

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 2000 to March 2001 represents the sixty-seventh year of the Academy since its founding.

2 THE FELLOWSHIP

2.1 2000 elections

A total of 373 nominations received for fellowship in different disciplines were considered first by the eight sectional committees and later by the council. Following postal balloting, twenty three new Fellows were elected, the fellowship effective from 1 January 2001. A list of their names follows while Annexure 1 gives their particulars. Also elected were three new Honorary Fellows.

- | | |
|------------------------|---------------------------------|
| 1. Acharya, S K | 13. Nitsure, Nitin |
| 2. Anil Kumar | 14. Ramesh, R |
| 3. Bhattacharya, Sudha | 15. Ram Sagar |
| 4. Chattaraj, P K | 16. Rao, R Raghavendra |
| 5. Das, Bhudev C | 17. Ravindranath, Vijayalakshmi |
| 6. Jayakrishnan, A | 18. Sahni, Girish |
| 7. Joshi, Amitabh | 19. Salunke, Dinakar M |
| 8. Lal, Shyam | 20. Sanyal, M K |
| 9. Maiya, Bhaskar G | 21. Sen, Diptiman |
| 10. Marimuthu, G | 22. Singh, Anil Kumar |
| 11. Mukerjee, Rahul | 23. Varadarajan, Raghavan |
| 12. Nagarajan, R | |

Honorary Fellows

1. Cheetham, A K
2. Fisher, Michael E
3. van den Heuvel, E P J

2.2 *In memoriam*

The following six fellows and two honorary fellows passed away during the period up to March 2001. Annexure 2 gives additional information about them.

Fellows

- | | |
|---------------------|-----------------|
| 1. V.C. Anguli | 4. K. S. Mani |
| 2. Bijan Bihari Lal | 5. R.S. Mishra |
| 3. C.K. Majumdar | 6. Biswajit Nag |

Honorary Fellows

- | | |
|-----------------|---------------|
| 1. Olivier Kahn | 2. Minoru Oda |
|-----------------|---------------|

2.3 *Strength of the fellowship*

	Fellows	Honorary Fellows
1 April 2000	813	43
Elected (Dec. 2000)	23	3
Deceased (Apr. 2000- Mar.2001)	5	2
1 April 2001	831	44

2.4 Fellowship analysis

The Academy has always taken care to elect fellows at a relatively younger stages of their career to act as an inspiration to them in their scientific pursuits. Annexure 3 is a table showing the average age of fellows elected subject-wise since the last 30 years. Annexure 4 is a list of fellows who were elected when they were 40 years of age or below.

3 COUNCIL

The council with N. Kumar as the president was in office until December 2000. In January 2001, a new council under the presidentship of K. Kasturirangan assumed office for the triennium 2001–2003. Two statutory meetings of the council were held in Bangalore on 15 July and 9/10 December 2000 and an additional meeting of the new council at Shriharikota on 17 February 2001.

4 ASSOCIATES

Of 23 nominations received, the following six were selected as Associates in 2000 (Annexure 5). The selections are restricted to those below the age of 32 and the tenure ceases after five years or after the Associates attain the age of 35 whichever is earlier.

So far 173 Associates have been selected since 1983, of whom 49 have since been elected as Fellows.

- | | |
|----------------------|------------------------|
| 1. Vinod Kumar Aswal | 4. Vijay Vinayak Patel |
| 2. Ramesh Hariharan | 5. Vidita A.Vaidya |
| 3. Arvind N. Nair | 6. Umesh V. Waghmare |

5 PUBLICATIONS

5.1 Journals

Publications continue to be the major activity of the Academy. The eleven journals are run by independent editorial boards consisting of active scientists who work on a purely honorary capacity. The chief editor and the members of the editorial board

periodically make way for a newer set of members to assume the responsibility of their respective journals. During the year, new editorial boards were constituted in the case of three of the journals: *Proceedings: Chemical Sciences* (with S.S. Krishnamurthy replacing V. Krishnan as the chief editor), *Proceedings: Earth and Planetary Sciences* (with S.R. Shetye replacing V.K. Gaur as the chief editor) and *Resonance* (with V. Rajaraman taking over as chief editor from N. Mukunda). N. Mukunda continues to be the overall editor of all Academy publications.

To maintain high standards and attract both authors and readers, many improvements have been made over the years in all aspects of publication, including journal production process, journal design, correspondence with authors, editors, reviewers and press. All these are now driven by computer-based methods, and e-mail is extensively used including for receiving manuscripts. Academy journals are among the very few published from the country which are covered in the science citation index of the Institute for Scientific Information (ISI), Philadelphia, USA. Respective journals are also covered by services such as *Chemical Abstracts*, *Biological Abstracts*, *INSPEC*, *GeoBase*, *Cambridge Scientific Abstracts*, *Medline*, etc.

Tables 1 and 2 give some relevant particulars of the eleven journals now published by the Academy. Table 3 gives the impact factors as published by ISI for the last few years. Table 4 gives the journal circulation figures for the year 2000.

5.2 Special issues of journals

Several journals brought out special issues on chosen topics as part of their regular numbers. A description of these follows:

(a) Cyclical evolution of solar magnetic fields: Advances in theory and observations



Guest Editors: P. Venkatakrisnan, Oddbjorn Engvold and Arnab Rai Choudhuri

Journal of Astrophysics and Astronomy, Vol. 21, Nos 3/4, September/December 2000, pp. 101–476.

The Kodaikanal Observatory was established in 1899. To mark the centenary of this Observatory, a colloquium on *cyclical evolution of solar magnetic fields: Advances in theory and observations* sponsored by the International Astronomical Union was held at Kodaikanal in December 1999. The

Proceedings of the colloquium was brought out in a special volume of the *Journal of Astrophysics and Astronomy* (JAA). The volume begins with a historical account of the Kodaikanal Observatory written by the late M.K.V. Bappu, the founding director of the Observatory who also happened to be the first editor of JAA. The remaining 66 articles have been divided into ten sections: synoptic observations, sunspots and solar cycle, filaments and coronal structures, vector magnetic fields, prominences, CMEs and flares, flux tubes and irradiance variability, magnetoconvection and stellar activity, helioseismology, dynamo mechanisms, cycle variation in the quiet corona and coronal holes, solar wind and interplanetary magnetic fields.

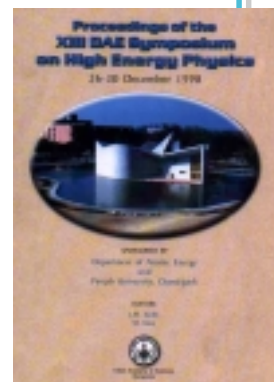
The various papers in this volume vouch for the continuing interest of solar physicists the world over in the fascinating interplay of magnetic fields and plasma dynamics leading to the sunspot cycle. These papers also demonstrate that the ramifications of the solar cycle extend from deep within the Sun out to the far reaches of the solar system.

(b) Proceedings of the XIII DAE symposium on high energy physics

Guest Editors: J.M. Kohli and M. Kaur

Pramana, Vol. 54, No. 4, April 2000, pp. 453–684

The Department of Atomic Energy regularly holds a symposium on *high energy physics*. The thirteenth in this series was held at the Panjab University, Chandigarh in December 1998. About 150 delegates from various universities and institutions in the country and a few from abroad participated in the symposium which focussed on recent developments in high energy physics. There were 22 plenary talks and about 150 contributed papers covering electroweak physics, tests of quantum chromodynamics, top and heavy quark physics, B-physics and CP violation, astro-particle physics and cosmology, quantum field theory, SUSY gauge theories, black holes, neutrino physics, quantum gravity and heavy-ion physics etc. With the approval of new experiments at LHC, the stage is set for pursuing the ambitious goals of new physics in the 21st century. New generation of experiments at RHIC will aim to open up new horizons on the frontiers of quark-gluon plasma and heavy-ion physics. Sixteen of the plenary talks are included in this special volume.

