SCIENCE NEWS

DISCUSSION MEETING ON NON-DEBYE RELAXATION IN CONDENSED MATTER

The discussion meeting, sponsored by the Indian Academy of Sciences was held in the Department of Physics, Indian Institute of Science, Bangalore, from 14 to 17 September, 1982 and was attended by about 35 physicists. It was co-sponsored by the Indian Institute of Science and the Raman Research Institute. The Department of Science and Technology, the Indian Academy of Sciences and the Indian Institute of Science together funded the meeting. Prof. T. V. Ramakrishnan of the Department of Physics (IISc) was mainly responsible for organizing the meeting.

The meeting was aimed at focussing attention on a pattern of behaviour common to very different classes of systems. This feature is beginning to be recognized phenomenologically but is fundamentally not understood. 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 characterized by a single relaxation time (hence the name non-Debye). The characteristic time-scales extend over several orders of magnitude; these glassy systems relax on *all* time-scales. In the last few years, due to the work of Jonscher and more particularly of Ngai, it appears that a single simple phenomenological form fits a bewildering variety of data and successfully relates apparently different properties of a particular system. The form implies non-exponential 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, inaugurated by Prof. P. S. Narayanan, (IISc, Bangalore), began with an overview by Dr K. L. Ngai (Naval Research Laboratory, Washington D.C.) entitled 'Evidence for universal behaviour of condensed matter at low frequencies/long times'. In addition to a quick review of his ideas on non-Debye relaxation, Dr Ngai described in detail their recent successful application to two classes of systems, namely, polymers and amorphous semiconductors The lecture demonstrated in remarkable wealth of detail, the universality of relaxation processes in disordered systems. Prof. N. Kumar (IISc, Bangalore) critically reviewed the extent theoretical ideas. It was clear that none did much justice to reality.

The meeting then moved on to specific areas; Mr B. Purniah (Reactor Research Centre, Kalpakkam) reviewed results on internal friction in metallic glasses and other disordered systems. It was brought out during discussion that relaxation spectra and their temperature dependence imply non-Debye behaviour, but have been fitted with bizarre combinations of conventional types. Prof. A. K. Raychaudhuri (IISc, Bangalore), described and analyzed the extraordinary richness of behaviour indicated by a single slide showing how ultrasonic attenuation in vitreous quartz varies with temperature (from 10^3 to 10^{-1} °K). The existence of characteristic temperature regimes, relaxation at all time-scales especially at low temperatures, the connection between high and low temperature behaviour of glasses, were all discussed by him. Relaxation in glasses was one of the major themes of the meeting. Dr Abhai Mansingh (Delhi University), one of the long-time workers in the field of dielectric relaxation in glasses, reviewed this area and pointed out the importance of mutually consistent information on dielectric absorption and dispersion over a wide frequency range as a precondition to drawing any conclusion regarding non-exponential response.

Dr K. L. Narasimhan (TIFR, Bombay) discussed AC conductivity of amorphous semiconductors; the conductivity goes as a fractional power of the frequency, the index depending on temperature. The existing microscopic explanations based on localization theory and on hoping ideas were reviewed by him succinctly. The inadequacies were apparent. Surprisingly, the phenomenological ideas of Ngai fit the data quantitatively. Dr B. A. Dasannacharya (BARC, Bombay) described the information obtained on excitations in metallic glasses and other disordered systems by inelastic neutron scattering. It is expected that with the special neutron facilities becoming available, low energy excitations of longer wavelength can be investigated.

The idea that in spin glasses (an assembly of magnetic moments coupled with random strengths) dynamics holds the key to even the static behaviour, was lucidly discussed by Dr Deepak Kumar (University of Roorkee) and by Dr C. Dasgupta (Minnesota).

Computer simulation of model systems, the large number of ground states, their mutual inaccessibility and consequent non-ergodic behaviour were described and compared with the general time-dependent behaviour observed in real spin glasses. Recent progress in the solution of the infinite range Ising spin glass model was detailed by Dr C. Dasgupta. One of the interesting comparisons, not made was between spin glasses and glassès.

