



# Patilka

January 1983 No.5 Newsletter of the Indian Academy of Sciences

## 48th Annual Meeting of the Academy

At the invitation of the Kumaun University, the Academy held its 48th Annual Meeting at Chalet Hall, Nainital from Saturday 9 to Monday 11 October, 1982.

The Meeting started with an inaugural function on the morning of Saturday 9 October. After a brief welcome address by Dr. S N Srivastava, Vice Chancellor of the Kumaun University, Dr. S Varadarajan introduced to the audience the two Raman Professors, Prof. K R Ramanathan and Prof. George Series, and then the Fellows present. In his Presidential address, he spoke of the "New World of Polymers", drawing attention to the exciting new developments taking place in the field of polymers and the scientific challenges in the study of the structure and properties of these materials. He also referred to the possibility of producing polymers from cellulose waste and renewable biomass.

There were two short specialised symposia and six lecture presentations by new Fellows.

The first symposium on the **Ecology of the Himalaya Mountain** was held on the afternoon of October 9, 1982. The first speaker Prof. S. L. Shah discussed the biotic pressure and ecological security in the Himalayan region. The present per capita land availability is merely 0.16 hectare, which will be reduced by the increase in population to 0.05 hectare by 2031. Even steeply sloping marginal lands and forested areas are now cultivated due to the pressure on land and against the need of 2 hectares of grazing land per unit cattle, only 0.5 hectare is available, even which will fall to its threshold value by 1986. The depletion of the forest stock will reach its threshold value by 2031. Prof. Shah suggested that the civil and pasture lands owned by the community (30 per

cent of the total land area) should be brought under plantation for fuel and fodder. The 0.55 tonne per capita per year requirement of fuel can be met by 52 per cent of these lands by 1991.

Dr. J S Singh dealt with Forest Ecosystems of Kumaun Himalaya. He gave an overview on information gathered on the structure and function of forest ecosystems. The forest area is distressingly small, as little as 2% of the geographical area being under a forest with a greater than 60% canopy cover and the regeneration of broadleaf species, particularly *Quercus leucotrichophora*, being alarmingly low. A multi-layered broadleaf forest would seem to be more suitable for maintaining catchments in healthy condition compared to single layered needleleaf forests. The broadleaf species also decompose much faster than the needleleaf species. Studies on germination, seedling growth, phenology, and bryocology are in progress and have yielded interesting results.

Prof. B P Ghildiyal spoke on Degradation and Conservation of Soil in the Central Sector in the Himalaya and first dealt with the population pressure and land resource degradation in the Himalaya. He discussed the mechanics of soil erosion and principles of land husbandry, and demonstrated the impact of improper land use in the Ramganga catchment, causing silting of the reservoir and drastic reduction in its life.

Projecting a fleeting glimpse of the fascinating flora of the western sectors of the Himalaya, Dr M A Rau dealt with the forest types including the *Pinus roxburghii* at lower levels, the mixed oak-rhododendron of the intermediate heights and the firs, spruces, blue pines and deodars of the higher altitude. Dr. Rau regretted the indiscriminate cutting down of trees of pine, white oak and rhododendron in eastern Kumaun.

Describing briefly the mineral resources of the Himalayan region Prof. R C Misra referred to the unscrupulous mining activities which have led to deforestation, soil erosion and landslides and disturbances in the cultural homogeneity of the inhabitants. In the

Mussoorie hills indiscriminate quarrying of limestone and strip mining of phosphate are being carried out and the limekilns and crushers in the Dun valley have added to the pollution of water and air.

Prof. K S Valdiya pointed out the several high-seismicity areas in the Himalayan chain and the geodynamic sensitivity of the boundary thrusts that separate the inhabited lesser Himalayan terrain from the Siwalik to the south and the Great Himalaya in the north. In these thrust zones erosion has assumed very serious proportions. On the whole, the rate of erosion in the catchment of the Himalayan rivers has increased five times since the geological past. This accelerated erosion has led to fast silting of reservoirs and repeated and damaging flooding of the plains. The construction of roads in the Himalayan region generated 44,000 million tons of debris. The recurrent landslides and rockfalls on these roads produce, (at the rate of 550 m<sup>3</sup> per kilometre of road per year), about 24 million cubic metres of debris annually, which slide down the slopes, killing vegetation and clogging the mountain streams and canals. Stripped of the protective vegetal cover, the Himalayan soils are fast losing their capacity of absorbing rain waters, so that on the one hand springs in the hills are drying up and water resources are dwindling, while on the other hand the plains are ravaged by recurrent damaging floods.

The evening lecture on the 9th October was by Dr. A P Mitra who spoke on the **Science of the Middle Atmosphere**. He spoke of this relatively thin region in the atmosphere bounded by the tropopause (10-15 km) and the mesopause (85 km) neglected in the past, since neither radio nor meteorological techniques could be used to study this region. He discussed the new tools such as high resolution spectroscopy now used to study atmospheric constituents at high levels and new techniques using sodar, MST radars, lidar and microwave radiometers to study its structure. There is further new interest in the middle atmosphere as a possible source of an explanation for sun-earth relationships. He stressed the importance of a study of atmospheric ozone and the possible causes for its depletion and likely dangerous consequences.

The second specialized symposium on **Polymer Science and Engineering** was held on the afternoon of Sunday 10 October. Polymer science and engineering is an emerging discipline of study in this country and holds considerable promise in delivering new synthetic materials for varied applications and towards conservation of scarce natural resources. These synthetic materials though derived from petroleum, are more cost-effective than metals, especially on volume basis, consume less energy during their fabrication and offer considerable versatility in

its ability to be shaped into intricate forms. The lectures presented during the symposium highlighted the science and engineering behind the design, synthesis, production and application of polymeric materials and brought to the forefront the interplay of varied disciplines such as chemistry, catalysis, thermodynamics, principles of fluid flow, chemical engineering, process modelling and simulation.

The opening talk of the symposium, provocatively titled, **Whither Polymer Engineering?** was delivered by Dr. R A Mashelkar of the National Chemical Laboratory, Pune. He stressed the significance of polymer engineering in transforming synthesized polymers into useful materials. The implications of the non-Newtonian behaviour of polymeric fluids to the area of polymer processing and its application to phenomena such as drag reduction was pointed out. Dr. Mashelkar briefly alluded to the research being pursued in these areas at NCL, Pune. However, he felt that far more attention deserved to be paid to the area of polymer engineering, if new polymers were to move away from being mere laboratory curiosities to become useful materials with well-defined applications.

The lecture by Dr. S Sivaram of Indian Petrochemicals Corporation Limited, Baroda, was titled Recent Advances in Polymerization of Ethylene and Propylene and dealt with some of the dramatic new developments in the technology of manufacturing poly-ethylene and poly-propylene using Ziegler-Natta catalysts. Catalysts with activities orders of magnitude larger than ones hitherto available have simplified process steps and led to lower production costs. The scientific rationale behind these new developments were examined. Some recent understanding in the mechanism of stereospecific propylene polymerization based on an intricate knowledge of the structure of polypropylene using <sup>13</sup>C NMR was highlighted. Evidences leading to the conclusion that chiral transition metal centres are responsible for isospecific propagation were presented.