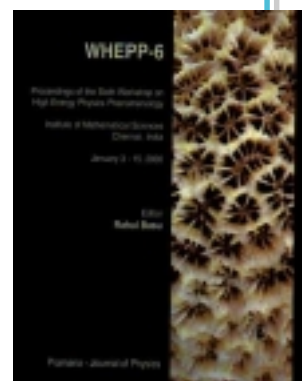


(c) Proceedings of the sixth workshop on high energy physics phenomenology

Guest Editor: Rahul Basu

Pramana, Vol. 55, Nos 1/2, July/August 2000, pp. 1–360.

The sixth workshop on *high energy physics phenomenology* (WHEPP-6) was held at the Institute of Mathematical Sciences, Chennai for two weeks during January 2000. It brought together a large number of active phenomenologists from all over the country and abroad. *Pramana* has been publishing the proceedings of these workshops. Unlike the previous volumes, the present proceedings of the sixth workshop includes both plenary and scheduled working group talks. There are 36 presentations including a report on the Indian neutrino observatory.



(d) Proceedings of the fourth international conference on gravitation and cosmology

Guest Editors: S. Bharadwaj, N.K. Dadhich and Sayan Kar
Pramana, Vol. 55, No. 4, October 2000, pp. 479–642.

The fourth international conference on *gravitation and cosmology* (ICGC 2000) was held in January 2000 at IIT, Kharagpur. It was attended by about 100 participants from India and abroad. In contrast to the earlier ICGC meetings, this meeting was smaller, the idea being largely motivated by the need to focus on a few topics as opposed to a broader spectrum. ICGC 2000 focused on two topics of contemporary interest: (i) cosmology, and (ii) black holes and other compact objects. There were ten plenary lectures during the morning sessions. The afternoon sessions were devoted to four workshops where new results were presented on the classical and quantum aspects of black holes and compact objects, theories/observations on cosmology, and a report on alternative scenarios. Additionally, there were a couple of special lectures — one on *Einstein's days and works in Prague* and another semi-popular lecture on *black holes* as well as an enthralling after dinner speech: “The lighter side of gravity – How Swami Gurutvananda received enlightenment?” This volume includes the texts of seven of the ten plenary talks, the summary of results presented at the four afternoon workshops, as well as the text of the after-dinner talk.

(e) Proceedings of the fourteenth national symposium on plasma science and technology

Guest Editor: T.S. Gill
Pramana, Vol. 55, Nos 5/6, November/December 2000, pp. 643–966.

The fourteenth national symposium on *plasma science and technology* (Plasma–99) organized jointly by the Plasma Science Society of India and the Guru Nanak Dev University was held at Amritsar in December 1999. Since this symposium was held at the threshold of the new millennium, the theme was, aptly, *Plasma physics in India — review and future trends* and contained invited review talks in various categories covering basic plasma physics, space and astrophysical plasmas, industrial plasmas and plasma processing, chaos and nonlinear phenomena, inertially confined fusion plasmas, novel plasmas and magnetically confined fusion plasmas. In all, there were 19 invited review talks and about 180 contributed papers. The present volume contains nine reviews and 26 of the contributed papers presented at the symposium.

(f) **Proceedings of the winter institute on foundations of quantum theory and quantum optics**

Guest Editor: S.M. Roy

Pramana, Vol. 56, Nos 2/3, February/March 2001, pp. 137–456.

There is a growing body of physicists worldwide who are interested in the emerging field of foundations of quantum theory and quantum optics and their technological applications to quantum information processing (including quantum computation and quantum communication). The urgency of seeding and sustaining research collaborations in this field involving experimental as well as theoretical physicists led to the holding of periodic winter institutes in India on *foundations of quantum theory and quantum optics*.

The advance of technology has made it possible over the last decade or so to perform critical experiments to test the foundations of quantum theory that were until recently regarded as gedanken experiments. In particular, interference and correlation experiments using single photons, single electrons and single neutrons as well as atomic, molecular and solid state physics experiments coupled with quantum optical techniques have been particularly valuable in shedding new light on non-local quantum correlations, wave-particle complementarity, macroscopic quantum tunneling, Schrödinger Cat states, the quantum Zeno effect, and Bose-Einstein condensation. Further, there have been new theoretical developments of great conceptual significance such as consistent histories, decoherence and spontaneous collapse, and the development of a causal quantum theory richer than the original theory of de Broglie and Bohm. In addition there is worldwide interest in the closely related fields of mesoscopic physics, quantum computation and quantum communication”.

The enthusiasm for the winter institute is perhaps due to the explosive growth of the field of quantum information processing. There were 96 participants including 48 speakers. There were separate discussion sessions in the afternoons with different coordinators taking charge of different focussed areas of research.

Of the 27 articles included in this volume, 11 are on foundations of quantum theory, six on quantum optics, seven on quantum information processing and three on mesoscopic physics. The guest editor hopes that this special issue will bear testimony to the standards attained at this first winter institute and prove to be an important source of reference.



(g) Modern trends in inorganic chemistry

Guest Editors: S.S. Krishnamurthy and A.G. Samuelson

Proc. Chem. Sci., Vol. 112, No. 3, June 2000, pp. 155–438.

The series of symposia on *modern trends in inorganic chemistry* (MTIC), which began in 1985 at the Indian Association for Cultivation of Science, Calcutta has evolved into a forum for the inorganic chemistry fraternity of the country to meet every two years and discuss the current status and future projections of research in various frontier areas of inorganic chemistry, both at the national and international levels. The meeting held at the Indian Institute of Science, Bangalore during January 2000 was the first in the new millennium and the eighth in the series (MTIC–VIII). It was jointly hosted by the Department of Inorganic and Physical Chemistry, Indian Institute of Science and the Jawaharlal Nehru Centre for Advanced Scientific Research.

This special issue of the journal contains 14 papers based on invited lectures delivered at the symposium. Apart from oral presentations, the conference had a rich and extensive poster programme, and abstracts of 100 posters are also included in this issue. The topics covered span a wide range in the field of inorganic chemistry including some emerging interdisciplinary areas.

(h) Bay of Bengal monsoon experiment

Guest Editors: Sulochana Gadgil and U.C. Mohanty

Proc. Earth Planet Sci., Vol. 109, No. 2, June 2000, pp. 205–314.

One of the most challenging problems in atmospheric science is to develop an adequate understanding of the variability of the Indian monsoon on various time scales: subseasonal, interannual and decadal, that could be translated into a predictive capability. The monsoon is strongly coupled to warm oceans surrounding the subcontinent. Most of the monsoon rainfall occurs in association with synoptic systems, such as lows and depressions, generated over the warm oceans and their subsequent propagation over the Indian landmass. The Bay of Bengal is exceptionally fertile generating these systems and plays an important role in monsoon variability.

Studies of satellite data over the past two decades have revealed the nature of convection/precipitation over the oceans and their relationship, with monsoon variability. These, in turn, have led to various hypotheses to explain the propagation of these systems in the atmosphere, their impact on the ocean and the recovery of the atmosphere and ocean to the predisturbance state. These hypotheses need to

be tested and refined by detailed observations of the air-sea coupling during the monsoon.

The BOBMEX field experiment, an acronym for the 'Bay of Bengal and the monsoon experiment' is aimed at accomplishing this objective by generating critical data on the subseasonal variation of important variables of the atmosphere, the ocean and their interface processes. This is the first major national effort at designing experiments to gain critical insights into the structure of monsoon variability. Under the first national observational programme of the monsoon trough (MONTBLEX), some observations of the variation of winds, surface fluxes and other parameters were made in the head Bay. BOBMEX envisaged the use of state-of-the-art instrumentation to obtain time series data at two critical locations over the Bay during July-August 1999. Prior to this, a pilot experiment was undertaken over the Bay in October-November of 1998 to test the instruments and obtain a first-order picture of the nature of variability. Results of this pilot experiment are presented in this volume in 12 papers dealing with various aspects of BOBMEX.

