:

- Detectors for infrared, X-rays and gamma rays
- Active and adaptive optics
- Polarimeter for X-ray astronomy
- Reflecting mirrors for hard X-rays

❑ **A National Centre for Space Sciences**

The committee has strongly recommended the setting up of a National Centre for Space Sciences under the auspices of ISRO. The mandate of such a centre would be to primarily pursue R&D work to cater to the future instrumentation needs of different areas of space research such as

- **Astronomy**
- **Atmospheric sciences**

Ocean studies

- **Aeronomy etc.**

Such a centre would also undertake the design and construction of payloads for the approved missions, in close collaboration with the respective scientific agencies.

Participation in International Projects

It is becoming clear that multinational collaboration is the new paradigm in big science. In view of this, the committee has recommended that the Indian astronomers should strive to collaborate in some of the major international projects that are currently being discussed.

This document is unique in many ways. This is the first time scientists from different institutions have been involved in a collective exercise to survey the progress made, as well as plan for the future in a comprehensive manner. The Academy hopes that this approach will promote further collaboration between the scientists working at various institutions, which in turn, will result in a symbiotic growth of different areas of research and development. The Academy also hopes that this book will serve to expose young college students in India to the many exciting opportunities for a research career in astronomy and astrophysics.

Astronomy in India: A historical perspective

Modern astronomy in India dates back to the middle of the eighteenth century, when the subject of astrophysics began with attempts to understand the spectra of the sun the stars. Indeed, some of the Indian astronomers participated in the momentous discoveries made in that period. A full fledged solar observatory was established in Kodaikanal at the dawn of the 20th century.

During the 1940's, a new chapter began with systematic experimental activity in the frontier area of cosmic rays. By the end of the 1950s considerable progress was made in the development of sophisticated instrumentation for balloon borne experiments. This experience enabled some of the cosmic ray physicists to enter the emerging area of 'X-ray astronomy' very soon after the discovery of the first X-ray source Sco X-1 in 1962. Soon after pulsars were discovered in 1968, a group of physicists ventured into ultra high energy gamma ray astronomy.

This was also the period when radio astronomy came of age in India. The unique radio telescope in Ooty became operational by 1970, followed a decade later by a synthesis telescope at Ooty, a millimeter wave telescope in Bangalore, and a low frequency array in Gauribidanur near Bangalore.

The 1980's also witnessed the commissioning of an indigenously built 2.3 m optical telescope at Kavalur, and a near infra-red telescope at Mount Abu.

In the mean time, The Indian Space Research Organization had successfully demonstrated its capability to build state-of-the-art remote sensing and communication satellites, as well as launch vehicles. This opened up possibilities for modest space-borne astronomical experiments. The first significant one was a gamma ray burst experiment on the SROSS C2 satellite launched in 1994. This was followed by the Indian X-ray Astronomy Experiment (IXAE) on IRS-P3 launched in 1996.

The dawn of the new millennium saw the commissioning of the versatile Giant Metrewave Radio Telescope (GMRT) in Khodad near Pune, as well as a 2 m optical telescope at the high altitude observatory at Hanle.

The success of the IXAE triggered a discussion about a dedicated astronomical satellite. This led to the concept of ASTROSAT — a multi-wavelength astronomical observatory. The various telescopes that will be on board the ASTROSAT are now under development at various institutions, and the satellite is expected to be launched in 2007/08.

2005 ASSOCIATES

Amritanshu Prasad
The Institute of Mathematical Sciences, Chennai
Areas of interest: Automorphic forms, representation theory and matrices over local rings

Partha Sarathi Chakraborty
Indian Statistical Institute, New Delhi
Operator algebra, noncommutative geometry and quantum groups

Rahul Siddharthan
The Institute of Mathematical Sciences, Chennai
Condensed-matter physics, biological physics, computational biology and regulatory genomics

Shankar Ghosh
Indian Institute of Science, Bangalore
Raman spectroscopy and carbon nanotubes

Tushar Jana
University of Hyderabad, Hyderabad
Polymer chemistry and materials

Aditya Mittal
Indian Institute of Technology, New Delhi
Biological membranes, dynamics of biological systems and biochemical engineering

Mahesh S Tirumkudulu
Indian Institute of Technology-Bombay, Mumbai
Fluid mechanics, colloids and interface science

Mukund Thattai
National Centre for Biological Sciences, TIFR, Bangalore
Bacterial signalling, computational biology and statistical physics

Yamuna Krishnan Ghosh
National Centre for Biological Sciences, TIFR, Bangalore
Structure and dynamics of nucleic acids, B-propeller proteins

SPECIAL ISSUES OF JOURNALS

Genetic determinism

Guest Editors: Vidyanand Nanjundiah, Stuart A Newman and Scott F Gilbert
Journal of Biosciences, *Vol. 30, No.1, February 2005, pp. 1–142*

This special issue of the journal is based on the talks given at a discussion meeting on the theme of Genetic Determinism held in Pelling, Sikkim in December 2003.

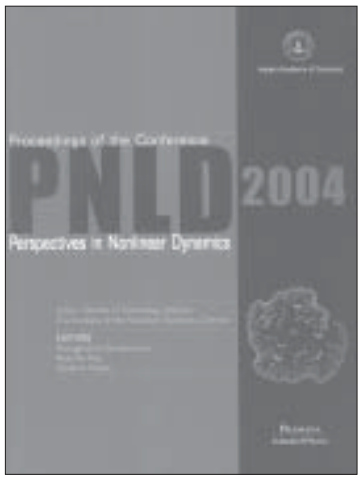
The basis of our understanding of the relation between genes and organisms — or between genotype and phenotype — is a long-standing issue in biology; it has been thrown into focus by recent advances in our ability to manipulate genetic material. An attractively straightforward view is based on what one might call genetic determinism. It holds that our phenotypes are, in effect, what our genes say they are. To begin with, phenotypes are considered capable of being partitioned. Each gene 'causes' or 'is responsible for' a particular part of the phenotype. A mutation in one gene would have an effect that can be looked at separately, from the effect of a mutation in some other gene. This view has been challenged as being simplistic, but how wrong is it? How good is the evidence that single gene changes lead to unitary changes in the phenotype with negligible attendant consequences? What are the implications of viewing living organisms as being in some sense specified by their genes – as opposed to being endowed with a fair degree of plasticity, morphological, behavioural and otherwise? Admittedly the two points of view are not entirely in opposition; to suggest otherwise would be to set up a straw man. But the fact of the matter is that the perennially fashionable notion of genetic determination lays stress on the former. It is this emphasis on one point of view that the Pelling meeting was designed to question.

As the articles in this issue show, what turned out was slightly different. Some speakers did subject the notion of genetic determinism to explicit and critical scrutiny; others (in particular the linguists) touched on it indirectly; and yet others spoke in support of the research strategy that advocates looking for single gene mutations that are strongly correlated with striking, 'single', effects on the phenotype. Unfortunately, not all those who spoke at the meeting are represented here. On the other hand, some of those who should have been in Pelling but were unable to make it, kindly provided written versions of the themes that they intended to discuss. An interesting presentation by Mathias Külpmann on the implications of modern biotechnology for national economies is being published in a separate issue of this journal as a Commentary. Minakshi Bhardwaj spoke on ethical issues underlying biotechnology, and it is hoped that her contribution too will appear separately.

