



Patrika

July 1992 No. 25 Newsletter of the Indian Academy of Sciences

58th Annual Meeting

At the invitation of the Physical Research Laboratory, Ahmedabad the 58th Annual Meeting of the Academy will be held at Ahmedabad from 6 to 9 November 1992.

The scientific programme will consist of two symposia, two evening lectures and lecture presentations by new Fellows and Associates.

The two scientific symposia will be on "The Near Earth Environment" and on "JBS Haldane".

All Fellows and Associates attending the Annual Meeting will be paid first class railway fare from their place of residence to Ahmedabad and back, in case they are unable to obtain travel support from other sources. Arrangements for the stay of Fellows, Associates and other delegates will be taken care of by the organizers.

During the period of the Annual Meeting, the Editorial Boards of the Academy journals and the Sectional Committees will also meet at Ahmedabad.

Mid-Year Meeting

The third Mid-Year Meeting of the Academy, now a regular feature of the activities of the Academy, will be held on Friday, 24 July 1992, at the Indian Institute of Science, Bangalore.

There will be fifteen lectures by new Fellows and Associates and an evening lecture by Prof. Debiprasad Chattopadhyaya on "In defence of the history of science in ancient India". The lectures by Fellows and Associates are:

V Kannan, University of Hyderabad, Hyderabad, "Alternation systems and Rivlin's Problem"

V S Sunder, ISI, Bangalore, "Hypergroups and subfactors"

D Mathur, TIFR, Bombay, "Probing interatomic potentials using low-energy ion beams"

P N Shankar, NAL, Bangalore, "How fast does a liquid evaporate?"

K Kesava Rao, IISc., Bangalore, "Gravity flow of granular materials"

S B Ogale, University of Poona, Pune, "Lasers in material science"

Kalidas Sen, University of Hyderabad, Hyderabad, "Chemical applications of density functional theory"

K Nag, IACS, Calcutta, "Activation of coordinated molecules"

J N Goswami, PRL, Ahmedabad, "Isotopic clues in meteorites and early solar system processes"

R Srinivasan, NGRI, Hyderabad, "Archaean crustal evolution of the Dharwar terrane of southern India"

S R Shetye, NIO, Dona Paula, "The movement and implications of the Ganges-Brahmaputra freshwater discharge on entering the Bay of Bengal"

R Nagaraj, CCMB, Hyderabad, "How proteins reach various destinations within the cell"

S K Basu, National Institute of Immunology, New Delhi, "In quest of magic bullets: Site-specific drug delivery"

Asha Chandola-Saklani, Garhwal University, Garhwal, "Timing of seasonal events in tropical birds: Environmental and hormonal interactions"

K N Ganeshiah, UAS, Bangalore, "Parent-offspring conflict in plants"

Harmonic Analysis

A discussion meeting on Harmonic Analysis, jointly sponsored by the Academy and the Indian Statistical Institute, was held during 11 to 13 March 1992 at the Indian Institute of Science, Bangalore. It was attended by about 40 mathematicians from all over India, working in the field of harmonic analysis and related fields like partial differential equations (PDE), ergodic theory and operator theory/algebras. About a third of the participants were Ph.D. students. The aim of the meeting was to enable people to meet and learn about research currently in progress in the above mentioned areas at different centres in India. This was the third in a series of such meetings (the first was held at the Bombay University in January 1988 and the second at IIT, Kanpur in January 1990). A fourth meeting is likely to be held in January 1994 at IIT, Bombay.

