



# Patrika

July 1983 No. 6 Newsletter of the Indian Academy of Sciences

## Golden Jubilee of the Academy

The Academy will be celebrating its Golden Jubilee in 1984. Registered at Bangalore on 24 April 1934, it was formally inaugurated at a public meeting held at the Indian Institute of Science on 31 July 1934, by Amin-ul-Mulk, Sir Mirza M Ismail, Dewan of Mysore. The whole of 1984 will be treated as the Golden Jubilee year of the Academy, with special meetings on 24 April 1984 and 31 July 1984 and an Academy week in November 1984 at Bangalore to coincide with the 50th Annual Meeting of the Academy.

Proceedings A and B of the Academy were first published in July 1934 and since then have been published regularly. Special Golden Jubilee numbers of all the journals of the Academy will be published during 1984. These will contain up-to-date reviews in all the major fields covered by the journals as well as original papers by Fellows of the Academy and distinguished scientists both in India and abroad.

The first volume of Prof. Raman's Collected Papers on Scattering of Light was published in 1978. Five more volumes of his collected papers are expected to be published during the Golden Jubilee year. A history of the Academy is also planned to be published.

The 50th Annual Meeting of the Academy will be held at Bangalore. Exhibitions on the heritage of science and on Prof. Raman's life and work will be arranged during the Meeting.

Special symposia will be held during the year, during or immediately after the 50th Annual Meeting. The subjects chosen are astronomy, particle physics, some aspects of biology, materials science, electronics and computers, climate changes and the ecology of the Western Ghats.

All Foundation Fellows will be special guests of the Academy at the 50th Annual Meeting and all their expenses for travel and stay at Bangalore will be met by the Academy.

## Evolution and fate of the universe

Academy lecture given by Prof. Martin J Rees, Plumian Professor of Astronomy, Institute of Astronomy, Cambridge, at Bangalore on 3 January 1983.

The title "*Evolution and fate of the universe – the universe from  $10^{-36}$  to  $10^{30}$  years*" reflects but does not fully convey the wide range of topics in astronomy covered in the lecture. Professor Rees guided the audience through the basic observations and the underlying physics of stars, galaxies and the universe as a whole, both at early and late epochs. This was a unique opportunity to listen to such an account from a person who had contributed to almost all the topics covered. Like Eddington, his illustrious predecessor at Cambridge, Prof. Rees closely followed a written text. It would be a mistake, however, to conclude that this detracted in any way from the rapport between speaker and audience or the atmosphere of expectancy, amounting almost to physical tension, which characterises the best lectures.

In response to a strong feeling that such a lecture should be more widely available, Prof. Rees agreed to the publication of the entire text in *Current Science*, where it has since appeared, in two parts, in the issues of May 20 and June 5, 1983. It is hoped that the summary which follows will act as an incentive to the readers to consult the original.

The life cycle of stars, like our sun, starts with their birth in interstellar clouds, followed by billions of years converting hydrogen to helium as a source of energy. This in turn is followed by their swelling in size to red giants and then shrinking to white dwarfs. But for heavier stars, life ends more dramatically with a supernova explosion, possibly accompanied by a collapsed object – a neutron star – at the centre. The classic example is the Crab Nebula and its associated pulsating radio source or pulsar. The

extreme conditions of matter in such an object are an example of how astronomy challenges and enriches physics. But as was first pointed out by Eddington, very simple physics involving atoms and gravity could have enabled astronomers on a hypothetical cloudbound planet to predict the existence and basic properties of stars. While phenomena like supernovae may seem exotic and remote, they are intimately connected with the formation of the chemical elements which make up all familiar objects including ourselves. Ironically, this widely believed relationship was discovered by Hoyle and his collaborators in their pursuit of the steady state theory of the universe which itself has not survived subsequent developments.