Several examples of NMR studies of disordered systems, particularly of superionic conductors, were described by Dr S. V. Bhat (IISc, Bangalore). Again, the relaxational behaviour departs characteristically from that due to a single relaxation time. Drs Kanwar Krishan and G. Ananthakrishna (RRC, Kalpakkam) focussed attention on the cooperative temporal phenomena in metals under irradiation and stress. The kinetics of formation, coalescence and growth of voids were described in terms of interesting coupled nonlinear models. The kinetics of spinodal decomposition, which can be considered as relaxation of an unstable mixture to a stable two-phase system, was summarized by Dr M. K. Phani (TIFR, Bombay). Dr N. V. Madhusudana (RRI, Bangalore) described some results on the dynamics of liquid crystals; the evidence regarding relaxational behaviour seems at present ambiguous and incomplete.

Prof. C. K. Majumdar (IACS, Calcutta) 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 for which a model is given. This kind of approach was one of the running theoretical themes of the meeting. Dr Deepak Dhar (TIFR, Bombay) suggested, for instance, that the lowest energy (spatially largest) localized eigenmodes of a disordered system determined its long-time relaxation behaviour. The energy density of such Lifshitz states is known; this argument leads to non-exponential behaviour with a single universal exponent. There was surprisingly little discussion of this radical idea, based on detailed results on a one-dimensional Ising model but applied to three-dimensional scalar and vector order parameter systems. Dr S. Dattagupta (University of Hyderabad) presented his work on the dynamics of quenched interstitials in BCC metals, modelled as a generalized interacting spin system. The non-Debye inelastic response is seen to emerge from the microscopic model due to a distribution of relaxation times. Dr V. Balakrishnan (IIT, Madras) discussed a directed random walk model for relaxation of chain molecules, and showed in detail how this exactly soluble model, leads to non-Debye relaxation. All theorietical work presented at the meeting attributes non-Debye relaxation to a microscopically determined distribution of relaxation times, a picture due originally to Neel who considered the relaxation of superparamagnetic clusters. A question not sufficiently discussed was whether this was the only possibility or whether there could be intrinsically non-exponential relaxation mechanisms, having something to do with disorder.

The meeting was made lively by active participation and by several short impromptu presentations of work and ideas. It probably succeeded in promoting the awareness of the problem; it is to be seen whether any significant new research will emerge out of this enhanced awareness.

XXI GENERAL ASSEMBLY OF THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES (IUBS), OTTAWA, CANADA.

The General Assembly of the IUBS was held at the Carleton University and presided over by Prof. E. De. Robertis. It was attended by over 100 delegates from various Academies and Institutions from all parts of the world. The opening ceremony was held on the forenoon of 23 August and was presided over by Professor W. A. Fuller, Chairman of the Canadian National Committee for IUBS. There were welcome addresses by Prof. Fuller, the Hon. J. Roberts, Minister of State for Science and Technology, Dr. Larkin Kerwin, President, NRCC, and Prof. De Robertis.

In his presidential address, Prof. De Robertis referred to the progress made by the IUBS in various areas after the last General Assembly at Helsinki (1979) and highlighted the scientific programme which included symposia or workshops on nitrogen fixation, conservation of genetic resources, and techniques of molecular biology applied to phylogenetic and evolutionary studies. IUBS collaborated with ICSU and UNESCO in the International Biosciences Network. The publication programme has been strengthened, culminating in the publication of *Biology International.*

Biology International

A major step forward was taken when the IUBS decided to launch a "Decade of the Tropics" initiated by Professor Otto Solbrig in his plenary lecture. Prof. Solbrig pointed out that the tropics contain phenomena and systems, the study of which contributed major advances in biological theory by virtue of numbers and diversity in plant, animal and microbial species and soils. Rational management of natural and artificial ecosystems would depend on this. Tropical organisms may have novel structures and functions and one suspects that tropical ecosystems have unique features. Professor Solbrig called attention to a number of areas in tropical biology which need study such as energy needs and vegetable biomass, nitrogen fixation, mycorrhizal associations, litter decomposition, nutrient status of tropical soils, systems of cultivation, soil biology and plant nutrients, pests, diseases and predators.

