

BOOK REVIEWS

Biotechnology: Strategies for life by Elizabeth Artebi and David Fishlock, The MIT Press, 28, Carleton Street, Cambridge, Massachusetts 02142, USA, 1985, pp. 239, \$39.95. Indian orders to Affiliated East-West Press Pvt. Ltd., 6, Roselyn Gardens Apartments, 20/1A Barnaby Road, Madras 600 010.

Biotechnology is an age old practice. Fermentation of beer or production of antibiotics by microorganisms or preparation of vaccines against infectious diseases are not new either in terms of concept or industry. However, in the last decade, the harnessing of recombinant DNA and immunochemical technologies have given an entirely new dimension to the application of biotechnology for the problems of health and disease, food and agriculture, environment and industry. In India, although biotechnology has become a popular jargon in scientific circles, the scope of this area in research and applications are not well understood in general.

This is an excellent monograph which covers the entire gamut of biotechnological applications starting from a historical perspective of each area and bringing up to the present day revolution taking place because of the capabilities achieved to engineer the gene. The excitement of an impending golden era is projected without losing sight of the fact that it is still an expectation and there is a long way to go. The hard realities of the economics involved, the competition between the new biotech firms, the dilemma of the scientists in the field to wear the lab coat or business suit or both, the approach of the government to this technology based on the culture of the peoples involved, have all been thoughtfully analysed to give a realistic account of the potentialities of the field. In a volume of this type, one cannot expect the intricacies of the science involved to be described in great detail, but enough is given by way of impressive photographs, diagrams and illustrations for a beginner to get a basic understanding of the science as well.

The monograph is divided into six parts containing a total of 24 chapters. There are overlaps but can all be looked in terms of the health and disease, food and agriculture, environment and industry. The initial chapters deal with essentially fermentation-based products. Wines and cheese, antibiotics and other secondary metabolites are discussed in relation to food and pharmaceutical industries. It is impressive to note that there can be as many as 2000 secondary metabolites ranging from growth promoters to antiobesity drugs essentially of microbial and plant origin with potential to be exploited by biotechnology. The importance of enzymes in food, textile and tanning industries, the possibility to achieve almost impossible chemical reactions through the use of enzymes and the new dimension offered by recombinant DNA technology for the production of

enzymes used in industry and research make it tempting to suggest that our country should start a few enzyme corporations.

A series of articles cover the biotechnology applications in the field of medicine. This part starts with a basic description of the history of the birth and development of the science of recombinant DNA technology. It is interesting to note that 1977 is suggested to be reckoned as the date of birth of modern biotechnology, when Stanley Cohen and others achieved the first successful construction of chimeric DNA. The application of biotechnology for the production of useful proteins such as insulin, growth hormone, lymphokines and other blood factors are vividly described. The phenomenal contribution of molecular biology to the understanding of cancer and genetic disorders is acknowledged. The potential of gene therapy is indicated. The development of diagnostics, both based on recombinant DNA and monoclonal antibody probes for a variety of diseases, is already a reality and is described as such. It is interesting to note that while an average patient wants a "magic bullet" to cure the disease, the clinicians' priorities are for specific, reliable and quick diagnostic probes. The possibility for targeting drugs to cancer cells using immunotoxins is highlighted. The revolution in vaccinology, whereby subunit vaccines produced by synthetic and/or cloning routes would replace conventional killed or attenuated infecting agent used in the name of vaccines, bids a new hope for India to fight against a variety of infectious diseases.

Research with plants has always lagged behind animals and so is the case with plant biotechnology. But the potential to develop plants resistant to diseases and to the pesticides and herbicides used is within the realm of this technology. The chapter on "Green gold" highlights these possibilities as well as the immense potential of tissue culture methodology coupled to different approaches to gene transfer in developing a new generation of plants. The incorporation of nitrogen fixation genes can eliminate requirement for nitrogen fertilizers although research in this area is proving to be complex and drawn out. In the farm area, attempts to improve the quality of meat and dairy produce by the use of hormones, vitamins, etc., and the advent of artificial insemination, embryo transplantation and sex selection are all highlighted.

Microbes can act as "metal traps" and thus be of use in mining industry. A whole range of biomaterials from biomicrochip to biopolymers having a wide variety of applications are on the horizon.