Coming then to galaxies, the fundamental question "Why should entities with such a characteristic mass and size form?" remains unanswered. However, granted that galaxies form from the gravitational collapse of gas, it is possible to rationalise the distinction between spiral and elliptical galaxies in terms of a delayed or a rapid formation of stars. Basically, gas clouds would tend to collide, dissipate their kinetic energy and form a flattened disc perpendicular to the axis of rotation. If stars formed very early, however, they would retain their motion in all three dimensions since collisions would be absent, resulting in an elliptical galaxy. The two major gaps in our theoretical understanding are thus the nature of the galaxy-forming gas masses, and what triggers and regulates star formation.

The centres of some galaxies are the seat of the most violent energetic and rapidly varying processes in the universe, quasars being the classic example. A consensus has emerged that such phenomena result from a runaway process in which gas and stars collapse and combine under the action of gravity to form a black hole. The concept of such a body from which even light cannot escape dates back at least to 1784 when John Michell, a decade before the better known work of Laplace, proposed it. The black hole is characterised by a spherical "one way membrane" from within which no traveller, and indeed no information, can reach the outside world. What is remarkable is that such concepts, which were the province of pure theory for decades, are now being vigorously followed up in constructing realistic theoretical models for active galaxies.

Such theoretical efforts have, however, nearly always been guided by observations which now cover the whole electromagnetic spectrum. There has been tremendous progress in techniques in recent times culminating in the keenly-awaited launch of the space telescope. This instrument is expected to make basic contributions to observational cosmology.

The science of cosmology is by definition the study of a unique object and a unique event. There is no question of the repeated and controlled experiment or even the statistical studies of many samples which characterise other sciences. Progress has been possible solely because "the observed universe, in its large scale structure, is simpler than we had any right to expect". On the length scale of a hundred million light years, still small compared to the total region of the universe which we can observe, homogeneity and isotropy seem to prevail. The discovery of the expansion of the universe by Hubble in 1929, and the discovery of microwave radiation, widely believed to be a relic of the big bang, by Penzias and Wilson in 1965, are two golden moments in cosmology. One more relic from an even earlier era than the background radiation may be the element helium which makes up a quarter of the material in the universe. This quantity is too large to be explained by formation in stars alone.

The process of extrapolating backwards does not stop with the formation of helium. The only theoretical limit is the era when the ill-understood quantum effects in gravity start to play a crucial role. One of the attractive speculations which has emerged from this backward extrapolation is a model for the creation of the excess of matter over antimatter, which seems to prevail today. The adage that cosmologists are "often in error but seldom in doubt" should however act as a warning against over-enthusiastic and uncritical acceptance of such ideas.

In the opposite direction, the ultimate future of the universe—recollapse or eternal expansion—hinges on the density of matter. Recent studies have shown that the rotation of galaxies and their movements around each other can only be understood if large amounts of dark matter are present, as much as 20% of that required to reverse the cosmic expansion. The extremely elusive nature of the intergalactic medium adds further uncertainty to the estimates of density and makes the outcome uncertain. It is a sobering thought that invisible neutrinos may dominate the dynamics of all the visible matter made of protons, neutrons and electrons, dethroning us further in the scheme of things.

One of the remarkable facts about the universe is that rather small changes in its critical conditions or in the physical constants could generate a totally different outcome, presumably inhospitable to observers like ourselves. The 'anthropic' school of thought turns this in reverse to postulate that things are as they are because we are as we are. To be taken seriously, such ideas require a statistical element in the underlying theory generating an ensemble of universe of which we, as observers, select one. The alternative, of course, is a

fundamental theory in which these apparently coincidental and even conspiratorial initial conditions and fundamental physical constants are themselves explained.

What we are finally left with is a sense of wonder that such apparently strange and exotic questions can now be attacked scientifically and that in our own lifetimes, observations which throw light on them, will be made.

## Proceedings – Earth and Planetary Sciences

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### Report by the editors

With a view to providing Indian scientists with a theme journal for publication of both original and state-of-the-art papers related to the earth, its oceans and the atmosphere, the Academy approved in 1977 the formation of a new section of the Proceedings devoted to Earth and Planetary Sciences. The first issue of the journal appeared in March 1978 and since then it has been published triennially in March, July and November every year. Thirteen issues of the journal totalling more than 1400 printed pages have so far appeared.