(i) International JGOFS symposium on the biogeochemistry of the Arabian Sea

Guest Editors: Peter Burkill, Roger Hanson, Dileep Kumar and P.S. Swathi, *Proc. Earth Planet Sci.*, Vol. 109, No. 4, December 2000, pp. 393–552.

Oceans constitute a massive reservoir of carbon dioxide, about 50 times larger than the atmosphere. Even minor variations in its carbon content therefore affect the atmospheric inventory significantly. The joint global ocean flux study (JGOFS) was accordingly designed as the core project aimed at addressing the biogeochemistry of carbon in the ocean, particularly the upper ocean biogeochemical processes which by mediating exchanges between the ocean interior and the atmosphere, lead to climate change. Such studies are expected to yield information on the magnitudes of spatial and temporal variabilities, and exchanges among various terrestrial reservoirs. The main objectives of this project are to determine and understand the factors controlling the time-varying carbon fluxes in the ocean, to evaluate related exchanges with other reservoirs, and to use this knowledge in developing predictive models of the earth system response to anthropogenic perturbations.

The tropical Arabian Sea has been regarded as a complex arena of dimly understood biogeochemical processes that have significant global implications. For instance,

the Arabian Sea makes a disproportionately large contribution to denitrification in the world oceans and maintains super saturation of carbon dioxide in its surface waters round the year. Yet, details of the processes responsible for sustaining these states still remain to be elucidated. Is it physics or biology? To examine these questions in the light of newly acquired information from the Arabian Sea process study, the JGOFS organized an international symposium on *Biogeochemistry of the Arabian Sea* at Bangalore during January 1999, followed by a week long training course on *modelling and synthesis*. This issue of the *Proceedings* contains a set of eleven papers selected from those presented at this symposium. The editors hope that the incisive selection of papers included in this volume would provide landmark contributions to the study of JGOFS.

(j) Advances in modelling, system identification and parameter estimation

Guest Editors: Jitendra R. Raol and Naresh K. Sinha,
Sadhana, Vol. 25, No. 2, April 2000, pp. 71–204.

The field of system modelling and identification has advanced at a rapid rate since the time of Gauss. As early as in 1795, Gauss made pioneering contributions to parameter estimation of dynamical systems. This century has seen applications of Kalman filtering (in 1960s) to the present-day neural networks and genetic algorithms. With a view to keeping in tune with this fascinating area, researchers and engineers working in this field were invited to contribute to this special issue of *Sadhana*. The ten contributory papers included in this volume span a wide range of techniques and applications of mathematical modelling system identification and parameter estimation with good mathematical theories, techniques, and applications to real-life practical problems. It is hoped that the volume will be useful to researchers and practising engineers as well as to postgraduate students working in this field.

(k) Emerging dynamic design techniques for mechanical and structural systems

Guest Editors: T.K. Kundra and B.C. Nakra
Sadhana, Vol. 25, No. 3, June 2000, pp. 205–340.

This special issue documents some of the contributed research papers discussed during the proceedings of International Winter School on *optimum dynamic design using modal testing and structural dynamic modification* held at IIT, Delhi during December 1997. The school was organized with the main objective of providing an opportunity for presenting the latest trends in the area of dynamic design by experts.

An attempt was also made to bring about an awareness of the state-of-art of the software and hardware in various tools of dynamic design, namely dynamic testing, identification, modification and model updating.

The dynamic design techniques are applicable to simple as well as complex structural and mechanical systems. Information from various sources shows that their successful application to reduce vibrations and improve design covers machine tools, car engines, scooters, tractors, rail vehicles, power generating turbines, aircraft engines and structures, helicopters, satellites and even consumer products like golf clubs, hair clippers, loudspeaker cabinets, lawn mowers, musical instruments, tennis rackets, disk drives of computers, oil sump lines, bicycles and a host of other consumer and industrial products and equipment. The editors hope that the papers in this volume would bring about an awareness of the emerging dynamic design techniques including their principles, applications, and the state-of-the-art developments in the area.

(I) **Nonlinear structural analysis**

Guest Editors: T.K. Varadan and Gangan Prathap
Sadhana, Vol. 25, No. 4, August 2000, pp. 341–422.

The Structures Panel of the Aeronautics Research and Development Board of India organizes a *national* seminar on aerospace structures (NASAS) every year on a specific theme. The eighth seminar was on *nonlinear mechanics* and was held at IIT, Chennai in October 1998.

During the last 50 years, nonlinear problems of mechanics and mathematical physics have attracted considerable attention. Earlier, almost all phenomenological studies were solved using linear or linearized systems. However, rapid advances in science and engineering have pushed frontiers of technology to such extents that linear theories no longer suffice. This is the case in aerospace structures where the use of low-rigidity thin-walled structures results in large deformations governed by nonlinear differential equations. The solution of such models by approximate analytical or computational techniques has also become very important.

Four invited and 40 contributed papers were presented at the national seminar. A great variety of topics were covered including themes such as nonlinear finite element analysis, composite structures, fracture mechanics, vibration, chaos, contact stresses, etc. — an interesting mix showing the emerging preferences and thrust directions.

This special issue of *Sadhana* is a collection of five papers selected from those presented at the seminar. It is also intended as a tribute to the late Professor KAV Pandalai who championed the cause of nonlinear structural analysis over nearly four decades of research and teaching and who initially assumed the task of organizing this special issue but could not complete the assignment due to his unfortunate demise in 1999.

(m) Advances in solidification processing

Guest Editor: Biswajit Basu

Sadhana, Vol. 26, Nos 1/2, February/April 2001, pp. 1–212.

Solidification phenomena are the heart of most of the product manufacturing processes. From conventional manufacturing processes like foundry casting, arc welding, ingot casting etc. to the latest technologies like crystal growth, near-net shape processing, laser processing, and plasma processing, solidification phenomena play a dominant role in process as well as product optimization. Over the last couple of decades, there has been significant progress in the fundamental understanding as well as in the modelling approaches to solidification phenomena. This has led to better product quality and higher productivity of conventional processing. Besides these, new advances in understanding the process have led to the development of several new technologies.

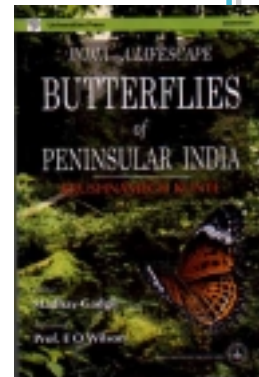
With this background, an international workshop was organised by the Tata Research Development & Design Centre, Pune, in association with the Indian Society of Heat & Mass transfer (ISHMT) and the American Society of Mechanical Engineers (ASME), January 2000 in Pune to review the latest developments on several aspects of solidification processing, namely, fundamental understanding and modelling, control and optimization, and new technologies and challenges for the next millennium. This volume of *Sādhanā* documents some of the issues that were presented and discussed in the workshop. It presents a wide range of interesting research work on the fundamentals (like segregation, microstructure, correction) and applications (thermal sprays, crystal growth, welding and continuous casting) of solidification phenomena. The editor hopes that this collection will be useful to researchers and practising engineers in their respective fields of application.

5.3 Special publications

(a) Butterflies of Peninsular India

Author: Krushnamegh Kunte; Editor: Madhav Gadgil,
Published in collaboration with Universities Press, Hyderabad,
Distributed by Universities Press, price Rs. 470/-

This book on butterflies of peninsular India represents the first fascicle to be published under Project Lifescape. This project is a part of the initiative of the Academy to enhance the quality of science education. The project aims to publish illustrated accounts of 1,500 Indian species (and higher taxonomic categories such as orders and families) of microorganisms, plants and animals. These accounts are meant to assist high school, college and postgraduate students and teachers of biology in reliably identifying these taxa. They would also include ancillary information on distribution, ecology and behaviour that would help design field exercises and projects focussing on first hand observations of living organisms. The information thus generated could feed into a countrywide system of monitoring ongoing changes in India's lifescape to support efforts at conservation of biological diversity, as well as control of invasives, of weeds, pests, vectors and diseases. Hopefully, the accounts would also stimulate popular interest in the broader spectrum of India's biological wealth, much as Salim Ali's books have done for birdlife over the last fifty-eight years.