Dr. V Nadkarni of the National Chemical Laboratory, Pune presented a talk titled Polymer Alloys: Science and Practice. Polymer-polymer blends are becoming increasingly commercially important. Dr. Nadkarni emphasized the fundamental scientific principles of polymer miscibility and structural compatibility and illustrated how one may *a priori* design newer alloy systems. Examples of commercial polymer alloys and the rationale behind their formation were discussed.

The talk by Dr. S K Gupta of the Indian Institute of Technology, Kanpur, was titled Simulation and Optimization of Polyethylene-terephthalate Reactors. Knowledge of the

detailed kinetics of individual reactions occurring during polymerization enables modelling of a polymerization process. Using such models it is possible to simulate and optimize commercial polymerization reactors, leading to enhanced production, minimized by-product formation and better product quality. Dr. Gupta illustrated how the various reactions leading to the formation of polyethylene terephthalate could be modelled and based on which performance of commercial reactors could be predicted. The power of this tool in achieving optimum performance of commercial reactors was clearly brought out by Dr. Gupta's lecture.

The evening lecture on the 10th October was given by Dr. H K Jain, Director of the Indian Agricultural Research Institute, New Delhi, on **Scientific transformation of India's agriculture: The second phase.** He spoke of the dramatic developments in agriculture in India since the 1960's, when the major emphasis placed by Government on the creation of high genetic potentials for crop yields and the expression of these potentials on farmers' fields, with the application of such industrial inputs as chemical fertilizers, pesticides and improved farm tools, in addition to large scale provision of irrigation, led to a manifold increase in production of not only wheat and rice but maize, sorghum, millet, pulses, oilseeds and cotton. A major reorganization and strengthening of agricultural research has provided India with one of the world's largest network of federal agricultural research institutes and State agricultural universities, resulting in the organization of high yielding varieties programmes as the main instrument of India's strategy for increasing agricultural production. The chemical fertilizer industry has grown so fast that India is now the fourth largest producer and consumer of fertilizer nitrogen in the world. India has also today the second largest area in the world provided with irrigation water. He concluded by warning scientists, planners and farmers against complacency and stressing the need for new planning policies for the future leading to higher growth rates of yields of major food crops than in the past and for evolving new management policies and management infrastructures to provide a network of agroservices to farmers.

There were a series of six lecture presentations by new Fellows. Dr. M N Rao spoke on The origin of our solar systems: early events, time scales and their consequences. Dr. Sushil Kumar presented his work on functions of cyclic 3', 5' adenosine monophosphate and receptor protein complex in *Escherichia coli*, while Dr. S Rajappa spoke on The scope for novel synthetic chemistry in drug research.

Dr. C L Mehta spoke on Light fluctuations and their applications. Dr. B A Dasannacharya

on Neutron scattering studies on disordered materials and Dr. T V Ramakrishnan on From liquid to solid.

On the afternoon of the 11th there was an interesting display of rock climbing by young school students, in one of the most beautiful natural amphitheatres in Kumaun Himalaya. In the evening a visit was organised to the U P State Observatory at Manora Peak.

A day long environmental excursion conducted by Prof. K S Valdiya on October 12 along the route Nainital-Manora-Bhavali-Gagar-Bhimtal-Naukuchiatal showed the delegates the nature and extent of environmental deterioration – the pollution of the lakes, the instability of hillsides and landsliding and mass wasting, the penetration of pine forests in the oak forests, the shrinkage of forest canopy, signs of desertification, drying-up of springs and dwindling of water in streams; and the problems of fuel and fodder.

The 48th Annual Meeting was the best attended of all Annual Meetings, despite the remoteness of the location and the difficulties of travel to Nainital. Excellent arrangements were made for travel from Delhi to Nainital and back.

The Academy is grateful to the Kumaun University and to the Local Organising Committee especially to Dr. K S Valdiya and his enthusiastic band of volunteers for the excellent organisation of the annual meeting. Despite the almost insurmountable difficulties in organising such a Meeting in such a small town like Nainital, the 48th Annual Meeting will remain one of the most enjoyable in one's memory.

The group photograph taken during the meeting is reproduced on pages 6 and 7.

# Council for the triennium 1983-85

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The outgoing Council held an election in December 1982 to constitute the Council for the next triennium 1983-85. The composition of the new Council is as follows.

**S Ramaseshan**, Indian Institute of Science, Bangalore President

**S Varadarajan**, Department of Science and Technology, New Delhi Past President

**V S Arunachalam**, Ministry of Defence, New Delhi

**S Dhawan**, Department of Space, Bangalore

**M Gadgil**, Indian Institute of Science, Bangalore

**C K Majumdar**, Indian Association for the Cultivation of Science, Calcutta

**M G K Menon**, Planning Commission, New Delhi

**A P Mitra**, National Physical Laboratory, New Delhi

**H Y Mohan Ram**, University of Delhi, Delhi

**B Nag**, Jadavpur University, Calcutta Vice President

**R Narasimha**, Indian Institute of Science, Bangalore

**V Radhakrishnan**, Raman Research Institute, Bangalore

**M S Raghunathan**, Tata Institute of Fundamental Research, Bombay

**C N R Rao**, Indian Institute of Science, Bangalore Vice President

**O Siddiqi**, Tata Institute of Fundamental Research, Bombay Vice President

**B V Sreekantan**, Tata Institute of Fundamental Research, Bombay.

**C V Subramanian**, University Botany Laboratory, Madras Vice President

**K S Valdiya**, Kumaun University, Nainital

**M S Valiathan**, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum

**G Venkataraman**, Reactor Research Centre, Kalpakkam

## Fellows elected in 1982

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**D S Bhakuni**, Central Drug Research Institute, Lucknow, for his contributions in natural products chemistry and alkaloid biosynthesis.

**M K Chandrashekar**, School of Biological Sciences, Kamaraj University, Madurai, for his outstanding contributions on chronobiology with special reference to biological rhythms.

**R Cowsik**, Tata Institute of Fundamental Research, Bombay, for his contributions in the

areas of cosmic ray physics and high energy astrophysics.

**K Gopalan**, Physical Research Laboratory, Ahmedabad, for his work on the solidification age of individual group of meteorites and development of techniques for the study of noble gas systematics in meteorites and lunar samples.

**M M Johri**, Tata Institute of Fundamental Research, Bombay, for his contributions to our understanding of plant cell differentiation.

**N Kumar**, Department of Physics, Indian Institute of Science, Bangalore, for his outstanding contributions in theoretical solid state physics.

**R A Mashekar**, National Chemical Laboratory, Pune, for his contributions in polymer science and engineering.

**K B Misra**, Electrical Engineering Department, Indian Institute of Technology, Kharagpur, for his outstanding contributions in the area of reliability engineering.

**K Naha**, Department of Geology and Geophysics, Indian Institute of Technology, Kharagpur, for his pioneering studies on the sedimentation and palaeogeography in the metamorphosed Precambrian terrain of eastern Singhbhum.

**N S Narasimhan**, Department of Chemistry, Poona University, Pune, for his fundamental and extensive contributions in lithiation reaction and synthesis of a variety of natural products.

**G Rajasekharan**, Department of Theoretical Physics, University of Madras, Madras, for his important and original contributions to high energy physics including discovery of shadow poles.