The papers have been grouped in the following sequence, chosen to reflect the main themes: history; genes and development, environment and plasticity; epigenetics; cancer and language. Reading them will make clear that broad questions on the role of genes and approaches to addressing them recur across levels and disciplinary boundaries.

Perspectives in nonlinear dynamics (PNLD 2004)

Guest Editors: Ramakrishna Ramaswamy, Rajarshi Roy and Neelima Gupte
Pramana *Vol. 64, Nos. 3/4 March/April 2005, pp. 307–632*



This special issue of *Pramana* has emerged out of the papers presented at the conference on Perspectives in Nonlinear Dynamics (PNLD 2004), jointly organised by the Indian Institute of Technology, Madras and The Institute of Mathematical Sciences in Chennai in

July 2004. This conference, a satellite to Statphys 22, the International Conference on Statistical Physics which took place in the preceding week in Bangalore, attracted over 120 participants, 35 of these from outside India. A detailed report of the meeting can be found in Current Science (87, 1167 2004).

PNLD 2004 brought together leading researchers from across the world and the energetic and active nonlinear dynamics community of India. The success of this conference was due to the enthusiastic participation and support of this collective, which has organised itself into a research community in the past twenty years. The meeting served a dual purpose: to showcase the volume and level of work done in this subject in India to the international community, and to expose the community to the cutting edge of forefront research done by leaders in the field from as many as 14 different countries who attended the meeting. These proceedings are intended to be a record of this conference, and to serve as a reference for the research which the conference hopes to have nucleated.

Electronic commerce and electronic business

Guest Editors: Y Narahari and NRS Raghavan
Sadhana *Vol. 30, Nos. 2/3 April/June 2005, pp. 87–498*

This special issue was motivated by the recent upsurge of research activity in the areas of electronic commerce and electronic business both in India and abroad. The current research activity is quite intensive in the use of mathematical tools such as cryptography, game theory, mechanism design, optimization, probability and statistics, and machine learning for modelling and improving the efficiency of transactions in e-commerce and e-business. There is a wide variety of challenging research problems in this area awaiting the attention of researchers and professionals in e-commerce and e-business.

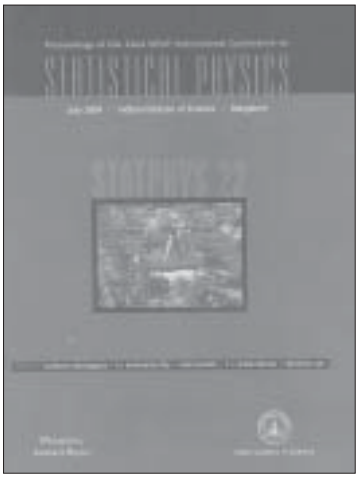
This special issue is targeted at researchers, research students, and industry research professionals interested in the areas of e-commerce and e-business. It has the objective of providing a state-of-the-art update of important recent technical advances and results in the area. The issue is the result of the efforts and initiative taken by leading researchers from active research groups in e-commerce. The authors are from academic institutions as well as from the industry.

There are a total of 18 papers in this special issue and these belong to three broad categories: (i) building blocks and enabling technologies; (ii) mechanisms, pricing, and business logic; and (iii) supply chains and electronic marketplaces. These papers can be classified into the following groups based on the nature of content of the articles: (a) Papers presenting a comprehensive survey of key technical and design issues in e-commerce and e-business, (b) papers presenting rigorous mathematical models to solve important research problems in e-commerce, and (c) papers describing the software architecture, design issues, and industry best practices.

Statphys 22

Guest Editors: S Dattagupta, HR Krishnamurthy, Rahul Pandit, TV Ramakrishnan and Diptiman Sen

Pramana *Vol. 64, Nos. 5/6 May/June 2005, pp. 635–1202*



The 22nd International Conference on Statistical Physics of the IUPAP, STATPHYS22 was held at the Indian Institute of Science in July 2004. STATPHYS conferences are the largest general meetings in statistical physics. They are the major established international conferences in this field and are very inclusive (chemical engineering, biology, information science… are all welcome parts). The conference theme has strong links to many branches of physics and chemistry, for instance condensed matter physics and physical chemistry, and has applications in many other fields such as high energy physics and astrophysics. Internationally, the subject is perceived to be of great importance by all countries with scientific research programmes.

Several world-class theoretical and experimental research groups have developed in India over the past 25 years, and these have made important contributions to the subject; some of these have received recognition in terms of plenary and invited talks at STATPHYS22. However, India had never hosted STATPHYS earlier. The STATPHYS22 meeting brought enormous benefit to researchers in physics and allied fields in India, especially the younger generation of Indian scientists who are doing doctoral and postdoctoral work in statistical physics and related areas. Thus, from India nearly 250 participated in this

conference; there were in all about 650 attending it, from 46 countries.

The scientific programme consisted of five days of exciting lectures ranging over all aspects of statistical physics, many presenting important new results for the first time to the community. Apart from the formal question-and-answer sessions, there was vigorous, continuous, scientific interaction among participants. There were two Boltzmann Award lectures, nine plenary talks, many invited talks, and several contributed oral and poster presentations on a variety of topics.

The papers presented at the conference have appeared in two consecutive issues of *Pramana* running to about 575 printed pages.

Aspects of sedimentary geology

Guest Editors: SK Tandon and Asru K Chaudhuri
Journal of Earth System Science, *Vol. 114, No.3, June 2005, pp. 195–380*

This collection of papers is a companion to the thematic issue on sedimentary geology. Many of the former students and friends of Sukomol Chanda, a Professor of Geology at Jadavpur University, who passed away in July 1998 were keen to dedicate some of their research work to their departed teacher. This collage of papers deals with various aspects of sedimentary geology of the Proterozoic and Gondwana basins of India; and the depositional setting and vertebrate biostratigraphy of the Triassic Dockum Group of Texas. Besides, three other papers deal with tidal flat structures: a journey from shallow to inner estuarine facies, nannobacteria and the formation of framboidal pyrite, and nanophase Fe^0 in lunar soils.

Ultrapure materials: Processing, characterization and applications

Guest Editors: TL Prakash and NR Munirathnam
Bulletin of Materials Science, *Vol. 28, No.4, July 2005, pp. 305–382*

The demand for ultrapure materials for electronics industry is constantly increasing the world over. The levels of purity achieved as represented in terms of number of nines (say 99.9999….at%) are also increasing year after year. Such pure materials are required for enhancing the efficiency of electronic devices. This is a specialized and cost-intensive research area and only a few research groups across the world are vigorously pursuing it. Recent surge in the studies of ultrapure materials and intensive academic discourse on important issues in the contemporary research areas of materials science and engineering and particularly related to microelectronics led to an International Symposium on "Ultrapure Materials: Processing, Characterization and Applications" held under the aegis of the Centre for Materials for Electronics Technology (C-MET), in November 2004 at Hyderabad.

The proceedings of this conference are brought out in this special volume. Most of the papers were invited talks covering all three parts of processing, characterization and applications of ultrapure materials. The technical topics covered include purification of transition, rare-earth and p-block elements and compound semiconductors such as HgCdTe and GaN. The applications of high purity materials in physical vapour deposition and radio-isotopes have been discussed. The characterization of ultrapure materials using mass spectrometry, glow discharge optical emission spectrometry and certified reference materials is also presented.