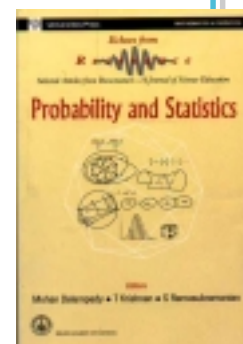
This book, of 300 pages contains natural history accounts of 76 butterfly species which are arranged according to their families and includes 186 exquisite colour pictures of butterflies.

The book was formally released during the Goa Annual Meeting by R.A. Mashelkar and was followed by the public lecture on butterflies by Madhav Gadgil.

(b) Probability and statistics – Echoes from Resonance

Editors: Mohan Delampady, T. Krishnan and S. Ramasubramanian
Published with Universities Press, Hyderabad, pp. 1–201

The Academy launched *Resonance* as a monthly journal devoted to science education in January 1996. It is aimed largely at undergraduate students and teachers of science, though material accessible to somewhat



younger students is also included. Each issue contains material in all areas of science and mathematics, in various formats. Some are individual general articles, others consist of series with several parts. An effort is always made to attain a good expository quality in all of them.

Echoes from Resonance is a series born out of *Resonance*, putting together in a coherent manner collections of articles (both series and single pieces) taken from *Resonance* and all written around a common theme. Typically the individual articles would have appeared quite independently at different times. These collections should prove useful to the reader keen to learn about a specific subject, with accounts given by different authors from different perspectives but all in an expository manner. These volumes should be useful for students and teachers alike, and complement the structure of individual issues of *Resonance*, each of which always tries to cover different areas of science and mathematics in a balanced manner.

6 ELECTRONIC PUBLISHING

(a) Web access

As part of its constant effort to keep up with developments in journal publishing worldwide, and to improve the visibility of its journals, Academy has equipped itself to make its journals available on the World Wide Web. Academy hosts web pages of all its journals on its web server which is on a leased 64 kbps line to the Internet. Nine of the eleven journals have web pages with full content on the Web and available free of charge. The journal sites have information about the journal, contact addresses, subscription details and information for authors. The contents page for each issue of a journal is linked to HTML files of abstracts of articles and PDF files of full articles (both text and illustrations).



The Academy website is at www.ias.ac.in with links to information on various activities of the Academy. A database driven search facility is available on the fellowship. The journal pages are also mirrored at the IISc website (www.iisc.ernet.in/~academy).

7 RAMAN PROFESSOR

Prof. Itamar Procaccia of the Department of Chemical Physics at the Weizmann Institute of Science, Rehovot in Israel was the seventeenth Raman Professor to occupy the Raman Chair. Procaccia is well known in the world of theoretical physics, in particular for the work he has done in turbulence and turbulent transport processes, nonequilibrium thermodynamics, nonlinear dynamical systems, and fractals.



Procaccia was in India in February-March 2001 for about 5 weeks and had a fruitful interaction with the faculty of the Indian Institute of Science. He also lectured at IISc on *anisotropy and its decay in developed turbulence*, at the Jawaharlal Nehru Centre Fluid Dynamics Colloquium on *statistically preserved structures in turbulence and the mechanism for anomalous scaling*, and at the Raman Research Institute on *fractal growth patterns and iterated conformal maps*. His Academy public lecture was entitled *turbulence: a 19th century problem with challenges for the 21st century*.

8 ACADEMY DISCUSSION MEETINGS

8.1 Origin and evolution of life

28 November – 1 December 2000, Orange County, Coorg

During the late seventies and eighties, catalysed by the visits to India of the late Cyril Ponnampereuma (the well-known Sri Lankan scientist who worked on the origin and evolution of the universe) there were a series of meetings in the broad area of chemical evolution and origin and early evolution of life. These meetings used to be vibrant. They also led to research activity in the area. In course of time, the tempo of the concerted efforts slackened and the area is now comparatively dormant in the country. Globally, considerable progress has recently taken place in work relating to the origin and early evolution of life. There is a need to revive the activities in the country in this area.

As regards evolutionary studies themselves, there are isolated pockets of excellence in the country. However, the overall strength in the area in India is rather poor. Considering that evolution is central to biology at all levels, this is a sad state of affairs.

The proposed meeting brought together those working in India in the area of origin of life and evolution for an in-depth discussion. There were five group presentations and Annexure 6 gives the titles of these presentations.

8.2 Computational fluid dynamics (CFD) with hyperbolic conservation laws (CFDHYP–2000)

1–3 December 2000, Orange County, Coorg



Hyperbolic conservation laws arise frequently in many disciplines, including compressible and vascular fluid dynamics, astrophysics and the theory of relativity. Of these, the hyperbolic partial differential equations arising in the dynamics of compressible fluids have been thoroughly studied; in particular aerospace computational fluid dynamics with hyperbolic systems has now reached

a considerable level of maturity. CFD codes developed for solving these laws on supercomputers are regarded as supertools for aerodynamic design and analysis. However, CFD has a much wider spread than what aerospace CFD has covered. The purpose of the present conference CFDHYP–2000 was to bring together scientists, engineers and young students actively engaged in doing R&D work in computational problems involving hyperbolic partial differential equations, for sharing their experiences with others and facilitating cross-fertilization. Scientists from the above fields lectured on their areas of specialization; in addition some lectures for understanding the basics of these various disciplines for the benefit of non-specialists were held. One of the unique features of CFDHYP–2000 is lectures delivered for the benefit of non-specialists by doctors on various medical concepts such as pathological events in atherosclerosis, coronary bypass, aneurysm of aorta and stents. Computer simulation of fluid flow associated with vascular phenomena is likely to play an increasingly important role in the treatment of patients. The organizers believe that all the participants now have a better awareness of and can actively contribute to “the seamless web of knowledge” about CFD with hyperbolic conservation laws.

The topics covered include hyperbolic systems, aerospace CFD, CFD in astrophysics and relativity, and computer simulation of flow problems arising in vascular fluid dynamics. Annexure 7 lists the lectures presented at the discussion meeting.

8.3 Function and plasticity of adult brain

25–28 February 2001, Orange County, Coorg

The format of the meeting was one of talks in the morning followed by extended discussions. These discussions were held informally during walks in the forests in small groups and the talks and discussions were continued in the evenings at the venue. The academic exchanges that began at 9.00 AM continued till 11.00 PM on all days.

The inaugural talk by John Nicholls on regeneration in Opossum spinal cord was held at Bangalore on 23 February and was preceded by his public lecture on value of basic research in neuroscience to society. The other lectures that followed were held at Coorg. Annexure 8 gives a summary of the talks followed by a full list of the programme.

9 ACADEMY PUBLIC LECTURES

9.1 Turbulence: A 19th century problem with challenges for the 21st century

Itamar Procaccia (Raman Professor), Weizmann Institute of Science, Rehovot, Israel

22 February 2001, 4.00 PM, IISc. Faculty Hall

Turbulence is an old problem that continues to challenge theorists and experimentalists alike. In his talk Procaccia explained, avoiding technicalities, some of the exciting recent ideas, and reviewed the most promising new experimental advances. On the theoretical side the role of statistically preserved characteristic structures (SPCS) was stressed and on the experimental side the advent of some ultra-fast tracking techniques. The notion of SPCS offers a novel view of the statistical theory of far-from-equilibrium systems.



9.2 Quest for unification

Edward Witten, School of Natural Sciences, Institute for Advanced Study, Princeton, New Jersey, USA

11 January 2001, 5.00 PM, CSIC Auditorium

The problem of quark confinement is the question of explaining why we never see an isolated quark, given that protons and neutrons are



made of quarks. In recent years, this problem has been linked in unexpected ways with the quantum mechanics of black holes.