There were altogether 16 technical lectures. The first three talks by Adimurthi on 'Symmetries of positive solutions of Laplace equations', by B R Nagaraj on 'Spectral analysis of partial differential equations' and by M Vanninathan on 'Fourier analysis of wave propagation problems' dealt with connections between Fourier analysis and PDE. The next four lectures by A Athavale on 'Unitary and spherical dilations: A hypercontractive perspective', by R Bhatia on 'The absolute value of a Hilbert space operator', by G Misra on 'The multiplication by determinant and trace on certain Hilbert spaces' and by R Vittal Rao on 'Resolvent of integral operators with difference kernels on L_2 spaces', mainly dealt with connections between harmonic analysis and operator theory/function theory. The two talks by J Mathew on 'Measure-free proof of Birkhoff's ergodic theorem' and by M Krishna on the 'Nature of some ergodic potentials' were on certain ergodic theoretic/probabilistic aspects, while T S S R K Rao's talk on 'Some linear topological properties of function spaces' was on functional analytic questions. The next four lectures, by S C Bagchi on 'Cyclic vectors of groups and semi-groups of translation operators', by Sanjiv Gupta on 'Multipliers on function spaces with p -summable Fourier transforms', by Shobha Madan on the 'Transference principle and its applications' and by U B Tewari on 'Multipliers of weighted l_p -spaces' focused on problems, some of which are still open, in classical harmonic analysis. S Kumaresan spoke on a differential geometric theme, 'Isoperimetric inequalities' while M Schurmann's talk on 'Non-commutative white noise' was on certain mathematical structures that arise in non-commutative probability theory.

Non-Accelerator Particle Physics

A discussion meeting on 'Non-Accelerator Particle Physics – Perspectives; jointly sponsored by the Department of Science and Technology and the Academy, was held at the Indian Institute of Science, Bangalore during 18 to 20 November 1991. The joint conveners were R Cowsik (TIFR, Bombay), G Rajasekaran (Institute of Mathematical Sciences, Madras) and N Mukunda (IISc., Bangalore).

The study of the fundamental aspects of the physics of elementary particles and fields, without recourse to the gigantic manmade high-energy particle accelerators such as the superconducting super collider or the large hadron collider, has its own fascination and advantages. For one, in view of the comparative smallness of the scale of experiments in this area, the scientist is able to participate in all its aspects – from the theoretical motivations which initiate the study to the design of the instruments and methodology and finally in the analysis of the results. Again the low energy consequences of the grand unification of all the forces at high energy might indeed provide the most accessible and clearest signatures of the physics that lies beyond the standard model. In India, there has been a great tradition in this field, using cosmic rays and astrophysical observations as probes to delineate the properties of elementary particles; a variety of "table-top" experiments to study the fundamental aspects of physical laws have also been performed. A partial list of the scientific topics discussed at the meeting is given below

1. Discrete symmetries and their experimental tests such as the electric dipole moments of electrons and neutrons.
2. Nuclear physics experiments probing discrete symmetries and the mass of the neutrino.
3. Study of the fundamental aspects of quantum mechanics and its nonlinearities with experiments like optical multiphoton interferometry.
4. The quark content of the photon and the interactions of TeV gamma-rays.
5. Search for new intermediate range forces.
6. Gravitation experiments.
7. Experimental searches for dark matter.
8. Study of new physics through ultra high energy gamma ray and neutrino astronomies.
9. Study of solar neutrinos.
10. Phenomenological, theoretical, astrophysical and cosmological studies relevant to NAPP.

An assessment of the national capabilities and the strategies for new initiatives was one of the objectives of the meeting.

The meeting started with remarks by Prof. N Mukunda as to the importance of studies in the areas of non-accelerator particle physics (NAPP) and the need to preserve national facilities where such work can be carried out. This was followed by remarks by Prof. B V Sreekantan, specifically addressing the issue of the possible closure of the mines at the Kolar Gold Fields (KGF), where fundamental research of great importance has been carried out for the past 4–5 decades. This was followed by a lecture by Prof. C Rajasekaran on the standard model of particle physics, possible extensions of this model and the experimental efforts that are needed for their verification.