**K J Rao**, Solid State and Structural Chemistry Unit, Indian Institute of Science, Bangalore, for his contributions in the area of physical chemistry including structure and spectroscopy of glasses.

**P R Roy**, Radiometallurgy Division, Bhabha Atomic Research Centre, Bombay, for his contributions to the development of plutonium metallurgy.

**S M Roy**, Tata Institute of Fundamental Research, Bombay, for his work in the field of strong interactions physics.

**S K Sinha**, Department of Plant Physiology, Indian Agricultural Research Institute, New Delhi, for his significant contributions to amino acid biosynthesis in higher plants.

**P N Tandon**, Department of Neurosurgery, All India Institute of Medical Sciences, New Delhi, for his original contributions in the field of neurosurgery.

**M Vijayan**, Molecular Biophysics Unit, Indian Institute of Science, Bangalore, for his contributions in X-ray analysis of crystalline complexes involving components of biopolymers and other biomolecules.

**N H Wadia**, Jaslok Hospital and J.J. Group Hospitals, Bombay, for his original contributions to neurology.

# Foundation Fellows

On the roll of the Academy



**Ayyar, V Ramanatha**  
 Born : 1892  
 Elected : 1935  
 Specialisation : Plant Breeding



**Bhagavantam, S**  
 Born : 1909  
 Elected : 1934  
 Specialisation : Solid State and Crystal Physics



**Chandrasekhar, S**  
 Born : 1910  
 Elected : 1934  
 Specialisation : Theoretical Astrophysics and Relativity



**Dasgupta, S N**  
 Born : 1902  
 Elected : 1935  
 Specialisation : Mycology and Plant Pathology



**Doss, K S G**  
 Born : 1906  
 Elected : 1935  
 Specialisation : Physical Chemistry, Sugar Technology and Electrochemistry



**Ganesan, A S**  
 Born : 1900  
 Elected : 1934  
 Specialisation : Spectroscopy



**Janaki Ammal, E K**  
 Born : 1897  
 Elected : 1935  
 Specialisation : Ethnobotany, Cytology and Cytogenetics



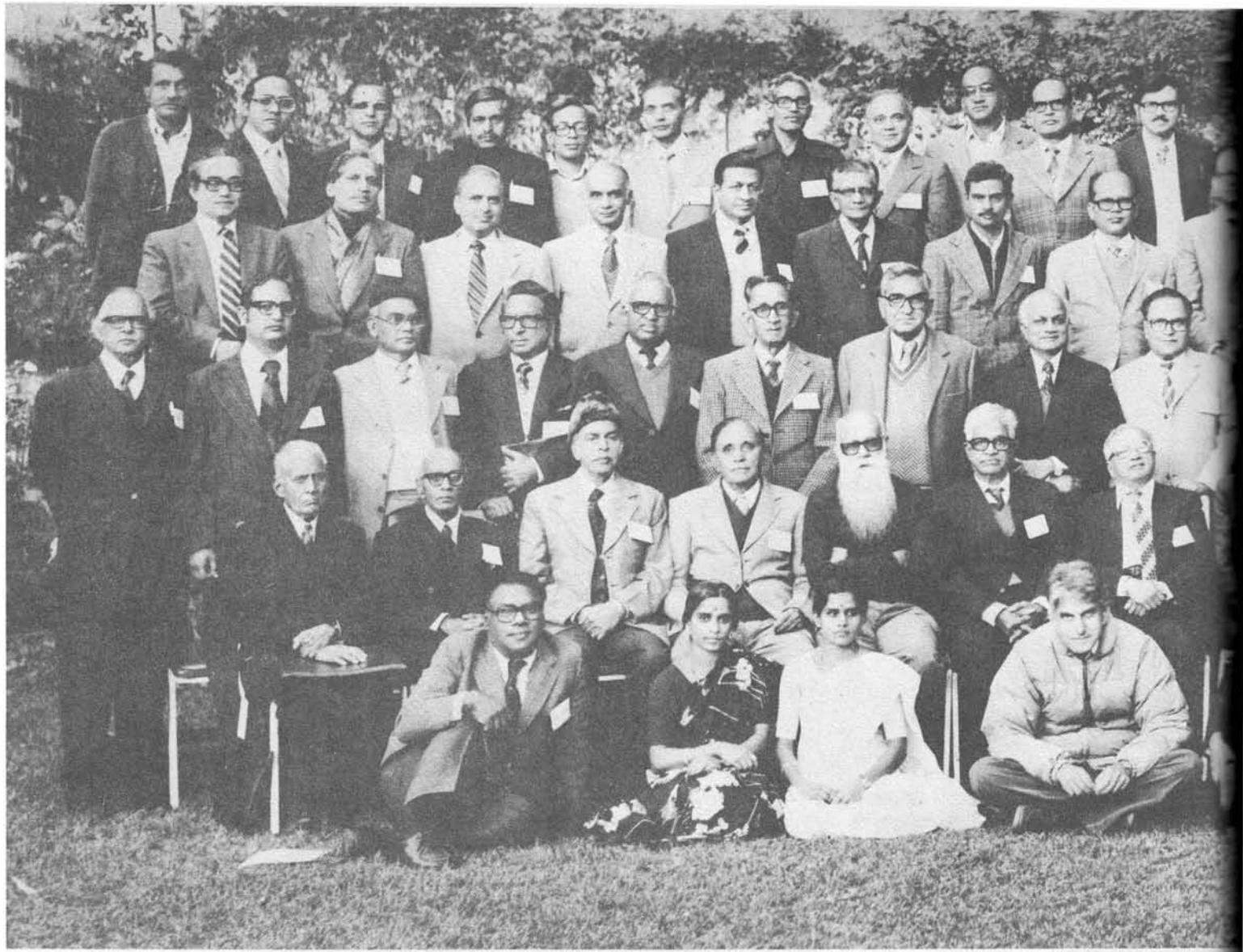
**Krishnamurti, K**  
 Born : 1902  
 Elected : 1934  
 Specialisation : Physical Chemistry, Colloid Science and Surface Films



**Madhava, K B**  
 Born : 1895  
 Elected : 1934  
 Specialisation : Statistics and Actuarial Science



**Mahajani, G S**  
 Born : 1898  
 Elected : 1935  
 Specialisation : Higher Dynamics, Ferro-Magnetism and Hydrodynamics



## Participants at the 48th Annual Meeting of the Academy, Nainital

(L to R)

- Top row V Radhakrishnan; S Sivaram; T N Ananthakrishnan; N V Madhusudana; K R Parthasarathy; B N Bhargava; S Rajappa; R Chidambaram; C V Vishveshwara; B S N Rao; G Madhavan; C J Saldanha; M K Chandrashekar
- Second row K K G Menon; S S Kapoor; S S Jha; T Ramakrishnan; D V S Jain; C C Patel; S M Deshpande; T Pradhan; J C Bhattacharyya; K S Valdiya; A P Mitra
- Third row S Y Padmanabhan; Virendra Singh; G K Manna; N Balakrishnan Nair; S Sriramachari; V Puri; F Ahmad; i S Narayanaswamy; U N Singh; V Jagannathan; R Ananthakrishnan; P K Das
- Fourth row S Paramasivan; P R Krishna Rao; Jagdish Shankar; M R A Rao; D K Banerjee; S Rangaswami; S C Sheth; S
- Fifth row C N R Rao; R Shyamala; B Meera; O Siddiqi; B K Nayar; P R Pisharoty; D D Awasthi; B K Bachhawat; S f