9.3 Towards a theory of everything



David J Gross, University of California, Santa Barbara, USA

3 January 2001, 4.00 PM, IISc Faculty Hall

The current state of string theory and the ambitious attempt to construct a unified theory was reviewed. The reasons why we have been led to this theory and the marvellous structures that it has revealed were discussed and its future prospects speculated.

9.4 Molecular biology of the human embryo and its clinical significance



R.G. Edwards, Churchill College, Cambridge, UK

4 December 2000, 4.00 PM, IISc Faculty Hall

Robert G. Edwards is a pioneer in the medically-assisted reproductive technology (MART) responsible for the birth of the first “test-tube” baby, produced by *in vitro* fertilization (IVF) embryo transfer procedure. Edwards elucidated early discoveries made by him and his coworkers, which included successful ovarian hyperstimulation protocols and an understanding of oocyte maturation and early embryo development. In later years, these helped improving IVF/MART techniques. Secondly he described important features of human embryos during preimplantation development and illustrated the occurrence of earliest embryonic differentiation and embryos exhibiting distinct polarities. He pointed out amazing similarities in molecular events during early development between the human and animals such as *C. elegans*, drosophils and xenopus. Edwards stressed the need to develop efficient systems for scoring embryos during development on morphological as well as molecular criteria, in order to assess normality and viability of embryo development, so that implantation rates can be improved markedly. Finally Edwards discussed the latest developments such as stem cell biology and therapeutic cloning and their clinical significance in cell/tissue transplantation medicine. He also mentioned advances made in preimplantation genetic diagnosis and its role in the management of inherited genetic disorders. He emphasized the need to develop molecular approaches in human embryology and to apply them in routine practice of MART to achieve improved pregnancy rates and take-home-baby rates.

9.5 How solids bend and break

James S. Langer, University of California, Santa Barbara, USA

20 October 2000, 4.00 PM, IISc Faculty Hall

Fracture dynamics remains a challenging research topic in engineering, mathematics, and nonequilibrium physics. Despite decades of effort, several fundamental problems remain largely unsolved. Langer suspected that the difficulties stem primarily from lack of an adequate theory of deformation near crack tips, where stresses and strain rates were very large. In an attempt to learn more about the physics of such situations, Michael Falk and Langer have performed molecular dynamics simulations of deformation and failure in a simple, two-dimensional, amorphous system. Langer described those simulations and some unconventional theoretical ideas that were emerging from them.



9.6 Electronic publishing and telecommunications: Impacts on the global science enterprise

Irving A. Lerch, The American Physical Society, USA

19 October 2000, 5.00 PM, NIAS Auditorium

While scientists have exploited the communications potential of the internet since its inception, the globalization of telecommunications has transformed the quality, breadth, immediacy and content of international scientific exchange. This has had a dramatic and far-reaching impact on scientific publication by transforming the science dialog. A spectrum of correspondence has emerged merging refereed reports (email exchanges and eprint servers) with refereed archival reports (paper, electronic distribution, CD ROM). This has accelerated the global dialog and broadened participation in community exchanges— in effect, creating a “collective intelligence”. It has also threatened to divide “haves” from “have-nots” owing to highly variable access costs and telecommunications infrastructures. However, a combinatorial analysis of group productivity as a function of telecommunications costs seems to indicate that this need not be an impediment to international collaborations. In addition, new kinds of scientific collaborations are coalescing around “virtual laboratories” (often referred to as “collaboratories”) whereby access, control, data analyses and communications are available to support widely distributed groups. The use of the



internet for both audio and video real-time and store-and-forward communications has provided some communities with new means for sustaining contact and given rise to ambitious education programmes such as the “virtual universities”. But rapid change has raised large questions as to payment, ownership, track and archival of huge volume of information by whom, proper role of the scientific community and its institutions, obligations of government and the other players, impact on regional and global scientific productivity and the beneficiaries.

9.7 Open archives and search engines”



Alan Gilchrist

Alan Gilchrist, Editor, Journal of Information Science, UK and Stevan Harnad, Department of Electronics and Computer Science, University of Southampton, UK

20 September 2000, 10.00 AM to 12.30 PM, RRI Auditorium



Stevan Harnad

Talks by Alan Gilchrist and Stevan Harnad, were jointly organised by the Academy, Raman Research Institute and the Karnataka Library Association. Harnad spoke about the “open archives initiative” and how it would be the ideal solution for scientists in developing countries for the twin problems of poor visibility caused by predominantly publishing their work in non-mainstream journals and inadequate access to information needed for their research due to escalating prices of journals and dwindling budgets. Gilchrist spoke about the inadequacies of the Internet and the search engines, despite all the hype, and how the traditional classification and cataloguing skills of the librarian could come to the fore once again in the era of knowledge management.

9.8 The strong interactions

Heinrich Leutwyler, Institut fur Theoretische Physik, Universitat Bern, Switzerland

30 August 2000, 5.00 PM, IISc Faculty Hall



Heinrich reviewed the development of our understanding of the forces that hold the constituents of matter together, emphasizing the role of strong interactions. In particular, he discussed the symmetry properties of these interactions and showed how the phenomenon of spontaneous symmetry breakdown manifests itself, both in the observed pattern of particles and in the forces acting between them.

10 MID-YEAR MEETING 2000

The eleventh mid-year meeting was held at the Faculty Hall of the Indian Institute of Science on 14 and 15 July 2000. There were two special lectures, an evening public lecture and 30-min lecture presentations by thirteen fellows and associates recently inducted into the Academy. In what follows, some of these lectures are briefly highlighted.

1. **Special Lecture: Abhijit Sen (Institute for Plasma Research, Gandhinagar)**
Clocks, fireflies and the Landau damping of plasma waves

An assembly of coupled limit cycle oscillators provides a useful mathematical paradigm for the study of collective behaviour in a wide variety of biological, physical and chemical systems. One well-known example is the phenomenon of 'phase-locking' of oscillators, which appears to occur naturally in a large community of 'flashing fireflies'. Other features, such as 'frequency entrainment', i.e. synchronization of oscillators with diverse frequencies to a single common frequency, find useful applications in cardiac pace maker cell collections, coupled chemical oscillations etc. This one-hour talk briefly reviewed the collective properties of coupled limit cycle oscillators and discussed their significance for many-body systems including the phenomenon of Landau damping in plasmas. It then discussed some recent work where the effect of 'time delay' on the collective properties of oscillator systems has been studied. Time delay is ubiquitous in most real systems due to finite propagation times of signals, interaction times of chemicals etc. It is found to have some novel effects on the onset and characteristics of various collective regimes. In particular, the so-called 'amplitude death' regime of oscillators is found to extend even to identical oscillators — a somewhat surprising result that can have interesting practical consequences e.g. in cardiac arrhythmia, tuning of coupled magnetron systems, etc.



2. **Special Lecture: Partha P. Majumder (Indian Statistical Institute, Kolkata)**
Ethnic India: A genomic view

The Indian sub-continent comprises over a billion people who are socially structured into a number of groups, which are largely intra-marrying. The cultural and linguistic diversity among these ethnic groups is enormous. Past studies using blood-group, serum-protein and red-cell enzyme markers have shown that the genetic diversity among ethnic populations of India is comparable to the major global morphological agglomerates,



such as the Caucasoids, Mongoloids, etc. Because of the intrinsic limitations of protein-coding loci, past genetic studies have provided a limited view of the process of peopling of India and the subsequent ethnic structuring of the peoples of India.