At the end of the meeting, a special session under the chairmanship of Dr K Kasturirangan (ISRO) was held to discuss the strategy for the implementation of the various ideas that were put forth during the meeting. The specific actions that need to be taken and were decided upon are listed below:

1. A comprehensive list of scientists in the country interested in NAPP should be prepared.
2. Efforts should be made to direct the attention of the scientists and the funding agencies towards the exciting possibilities in the areas of NAPP.
3. Contact between theorists and experimentalists should be encouraged and maintained from the very beginning in this area.
4. Steps should be taken to attract students to this area.
5. Considering the strategic closeness of Bangalore to the KGF, Gauribidanur, a Centre focussing its research interests in the area of NAPP, should be set up in Bangalore. Funding for such a Centre may initially be from the DST, but in view of the wide impact of the research, other organizations such as the Department of Atomic Energy and the Department of Space should also be urged to provide funds for research in areas overlapping with their interests.
6. Details of the operation and financing of such a Centre will have to be worked out in detailed discussions between the DST and a senior member of any hosting institution. In particular one may explore whether a unit devoted to NAPP could be established by the DST within the Indian Institute of Astrophysics, Bangalore.
7. Concerning the KGF facility, its continued existence now is possible only if several institutions and agencies come together and cooperate in planning and sharing the burden. Its use in other areas of science such as geology and biology needs also to be pursued.

Special Issues of Journals

Sādhana — *Academy Proceedings in Engineering Sciences*, Vol. 17, Part I, March 1992, pages 1–236. Parallel and Distributed Computing.

Advances in hardware technologies have led to the extensive use of sophisticated processors to build multiprocessors and distributed processors for a spectrum of real time systems such as home appliances, process control systems, flexible manufacturing systems and tactical control systems. This in turn has led to challenges in programming distributed, parallel and real-time systems.

The primary purpose of this special issue was to present (a) the issues and principles of specification and verification of real-time distributed programs, (b) issues of reasoning true concurrency, (c) principle of partial information of distributed programming and (d) issues of building and programming scalable concurrent computers.

The issue consists of eight papers covering the above topics.

Proceedings Chemical Sciences — Vol. 104, Number 2, April 1992, pages 79–350. Mechanisms of Photoinduced Electron Transfer.

This special issue brings together twentyfive invited and contributed papers presented at the International Symposium and Workshop on “Molecular Mechanisms of Electron Transfer, Basis of Solar Energy Storage” held at Cairo, Egypt in January 1991. The symposium was hosted by the Ain Shams University, Cairo, Egypt. The wide range of topics reflects the interaction between different areas of photochemistry such as electron transfer mechanisms and their impact on solar energy storage, and are of importance in solar energy conversion and storage.

Bulletin of Materials Science — Vol. 15, No. 3, June 1992, pages 189–288. Proceedings of the Sixth National Seminar on Ferroelectrics and Dielectrics.

The special issue contains twelve papers presented at the Sixth National Seminar on Ferroelectrics and Dielectrics held at the Kakatiya University, Warangal, during 17–19 December 1990. The topics include theoretical studies, general aspects of behaviour of ferroelectrics and dielectrics and their applications.

Obituaries

Vishnu Madhav Ghatage was born in a small village Hasur in Kolhapur (Maharashtra) on 24 October 1908.

His early schooling was in Kolhapur. He graduated from S.P. College, Pune, following which he obtained his post-graduate degree in Physics at the Royal Institute of Science, Bombay in 1932. He did his M.Sc. thesis work at the Kolaba observatory on the topic of vortex formation.

With a scholarship awarded by the Bombay University in 1933 he joined the Kaiser Wilhelm Institute at Göttingen, Germany, where he studied under eminent scientists like Betz, Flugge, Tollmien, and finally conducted research for his Ph.D. degree under Professor Prandtl, an academician whose scientific work is the foundation of present day aerodynamics. He chose "Model experiments for the relative motion of air columns of different temperatures" for his research work. As this study related to cumulus clouds, a scientific phenomenon of great importance to gliding, the Gliding Society of Germany funded the research. He obtained his doctorate in 1936 and after his return to India the same year, he worked as Professor of Physics for four years in Pune and Bombay before he could secure for himself a job in Aeronautics at the Hindustan Aircraft Ltd., Bangalore.

