The real significance and evolutionary history of increasing number of functionally redundant genetic pathways are still matters of debate. This may remain so as evolution cannot be tested experimentally and the survival or essentiality in evolutionary terms cannot be determined. Such a redundancy or overlapping function may, however, be a necessary requirement for development and evolution of complex forms of life[3].

A lot of repetitive DNA, likewise discarded as junk at one time, now appears to be of significance in the structure and function of chromatin. Repetitive DNA sequences are uniquely distributed along the chromosomes and with the help of specific proteins that recognize such repetitive DNA stretches in association with non-histone chromosomal proteins provide means for global structuring of chromatin and gene regulation. Role of repetitive DNA has also been noticed in general fitness[4]. In order to explain trans-sensing effects[5] the interaction of homologous regions of the genome at higher order chromatin organization is crucial and the need of non-coding repetitive sequences that help in such organization and spatial disposition of 'functional DNA' should, therefore, justify their evolution and maintenance.

1. Gimeno, C. J., Ljungdahl, Styles, C. A and Fink, G. R., *Cell*, 1992, **68**, 1077–1090.
2. Drabin, D. G., *Cell*, 1991, **65**, 1093-1096.
3. Tautz, D., *BioEssays*, 1992, **14**, 263–266.
4. Wu, C-I., True, J. R. and Johnson, N., *Nature*, 1989, **341**, 248–251.
5. Tartof, K. D. and Henikoff, S., *Cell*, 1991, **65**, 201-203.

RAKESH K. MISHRA
Centre for Cellular and Molecular Biology
Hyderabad 500 007
India

NEWS

Brain storming sessions in the area of plant sciences

The Department of Science and Technology through its Science and Engineering Research Council (SERC) has been instrumental in promoting frontline areas of research in the country. The period 1975–80 was one of exploring mechanisms for supporting R&D projects to individual scientists to carry out specific time-bound research projects in the areas of their interests. During 1980–85, the need to initiate an innovative approach for promoting R&D activities through identification of 'thrust areas' was felt and Programme Advisory Committees (PACs) consisting of experts, in the different identified areas, were constituted.

In the late eighties, an in-depth exercise to review and update thrust areas was taken up through a series of national seminars. In the area of life sciences, such a seminar was organized at Lucknow during 6–8 December, 1988 and 'new challenging areas' that needed support were identified. The details of these were published in *Current Science* (1989, 58, 1275–1315), and in the DST document 'Challenging Areas in Life Sciences' (1990).

Each of the PACs in life sciences has been evolving action plans for considering new strategies and mechanisms for supporting the identified areas in the future. It was decided that the programme advisory committee on plant sciences would organize brain storming sessions in order to review state-of-the art in the identified area, to identify special areas of relevance to the country and to suggest appropriate mechanisms for developing and supporting the areas identified.

Experts in the identified areas were invited to review the state-of-the-art. Special areas of relavance to the country were identified based on the presentations by experts and through discussions with participants. Middle career and young scientists were invited to present pre-proposals which were discussed by the experts who helped in focusing and evolving meaningful projects.

The need for setting up of units/core groups around outstanding scientists, generate co-ordinated/network programmes, national facilities, organizing training programmes or summer/winter schools for human resource development was also discussed. The brain storming sessions were planned in great detail and well in advance so that a well-focused agenda was available and the sessions were more effective.

The list of brain storming sessions organized so far is given in Table 1.

The brain storming sessions were held in different parts of the country in order to enable interaction with a wider cross section of the scientific community. One of the salient features of the brain storming sessions has been the publication of a series of technical reports highlighting the importance of the emerging areas and recommendations, indicating steps that need to be initiated in order to grow these identified areas. Three such technical reports have already been brought out in consultation with experts. These have been circulated to the scientific community as well as to various government agencies. A summary of the recommendations of the first three brain storming sessions is summarized below for general information. Summaries of the other brain storming sessions will follow after detailed reports are brought out.

Plants in relation to their environment

Plant ecology in its broadest sense has acquired global importance in view of the large-scale damage to natural ecosystems. Deforestation is one of the major causes of climatic and edaphic changes. Recurrent climatic aberrations like droughts, floods, etc. affect plant ecosystems, which subsequently influence animals and finally humans. Many of the issues have assumed global dimensions. There is significant reduction in the protective ozone layer and

Table 1.