During this period, we received for consideration 249 papers, of which 138 were accepted for publication. Excluding the papers which are still under consideration, the rejection rate has been on an average about 30%. We are glad to report that, in spite of this, the rate at which the papers are received has increased considerably in the last two years. The areas which fall under the purview of the new journal are aeronomy, electromagnetics, exploration geophysics, geochemistry, geodesy and gravity, geomagnetism and palaeomagnetism, hydrology, meteorology, mineralogy, petrology and crystal chemistry, oceanography, particles and fields, interplanetary space, ionosphere, magnetosphere, physical properties of rocks, planetology, seismology, tectonophysics, volcanology and information related to geological items and to geographic regions.

In line with the other journals of the Academy, we follow a strict refereeing policy for both original and state-of-the-art papers. All papers which are received for consideration are sent to two referees, who are experts in the field. In cases where both the referees feel that the paper can be accepted for publication with only minor changes, the author is requested to revise the paper and on receipt of the revised paper, one of the members of the editorial

board checks if all the necessary changes have been made before final acceptance for publication. In cases where referees' comments imply major modifications, such as carrying out some complementary experiment or analysis, removing some erroneous data or conclusions, etc., the papers are sent back to the reviewers for their concurrence, before either accepting or rejecting the paper. There are some papers on which the referees' opinions are divided, where one referee feels it should be accepted for publication and the other feels that it does not contain significant material to warrant publication. For such papers a third opinion is sought, generally that of a member of the editorial board. We generally insist that all suggestions made by the referees are taken into account by the author while revising the paper. Although some authors may not be happy in being asked to modify their papers, it is our observation that whenever we have insisted on such matters, the overall quality of the paper improved significantly. We must also point out the difficulties the editors face, when at times, one referee just gives his comment in one line saying that the paper is recommended for publication, while the other referee rejects the paper outright giving detailed reasons for his decision.

Another very sensitive area concerns the objectivity of the referees and of the authors while replying to the referees' comments. We urge both referees and authors alike to be more critical and objective in their statements. Another feature we would like to comment on concerning the manuscripts received is that about 50% of the authors, who are from laboratories with excellent facilities for the preparation of manuscripts, do not follow the instructions given for the preparation of papers. This relates particularly to drawings. We request the authors to keep in mind at the time of the preparation of both big diagrams or tables, the size in which they would appear finally. This would avoid duplication of efforts at the editorial office and expedite the publication process.

We shall be glad to receive original as well as state-of-the-art papers from Fellows and other scientists working in the area of Earth and Planetary Sciences. We sincerely believe that the standard of our journal will continue to improve, if all active scientists of the country decide to publish their quality papers in the journal. From the editorial point of view, we shall try our best to cut down on refereeing time, if this can be done without lowering the quality of papers and the overall standard laid down for the Proceedings.

# The fundamental atomic constants : the ubiquity of alpha

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Academy lecture given by Prof. G W Series, FRS, sixth Raman Professor, at Bangalore on 3 February 1983

The dimensionless fine structure constant alpha, now defined as  $e^2/hc$ , found its way into physics as the velocity of the electron in Bohr's first orbit, relative to the speed of light. In this sense it was a quantity which could not be measured. It turned up in a measureable way in Sommerfeld's relativistic theory of the hydrogen atom as the factor governing fine structure intervals in the spectrum. But the fine structure itself in Sommerfeld's day was difficult to measure. Today we do it by radio frequency spectroscopy, taking account of Lamb shifts; also we can get a value from hydrogen hyperfine structure, and we compare these values with  $e^2/hc$  computed from 'best' values of the atomic constants.