DISCUSSION MEETINGS

The Fluid Earth

Indian Academy of Sciences/JNC, Bangalore
10–14 January 2005

A three-day meeting on the fluid earth was organized by the Academy. Participants from NGRI and C-MMACS attended the meeting. The discussions focussed on earth science issues essentially involving material flows and how their solutions could be greatly facilitated using the powerful concepts of structural homologies and geometrical similitude. The topics covered included solidification of inner core, compaction and melt extraction, mantle plumes, magma chambers, conduit flows, eruptive dynamics, pyroclastic flows and turbidity currents, and flow in porous media .

Machine learning

Indian Academy of Sciences, Bangalore
2–3 September 2005

The meeting held at the Academy supported by Infosys Limited was attended by over 40 participants from academia spanning departments and industries and research institutions. The meeting was intended to bring together many of the active workers in the country in this emerging research area so that they could familiarize themselves with each other's work

and discuss issues of mutual interest. The most active application area of machine learning today is information retrieval. The meeting began with talks by Soumen Chakrabarti (IIT, Mumbai) on an overview of machine learning applications to web search for annotating the corpus with entities and relationships leading to graphical models that capture flexible type information and uncertainty. This was followed by Sudeshna Sarkar (IIT, Kharagpur) who described the work on e-learning wherein user profiles are represented in terms of a hand-crafted domain ontology and used for identifying appropriate learning materials for the users. She also discussed approaches to collaborative clustering in recommender systems. Mandar Mitra (ISI, Kolkata) surveyed several recent machine learning approaches to information retrieval in a comparative frame work, leading to their relative ranking.

The talks by Probal Choudhuri (ISI, Kolkata) and Sudeshna Adak (GE India Technology Centre, Bangalore) were devoted to applications of machine learning to bioinformatics and the talks by Abhinanda Sarkar (GE India Technology Centre, Bangalore) and K Ravikumar (General Motors, Bangalore) were devoted to management applications of machine learning. The talks by Pabitra Mitra (IIT, Kharagpur), B Ravindran (IIT, Chennai) and Sameer Jalnapurkar (IISc, Bangalore) were of a foundational nature. There were also six student presentations on phonetic engine for speech recognition, learning ontologies from domain corpora, knowledge management using CBR, association rule mining in spatio–temporal domain, topic distillation by support vector data description, and mining symbolic sequences.

SUMMER FELLOWSHIPS

The summer fellowships have become an important component of the science education programmes of the Academy. The number of both the applications received and the fellowships offered for students and teachers have steadily gone up. The following gives the data for 2005.

Subject	Student	Teacher
Biology	71	22
Chemistry	35	8
Physics	35	5
Engineering	17	4
Earth Sci.	7	1
Mathematics	12	3
Total	**177**	**43**

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

Ahmedabad	1	Allahabad	1
Bangalore	92	Bhubaneswar	1
Calicut	1	Chandigarh	2
Chennai	6	Dharwad	1
Dona Paula	1	Gandhinagar	1
Hyderabad	31	Kanpur	7
Kolkata	19	Lucknow	3
Madurai	3	Manesar	1
Mumbai	16	Mysore	5
Nainital	1	New Delhi	10
Pune	9	Trichi	2
Trivandrum	6		

REFRESHER COURSES

Instructional workshop on cryptology

Cochin Univ. of Sci. and Tech., Cochin
May 2–14, 2005

No. of participants: 39
Course Director: R Balasubramanian (Ins. Math. Sci., Chennai); **Course Co-ordinator:** A Vijayakumar (CUSAT, Cochin)

Resource persons: C Pandurangan, S Sribala, R Sivaramakrishnan, B Sury, MP Sebastian, CS Yogananda, R Balasubramanian ,V Arvind, M Sethumadhavan, RS Chakravarti, A Vijayakumar and Bimal Roy.

Teacher participants were from Anand, Bangalore, Calicut, Chandigarh, Chennai, Coimbatore, Gudiwada, Irinjalakuda, Kandukur, Kannur, Kanpur, Kasaragod Kollam,Komarapalayam, Nagpur, Payyannur, Thane, Thevara, Trichur, Trivandrum, Vijayawada, Warangal.

Topics covered: Number theory, enciphering matrices, congruences, quadratic residues, finite fields, primality and factoring, PKC, elliptic curves, zero knowledge proofs and applications, digital signature, recent trends in cryptography, extended RSA, EIGamal encryption, AES, DES, stream ciphers, LFSR.

Experimental Physics

Indian Institute of Technology, Guwahati
May 9–22, 2005

No. of participants: 10
Course Director: Mihir K Chaudhuri (IIT, Guwahati)
Course Co-ordinator: A Srinivasan (IIT, Guwahati)

Resource persons: R Srinivasan (RRI, Bangalore), S Mitra (Jadavpur University, Kolkata), KRS Priolkar, SM Sadique, Efrem D'Sa, Shafi Ahamed, Preeti Bhobe (all of Goa University), A Chattopadhyay, PS Robi, A Srinivasan, S Ravi, SB Santra, A Perumal, PK Giri, SK Khijwania, S Sarma, L Chakraborty and AC Deka (all of IIT, Guwahati).

The teacher participants represented institutions from Assam, Churachandpur, Darjeeling, Dewas, Dibrugarh, Diphu, Guwahati, Hyderabad, Jabalpur, Nagercoil, Suryamaninagar.

The programme consisted of a morning lecture, followed by laboratory sessions extended till late in the evening. The lectures were on selected topics of relevance to the course theme. The lectures were delivered by resource persons drawn from the Academy, Goa University and IIT, Guwahati.

The laboratory sessions consisted of construction projects, experiments based on the project instruments, and general experiments. Construction of a constant current source, a temperature controller and a lock-in amplifier formed the project work. An experiment on dielectric constant measurement, Stefan's constant measurement, Weidemann-franz law verification, thermal diffusivity measurement and mutual inductance measurement formed the project based experiments. One set of tested experimental set-up for each of the above project based experiments were brought by the Goa team. Hall effect, electrical resistivity (using four-probe method), melting point of a solid, indexing of powder X-ray diffraction pattern and polarization of light were the general experiments offered to the participants.

Science education programme on foundations of physics

Central Mechanical Engineering Research Institute, Durgapur
May 16-21, 2005

No. of participants: 150

Resource persons: Amitabha Ghosh (IIT, Kanpur), HS Mani (Inst. Math. Sciences, Chennai), AK Mallik and P Gupta Bhaya (IIT, Kanpur) JK Bhattacharjee (IACS, Kolkata).

In order to inspire young minds in science, and to first arrest and then reverse the alarming trend of brilliant minds being distanced from the fascinating world of sciences, a week-long science education programme on foundations of physics was organized at Durgapur. Thirty four students from Durgapur, Jamshedpur, Purulia and Asansol participated in the programme.

The course, the first of its kind in this country, purported to familiarise students with the conceptual foundations of physics so that this exposure helps the students to come out with a much better and deeper understanding of the most fundamental concepts of the basic branch of physical sciences. Another important outcome that this programme envisaged was inculcation within the stuents a correct understanding of the process how scientific theories evolve. Possessing a better idea of the working of science can be of immense help to students during their future career.