In every one of the chapters the discussion does not stop with an academic exercise. The emphasis is on application, vividly describing, the level of world market for each product, the major and minor companies that are in the field, and the success stories as well as several instances of abortive failures. The last few chapters highlight the unique problems associated with the advent of modern biotechnology. The recollection of a cartoon where a university teacher with a test tube in hand is lassoed by a dollar in the form of a double helix tells all about the turmoil in research ethics at the intellectual level. Biotechnology is a land of promise and this promise is being sold! The ideas on the importance of venture capitals, the cut-throat competition among new biotech firms - the larger fish swallowing the smaller fish, the attitudes of the governments, the sudden realization that life forms can be patented and the need for a new breed of

engineers who are sensitive to life processes, make exciting and lively reading. The spirit of enterprise, the environment for venture capitals and the availability of infrastructure have pushed the US to the forefront in exploiting biotechnology. The pragmatism to achieve the end result irrespective of the approaches used makes Japan a close second. I hope the monograph spurs at least a few elements of the sleeping giant into action! The monograph is a beautiful edition with excellent quality colour pictures and illustrations. It will stand out in an ordinary book shelf not necessarily because of its rather large dimensions but it really deserves to be so!

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Advances in gene technology: Molecular biology of the immune system edited by J. W. Streilein, F. Ahmad, S. Black, B. Blomberg and R. W. Voellmy, ICSU Short reports, Vol. 2, Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, England, 1985, pp. 366, £30. Indian orders to: Affiliated East-West Press, 6, Rosclyn Gardens Apartments, 20/1A Barnaby Road, Madras 600 010.

Immunology, specially the molecular biology of the immune system has been on the forefront of research in biology and medicine in recent years. The book under review presents the proceedings of the 17th Miami Winter symposium on the molecular biology of the immune system. Miami Winter symposia are scientific events generally looked forward to by active scientists. This reviewer feels that reading this volume is possibly the next best thing one could do to actually taking part in the symposium. One can almost catch the flavour and feel the excitement that must have prevailed during the scientific deliberations.

This volume presents two types of articles, namely symposia presentations and poster presentations. The symposia presentations are more or less full length short papers describing original work of authors who are leading scientists in their respective sub-specialities. The poster presentations are essentially extended abstracts. Thus for detailed information about the data and the methodology used, one should look to the journals.

There are 28 symposia presentations, grouped under the headings: 'Immunoglobulins', 'Major histocompatibility complex', 'Interleukins and mediators', 'T-cell receptor', 'Complement components', 'Cell surface markers' and 'Immune network'. All the above topics are fit to be subjects of independent symposia. Thus the coverage and scope of these subjects as dealt in this symposium have been rather limited. However, the major emphasis has been the dissection of the genes coding for various molecules of the immune system, and a closer look at these molecules. The interplay of various molecules at the gene and cellular level has been brought into sharp focus. The contributors, amongst others, include Tonegawa, Alt, Honjo, Brinster, Bach, Flavell, Natheson,

Baggioni, Davis, Beavan, Porter, Muller-Eberhard, Saito and Sachs; all 'wizards' in the art of the study of the immune system.

The poster presentations present about 128 extended abstracts. These presentations in no way lack in quality or in their scientific importance. Some of the important findings about T-cell receptors specially from the groups of J. Strominger and R. Axel are presented in this section. The topics covered in this section are much more varied than the symposia presentation and provide a bird's eye view of the happenings in basic immunological research to day.

Every library will be richer by having this book on its shelves. It is a good book in an immunology laboratory, both for serious and leisure reading.

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Viruses and cancer edited by P. W. J. Rigby and N. M. Wilkie (Proceedings of 37th Symposium of the Society for General Microbiology, held at Warwick, April 1985). Cambridge University Press, The Edinburgh Society, Shaftesbury Road, Cambridge CB2 2RU, UK, 1985, pp. 323, £32.50. Indian orders to: Affiliated East-West Press, Madras 600 010.

The volume presents the current thinking about the relationship of various viruses in the causation of cancers in man and animals. In recent years a large number of RNA and DNA viruses with oncogenic properties have been described. Robin Weiss in his introductory article has described the role of these viruses in development of natural tumors, and the cofactors required for oncogenesis. The discovery of oncogenes and their homologues in normal cells have greatly aided our understanding of the process of carcinogenesis and Dr. Weiss deals with these aspects in his article "Unravelling the complexities of carcino genesis". This topic has set the tone for the rest of the articles in this book which deals with specific viruses and the state of our knowledge of these viruses. The molecular biology of hepatitis B virus (suspected to cause hepatocellular carcinoma in man) is discussed by William Masson and his collaborators. This article provides the complete map of the genome of the hepatitis B virus. Masson *et al* compare the mechanism of replication of other animal viruses related to hepatitis virus, namely ground squirrel hepatitis virus, woodchuck hepatitis virus, duck hepatitis virus. A. J. Zuckerman from London has discussed the biology and epidemiology of hepatitis virus. This article discusses data pertaining to biology of the hepatitis virus including its structures and antigenic properties, immune response to acute infection and epidemiology of the virus including its mode of spread, the carrier state, age distribution and prevalence in various parts of the world. The relationship between hepatitis B virus and hepatocellular carcinoma has also been discussed. This section is rather short, and therefore does not provide all the information one would like to have on the role of this virus in hepatoma.