He worked in the HAL Design Office for two years. In 1942, he joined the Indian Institute of Science to start a post-graduate diploma course in aeronautical engineering. He remained until 1948 at the Institute, where he taught fluid mechanics, solid mechanics and aircraft design, besides supervising experiments in the low speed wind tunnel. Those who studied under him remember him with great affection and high regard, as he was not only an excellent teacher but also a friend, who guided and helped the young engineers in their chosen careers and directed their energies in creative pastimes.

In 1948 he returned to HAL as Chief Designer to develop an *ab initio* piston engined trainer HT-2, which he and his team accomplished during 1948–52. The HT-2 aircraft went into production and found service with the Indian Air Force for two decades. He not only developed the HT-2 but laid the foundation of aircraft design-development activity in India, a singular achievement, when one looks back into the history of aviation industry in the country.

He was involved in many aircraft projects during the period 1948–67, but those which went into production were Pushpak, a

piston-engined light aircraft used by Flying Clubs, Krishak a piston-engined aircraft used by the IAF for air observation patrol duties and HJT-16 Kiran a basic jet trainer used by IAF for intermediate pilot training. During this period, development of a 2500 lb thrust, straight jet engine was also undertaken under his technical leadership but unfortunately this did not go beyond the prototype stage.

He was awarded Padma Shri in 1965 by the Government of India for his pioneering work in the field of aeronautics both in educating and training designers and also for demonstrating Indian ability to design and develop several aircraft in the country.

In the late fifties, the Government of India approved fighter aircraft development (HF-24 Marut) but this project was assigned to a German team under Dr Kurt Tank and many of the Indian designers trained and nurtured by Dr Ghatage were transferred to this project. This caused a kind of split in the Design Department which was a source of great unhappiness to Dr Ghatage. Later on, an integrated design organization was restructured at HAL but by then Dr Ghatage had left HAL.

He was a Fellow of the Royal Aeronautical Society of London, the Aeronautical Society of India, and the National Institute of Sciences of India and a Member of the Institute of Engineers India, and the USA Institute of Aeronautical Science. He was a recipient of the Sir Walter Puckey Indian Prize for contribution to production engineering in India, and the National Design Award. He was elected a Fellow of the Academy in 1945.

He retired as General Manager of HAL in 1970. After retirement from HAL he remained active in the general engineering field, rendering consultancy services to industry in the corporate sector. On the occasion of his 75th birthday HAL jointly with Aeronautics R&D Board, Indian Institute of Science, and Aeronautical Society of India, organized a two-day seminar in October 1983 on "Design and Development in Aeronautics"

Well-known for his pioneering work in aeronautical education and design, he was known to his admirers as an artist, a scholar and a philosopher.

He was a portrait painter of originality using mostly water colours. He had a good eye for colour and was equally good in black and white shading, and sepia stump work. A voracious reader of Marathi literature, a Sanskrit scholar, and a discerning critic of Indian classical music, he was in the best tradition of his generation, a well rounded personality.

A keen golfer, he was elected Captain of the Bangalore Golf Club in 1957 and later on he was a Founder Member of the Karnataka Golf Association and its first President. He passed away at Bangalore on 6 December 1991.

Vasant Shankar Huzurbazar was born on 15 September 1919 of Shanker Aboji and Ganga Huzurbazar in Kolhapur, Maharashtra. Emerging first in all subjects in Rajaram High School at quite an early age, he had his first encounter with 'probability' in a chapter of 'Higher Algebra' by Hall and Knight and also in a chapter in a text book on inductive logic, which he borrowed from his elder brother out of curiosity. However, further progress in this direction was delayed by the total absence of probability and statistics in the undergraduate mathematics curriculum of the Bombay University. He was initiated into mathematical research with the publication of his first paper while he was studying for M.Sc. at the Banaras Hindu University during 1940–41. During this period the Indian Science Congress decided to start a separate section on Statistics and invited Sir Maurice Hallet, Governor of UP to inaugurate its session in 1941. The inaugural lectures of Sir Maurice and Mahalanobis in which Statistics was described as the "arithmetic of human welfare" and a concluding popular lecture on "probability theory" by the eminent physicist Sir C V Raman made a deep impression on young Huzurbazar and influenced him in no small measure to pursue higher studies in the virgin field of Statistics.