Session	Venue	Date	Chairman
Plants in relation to their environment	Pondicherry University, Pondicherry	5–7 February 91	H. D. Kumar
Microbiology	Maharashtra Association for the Cultivation of Science, Pune	30 April 91 2 May 91	K. K. G. Menon
Genetics and molecular biology of plant responses to stress	Bhabha Atomic Research Centre, Bombay	24–26 September 91	S. K. Sinha
Development and differentiation in plants — Genetics and molecular aspects	Indian Institute of Science, Bangalore	29–31 October 91	M. M. Johri
Tree biology	North Eastern Hill University, Shillong	18–20 February 92	H.Y.Mohan Ram

emissions of greenhouse gases have the potential to drastically alter the world climate. The earth's atmosphere is being changed at an unprecedented rate as a result of inefficient and wasteful use of fossil fuels and rapid increase in population growth, resulting in widespread desertification and decrease of plant and animal species, and acidification of lakes and soils. It was felt that projects in this area should concentrate on flux of methane and nitrous oxide, effects of carbon dioxide fertilization on plants and communities, effects of enhanced UV-B radiation on plants and communities and modelling of processes and ecosystems. In the area of terrestrial ecology, it was felt that efforts should be made to study phytogeography and evolutionary ecology on sustainable utilization of wild plants, restoration ecology, conservation of plants and ecosystems, ecological consequences of natural ecosystem transformations and vegetative mapping and analysis along environmental gradients. Similarly, in the area of aquatic ecology, in addition to the study of biology and ecology of algal blooms, algal biotechnology and aquaculture, pollutant scavengers, land–water interactions, carbon, nitrogen, phosphorus and sulphur fluxes as well as impact of UV-B radiation on aquatic productivity should be studied with emphasis on special aquatic ecosystems.

Microbiology

Environmental issues and the increasing cost of energy have created a tremendous international interest in the utilization of microorganisms (as against chemical and physical processes) for obtaining useful products. The potential benefits from microbial applications in industrial processes either directly or through exploitation of genetically tailored varieties range from industrial enzymes, dairy products, utilization of agricultural and mining wastes, biopesticides, biofertilizers, biogas, etc. Application of microbial studies in India has largely centred around production of antibiotics and yeast. We have not been able to either develop efficient microbes or harness them. The group attempted to identify the direction, microbiological research should take so that the fruits of such research may be used to satisfy the needs of the country not only in terms of self-sufficiency but also in terms of self-reliance. Microorganisms were, at one time, considered to consist mainly of man's worst enemies but are now being counted amongst man's best friends. They are used in the production and preservation of foods, feeds and flavours, biological control of pathogens, nitrogen fixation, development of bioinsecticides, waste treatment and utilization, antibiotics, vaccines, chemicals, enzymes, etc. In addition to the study of biology of actinomycetes and the establishment of an authentic collection with strains isolated from indigenous resources, were microbial genetics, microbial enzymes for development of cassette-expression systems in fungi for various enzymes, DNA technology for microbial enzymes and use of contemporary separation technologies in down stream processing. Studies on microbial biodiversity should not only include taxonomy and germ-plasm conservation but also physiological studies to ensure proper *in vitro* conservation without strain deterioration in artificial culture. It was also felt that study of methanogens is very important from the point of view of ruminant nutrition and production of gobar gas. It was apparent that there were very few focused schools of research in India. The group, therefore, emphasized the need to organize training courses for scientists wanting to make a long-term commitment to this area of research.

Genetics and molecular biology of plant responses to stress

With increasing human and livestock population, there is an ever-increasing demand to produce more on limited cultivable land. Although useful plants have been selected and bred for improved yield, often the high-yield potentials are limited by various stress factors. There is, therefore, an urgent need to understand the mechanisms of tolerance of plants to abiotic factors such as drought, flooding, salinity, extremes of temperature and alkalinity, and biotic factors such as diseases, pests, etc.

Plants have evolved complex mechanisms to cope with different types of biotic and abiotic stresses. It is important to study how plants perceive signals from pathogens, insect pests, water, nutrient or salinity stress, process them and then mobilize their defence mechanisms.

The group identified various important crop diseases and pests that need to be studied urgently. The group also felt that as no single laboratory is likely to have all the requisite genetic stocks, expertise and infrastructure necessary for this kind of research, a cooperative approach to work on an agreed common programme of work was needed. This is also likely to generate useful and reliable data in a short time.

The brain storming sessions have

been received very well by the scientific community who have felt that the review talks and discussions were of consistently very high academic standard. They have also felt that these sessions provided a unique opportunity to the senior and young researchers to exchange ideas about their work on the same platform. DST has received several requests from scientists to organize more brain storming sessions even on the subject areas already covered and from young researchers to participate in more than one session. The exercise has also helped DST to generate some good projects.