This lands us in deep water. The atomic constants are determined from precision measurements of many combinations of constants – the Rydberg, the ratio of nuclear to Bohr magneton, the ratio of electron charge to Planck's constant – altogether an overdetermined set. We need, of course, a coherent set of units such as the SI *defined* units. But to establish a set of units for laboratory use is not the same thing as to agree on a definition. At the level of parts-per-million accuracy, different methods of realizing the ampere, for example, prove to be inconsistent. So the determination of the atomic constants is intimately connected with the laboratory realization of the SI system. When inconsistencies are found they disclose errors either in the carrying-out of experiment or in the working-out of theory. Time and again new physics has come from the recognition of small inconsistencies.

Two remarkable discoveries in recent years brought superconductivity and semiconductor physics into the arena of the atomic constants : the a.c. Josephson effect in 1962, whereby the volt is now realized through the irradiation of a junction between two superconductors with microwaves of specified frequency ( $2e/h$ ); and the discovery of von Klitzing in 1980 that the transverse resistance of a two-dimensional flow of electrons subjected to magnetic field (Hall effect) is quantized in sub-multiples of  $e^2/h$ . But

that takes us back to the beginning,  $e^2/hc$ , since the speed of light has been promoted, under the onslaughts of laser spectroscopy, to the status of a fixed number. So Bohr's circular orbits, re-born as Landau orbits, tell us seventy years later that there are more things in  $e$  and  $h$  than were dreamt of in the old philosophy.

## Young Associates of the Academy

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Encouragement of promising young scientists to do work of high quality has been emphasized as one of the aims of the Academy in its manifesto "Role of the Academy". The Council of the Academy, after considering in detail a report of a special committee appointed by the President, has now decided to grant formal recognition to bright young scientists by designating them Young Associates of the Academy.

The selection will be limited to scientists below 35 years in age and the recognition will be granted for a maximum period of five years. There will be only 100 such scientists at a time.

The Young Associates will have the privilege of attending the Annual Meetings of the Academy to present their work and will receive free of charge one Academy journal of their choice. They will be free to mention their selection as Young Associates, while applying for positions and obtaining research grants.

In order that the mechanism for selecting Young Associates does not become too cumbersome, the selection will be based on the recommendations of selected individual scientists whose judgement can be trusted and who have the gift for identifying young talent. The final decision will be made by the President with the assistance of a small committee. All Fellows of the Academy will, however, be free to suggest names of scientists for the Associateship.

The selection of the first batch of thirty Young Associates will be made shortly. It is hoped that it will give young scientists the necessary incentive and encouragement to accomplish greater things as well as enable them to obtain necessary facilities for their research work.



Selected Papers of Prof K R Ramanathan being presented by Prof S Ramaseshan

## Prof. K R Ramanathan is ninety

Prof. K R Ramanathan, one of the most distinguished Fellows of the Academy and an old associate of Prof. CV Raman, attained the age of ninety on 28 February 1983. The Academy commemorated this unique occasion by the publication of the 'Selected Papers of Prof. K R Ramanathan' in two volumes, copies of which were formally presented to him by Prof. S Ramaseshan, President of the Academy, at Ahmedabad on 22 February 1983, at a function organised to felicitate him. In 1953, on the occasion of his sixtieth birthday the Academy had published a special issue of the Proceedings A - Physical Sciences.

Prof. Ramanathan was born at Kalpathi, Palghat on 28 February 1893. He had his early education in the Government Victoria College, Palghat and the Presidency College, Madras, from where he took his Bachelor's and Master's degrees in Physics. Prof. Stephenson of the Maharajah's College of Science, Trivandrum, who was his examiner, was so impressed with young Ramanathan that he immediately offered

him the post of demonstrator in his Department. During the seven years he worked in Trivandrum, he also served as Honorary Director of the Trivandrum Observatory. His first scientific paper was on 'Thunderstorms in Trivandrum' published during this period.