In 1946, supported by financial assistance from the Banaras Hindu University, the Bombay University and the J N Tata endowment, he left for Cambridge and started his research under the guidance of the renowned mathematician and geophysicist Sir Harold Jeffrey, Plumian Professor in Astronomy and Experimental Philosophy. Sir Harold Jeffrey was already a controversial figure amongst statisticians for his propounding the notion of inverse probability and its relationship with the Bayesian approach to statistical inference. On the completion of his doctoral thesis which was adjudged as the best among all the theses in Mathematics submitted to the University of Cambridge in 1949–50, Huzurbazar was awarded the coveted Adams Prize. The basic results of his thesis were published in the Proceedings of the Cambridge Philosophical Society in 1949 and also included in a later edition of Harold Jeffrey's well known book "Theory of Probability".

During his stay in England he came into contact with late Sir Ronald Fisher, pioneer in modern statistical theory. Fisher had introduced his celebrated method of maximum likelihood for the estimation of parameters of a probability

distribution, but several basic questions relating to this method necessitated further research. Huzurbazar published a famous and widely quoted paper in the *Annals of Eugenics* in 1948, where he showed that a consistent solution of the likelihood equation is unique and that it has the property of maximum likelihood with a probability approaching 1 as the sample size approaches infinity. He showed that for the class of distributions admitting sufficient statistics, the likelihood equation has a unique solution for samples of any size, and this unique solution makes the likelihood function an absolute maximum. In this context he made a famous conjecture that, for independent and identically distributed random variables X_1, \dots, X_S with a distribution depending on an unknown parameter, if the conditional distribution of X_i given a statistic $T(X_1, \dots, X_S)$ is independent of the parameter for each i , then T is globally sufficient. One particular version of this conjecture was solved by V N Sudakov. Finally the conjecture was settled by J K Ghosh. Huzurbazar's work on sufficiency and related problems is the subject matter of his monograph "Sufficient Statistics" published by Marcel Dekker, New York in 1976.

After his return from Cambridge, Huzurbazar settled down to a long and distinguished career in the Department of Mathematics and Statistics at the University of Poona and guided its destiny during 1953–76. Owing to his untiring efforts Poona University has become a centre of excellence in the field of Statistics in India.

From 1979, till his death in 1991, he served as a Professor at the University of Denver, Colorado in the U.S. In the light of his long teaching and research experience he had recently undertaken a project to write quality text-books for the use of graduate and research students in Statistical Inference, Probability Theory and Measure Theory. He was a member of the International Statistical Institute from 1971, a Fellow of the American Statistical Association, and a Fellow of the Indian National Science Academy since 1957. He was elected a Fellow of the Academy in 1961. He was President of the Statistics Section of the Indian Science Congress during 1966–67. In recognition of his outstanding contributions to the field of Statistics the President of India conferred on him the title of Padma Bhushan in 1974.

He passed away on 15 November 1991 at Denver, Colorado.

Jagdish Shankar was born on 3 October 1912. After obtaining the master's degree in 1934 by research, his work on determining molecular

orientation from X-ray diffraction studies and magnetic anisotropic data, won him the Ph.D. degree from the Bombay University in 1939. Commencing with the Royal Institute of Science, Bombay he taught in different institutions for about a decade. During his tenure at the Delhi University he proceeded to USA and took an MS degree in Chemical Engineering from Columbia University in 1947.

At the invitation of Dr H J Bhabha, he joined the then Atomic Energy Establishment, Trombay in 1949, as the Chief Chemist, with the mandate of formulating and executing the chemistry programme in the nascent nuclear technology. Although his laboratories were located in temporary sheds, soon the address of 414-A Cadell Road became and remained synonymous with chemistry activities of Indian Atomic Energy programme for years.