The broad topics of the course were:

Evolution of Newtonian dynamics, gravitation, special topics on Newtonian dynamics, analytical mechanics, thermodynamics, concept of special theory of relativity, physical foundation of general theory of relativity, foundation of quantum physics and nonlinear and chaotic dynamics.

A separate interactive session was also organized on one evening to discuss the effectiveness of such programmes and to assess the status of scientific awareness among the people, especially young minds. There were 150 participants in the session from academic institutions, students, parents and science loving persons.

Interdisciplinary approaches in biology

Centre for Cellular and Molecular Biology, Hyderabad
25 May – 8 June 2005

No. of participants: 27
Course Director: Somdatta Sinha (CCMB, Hyderabad)

Resource persons: D Balasubramanian, R Gadagkar, V Nanjundiah, Saurabh Ghosh, Partha P Majumder, SE Hasnain, J Nagaraju, Ramesh K Aggarwal, MV Jagannadham, Rakesh Mishra, Satish Kumar, TRK Murthy, Nandini Rangarajan, Ch Mohan Rao, R Sankaranarayanan, LS Shashidhara, S Sindhu, Lalji Singh, Somdatta Sinha, Ravi Sirdeshmukh, C Suguna, K Thangaraj, Amitabh Joshi, AS Raghavendra, M Srinivasan, Rajgopal Srinivasan and M Vidyasagar.

The teacher participants were from Ananthapur, Bangalore, Coimbatore, Gwalior, Hyderabad, Jalandhar, Kochi, Kolkata, Kurukshetra, Madurai, Mangalore, Nagpur, Nanded, New Delhi, Nirjuli, Pudukkottai, Sagar, Secunderabad, Sitapur, Tiruchirappalli, Vellore, Vijayawada, Visakhapatnam.

Biological research today has reached a very exciting stage. Traditionally specializing in a particular field has been the rule. Now a "biologist" not only requires a wide repertoire of knowledge in different fields of biology, it also helps to have a fairly strong background in physics, chemistry, mathematics, and some aspects of engineering. Additionally it facilitates collaborating with other scientists who were trained in different disciplines, if one learns to communicate with its practitioners at an early stage in their careers and appreciate the contributions that each discipline can make to biology.

Modern biology uses concepts and methods from other sciences to elucidate the working of life processes. Measurement and analyses of biological data employ quantitative methods from physics, chemistry, engineering, information technology, mathematics and statistics. Prediction and description of life processes also make use of concepts from other disciplines. This course was envisaged to introduce biology teachers to some of these aspects in relation to specific biological problems. The aim was to expose them to the interdisciplinary nature of modern biology with lectures, tutorials, hands-on problem-solving sessions, and laboratory demonstrations.

This refresher course attempted to prepare the biology teachers at the postgraduate level (who train our future generation of biologists) for teaching the new biology that is increasingly becoming interdisciplinary encompassing many fields within and outside biology. The hope was that the course had been able to transfer at least some of the excitements of interdisciplinary studies in modern biology to the participants who in turn would be able to pass on the same through their teaching to their students.

The course was divided into five modules: (i) Evolution, ecology, biostatistics, biomathematics, bioinformatics (ii) genome organization and genomics (iii) protein structure, function and proteomics (iv) development and (v) special topics.

The mathematical, computational and experimental techniques that were demonstrated and hands-on experience were imparted in groups were :

(i) Biostatistics (ii) simulation and plotting using simple software (EXCEL) (iii) bioinformatics (iv) transgenic laboratory (v) microarray facility (vi) software for phylogenetic analysis (vii) DNA sequencing facility and software (viii) protein purification and mass spectrometer (ix) structure determination methods and X-ray crystallography facility and (x) drosophila culture and mutant screening methods.

Earth system science

Indian Academy of Sciences, Bangalore
25 June –6 July 2005

No. of participants: 19
Course Directors: V. Rajamani (JNU, New Delhi); SK Tandon (Univ. of Delhi)

Resource persons: V Rajamani, SK Tandon, R Ramesh, SR Shetye, A Bhattacharya, Rajiv Sinha,

J Srinivasan, IVR Murthy, DC Srivastava, Malay Mukul, S Balakrishna, Devesh Sinha, and PK Saraswathi.

Topics covered: Earth's life, gravity, climate, and resources, planetary science, global ocean thermohaline circulation, role of oceans in Indian summer monsoons, fluid mechanics, thermodynamics, characteristics of atmospheric circulation, radiation and climate, supply, removal and redistribution of elements, earthquakes and internal structure, mechanical properties of rocks, kinematics of deformation, deformation in earth's crust, chemistry of the earth, classification of elements, formation of igneous rocks, radioactivity in earth sciences, radiometric dating of rocks, rock metamorphism, the hydrologic cycle, river systems, sediment routing system, physiography and landscape analysis, stratigraphy: geological history, time, functional morphology, taphonomy and resolution of stratigraphic records, rock weathering and forming minerals, rivers,. fossil fuel, stable isotopes in climate studies and water, etc.

Science Education Panel —activities organized since December 1999

	Mathe-matics	Theoretical Physics	Experi-mental Physics	Chemistry	Life Sciences	Earth Sciences
Refresher Courses	8	5	7	4	12	4
Lecture Workshops	6	7		14	16	–

Summer Research Fellowships since 1995

	Fellowships offered	Fellowships availed
Students	909	857
Teachers	247	245

Teacher invitees at Academy meetings since 1996:

Mid-Year	244
Annual	304

LECTURE WORKSHOPS

Frontiers in chemistry

Madurai Kamaraj University
9-11 March 2005

Participants: 145 students and faculty from colleges

Speakers: T Ramasami, AB Mandal, TK Chandrashekar, M Periasamy, PT Manoharan, MV Sankaranarayanan, S Umapathy, S Natarajan, AR Chakravarty, M Vairamani and R Ramaraj.

Topics covered: Geometrical factors in host-guest interactions involving biomolecules; tetrapyrrolic macrocycles: the molecules of life; receptors for cations and anions; development of organotitanium reagents for synthetic applications; mossbauer spectroscopy and its applications; basics of spectroscopy; over view ofmass spectrometry; use of hydrothermal methods in the synthesis of new inorganic materials; application of mass spectrometry in pharma industries; laser spectroscopy; copper containing proteins; how much we know about self-aggregated systems?; high-nuclearity copper (II) complexes; electrical double layer; DNA cleavage by copper complexes; micellar catalysis and its importance.

Microscopic techniques in biology

University of Pune
9–11 March 2005

Participants: 120 students and faculty from colleges

Speakers: BB Nath, AN Bhisey, RA Bhisey, UV Wagh, Nishigandha Naik, L Limaye, AC Mishra and A Basu.

Topics covered: Light microscopy, cytophotometry using UV and visible light; fluorescence microscopy, principles and applications of confocal microscopy; applications of flow cytometry; introduction to election microscopy and application of modern electron microscopic techniques.

Quantum computers

Jawaharlal Nehru University, New Delhi
10–15 March 2005

Participants: 35 students and faculty from JNU and other institutions

Speakers: Anu Venugopalan, Subir K Sarkar, Karmeshu, Rupamanjari Ghosh and Deepak Kumar.

Topics covered: Quantum mechanics; information science; two–level systems; quantum algorithms and physical systems.

OBITUARIES

Debi Prosad Burma (elected 1976), a pioneer of modern molecular biology, particularly the structure and function of ribosome, passed away on 4 February 2005 at Kolkata after a brief illness.