S Goel; T V Ramakrishnan; K L Chopra; V Nadkarni; S K Gupta; M V George; R A Mashelkar; K Nagarajan;  
B A Dasannacharya; N S Sathya Murthy; S P Pandya; M V Bhatt; C R Narayanan; U R Ghatak; Y S Murty;  
S K Trehan; C S Vaidyanathan; N Appaji Rao; NK Notani; B B Biswas ; Sushil Kumar; N R Moudgal;  
R Ramanathan; M S Narasimhan; R J Hans-Gill; Anna Mani; P C Vaidya; Sukh Dev; T R Govindachari



**Narlikar, V V**  
 Born : 1908  
 Elected : 1935  
 Specialisation : General Relativity and  
 Field Theories



**Patel, J S**  
 Born : 1905  
 Elected : 1934  
 Specialisation : Plant Breeding and  
 Agronomy



**Ramaswamy, S**  
 Born : 1907  
 Elected : 1935  
 Specialisation : X-rays and Solid State  
 Physics



**Ramiah, K**  
 Born : 1892  
 Elected : 1934  
 Specialisation : Agronomy and Plan:  
 Genetics



**Rao, S Ramachandra**  
 Born : 1899  
 Elected : 1934  
 Specialisation : Magnetism



**Sahni, M R**  
 Born : 1899  
 Elected : 1934  
 Specialisation : Palaeontology



**Siddiqi, M R**  
 Born : 1908  
 Elected : 1934  
 Specialisation : Mathematics and  
 Mathematical Physics



**Singh, B N**  
 Born : 1898  
 Elected : 1934  
 Specialisation : Plant Physiology,  
 Agricultural Botany,  
 Agronomy  
 and Agriculture



**Tawde, N R**  
 Born : 1898  
 Elected : 1934  
 Specialisation : Spectroscopy, Optics  
 and Chemical Physics



**Ramanathan, K R**  
 Born : 1893  
 Elected : 1934  
 Specialisation : Meteorology,  
 Hydrology, Physics of  
 the Upper  
 Atmospheres,  
 Geophysics and  
 Sun-Earth Relationsh :

**Desai, S V**  
 Born : 1900  
 Elected : 1935  
 Specialisation : Biochemistry  
 and Microbiology

**Joshi, S S**  
 Born : 1898  
 Elected : 1934  
 Specialisation : Physical and Inorgan:  
 Chemistry, Reactors  
 under Electric Dischar

# Discussion meeting on Non Debye relaxation in condensed matter

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The discussion meeting, sponsored by the Academy, the Indian Institute of Science and the Raman Research Institute, was held during September 14–17, 1982.

The meeting was aimed at focussing attention on a pattern of behaviour common to very different classes of systems. For example, dielectric relaxation in supercooled liquids, plastic crystals and glasses, spin relaxation in spin glasses, charge transport in amorphous semiconductors, stress relaxation in glasses, volume relaxation in polymers all seem to exhibit very similar features. The relaxation spectra are broad, and are not described by a single relaxation time (hence the name Non Debye). The time scales extend over several orders of magnitude; these glassy systems are relaxing on *all* time scales. In the last few years, due to the work of Jonscher and of Ngai, it appears that a single simple phenomenological form fits a great variety of data and relates different properties of a particular system. The form implies nonexponential relaxation, and is connected with the poorly known nature of low energy excitations in glassy systems. The field thus seemed ripe for a meeting where specialists detail the evidence, common patterns and differences are discussed, models analyzed, and possible directions for experimental and theoretical research indicated.

The meeting began with an overview 'Evidences for universal behaviour of condensed matter at low frequencies/long times' by K L Ngai of the Naval Research Laboratory, Washington, D.C. He reviewed his ideas on Non Debye relaxation and described in detail their recent successful application to polymers and amorphous semi conductors. N Kumar of the Indian Institute of Science, Bangalore reviewed the theoretical ideas. It was clear that none did much justice to reality.

The meeting then moved on to specific areas; Mr. B Purniah of the Reactor Research Centre, Kalpakkam, reviewed results on internal friction in metallic glasses and other disordered systems. Dr. A K Raychaudhuri of I.I.Sc., Bangalore, described and analyzed the extraordinary richness of behaviour implied in a single slide showing how ultrasonic attenuation in vitreous quartz varies with a very broad range of temperature (from  $10^3$  °K to

$10^{-1}$  °K). Relaxation in glasses was one of the major themes of the meeting. Dr. A Mansingh of Delhi University, reviewed dielectric relaxation in glasses, and Dr. K L Narasimhan of TIFR, Bombay discussed AC conductivity of amorphous semiconductors. Dr. B A Dasannacharya of BARC, Bombay described the information obtained on excitations in metallic glasses and other disordered systems by inelastic neutron scattering.

The idea that in spin glasses, dynamics holds the key to even the static behaviour was lucidly discussed by Dr. D Kumar of Roorkee University and by Dr. C Dasgupta of the University of Minnesota. Computer simulation of model systems, the large number of ground states, their mutual accessibility and consequent nonergodic behaviour were described and compared to the behaviour of real spin glasses. One of the interesting comparisons not made was between spin glasses and glasses.

Several examples of NMR studies of disordered systems, particularly of superionic conductors, were described by Dr. S V Bhat of I.I.Sc., Bangalore and clearly indicate Non Debye behaviour. Dr. Kanwar Krishan and Dr. G Ananthakrishna of RRC, Kalpakkam focussed attention on the kinetics of formation, coalescence and growth of voids in irradiated metals. The kinetics of spinodal decomposition was summarized by Dr. M K Phani of TIFR, Bombay; Dr. N V Madhusudana of RRI, Bangalore described some results on the dynamics of liquid crystals.

Dr. C K Majumdar of IACS, discussed his pioneering work on stress relaxation of glasses as arising from size dependent diffusive relaxation of domains with a distribution of sizes. The observed non-exponential relaxation is thus due to a distribution of relaxation times. This kind of approach was one of the running theoretical themes of the meeting. Dr. D Dhar of TIFR, Bombay suggested, for instance, that the lowest energy (spatially largest) localized eigenmodes of a disordered system determine its long time relaxation behaviour. Dr. S Dattagupta of Hyderabad University and Dr. V Balakrishnan of I.I.T., Madras also presented models where Non Debye response emerges from a microscopic model due to a distribution of relaxation times. A question not sufficiently discussed was whether there could be intrinsically nonexponential relaxation mechanisms having to do with disorder.

The meeting probably succeeded in the aim of consciousness raising; it is to be seen whether significant new research will emerge out of this enhanced awareness.

# Proceedings – Engineering Sciences

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## Report by the editors

The Academy took a historic decision in 1977, when it approved the publication of a new section of its Proceedings devoted to Engineering Sciences. This decision was a recognition of the importance of science and engineering to each other and of the interest that developments in engineering hold not only to technologists but to scientists in general as well.

The Academy has always believed that the publication of the results of scientific research in India is an integral part of promoting science in the country. The publication of the *Proceedings* in Engineering Sciences was thus a further affirmation of this belief, but there were other reasons why a special kind of journal in engineering sciences was felt by many Fellows to be long overdue in the country. This feeling led to the formulation of a rather unusual editorial policy, which has guided the journal since its birth and shaped its emerging character.

