centuries the European industrial revolution continued hand-in-hand with colonial empire building. In recent times, the scientific and technological commitment of the US is very much rooted in its anti-intellectualism and narrow nationalistic tendencies as reflected *in its* aggressive *imperialistic* policies. Social unrest, crimes, violence, and extreme self-destructive tendencies are comparatively high among technologically advanced countries and in American society. One wonders if there is a direct correlation between advancement in techno-science and social violence. It is, however, known now that activities in high-tech fields lead to high tension.

In the post-World War decade it was the period of scientific breakthroughs and revolutionary discoveries when researchers were engaged in nuclear explosions and in outer space research. But in the late seventies, the early enchantment with the wonders of science gave way to concern about social responsibility and environmental hazards. In the eighties and nineties, our attention has been shifted from the traditional *conquest* to the *consequences* of science; from the preoccupation with progress to a more critical reflection about accountability and assessment of science and technology. Long-term consequences of nuclear power, especially relating to dismantling of nuclear reactors and waste management, in terms of biological effects and also in terms of cost of long-term-waste management, are quite serious. But it is only the scientists who can assess the long-term hazards of nuclear waste. No spiritual head of a religion is, therefore, concerned about it.

In social interpretation of science and in the process of transferring generic technology to industry, there is scope for social accountability, which must counterbalance open-ended support for scientific research. The critical science movement raises science policy issues and thus plays an important role in the advancement of S&T systems. It must not be confused with fundamentalist or religious antiscience or anti-intellectualism, as Kapitza appears to have presumed.

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NEWS

Is organic chemistry undergoing a metamorphosis?

Leading Indian organic chemists were pondering over this very question during a meeting held in Bangalore in February this year, under the auspices of the Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science (IISc), Bangalore. The organizers, S. Chandrasekaran (IISc), G. S. R. Subba Rao (IISc) and Goverdhan Mehta (University of Hyderabad), brought together both seasoned organic chemists and younger practitioners in the field to express their views and deliberate on the 'Future directions in organic chemistry'.

The meeting had several talks in emerging areas that are likely to have a major impact in steering the field. T. P. Radhakrishnan (University of Hyderabad) started the session with a review of the current status of the search for molecular magnets. Citing several attempts to prepare organic ferromagnets, success, he said, was achieved only very recently (*Science*, 1991, **252**, 1415). He described the problem of designing organic magnets as being two-fold; one is the molecular level control of the topological distribution of spin sites and the second is the control of solid state packing motifs that would bring about ferromagnetic coupling in two and three dimensions. Although the former challenge is being rationally addressed by the synthetic chemists, the latter remains largely fortuitous in nature. The latter problem, he emphasized, must be handled through a symbiotic interaction with physicists and material scientists.

In yet another interface area with material science, Suresh Das (Regional Research Laboratory, Thiruvananthapuram) discussed a subject currently very much in vogue, namely, nonlinear optical materials. Explaining some of the basic molecular criteria for nonlinear optical activity, he stressed the importance of the right molecular assembly in bulk in order that useful NLO properties may be observed and exploited. Here again, as in the case of organic magnets, the difficulty lies in the unpredictability of packing motifs even in the case of simple molecules. Methods to obviate this situation by the use of polymeric hosts and covalently bound side-chain NLO polymers, in conjunction with poling techniques to orient molecules, were highlighted.

The second main theme of the session, the interface with biology, received due attention with several talks covering topics ranging from neurochemistry to self-assembling systems. M. Nagarajan (University of Hyderabad) made a presentation on the various aspects of DNA-cleavage systems, specifically those that are initiated at the sugar residues. The mode of action of a variety of potent anti-cancer antibiotics is believed to occur by the cleavage of DNA. In antibiotics such as esperamicin, dyenamicin, etc., a strained ene-diyne moiety that is activated by the opening of an epoxide ring generates a diradical species by Bergman cyclization which then goes on to abstract a proton from either the 5′ or the 1′-carbon of the deoxyribose and initiates DNA cleavage. Highlighting some of the synthetic models based on the ene-diyne mechanism, he went on to discuss transition–metal–complex-based systems, with selective intercalating ligands, which are capable of site-specific DNA-cleavage based on a similar H-abstraction mechanism.

With AIDS predicted to take on epidemic proportions, the presentation by T. K. Chakraborty (Indian Institute of Chemical Technology, Hyderabad) on immunochemistry was of immediate relevance. Noting that the success of organ transplantations owes a great deal to immunosuppressants, he stressed the importance of the precise determination of conformational changes in the drug as it binds to the protein, which is believed to be the primary event in a chain of events leading to immunosuppression. Predicting the occurrence of endogenous immunosupressants (yet undiscovered), he emphasized the role that an organic chemist can play, in collaboration with cell biologists and immunologists, in the design and construction of useful analogues of therapeutic value. Similar effort, he felt, will also be rewarded if the key active structural elements of structurally complex natural immunostimulants can be identified and mimicked in the laboratory.