Born in Burdwan on 1 February 1925 Burma passed the matriculation in 1941, B.Sc in 1945 and M.Sc in chemistry in 1947 from the University College of Science, Kolkata. He started his research career in Bose Institute, Kolkata, under D.M. Bose, the then Director of the Institute. His Ph.D. work was on paper chromatography when the subject was in its infancy. He established a technique of circular chromatography using filter paper. After completing his Ph.D he first went to Canada (1954–1955) with an NRC Fellowship and then moved to the laboratory of R.H. Burris at the University of Wisconsin, Madison where he worked (1955–1957) on the mechanism of nitrogen fixation in Azotobacter vinelandii. Next year he joined the laboratory of B.L. Horecker at the National Institute of Health, USA, where, within six months he purified and characterized L-ribulose kinase and L-ribulose-5-phosphate-epimerase, the two enzymes involved in L-arabinose metabolism. In 1957, Burma returned to India to join Bose Institute, where he worked for three years (1957–1960) on the pentose phosphate pathway in plants and cell-free protein synthesis in microorganisms. In January 1960, he went again to USA to work with Severo Ochoa, the Nobel Laureate, in New York University, School of Medicine. There he worked on DNA-dependent RNA synthesis. This was indeed a milestone of his landing in molecular biology and development of the concept of structure-function relationship of ribosome, which was his life-blood later. In 1961, at the invitation of B.C. Guha, Burma joined the newly created Department of Biochemistry of Calcutta University as Reader. However under a unique arrangement Burma taught in the Biochemistry Department of the University but retained his laboratory and research at the Bose Institute. In 1964 Burma joined the Banaras Hindu University as Professor and Head of the Department of Biochemistry and Biophysics in the College of Medical Science. In BHU, his primary research interest was structure-function relationship of ribosome, in which he made seminal contributions. His group provided first evidence that RNA-RNA interaction is responsible for the association of 30s and 50s ribosomes to form 70s ribosomes and demonstrated that loose couple 70s ribosomes are not artefacts. The two populations can be interconverted both in vitro and in vivo. His pioneering work laid an important foundation for much of the RNA research in India. He formally retired from BHU in 1985 although he continued his association with BHU for some more time as CSIR Emeritus scientist in the Molecular Biology Unit.

Burma was a voracious reader, keeping himself abreast not only in the field of ribosomology, but also in various fields of biology, especially molecular biology, immunology and biotechnology. He received the J.C. Bose Medal of INSA, the B.C. Roy Memorial Award of Medical Council of India; the Hari Om Ashram Award of UGC, the Amulya Ratan Medal of Calcutta University, the J.C. Ray Medal of Indian Institute of Chemical Biology and life-time award of Bose Institute. He was elected to Indian National Science Academy; National Academy of Sciences, National Academy of Medical Sciences, and the International Academy of Medical Sciences. During the last phase of his life, he wrote two books: “Music of Life”, and “Bose Institute, Ribosome and Myself”.

He leaves behind his wife Maharani who was also his scientific companion, and two sons.

Ranjan Roy Daniel (elected 1966) passed away on 27 March 2005 following a prolonged illness. After a successful scientific career at the Tata Institute of Fundamental Research, Daniel had initiated and managed many scientific projects in the country, bringing together scientists working in different areas and departments, to achieve common science goals. His involvements in international organizations brought credit to his endeavour and to the nation for promoting science in developing countries.

Daniel was born in Nagercoil in Kanyakumari District of Tamil Nadu State, as the third of five children to Masilamani Arumanayagam Daniel and Theresa Chellammal on 11 August 1923. His entire schooling from 1928 to 1939 was in the Scott Christian High School, Nagercoil. After passing the Intermediate in 1941 from the Scott Christian College, he studied at Loyola College, Madras and obtained B.Sc. degree from University of Madras in 1943. He then worked as a physics demonstrator in the Scott Christian College for

a year. Persuaded by his classmate D Venkatesan, Daniel went to Banares, took his M.Sc. Degree in Physics from BHU with wireless as special subject in 1946 and worked as a temporary lecturer for a year.

Daniel's research career started when he joined the Tata Institute of Fundamental Research (TIFR) in 1947 as a research assistant. He worked on meson scattering and charge particle interactions in nuclear emulsions under the guidance of Homi J. Bhabha. The Government of India sponsored him for higher studies at the University of Bristol in UK in 1951 where he carried out research at the H.H. Wills Physics Laboratory using nuclear emulsions exposed to cosmic rays at high altitudes and obtained the Ph.D. Degree in 1953 on production of heavy meson under D.H. Perkins. He returned to TIFR in the same year and concentrated on the study of the production of heavy mesons in nuclear interactions at high energies. The study of nuclear scattering of *K*-mesons was used to test the concept of the conservation of strangeness in strong interactions. He was also involved in the study of high-energy interactions using accelerator particles.

When the discovery of fundamental particles and the study of their properties using cosmic rays were taken over by accelerator experiments with controlled beams in late fifties, the emulsion group at TIFR turned their attention to primary cosmic ray studies. He did not lose any time in taking a lead role in this endeavour with the help of young scientists coming out of the Atomic Energy Training School. His interest in this area varied from high-energy interactions by cosmic rays well beyond the realm of accelerator energies to composition and energy spectra of primary nuclei. The advantage of the geographical location of India, over which cosmic ray particles of rigidity more than 10 GV/c could alone penetrate the earth magnetic field, was fully made use of by balloon-borne emulsion detectors to study high energy primary cosmic rays. He measured fragmentation cross-sections of high-energy heavy nuclei and undertook a study of the transformation in the composition of galactic cosmic radiation due to their interaction with interstellar gas during propagation in the Galaxy. His participation in the international collaboration to study nuclear interactions at 'jet' energies using ICEF emulsion stack exposed to cosmic rays, yielded interesting results.

The first attempt to measure the energy spectrum of high-energy cosmic ray electron component was started in 1961, using a stack of hyper-sensitized nuclear emulsion stack exposed over Hyderabad, but the emulsions could not be processed properly. Successful processing was achieved in the next attempt in 1963, when an identical stack was oriented in the East-West direction during the balloon flight. Search for electrons was undertaken by him along with a few senior members of the emulsion group for a year, but yielded no results and his colleagues abandoned the search. He did not take this disappointment to heart, but decided to continue the search alone patiently with hope. While carrying out this experiment with a help of only one scanning girl, two questions arose for the first time in emulsion technique. What is the detection probability of an electron for the criteria adopted in the search and how it varies with energy? How to overcome the effect of spurious scattering while determining the energy? These questions were answered by the results of extensive theoretical calculations carried out by his colleague SA Stephens and though he was convinced, as a true experimentalist, Daniel was satisfied only after these results were verified using emulsion stacks exposed to accelerator energies. Together with Stephens, Daniel published many papers relating to cosmic ray confinement, relationship with the universal black body radiation, galactic radio background and magnetic field distributions and galactic halo; K.C. Anand was also a partner in some of these. The electron era in TIFR came to an end in 1973, when it was found difficult to maintain the same momentum using the same technique. He joined the group NASA Johnson Space Flight Centre as NRC Senior Research Associate in 1976 for a year with Stephens and had many publications and three extensive review articles.