This policy recognizes that there are already numerous professional journals in the country and abroad, serving various branches of engineering science. What has been lacking, it was felt, was a journal whose breadth reflects the richness of the subject, with its challenging scientific problems and its impressive technological achievements; such a journal, which the Academy was uniquely fitted to establish, could prove of great value to the engineering community as a whole. It was decided therefore that the journal should cover all branches of engineering science, including mechanics (fluid, solid, thermal), computer science, electronics, energy, aerospace technology, materials science, nuclear engineering, systems analysis, alternative technologies, etc. The Editorial Board of the *Proceedings – Engineering Sciences* agreed to encourage specially papers (i) likely to be of interest to more than one professional group, either because the work was fundamental or because it reflected the best in current technology (ii) summarising, at a sufficiently technical level, work done on special projects of interest to engineering scientists (iii) offering extensive critical reviews, especially of subjects of interest in the country. The publication of highly specialized work was considered more appropriate to the many professional journals already being published.

The criteria for the acceptance of papers in the journal have therefore been the breadth of interest – irrespective of whether the paper reports research or development, theory or experiment, original work or review – and the quality of the work reported and its presentation (text, diagrams, etc). Papers on developments in Indian technology are required to pay special attention to the problems peculiar to the country in such projects.

This policy has been constantly re-examined by the Editorial Board, and was enthusiastically reaffirmed by Fellows at the last Annual Meeting of the Academy.

During the last four years, the new section of the *Proceedings* has faithfully carried out its declared policy. Thus, its pages have ranged in subject matter from spacecraft to bullock carts, from cryptography to nonlinear waves and from the design of special alloys to the properties of coir fibre. The journal may well be the only medium in the world which tells engineering scientists of the most interesting work being done by their own colleagues in other branches of engineering – and does this in a way that is at once both intelligible and technically meaningful.

The execution of the journal's policy has demanded special effort in at least two directions. One is the careful attention given to the editing and production of the journal. The second is the commissioning of a large number of special issues devoted to topics of current interest, nationally and internationally. Each of these theme issues is organized by one or more guest editors on invitation from the Academy – a procedure that enables the journal to utilize the special knowledge of distinguished engineering scientists outside the Editorial Board. Five such special topical volumes have already been published (see list in Patrika, June 1981 and in this issue). Each of these has presented a definitive account of the state of the art in its subject at the time of publication. In the coming year further special issues are planned on such subjects as Indian river systems, remote sensing and wood heat.

The *Proceedings – Engineering Sciences* has sought to maintain a judicious balance between contributions from within the country and abroad; the ratio has been 71 : 29 during 1978-82. While the response to the journal has thus been technically enthusiastic, our circulation is not as large as it should be; to increase it so that the journal can become more nearly self-sustaining, would be our next major goal in coming years.

## Volume 1 (July-December 1978)

### Aerospace Sciences

A glimpse of the Indian space programme; *S Dhawan*. Supercritical aerofoils: a survey; *M A Ramaswamy*. Theoretical modelling of aerodynamic noise; *J E Flowcs Williams*. Development of hypersonic shock tunnel; *N M Reddy*. Airworthiness of aircraft. Part I. A stochastic model; *R Narasimha and M R Ananthasayanam*.

### Systems Science

Error regulation in a string of high speed vehicles; *E O Adegbeyeni*.

### 'Aryabhata' Project

An overview of the Aryabhata project; *U R Rao*. The stabilisation system; *P S Goel, P N Srinivasan and N K Malik*. The power system; *S Y Ramakrishnan, R S Mathur, M Subramanian, T Kanthimathinathan, Sudarshan Sarpangal, S T Venkataraman and N S Savalgi*. The thermal control system; *H N Murthy, V K Kaila, V Prasad, D R Bhandari, H Bhojaraj and P P Gupta*. Attitude and temperature sensors; *G A Kasiviswanathan, V P V Varadarajulu, P R Venkateswaran and T K Alex*. The telemetry system; *D V Raju, R K Rajangam, P S Rajyalakshmi, C N Venkateshaiah, R Seshaiyah, V Nalanda, S R Nagaraj and R Sivaswamy*. The communication system; *M K Saha, V Gopala Rao, N Manthaiyah, S Kalyanaraman, M L N Sastry, D John and M K Nair*. The telecommand system; *R Ashiya, J P Gupta, Y K Singal, D Venkataramana, A Bhaskaranarayana, U N Das and B V Seshadri*. Antenna systems for the Aryabhata mission; *S P Kosta, S Pal, P K Reddy, V K Lakshmeesha, K N S Rao, K N Shamanna, V Mahadevan, V S Rao and L Nicholas*. The tracing system; *M K Sahu, S Kalyanaraman, S N Prasad, R N Tyagi, T K Jayaraman, M Sambasiva Rao and S G Basu*. The structure; *A V Patki*. The system integration; *V A Thomas, M N Sathyanarayan, V R Katti, A A Bokil, N R Dathatri, G Mohanakrishnan, K Pattabhiraman, T K Goswami, T L Danabalan and I Selvaraj*. The ground checkout system; *Tarsen Singh, A D Dharma, O P Sapra, V R Pratap, K A Narayanan, S Subbaiah, J V Ingle, Miss A S Bhamavathi and B K Shamaprakash*. Orbit computations; *R S Bhat and C K Rajasingh*. A statistical analysis of weight and cost parameters of spacecraft with special reference to Aryabhata; *P N Pathak*. An experiment to detect energetic neutron and gamma rays from the sun; *M V K Appa Rao, S V Damle, R R Daniel, G S Gokhale, Goerge Joseph, R U Kundapurkar and P J Lavakare*. The aeronomy experiment; *S Prakash, B H Subbaraya, V Kumar, P N Pareek, J S Shirke, R N Misra, K K Goswami, R S Singh and A Banerjee*. The x-ray astronomy experiment; *U R Rao, K Kasturirangan, Y K Jain, Arun Batra, V Jayaraman, R A Ganage, D P Sharma and M S Radha*.

### Computer Simulation

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## Volume 2 (January-December 1979)

### Applied Mechanics

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### Aerospace Technology

A review of hybrid rockets: present status and future potential; *H S Mukunda, V K Jain and P J Paul*. Systems analysis for planning of air fleets and maintenance facilities; *V V S Sarma, K Ramchand and A K Rao*.

### Computer Simulation

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### Hydrology

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### Materials Science

Metallic glasses— a new class of materials: their scientific and industrial importance; *Pol Duwez*. High-resolution and high-voltage electron microscopy at the University of California, Berkley; *G Thomas and K H Westmacott*.

### Rural Technology

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### Space Technology

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### Wind Energy

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## Volume 3 (January-December 1980)

### Energy

A study of a commercial MHD power plant scheme; *S A Pashkov and E V Shishkov*.

## Materials Technology

Improved electroless process of copper coating ceramics. 1. Some parameters of coating glass substrates; L G Bhatgadde and S Mahapatra.

