

ANNUAL REPORT

2005 - 2006



INDIAN ACADEMY OF SCIENCES BANGALORE



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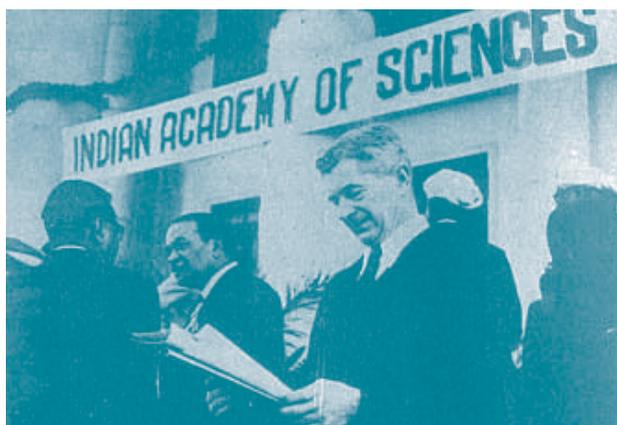
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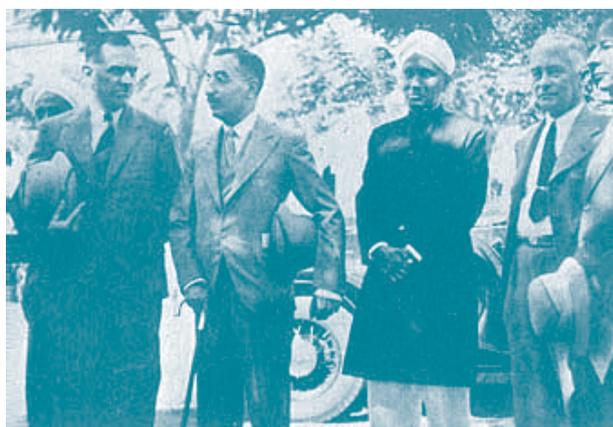


1 INTRODUCTION

The Academy was founded in 1934 by C V Raman with the main objective of promoting the progress and upholding the cause of science (both pure and applied). It was registered as a Society under the Societies Registration Act on 24 April 1934.

It commenced functioning with 65 Fellows. Its formal inauguration took place on 31 July 1934 at the Indian Institute of Science, Bangalore. On the afternoon of that day its first general meeting of Fellows was held at which C V Raman was elected its President and the draft constitution of the Academy was approved and adopted. The first issue of its proceedings was published in July 1934.

The present report covering the period April 2005 to March 2006 represents the seventy-second year of the Academy since its founding.



2 THE FELLOWSHIP

2.1 2006 Elections

A total of 347 nominations received for Fellowship in different disciplines were considered by the eight sectional committees and subsequently by the council. Following postal balloting, twenty nine new Fellows were elected, the Fellowship effective from 1 January 2006. A list of their names follows while Annexure 1 gives some of their particulars. Also elected were two new Honorary Fellows.

New Fellows:

- | | |
|---------------------------|-----------------------------|
| 1. Banerjee, Soumitro | 16. Kundu, Gopal Chandra |
| 2. Basak, Amit | 17. Majumder, Hemanta K |
| 3. Basu, Joyoti | 18. Mandal, Chitra |
| 4. Bhat, BV Rajarama | 19. Mandal, Nibir |
| 5. Bhat, GS | 20. Puri, Sanjay |
| 6. Bhattacharya, Samaresh | 21. Rajasekharan, Ram |
| 7. Bose, Arup | 22. Ramakrishna, BS |
| 8. Chakravarty, Charusita | 23. Ramakrishnan, S |
| 9. Deb, Kalyanmoy | 24. Raychaudhuri, Amitava |
| 10. Dev, Bhupendra N | 25. Sengupta, Surajit |
| 11. Ghosh, Swarna Kanti | 26. Sonti, Ramesh V |
| 12. Guru Row, TN | 27. Thelma, BK |
| 13. Hasan, Gaiti | 28. Trivedi, Sandip P |
| 14. Jayaraman, A | 29. Visweswariah, Sandhya S |
| 15. Khurana, Jitendra P | |

New Honorary Fellows:

- | | |
|------------------------|--------------------|
| 1. Ranajit Chakraborty | 2. Michael L Klein |
|------------------------|--------------------|

2.2 In memoriam

The Academy regrets to report the death of the following twelve Fellows and an Honorary Fellow during the period up to March 2006. Annexure 2 gives additional information about them.

Fellows:

- | | |
|--------------------------|-----------------------------|
| 1. Banerjee, Manoj Kanti | 7. Rangaswami, G |
| 2. Das Gupta, MK | 8. Raychaudhuri, Amal Kumar |
| 3. Desikachary, TV | 9. Sarkar, SN |
| 4. Ghatak, UR | 10. Subrahmanyam, R |
| 5. Merchant, JR | 11. Venkateswarlu, K |
| 6. Ramachandra Rao, B | 12. Venkoba Rao, A |

Honorary Fellow:

Bondi, Sir Hermann

2.3 Strength of the Fellowship

	Fellows	Honorary Fellows
1 April 2004	858	47
Elected (Dec. 2005)	29	2
Deceased (2005 – 2006)	12	1
1 April 2006	875	48

2.4 Women in Fellowship

The Indian Academy of Sciences is distinguished by the fact that among the founding fellows of the Academy was a woman scientist: the distinguished plant geneticist E K Janaki Ammal. However, in the years that followed this number remained rather small: in 1940 there was only one woman out of a total of 240 Fellows. In 1976 the total number of Fellows nearly doubled to 430 and six of them were women. The three plots in the Graph show that the number has increased steadily *albeit very slowly* from 1986 onwards when it stood at 8 in a total of 518. In the latter half of the last 72 years since the Academy was founded, the overall situation thus improved somewhat, the percentage of women increasing by about a factor two standing currently at 5.25% : 46 women out of a total Fellowship of 877 (as on 1st January 2006).

As can be seen from the Table in the following page showing the subject-wise gender breakup of the Fellowship, this *small* increase is almost entirely due to the larger presence of women in the Fellowship in Medicine (about 25%), Animal Sciences (about 20%) and in General Biology (about 12%). While indeed it reflects the larger participation by women in these disciplines at all levels as is normally perceived, one wonders whether the participation in areas such as Physics, Chemistry is indeed as low as 1–2% as is seen in the Fellowship. Further, it is also not clear whether quantitatively the fraction in Life Sciences in the Fellowship, is commensurate with the larger participation by women in these disciplines at all levels. While no one would ever advocate any proportional representation, this is a question worth asking. Surprisingly Mathematics does better than Physics and Chemistry, where the percentage stands at about 5%. In Engineering and Technology, all the 131 Fellows at present belong to the same gender. Of course, the rather small number of women in the Fellowship meant that only a small number of them have been office bearers of the Academy.

The small number of women in the Fellowship seen here is consistent with the general picture seen in all such bodies the world over. However, a small analysis on the success rates of nominations indicates that in the last thirty years or so (the period covered by the analysis) there is *no gender dependence of the success rate of a nomination*. It is gratifying to see this. This then clearly points towards the way to correct the imbalance that is seen: being more proactive about nominating more deserving women scientists to the Fellowship. One believes that this will help the gender distribution in the Fellowship

Subject-wise gender decomposition of the Fellowship through the years

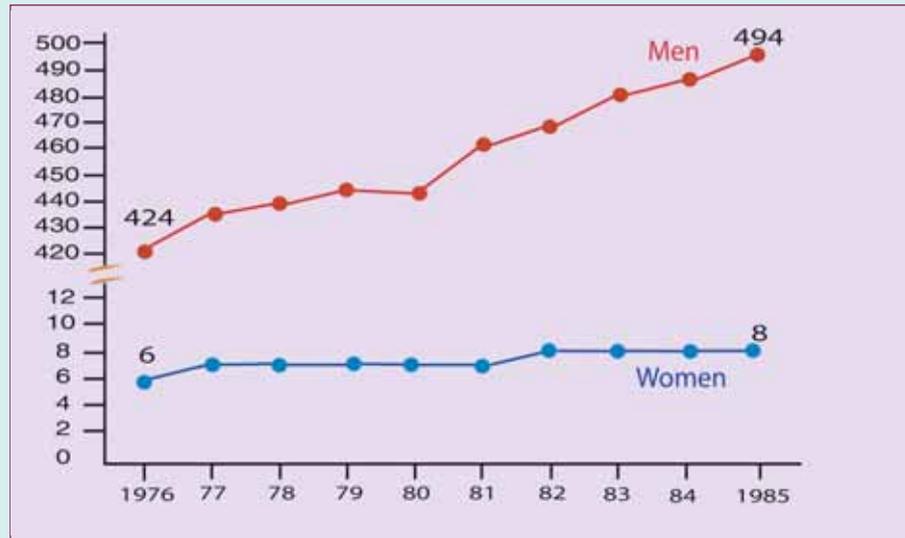
Subject	1940		1976		2006	
	Men	Women	Men	Women	Men	Women
Math. Sci.	17	-	34	-	70	4
Physics	34	-	83	-	178	3
Chemistry	41	-	65	1	134	3
Engineering	27	-	60	-	131	-
Medicine	23	-	35	3	56	14
Earth Planet. Sci.	23	-	33	1	74	1
Animal Sciences	26	-	33	-	39	7
Plant Sciences	43	1	62	1	55	2
General Biology	6	-	19	-	94	12
Total	240	1	424	6	831	46

to be more representative of the number of women participating in the country in scientific activities in various disciplines at high level of achievement.

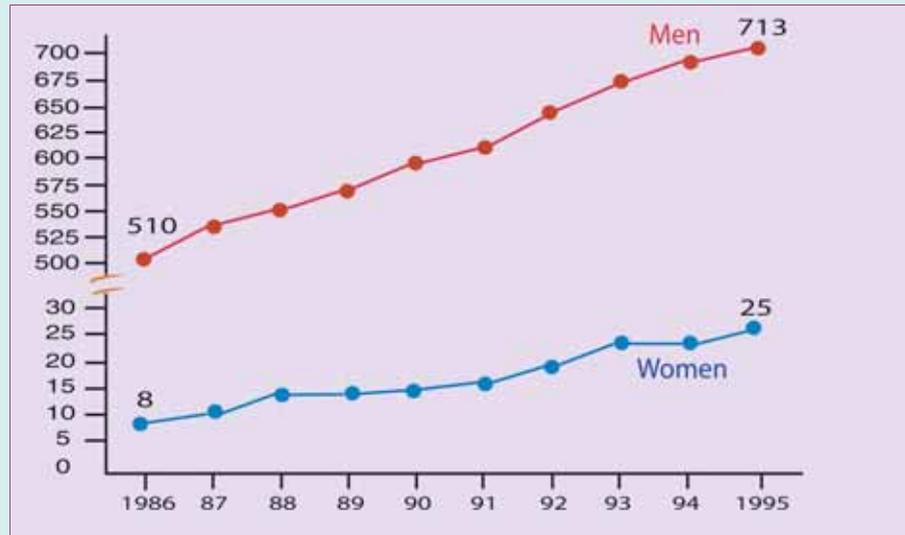
Panel for Women in Science: A Committee was formed by the President of the Indian Academy of Sciences in 2003 to look into the issues of Women Scientists. The convener Rohini M Godbole along with members R J Hans-Gill and D Balasubramanian, were asked to formulate the terms of reference and define appropriate action points. The Committee took note of the report (at that time under preparation) brought out by the Indian National Science Academy on 'Science career for women: an examination of the Indian women's access to and retention in scientific careers'. It was felt that while such a report which collects some facts and figures was very essential, it was definitely going to support the obvious fact that the participation by women in 'practice of science' is rather small and hence discussions of remedial measures do not need to wait for the completion of the report. The recommendations of the Committee included setting up, as a first step, a page for 'Women in Science' on the Academy's website. The remaining recommendations (among other things) can be seen in this web page at the Academy's website. Another recommendation of the Committee was to have a Panel of the Academy for Women in Science, which will work towards putting into practice various interesting programmes that the Committee had suggested. A panel discussion on 'Women in Science' was held during the annual meeting of the Academy at Guwahati in November 2003 and Rohini Godbole reported to the Fellows of the Academy about the Committee's report. One of the point of discussions, relevant to the Fellowship, was about an unwritten policy in various institutes in India which prevent the husband and wife being employed at the same institution. The Committee members agreed that such policies are in fact counterproductive and come in the way of development of the career of (mainly the) woman spouse. Since a large number of individuals involved in decision making at the institutions happen to be Fellows of the Academy, it was suggested that the Committee bring this fact to the notice of Fellows of the Academy. In 2005 a panel of the Academy for Women in Science was formed and it has already set in motion various programmes, information about which will be made available on the web page as they progress.