He also undertook a research programme to look for energetic neutrons from the Sun. The same detector was used to study energetic neutrons and low energy gamma rays in the atmosphere and upper limits on cosmic gamma ray flux were obtained. But, seeing the end to cosmic ray research using nuclear emulsions, he decided to promote the idea envisaged by many in the cosmic ray group to look into the relatively unexplored area of far-infrared astronomy. It was a Herculean task, as cryogenic technology at liquid helium temperatures was not available in this country and technique to maintain a stable platform to keep a large telescope pointing to directions as preplanned needed very careful innovations. It took a decade for getting the infrared telescope operational, in spite of the frustration for not able to publish papers over this period. But, the telescope was lost during the first flight shattering their hope. He gave support and stood by them, at the time of the loss of the telescope and an attempt to abandon this project. He convinced the Institute to provide the required fund to make a better telescope than the one previously flown. Many papers were published using this new telescope.

By this time he enlarged his interest to national projects and had a very successful career as a major scientific

figure in India. As Chairman of the Advisory Committee for Space Science of ISRO, he provided leadership for many projects such as, the Indian Middle Atmosphere Programme using balloons and rockets, the MST Radar Project near Tirupati, manufacture of small telescopes for schools to promote education on Astronomy etc. He also persuaded and encouraged scientists to carry out scientific experiments using Indian satellites to promote a sense of national achievements in spite of the low success for such initial ventures, which may not lead to exciting results.

He passed away on 27 March 2005 leaving behind his wife Padmini, three daughters and a son.

Usha Ranjan Ghatak (elected 1976) was born at Brahmanberia, now in Bangladesh on February 26, 1931 as the fourth of the seven children to Hem Ranjan Ghatak and Soudamini Devi. He got his early education in Bangladesh passing the matriculation in 1947. After the country's partition he moved to Agartala, Tripura where he passed his I.Sc. Examination in 1949. He then migrated to Calcutta and obtained his B.Sc. degree with honours in Chemistry from Asutosh College. He received his Masters degree in Chemistry from Calcutta University as a topper in 1953 and secured the Calcutta University Gold Medal and Motilal Mullick Medal. He then joined the group of Professor PC Dutta, a renowned synthetic organic chemist at the Indian Association for the Cultivation of Science (IACS) and obtained his Ph. D. degree in 1957 from Calcutta University. After spending another two years in IACS as a research associate he moved to USA for his postdoctoral assignments in 1959. During the following four years he worked at the University of Maine (Orono), the University of California (Berkeley) and the St. John's University (New York) in a wide field of organic chemistry from natural products to peptide synthesis.

Ghatak returned to India in 1963 and joined as a reader in the Department of Organic Chemistry, IACS. He started his independent research in the area of organic synthesis. Within a short time he established himself as an organic chemist of high repute both nationally and internationally. He made substantial contributions to methods for stereochemically controlled organic synthesis, particularly in the fields of polycarbocyclic diterpenoids and bridged-ring compounds related to bioactive natural products. His work is marked by a deep understanding of the conformational, steric and mechanistic factors which control bond formations in organic synthesis.

At a very early stage Ghatak and his co-workers developed a simple stereocontrolled total synthesis of some resin acids of profound contemporary interest and settled the stereochemical assignments of all the four possible racemates of deoxypodocarpic acid, desisopropyl dehydroabietic acid and the corresponding 5-epimers. These discoveries clarified the stereochemical uncertainties that existed in the literature for the related synthetic compounds and have been widely referred by later workers in the field.

Ghatak developed a general synthetic strategy which is of considerable potential towards synthesis of a large number of teyracyclic gibbanes and phyllocladane synthons based upon intramolecular copper-catalysed carbenoid addition to double bond by thermal decomposition of gamma, delta – unsaturated diazomethyl ketones. This has been successfully demonstrated in achieving the total synthesis of compounds related to gibberellins, the plant hormones. These molecules posed a challenging synthetic problem from structural as well as stereochemical points.

During the last phase of his tenure in IACS he secured a remarkable achievement in the free radical cyclization chemistry. The regio- and stereo-specific 6-endo and 7-endo-aryl radical cyclization leading to a simple convergent general method of synthesis for some linear polycarbocyclic systems was developed. This protocol was successfully employed in the stereocontrolled generation of several chiral centres in a single step.

His pioneering contributions in synthetic organic chemistry earned him wide recognition resulting in many awards such as the Shanti Swarup Bhatnagar award in Chemistry (1974), Fellowship of the Indian National Science Academy (1980), and the Chemical Research Society of India gold medal (2003).

During his tenure at IACS, several sophisticated instruments like high field NMR, GC, and LC were procured for the department. Ghatak became the Director of IACS in 1989 for four years. After superannuation he continued as professor of organic chemistry till 1996. He then joined the Indian Institute of Chemical Biology, Calcutta as Emeritus Scientist and was associated with this Institute till the end.

Ghatak was a much loved and admired person, easily approachable. He passed away on 18 June 2005 at his residence after a massive heart attack leaving Anindita, his wife.

Govindachetty Rangaswami (elected 1960) passed away in Salem on 9 September 2005 four weeks prior to the planned celebrations of his 80th birth anniversary in Coimbatore. He was a combination of plant pathologist, agricultural microbiologist and a technocrat known for his organizational abilities and as a builder of agricultural institutions in South India.

GR, as he was known by his students and well wishers, was born on 21 January 1925 in Kuttapatty village, Salem district, Tamilnadu in a middle class family. He graduated from the Agricultural College, Coimbatore in 1946. After postgraduate studies on an antifungal antibiotic produced by *Bacillus subtilis* (bulbiformin) at IARI New Delhi, he went to USA to obtain a Ph.D. degree of the Rutgers University under the guidance of the Nobel Laureate S A Waksman. His doctoral research related to the isolation, characterization and elucidation of properties of Mycothricin, a new polypeptide antibiotic of the Streptomycin group. On returning to India, GR's interest was naturally towards an understanding of the use of antibiotics in the control of plant diseases since his earlier pubished papers were on the blast disease of rice. He had studied the distribution of stomata and silica in relation to rice blast disease including varietal differences. The two areas of plant pathology which interested him in the earlier days were the bacterial diseases of plants and soil actinomycetes especially of the Streptomyces lavendulae group.

GR was basically interested in plant diseases as evidenced by his three books — on Pythiaceous fungi, bacterial diseases and diseases of crop plants in India but his eagerness to develop agricultural microbiology fructified when he joined the Annamalai University in Chidambaram where he was instrumental in starting an Agricultural College in 1959 for award of BSc in Agriculture. He developed an agricultural microbiology department and advocated the concept of holistic approach towards understanding the useful and harmful aspects of microorganisms in agriculture.

At Annamalai GR attracted a number of students for masters and Ph.D degrees which helped him to pursue his first love towards plant diseases and also branch off to diverse fields such as root nodule symbiosis, free-living nitrogen fixers like Azotobacter chroococcum, root knot nematodes, rhizosphere and phyllosphere microbiology, plantation crops, microbiology of composting, anaerobic digestion of cellulose in biogas production and bacterial fertilizer production. In short, his interest fanned over the entire gamut of microbes and plants including mushroom cultivation.

GR's appointment as Dean of Agriculture in the University of Agricultural Sciences (UAS), Bangalore in 1965 was another opportunity to shape the curriculum and fashion teaching in agriculture on the lines of the trimester system of the land grant colleges in USA. A department of agricultural microbiology came into being at UAS during his tenure. He wrote his book on agricultural microbiology from his experience on teaching the subject.