Under his leadership, well-equipped laboratories for analytical chemistry, spectroscopy and advanced research in the emerging field of recoil chemistry were established. Besides, he initiated and encouraged research in solid state chemistry, X-ray and electron diffraction, thermal analysis and radiation chemistry. As the programme initiated by him expanded and flourished, Analytical Chemistry, Spectroscopy, Applied Chemistry and Chemical Engineering Divisions were established out of the Chemistry Division. His chemical engineering background was useful in establishing the solvent extraction, ion exchange, distillation and zone refining units for preparing high purity materials required in the exacting nuclear and electronic industries. Based on the developmental work carried out in the division, a high purity materials plant was set up as part of the Nuclear Fuel Complex at Hyderabad to manufacture B, Nb, Ta, Se, Au etc.

The knowledge accrued over the years of work on the radiolysis of aqueous media during his tenure and afterwards, became very useful in examining the role of oxygen and hydrogen in nuclear reactors under accident conditions. Under his prudent leadership the risk-prone chemical operation of removing the biofouling of the CIRUS nuclear reactor was successfully carried out in the sixties. He recognized very early the necessity of having stringent control of the chemical parameters of reactor water to minimize corrosion. Such foresight led to the establishment of the Water and Steam Chemistry Laboratory at Kalpakkam. The research groups in Recoil and Radiation Chemistry made notable contributions. He was a champion of instrumentation in chemical research. This is reflected in the development and transfer of knowhow of the first indigenously designed gas chromatograph to industry.

He was elected a Fellow of the Academy in 1975. He was keenly involved in the activities of the Indian Chemical Society which he served in various capacities, ultimately as its President. He was elected President of the Chemistry Section of the Indian Science Congress Association in 1965.

After retirement from BARC in 1972, he served as an Emeritus Scientist and later Adviser in the Department of Atomic Energy. During 1975 his services were utilised by the University Grants Commission as Director of the Science Research Council to streamline the selection and funding of research schemes. He was also an adviser to the Vice-Chancellor of Kashmir University, Srinagar.

His admirers and students organized a national symposium on "Emerging Frontiers in Chemistry" on his 75th birthday in November 1987 and the Indian National Science Academy published a special commemorative volume on this occasion.

He passed away at Bombay on 31 January 1992. He is survived by his wife and six sons.

Prince Kumar Malhotra was born on 20 April 1935 at Jammu Tawi in Jammu and Kashmir. He passed away on 7 March 1992 while attending a conference on 'LHC Physics and Detectors' at Evian France near Geneva. He was 56 years old. He was well known as a leading experimental physicist for his research work in the field of High Energy Physics and Cosmic Rays.

He joined the Tata Institute of Fundamental Research in 1956, after taking his M.Sc. degree from the Panjab University. He started his research work using nuclear emulsions flown at high altitudes and exposing them to very high energy cosmic rays. He was awarded his Ph.D. degree from the University of Bombay in 1964. His early work on cosmic ray jets and his formulation of the dependence of multiplicity distribution with energy, known in the literature as 'Malhotra-Wroblewski' relation, fetched him wide international recognition.

He took a leading role in setting up the Experimental High Energy Physics group at the TIFR. This group has carried out several experiments in particle physics using Bubble Chambers in collaboration with CERN and several universities and laboratories from India, Japan, Europe and USA. In 1983, the group under his leadership joined the L3 collaboration to carry out an experiment with electron-positron collisions with the LEP accelerator at CERN. It also fabricated more than 1000 proportional chambers indigenously.