A. Nangia (University of Hyderabad) speaking on catalytic antibodies (abzymes) emphasized the importance of broadening the scope of organic chemistry to encompass elements of biochemistry and biology. Describing some of the recent advances in antibody catalysed reactions, he cited the now classic examples of the work of Richard Lerner and Peter Schultz. Although currently in its infancy, with the demonstration of its utility only for simple transformations *in vitro*, looking ahead, he predicted more target oriented generation of catalytic antibodies for specific purposes and the possibility of *in vivo* synthesis of target molecules, with enzyme-like turnovers.

Introducing a relatively unfamiliar subject (to a majority of the organic chemists), Vijayalakshmi Ravindranath (National Institute of Mental Health and Neuro Sciences, Bangalore) made a lucid presentation of a rather complex subject, neurochemistry. Stressing the close relationship of research in this area to the development of drugs for a variety of neurological disorders, she went on to explain the current understanding of neurotransmitter and receptor functions. Commenting on the role of organic chemists, she said that the understanding of the structure/activity relationships of specific receptor agonists and antagonists will not only help understand receptor function, but may also lead to new synthetic pharmacological agents for the treatment of a variety of neuropsychiatric disorders.

Moving on to a slightly different theme, synthetic models that mimic, at least in part, complex biological systems, S. Bhattacharya and U. Maitra (both from IISc) discussed the efforts in the area of self-assembling systems. The former citing several examples from the recent literature, discussed the importance of synthetic analogues of the major component of cell membranes, namely, lipids. Contrasting the instability of synthetic bilayer assemblies (liposomes and vesicles) with that of cell membranes, he described recent efforts to stabilize them by polymerization of appropriately functionalized vesicular assemblies. The study of molecularly organized systems would both enable better understanding of structure and function in biological membranes and also lead to the development of new materials, especially those that rely heavily on molecular ordering of the individual components in order that a collective bulk property is exhibited. The ability of organic chemists to design and synthesize a variety of amphiphilic structures with a specific function, be it catalysis or NLO property, plays a key role in the whole process.

U. Maitra, covering a much larger range of self-assembling molecules, emphasized the need for a clearer understanding of the mechanisms underlying self-assembly. Molecular recognition, especially when specific H-bonding motifs are built into the molecular subunits, is often the primary event leading to the formation of supramolecular assembly, be it in solution or in the solid state. Citing several functional devices from the recent literature, such as molecular wires, liquid crystalline polymers, molecular shuttle, molecular train, etc., he concluded by suggesting that this rather young and exciting field will continue to draw the attention of a growing number of chemists, the limit being the imagination of the synthetic chemist to design and synthesize a variety of molecular subunits that will self-assemble in a predesigned manner based on the principles of molecular recognition and self-assembly. In collaboration with material scientists such an effort, he felt, will lead to the development of new molecular devices, some of which may be based on phenomena yet undiscovered.

Describing a more familiar and well-rooted subject of asymmetric synthesis, Javed Iqbal (Indian Institute of Technology, Kanpur) discussed a more recent offshoot, namely, catalytic asymmetric synthesis. Citing numerous examples of homogeneous, heterogeneous and enzymatic systems, he gave a flavour of the kinds of directions that are actively being pursued. Use of chiral metal complexes for epoxidation, hydrogenation, hydroboration and C–C bond formation were a few of the topics that were discussed. With the recent demonstration of the utility of enzymes in organic solvents, he was confident that enzymatic catalysis will gain more acceptance among practising synthetic chemists.

J. Chandrasekhar (IISc), describing the merits and demerits of the various molecular modelling methods, such as empirical molecular mechanics, quantum mechanical and molecular dynamics methods, expressed the hope that some of these methods would soon be used routinely by organic chemists to plan and design experiments. Explaining the limitations of the methods used for describing static structures, he described the Monte Carlo or molecular dynamics methods as being the most appropriate for examining problems related to bioorganic systems and solvated systems. He warned, however, that these dynamic methods are far more expensive requiring raw computer power and also heavily rely on the quality of the potential functions selected for the calculation (which of course is a nontrivial task). His explanation of the thermodynamic perturbation cycle technique for calculating small energy differences ($\sim$0.5 kcal/mol) in solution between two possible substrates S1 and S2 binding to another molecule, generated interest in the audience due to its possible application to host-guest and enzyme–substrate interactions.