The addition of “neutral” DNA markers — autosomal, Y-chromosomal and mitochondrial — to the repertoire of population genetic studies has provided immense opportunities to understand the peopling of India and the structuring of the Indian peoples into ethnic groups. This talk provided results of recent studies on ethnic groups of India using various kinds of DNA markers. These results are then used, in conjunction with pre-historic, historic, linguistic and cultural data, to provide a view of the process of peopling of the Indian sub-continent, including some pre-historical demographic events that are statistically estimable from DNA marker and sequence data. The speaker also contrasted his data on mitochondrial DNA and Y-chromosomal haplotypes to shed some light on the ethnic organization of the people of India subsequent to the arrival of modern humans into India from out-of-Africa about 60,000 – 80,000 years ago.

3. **Evening Public Lecture: K.S. Valdiya (Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore)**
Rising Himalaya: Resurgent Indian shield in South India



The impact of the northward-pushing Peninsular India is manifest in the Himalaya that is being inexorably pressed against the mainland Asia as well as in the southern Indian Shield at the tail end of the mobile landmass. Valdiya spent a significant part of his career working in the Himalayas to study its geology. According to him repeated occurrence of earthquakes, increase in elevation of mountain ranges, reshaping of landforms that betray remarkable youthfulness, deformation of very young sediments and natural blockade of streams and rivers crossed by active faults, among many developments, testify to the neotectonic resurgence of the leading and tail ends of the moving Indian landmass.

4. **Presentations by new Fellows/Associates**

There were twelve 30-minute presentations by newly elected fellows and associates. Ushadevi N. Bhosle (TIFR, Mumbai) spoke on her theoretical work on moduli spaces of bundles on curves and their compactifications. M.K. Ghosh (IISc., Bangalore) spoke on maximum principle and Harnack’s inequality. P.P. Chakrabarti (IIT, Kharagpur) presented a survey of the techniques of heuristic search covering the major search frameworks, fundamental search algorithms and

their properties. Indrani Bose (Bose Institute, Kolkata) spoke of two spin models, viz. the spin ladder model and a frustrated spin model in two dimensions and highlighted the success of these models in explaining new phenomena. S.M. Bhattacharjee (Institute of Physics, Bhubaneswar) showed that a double-stranded DNA can be opened by a force only if the force exceeds a critical value, and this unzipping is a critical phenomenon. The difference between the scaling behaviour of unzipping by force and thermal melting and the hypothesis that long-range critical correlations within the unzipped part drive the highly correlated biochemical functions during replication or transcription. Maneesha S. Inamdar (JNCASR, Bangalore) explained the work of her group to unravel the events during normal blood vessel formation, using the mouse as a model system. Pratima Sinha (Bose Institute, Kolkata) spoke on chromosome transmission during cell division and M. Vairamani (IICT, Hyderabad) on his chiral recognition studies by mass spectrometry. R. Ramaraj (MKU, Madurai) spoke on photoelectrochemistry in micro- and macro-heterogeneous system. In his talk on elephants, agriculture and people, R. Sukumar (IISc., Bangalore) touched upon ecological aspects of crop raiding by elephants, which according to him is partly due to the degree of fragmentation of habitat and partly due to the higher nutritive value of cultivated crops compared to wild forage plants. Sukumar also discussed the lacunae in our understanding of this issue and the implications for managing elephant-human conflicts. Amit Ghosh (IMT, Chandigarh) spoke on emergence of new strains of *vibrio cholerae*: implications for the recombinant oral vaccine strain VA1.3. R. Narasimhan (IISc., Bangalore) spoke on numerical simulations of fracture initiation in ductile materials under dynamic loading and proposed a simple model which enables rationalization of the observed dynamic fracture behaviour of ductile materials. The concluding talk of the mid-year meeting was by T. Radhakrishna (Centre for Earth Science Studies, Trivandrum) on mafic dyke intrusions and the late cretaceous geodynamics along the western continental margin of India.

The mid-year meeting was attended by about 200 fellows and associates from all parts of the country and 17 teachers selected from the Academy database of teachers. The public lectures and special lectures attracted an audience of nearly 250 to 300 in the faculty hall. The full programme is in Annexure 9.



11 GOA ANNUAL MEETING



The National Institute of Oceanography in association with the Goa University invited the Academy to hold its annual meeting in Goa. This invitation was accepted and the meeting, sixty-sixth in the series, was held from 24 to 26 November 2000. The inaugural function as indeed the scientific programme

was held at the Kala Academy, Panaji, Goa and consisted of a welcome address, the traditional introduction of fellows by N. Kumar, the president of the Academy followed by his scientific address. The following is a summary of the scientific programme and other events.



11.1 Presidential address

Cold atoms

N. Kumar, Raman Research Institute, Bangalore



A gas of identical and, therefore, quantum-mechanically indistinguishable atoms is cold in an absolute sense if the de Broglie wavelength for its thermal motion exceeds the mean interatomic spacing. For atoms obeying Bose statistics, the resulting overlapping of waves leads to the Bose-Einstein condensation – with an extensive occupation of the lowest single-particle state. The BEC is a macroscopic-scale quantum phenomenon with several counter-intuitive properties, including superfluidity, well known for long in liquid ^4He – almost exclusively. Recently, this helium-centricity was ended decisively with a series of remarkable experiments culminating in the realization of BEC in the dilute alkali-atomic gases, and some other systems. This required confining a few million atoms in mm-sized traps for a few minutes, and cooling them down to nanokelvins, using magnetic fields and light (laser) beams that involve some of the cleverest techniques and ideas in recent times. This lecture was all about the How and the Why of trapping and cooling of atoms towards BEC. About basic implications and practical applications, e.g. atom lasers. Also, about its probable future. The talk concluded with some observations on the work in this area going on in the country. This was followed by three days of lectures and symposia. The highlights of the scientific programme follow:

11.2 Special Lectures

(a) *Glimpses into the earth's interior from observations of objects in space*

P. M. Mathews, University of Madras, Chennai

Lunar and solar gravitational forces subject the earth constantly to a stretch-and-squeeze action (resulting in solid earth tides), raise ocean tides, give rise to variations in earth's spin and generate torques which cause variations in the earth's orientation in space. Measurements of such effects are made with almost unimaginable precision by means of space geodetic techniques, which variously employ the most distant objects in the universe (quasars), or the moon, or artificial earth satellites, as reference objects. How well can such observations be accounted for, and future behaviour accurately predicted (e.g. for use in space missions), from geophysical theory? What earth parameters play the most influential roles in determining the observed responses to luni-solar forcing? What has been learned about the earth itself by confronting theory with observations? These questions were discussed in the light of recent work in this field, following a broad survey of the phenomena involved and of the methodology of space geodesy. According to Mathews, the present-day space observations give us glimpses of the earth's interior to surprising depths.



(b) *Genetic engineering for developing plants for high soil salinity environment*

S.K. Sopory, International Centre for Genetic Engineering and Biotechnology, New Delhi

One third of world's irrigated land is presently contaminated with high level of salt, and in the coming decades, more land area will become unsuitable for crop agriculture due to high salinity and for want of water. It has therefore been emphasized, time and again, to utilize all available technologies and the gene pool to develop plants that are tolerant or resistant to abiotic stress.

In his lecture, Sopori described the mechanisms leading to an understanding of plant responses to salinity stress, especially the role of calcium and various calcium-binding proteins. Attempts to transfer the potential genes and modulate their expression in transgenic plants to confer tolerance to the otherwise salinity-susceptible plants were described and the work done by his group on two calcium-binding proteins, and over-expression of these proteins by genetic manipulation leading to salt tolerance was presented.



Since abiotic stress leads to changes in many metabolic pathways, Sopory suggested that a basic fundamental knowledge with regard to different mechanisms, in halophytes and in non-halophytes, should be undertaken to modulate metabolism and development for better growth and productivity of crop plants under unsuitable soil and environmental conditions.