He was instrumental in organizing Bubble Chamber analysis activities in several Indian Universities — Jammu, Chandigarh, Banaras and Delhi. He spent several years in (i) Northwestern University, USA (1965–67), where he carried out studies of negative kaon particles interacting with helium nuclei, (ii) CERN, Geneva (1975–76), where he studied the general characteristics of particle production and transverse spectra of the mesons in hadronic collisions, (iii) Fermilab, USA (1981–82), where he worked on the electron-positron collisions leading to the production and decay of gauge vector boson Z, yielding precision measurements of its parameters. These measurements have led to the important conclusion that light neutrinos exist only in three flavours — a result of paramount importance to particle physics and also to astrophysics.

He was elected a Member of the IUPAP (International Union of Pure and Applied Physics) Commission on Particles and Fields (1981–87). He was elected a Fellow of the Academy in 1985.

Apart from his major professional contributions, he possessed an extremely friendly and popular personality. He will be greatly missed by his many friends and colleagues in the high energy physics community.

Jashbhai Shankerbhai Patel was born on 11 December 1905. He received his post-graduate training for M.S. in Plant Breeding in Cornell University, Ithaca, USA under the renowned maize geneticist Dr Wiggins. Subsequently, he received his Ph.D. from Edinburgh in Agriculture, encompassing a range of disciplines.

On his return to India in 1930, he first served as Oil Seeds Specialist to the Government of Madras in charge of research and development in groundnut, castor, coconut and til. He initiated cyclic crossing in coconut and observations from seedling to regular bearing age of selected plants in two contrasting environments. His work on a range of oil seeds and heterosis breeding under his guidance were concepts far beyond those times.

In 1938 he joined as the Director of Jute Agricultural Research, Dacca, and in 1949 as the Director of Agriculture, Bihar, responsible for the construction of minor irrigation projects, wells and tubewells, reclamation of land, soil conservation, popularization of improved seeds, implements and fertilizers. As the Chief of Agriculture in Bihar, he reorganized agricultural research and education in that State till 1955, when he was called upon by the Government of India as Adviser, Agriculture, in the Ministry of Community Development and in 1959 as the Agricultural Commissioner in the Ministry of Food

and Agriculture. During his tenure as the Agricultural Commissioner, he streamlined the research and development of commodity committees, established and expanded the activities of their research institutes, with equal emphasis on comparative demonstration of scientific practices as a package versus the traditional farmer's method, with data on cost/benefit ratios. These demonstrations were the forerunners of the national demonstrations during the 60's and the present on-farm trials by ICAR.

On retirement as Agricultural Commissioner, he was invited to take up the Vice Chancellorship of the Jawaharlal Agricultural University in Jabalpur, MP, where his wide experience was channelled into research and extension of crops, forests and animals in an interdisciplinary effort.

Subsequently, he served the Gujarat Government as their Adviser for the Narmada Water Commission.

He was a Member, National Planning Council, and President, Indian Society of Agricultural Engineers for 10 years. He was a Foundation Fellow of the Academy. He was awarded the Padma Shri in 1965.

He is remembered by his fellow scientists with respect and affection as a benevolent boss, firm in his conviction based on reason and compassion for worthy causes. He did not hesitate to cut redtape for a just cause and reversed some major decisions which were impediments to rapid execution and progress.

He passed away on 20 April 1992 at Baroda.

Mandikal Ramanna Ashwathanarayana Rao was born on 7 November 1910 at Gowribidanur in Karnataka State. He graduated from Central College, Bangalore, with chemistry as one of the optional subjects and took his M.Sc. degree in inorganic chemistry in 1933 from the University of Mysore. After a brief stay as a research scholar at the Indian Institute of Science (1934–35), he went back to Central College as a lecturer in the Chemistry Department and served the then Mysore University till 1944, during which period he took his D.Sc. degree from the University of Madras. His thesis was on "A new method for preparing unstable iodides". He standardised several preparative and analytical methods for a variety of inorganic compounds particularly those which were very unstable in nature. He was able to characterize the nature of many newly identified and isolated chemical entities.

He was appointed a lecturer in the Department of General Chemistry at the Indian Institute of Science in 1944 and as Assistant Professor in 1957. His work here was on the electrochemical preparation of inorganic

compounds, chlorination of rubber and surface properties of rubber and other polymers and beneficiation of minerals.