Gender distribution in Fellowship through the years

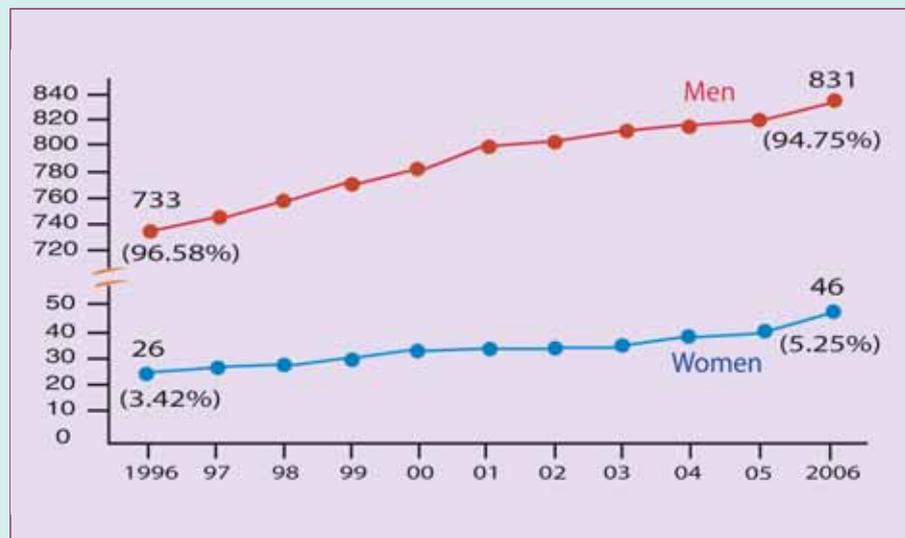
1976 - 1985



1986 - 1995



1996 - 2006*



*Note: Over the period 1996 to 2006 the percentage of women changed from 3.42 to 5.25 and that of men changed from 96.58 to 94.75.

3 COUNCIL

Two statutory meetings of the council were held in Bangalore on 9 July and 10/11 December 2005.

4 ASSOCIATES

Forty-five nominations were received and the following nine were selected as Associates in 2005 (see also Annexure 3). The selections continue to be restricted to those below the age of 32 and their tenure ceases after five years or after the Associate attains the age of 35 whichever is earlier.

1. Prasad, Amritanshu
2. Chakraborty, Parthasarathi
3. Siddharthan, Rahul
4. Ghosh, Shankar
5. Tushar Jana
6. Mittal, Aditya
7. Tirumkudulu, Mahesh S
8. Thattai, Mukund
9. Ghosh, Yamuna Krishnan

5 PUBLICATIONS

5.1 Journals

All the following eleven journals continue to appear on their scheduled dates of appearance.

1. Bulletin of Materials Science
2. Current Science (fortnightly)
3. Journal of Astrophysics and Astronomy
4. Journal of Biosciences
5. Journal of Chemical Sciences (formerly Proc. Chemical Sci.)
6. Journal of Earth System Science (formerly Proc. Earth Planet. Sci)
7. Journal of Genetics
8. Pramana (Journal of Physics)
9. Proceedings (Mathematical Sciences)
10. Resonance – Journal of Science Education
11. Sadhana – (Engineering Sciences)

Table 1 gives journal-wise data on the number of pages published during the calendar year 2005. Table 2 presents journal-wise information on papers submitted for publication and Table 3 gives the journal circulation figures for the calendar year 2005.

The previous report for the year 2004 – 05 had reported the software program that facilitates online processing of all editorial operations connected with the physics journal *Pramana*. During the current year, this programme was adapted for the following four journals.

- *Current Science* (programme known as “Current Science Connect”)
- *Journal of Chemical Sciences* (programme known as “JCS Chemport”)
- *Journal of Biosciences* (programme known as “eBiosciences”)
- *Proceedings: Mathematical Sciences* (programme known as “eMathsci”)

It is expected that the program will be fully functional during 2006 –07.

5.2 Special issues of journals

Many special issues of topical importance were published as part of the regular numbers of some of the journals. A description of these follows:

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 was targeted at researchers, research students, and industry research professionals interested in the areas of e-commerce and e-business. It provides a state-of-the-art update of important recent technical advances and results in the area. The issue is the result of 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.

The 18 papers in this special issue can be broadly classified into three broad categories: (i) building blocks and enabling technologies; (ii) mechanisms, pricing, and business logic; and (iii) supply chains and electronic marketplaces.



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 Bangalore 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. 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.

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 appeared in two consecutive issues of *Pramana*.

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. This is a collage of papers written in memory and honour of the late Sukomol Chanda, and 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 Fe⁰ 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.

Asteroseismology

Guest Editors: Ram Sagar and S Seetha

Journal of Astrophysics and Astronomy, Vol. 26, Nos. 2/3, June/September 2005, pp. 123–357

Stars have been observed for ages. It is only recently that we have been able to study the interiors of the stars. Stars oscillate, exhibiting pulsations – different stars pulsating in different ways – and the study of the interiors of stars by studying these pulsations is termed 'Asteroseismology' similar to the seismology of Earth where the Earth's interior is understood by studying the oscillations during an earthquake.

There are several stars which exhibit pulsations: the classical Cepheids, the Sun, rapidly oscillating Ap stars, delta-Scuti variables, beta-Cep stars, white dwarf variables, sub-dwarf B stars, etc. For some stars, the observations and theoretical interpretations have been going hand in hand, whereas for some, theoretical explanations of observed frequencies are currently not possible, and in some others observations indicate a lack of oscillations where they are theoretically predicted. An international Workshop on Asteroseismology was organized by the Aryabhata Research Institute of Observational Sciences (ARIES) at Nainital in December 2004. The Workshop held to coincide with the golden jubilee of the Institute was primarily to discuss the current maturity in the field and understand as many types of stellar oscillators as possible.

This special issue comprises a collection of refereed and accepted papers based on the presentations at the Workshop.

Chemical reactivity

Guest Editor: PK Chattaraj

Journal of Chemical Sciences, Vol. 117, No.5, September 2005, pp. 359–616

Considering the importance of chemical reactivity and its strong foundations within a conceptual density functional theory (DFT) framework this special volume was brought out. Leading experts in this field from across the globe contributed papers on diverse aspects of reactivity theory.

These papers cover the whole gamut of topics within a DFT parlance encompassing different systems such as clay-type inorganic materials, boron porphyrin complexes, zeolites and hypervalent silicon compounds, as well as various concepts such as electron localization function, molecular quantum similarity, condensed atomic indices, Coulomb holes, reactant resolution, higher order energy derivatives, excitation energy, charge sensitivity, reaction force, electron propagators, separability and N-representability. There are also contributions which deal with intramolecular hydrogen shifts, cycloaddition reactions, interactions among toxins and biosystems, and electronegativity equalization. Two papers by Ralph G Pearson and Robert G Pearson give a personal account of the evolution of the hardness concept. Pearson in his article has set out fourteen problems in DFT.



Nanoscience and technology

Guest Editors: AK Sood, KN Ganesh, CS Sundar and AK Raychaudhuri

Pramana, Vol. 65, No.4, October 2005, pp. 547–748

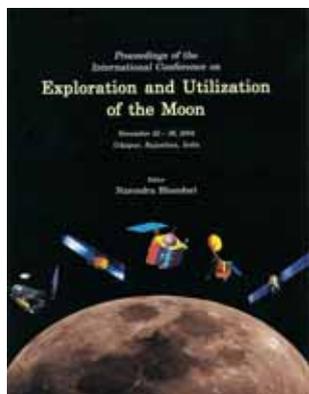
The dawn of 21st century is marked by the birth of a new science, nanoscience and the emanating nanotechnology. Nanostructures are intermediate in size between molecular and mesoscopic structures (length scale up to ~ 100 nm). As a result, they are uniquely suited for detailed atomic-level engineering. Viewed as molecules, they are so large that they provide access to realms of quantum behaviour that are not otherwise accessible; viewed as materials, they are so small that they exhibit characteristics that are not observed in larger structures. They combine small size and complex organizational patterns with the potential for very high packing densities and strong lateral interactions. Individual nanostructures involve clusters, quantum dots, nanoparticles, nanowires and nanotubes; collections of nanostructures involve arrays, assemblies and superlattices.

The uniqueness of the physics, chemistry, structural response and dynamics of the nanostructures constitutes the essential motivation for studying nanomaterials. Their electronic and magnetic characteristics are often dominated by quantum behaviour. They are emerging as key components in information technology devices with unprecedented functions. Many clear applications for nanotools and nanostructures are already evident and are targets of several emerging technology development programmes. Successful applications of nanoscience and nanotechnology require a fundamental understanding of properties of isolated individual nanostructures and ensembles, design and construction of nanoscale building blocks, interconnections to achieve new functions, bio-inspired fabrication of functional nanosystems and physics of molecular electronics.

Some of the nanotechnology products comprise of high-density information storage devices, new protective coatings for corrosion/erosion resistance, thin layers for optical filtering and thermal barriers, nanostructured polymers and catalysts, highly porous, sponge-like materials and aerogels for catalysis and energy applications, sensors for detecting pico and femtomoles of substances, self-assembled systems and lithographs etc. Development of tools and techniques for characterizing nanostructures is also a challenging area. Nanoscience and nanotechnology thus uniquely combine the concepts of engineering physics, materials chemistry and biology into making functional devices of unimaginable versatility for a variety of health, societal, and environmental applications.

Keeping in pace with the global nanotechnology competition, the Department of Science and Technology, New Delhi launched a national programme 'Nanoscience and technology initiative' to focus on the overall research and development in this area and create advanced facilities encompassing universities, national laboratories and industry so that India can become a significant global player in this area and help bring the products of technology to the benefit of people.

This special volume which appeared in two issues of *Pramana* presents peer-reviewed contributions in the area of nanoscience by various researchers supported by the programme during the past two years and presented at the First National Conference on Nanoscience and Technology held at NCL, Pune during March 2005.