## Mechanics

Modelling of gusts and wind shear for aircraft assessment and certification; J G Jones. Continuous and dispersed phase coefficients for heat and mass transfer involving single-file drops; K Venkataraman, T E Degaleesan and G S Laddha. Complete solution for a two-dimensional tanh-conductivity arc; G C Das. Nonsimilar laminar incompressible boundary layers with vectored mass transfer; B J Venkatachala and G Nath. Recent development in integral equation method in transonic flow; Pradip Niyogi. Propagation of spherical shock waves in water; V P Singh, A K Madan, H R Suneja and Dal Chand. Sectional versus full model wind tunnel testing of bridge road decks; R L Wardlaw. Some trends in structural design; P N Murthy. Mass transfer effects on the generalised vortex flow over a stationary surface with or without magnetic field; B J Venkatachala and G Nath.

## Nuclear Technology

The Chandigarh variable energy cyclotron; I M Govil and H S Hans.

## Space Technology

Attitude and orbit control for satellite broadcasting missions; C A Markland.

## Systems Theory

Fault-tolerant computing concepts for aerospace applications — a survey; A Pedar and V V S Sarma. Complexity reduction in a telephone switching system; T C Palanivelu and E V Krishnamurthy.

## Alloy Design

Alloy design — a historical perspective; R W Cahn. Metallurgical synthesis; H M Burte and H L Gagel. Strengthening mechanisms in alloys; T Balakrishna Bhat and V S Arunachalam. Strengthening against creep. M L Bhatia. Alloy design for fracture resistance; Y V R K Prasad and P Rama Rao. Microstructural synthesis; S Ranganathan and P Ramachandrarao.

## Volume 4 (January-December 1981)

### Aerospace Sciences

Low-speed aerodynamic characteristics of wings with sweep discontinuities; Sridhar M Ramachandra and Sheo Prakash. On the instability of spinning projectile due to a nonlinear Magnus moment; S M Sharma.

### Alloy Design

New developments in carbon and alloy steels; V Ramaswamy and V Raghavan. Challenges in alloy design: Titanium for the aerospace industry; D Banerjee and R V Krishnan. Zirconium alloys in nuclear technology; R Krishnan and M K Asundi.

### Energy

Hydrogen energy: an inexhaustible abundant clean energy system; M G Nayar.

### Energy Engineering

The development of MHD energy conversion methods in the USSR; V A Kimlin and A Ye Sheindlin.

### Fluid Mechanics

A glimpse of fluid mechanics research in Bangalore 25 years ago; Satish Dhawan. Prospects for useful research on coherent structure in turbulent shear flow; Donald Coles. Role of coherent structures in turbulent shear flows; A K M Fazle Hussain. On the solutions of Navier-Stokes equations and the theory of homogeneous isotropic turbulence; Huang Yung-Nien and Chou Pei-Yuan. Mathematical modelling of turbulent shear flows; M Ohji. Three-dimensional aspects of boundary-layer transition; Itiro Tanii. Flow visualization studies of vortices; T Matsui. On the finite amplitude water waves; G B Whitham. Storm surges in the Bay of Bengal; P K Das. Generation of large scale circulation in turbulent convection; Ruby Krishnamurti. Fluid dynamics of the monsoon; Sulochana Gadgil. Inviscid transonic flow field analysis; T C Lin and Jia Zhenxue. Transonic flow past thin wings; Pradip Niyogi. Thermal and fluid mechanical problems in space flight; Koichi Oshima. Rear-fluid effects in flow cavitation; Vijay H Arakeri. Wind tunnel tests on slow running vertical axis wind rotors; S Sivasegaram.

## Materials Science

Structure and properties of coir fibres; K G Satyanarayana, A G Kulkarni and P K Rohatgi.

## Techniques

Gigawatt power electron beam generator; K K Jain and P I John. Liquid bubble manometer for low differential heads; A Ramakrishna Rao and S Vedula.

## Wind Engineering

Suppression of wind-induced instabilities using nutation dampers; V J Modi, J L C Sun, L S Shupe and A S Solyomvari.

## Volume 5 (January-December 1982)

### Aerospace Engineering

A review of satellite lifetime and orbit decay prediction; J De LaFontaine and S C Garg

### Aerospace Sciences

The attitude control system of the satellite for earth observation 'Bhaskara'; P S Goel, S Nagabhushanam, S Murugesan and M M M Patnaik.

### Data Systems

Data security: a cryptographic approach; A K Raina and S C Kak.

### Energy Engineering

An Indo-Soviet experiment on an MHD generator test section at the Soviet U-02 facility; P V Ananthapadmanabhan, A V Bapat, A K Das, B K Karan, R Majumdar, R K Monwah, D S Patil, S V K Rao, V K Rohatgi, K G Sankaran, P Satyamurthy, R Sharma, P B Shrivastava, M K Totlani, N Venkatramani, F A Akopov, A V Karpukhin, V V Kirillov, V I Maksimenko, A S Prokop, A I Romanov, B V Roshin, E V Shishkov, A S Tikhotsky, V I Zalkind, N I Antonov, V V Brajevsky, D K Burenkov, V A Efremov and V N Sukhov.

### Fluid Mechanics

A hydrodynamic study of vascular lesion; Mitutosi Kawaguti Akiko Hamano. The aerodynamics of flexible membranes; Barry G Newman. Acoustic remote sensing of the boundary layer; S P Singhal and B S Gera. Modern methods of numerical investigation of rarefied gas phenomena; F G Tcheremissine.

### Materials and Structures

Interfacial cracks between two dissimilar anisotropic materials; P C Misra and A K Das. Dynamics of an inflatable structure suitable for use in submarine detection: a brief review; V J Modi.

### Woodstove Technology

The science of 'wood combustion'; H W Emmons and Avind Atreya. The pyrolysis of biomass: A general review; C A Zaror and D L Pyle. On designing woodstoves; P Verhaart. The efficiency of firewood devices. Part I (Open fires, chulas and heaters); Siddhartha Bhat M. A comparison of the performance of three wood stoves; J Claus and W F Sulilatu. The performance of Thai charcoal stove; P D Dunn, Poonsab Samootsakorn and N Joyce. Fuel efficiency and performance of traditional and innovative cookstoves; H S Geller. Improved chimneyless fuelwood cookstoves (Pondicherry region); C L Gupta, Usha K Rao and U Prema.

# Special publications of the Academy



In addition to the eight special publications described in Patrika No. 2 of June 1981, the following six volumes have been published during the last two years.

## 1. Engineering Sciences

- 1.1 Volume 4. *Alloy Design*. Edited by S Ranganathan, V S Arunachalam and R W Cahn. Published in 1981. Price Rs. 100, US \$ 25 162 pages

Science was late in coming to metallurgy. Empirical knowledge with the metal craftsmanship accumulated over generations had provided all the metals and alloys needed till the last century. With the discovery of the structure and of the relation between structure and properties of alloys the possibility of 'designing' alloys has emerged.

This volume brings together a series of articles which cover comprehensively various facets of the science of alloy design. An account of the historical perspective of alloy design is followed by a summary of the science of metallurgical synthesis. Articles on the development of steels and the design of titanium and zirconium alloys in two critical technology areas, the nuclear and aerospace industries, follow.

This decade marks the transition to a totally new concept in the design of alloys—the use of amorphous structures for a wide variety of applications. As presaged in one of the articles, an understanding of the properties of metallic glasses will increasingly occupy the attention of metallurgists and material scientists in the years to come.