11.3 Public Lectures

(a) *The magic in chemistry*



S. Ranganathan, Indian Institute of Chemical Technology, Hyderabad

It was an hour of visual delight to capture the basic excitement in chemistry, as a discipline that profiles the dynamic melody between energy and matter, which played an important role in our atavistic and early evolution. There is still no better way to propagate the message and benefit of science than presenting its manifestations, which project the basic principles. Indeed, when teaching enjoyed a premier place in the dissemination of science, experimental demonstration was always the forum and one could find illustrations of this from the time of Faraday, Raman and our own early development. This art, due to diminishing appreciation, has all but vanished from our classrooms and academic gatherings. A revival would have a positive influence in our understanding, learning and propagation of science and Ranganathan described his talk as a very small step in this direction. The dozen eye-catching demonstrations that he illustrated covered the principles of partitioning on a matrix, heats of reactions, light scattering, Tyndal effect, electron transfer, the change of chemical energy to light energy, smart gels, exothermic reactions, the drop in electron potential to heat and light, principles of chemical explosion, entropically driven enthalpically unfavourable processes, fine dispersions and myth and reality, by displays, respectively, burn without pain, cold fire, electron shuttle, sunset, chemiluminescence, jel shakti, fire with water, sugar on fire, volcano, chemical chill, smog and Bengal fire.

(b) *Butterflies*



Madhav Gadgil, Indian Institute of Science, Bangalore

Butterflies are amongst the most colourful of actors in the drama of co-evolution of flowering plants and insects. In their life cycle they achieve a neat separation of the two forms of interactions amongst plants and insects; hostile in case of larvae with plants evolving chemicals to repel herbivores and mutualistic in case of adults with plants producing nectar to reward them for pollination.

The larvae move little; the relatively short-lived adults a great deal from flower to flower and from host plant to host plant to lay eggs. Butterflies possess colour vision and flowers use colour markings to attract and guide them. Thus equipped, butterflies have evolved broad, colourful wings and a flapping flight to attract mates. But this also attracts predators and butterflies evade them with devices such as fast, erratic flight. Some species of butterflies can tolerate and accumulate toxic compounds produced by plants to discourage herbivores and adults of these species are free of predation by lizards and birds. These unpalatable butterflies possess brightest of colours and a most leisurely flight. They may aggregate in large gatherings, often of several species and undertake long distance migrations. Little studied, the Indian butterflies present a great opportunity to combine solving intellectual puzzles with enjoyment of beauty while exercising in fresh air. Madhav Gadgil illustrated his talk with a number of colourful slides to drive home the point.

11.4 **Microsymposium: Climate, Monsoon and India's water**

Precipitation during the Indian Summer Monsoon is the main source of water for India. Of the total amount of water received annually from precipitation, [400 x 10⁽⁶⁾ m⁽³⁾] the country uses approximately 15% for irrigation and 5% to meet industrial and domestic needs. About 45% flow out to the sea, a large fraction of it to the Bay of Bengal. Without the monsoon, India would be a barren land. The country's dependence on this resource can be gauged from the fact that a small deficit in monsoon precipitation can lead to major adverse impacts on the country's economy. The Indian Summer Monsoon is also an important element of the global climate system. A complex series of interactions between monsoon and the rest of the elements of the climate system determines availability of water in India. This microsymposium provided glimpses of the complex processes that go on in this system. R. Ramesh discussed how the monsoon varied during the last 10,000 years. Historically the monsoons have been a stable (but with considerable interannual variability) feature of the global climate. A concern today is that man-made influences might be disturbing this stability. A. Jayaraman discussed the impact of man-made fine suspended particles in the atmosphere on precipitation. Besides influencing precipitation, the cloud also has an impact on the radiation budget of both the local atmosphere and the ocean. M. Sareen discussed a possible impact of the monsoons on the global climate on geological timescales. It turns out that the weathering of continental rocks in Himalayan rivers fed by monsoon precipitation can remove

atmospheric carbon dioxide. Predicting behaviour of such systems is a risky proposition. Nonetheless, practical considerations today require that predictions be made. In fact, come May, India eagerly awaits the prediction from the India Meteorological Department (IMD) about precipitation expected during June-September (and hence availability of water for the rest of the year). M. Rajeevan described how IMD has been making these predictions since 1988 and he discussed other techniques that have been in use worldwide to make seasonal predictions, and their success rates.

11.5 Lecture presentations by new Fellows/Associates

There were ten 30-minute presentations by new Fellows and Associates spread over the three days. Kulinder Pal singh (TIFR, Mumbai) gave the first talk on *peering into the hearts of galaxies*. Composed of hundreds of billions of stars and swirling masses of gas and dust bound together in different shapes, galaxies are truly majestic objects in the sky. Contained in their hearts or nuclei are perhaps the most powerful engines in the Universe. The knowledge gained from the studies of recent images, spectra, and rapid variations in the light output (X-ray, optical, etc.) from the nuclei of galaxies was dwelt upon and the rich potential of new diagnostic tools in X-rays that are just beginning to become available was highlighted. Santanu Bhattacharya (IISc, Bangalore) spoke on lipids which are molecules that spontaneously form *organized assemblies* in aqueous media. These are fundamental building blocks of biological membranes and the functions carried out by the cell membranes are indispensable for life. A large number of naturally occurring lipids is known and they have a variety of biological roles. However, their isolation in pure form requires their chemical synthesis, which opens up opportunities for their molecular design. Membrane formation from lipid analogues of defined molecular structure provided critical insights about their physical, chemical, and biological properties. The speaker mentioned a number of lipids developed in his laboratory. Somdatta Sinha (CCMB, Hyderabad) in her presentation on collective behaviour in biological systems discussed a few examples from different biological processes using a computational approach. T.K. Chandrashekar (IIT, Kanpur) in his talk on receptors for anions and cations highlighted the receptor properties in solid and solution phases of two expanded porphyrins (sapphyrin and rubyrin). Baldev Raj (IGCAR, Kalpakkam) spoke on his studies concerning probing of microstructures and their evolution by acoustic and magnetic methods. The title of the talk by Shubha Tole (TIFR, Mumbai) was how the brain was

built. The brain, a complex, powerful organ, arises from a simple sheet of embryonic tissue. In the past ten years, exciting findings have emerged about the development of brain from the earliest stages of the embryo. She began by describing the challenge faced by the embryo and summarized her findings that reveal some molecular players involved in this process. She then focussed on the development of cerebral cortex, the brain structure that is responsible for our highest cognitive and perceptual functions and finally, the ongoing work in her laboratory, and the attempt to place this within a broader framework of the directions of neuroscience research over the coming years. In his lecture on cluster explosion dynamics in intense laser fields, M. Krishnamurthy (TIFR, Mumbai) brought out the theoretical challenges in understanding the dynamics of the nanoplasma evolution and from an application viewpoint the new possibilities to physical sciences like table top accelerators, table top nuclear fusion studies, pulsed X-ray generation, etc. He presented experiments recently initiated at TIFR and discussed the first results. G. Krishnamoorthy (also of TIFR, Mumbai) spoke on fluorescence dynamics in biology. One of the challenges in biology is to explain the function of complex systems observed in the timescale of milliseconds to hours from the dynamics the systems undergo in the shorter timescales of femtosecond-millisecond. Time-domain fluorescence is an ideal method for studying the dynamics. The fluorescence methods for studying various aspects with emphasis on correlation between dynamics and function were highlighted in this talk. The last talk was by Ram Seshadri (IISc, Bangalore) on carbonate mineralization and biognostic routes to new materials. Mineralization processes in natural systems are complex and fascinating. Living systems display a remarkable tendency to precipitate minerals from solution with exquisite control over the phase, size and shape of crystals and their modes of aggregation. While determining how these are achieved is important from the viewpoint of developmental processes in biology, there is also the imperative to understand how Nature manages to prepare high-performance materials from rather mundane crystalline phases such as calcium carbonate and that too under near-ambient conditions of temperature and pressure. Concentrating on the key role played by thin organic layers in natural mineralization processes, attempts were made to crystallize minerals on organic monolayers self-assembled on suitable metal or oxide substrates. Seshadri reviewed the work of his group in this area, and touched upon the use of natural biomineral forms as templates,





and their recent efforts to prepare macroporous materials using *biognostic* approaches.