Besides Prof. Solbrig s lecture, the scientific programme of the Assembly included two symposia, on "The biology of the Northern Oceans (August 25) and "Environmental education through biology (August 26)

The first symposium was sponsored by the Royal Society of Canada and the NRCC and dealt with aspects such as primary production and climatic change, dynamics of ice edges, marine ecosystem patterns, Benthos distribution and Zooplankton. Critical studies on variation in temperature in relation to the development and disappearance of ice were described and data given. The importance of remote sensing in ocean management and climate studies was emphasised. T. Platt spoke on phytoplankton biology in the Arctic. The response of phytoplankton (mainly diatoms) to extremes of temperature, day length, available light, water column stability was described. Nutrient uptake rates determined by tracer techniques compared well with data from the seas.

The Symposium on Environmental Education through Biology dealt with issues in environmental education (Prof. P. J. Kelly), case studies of environmental eduation and strategies for future activities (Prof. Kelly). Case studies were presented by delegates from Arab Gulf States, Malaysia, etc. who were involved in biological education.

A scientific lecture on "Forestry—The global view" by Professor Bruce Zobel of the North Carolina State University (August 24), described the denudation and destruction of virgin forests in the Americas and his pivotal role in initiating and carrying out afforestation programmes to combat the situation. Prof. Zobel's description of the achievements in afforestation with pines was highlighted by suitable colour transparencies.

The recommendations of the adhoc Committee of Review on structure of the IUBS were discussed and the Assembly adopted the final recommendations as published in No. 4 of the 1981 issue of *Biology International.*

The Assembly adopted resolutions on the following:

A decade of the tropics,

Biological monitoring of the state of the environment (bioindicators),

Vegetation map of Europe,

Medicinal plants

Biological nomenclature,

Transfer of technology to rehabilitate lost marginal lands in arid and semi-arid regions and

Taxonomic and biological development in the Arab and African regions.

The present author contends that India should make an effort to understand the form, structure, function and interactions of our flora and fauna, including the innumerable microscopic organisms.

C. V. Subramanian, Director, Centre for Advanced study in Botany, University of Madras, Madras; Member, Executive Committee (IUBS) and Chairman of the Section of General Mycology.

