animals, a trained and experienced animal scientist should be included in the team

(6) Awareness can be generated amongst users through appropriate posters and video tapes in major scientific meetings.

(7) In addition to two or three national centres for laboratory animals (breeding, supply, training, etc.) like LAISC and the Laboratory Animals Centre at the CDRI, creation of smaller regional facilities can be considered. The bigger national centres should have state-of-the-art technologies like development of transgenic animals.

(8) Institutions should constitute ethics committees for animal experimentation. This committee should include at least one veterinarian, qualified animal scientist.

(9) The quality of commercial diet in the country is inconsistent and unsatisfactory. Certification from the Indian Bureau of Standards (formerly Indian Standards Institute) should be made mandatory for commercially produced laboratory animal feeds.

(10) To improve the human resource in the country, specialized training programmes for veterinary science as well as biological science graduates should be evolved. Veterinary institutions can play a major role in providing this training with advice and assistance from the existing national centres like LAISC and CDRI.

(11) Pharmaceutical companies and allied agencies should be brought under strict guidelines with regard to the use of good-quality laboratory animals for drug development and testing. The guidelines can be formulated by a committee of experts.

Mahtab S. Bamji, National Institute of Nutrition, Hyderabad.

Workshop on statistical physics

A workshop on statistical physics in Calcutta from 27 December 1991 to 7 January 1992, organized by the S. N. Bose National Centre for Basic Sciences, was devoted to the frontier areas of statistical physics. The highlights were (i) transport in porous media, (ii) physics of glassy systems, such as supercooled liquids and proton glasses, granular materials, polymers, neural/immune networks, and (iii) dynamics of amphiphilic membranes. In addition, the M. N. Saha and the S. N. Bose memorial lectures were delivered by H. E. Stanley on the interesting topic of fractals.

Porous media. Engineers have been using many simple empirical rules to deal with porous media, particularly because of their technological importance, e.g. in oil recovery. Only recently physicists have begun serious attempts either to find justification of these rules or to propose better alternatives from the study of the physical processes involved. Pabitra Sen (Schlumberger) and Partha Mitra (Harvard/Schlumberger) together delivered four talks on the methods of characterizing the geometry of porous materials from the studies of their transport properties. They also talked about the theory of pulsed NMR measurements in porous media. Dietrich Stauffer (Köln) reviewed the results of large-scale computer simulation of fluid flow through porous media using the techniques of cellular-automata hydrodynamics.

Glassy systems. In spite of thousands of papers written on the nature of the glass transition this phenomenon remains poorly understood. In their talks Chandan Dasgupta and Sriram Ramaswamy (both IISc, Bangalore) presented evidence for (a) the existence of a large number of metastable states in glasses using Ramakrishnan–Youssouf density functional theory and (b) the absence of divergence of any correlation length at the glass transition. The orientational glasses have attracted a lot of attention in recent years because a clear understanding of the latter may provide crucial insights for a better understanding of the glass transition in general. Sushanta Dattagupta (JNU) talked about recent predictions about NMR in $(Rb)_{1-x}(NH_4)_xH_2PO_4$, not only is the exchange interaction random but there are also random fields in these systems. In addition, there are quantum effects because of hydrogen tunnelling.

Granular materials exhibit unusual properties, intermediate between those of liquids and solids. Using the thermodynamic approach of Edwards, Anita Mehta (Birmingham) built up a theory of dynamics of powders in which a quantity called the compactivity, which plays a role analogous to temperature was attributed a microscopic meaning in terms of fluctuation properties of clusters of grains. This picture was substantiated by Mehta in terms of computer-simulation studies. While Mehta's approach was a dynamic one, an alternative viewpoint on the statistical mechanics of grains has emerged recently in terms of an analogy with ordinary critical phenomena, giving rise to the new field of self-organized criticality. Deepak Dhar (TIFR) pointed out how self-organized systems exhibit power-law correlations in an exactly solvable model.

Jyotsana Lal (Saclay) presented recent light-scattering data on the effects of polymer networking on the phase-separation behaviour in a system where one of the components is gelatin, which undergoes sol–gel transition. Exact results for various critical exponents characterizing 'directed' polymers and some related vertex models were presented by Somen Bhattacharya (IOP, Bhubaneshwar).