He joined Prof. CV Raman as a University of Madras research scholar towards the end of the year 1921, and collaborated with him in the studies of the molecular scattering of light, then in progress in Prof. Raman's laboratory in Calcutta. He published ten papers on molecular scattering of light and X-ray diffraction in liquids, gases and mixtures within a period of less than one year and was awarded the DSc degree of the University of Madras for this work.

Domestic responsibilities forced him in 1922 to take up a teaching appointment at Rangoon. Even so, he continued to visit Calcutta during the vacations and collaborate in the work going on in Prof. Raman's laboratory. Three years later he resigned his lecturership at Rangoon to take up the position of Meteorologist in the India Meteorological Department. He retired from the Department in February 1948, on attaining the age of 55 years and soon after joined the Physical Research Laboratory, Ahmedabad as Professor of Atmospheric Physics and its first Director. He retired from the Directorship in 1966, but continues to work as an Emeritus Professor.

Prof. Ramanathan's work in light scattering is well known. During the year he spent at Calcutta, he carried out a series of studies in collaboration with Prof. Raman on the intensity and depolarization of light scattered by substances like ether, benzene and carbon dioxide as they passed from the liquid to the gaseous state through their critical temperatures. In addition to these investigations, Raman and Ramanathan also began studies on the role of concentrations of components in light scattering by liquid mixtures and extended their ideas of the fluctuation theory to the understanding of X-ray diffraction by liquids.

It was during his visits to Calcutta on his vacations from Rangoon, that he began work on an intensive examination of the molecular diffraction of light by water. He detected a 'weak fluorescence' in the scattered beam, and attributed it to impurities in the liquid. Raman, who was not satisfied with this explanation, felt it was a characteristic of the substance, and his investigations of this 'feeble fluorescence' during the next few years led to the discovery of the Raman Effect in 1928.

Prof. Ramanathan's research work in the India Meteorological Department covered a wide range of subjects, in each of which he has made basic contributions. Solar and atmospheric radiation, the spectrum of the night sky, meteorological optics and acoustics, terrestrial magnetism, seismology, studies of the Indian monsoon and of storms, depressions and cyclones in the Indian seas, and the general circulation of the atmosphere over India and its neighbourhood, were all of equal interest to him. His principal preoccupation, however, was the study of the thermal structure and movements of the upper air, and it is in this field that his contributions are outstanding. He organized the first upper air soundings over India from Agra using Dines meteorographs and high altitude balloons, and was the first to publish the now famous diagram showing the distribution of upper air temperatures over the world up to 25 km in summer and winter. It incorporated the valuable sounding-balloon data obtained at a number of stations in India, and a few stations in other parts of the world. This diagram showed clearly the cold and high tropopause over the tropics, and the marked inversion above the tropical tropopause. It also revealed that the coldest air in the atmosphere occurs above the equator, and not the poles. In spite of the immense amount of data gathered since on the upper atmosphere, Prof. Ramanathan's diagram still retains its premier place.

Prof. Ramanathan established the new Upper Air Division in the Meteorological office at Poona in 1928 and during the next few years with his colleagues and research students carried out here a comprehensive study of the

upper atmosphere over India and its neighbourhood, and also undertook a systematic analysis of the upper winds. His memoir on the general circulation of the atmosphere over India and its neighbourhood was the first clear and comprehensive study of the subject and is still considered a standard work of reference on the subject.

Prof. Ramanathan's research work at the Physical Research Laboratory was mainly concerned with studies of atmospheric ozone, night airglow, ionospheric and space physics, and solar and galactic influences on the ionosphere. He established the network of Dobson ozone spectrophotometer stations in India, and with his collaborators took the first measurements of the vertical distribution of ozone in the atmosphere over the tropics. With Dave, he evolved and extended the use and development of the Götz Umkehr method of finding the vertical distribution of ozone in the atmosphere.

His major contributions in the study of atmospheric ozone are on the extremely important relationship between atmospheric ozone and the general circulation of the atmosphere, which he announced during his Presidential address to the International Association of Meteorology at Rome, in 1954. The attention attracted by this address led to the establishment of a large number of ozone measuring stations in the world during the International Geophysical Year, and the theoretical studies of the behaviour and transport of ozone in the upper atmosphere.

