CORRESPONDENCE

centuries the European industrial revo-
lution 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 re-
lected in its aggressive imperialistic
policies. Social unrest, crimes, violence,
and extreme self-destructive tendencies
are comparatively high among techno-
logically advanced countries and in
American society. One wonders if there
is a direct correlation between advance-
ment 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 re-
searchers 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 atten-
tion has been shifted from the traditional
conquest to the consequences of science;
from the preoccupation with progress to a
more critical reflection about account-
tability 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 biologi-
gical 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-intellectu-
alism, 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 to-
gether 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 Hyder-
abad) started the session with a review of
the current status of the search for
molecular magnets. Citing several at-
ttempts 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 chal-
lenge 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, Thiruvanantha-
thuram) 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 import-
ance 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 neurochem-
istry to self-assembling systems. M.
Nagarajan (University of Hyderabad)
made a presentation on the various
aspects of DNA-cleavage systems, specifi-
cally 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 esperamycin,
dynaminic, 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 mecha-
nism, he went on to discuss transi-
tion-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 immunosuppressants (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 (enzymes) 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 pre-designed 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, hydroamination, 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 practicing 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 (~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
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 predator 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 endonuclease 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 Instituté, 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 farasene, caryophyllene, polygaloid 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