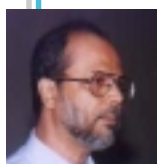
There was a 90-minute panel discussion on the exciting new Human Genome Project. The panelists included H. Sharat Chandra (IISc, Bangalore), Usha VijayRaghavan (IISc, Bangalore), J. Gowrishankar (CCMB, Hyderabad) and M. Vijayan (IISc, Bangalore).



E. Desa

On the last day, the participants were treated to a visit to the 17th century Basilica of Bom Jesus and a boat cruise towards Panaji with live entertainment of folk music and dance.

The Goa meeting was one of the best organized in recent times, the credit for which should entirely go to E. Desa, Satish Shetye and his colleagues at NIO. The Vice-Chancellor of University of Goa B.S. Sonde and his colleagues also helped in the organizational arrangements. About 180 Fellows attended the meeting from outside Goa and with Associates, invited teachers, spouses etc the number of attendees from outside Goa crossed 300. The full programme is in Annexure 10.



Satish Shetye

12 SCIENCE EDUCATION PROGRAMME

Four main activities are being carried out as part of the efforts to contribute to the improvement of science education in the country. These are (a) summer fellowships (b) participation of teachers in meetings (c) refresher course for teachers (d) lecture series for student/teachers.

12.1 Summer fellowships

Summer Fellowships are awarded to bright students and motivated teachers to work with Fellows of the Academy on research-oriented projects. During the summer of 2000, 69 students and 10 teachers were awarded two-month fellowships to work with Fellows at different parts of the country.

12.2 Participation of teachers in Academy meetings

Over the years, with the help of its Fellowship, the Academy has built up a database of teachers from colleges and universities all over the country. Up to about 30 teachers are invited to participate, as guests of the Academy, in its mid-year (July) and annual (October–November) meetings. This provides opportunities to teachers to attend scientific programmes, as well as to meet and interact with Fellows. At the two

meetings held in 2000, 71 teachers attended the lectures, at the end of which an interaction session was held at which teachers were invited to present their views and the problems they faced in their teaching work.



12.3 Refresher courses for teachers

This is an important programme to help motivated teachers improve their background knowledge and teaching skills. The duration is two weeks and approximately 30 teachers selected from all over the country undergo a rigorous course of lectures, discussions and problem-solving sessions. During the year, three refresher courses were held and the following is a summary of these meetings.

(a) Refresher course in animal sciences

Karnatak University, Dharwad, 1–15 June 2000

No. of participants: 17

Resource persons: S.K. Saidapur, R. Gadagkar, H.A. Ranganath, K. Muralidhar, Amitabh Joshi



Inaugurating the course, R. Gadagkar described the various Academy programmes to promote science education in the country and stressed the need for interaction between universities and national research institutes. A series of lectures and laboratory sessions were held from 1–15 June 2000. The lectures were delivered in various frontier areas of biology such as behavioural ecology, chronobiology, evolutionary biology, endocrinology and modern genetics. The laboratory exercises on ELISA of steroid hormones, induced breeding in frog, study of development stages in frog using live material, *Drosophila* morphology, preparation of slides of polytene chromosomes, identification of mutants in *Drosophila*, enzyme histochemistry of steroid dehydrogenases, and some surgical techniques in rat were conducted. A discussion session was held during which various issues such as decline in the number of students to UG courses in colleges, and modernizing the teaching programme were considered. The participants were appraised about applying for research projects to various R&D agencies. The general response of the teachers to the course was very good. The course was concluded by a talk by S.K. Saidapur on Biology in the 21st century.

(b) Winter school on modern biology

Indian Institute of Chemical Biology, Kolkata, 6–17 November 2000

No. of participants: 38

Resource persons: Chitra Dutta, Rukhsana Chowdhury, Samir Bhattacharya

This refresher course on modern biology was held to acquaint college and university teachers with developments in modern life sciences. Four lectures each of 90-minute duration were held every day on two different topics. The lectures included formal teaching and interactive discussions. The topics covered included (a) general concepts (b) immunology (c) gene expression (d) genome research (e) membrane (f) proteomics (g) carbohydrates (h) recombinant DNA, and (i) cell signalling. The course was rated highly by all participants and its content considered informative covering many important areas of modern biology. The quality of teaching was highly appreciated and the resource persons were happy with the level of interaction and enthusiasm of the participants. It was felt that refresher courses in life sciences should be arranged more frequently.

(c) Refresher course in theoretical physics

Bishop Moore College, Mavelikara, 6–18 November 2000



No. of participants: 25

Resource persons: N. Mukunda, S. Chaturvedi, R. Simon, R. Jagannathan and J. Sethuraman

This course was held at a quiet farming resort at a place near Adoor in Kerala and was attended by 25 teachers from all over India. An equal number of local students

and teachers also attended.

The topics covered in the course included (a) thermodynamics and statistical physics (b) mathematical methods in physics (c) quantum mechanics and (d) physics of waves. Three hours were devoted each day to formal lectures in the morning session and to problem-solving sessions in the afternoon.

The limitation of only 4 speakers, each giving 9 hours of lectures on a chosen topic with equal time used for problem sessions, was academically a good success. The seriousness of the entire effort was appreciated by the participants.

The overall impression among participants was that this course was very useful and

much better than the ones conducted by UGC and Academic Staff Colleges. The lectures were considered excellent and the duration just adequate. The discussion sessions were quite useful so much so that some felt that more time should have been made available for discussions. A few felt that detailed syllabus, lecture notes and problem sets should be made available well in advance to help teachers to study and come prepared with doubts and clarifications. The venue of the course and the serene ambience were appreciated by all participants and it was felt that such courses should be organized at more regular intervals.

The Science Education Panel of the Academy plans more courses in the coming months working with colleges in subject areas of mutual interest. The experience indicates that there is a real need for such refresher courses organized and run in short-duration lecture programmes.

12.4 *Lecture series for students/teachers*

Academy arranges two or three-day lecture programmes on carefully chosen topics at selected college and university departments for the benefit of local students and teachers. Speakers include Fellows and others from nearby institutions.

During the year, the following lecture series was arranged:

(a) *Current trends in chemistry*

University of Delhi, Delhi, 3–4 November 2000

Speakers: N. Sathyamurthy, R.N. Mukherjee, B.M. Deb and Pushpa Bajaj

The topics covered include (a) elementary chemical reactions (b) inorganic chemistry – the biological perspective (c) production of acrylic fibres (d) bonding, structure and interaction (BONSAI !!)

In addition to the above programme, M.A. Viswamitra of IISc, Bangalore delivered two lectures under the auspices of the Academy at the summer project programme for class XI to III year B.Sc. students in the physics department of University of Pune on 10/11 May 2000. The topic of the two lectures was on crystallography (its method and applications to biological molecules) and on drug design.

13 ACADEMY FINANCES

Prudent management of the available resources, increased assistance from the Department of Science and Technology and the support received from the Ministry of Human Resource Development, New Delhi for publication of *Resonance* all helped in ending the year on a satisfactory note despite a raise in expenditure both under Plan and Non-Plan. Printing of publications and postage constituted 45% of the expenditure under Non-Plan and 29% on staff salaries and the remaining 26% on administrative expenses. Under Plan, thanks to DST, the activities of science education panel, the discussion meetings and annual meetings are being carried on satisfactorily. Savings from Plan are being used for the construction of a small building to provide accommodation for fellows, summer students etc at the Academy land near HMT.

14 ACKNOWLEDGEMENTS

The Academy's publication activities are possible because of the honorary 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 and conducting programmes on science education, etc. The Department of Science and Technology has made available generous financial assistance under Plan and Non-Plan budget of the Academy. They and other funding agencies such as the Ministry of Human Resource Development have greatly contributed to the activities undertaken by the Academy. The local organizing committee at Goa University, Goa and the Academy staff in Bangalore have ensured a large participation at the scientific meetings of the Academy.