Another important breakthrough in the study of the geographical distribution was his work on the dependence of an ozone distribution on meteorological phenomena such as jet streams and their location, tropopause discontinuities and inter-latitudinal air exchange.

His third major contribution was the discovery of the quasi-biennial oscillation of total ozone in the tropics associated with the 26-month oscillation in stratospheric winds and temperatures, which he announced in his Presidential address at the International Ozone Symposium at Albuquerque in 1964. He also pointed out that the variations in the northern and southern hemispheres are in opposite phases.

Prof. Ramanathan has been deeply interested in twilight and airglow studies since 1930. The first airglow spectrum at low latitudes was taken by him in Poona in 1930. This work, continued by him and his students at Poona and later Ahmedabad, Mount Abu, Gulmarg and Srinagar, established the nocturnal and seasonal variations of the green and red lines of oxygen and the effect of solar flares on the green emissions. One of the major

contributions, again with Dave, was the estimation of the contribution of secondary and higher order scattering in twilight.

Of importance are also the contributions made by Prof. Ramanathan and his students to ionospheric and space studies during the last 30 years, such as the effect of electron-ion collisions in the F-region of the ionosphere on the absorption of cosmic radio noise, and the effect on the lower ionosphere of X-rays from discrete galactic sources. He considered, long before any one else, the ionosphere as another region where circulation systems similar to those in the lower atmosphere were bound to exist.

He also took an active part in the work of COSPAR and space research both in India and abroad. The successful implementation of the Indian and global meteorological rocket network and the synoptic exploration of the dynamic structure of the upper atmosphere were in a large measure due to Prof. Ramanathan's support. Of even greater importance in the long term is the interest and support Prof. Ramanathan provided for the studies of interaction between the neutral and electrical atmospheres. His recognition of the thread of unity, which is a principal characteristic of space age atmospheric physics, is possibly the greatest contribution to be attributed to Prof. Ramanathan.

It is interesting that Prof. Ramanathan never left the shores of India until after his retirement from the Meteorological Department at the age of 55. However, the world meteorological community which knew of him and his outstanding contributions to the subject recognised his work by awarding him the International Meteorological Organisation Prize in 1961 and electing him President of the International Association of Meteorology (when he delivered his classic lecture on atmospheric ozone and the general circulation of the atmosphere). He was also elected President of the International Union of Geodesy and Geophysics in 1957, and President of the International Ozone Commission for three terms starting in 1961.

As President of IAMAP, IOC and IUGG, he effectively promoted international co-operation in research in meteorology and atmospheric physics, geophysics and oceanography, hydrology and aeronomy, and the organization of various international observational programmes such as the International Geophysical Year, the International Geophysical Cooperation, the International Years of the Quiet Sun, the International Indian Ocean Expedition, the International Hydrological Decade and Monex. He played a crucial role in the establishment of the International Meteorological Centre at Bombay during the IOE, and the formation of the Indian Institute of Tropical Meteorology thereafter.

As a recognition of Prof. Ramanathan's contributions to scientific knowledge and his leadership in research, the Indian National Science Academy awarded him the Aryabhata medal. The Royal Meteorological Society elected him an Honorary Fellow in 1960. He was honoured by the President of India with the award of the Padmabhushan in 1965, and the Padma Vibhushan in 1975 for his services to science and the country.

A Foundation Fellow of the Academy, and one who occupied its prestigious Raman Chair, he is the most distinguished meteorologist India has produced. Although he took part in Raman's epoch making researches on the scattering of light and was associated with him for many years, it is as a meteorologist and as one who contributed significantly to the building up of scientific meteorology that he will be remembered most.

