cribed the differences in animal, microbial and plant systems. This is followed by an impressive account of the advances made in a variety of ways to translate basic scientific knowledge to useable technology. Various techniques devised for bringing about this translation have been described. They have also narrated the impact of biotechnological research in diverse fields such as biocatalysts, energy, crop improvement and protection, bioactive molecules, gene therapy and embryo transfer technology, concluding with remarks on how this emerging field will help the third world.

In an extremely informative and well-illustrated article Ghosh has presented opportunities available to Indian industry in the field of biotechnology. Enumerating case studies in different fields such as diagnostics, vaccines, antibiotics, bioactive molecules, aquaculture, horticulture and industrial enzymes, Ghosh has unfolded investment opportunities for biotechnological industry in India. The accuracy of his projections is evident from the fact that during the brief period of his presentation of the forecasts and the publication of the book, industry has already moved in; whereas products like detergent enzymes have reached the market place, other areas are at different stages of progress.

Ghosh has a word of caution about the long lead times between scientific discoveries in biotechnology and their commercialization. The high interest rates in India added to the high risks for novel products and long lead times are discouraging factors for industry to move in. He foresees quicker success if pilot scale experimentation and validation is meticulously worked out to cut the lead time. A number of mechanisms exist today with funding support from financial institutions, NRDC, DBT, etc. for sharing the risk in such validation without much visible impact. Ghosh has also made an important point that investors will have to take venture risks now, as in future, the costs of procurement of off-the-shelf technology will be enormous and often, the state-of-the-art technology will not be available for purchase.

The success story of concerted efforts aimed at strain improvement for the antibiotics industry is narrated by Rowlands. Although we have a number of collaborative research associations in India in several groups of industries it is sad to see that all major fermentation industries have to go out for inducting improved strains every once in a while. As pointed out by Ghosh, the best yielding strains are not always available. India could do well to get over this area of weakness by a get together of our numerous breweries, distilleries, antibiotics, industry and the like. The upgradation of penicillin productivity from 2 units/ml to 100,000 units/ml is indeed quite an achievement. By and large strain improvement still appears to follow the classical course of subjecting strains to chemical and physical methods of mutagenesis. Jain has described some attempts at creating genetically engineered strain of cellobiohydrolase. Bajaj in his article has decribed some of the precautions that need to be taken in optimizing the conditions of upscaled fermentations with improved strains.

Proteins as naturally occurring biologically active molecules generally suffer from the weakness of low stability at ambient temperatures. Suzuki has given an excellent presentation tracing the conditions leading to stabilization of proteins and opened up the possibility of getting over this weakness when one attempts to make them using genetic engineering techniques.

Even after successfully cloning a gene leading to desired protein synthesis two obstacles remain. The synthesis is not efficient unless the synthesized molecule is transported across the membrane into the medium. Secondly, having secreted into the medium, it needs protection from proteases which are often also secreted into the medium by the cells. Strategies involved in transport and protection from proteases are described in an article by Takagi.

Schumacher *et al.* describe the cloning and large-scale production of creatinase which meets all the requirements of a product useful in a complex clinical diagnostic kit. In the same chapter on industrial enzymes and biocatalysts, Vandamme has dealt with penicillin and cephalosporin acylases, their production and immobilization and Jensen deals with lipases useful in the detergent industry.

The chapter on fermentation technology includes various aspects of the subject such as design, scale up and mathematical modelling of fermenters, precautions in operation and some new directions including upscaling of plant cell cultures for producing rare phytochemicals.

Some of the opportunities available to us for export of products need proper logistic support as in the field of horticulture described by Reddy.

Other articles of interest include that on the potential of drug targeting using gene fusion by Soria, on protoplast fusion by Deobagkar and expression of insecticidal protein genes by Komano *et al.* The book also includes contributions on biotransformation and biodegradation and a number of miscellaneous presentations made during the course of the Symposium.

In the Indian context, the book indirectly brings home several messages. Perusal of the article on biotechnology application in Kuwait makes us conscious of our strengths built up in this country in this young branch of science and the opportunities we can have in exploiting the markets in the developing world. It also reminds us of our weaknesses in exploiting the capabilities of microbes, even if we created good new ones, and the existing need for manpower development in fermentation technology. One of the tragedies in this country—thanks to our present day value system—is that there is too much emphasis on basic research (upstream) and very little on application of knowledge gained for social benefit. It will be unfortunate to see some day, that we are required to import finished products which were made in the developed world, exploiting the fruits of basic researches conducted here.

The book might be of interest to policy makers as also to decision makers in industry thinking of diversifying in this new branch of science.

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Nervous Systems—Principles of Design and Function. R. N. Singh, ed. Wiley Eastern Ltd., 4835/24, Ansari Road Daryaganj, New Delhi 110 002. 1992. 506 pp.