- 1.2 Volume 5. *Surveys in Fluid Mechanics*. Edited by R Narasimha and S M Deshpande. Published in 1982. Price Rs. 30, US \$ 30 321 pages

The motion of fluids is a subject of great interest to a wide variety of engineers and scientists. Apart from numerous

applications in almost all branches of engineering, a variety of fascinating fluid dynamical problems arise in meteorology, oceanography and astrophysics. And there are aspects of fluid flow such as turbulence and separation that have to this day defied all attempts at understanding them and have posed a fundamental challenge not only to engineers but to mathematicians and physicists as well.

This volume presents surveys of a variety of topics in fluid mechanics. The papers are extended versions of the invited lectures that were given at the First Asian Congress of Fluid Mechanics held in Bangalore during 8-13 December, 1980. The editors are justified in their hope that in bringing out this volume they will provide useful surveys of some of the most recent advances in fluid mechanics, at the same time it offers a cross-section of work being done in Asian countries on fluid mechanical problems.

Papers on some of the fundamental problems of fluid mechanics are followed by a series of papers on problems of natural or geophysical interest, waterwaves, storm surges, the monsoon and natural convection. The rest of the papers are concerned with technological applications, transonic dynamics, and thermal and fluid mechanical problems in space flight, flow cavitation and wind mill rotors.

The papers provide interesting and stimulating reading and serve to demonstrate what a wide variety of challenging problems still remain in the attempt to understand and control the diverse phenomena that are exhibited in the flow of even such simple fluids as air and water.

## 2. Nuclear Tracks

- Research in Space Physics, Geophysics and Nuclear Physics*. Edited by J N Goswami. Published in December 1981. Price Rs. 40, US \$ 8 124 pages

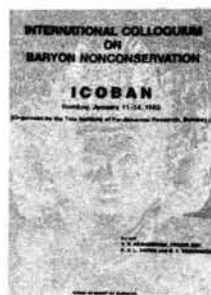
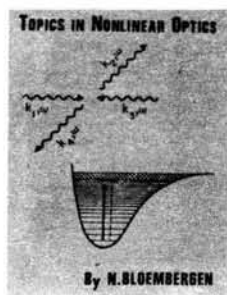
The nuclear track technique developed in the early 60's has found significant applications in a wide variety of research fields including nuclear physics, cosmic rays, planetary and space sciences, geophysics, geo-chronology, biophysics and several branches of applied sciences. The wide applications of this technique arise from the fact that a wide range of natural and artificial detector materials, having very different properties to suit the experimental requirements, are available.

At present there are over twenty institutions and universities in India engaged in different fields of research

using the nuclear track technique. This volume presents the key papers presented at the second national seminar-cum-workshop held at the Physical Research Laboratory, Ahmedabad, during February 24-26, 1981, the first biennial seminar having been organized by the Bhabha Atomic Energy Centre in 1979. The seminar which included topical reviews as well as contributed papers and panel discussions on subjects of current research interest had benefited by the active participation of a number of scientists from the USA, USSR and France.

The volume is so designed as to serve as a reference or source book by research workers in this field and contains seven key papers presented in the various seminars and the panel discussions organized during the seminar-cum-workshop, covering a wide spectrum of topics including researches in lunar and meteorite samples, geo-chronology, contemporary and ancient energetic particles in interplanetary space and studies on nuclear fission.

The scope for research in the field of space sciences, geo-chronology and nuclear physics using nuclear track techniques is very great. Analysis of cosmic ray tracks on board Skylab III led to the observation of the anomalous cosmic ray component in near earth orbit and this experiment by TIFR-PRL scientists is described, as well as future experiments in Spacelab Missions in 1984.



### 3. Crystallographic Statistics

*Progress and Problems*. Edited by S Ramaseshan, M F Richardson and A J C Wilson. Published in 1982.  
Price Rs. 50, US \$ 18 313 pages

This volume had its origin in a micro-symposium held on 22 August, 1981, in the course of the 12th International Congress of the International Union of Crystallography. Certain authors were invited to review specific fields within the general area of crystallographic statistics and the rest of the time allotted to the symposium was filled with selected contributed papers. Additional contributed papers were presented as posters at other

times during the Congress, and papers of all three types were discussed at an ad-hoc session following the symposium.

The present volume like the symposium out of which it arose, concentrates on crystallographic statistics as such and includes papers, in addition to Professor Hauptman's general introduction, on Bayesian statistics, intensity statistics, statistics of recorded counts and Wiener methods for electron density. Some contributed papers touching on the subject via altered weights are included as alternatives to least squares, after an editorial background note.

### 4. Topics in Nonlinear Optics

*Selected Works on N Bloembergen*.  
Published in 1982.  
Price Rs. 50, US \$ 20 291 pages

Professor Nicolaas Bloembergen, Gerhard Gade University Professor at Harvard University, was invited in 1978 by the Academy, of which he is an Honorary Fellow, to occupy the Raman Chair. During his stay at Bangalore from September to December 1979, he gave a series of lectures at a discussion meeting on Nonlinear Optics, arranged by the Academy at the Indian Institute of Science. He also delivered the Gandhi Memorial Lecture entitled 'Reflections on Light' at the Raman Research Institute on 2 October, 1979.

This volume contains the text of some of the lectures Professor Bloembergen gave at the Discussion Meeting and of the Gandhi Memorial Lecture. Seventeen of the papers and review articles published by him on nonlinear optics in recent years and selected by him are also included in this volume.

In 1981, Professor Bloembergen's brilliant contributions in nonlinear optics and laser spectroscopy was recognized by the award of the Nobel Prize to him, jointly with A L Schawlow and K Siegbahn. His Nobel lecture given at Stockholm in 1981 is also included in this volume.

### 5. Proceedings of the International Conference on Baryon Non-Conservation: ICOBAN

Edited by V S Narasimham, Probir Roy, K V L Sarma and B V Sreekantan. Published in 1982.  
Price Rs. 50, US \$ 20 283 pages

An International Colloquium ICOBAN with focus on baryon non-conservation, proton decay and neutron-antineutron oscillation was held in the second week of January 1982 at the Tata Institute of Fundamental Research, Bombay. The programme had a suitable mix of theory

and experiment, invited and contributed papers, with practically every group in the world involved in proton decay measurements being represented. The first results of the neutron-antineutron oscillations from the Grenoble experiment were presented at this symposium.

The proceedings of the meeting presented in this volume contains 35 invited talks. A list of the contributed papers is included as well as two lively summary talks, one by Professor Chudakov on the status of proton decay experiments and the other by Professor Mohapatra on the theoretical aspects covered in the colloquium.

## Obituaries

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**Manali Kallat Vainu Bappu** passed away at Munich on August 19, 1982 after a major bypass heart surgery. In his untimely death, India has lost not only a great scientist but one of the main architects of modern Indian astronomy.

Vainu Bappu was born in Madras on August 10, 1927 as the only child of his parents. He followed in the foot-steps of his father, who was an astronomer at the Nizamiah Observatory and his first paper was published when he was sixteen, describing the spectrum of the night airglow obtained by means of a spectrograph. After obtaining his Master's degree in physics from the Madras University, he joined Harvard University in 1949. While still a student, he discovered the Bappu-Bok-Newkirk comet for which he won the Donohoe Comet Medal (1949) of the Astronomical Society of the Pacific. After obtaining his Ph.D in 1952, he joined the Hale Observatory on a Carnegie Fellowship. Soon after he discovered the Wilson-Bappu effect in the stellar chromospheres, which has been extensively used for stellar distance determination.