In spite of his erudition, his scientific achievements and the recognition that he has received, the characteristic that most impresses anyone who meets him is his modesty and humility. We are confident that all Fellows will join us in paying our tribute to a great scientist, who by his energy and enthusiasm for research has inspired many generations of students, and who has had an enduring influence on the growth and development of several scientific fields during the last seven decades, both in this country and abroad. We wish Prof. Ramanathan many more happy and active years.

# 49th Annual Meeting of the Academy

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At the invitation of the National Chemical Laboratory, the 49th Annual Meeting of the Academy will be held at Pune from Monday 7 to Wednesday 9 November 1983.

The tentative scientific programme consists of:

(a) The Presidential address by S Ramaseshan

(b) A symposium on tissue culture-  
Convener: H Y Mohan Ram

Photosynthesis in cultured cells-A Gnanam

Induction of haploids: achievements, problems and possibilities - Sudhir Sopory

Isolation and fusion of protoplasts and somatic fertilization-S S Bhojwani

Tissue culture and micropropagation-  
A F Mascarenhas

(c) A symposium on Frontiers in organic synthesis-Convener: A V Rama Rao

Some aspects of steroid synthesis-G S R Subba Rao

Synthetic design of platonic hydrocarbons - G Mehta

Car-3-ene, a versatile resource for important industrial fine chemicals-Sukh Dev

New stereocontrolled synthetic routes to bridged-ring and alicyclic compounds-  
U R Ghatak

Synthesis of biologically active compounds with a difference - A V Rama Rao

(d) A series of lectures on the Indian Antarctic expedition - S Z Qasim, V K Raina, R Sen Gupta and A H Perulekar with slides and film shows of the two Indian Antarctic expeditions

(e) Lecture presentations by Fellows:

Neutrinos in the universe-R Cowsik

Development and differentiation in plants -  
M M Johri

Diamagnetism - a surprise in theoretical physics - N Kumar

Modelling and simulation in polymer engineering - R A Mashelkar

Research in reliability engineering during seventies - K B Misra

Energy conservation - an organic chemist's attempts - N S Narasimhan

Unification of the forces of nature  
- G Rajasekaran

Glass transition: a veritable clue to the nature of glassy state - K J Rao

Intracranial vascular malformations -  
P N Tandon

Non-covalent interactions and molecular association involving biomolecules -  
M Vijayan

Correlation of the tectonic belts in Kumaun. lesser Himalaya: a geochronological approach  
- K Gopalan

(f) Evening lectures -

Anti-leprosy vaccine - the global scene -  
M G Deo

Microprocessors - B Nag

During the period of the Annual Meeting, the Editorial Boards for various journals and the Sectional Committees will also meet at Pune.

The Council of the Academy has decided that all Fellows, attending the meeting and who are not able to obtain travel support from other sources, will be paid first class return train fare from their places of residence to Pune and back.

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## Obituaries

**Phanindra Chandra Dutta**, Emeritus Professor and former Head of the Department of Organic Chemistry, Indian Association for the Cultivation of Science, Calcutta, passed away on 13, June 1983.

Born in 1912, Prof. Dutta had his early education in Agartala and Rajshahi, now in Bangladesh. He obtained his MSc and DSc degrees from the Calcutta University, the latter working with Prof. P C Mitter. He was awarded the Nagarjuna prize for independent research in 1938. His work with Prof. Paul Karrer in Zurich was the beginning of his long association with some of the most distinguished scientists in organic chemistry like Professor G Stork and Professor R B Woodward at Harvard, Prof. V Prelog in Zurich, Prof. D H R Barton in London. He returned to India in 1953 to take charge of the Department of Organic Chemistry, Indian Association for the Cultivation of Science, Calcutta, where during his 24 years of activity he carried out important researches relating to the synthesis of the complex structural framework of terpenoid natural products and established an internationally reputed school in synthetic organic chemistry. He was a pioneer in introducing in this country the concept of stereocontrol for synthesis of multi-asymmetric centred polycyclic compounds, close on the heels of its development at Harvard. He

successfully applied this concept for the synthesis of resin acids, diterpenes of complex structures and sesquiterpenes. He also published one of the earliest papers on synthetic approaches to some complex sesquiterpenoids. He continued to work even after his retirement and was associated with a project for conversion of quinine to quinidine, during his last days.