Detailed reports and recommendations of the brain storming sessions, including lists of participants, are available with the Department of Science and Technology, New Delhi.

We are grateful to the past and present chairmen and members of the programme advisory committee on plant sciences, chairmen of the brain storming sessions, experts and participants for their advice and help in organizing these sessions and for making them successful by their participation.

Parveen Farooqui, Department of Science and Technology, New Delhi.

RESEARCH NEWS

Organic structures with remarkable carbon–carbon distances

J. Chandrasekhar

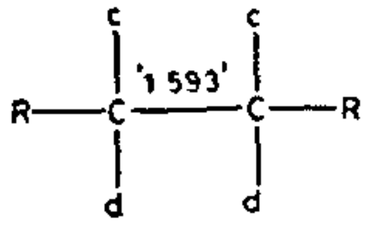
There is a general feeling amongst chemists that C–C bond lengths are entirely predictable and correspondingly uninteresting. Variations from average values (C_{sp3}–C_{sp3}: 1.530 (15) Å; C=C: 1.322 (14) Å; C≡C: 1.181 (14) Å, and 1.384 (13) Å in benzenoid rings)[1] are mainly due to steric repulsions involving substituents and not because of any novel electronic interaction. Nonbonded C–C contacts are even less of interest, as no non-covalent attractive force involving carbon atoms is expected, with the sole exception of π-stacking interactions.

The above generalizations hold good for a majority of systems. But a critical evaluation of known C–C distances shows a surprisingly large variation which deserves to be highlighted.

Let us begin with single bond lengths. Elongated bonds as found in **1** and **2** are easily attributed to steric interactions[2,3]. Interestingly, the central C–C bond length in [1.1.1] propellane (3)

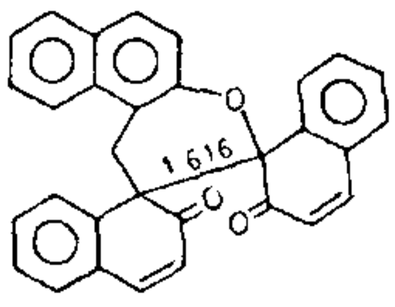
3

with two 'inverted' carbon atoms is not particularly long (average = 1.599 Å for the two distinct molecules present in the crystal)[4]. Similar values are observed as a consequence of captodative electronic interactions in **4** (ref. 4) although steric



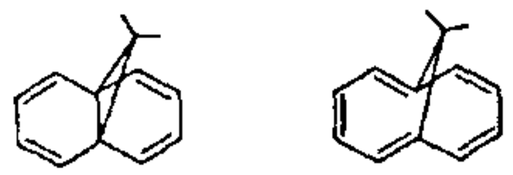
4 (c = CN, COOR, ---
d = SR, OR ---)

contributions are also present. The same effect is presumably responsible for the observed length as well as reactivity of a C–C bond in **5** (ref. 6).



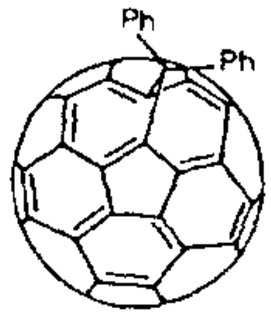
5

Long C–C distances are also observed in conjugated molecules in which the σ bond can participate in a sigmatropic rearrangement. An exceptionally long bond of this kind has been determined in the 1,6-methano[10] annulene derivative, **6**, which exists in the bisnorcaradiene (**6a**) and not the [10]annulene form (**6b**), on the basis of

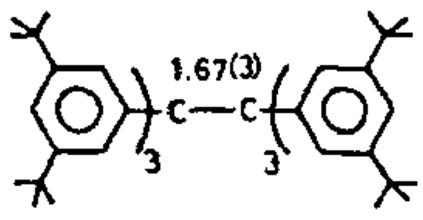


6a 6b

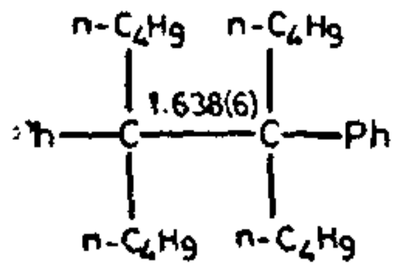
NMR results. The libration-corrected central bond lengths in the two distinct molecules present in the crystal are 1.836 and 1.780 (0.007) Å (ref. 7). *Ab initio* calculations had to be used to confirm the presence of the central C–C bond. It is interesting to speculate on the corresponding distance in the diphenylcarbene complex of buckminsterfullerene, **7**, which is essentially **6** fused to a larger aromatic framework. NMR results



7



1



2