Exploration and utilization of the Moon

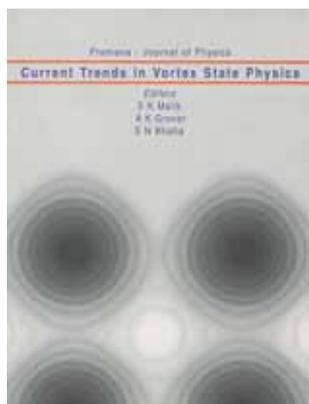
Guest Editor: N Bhandari

Journal of Earth System Science, Vol. 114, No.6, December 2005, pp. 573–822

An International Conference on Exploration and Utilization of the Moon (ICEUM-6), sixth in the series, was held during November 2004 at Udaipur, Rajasthan under the aegis of the International Lunar Exploration Working Group (ILEWG). This conference was organized at a time of renewed interest in the exploration of the Moon and a large number of lunar missions were being planned. This new era started with the SMART-1 mission of European Space Agency (ESA) which attained a lunar orbit on 15 November 2004, just before the conference, exhibiting the success of the ion propulsion system. This mission is expected to be followed by Lunar-A and SELENE by Japan, Chandrayaan-1 by India, Chang'E by China and the Lunar Reconnaissance Orbiter (LRO) by USA during the next few years. There will thus be a continuous presence on the Moon till the end of this decade, and possibly a permanent presence during the next decade, offering excellent opportunities for international collaboration. The ILEWG endeavours to optimize the scientific and technical outcome of these various missions by facilitating international collaboration and by debating priorities, problems and strategies.

The main themes of the Udaipur Conference encompassed all scientific aspects of the Moon — robotics, engineering, space flight dynamics, navigation and control, lunar exploration programmes of various International Space Agencies. The present volume contains 29 papers presented at the conference and accepted after a review process. Topics include origin and early evolution of the Moon, orbital dynamics, science on the

Moon, results of Clementine mission, new missions to the Moon, e.g. Lunar-A, SELENE, Chandrayaan-1, Chang'E, and Telerobotic explorations of the Moon.



International Vortex Workshop

Guest Editors: SK Malik, AK Grover and SN Bhatia

Pramana, Vol. 66, No. 1, January 2006, pp. 1–312

The idea of this special issue on vortex state studies originated when the Tenth International Vortex Workshop (IVW-10) was being planned to be held at TIFR, Mumbai during January 2005. Normally no formal proceedings of such workshops were being brought out but it was felt that it would benefit the scientific community if articles on contemporary subject in the area of vortex physics are published. There was enthusiastic response to this idea resulting in the emergence of this issue which hopefully is timely and useful to the scientific community at large, specially the young researchers.

The vortex state refers to the mixed phase of superconductors, where the magnetic field permeates and microscopically sub-divides the specimen into normal cylindrical regions surrounded by circulating supercurrents in the form of vortices. A superconductor in a magnetic field can sustain large current density without dissipation of heat only if the vortices do not move around and/or start flowing. Though the vortex state studies have been on for a long time, the discovery of high temperature superconductivity gave a fresh impetus to this field. This discovery in metallic copper oxide systems in 1987 raised the hope that these materials would transform the electrical power and the microelectronics industry. However, insurmountable difficulties in devising innovative ways to prevent the movement of vortices at boiling point of liquid nitrogen in the high temperature superconductors slowed down their development for novel applications.

The discovery of high temperature superconductivity gave an opportunity to a large section of the community of condensed matter physicists, statistical physicists, materials scientists and engineers to study the vortex state in a variety of materials. The appearance of a very comprehensive and timely article in *Reviews of Modern Physics* in 1994 further attracted the attention of researchers in this area of physics, culminating in the holding of Workshops on Vortex Dynamics. The number of researchers working in this area has steadily increased as gauged by the number of prospective participants in such Workshops. The Nobel prize in Physics for the year 2003 was awarded to AA Abrikosov, who pioneered the idea of vortex state in superconductors.

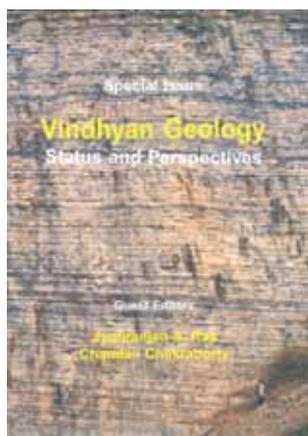
This special issue presents twenty six articles on a variety of areas in vortex research. It includes a review on experimental results in vortices in dilute Bose–Einstein condensates which is a new topic added to the deliberations of the Tenth Vortex Workshop.

Metal oxides and related materials

Guest Editors: S Natarajan and TN Guru Row

Journal of Chemical Sciences, Vol. 118, No.1, January 2006 pp. 1–154

This special issue contains a collection of articles contributed by participants of an international conference on “Recent development in metal oxides and related materials” held in Bangalore during January 2006. It contains sixteen articles on a variety of topics in chemical sciences which lie at the forefront of current international activity. The topics include: carbon nanotubes, fluorescence resonance energy transfer, nanoparticle synthesis, magnetic transport properties of rare earth manganates, lead-acid battery, density matrix renormalization group theory, ionic conduction, electronic homogeneity of ordered double perovskites, synthesis by molten salt method, layered hydroxides and its fictionalization, low-dimensional phenylarsonates, polyoxovanadates, layered vanadium phosphates and bismuth tungstates.



Vindhyan geology

Guest Editors: JS Ray and C Chakraborty

Journal of Earth System Science, Vol. 115, No. 1, February 2006, pp. 1–184

Several significant events in earth history occurred during the Proterozoic Era affecting the lithosphere, atmosphere and the biosphere. Covering almost two billion years of geologic time, the Proterozoic Era witnessed the formation of stable continents, an oxygenated atmosphere, evolution of multicellular life and extensive glaciations. India has been an integral part of the supercontinents prior to Gondwanaland, and hosts several Proterozoic sedimentary successions that contain information on ancient depositional environments and processes. The Vindhyan supergroup of central and western India is one such major sedimentary succession. With a rock record that embraces much of geological time and space, the Vindhyan have been extensively studied over the last few decades. However, it is particularly the last few years that have seen a surge of research on these rocks, in part because of a couple of contentious fossil discoveries with profound implications.

It was therefore felt that a comprehensive volume including the recent advances in Vindhyan geology would be valuable in bringing about a better understanding of the development of this great succession and the global implications of various discoveries. This special issue contains eleven peer-reviewed research papers that cover many aspects of the Vindhyan. The main goals of this multidisciplinary research volume are to: (a) evaluate and synthesize the large quantity of data available from earlier studies; (b) present new data, ideas and methods to resolve the outstanding issues; and (c) identify the future areas for research.

The papers in this volume deal with the stratigraphy and sedimentology of the Vindhyan rocks on the paleobiology, on the new stable isotope data from the carbonate formations in the Son valley, the results of a seismic reflection study in the Vindhyan of Rajasthan, a review of the recent geochronology of the Vindhyan sequences and the petrological and geochemical aspects of kimberlitic rocks that intrude the Vindhyan supergroup.

Machine learning

Indian Academy of Sciences, Bangalore

2–3 September 2005

Co-ordinator: V S Borkar



The meeting 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 framework, 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.

Instructional Workshop on Operator Theory and Operator Algebras

Indian Statistical Institute/Indian Institute of Science, Bangalore

12–17 December 2005

Co-ordinator: G Misra

The Workshop consisted of a short course on Lie groups and representation theory (by A Sitaram). H Upmeyer presented a survey of Toeplitz operator algebras on bounded symmetric domains. There were a variety of lectures on topics from Banach space geometry, model theory, operator algebras, Hopf algebras and harmonic analysis. An interesting lecture by M Putinar on relations between positivity and decompositions of polynomials as sums of squares was also held. This Workshop preceded an international conference on operator theory and operator algebras.

Intracellular calcium signalling

Orange County, Coorg

30 November–4 December 2005

Co-ordinator: Veronica Rodrigues

This international meeting held at Orange County was attended by participants from six countries, with a majority from India. The meeting was timed to coincide with recent rapid advances in the area of calcium signalling triggered by emerging post-genomic technologies. A Rao (Harvard) presented her work on the use of RNAi screening technologies to discover novel components of the cellular calcium signalling circuit. R Lewis (Stanford) spoke on the function of one such component STIM, in sensing and regulating intracellular calcium. K Rao (ICGEB, New Delhi) discussed the link between calcium and cell death signals in the immune system followed by D Clapham (Harvard) who discussed the function of a novel calcium channel (Catsper) in regulating cell motility. Mike Berridge (Cambridge) and Ole Petersen (Liverpool) provided historical perspectives on the development of the field and their visions for its future in the light of recent developments. There were other talks on the function of calcium in physiological systems such as vision by KW-Yau (John Hopkins) and RC Hardie (Cambridge), insect flight (Gaiti Hasan, NCBS, Bangalore), olfaction by K Storkuhl (Germany), A Fiala (Germany) and V Rodrigues (TIFR, Mumbai) and animal development by N Spitzer (UCSD); K Mikoshiba (Japan); A Millar (HongKong) and T Schwarz (Harvard). Lectures on novel functional aspects of several molecules that are central to calcium signalling were delivered by CW Taylor (Cambridge), R Dolmetsch (Stanford), T Shuttleworth (Rochester), A Galione (Oxford), R Padinjat (Cambridge) and C Montell (John Hopkins). Excellent contributions from younger scientists drawn from the participants enriched the meeting. The meeting drew together a number of emerging threads on the molecules that mediate the effects of calcium in cellular physiology.

Flow control and diagnostics

Orange County, Coorg

19–22 February 2006

Co-ordinator: R Narasimha



Flow diagnostics and control have always been of great importance in technology, but in recent decades they have become particularly active areas of research. This great surge of current interest can be traced to two reasons. The first is the potential for control of turbulent flows revealed by the discovery of coherent structures in what generally had been

considered as motion with complete disorder. The second is that great advances have recently been made in the technology of sensors, actuators, computers and related systems, making it attractive to consider small active control systems with a performance surpassing those that had earlier been available. Progress in MEMS and in nanotechnologies is unveiling ever newer possibilities.

An Academy Discussion Meeting to consider these advances seemed appropriate. There were 27 participants including from USA and UK. The four-day programme contained 22 presentations in sessions that dealt with flow control, flow diagnostics and flow instability.

7

ACADEMY PUBLIC LECTURES



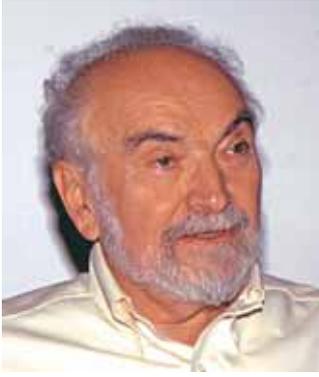
Soap bubbles and crystals

Jean Taylor

New York University, USA

19 October 2005, Indian Institute of Science, Bangalore

Creating a mathematical model for soap bubble clusters required the development of a new subject, Geometric Measure Theory. It was only in 1976 that the “rules for bubbles” observed a century before were actually proved. The internal structure of metals, ceramics, and other materials is related to soap bubble clusters, but has many more features. Jean Taylor also touched upon the current research that involves shrinking, slipping, sliding, and rotating crystals.



The arrow of time

Joel L. Lebowitz

The State University of New Jersey, USA

17 November 2005, Indian Institute of Science, Bangalore

In the world about us the past is distinctly different from the future. Milk spills but doesn't unspill; eggs splatter but do not unsplatter; waves break but do not unbreak; we always grow older, never younger. These processes all move in one direction in time – they are called "time-irreversible" and define the arrow of time. It is therefore very surprising that the relevant fundamental laws of nature make no such distinction between the past and the future. This leads to a great puzzle – if the laws of nature permit all processes to be run backwards in time, why don't we observe them doing so? Why does a video of an egg splattering run backwards look ridiculous? Put another way: how can time-reversible motions of atoms and molecules, the microscopic components of material systems, give rise to the observed time-irreversible behaviour of our everyday world? The resolution of this apparent paradox was the subject of this talk.