Neural networks and immune networks have several characteristics reminiscent of spin glasses. Chandan Dasgupta (IISc) and Bikas Chakrabarti (SINP, Calcutta) summarized the progress made over the last few years, following the pioneering work of Hopfield, on content-addressable memory and the behaviour of neural networks in living systems. Although the possibility of a similar network-like behaviour of the immune system was pointed out long ago, a quantitative picture of immune response has emerged only recently. This work was reviewed in three lectures by Debashish Chowdhury (JNU) and Dietrich Stauffer (Köln).

Amphiphilic membranes. Until very recently no microscopic model was developed to study the bursting of the thinnest possible soap films, the so-called Newton black films, where hydrodynamic effects are expected to be negligibly small. Using a microscopic model defined on a lattice, Debashish

Chowdhury (JNU) discussed the effects of the edge energy on the lifetime of soap films. The lamellar phase of the amphiphilic molecules consists of a stack of approximately parallel membranes. Therefore the steric repulsion is expected to play an important role in the behaviour of this phase at finite temperatures. Sriram Ramaswamy (IISc) summarized recent results on the dynamic behaviour of this phase.

The proceedings of this meeting are expected to be published in *Physica A*.

Debashish Chowdhury, Sushanta Dattagupta, School of Physical Sciences, Jawaharlal Nehru University, New Delhi

OPINION

Increased microbial immobilization of nutrients will adversely affect afforestation in dry tropics during future climatic change

Sovan Roy

Afforestation in leached and impoverished soils of dry tropics, if delayed, may be unyielding, as increased global warming and lowered soil water potential may increase microbial immobilization of nutrients in soil, reducing their availability to plants.

Management of global change in CO_2 concentration in air by carbon sequestering through rapid afforestation[1,2], especially in the nutrient-poor dry tropics[3], if delayed, may be jeopardized with changed microbial behaviour in soil. Various types of microbial encystments occur as an adaptation to heat and moisture stress in soil to avoid desiccation[4]. Encystment triggers accumulation of extracellular cyst-forming nutrients[5]. Also, lowered soil water potential triggers the accumulation of solutes within microbial cells from outside[6]. Increased global temperature due to infrared radiation trapping resulting from increased atmospheric loading of CO_2 and other greenhouse gases[7,8] will thus potentially lead to increased nutrient immobilization in microbial biomass through encystment and intracellular accumulation. Though the future patterns of precipitation and soil moisture are still not well-understood[9], as the surface and the atmosphere warm the saturation vapour pressure will increase exponentially with temperature, leading to more evaporation (including transpiration) from the earth[10]. The increased atmospheric loading of H_2O vapour will drive the temperature further higher through feedback effect, as the H_2O vapour is a strong greenhouse gas[10]. Thus exacerbated moisture stress due to lower water potential of soil and increased surface temperatures will increase immobilization both in encysting and noncysting microbial populations and reduce the release of nutrients in the growing season[11]. Increased water potential in soil is needed to induce plasmoptysis in microbial cells[11] and microbial predation to release nutrients[12,13]. Afforestation in the degraded, nutrient-limited dry tropical forests and savanna will be the abject victim where mineralization of microbial biomass in presence of higher water potential, in soil, is the chief source of nutrients during growth season[12,13]. The nutrients released from microbial biomass during first four weeks of rainy season contribute up to 32 kg per ha N and 13.2 kg per ha P in forest soils, and 25 kg per ha N and 10 kg per ha P in savanna soils[13]. These amounts are contributed by noncysting as well as encysting forms of microflora and are greater than the contributions from other sources of nutrients in dry tropical forests and savanna. The nutrient release from decomposing litters during the whole rainy season (12 14 weeks) which is supposed to be the next important source of natural plant nutrients in dry tropics is only 22 kg per ha N and 1.4 kg per ha P in forest soils, and 19 kg per ha N and 1.8 kg per ha P in savanna soils[14]. This is much lower than the amount of nutrients released through mineralization of microbial biomass only during first four weeks of the rainy season[13]. Moreover, prevailing time of litter decomposition, which is more than a year in dry tropics[15,16], is likely to prolong due to decreased microbial activity in suboptimum soil moisture level. There exists a possibility of litter accumulation in subsequent years after afforestation and consequent mulching effect, reducing the evaporation of water from soil, but in dry tropical forests strong wind current in winter and summer sweeps dry litters in different types of depressions, exposing larger portions of the forest floor[17]. Further, the increased litter accumulation will increase the fuel load on the floor and consequently will increase frequency of forest fires[18]. Thus any mulching effect due to litter accumulation in afforested land will be negated.

Nutrient deficiency in soil has been found to be detrimental to forest plantations in North Luzon in the Philippines, resulting in die-back, chlorosis and poor growth[19]. Among the