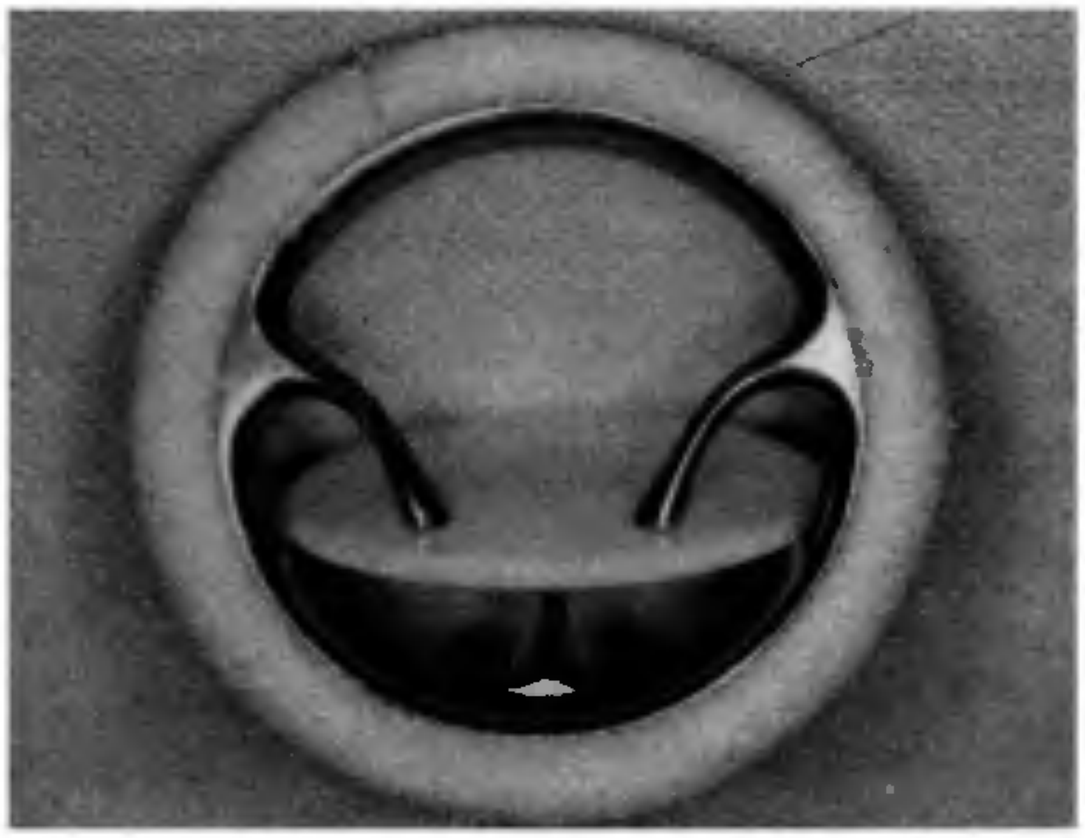
CHITRA HEART VALVE PROSTHESIS

Heart valves are passive, one way check valves. What makes them unique is their special environment They are immersed in flowing blood which is chemically unstable and is readily coagulated by foreign materials. It transports delicate cells that must not be injured. Moreover, the valves guard an orifice which continuously changes in size between pulsatile and irregular chambers. And lastly, the valve mechanism must withstand the stress of beating forty million times a year during the life span of an individual.

Notwithstanding the marvel of heart valves, the replacement of diseased valves by mechanical substi-

tutes has become well established in cardiac surgery during the last two decades. Among various early designs, ball and tilting disc valves have outlasted other models and given new life to millions of patients.

In view of the high cost of prosthetic valves which are imported, Sree Chitra Tirunal Institute for Medical Sciences & Technology, Trivandrum have developed a tilting disc valve which consists of a durable plastic disc and a titanium metal cage (figure 1). The cage is mounted inside a polyester fabric ring which is essential for its intracardiac fixation by surgical sutures. The titanium cage is completely machined from a single block of titanium metal by a new process developed by the Biomedical Technology Wing of the Institute. The integral strut valves have crosed 300 million cycles in the accelerated wear tester without any failure and demonstrated a durability equivalent of 7½ years in the human heart. Currently undergoing implantation trials in pigs, the Chitra tilting disc valve is expected to be available for patients towards the end of 1983.



ANNOUNCEMENTS

WORKSHOP ON PLANT VIRUSES AND MYCOPLASMAS

The Workshop on Plant Viruses and Mycoplasmas sponsored by UNESCO and COSTED and organised by the Department of Botany, National University of Singapore, will be held during 24–27 May, 1983.

The objectives are as follows: (1) To summarise research, development and technological advances in plant viruses, mycoplasmas and plant diseases caused by them, particularly in the Asian region; (2) To assess the status of current trends of research and research techniques; (3) To provide an opportunity for the exchange of information and ideas relevant to developing countries of Asia; and (4) To ascertain possible research collaborations.

The meeting is open to scientists, research workers, University teachers and those interested in plant viruses and mycoplasmas.

Further details may be obtained from The Organisers, Workshop on Plant Viruses and Mycoplasmas, Department of Botany, National University of Singapore, Lower Kent Ridge Road, Singapore 0511, Republic of Singapore.

TWELFTH ETHOLOGICAL SOCIETY OF INDIA

The Twlefth Annual Conference of the Ethological Society of India will be held from 27 to 29th May 1983 at the Department of Physiology, St. John's Medical College, Bangalore. Guest lectures, Symposia, Free Communication and Poster sessions in Ethology will be held. This includes all aspects of behaviour, individual and social, of both invertebrates and vertebrates including experimental analysis of mechanisms of behaviour. Papers on biopsychology are also welcome. Routine natural history observations are of limited interest. Abstracts and papers presented at the conference will be subsequently published in the Bulletin of Ethological Society of India.

Further details may be had from Dr. B. S. Rao, Organising Secretary, XII Annual Conference of ESI, Department of Physiology, St. John's Medical College, Bangalore-560 034.