A shock wave cosmology

Blake Temple

University of California, Davis, USA

23 January 2006, Indian Institute of Science, Bangalore

In this talk the speaker discussed a model of cosmology that refines the standard model (based on the Friedmann universe) by the incorporation of a shock wave. The model explores the possibility that the Big Bang explosion that caused the outward motion of the galaxies, was an explosion of finite total mass, instead of the infinite mass explosion inherent in the standard model. In the shock wave model, which is based on the author's recent joint work with J Smoller, the explosion of the Big Bang generates an outgoing, spherical, entropy satisfying shock wave that emerges from the centre of the explosion at the instant of the Big Bang (something like the blast wave of a nuclear explosion), and the expanding galaxies correspond to the region inside the wave. One of the main consequences of this model is that when the shock wave is far enough out to be consistent with astronomical observations, (beyond one Hubble length—the distance light can travel since the Big Bang explosion) the whole explosion begins inside a (time-reversed) Black Hole—a White Hole in which everything is exploding outward instead of collapsing inward. In the shock wave model, the universe eventually emerges from the Black Hole, and from then on expands like the famous Oppenheimer–Snyder solution—a finite ball of matter expanding into empty space. We are inside the explosion, but to an observer in the far field beyond the shock wave, the end stage of the explosion would look like a giant supernova. It also follows from our model that information about the shock wave propagates inward from the shock wave, into a large shadow region of uniform expansion

at the centre of the explosion—and to an observer (like us) on the inside of this shadow region, everything looks exactly like the Friedmann universe up until the time when the shock wave comes into view from the farthest field of observations. That is, in the shadow region, up until the time when the shock wave comes into view, everything looks the same as in the standard model. Other interesting consequences of the shock wave model include the unexpected emergence of the correct equation of state at the Big Bang, the breaking of the time symmetry by the entropy condition, and interesting mathematical consequences of the reversal of space and time inside the Black Hole. In this talk the speaker gave an introduction to Einstein's theory of general relativity, and then discussed this shock wave cosmology within this context. The talk began and ended with a computer visualization of the model due to Zeke Vogler.

Brighter than a million suns: the FERMI @Elettra project

Carlo Rizzuto

University of Genova and Elettra Laboratory, Trieste

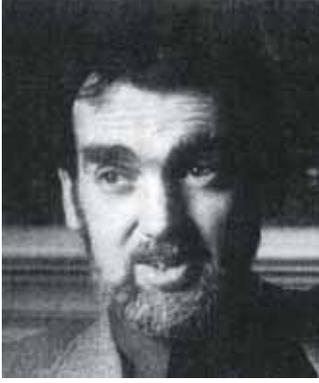
1 February 2006, Indian Institute of Science, Bangalore

The FERMI@Elettra international project is developing a light source, using Einstein's equivalence between mass and energy, to produce light flashes billions of times more brilliant than light flashes produced by any present technique, spanning over all colours, and with a time structure allowing to film the behaviour of materials down to atomic levels.

The light will be generated by a "free electron laser", based on electrons travelling nearly the speed of light, shedding part of their mass-energy in a coherent way, when stimulated by magnetic forces. The continuous improvement in the capability of studying, understanding and designing new materials has allowed the development of new products, from metallic bearings or catalysers to microchips and medical drugs, and has been a main component of the knowledge fuelling the most impressive and durable industrial and economic growth of the last centuries.

The study and modification of materials, down to the individual atoms, requires the use of "probes" either to capture the information on how the various qualities arise, or to manipulate them. One of the most powerful probes is the light, "reading" the inside of materials or "writing" lithographies.

The development of FERMI will allow to explore and modify materials, with a time and space resolution that could not be thought of until recently and is expected to open entirely new frontiers.



Reflections on the legacy of Harish-Chandra

Robert P Langlands

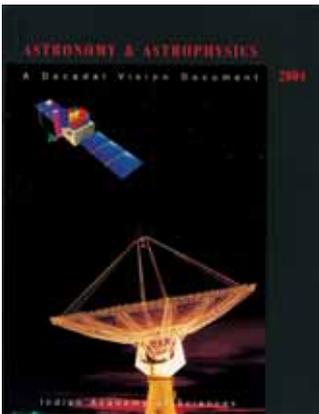
Institute for Advanced Study, USA

20 March 2006, Indian Institute of Science, Bangalore

This lecture was an attempt to understand Harish-Chandra's place in the mathematical firmament. Harish-Chandra made outstanding contributions to harmonic analysis on reductive groups. His research centred around the study of semi-simple Lie groups and Lie algebras and he created a theory which had implications for many domains from geometry to number theory. Harish-Chandra was a Fellow of the Academy and died in 1983 when he was sixty.



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.

The book 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 Organization. These are (i) a small solar coronagraph 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

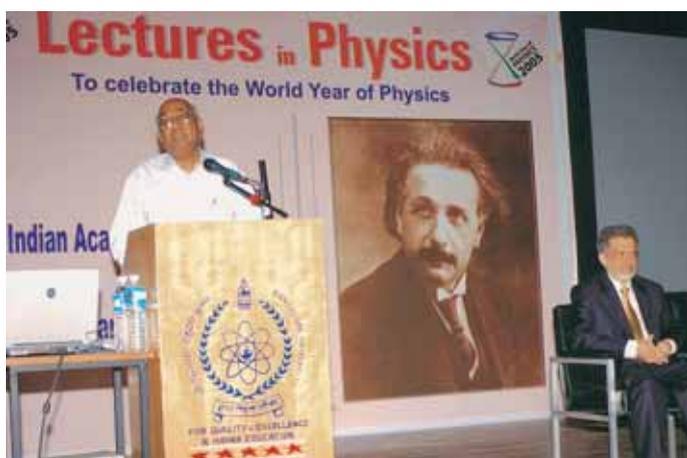
college students in India to the many exciting opportunities for a research career in astronomy and astrophysics.

9 RAMAN CHAIR



Prof. Anne McLaren is a Wellcome Principal Research Associate, and a Member of the European Molecular Biology Organization (EMBO). She visited India as the twenty-third Raman Professor of the Academy during the period November–December 2005. McLaren is a distinguished mammalian geneticist, an authority on early mammalian development and has made major contributions to our understanding of mammalian development especially in genetic and epigenetic underpinnings. Her research has ranged widely over developmental biology, reproductive biology, and genetics including molecular genetics, using the laboratory mouse as a model. She was the head of the MRC Unit on mammalian development for over 25 years and received some of the world's highest scientific honours. She has been an adviser to the UK Government on policies concerning human embryo technology and stem biology. During her visit to India she was based at the Indian Institute of Science and visited and lectured at Bangalore and Hyderabad.

10 MID-YEAR MEETING 2005



Inauguration by Academy president
TV Ramakrishnan



N Mukunda

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

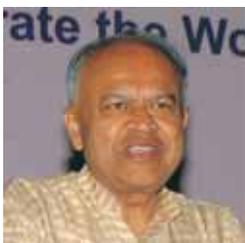
The year 2005 was designated the International Year of Physics. It is exactly a century since Albert Einstein's creative outburst in 1905, his year of miracles. As part of its Mid-Year Meeting, the Academy joined hands with Bangalore University and organized a half-day programme of special lectures on July 7th at the new Jnana Jyothi Auditorium located in the historic Central College campus in the heart of the city. 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 President TV Ramakrishnan and Vice-Chancellor MS Thimmappa, 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



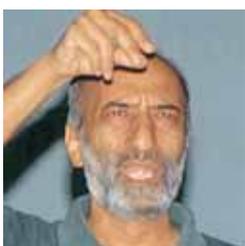
N Kumar

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).



JV Narlikar

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 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.



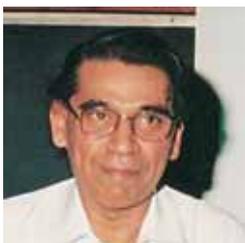
Sriram R Ramaswamy

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'.



D Chatterji

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. The full programme is in Annexure 4.



T Ramasami

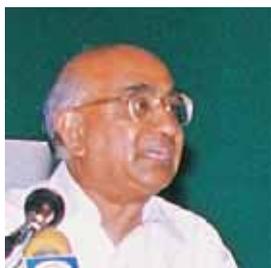


Kiran Mazumdar-Shaw

II ANNUAL MEETING 2005 - TRICHY



The seventy-first Annual Meeting of the Academy was held at Bharathidasan University, Tiruchirapalli from November 11 to 13, 2005. A good number of Fellows – about 120 – and an unusually large number of teacher invitees, many from educational institutions in and around Tiruchirapalli, were present.



TV Ramakrishnan

The opening lecture by the President of the Academy, TV Ramakrishnan, was on "Transition metal oxides: Quantum many-body physics meets solid state chemistry". He surveyed a large number of currently active research areas, including perovskite oxides, colossal magnetoresistance in manganites, cuprates and their phase diagram, and some theoretical approaches to these phenomena. As he expressed it, 'chemical realities and increasing ability to make and probe things lead to unexpected new worlds'. The older familiar pictures fail in these new realms, and theorists need to puzzle over new materials and new phenomena. The talk succeeded admirably in bridging physics and chemistry in selected areas.



CNR Rao

A special half day Symposium on 'Physics and Chemistry of Materials' under the overall convenership of CNR Rao covered unusually large ground, much of it inaugurated in his own work over the decades. The five speakers, all of them close collaborators of the convener, spoke about manganites, oxide materials, nanomaterials, and open-framework structures. This symposium was capped by a public lecture titled 'Science for our future: Personal reflections on doing science in India' to a very large audience, at the beautiful and spacious BHEL auditorium, wherein Rao recalled his life-long experiences and challenges, and the impact his work has had at the international level.

The second Symposium of the meeting on 'Genomic Landscape and Structure of the People of India' was put together by Partha P Majumder. This fascinating story of the movements of human populations over a few tens of thousands of years, starting in Africa and passing through India to other parts of the world, showed how DNA and chromosome studies at the microscopic level can shed light on questions till recently examined mainly by archaeological and anthropological methods. In his opening presentation, Majumder described how female and male population movements are susceptible to separate study and one can reconstruct the entire process of peopling of India. Other speakers covered human prehistory, cultures and migrations in India from the archaeological viewpoint; genomic approaches in general and studies of haploid chromosomes in particular; and what such studies have to say about our past and what remains to be done.



V Shanta

The second public lecture by V Shanta of the Cancer Institute, Chennai was given to another large audience at the New Auditorium of Bishop Heber College, on the topic 'Cancer causes and prevention'. The speaker, recently honoured by the Magsaysay Award, gave a very informative and lucid presentation bringing home the magnitude of the burden of cancer in India, including the continuing annual increase in incidence of various types. Many cancers can be traced to lifestyles and the environment in the widest sense. By the same token, many of them are preventable, by such measures as reducing exposure to cancer-causing factors and changes in personal habits and hygiene.

The first special lecture on 'Volcanic poisoning and mass extinctions' by KV Subbarao dealt with events on the Indian subcontinent over 60 million years ago, the Deccan volcanic episode which caused global mass extinctions. The disappearance of dinosaurs may be due to this or, alternatively, to a meteorite impact. Apart from different technical aspects and impressive pictures of the 'canyons' in the Western Ghats, the speaker also spoke about the impact of research in India in this field, on a global scale.