During the discussion sessions that followed the talks, several important points emerged. It was generally felt that the emphasis of organic chemistry has changed from one that revolved around the elaborate and painstaking multistep synthesis of natural products to one where the thrust is on (a) synthesis of novel designer molecules based upon an anticipated expression of a particular property and (b) utilization of naturally occurring processes to perform specific transformation on both naturally occurring and purely synthetic targets. In the light of two main emerging interface areas namely, one with biology and the other with material science, it was also felt that organic chemists can no longer afford to work in isolation and will have to collaborate with scientists from other disciplines. The lack of adequate vocabulary to appreciate advances in these interface areas must be overcome in order to be a more effective practitioner of organic chemistry in future. To this end, it was refreshing to hear D. Balasubramanian (Centre for Cellular and Molecular Biology, Hyderabad) speak on 'cloning of a gene' and it was felt that lectures of this nature may help bridge the gap between different disciplines. Some participants also expressed the view that natural products chemistry needs to be revived but in a more focused and target oriented manner. Finally, it was also felt that organic chemistry for its own sake will also continue to be practiced, leaving at least a few who will continue to enjoy the pure, simple and *no-strings-attached* excitement of discovery in science.

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Biotechnology in insect control

A week-long workshop in Madras (20-27 January 1992) organized in collaboration with the Centre for Biotechnology, Anna University, Madras, on the theme 'Biotechnological approaches to the biological control of insects' provided a forum for useful interactions between participants and experts drawn from diverse fields such as biotechnology, microbiology, virology, electrophysiology, entomology and natural enemy mass production technology. The programme was aimed at: (i) identification of various phenolics and volatiles that play a role in the nutrition of phytophagous insects, through TLC, HPLC, auto amino acid analyser and GC-MS; (ii) assessment of insecticidal proteins produced by *Bacillus thuringiensis*, (iii) protoplast fusion technique and DNA analysis by restriction mapping, (iv) efficacy of baculoviruses; and (v) demonstration of techniques for mass production of parasitic and predatory insects.

Inaugurating the workshop, M. S. Swaminathan highlighted the need for employment of techniques from recent developments in genetic engineering and biotechnology to enhance genetic resistance of plants to insects, indicating that diverse strategies are available for transferring genetic materials across sexual barriers such as protoplast fusion, direct DNA intake and the like. The scope of biological control of insect pests expands further in the light of continuous advances in biological productivity and consequent changes in the ecology of the field.

S. Jayaraj (Tamil Nadu Agricultural University, Coimbatore) highlighted the growing relevance of microbial pathogens in the control of insects, touching particularly upon nuclear polyhedrosis viruses (NPVs), *Bacillus thuringiensis* and such fungi as *Verticillium lecanii* and *Metarhizium anisopliae*. Describing the heritable variants of baculoviruses, he indicated the role of restriction endonuclear analysis of viral DNA, enabling altered virulence patterns. He also indicated as to how this technique could be used to manipulate the genomes of known NPVs towards the construction of novel ones. The scope for developing reliable and economic cell culture systems for mass production of insect viruses was also emphasized. Insect cells can be grown in fermenters of the type used for vaccine production, the slack periods of such plants being used for insect virus production.

T. N. Ananthakrishnan (Entomology Research Institute, Madras), speaking on the 'prospects of biotechnology in biological control', laid stress on the specific molecular pathways which regulate host plant resistance and facilitate development of counter adaptations in their respective insect herbivores. These aspects are interlinked with the importance of inducible defenses whose efficiency is compared with other selective agents like biological control agents. While the production of natural and induced-defence chemicals in plants is well known, the interaction between the insect-damaged plants and the third trophic level of insect parasites and predators is not very well known, and there is convincing evidence for the active release of volatile chemicals by insect-interfered plants that attract natural enemies of the insect. Therefore chemical responses evoked in plants by phytophagous insects tend to play an important role in host habitat location by parasitoids. Genes responsible for the production of such substances like farnasene, caryophyllene, polygodial and the like are under investigation (Figure 1).

R. Senrayan (Entomology Research Institute, Madras) indicated that host/prey selection and acceptance mechanism among parasitoids and predators in natural ecosystems are regulated by a combination of factors, viz. nutrition and semiochemical sources of the host. Nutritional quality of hosts and host plants is a prime factor that influences the third trophic level organisms in terms of host selection, acceptance and suitability. Similarly, volatile semiochemicals from plants as well as host sources attract natural enemies and retain them in the microhabitat. Both nutritional and semiochemical sources of insect hosts and host plants have a positive selection value for the crop plants by reducing the herbivore pressure and lowering their fitness. The nutritional and semiochemical interaction between hosts and natural enemies are governed by visual, olfactory, and gustatory signals so that, synchrony in habitat location and host detection can be signalled between hosts and natural enemies. Modern genetic engineering techniques can evoke profound alterations in plant semiochemical sources which are vital for parasite–host interactions.

V. D. Padmanabhan (Department of Animal Biotechnology, Tamil Nadu Veterinary and Animal Sciences University, Madras) speaking on 'cell lines' indicated that *in vitro* culture of cell types has come to stay as a vital source of conservation of the genomic identity. This technique, involving embryos, single cells, tissues and organs, has grown today into an effective source for several genetic engineering/molecular biological