This book is a collection of papers that were presented at the second International Conference on Neurobiology

held at Goa in December 1991. Neurobiology is a very rapidly developing subject and is no more restricted to morphological/anatomical/histological or electro-physiological studies of the nervous system in certain model system but involves, in addition to and in combination with these traditional approaches, the use of a wide variety of cell biological/molecular and genetical techniques in diverse organisms. This wide panorama of approaches to understand the intricacies of the nervous systems in phylogenetically close and distant animals is reflected in the thirty-one papers that are included in this book. The organisms used range from flatworms to human and the aspects discussed vary from functional anatomy to signal transduction, development and genetic control of both central as well as peripheral nervous systems. Many common patterns emerge from such studies and therefore, the book is aptly titled *Nervous System—Principles of Design and Function.*

Receiving the environmental signals, their transduction to reaction controlling centers and the appropriate response to these signals is a fundamental property of living systems which has become operationally as well as organizationally more intricate with increasing biological complexity of multicellular organisms. It is important that we learn the operation of this complex biological organization in all its details not only from the point of view of understanding 'life' but also from the point of view of immediate clinical and social applications in human society. The biological systems are enormously diverse, often bizarrely so. Yet there is a basic commonalty in this diversity which allows us to not only build phylogenetic trees but which also allows extrapolations from one system to another. Nervous system is no exception to this. It is this unity in diversity that allows one to select any convenient model for study and still be able to contribute to our understanding of the most complex part of the biological organization that the nervous system is. This is repeatedly reinforced while going through the series of individual research contributions that have been compiled in this book by R. N. Singh.

One obvious point that emerges from a perusal of the various papers in this book is that the study of 'Nervous system' as typically included in most curricula of Zoology needs a thorough change. One cannot simply confine to morphological and histological description of the nervous system, because it is now possible to view the nervous system from the functional and evolutionary points of views as well. Another lesson that can be learnt from this collection of papers is that 'Genetics' holds the key to unravel mysteries of not only complex biological organization but also of apparently simple events like a fly being able to identify a given chemical through its taste or odour. Neurogenetics reveals that such simple sensory and motor phenomena also have a genetic basis. The power of 'Reverse Genetics' can help one appreciate the 'beauty' of biological organization and understand this organization in physico-chemical terms. As the field of Developmental Biology has been revolutionized in recent years through the application of 'direct' as well as 'reverse' genetics, so can the field of Neurobiology be. *Drosophila* of course holds the most promising place once again, thanks to the very rich genetic information available (this is obvious from the number of articles in the present volume that use the various genetic approaches possible with *Drosophila*). As several of these papers also reveal, the material and the information obtained from studies using *Drosophila* can be applicable in understanding other nervous systems as well. The book would have served its purpose, if it can stimulate neurobiologists and those who work in related areas to take these lessons.

The book would have been more useful if a little extra effort was put in its publication. The different papers follow very different styles of presentation, not only in the format but also in their contents. It would have helped a wider audience if the authors were asked to give a more general background to the problem addressed by them. In the present form, many of the papers may not be comprehensible to non-specialists in the field or even to qualified 'neurobiologists' working with a different model system. Editing of the manuscripts would also have removed at least some of the errors of grammar/syntax and print that exist. While direct reproduction of 'ready for press' manuscripts is a convenient method to help quick publication, it should have been ensured that the manuscripts were indeed prepared in that form; a number of papers remain in the traditional manuscript format with figures grouped at one point and their explanations at some other place—this does not make smooth reading. Another common problem with Conference Proceedings is the absence of peer-review of the papers before publication.

The subject index at the end is useful. Unfortunately, however, it is not as exhaustive as it could have been—to cite a case, *Drosophila* is not listed in the index although a large number of papers are devoted to this organism. The papers grouped at the end as 'late arrivals' too do not appear to be indexed. The sub-grouping of different papers in the book is only of limited use since this has not really helped in building themes, essentially because the constituent papers deal with very diverse models and systems. Also 'late arrivals' is an inappropriate class; even at the cost of some delay in publication schedule, these should have been classified under appropriate subgroups, once these were identified.

Another drawback of this volume is the rather poor reproduction of half-tone illustrations. This becomes particularly unfortunate where histological or ultra-structural details are essential components of the description.

A volume comprising of contributed papers at a Conference can only have a limited utility, especially (as in the present case) when the individual contributions are essentially original research data rather than reviews of relevant current topics. Such papers often contain material that has already been published elsewhere; even if the data are presented for the first time in the conference, they tend to get stale by the time the published volume is available to readers. However, to the extent that this book is primarily addressed to researchers in less developed countries so that they can have a 'taste' of the current trends in neurobiology and can have some access to more detailed literature through these articles, this book serves its purpose. For general readers, this volume will have very limited utility.

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