RK Shyamasundar's special lecture on 'Computer science: Scientific and engineering fascinations and challenges' dealt with a subject of great current intellectual as well as technological interest. The emphasis was rightly on the basic concepts which have evolved slowly compared with applications. Ideas such as computability, robustness, universality, Turing machines and artificial intelligence have considerable subtlety and are not so easily grasped even by scientists in other fields. The speaker succeeded in conveying the essence of these ideas to a diverse audience.

Lectures by recently elected Fellows and Associates covered a wide range from 'Portal hypertensive bleeding' by SK Sarin to 'Image mining' by Subhasis Chaudhuri, and from 'Supercooled liquids' by Shankar Das to 'Human papillomavirus' by MR Pillai.

Thanks to the untiring efforts of the local hosts, in particular M Lakshmanan and M Palaniandavar and volunteers from the university and the several educational institutions in the town, the arrangements for all aspects of the meeting were excellent. The full programme is given in Annexure 5.

12 SCIENCE EDUCATION PROGRAMME

Four main activities are being carried out under this programme towards our effects for improvement of science education and teaching in the country. These are (a) summer fellowships (b) participation of teachers in Academy meetings (c) refresher courses for teachers (d) lecture series for student/teachers.

12.1 Summer fellowships

This has become an important component of the science education programmes of the Academy. Summer Fellowships are awarded to bright students and motivated teachers to work with Fellows of the Academy on research-oriented projects. Started on a relatively small scale in 1995, the programme has grown in size both in terms of the number of applications received and the number of fellowships awarded. The programme conducted by the Academy has an all-India character in that the selected summer fellows work in institutions around the country. During the year 2005 summer fellowships were offered to 44 teachers and 202 students from all over the country.

Academy Summer Fellowships offered:

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Students	3	12	31	33	57	69	93	88	116	167	202	202
Teachers	-	-	7	8	8	10	26	29	39	37	44	36

12.2 Participation of teachers in Academy meetings

The Academy has a database of teachers from colleges and universities all over the country based on recommendations received from Fellows of the Academy. A few of these teachers are invited at the Academy mid-year and annual meetings every year to give them an opportunity to attend scientific lectures and to meet and interact with Fellows. About 120 teachers attended the Academy meetings in Bangalore and Tiruchirappalli. Over the past decade, about 650 teachers have attended Academy meetings.

12.3 Refresher courses for teachers

This important all-India programme is designed to help motivated teachers to improve their background knowledge and teaching skills. The course is for two weeks and teachers selected from all over the country undergo a rigorous course of lectures, discussions and tutorial sessions. During the last 7 years refresher courses on a variety of topics have been organized throughout the country. The following refresher courses were held during the year.

(a) Instructional workshop on cryptology

Cochin Univ. of Science and Technology, Cochin, 2–14 May 2005



No. of participants: 39

Course Director:

R Balasubramanian

Course Co-ordinator:

A Vijayakumar

Resource persons:

C Pandurangan (IIT, Madras);

S Sribala (Univ. of Madras);

R Sivaramakrishnan (Univ. of

Calicut); B Sury (ISI, Bangalore); MP Sebastian (NIT, Calicut); CS Yogananda (SJV College of Engineering, Mysore); R Balasubramanian and V Arvind (both of Inst. Math. Sciences, Chennai); M Sethumadhavan (Amritha Viswavidyapeedham, Coimbatore); RS Chakravarti and A Vijayakumar (CUSAT) and Bimal Roy (ISI, Kolkata).

Teacher participants were from Anand, Bangalore, Calicut, Chandigarh, Chennai, Coimbatore, Guduwada, 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, ElGamal encryption, AES, DES, stream ciphers, LFSR.

(b) Experimental Physics

Indian Institute of Technology, Guwahati, 9–22 May 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 Bhoobe (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 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.

(c) Science education programme on foundations of physics

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



No. of participants: 150

Course Director: Amitabha Ghosh (IIT, Kanpur)

Resource persons: Amitabha Ghosh (IIT, Kanpur); HS Mani (Inst. Math. Sciences, Chennai); AK Mallik and P Gupta Bhaya (IIT, Kanpur) and 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 familiarize 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 the inculcation within the students 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.

Topics covered: 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.

(d) 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.

(e) 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.

(f) Theoretical physics

SB College, Changanassery, 19–30 September 2005



No. of participants: 28

Course Director: S Chaturvedi (Univ. of Hyderabad)

Course Co-ordinator: C A Xavier (St. Berchmans College, Changanassery)

Resource persons: N Mukunda (IISc, Bangalore);

S Chaturvedi (Univ. of Hyderabad); R Simon and R Jagannathan (Inst. of Math. Sci., Chennai) and V Balakrishnan (IIT, Madras).

Theoretical physics is one of the toughest areas in physics, which is often ignored by students as well as teachers. A better understanding of the subject provides equal importance to both theory and experiment. Equipping the teaching community with all

the aspects of theoretical physics, is therefore, very important in physics education. This course was organized keeping this in mind.

Topics covered: Tensor analysis and relativity, group theory and applications, nonlinear dynamics and integral transforms. The programme consisted of three 90 min lectures in the morning followed by two tutorial sessions in the afternoon. There were also common lectures of a more general nature. The participants were given course materials and books on theoretical physics.

The teacher participants represented institutions from Alappuzha, Kolkata, Changanassery, Chennai, Delhi, Kochi, Kollam, Mumbai, Parumala, Perambalur, Puttur, Sivakasi, Solapur, and Trichy.

(g) Probability, stochastic processes and applications

Cochin University of Science and Technology, Kochi, September 26–October 7, 2005



No. of participants: 38

Course Director: M K Ghosh (Indian Institute of Science, Bangalore)

Course Co-ordinator: A Krishnamoorthy (CUSAT, Kochi)

Resource persons: B Rajeev and S Ramasubramanian (ISI, Bangalore); B Krishnakumar (Anna University, Chennai); RP Pakshirajan (Bangalore); MK Ghosh and Srikanth K Iyer (IISc, Bangalore); A Krishnamoorthy and MN Narayanan Namboodiri (CUSAT, Cochin).

The schedule of the course included one lecture of 90-min duration with four sessions each day. The lecture topics covered probability measure on metric spaces, stochastic models, stochastic calculus, deterministic and stochastic control, queueing theory, Toeplitz and quasi-Toeplitz matrices, probability theory and stochastic differential equations.

Each participant received a copy each of the books by B Oksendal, by SM Doss and by KL Chung and Farid Aitsahlia.

The teachers were from Assam, Bhagalpur, Bodinayakanur, Burdwan, Chennai, Cheyyar, Chittoor, Coimbatore, Guwahati, Kannur, Kochi, Kolenchery, Kollam, Kottayam, Madurai, Palakkad, Pattambi, Rajampet, Tiruchirappalli and Trivandrum.

(h) Foundation course in physics and chemistry of the earth

University of Allahabad, Allahabad, November 7–27, 2005

No. of participants: 13

Course Director: A K Gupta (University of Allahabad)

Resource persons: AK Gupta, VK Gaur (C-MMACS, Bangalore); S DasGupta and Nibir Mandal (Jadavpur) and Pinaki Majumdar (HCRI, Allahabad).

This course for young faculty and researchers in the field of Earth Sciences was aimed at sharpening the conceptual foundations of young earth scientists towards creating capabilities for understanding and analysing planetary systems and processes generally relating to the earth in particular, in a quantitative manner. It was thus designed to focus on the most basic aspects of physico-chemical principles and their numerical application in calculating the thermodynamic conditions of critical earth processes such as lithospheric stretching leading to development of sedimentary basins, physics and chemistry of melts, amongst other topics. This course focussed on the following three topics and their numerical applications to earth science problems: (a) continuum mechanics, (b) thermodynamics, and (c) physico-chemico mineralogy.

The course consisted of two lectures every day followed by two tutorials, both of 75 minutes. Two theory and practical classes were also conducted on each day.

The teacher participants were drawn from Ahmedabad, Allahabad, Bangalore, Dehra Dun, Kolkata and Tiruchirappalli.

(i) Physics of the atmosphere

Indian Institute of Science, Bangalore, November 14–25, 2005



No. of participants: 38

Course Director: BN Goswami (IISc, Bangalore)

Resource persons: R Narasimha (JNCASR, Bangalore);

J Srinivasan, BN Goswami, Sulochana

Gadgil, GS Bhat, R Nanjundiah, SK Satheesh (all of CAOS, Bangalore); D Sengupta, M Venkatachalappa and P Siddheswar (Bangalore University); PV Joseph (Cochin); BH Subbaraya, V Jayaraman and G Viswanathan (ISRO, Bangalore).

The teacher participants were from Allahabad, Anjar, Bangalore, Chennapatna, Chikballapur, Ernakulam, Guwahati, Hoshiarpur, Jhansi, Jharkhand, Kakinada, Kanchipuram, Kannur, Karaikudi, Malout, Mangalore, New Delhi, Pudukottai, Pune, Rewa, Srinagar, T.Kallikulam, Tirunelveli, and Tumkur.

Extracts from the report by Course Director

As teaching of atmospheric physics is not widespread in the country, the philosophy of this course was to introduce important phenomena in the atmosphere and to give an overview of quantitative aspects of dynamics and thermodynamics that provide physical understanding and predictive capability of these phenomena. Observing techniques, diagnosis of global observations and development of three-dimensional global models for weather and climate predictions were discussed. Recent developments in this field were also highlighted as special lectures.

In his inaugural talk J Srinivasan highlighted the recent and exciting developments in atmospheric sciences. The course began with some basics such as composition of the atmosphere, atmospheric general circulation, horizontal and vertical structure of wind and temperature by Goswami followed by atmospheric thermodynamics by GS Bhat and atmospheric radiation by J Srinivasan. With this background PV Joseph and P Siddheswar introduced the synoptic systems, monsoon depression, equation of motion and continuity equation. M Venkatachalappa spoke on atmospheric waves and R Nanjundiah introduced complexities of developing three-dimensional general circulation models for prediction of weather and climate and highlighted the challenges in developing more accurate models for prediction. SK Satheesh discussed aerosols, clouds and precipitation. Special topics on Indian monsoon and its variability by Sulochana Gadgil, and on El Nino and southern oscillation (ENSO), global warming, tropical cyclone (TC) and thunderstorms were discussed in order to provide a flavour of interesting physical processes involved in some of the important and challenging weather and climatic phenomena.

The afternoon sessions were devoted to demonstrations and laboratory work. Some fluid dynamics movies illustrating some basic fluid dynamics processes (e.g. drag, vorticity etc) were shown to the participants. An introduction to principle involved in remote sensing techniques was given by SK Satheesh who also demonstrated the working of the automatic weather station and various radiometers and instruments used for measurement of aerosol. Bhat demonstrated how density stratification could lead to certain oscillations in the atmosphere and ocean. A visit to ISRO Satellite Centre to understand various steps of satellite integration was also arranged.

Quantitative aspects of atmospheric sciences were emphasized throughout the course. In order to carry forward quantitative aspect of the training during the course the participants were given a book entitled 'Meteorology—Understanding the Atmosphere' by

Steven A Ackerman and John A Knox which had a wide range of topics covered during the course. It is envisaged that the teacher participants will involve students in their respective places to maintain regular record of these important climatic variables. This is expected to not only provide good records of climatic data over a number of places but also enthuse some young students to get into this field.