He was promoted as Professor of Physical Chemistry in 1960 and Chairman of the Department, now named, Department of Inorganic and Physical Chemistry.

He was elected a Fellow of the Academy in 1956. He served for three years as UGC Professor in the Institute after his retirement in 1971 and for 15 years as Editor of *Current Science*. He passed away after a brief illness at Bangalore on 24 May 1992.

Kartar Singh Thind was born in Punjab on 30 October 1917. He had his school education in Sultanpur Lodhi and his higher education in the Panjab University, taking his B.Sc. Honours (1939) and M.Sc. Honours (1940) degrees from that University. Deputed by the Government of India for higher studies abroad he joined the University of Wisconsin at Madison and obtained a Ph.D. in plant pathology in 1948.

Returning to India, he successively held the posts of Regional Potato Development Officer in Himachal Pradesh (1949), Senior Lecturer in Botany (Mycology and Plant Pathology), Panjab University (1949–57), Reader (1957–62), Professor (1962–67), Senior Professor (1967–77) and Head of the Botany Department (1976–77), in the same University. His re-appointment as Professor (1977–80) and financial support from DST enabled him to work in the Department and the University uninterruptedly for over forty years.

Though his Ph.D. degree was in plant pathology, and he did carry on work on problems in plant pathology, he is best known for his contributions to systematic mycology. The general training he received in the Panjab University in the honours courses equipped him well for the work he took up from the early fifties until after his retirement in 1980. His most significant contribution is undoubtedly his pioneering and extensive exploration of the mycoflora of the North-Western Himalayas (1952–76) and of the Eastern Himalayas (1977–86). The M.Sc. Honours course in Mycology attracted many students during these years and most of the work was carried out vigorously by him and his many students in an endeavour to map the Himalayan mycoflora. Surveying his contributions as a whole, one sees in it wonderful planning and phasing of the work in terms of the manpower and resources available. Besides the Myxomycetes, several groups of the Basidiomycotina and the Ascomycotina were collected and described. These include the Xylariaceae in the

Pyrenomycetes, the Pezizales and the Helotiales in the Discomycetes, the Aphyllophorales (Clavarioid, Thelephoroid, Hydroid and Polyporoid fungi) in the Hymenomycetes, and the class Gasteromycetes as a whole. Taxa were elegantly and accurately illustrated, an important element of the work. The exploration of the Himalayan mycoflora led to an uncovering of a remarkable number of not only new records, but description of a number of new species and some new genera too.

While the mycological exploration of the Himalayas by Thind and his students is in itself a major achievement, he also consolidated our knowledge of some of the fungal groups by his monographs of some of them. His *Clavariaceae of India* (1961) and *The Myxomycetes of India* (1977) are authoritative examples. He used the best methods for his anatomical studies of the larger fungi and placed great emphasis on the importance of tissue systems in the fungi.

The systematic and thorough nature of his work is reflected in the Mycological Herbarium he built in the Panjab University.

Apart from his research he was reputed to be one of the finest teachers in the areas of mycology and plant pathology. He was a Member of the Executive Committee of the International Mycological Association (IMA) from 1971 to 1983, President of the Indian Phytopathological Society (1972), President, Section of Biological Sciences, National Academy of Sciences of India (1973), President, Indian Botanical Society (1973), President, Section of Botany, Indian Science Congress (1976) and President, Mycological Society of India (1979). He was Chairman of the Committee for the Development of Asiatic Mycology of the IMA during 1977–83. A recipient of the Panchanan Maheshwari Medal of the Indian Botanical Society, he was also awarded the Prof. T. S. Sadasivan Lecture Award by the Indian National Science Academy. He was elected a Fellow of the Academy in 1960.

He had remarkable qualities which endeared him to all. He remained active almost till the end except perhaps for the last few months, when a terrible affliction overtook him which he bore patiently and from which there was no possible recovery. He passed away at Chandigarh on 3 December 1991.