Howley *et al* in their article "Molecular biology of bovine papilloma viruses" and Harald Zur Hausen in the article "Genital papilloma infections" have described the tumorigenic potential of papilloma virus. In the former article the authors have described the work and reviewed the literature on transforming papilloma viruses specially those of cattle, sheep, deer and European elk. Some of these viruses transform rodent cells *in vitro*. The genomic organisation of the papilloma virus, the functions of the various segments of the virus genome, and the C-DNA cloning of the transforming RNAs have been dealt with in this article. In the other article, Zur Hausen has provided evidence for the involvement of the HPV in cervical and penile carcinoma of humans. About 50% of cervical cancers show the presence of HPV-16 DNA, and about 20% of tumors are positive for HPV-18 DNA. About 90% of all the cervical tumors tested show the presence of DNA of one type of HPV or the other - a very remarkable correlation indeed. The author suggests the interaction with mutagenic initiating events, smoking and herpes simplex virus infection may be important factors in genital carcinogenesis.

There are two articles on Epstein-Barr virus, one by Griffin, Karran, King and Chang from England, on "Immortalising genes encoded by Epstein-Barr Virus" and the other by M. A. Epstein, the co-discoverer of the virus on "Interventions against EB virus-associated tumors". EB virus is associated with Berkitt's lymphoma, nasopharyngeal carcinoma and lymphomas in immune depressed state, all human malignancies as well as with infectious mononucleosis. These two articles provide the current state of the knowledge about the involvement of EB virus in cancers. The article on adenovirus by Gallimore, Byrd and Grand deals with adenovirus genes involved in transformation. The authors build up a strong case for the involvement of the E1 region of virus genome in the neoplastic transformation. The data cited by the authors are extensive and convincing.

Of the five articles on retroviruses, one by Dickson and Peters deals with 'oncogenesis by mammary tumor virus', Berry and his colleagues discuss about 'Bovine leukemia virus'. Neil discusses 'Molecular aspects of feline leukemia viruses and their associated diseases', Yoshida and colleagues speak on 'Molecular biology of human T-cell leukemia virus', Ratner, Sarin, Wong-Stall and Gallo speak on 'human and primate T-lymphotrophic retroviruses (HTLV and PTLV) subtypes, biological activity and role in neoplasias', and Santos and colleagues discuss transforming *ras* genes'.

Dickson and Peters have provided strong evidence for insertional mechanism of mammary carcinogenesis in mouse by MMTV. They have presented data to show that two regions namely int-1 and int-2 located in two different chromosomes are sites for MMTV proviral DNA integration. Burny and colleagues have provided an excellent review of the bovine leukemia virus, specifically BLV proviral DNA sequences and proteins. Similarly Neil has presented an interesting review on molecular biology of feline leukemia viruses. Both these articles discuss the molecular basis of the neoplastic transformation and the epidemiology of the diseases produced by these viruses. There are two well documented articles on human T-cell leukemia virus (HTLV) written by the Japanese group (Yoshida *et al*) and the US group (Ratner *et al*). Both these groups have done pioneering work in this field which has gone a long way to establish viral etiology of

at least some of the human malignancies. One would find a wealth of information in these two articles starting from the isolation of HTLV in USA and Japan to complete characterisation of the genomes of the various virus isolates. The last article of the book is a review on the structure, malignant activation and role of *ras* genes in malignant transformation in human and animal tumors. This is a well presented up-to-date review and critically examines *ras* genes in various tumors.

In summary this reviewer feels that *viruses and cancer* is an outstanding book in tumor virology and should be read by those involved in carcinogenesis research.

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The neutral theory of molecular evolution by Motoo Kimura. Cambridge University Press, 1983, pp. xv + 367, £12.50. Indian orders to: Affiliated East-West Press, Madras 600 010.

Tucked away in the fastness of the introductory chapter of this book is the statement which should prepare the reader for what is to come. "I include", says Kimura, "in the word evolution, *all* changes, large and small, visible and invisible, adaptive and non-adaptive". Seemingly innocuous, the statement holds great significance. It changes the entire concept of evolution, robs it of its moment and distinction. One is not sure if Kimura has the right to interpret "Evolution", as he, with incredible boldness, appears to do, but he does it anyway seeing that his whole concept of molecular change has to fit into his favourite mould. Evolution at the molecular level, for Kimura, is change, any change, with any effect or none. Any alteration in the structure of a genetic molecule is, for him, evolution.