Five special lectures on 'Origin and evolution of the atmosphere' by BH Subbaraya; Indian satellite programme for climate studies by V Jayaraman; atmospheric radars by G Viswanathan; ENSO and seasonal prediction by Jerome Vialard and 'palaeoclimate reconstruction' by GB Pant were arranged.

The participants felt that the course provided them the confidence and excitement to teach introductory atmospheric science course being offered in many institutions.

(j) Applied stochastic processes

Indian Statistical Institute, New Delhi, December 5–17, 2005

No. of participants: 20

Course Directors: S Ramasubramanian and RL Karandikar

Resource persons: RL Karandikar and Abhay Bhatt (ISI, New Delhi); Siva Athreya and S Ramasubramanian (ISI, Bangalore); Anish Sarkar and Rahul Roy (ISI, New Delhi).

The teacher participants represented institutions from Bangalore, Baroda, Bhimavaram, Burdwan, Chirala, Cochin, DehraDun, Gangtok, Gorakhpur, Kolkata, Narasaropet, Ongole, Pune, Thiruvananthapuram, Vettavalam, Vidisha, and Vijayawada.

The aim of the refresher course was to introduce to the participants some aspects of probability theory and stochastic processes applicable in some disciplines without bringing in heavy mathematical machinery. These were illustrated via some simulations. A conscious effort was made to have participants from diverse backgrounds, consequently the mathematical background assumed was minimal. After explaining the basic concepts of probability theory, the lectures quickly went on to cover topics such as Markov chains, Martingales, branching processes and Poisson processes. Monte Carlo methods with reference to Markov chain Monte Carlo were also covered and illustrated.

12.4 Lecture workshops for students/teachers:

(a) Chemistry for society — Reactions to reality

Sri Sathya Sai Institute of Higher Learning, Prasanthinilayam, 24–26 September 2005

Participants: 108 students and teachers from Sri Sathya Sai Institute

Course Co-ordinator: Chelli Janardhana

Speakers: V Chandrasekhar (IIT, Kanpur); SS Rajan and P Ramamurthy (Univ. of Madras); S Rengaraj (Hongkong); Surendra Kulkarni (GE Materials); A Venkateswarlu (Reddy's Foundation); HB Singh (IIT, Mumbai); G Mugesh and A SriKrishna (IISc, Bangalore); R Venkateswarlu (Andhra University); G Manickam (Biocon, Bangalore); S Sri Hari (Kakatiya University); KV Srinivasan (NCL, Pune); and D Basavaiah (Univ. of Hyderabad).

Topics covered: Stannoxames and phosphonates, crystallography and drug design, organochalcogen chemistry, thyroid hormone synthesis, anti-thyroid drugs, bioactive lignans, etc.

(b) Molecular endocrinology and gamete biology

Daulat Ram College, Delhi, 3–4 October 2005

Participants: 59 students and teachers from the Daulat Ram and other colleges

Course Co-ordinator: K Muralidhar

Speakers: K Muralidhar, Umesh Rai and Rita Singh (all of Delhi University); Satish Gupta (NII, New Delhi).

Topics covered: Mechanism of hormone action, regulation of hormone biosynthesis and secretion, differential gene expression, germ cell apoptosis, hormonal influence on the immune system, molecular mechanisms in reproductive processes, molecular aspects of fertilization, biology of gametes, and gamete antigen based immuno-contraception.

(c) Modern biology: 'Facets and prospects'

M.S. University of Baroda, Vadodara, 10–11 October 2005

Participants: 220 students and faculty from universities and colleges

Course Co-ordinator: G Naresh Kumar

Speakers: Veronica Rodrigues (TIFR, Mumbai); RK Rao (Tennessee); Utpal Nath and Annapoorni Rangarajan (IISc, Bangalore); Santha Ramakrishnan (Jubilant Biosystems, Bangalore); BB Chattoo (MS Univ. of Baroda); Sorab Dalal (Tata Memorial Centre, Mumbai); Sunita M DeSouza (Astra Zeneca, Bangalore); Vishwas Sarangadhar (Reliance, Mumbai); Subita Srimal (Mehta Partners, Bangalore).

Topics covered: Little fly, genetic control of organ shape in plants, cancer stem cells, peptidoglycan synthesis, pre-clinical and clinical studies, etc.

(d) Frontiers in biotechnology

CMS College, Kottayam, 14–15 October 2005

Participants: 172 students and faculty from CMS and other colleges in Kottayam

Course Co-ordinator: Joseph P Varghese

Speakers: K Veluthambi and R Usha (MKU, Madurai); Y Annamma Varghese (Rubber Institute, Kottayam); Imran Siddiqi (CCMB, Hyderabad) and Joseph P Varghese (CMS College, Kottayam).

Topics covered: Genetic engineering of rice, genomics and proteomics of plant viruses, molecular markers and plant genetic resources, meiotic chromosome organization in plants, and DNA based molecular markers.

(e) Einstein's legacy

St. Pious College, Hyderabad, 28–29 October 2005

Participants: 177 students and faculty from universities and colleges in Hyderabad

Course Co-ordinator: S Chaturvedi

Speakers: N Mukunda (IISc, Bangalore); R Jagannadhan and R Simon (IMSc, Chennai) and V Balakrishnan (IIT, Chennai).

Topics covered: Space, time and matter, Einstein and quantum mechanics, Einstein and brownian motion, and Bose-Einstein condensation.

(f) Experimental physics

Maharani Lakshmi Ammanni College, Bangalore, 4–5 November 2005

Course Co-ordinators: R Srinivasan and KR Rao

Over the past five years, the Academy organized seven Refresher Courses on Experimental Physics at various places in the country which were attended by 20 to 25 postgraduate teachers. These consisted of lectures and seminars on various aspects of experimental physics and on several electronic kits developed for this purpose. The lectures were followed by the teachers carrying out a number of experiments mainly at the M.Sc. level, assembling the kits and using the kits to do experiments.

The kits related to: a constant current supply, a temperature controller, a capacitance measurement circuit, a signal generator and audio amplifier, an on-line data collection kit, a furnace and a lock-in-amplifier. The kits, excepting the on-line data collection kit, cost not more than Rs 2500/- each and are sufficient in their technical specifications for student experiments. They are thus cost effective and easily serviceable.

Using these kits a variety of experiments at the M.Sc level were conducted; for example: (a) the constant current source could be used for (i) measuring temperature coefficient of resistance of copper, (ii) temperature coefficient of resistivity of a semiconductor and

determination of energy band gap, (iii) Stefan-Boltzmann constant and emissivity of a surface (iv) measurement of specific heat of copper (v) measurement of the electrical and thermal conductivity of copper to determine its Lorentz number and (vi) thermal diffusivity of brass;

(b) the capacitance measurement circuit could be used for comparison of capacitances, measurement of dielectric constant of a liquid, and measurement of the dipole moment of an organic molecule;

(c) the signal generator-cum-audio-amplifier could be used for measurement of self-inductance, study of series and parallel resonant circuits, measurement of relaxation time constant of a serial light bulb, and demonstration of rotating magnetic field. Along with a bridge balance detector the signal generator can be used to study various types of AC bridges;

(d) the lock-in-amplifier could be used for measurement of mutual inductance and measurement of small resistance by AC technique;

(e) the IGCAR kit, namely on-line data collection kit, has been used for acquiring online data on at least six experiments and for study of a ferroelectric phase transition. Many other experiments were designed and developed based on these kits; additional kits are under development.

Over the two-week period at each Refresher Course, each one of the teachers was provided with four knocked-down kits for assembly, testing and operation. The teachers were guided in gaining hands-on-experience by the resource persons from Goa University and scientists of IGCAR, Kalpakkam. Starting from rudimentary steps like proper soldering, the teachers were led through the exercise and the programme has worked well to the satisfaction of the participant teachers.

Enthused by the positive response from the nearly 100 participant teachers so far, this two-day demonstration workshop was organized where all the kits and experiments were demonstrated before the nominated teachers with a view to bring these kits and new experiments to the attention of a wider audience.

The morning sessions were devoted to lectures on the details of the kits by KR Priolkar, Efren D'Sa, Sadiq (all from Goa University), J Jay Pandian (IGCAR) and R Srinivasan. Jay Pandian's lecture touched on several aspects of modern experimental support systems that could be configured using currently available PCs and associated software; he dealt at length on embedded systems and virtual experiments. The afternoon sessions were devoted to demonstration of the kits and related physics experiments to groups of

teachers. By rotation, all the groups were shown all the kits and experiments. The teachers were provided with a detailed manual on the kits and experiments before the Workshop.

A feedback revealed that the teachers were greatly benefitted by the Workshop. Some expressed the view that, although the kits and other aspects covered in the workshop were useful, there may be stumbling blocks in changing existing curricula and introducing such approaches at many colleges and universities due to various reasons. They suggested that the Academy might take up the matter at higher levels in the universities and UGC to make the programme more effective.

Following the Workshop, the Academy supported a two-day workshop on New Trends in Teaching Physics, sponsored by the Indian Association for Physics Teachers, and held at the VVS College for Women at Bangalore at the initiative of BN Chandrika.

(g) Modern chemistry and biology

Aurora's Degree College, Hyderabad, 28–29 November 2005

Participants: Students from colleges in Hyderabad

Course Co-ordinator: TP Radhakrishnan

Speakers: TP Radhakrishnan, Abhani Bhuyan, MV Rajasekharan and M Periasamy (all of Univ. of Hyderabad); V Nagaraja (IISc, Bangalore); Jagadish Mittur (Monsanto, Bangalore); Nasreen Z Ehtesham (NIN, Hyderabad) and Viji Draviam (Massachusetts).

Topics covered: Nano-materials, perspectives in coordination chemistry, GM feed, agricultural biotechnology, endonuclease and topoisomerase, and chromosome segregation.

(h) Fundamental and advanced aspects in spectroscopy

St. Joseph's College, Irinjalakuda, 14–15 February 2006

Participants: 110 post-graduate students and teachers from universities and colleges in Kerala

Course Co-ordinator: S Umapathy

Speakers: E Arunan, BJ Cherayil, PK Das, S Ramakrishnan, KL Sebastian and S Umapathy (all of IISc, Bangalore).

Topics covered: Electronic, vibrational, rotational and NMR spectroscopy.

(i) Frontiers of physics

St. Philomena's College, Mysore, 17–18 February 2006

Participants: 200 students and teachers from colleges in Mysore

Course Co-ordinator: HA Ranganath

Speakers: C Sivaram (IIA, Bangalore); GI Menon (IMSc, Chennai); Sreekanth (RRI, Bangalore); V Balakrishnan (IIT, Chennai); P Balam, AM Umarji and S Ramasesha (IISc, Bangalore).

Topics covered: Universe, machines at the molecular scale, quantum computation, non-equilibrium phenomena, experiments at low temperatures, and organic electronic materials.

(j) QuarkNet workshop

Indian Institute of Science, Bangalore, 10–11 March 2006

Participants: 23 lecturers from various schools and colleges in Bangalore

Course Director: Rohini Godbole

A two-day Workshop for school and college teachers, in and around Bangalore was held on March 10 and 11, 2006, at the Digital Information Services Centre (DISC) in IISc, Bangalore. The Workshop coincided with two days of International Linear Collider Workshop (LCWS06) from March 9–13, 2006. The QuarkNet team from the Fermi National Accelerator Laboratory (FAL) along with SC Tonwar and BS Acharya from TIFR and Raghava Varma from IIT, Mumbai conducted the Workshop.