**Tryambak Shankar Mahabale** was born on 19 October 1909 at Ahmednagar. He received his early education at Ahmednagar and Nasik. He graduated in science in 1932 from Fergusson College, Poona. He obtained his MSc and PhD degrees in 1935 and 1939 respectively from the Bombay University.

He began his career as a sugar chemist, later joining B J Medical School and Fergusson College as a lecturer. He also worked at the Gujarat College, Ahmedabad and as Associate Professor at the Institute of Science, Bombay. He was Assistant Editor of the "Wealth of India", New Delhi for many years and joined the University of Poona in 1953 as Professor and Head of the Botany Department. After his retirement, he joined the Maharashtra Association for the Cultivation of Science as Honorary Professor and served in this capacity till the end.

Many honours came to him during his lifetime. He was elected a Fellow of the Academy in 1951. He was President of the Indian Botanical Society in 1968, and one of the Vice-Presidents of the Palaeobotany Section of the International Botanical Congress. He was awarded the Birbal Sahni Gold Medal in 1978 by the Indian Botanical Society.

Mahabale's published work, which included a monograph on Palms of India, is characterised by the diversity of his interests and bears witness to his lively scientific curiosity and profound appreciation of the manifold aspects of plant life from Bryophytes to Angiosperms, both fossil and living.

He was a fascinating and lovable person, a man of immense charm and warmth, yet modest and retiring by nature. He was remarkable for the breadth and depth of his knowledge. Mahabale at heart was a 'naturalist', an insatiable collector and loved plants. He is survived by his wife, two sons and four daughters. He will be greatly missed by his colleagues and his many friends and students.

**Axel Hugo Teodor Theorell**, the distinguished biochemist, was born in Linköping, Sweden on 6 July 1903. He obtained his MD from the Caroline Institute at Stockholm and worked as a lecturer and later Assistant Professor of Medical Chemistry at Uppsala. He was from 1937 the Director of the Department of Biochemistry at the Medical Nobel Institute.

He received the Nobel Prize in physiology

and medicine in 1955, for his work on oxidizing enzymes of cell respiration. He was the first to crystallize myoglobin in 1932 and to purify, crystallize and reversibly split "yellow" enzyme into protein and coenzyme parts. The study of the "old flavoprotein enzyme", the prosthetic group of which is the flavin mononucleide (FMN), was carried out by him with Prof. Otto Warburg when he was holding a Rockefeller Foundation Fellowship at the Kaiser Wilhelm Institute (now Max Planck Institute) for Cell physiology at Berlin-Dahlems. It is the electrophoretic separation of this enzyme from a polysaccharide, which accompanied it, that enabled him to purify this enzyme and to determine its main properties.

Of special interest, however, is his extensive study of cytochrome c, the extractable and soluble component of the cytochrome system, which constitutes the intracellular respiratory chain of catalysts linking the dehydrogenase systems with molecular oxygen, thus providing the essential path for hydrogen or electron transfer from the activated molecules of substrates to oxygen. To the study of the physico-chemical properties of cytochrome c and other haemoproteins, the mechanism of the reactions in which they are involved and the nature of the links between their prosthetic groups and protein, Professor Theorell applied great technical skill and a variety of modern physico-chemical and biochemical methods.

Prof. Theorell and his co-workers also studied the properties of alcohol dehydrogenase extracted and purified from liver, and they were able for the first time to follow spectrophotometrically the kinetics of reactions between the enzyme and the reduced co-enzyme I. From this work emerged a method for the precise estimation of minute amounts of alcohol, which is of great value in medico-legal work.

Prof. Theorell established a very active centre of research at Stockholm which attracted many workers from different countries to his department to study a great variety of biophysical and biochemical problems. He passed away at the age of 80.

Editor : Anna Mani

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