Recognizing his ability as an able science administrator, GR was called upon to estabilish an Agricultural University in Coimbatore, became its founder-Vice Chancellor in 1971 and continued there for two full terms. The University witnessed phenomenal expansion during this period.

During the years in Bangalore and Coimbatore, GR's students began investigating the interaction between soil microorganisms in the root region (rhizosphere) and various crops. These findings revealed that rhizosphere microflora can be altered by spraying chemical nitrogen sources on the leaf thereby implying that host-mediated transport of chemicals to the root region influenced the number and activity of microorganisms near the root zone.

GR's interest was also focussed on symbiotic and non-symbiotic nitrogen fixing micoorganisms. He was concerned about the indiscriminate use of chemicals in agriculture whether as fertilizers or pesticides. Therefore, units solely devoted to production and quality control of Rhizobium, Azotobacter and Azospirillum inoculants were developed in the agricultural universities of Bangalore and Coimbatore under his guidance. In fact Tamilnadu has been the biggest user of biofertilizers. Many of his students investigated the occurrence and benefits of phosphate mobilizing arbuscular mycorrhizal (AM) fungi, especially in millets and more particularly the synergestic beneficial effect of Rhizobium and AM fungi in root nodulation and productivity of leguminous crops.

GR had the ability to mobilize national and international funds to develop a wide range of projects in agricultural science. His services beyond South India began when he assumed the charge of the National Academy for Agricultural Research Management (NAARM) in Hyderabad between 1978 and 1980, Advisor on Agriculture to the Planning Commission in 1980 and Technical Advisor in Agriculture to the Commonwealth in UK in 1981.

As one of the past Presidents of the Association of Microbiologists of India, GR reorganized the working of the Association and enacted rules to bring in harmony in an otherwise chaotic situation existing in the organization prior to his intervention. He was also the past president of the Indian Phytopathological Society of India. Recognizing his services to the Agricultural Universities in Bangalore and Coimbatore, he was conferred honorary doctorate degrees by these universities. In 1977, Tami scholars conferred upon him the title of "Ariviyal Maamani" in 1977 and even in his retirement, he wrote a book "My life with microbes and agriculture".

Rangaswamy is survived by his wife Jayalakshmi, one son and a daughter.

Amal Kumar Raychaudhuri (elected 1982) passed away on June 18, 2005. AKR was born in Barisal, now in Bangladesh, on 14 September 1923. After his schooling he joined the Presidency College, later to become his playground for a glorious academic innings. After M.Sc, he joined the Indian Association of Cultivation of Science (IACS) in 1945 as a research scholar and was asked to do experimental work which he was not cut out for. This lasted for four years of sheer frustration and agony. Undeterred he taught himself in complete isolation the abstract and difficult differential geometry and general relativity (GR). It is this drill of self-learning which formed the foundation for his later work.

Then he taught for a couple of years at the Asutosh College. He rejoined IACS in 1952 as a research officer. This was indeed the most trying time of his research career. GR was not considered worthy of attention of a young researcher and he was asked to work on electronic energy bands in metals. He wrote two papers just to keep his job at the institute. The path-breaking equation was discovered in 1954 under such adverse and challenging circumstances.

The liberating event occurred in 1961 when he joined the Presidency College as a professor and a glorious and most rewarding academic career then unfolded for nearly three decades. He trained and inspired a galaxy of brilliant students spread all over the globe and many of them are at the frontiers of their fields of interest. Against the backdrop of all good scientists flocking in research institutes rather than universities, people like AKR who are few and far between served as lighthouse inspiring and exciting young minds.

Before discovering his beautiful equation, he wrote one of the very first papers on condensations in expanding universe and also discussed in another paper the question of the Schwarzschild singularity which was at that time generally believed, including by Einstein himself, not to be attainable. He constructed a non-static collapsing solution and showed that there was nothing to prevent such a happening. These were also very important and interesting papers which were done while he was working as a temporary lecturer in Asutosh College, perhaps a feat unparalleled in the history of that college or any college.

The Schwarzschild radius was non-singular but there was a genuine physical singularity as the radius goes to zero where spacetime curvature diverges. In cosmology too there was the big-bang singularity of the homogeneous isotropic and expanding universe. The natural question to ask was whether singularity of gravitational collapse or of expanding universe is due to homogeneity and isotropy or generic and inherent character of GR, Einstein's theory of gravitation? For instance, could rotation which opposes gravity avert its occurrence. AKR then addressed the fundamental question of singularity in the most general form with no reference to any symmetry and any specific property of spacetime and energy distribution. He considered evolution of a congruence of ordinary particles, which are characterized by time-like velocity vector, under its own gravity. Taking the timelike velocity as the eigenvector of the Ricci curvature and then by using the Einstein equation, he obtained his celebrated equation — the Raychaudhuri Equation. The most profound result emanating from the equation was that singularity is a generic and inevitable feature of GR. It was left to the mathematical prowess of Roger Penrose and Stephen Hawking to prove in mid-sixties the most general and powerful theorems to establish this result rigorously.

It was only in late fifties when he learnt that his paper was much talked off in the West and was referred by Jordan and Heckmann that he gained confidence to submit his thesis for D.Sc. in 1959. First recognition came from far, and yet it did not make much news at home until Jayant Narlikar's return to India in 1972. It was then that AKR surfaced on the Indian scene and slowly Academies and other academic agencies started taking note of him.

It is noteworthy that though he was an icon for his students yet not many of his good students took to

research in GR, perhaps because he thought there was greater excitement and action in other fields like high energy and condensed matter physics. A good measure of a teacher is reflected in the heights scaled by his students. Several of his students are world class and well-recognized scientists. As a researcher, he made the indelible contribution by his equation — the Raychaudhuri equation — governing the dynamics of the universe, which will stand firm so long as Einstein's theory of gravitation — general relativity (GR) stands.

The Inter-University Centre for Astronomy and Astrophysics together with Vigyan Prasar are jointly making a documentary on him, the shooting of which was fortunately completed just before his death. Hopefully the film would transmit to the younger generation some of Raychaudhuri's spirit of scholarship and dedication. He leaves behind his wife, two sons and two daughters.

One of the last icons of the Raman-Bhagavantam school of molecular spectroscopists, **Kunapuli Venkateswarlu** (elected 1958) died on July 2, 2005. Born on June 6, 1916 at Nuzvid, Andhra Pradesh, he passed M.Sc. in physics in 1939 from Andhra University, securing first class first rank and winning the Metcalf Gold Medal. In 1939 he was awarded D.Sc. for his research in physics. A long and chequered career awaited him at several academic institutions. For about nine years, starting 1939, he served the Andhra University in various capacities as a teacher. During 1948–50, as a Madras Government overseas scholar in geophysics, he got trained at the Cambridge University, the California Institute of Technology and in the US Geological Survey. On his return, he was appointed special officer for ground water resources by the Government of Madras. After a two-year stint in that job, he joined Annamalai University as reader in physics, and later became the professor and head of the department of physics of that University. After about 7 years he was invited by the Kerala University to set up its Physics Department which was then at Ernakulam (now CUSAT). Under his leadership that department earned reputation as a centre of advanced research in many areas. He moved to PSG College of Arts and Science in 1969 as postgraduate and research professor in physics, a post he held with distinction for two years. He was a visiting professor of physics at Florida Institute of Technology from 1981–83. He also served as visiting professor at various institutions in India and abroad. Since 1983, he had been living almost as a recluse at Coimbatore.