Our education system places lot of emphasis on acquisition of knowledge and memorizing facts. These are, no doubt, necessary skills but what is more important is to produce students with a high degree of analytical abilities. It is here that our education system is found wanting. Students are encouraged to cram a lot of information in their courses and are not provided enough learning experience to evaluate and analyse the data collected.

QuarkNet is a teacher professional development programme funded by the National Science Foundation and the US Department of Energy. School teachers work on particle physics experiments and join a cadre of scientists and teachers working to introduce some aspects of their research into their classrooms, bringing them to the frontiers of 21st century research in particle physics. The QuarkNet centres are connected to high-energy physics experiments operating at CERN in Switzerland, at Fermilab in Illinois, at SLAC in California and others. In the framework of this programme physicists mentor work and collaborate with high school teachers spread across the globe. QuarkNet resource persons travel around the world and show the teachers and students how to build a simple cosmic ray detector, which consists of a plastic scintillator, a common piece of equipment in any nuclear or particle physics laboratory. Along with the detector is attached a global positioning system and a data acquisition card which can be hooked on to any personal computer. On the occasion of the International Linear Collider Workshop the QuarkNet team comprising of Marge Bardeen and Robert S Peterson came with some scintillator pieces, photomultiplier tube, GPS receivers, data acquisition card and

other relevant material from FAL. They conducted the Workshop attended by physics teachers in and around Bangalore. The teachers were first introduced to the subject of cosmic rays and how to detect them. They were then involved in the process of assembling detector using a plastic scintillator, a light guide etc and then hooking up the data acquisition card and the GPS receiver to a PC. The GPS system gives the data a time stamp. All the data the detector collects then resides on the QuarkNet portal (<http://quarknet.fnal.gov/e-lab>) at FAL. The students/teachers are given username and passwords, using which they would be able to use the whole set-up to collect data and upload it to the QuarkNet portal. One can, in turn, have access to the data collected by other schools/students across the globe who are also participating in the experiment. They will be able to further participate in analysing these data, in the process of learning the basics of data analysis.

In all, 23 teachers from various schools and colleges (22 from local schools and colleges and one from Pune) participated in this exercise. Rohini Godbole described the purpose of the Workshop. Marge Bardeen introduced the concept of QuarkNet and its aim to teachers. These were followed by an inspiring lecture by S.C. Tonwar on what cosmic rays are, how they are detected, what questions about our universe they have helped to answer and so on. This was followed by an equally informative lecture by B.S. Acharya on detector technology, how they are built, and what we measure using them.

The teachers were then asked to explore the QuarkNet URL at FAL. This was a learning experience for all participants. They were allowed access to some of the data collected elsewhere and see some of the posters prepared. Many of them were creatively thought out problems. This provided inkling into the nature of work that could be carried out using the detectors. Later, in the evening the teachers were divided into four groups: one to assemble the detectors, the other three to choose one set of data to be analysed. The next day the detector group started fabricating the detector while the other groups tried to converge on what analysis they should do. The groups engaged in data analysis presented what they were going to look for while the detector group started assembling the detector. Even while assembling, a whole range of physics was discussed at length. In the afternoon, it was a moment of joy for the assembly team to see their detector detecting cosmic rays. The participants were finally given a short time to present what they learnt from their efforts. Judging by the response of the participants, the meet was a big success.

The entire hardware kit used in the Workshop was gifted to the participants for follow up action by the QuarkNet team from USA. The detector is now set up at the Jawaharlal Nehru Planetarium, Bangalore.

13 FINANCES

The activities of the Academy are carried out under Non-Plan and Plan. Non-Plan mainly consists of publications activity while Plan includes programmes on science education, annual/mid-year meetings/discussion meetings etc. A summary of the income and expenditure for 2005–2006 follows. Annexure 6 is an abridged version of the audited statement of accounts for the financial year

(a) Non-Plan (Publications activity)

Income	Rs. in lakhs	Expenditure	Rs. in lakhs
Grant –DST	60.00	Journal Printing	30.41
Grant – DAE	1.00	Postage	20.64
Subscriptions	58.81	Salaries	63.18
Others	18.67	Others (maintenance of building, equipment, etc.)	22.36
		Surplus	1.89
	138.48		138.48

(b) Plan

Income	Rs. in lakhs	Expenditure	Rs. in lakhs
Grant – DST	199.50	Science Panel	59.23
		Annual/mid-year meetings	38.95
		Others (special publications, pension fund, modernization)	94.69
		Surplus	6.63
	199.50		199.50

14 ACKNOWLEDGEMENTS

The Academy's publication activities are largely due to the voluntary and unpaid services of editors, members of editorial boards and the large number of reviewers who examine and comment on manuscripts sent to them for opinion. Several Fellows also contributed their services in other Academy activities such as organizing annual meetings and discussion meetings. The various science education programmes were carried out with the help of N Mukunda and the members of the Science Education Panel in which a number of Fellows and others participated. The Department of Science and Technology, the Department of Atomic Energy and others have made available generous financial assistance to the Academy and have thus contributed to the activities undertaken by the Academy. The local organizing committee at Tiruchirappalli and the Academy staff in Bangalore have ensured a large participation at the scientific meetings of the Academy.

TABLE 1

Information about published pages in journals (January to December 2005)

	Vol.No.	No. of issues	No. of papers	Total No. of pages 2004	**
1. Bulletin of Materials Science	28	7	117	750	↑172
2. Current Science	88,89	24	1329	4378*	↑810
3. J. Astrophys. Astron.	26	4	33	458	↑234
4. Journal of Biosciences	30	5	89	800	↑274
5. Journal of Chemical Sciences	117	6	83	704	↓152
6. Journal of Earth System Science	114	6	77	842	↑4
7. Journal of Genetics	84	3	39	360	↑55
8. Pramana	64,65	12	215	2358	↓383
9. Proceedings (Math. Sci.)	115	4	43	542	↑114
10. Resonance	10	12	147	1410	↑252
11. Sadhana – Engg. Sci.	30	6	44	786	↑91
Total			2216	13388	↑1471

* including briefer items such as news, correspondence, etc.

** As compared to last year's figures

TABLE 2

Information on papers submitted for publication (January to December 2005)

	Accepted	Rejected	Pending	Total	**
1. Bulletin of Materials Science	95	55	63	213	↑7
2. Current Science	840	1047	265	2152*	↑559
3. J. Astrophys. Astron.	27	15	21	63	↑23
4. Journal of Biosciences	64	201	34	299	↑61
5. Journal of Chemical Sciences	83	89	44	216	↑94
6. Journal of Earth System Science	33	44	20	97	↑45
7. Journal of Genetics	44	57	6	107	↑9
8. Pramana	186	137	110	433	↓19
9. Proceedings (Math. Sci.)	32	171	65	268	↑85
10. Resonance	147	85	24	256	↑22
11. Sadhana – Engg. Sci.	40	33	71	144	↑65
Total	1591	1934	723	4248	↑951

* including briefer items such as news, correspondence, etc.

** As compared to last year's figures

TABLE 3

Circulation details of journals (January to December 2005)

	Subscription		Complimentary		Fellows & Associates	Total	**
	India	Foreign	India	Foreign			
1. Bulletin of Materials Science	1598 ^a	29	77	26	136	1866	↑91
2. Current Science	4747 ^c	262 ^d	134	55	89	5287	↓17
3. J. Astrophys. Astron.	624	120	67	23	101	935	↑47
4. Journal of Biosciences	1506	47	76	110	290	2029	↑201
5. Journal of Chemical Sciences	958	35	66	82	183	1324	↑145
6. Journal of Earth System Science	641	35	69	99	99	943	↑52
7. Journal of Genetics	1012	98	72	58	189	1429	↑115
8. Pramana	1255	38	81	47	239	1660	↑169
9. Proceedings (Math. Sci.)	1052	60	68	89	130	1399	↑162
10. Resonance	4707 ^b	34	194	7	-	4942	↑313
11. Sadhana – Engg. Sci.	874	21	65	29	147	1136	↑148

a. Includes about 600 MRSI members in India and abroad

b. Includes about 2175 personal subscribers

c. Includes about 1925 personal subscribers

d. Includes about 200 institutional subscriptions from third world countries

** as compared to last year's figures



1. Banerjee, Soumitro
 Indian Institute of Technology,
 Kharagpur
 Sp: Nonlinear dynamics, and
 electrical engineering



9. Deb, Kalyanmoy
 Indian Institute of Technology,
 Kanpur
 Sp: Optimization and design,
 genetic algorithms and
 multiobjective optimization



2. Basak, Amit
 Indian Institute of Technology,
 Kharagpur
 Sp: DNA-interacting agents,
 asymmetric synthesis and
 enzymology



10. Dev, Bhupendra N
 Indian Association for the
 Cultivation of Science, Kolkata
 Sp: Surface & nanoscale physics,
 x-ray physics and ion-solid
 interactions



3. Basu, Joyoti
 Bose Institute, Kolkata
 Sp: Molecular microbiology with
 special reference to mycobacteria,
 understanding host-pathogen
 interactions, and membrane
 biology



11. Ghosh, Swarna Kanti
 Tata Institute of Fundamental
 Research, Mumbai
 Sp: Infrared astronomy,
 interstellar medium and
 astronomical instrumentation



4. Bhat, BV Rajarama
 Indian Statistical Institute,
 Bangalore
 Sp: Quantum probability, operator
 algebras and operator theory



12. Guru Row, TN
 Indian Institute of Science,
 Bangalore
 Sp: Chemical crystallography,
 intermolecular interactions and
 polymorphism and drug design



5. Bhat, GS
 Indian Institute of Science,
 Bangalore
 Sp: Tropical convection, boundary
 layer and field studies



13. Hasan, Gaiti
 National Centre for Biological
 Sciences, Bangalore
 Sp: Inositol trisphosphate and
 calcium signalling in neuronal
 physiology



6. Bhattacharya, Samaresh
 Jadavpur University, Kolkata
 Sp: Inorganic chemistry,
 coordination chemistry, and
 organometallic chemistry



14. Jayaraman, A
 Physical Research Laboratory,
 Ahmedabad
 Sp: Atmospheric science, aerosols
 and radiative transfer



7. Bose, Arup
 Indian Statistical Institute, Kolkata
 Sp: Probability and statistics



15. Khurana, Jitendra P
 University of Delhi South Campus,
 New Delhi
 Sp: Photoperception and signal
 transduction in plants, structural
 and functional genomics and plant
 hormone action



8. Chakravarty, Charusita
 Indian Institute of Technology,
 New Delhi
 Sp: Chemical physics and
 theoretical and computational
 chemistry