Bappu returned to India in 1955. The founding of the U.P. State Observatory at Nainital and the rejuvenation of the Kodaikanal Observatory were the results of his far-reaching vision, pioneering zeal and indefatigable industry.

A still greater contribution was the creation of the Indian Institute of Astrophysics and the Kavalur Observatory. An active centre of research in astronomy and astrophysics, the Institute is a monument to Bappu's creativity and leadership.

His main scientific contributions are on the physics of the sun and the stars, on the physics of the solar system, physical phenomena in galactic and extra-galactic systems and

astrophysical observational techniques. He led four expeditions for observing the total eclipse of the sun. He played a leading role in the discovery of the rings around the Uranus by Indian astronomers in 1977. The design and construction of Asia's largest telescope—the ninety inch—and its installation at Kavalur was the last major project in which he was engaged.

Vainu Bappu won many awards and honours. To name a few, he was elected a Foreign Fellow of the Belgian Academy of Sciences and an Honorary Associate Fellow of the Royal Astronomical Society and Honorary Member of the American Astronomical Society. He won the Bhatnagar Award in 1970, the Meghnad Saha Award in 1977, the Hari Om Ashram Award in 1977, Padma Bhushan in 1981 and the S.N. Bose Medal of the Indian National Science Academy for 1983. He was a Fellow of the Indian Academy of Sciences and a Fellow of the Indian National Science Academy. He was the Vice President of the Indian Academy of Sciences since 1980 and Chairman of the Editorial Board of the Journal of Astrophysics and Astronomy, of which he was one of the founders. He was the first President of the Astronomical Society of India in 1973-74. He was Vice President of the International Astronomical Union from 1967 to 1973 and was President of the Union for the last three years, a unique honour.

For all his achievements and honours, Vainu Bappu was a charming, friendly and extremely lovable person. Beneath his commanding presence and the aura of leadership, lay his profound simplicity that stemmed from a total dedication to his calling and a full understanding of the individual's role in the larger scheme of things. He loved nature and all things in it. Many paintings and the exquisite gardens he created at the Kodaikanal, Kavalur and the Indian Institute of Astrophysics campuses bear eloquent testimony to this enchanting quality of a great scientist and natural philosopher.

Vainu Bappu leaves behind his wife and his mother. For them as well as for countless number of his friends and admirers, his sudden passing away is an irredeemable loss.

**U Sivaraman Nair**, the distinguished statistician, died on August 8, 1982 at Tokyo. Born on 14 December, 1902, he had his early education in Trivandrum and he took his Master's degree in Mathematics from the University of Madras. He started his academic life as a teacher of Mathematics in the Maharajah's College of Science, and did his doctoral dissertation in statistics under the guidance of Prof. E S Pearson at the University of London. He was the first Professor and Head of the Department of Statistics in the University of Travancore, which under his leadership became a well known centre of statistical research in India. He was the President of the Statistics Section of the

Indian Science Congress held at Allahabad in 1949.

Sivaraman Nair did not confine himself to teaching and research. He was statistical adviser to the Government of Travancore for its 1941 census, and superintendent for the 1951 Travancore-Cochin census. He organized the Department of Statistics for the Kerala State, now known as the Directorate of Economics and Statistics and was regional adviser for census and agricultural sampling for Asia and the Far East from 1958-1965.

Sivaraman Nair was greatly respected as an eminent teacher and statistician and will be sadly missed by his students and colleagues and the many institutions to which he continued to render valuable advice till his death.

**Prafulla Kumar Sen** was born on 7 December, 1915 at Calcutta, in a distinguished family which had produced many physicians and savants, including the great Keshab Chandra Sen of Indian renaissance. He had his early education in Nagpur and graduated in medicine from the Seth G.S. Medical College and KEM Hospital, Bombay, which was to become the scene of his professional life and work for over thirty eventful years. He received the degree of Master of Surgery from Bombay University with distinction in 1940 and began his academic career as a Lecturer in Surgery at the Seth G.S. Medical College. A year as a Rockefeller Foundation Fellow in the University of Pennsylvania under Dr. Ravdin was a turning point in his career, starting him on a life-long mission of integrating research with surgical practice. He accepted the offer of the first full-time Chair in Cardiovascular and Thoracic Surgery at the Seth G.S. Medical College in 1956 and soon established a preeminent national centre for cardiac surgery, cardiac sub-specialities and cardiothoracic training at the KEM Hospital, Bombay. Following his retirement in 1973, he moved to Calcutta where he had been invited to organise a Cardiovascular Centre at the Calcutta Medical Research Institute.

Sen pioneered the development of cardiac surgery in India and initiated a series of newly described cardiovascular operations between 1955 and 1980 at the KEM Hospital. He followed these efforts by the introduction of the heart-lung bypass which was to take giant strides under his leadership over the next few years. His seminal role in the growth of cardiovascular and thoracic surgery in India owed as much to his surgical prowess as to his genius in training a younger generation of fine surgeons and investigators. His approach to surgery was characteristically Hunterian. No theory or surgical advance escaped his searching scrutiny or won his uncritical approval. Nor did interdisciplinary boundaries restrain his investigative spirit which raced like

a tireless steed. His contributions to cardiovascular surgery were numerous but his identification and detailed studies of aortoarteritis in India will perhaps outshine others as a major surgical classic.

It was but natural that scientific and other honours should come to him in profusion from India and abroad. Even an abridged list must include the Fellowships of the Indian Academy of Sciences, the National Academy of Medical Sciences and the American College of Surgeons, and awards such as the Col. Amir Chand Prize of the Indian Council of Medical Research, the B C Roy Award of the Indian Medical Council, the Vishnevsky award of the Academy of Medical Sciences of the USSR, the Presidentship of the Thoracic Section of the Association of Surgeons and Padma Bhushan. He carried the weight of these honours as lightly as his own profound surgical erudition.

A man of powerful physique and expression, Sen stood out in any gathering and left an indelible impression on any one who came under his spell or even met him casually. He will be sorely missed by his grateful patients, students, friends and the world of medical science.

**Madhavasetty Ramalingam Rajasekarasetty** passed away at Mysore in July 1982. Born in 1919, he had a brilliant academic career, starting his research in cytogenetics while studying for his M.Sc at the Central College, Bangalore. He worked in mice genetics under the late Prof. L.C. Dunn and after receiving his Ph.D. from the USA he returned to India where he rejoined his old college. In course of time he became the Professor and Head of the Department of Zoology of the University of Mysore. Under his leadership this Department became a centre of cytogenetical research, particularly drosophila, silk worms, grasshoppers and mammals.

Professor Rajasekarasetty's research studies in later years were on the role of chromosomes in the evolution in different insects specially the grasshopper, drosophila and heteroptera and recently of X-ray and chemical induced chromosome aberrations in grasshoppers. He was one of the most liked scientists in the country, with a large circle of friends and admirers.

He leaves behind his wife and son.

Editor: Anna Mani

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