The late Professor S. Bhagavantam was Venkateswarlu's mentor. There is a joint paper by them on the scattering of light in single crystals, published in 1944 in the Proceedings of the Academy. His most important piece of work of his pre-doctoral days is on the temperature effect in Raman line intensities in crystals, which showed for the first time that the traditional Placzek theory is inadequate in explaining the high temperature behaviour. During his initial years as a demonstrator in physics, he conducted several investigations on ultrasonic velocities in organic liquids; which provided the spring board for elaborate investigations by his school in later years. In 1955, he launched a programme of determination of harmonic force constants of molecules and radical species. His group investigated the general valence and Urey–Bradley force fields of hundreds of systems. They found that while bond stretching force constants exhibited a fair degree of characteristics, others such as bending, twisting and interaction constants are sensitive to bond environment. Later he extended his work to calculation of additional constants such as mean amplitudes, coriolis coupling coefficients and rotation distortion constants. Such studies are relevant to the problem of elucidating molecular structure. As most of these computations were performed either in the pre-computer era or during the early years of development of computer technology, the enormity of the numerics involved can be easily discerned. The parameter representation developed by his school came in handy for making use of additional data in force field analysis.

Despite deep involvement in computational physics, he was at heart an experimental physicist of classic distinction. He directed studies on magnetic susceptibilities, ultrasonic velocities and even X-ray diffraction. During his tenure as a geophysicist he carried out an exclusive groundwater survey of Tamilnadu using the resistivity method.

Venkateswarlu trained over two dozen Ph.Ds and numerous M.Scs in physics. He was responsible for building the physics department of Annamalai Uiversity from its fledgeling state. He brought serious physics to Kerala and initiated research activities. An outstanding teacher with a penchant for simple and direct presentations, he radiated considerable charm and warmth which endeared him to his students. He is survived by two sons and two daughters.

POSTERS

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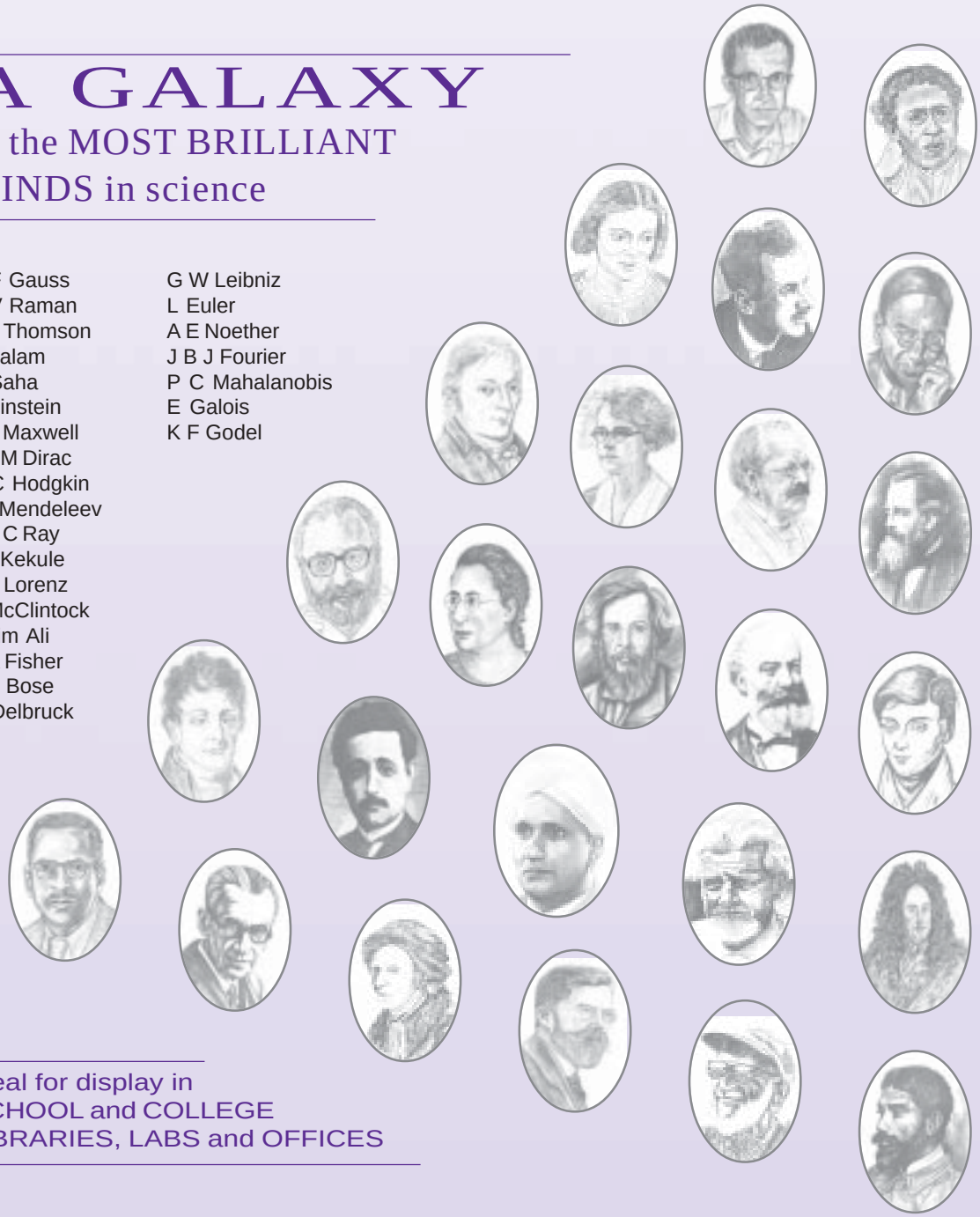

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Academy Initiative in University Science Education

The Science Education Panel of the Academy offers several two-month Summer Fellowships to enable students/teachers to work with Fellows of the Academy during 2006. The announcement inviting applications along with the application format and a list of Fellows willing to accept students/teachers for work on joint short-term projects are included as a supplement in the October 2005 issue of *RESONANCE* – journal of science education. This information is also available in the Academy website.

Proposals are invited from interested students and teachers for these Fellowships. The proposal should include a brief resume of the applicant (in the required format), a one-page description of the planned activity, the Fellow with whom the applicant would like to work and the tentative dates of visit as convenient to the applicant. The planned activity should clearly state the specific experiment or theory that the applicant would like to work on and NOT a general description of the area. Student applicants should include a recommendation letter from a teacher familiar with their work, in a sealed envelope.

Completed proposals should reach the Academy office by 31 December 2005. Information of selection along with concurrence of the Fellow will be despatched by early March, 2006.

The selected students/teachers will be provided appropriate round trip train fare and an honorarium to meet the boarding and lodging expenses at the place of work.

31 September 2005
Professor N. Mukunda
Chairman, Science Education Panel

Contact:

The Executive Secretary
Indian Academy of Sciences
C.V. Raman Avenue
Post Box No. 8005
Sadashivanagar P.O.
Bangalore 560 080

Deadline for receiving proposals:
31 December 2005

Website: www.ias.ac.in
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