**16. Kundu, Gopal Chandra**

National Centre for Cell Science, Pune

Sp: Signal transduction, cancer biology and regulation of gene expression

**17. Majumder, Hemanta K**

Indian Institute of Chemical Biology, Kolkata

Sp: Biochemistry, molecular biology and parasitology

**18. Mandal, Chitra**

Indian Institute of Chemical Biology, Kolkata

Sp: Glycobiology, immunobiology and glycoimmunology

**19. Mandal, Nibir**

Jadavpur University, Kolkata

Sp: Structural geology, and tectonics

**20. Puri, Sanjay**

Jawaharlal Nehru University, New Delhi

Sp: Statistical physics, condensed matter physics and nonlinear dynamics

**21. Ram Rajasekharan**

Indian Institute of Science, Bangalore

Sp: Biological sciences, lipid metabolism and plant biotechnology

**22. Ramakrishna, BS**

Christian Medical College & Hospital, Vellore

Sp: Gastroenterology/medicine, transport physiology and cell biology

**23. Ramakrishnan, S**

Indian Institute of Science, Bangalore

Sp: Polymer synthesis, polymer folding and assembly and hyperbranched polymers

**24. Raychaudhuri, Amitava**

Harish-Chandra Research Institute, Allahabad

Sp: Particle physics

**25. Sengupta, Surajit**

SN Bose National Centre for Basic Sciences, Kolkata

Sp: Condensed matter physics, statistical mechanics and materials science

**26. Sonti, Ramesh V**

Centre for Cellular & Molecular Biology, Hyderabad

Sp: Plant-microbe interactions, plant genetics, and bacterial genetics

**27. Thelma, BK**

University of Delhi South Campus, New Delhi

Sp: Human genetics, pharmacogenetics, and medical genomics

**28. Trivedi, Sandip P**

Tata Institute of Fundamental Research, Mumbai

Sp: String theory, particle physics, and quantum field theory

**29. Visweswariah, Sandhya S**

Indian Institute of Science, Bangalore

Sp: Cell biology, protein structure and function, and biochemistry

HONORARY FELLOWS**1. Ranajit Chakraborty**University of Cincinnati
Ohio, USA**2. Michael L Klein**University of Pennsylvania
Philadelphia



1. Manoj Kanti Banerjee
(b. 25-5-1931, d. 18-2-2006)
Elected: 1977
Sp: Nuclear physics



2. MK Das Gupta
(b. 1-9-1923, d. 28-11-2005)
Elected: 1990
Sp: Radio astronomy, solar-terrestrial physics, and electronics



3. TV Desikachary
(b. 18-9-1919, d. 4-11-2005)
Elected: 1957
Sp: Phycology (Botany)



4. UR Ghatak
(b. 26-2-1931, d. 18-6-2005)
Elected: 1976
Sp: Synthetic organic chemistry, and bio-organic chemistry



5. JR Merchant
(b. 14-6-1922, d. 8-2-2004)
Elected: 1964
Sp: Organic chemistry



6. B Ramachandra Rao
(b. 21-11-1922, d. 24-9-2005)
Elected: 1974
Sp: Space physics, ultrasonics, and electronics



7. G Rangaswami
(b. 10-5-1925, d. 7-9-2005)
Elected: 1960
Sp: Agriculture, microbiology, and plant pathology



8. Amal Kumar Raychaudhuri
(b. 1-11-1923, d. 18-6-2005)
Elected: 1982
Sp: General relativity, gravitation, and cosmology



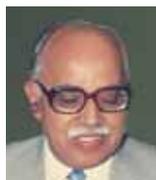
9. SN Sarkar
(b. 22-4-1920, d. 10-9-2004)
Elected: 1978
Sp: Precambrian stratigraphy, structural geology, and geochronology



10. R Subrahmanyam
(b. 31-1-1919, d. 5-3-2006)
Elected: 1956
Sp: Marine biology, and algology



11. K Venkateswarlu
(b. 6-6-1916, d. 2-7-2005)
Elected: 1958
Sp: Raman spectroscopy and molecular dynamics



12. A Venkoba Rao
(b. 20-8-1927, d. 25-10-2005)
Elected: 1984
Sp: Psychological medicine

HONORARY FELLOWS DECEASED



Sir Hermann Bondi
(b. 1-11-1919, d. 10-9-2005)
Elected: 1997



1. Amritanshu Prasad
The Institute of Mathematical Sciences, Chennai
Sp: Automorphic forms, representation theory, and matrices over local rings



6. Aditya Mittal
Indian Institute of Technology, New Delhi
Sp: Biological membranes, bionanotechnology, and biochemical engineering



2. Partha Sarathi Chakraborty
Indian Statistical Institute, New Delhi
Sp: Operator algebras, and noncommutative geometry



7. Mahesh S Tirumkudulu
Indian Institute of Technology, Mumbai
Sp: Fluid mechanics, and colloids and interface science



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



8. Mukund Thattai
National Centre for Biological Sciences, Bangalore
Sp: Genetic networks



4. Shankar Ghosh
Tata Institute of Fundamental Research, Mumbai
Sp: Raman spectroscopy, and carbon nanotubes



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



5. Tushar Jana
University of Hyderabad, Hyderabad
Sp: Polymer chemistry and materials science

A. Lectures in Physics

1. N Mukunda, Indian Institute of Science, Bangalore
Light, space and time
2. N Kumar, Raman Research Institute, Bangalore
Bose–Einstein condensation: where many become one and there is plenty of room at the bottom
3. J V Narlikar, Inter-University Centre for Astronomy & Astrophysics, Pune
Einstein and our understanding of the universe
4. Sriram Ramaswamy, Indian Institute of Science, Bangalore
Brownian motion: Then and now
4. A N Lahiri Majumder, Bose Institute, Kolkata
L-myo-inositol 1-phosphate synthase: Evolutionary divergence and role in stress-tolerance
5. G K Lahiri, Indian Institute of Technology, Mumbai
Tuning intermetallic electronic coupling in polyruthenium systems via molecular architecture
6. Atul H Chokshi, Indian Institute of Science, Bangalore
Role of interfaces in mechanical properties of polycrystalline materials
7. B.R. Arora, Wadia Institute of Himalayan Geology, Dehra Dun
Electrical conductivity imaging of frontal Himalaya: Geodynamic implications

B. Special Lectures

1. D Chatterji, Indian Institute of Science, Bangalore
A tiny molecular machine and its architecture
2. T Ramasami, Central Leather Research Institute, Chennai
Collagen-based smart biomaterials
8. K Krishnamoorthy, Vikram Sarabhai Space Centre, Thiruvananthapuram
Towards an aerosol climatology for India
9. P N Pandita, North-Eastern Hill University, Shillong
Low energy implications of supersymmetric grand unification

C. Public Lecture

Kiran Mazumdar-Shaw, Biocon, Bangalore
The need for shared vision between academia and industry

D. Lecture Presentations by Fellows/ Associates

1. R C Budhani, Indian Institute of Technology, Kanpur
Antagonistic orders in tailored superlattices of hole-doped Mott insulators
2. Suresh Das, Regional Research Laboratory, Thiruvananthapuram
Photoresponsive liquid crystalline and luminescent materials
3. Chandrima Shaha, National Institute of Immunology, New Delhi
Kinetoplastid parasites—do they commit suicide?
10. V. Shankar, Indian Institute of Technology, Kanpur
Stability and dynamics of fluid flow past deformable solid media
11. Sulabha K Kulkarni, University of Pune, Pune
Surface engineered small particles
12. G C Mishra, National Centre for Cell Science, Pune
Differentially activated B-cells acquire different capacity to activate CD8+ T cells
13. Sujatha Ramdorai, Tata Institute of Fundamental Research, Mumbai
Elliptic curves and number theory

A. Presidential Address

TV Ramakrishnan, Banaras Hindu University,
Varanasi

Transition metal oxides: Quantum many-body physics meets solid state chemistry

B.(a) Symposium: Physics and chemistry of materials

1. AK Raychaudhuri, SN Bose National Centre for Basic Sciences, Kolkata

Manganites – Phenomena and physics

2. DD Sarma, Indian Institute of Science, Bangalore

Electronic structure of oxide materials

3. GU Kulkarni, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Chemistry of nanomaterials

4. S Natarajan, Indian Institute of Science, Bangalore

Open-framework materials — what is new?

5. AK Ganguli, Indian Institute of Technology, Delhi

Chemistry of oxide materials

(b) Symposium: Genomic landscape and structure of the people of India

1. MLK Murty, University of Hyderabad, Hyderabad

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

2. K Thangaraj, Centre for Cellular and Molecular Biology, Hyderabad

Genomic approaches to reconstructing the Indian population histories

3. Partha P Majumder, Indian Statistical Institute, Kolkata

Genomic diversity and structure of ethnic India: Lessons from haploid chromosomes

4. Mitali Mukerji, Institute of Genomics and Integrative Biology, Delhi

The Indian human genome variation initiative: Overview and first results

5. Vidyanand Nanjundiah, Indian Institute of Science, Bangalore

Genomics and our past: Where are we and where do we go from here?

C. Special Lectures

1. KV Subbarao, University of Hyderabad, Hyderabad

Volcanic poisoning and mass extinctions

2. RK Shyamasundar, Tata Institute of Fundamental Research, Mumbai

Computer science: Scientific and engineering fascinations and challenges

D. Public Lecture

V Shanta, Cancer Institute, Chennai
Cancer causes and prevention

E. S Ramaseshan Memorial Lecture

CNR Rao, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Science for our future: Personal reflections on doing science in India

**F. Lecture presentations by Fellows/
Associates**

1. SK Sarin, G.B. Pant Hospital, New Delhi
Portal hypertensive bleeding: Evolution of protocols and future options
2. Amalendu Chandra, Indian Institute of Technology, Kanpur
Hydrogen bond dynamics in aqueous solutions: Ab initio molecular dynamics study
3. Subhasis Chaudhuri, Indian Institute of Technology, Mumbai
Can we include the third dimension during image mining?
4. DP Kasbekar, Centre for Cellular & Molecular Biology, Hyderabad
Dominant suppressors of repeat-induced point mutation
5. Shankar P Das, Jawaharlal Nehru University, New Delhi
Heterogeneity in supercooled liquids
6. Subhabrata Chakrabarti, L.V. Prasad Eye Institute, Hyderabad
A molecular genetic perspective on primary congenital glaucoma in India
7. VA Raghunathan, Raman Research Institute, Bangalore
Organization of cholesterol in model membranes
8. M Radhakrishna Pillai, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
Human papillomavirus associated cervical cancer in India

STATEMENT OF ACCOUNTS

2005-2006

INDIAN ACADEMY OF SCIENCES BANGALORE



(Amount in Rupees)		
RECEIPTS	2005 –2006	2004 –2005
I Opening balances:		
a) Cash in hand	1,130	13,488
b) Bank balances		
Savings account	9,69,831	(-) 1,69,234
II Grants received:		
a) From Govt. of India	2,60,50,000	2,46,75,000
b) From other sources	32,500	27,000
III Income on investments from:		
a) Own funds	34,43,316	51,87,406
IV Interest received:		
a) On bank deposits (SB)	10,69,853	1,06,299
V Other Income	70,66,153	78,83,436
VI Any other receipts:		
Contribution to corpus fund	9,78,729	1,52,872
VII Investments matured	2,62,36,000	1,46,05,000
TOTAL	6,58,47,512	5,24,81,267

PAYMENTS		
I Expenses:		
a) Establishment	63,18,381	82,14,799
b) Administrative expenses	2,69,50,642	2,30,93,757
II Investments and deposits made out of own funds	3,01,00,000	1,84,00,000
III Expenditure on:		
a) Fixed assets	9,35,575	18,01,750
IV Other payments	3,50,387	NIL
V Closing balances:		
a) Cash in hand	7,157	1,130
b) Bank balance	11,85,370	9,69,831
TOTAL	6,58,47,512	5,24,81,267

As per our report of even date annexed
For B R V GOUD & Co
Chartered Accountants

Place: Bangalore

Sd/-

Date: 28.06.2006 (TV Ramakrishnan)

President

Sd/-

(N Balakrishnan)

Treasurer

Sd/-

(G Madhavan)

Executive Secretary

Sd/-

(BRV Goud)

Partner

Indian Academy of Sciences, Bangalore

71st Annual Meeting

November 11-13, 2005

Bharathidasan University
Tiruchirappalli