And thereby hangs this book. It has no relation whatsoever with the Darwinian concept of Evolution, none with phenotypic change, nor with the functional processes which relate gene change and its expression. It is simply a book on change at the molecular level, its appearance, its frequency, its distribution and the rates of its substitution. Indeed, Kimura's book should more appropriately be titled "The biology of molecular change". "Evolution" in the present title has only resulted in confusion and ambiguity.

Kimura has all the right, and clearly all the competence, to view molecular change in precise mathematical terms and can lay claim to validity of his efforts as an academic exercise of some value, but then he should not bring in Evolution according to Darwin, which itself is teetering on the brink of a precipice. "Laws governing molecular evolution are clearly different from those governing phenotypic evolution" (p. 326). With this crucial statement Kimura effectively and completely severed all connection between the gene and its phenotypic expression.

In this context, Kimura's efforts early in the book to explain theories of the mechanism of evolution especially of Natural Selection, seem non-functional and even un-informed.

Darwin's Natural Selection concept, as even a major mechanism of evolution, is on its way out and very soon studies on evolution (not only molecular evolution) should be guided by a correct and responsible understanding of Natural Selection – its status, its role in perpetuation of change and its part in species formation.

The diversity of reactions by students of Evolution (in the strict Darwinian sense) to Kimura's ideas is embedded in and stems from the irresoluteness of our understanding of the relationship between molecular change and evolutionary change.

Having said this, it seems necessary to take a look at Kimura's "new" theory of neutral mutations. Briefly it is this. Let us take an example of a protein. Assume that a certain amino acid undergoes a change, or it is substituted by another amino acid. The total protein, with changed or substituted amino acid functions exactly as before, like the original protein. That is neutral change, or in Kimura's words, neutral evolution. Kimura finds changes in other molecules too, and discovers nucleotide substitutions as the most prevalent changes (evolutionary?) at the molecular level. Kimura claims that stochastic theory supports his views of variation and change at the molecular level and extensively employs the mathematical formulation of chance mutations occurring in biological and genetic molecules.

In the words of Kimura, the great majority of mutations are selectively neutral or near neutral, at the molecular level. So is much of intraspecific genetic variability manifested in the form of protein polymorphism.

Having thus cut asunder genes and their expressions, the so-called synthetic theory is ready to be interred and the final obsequies pronounced. However, the neutral theory has still much ground to cover and a great deal of criticism to overcome. Kimura's voice is strong and resonant but Darwin and his cohorts are not out for easy stalling.

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Biophysics and biochemistry at low temperatures by Felix Franks, Cambridge University Press, Cambridge, 1985, pp. 210, £27.50. Indian orders to: Affiliated East-West Press, 6, Roselyn Gardens Apartments, 20/1A Barnaby Road, Madras 600 010.

I am truly impressed by this book. It is concerned with the physical and chemical aspects of life and components of the living organisms at low temperatures. Now a days we increasingly read about the revolutionary new concepts of cryonics, the science of preserving living organisms for indefinite periods of time at low temperatures. Although the present book is not on cryonics, it deals with the basic concepts involved in cryonics.

The most important concepts in a living organism are water, proteins, cells, tissues, and organs. The book deals with the effect of temperature on these components of life. It emphasises more on the physical aspects of low temperature applications (probably because of the physics background of the author) than on biology.

The book has ten chapters. In the first, a brief but important discussion is given of water – the elixir for life. The chemical features of water and its features with respect to hydration, solutes and freezing are discussed. The physics of water at subzero temperatures is discussed in more detail in the next chapter. The formation of ice by various nucleation processes and the properties of various aqueous solutions are discussed. In the topic on proteins and their functions at low temperatures, their stability, reactivity and kinetics are discussed.

From proteins, the next logical development is the study of a biological cell. What happens to a cell on freezing? How does its membrane behave? Does gradual freezing and cold shock have different effects? These are discussed in detail. Do the plants offer resist external exposure to chill conditions? Many antifreeze peptides exist in fish and insect species. The tolerance of the living organisms to freezing is of vital importance in cryonics. The experimental presentation of cells, tissues and organs in cryogenic conditions is a hot topic today. The problems encountered in these are discussed in detail. Where does all this lead to? The question has many angles – scientific, technological, social, philosophical and moral. The book has restricted itself to the scientific issues.

I enjoyed reading the book. As my background also happens to be physics, it became straightforward. A pure biologist may have wished that the topic could have been discussed in a different format. The book reveals not just the interdisciplinary nature of biology, but shows the vitality of physics ideas in handling biology problems.

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Wood-Chemistry, ultrastructure, reactions by Dietrich Fengel and Gerd Wegener. Walter de Gruyter and Co, 13, Genthiner Strasse, D-1000 Berlin 30, West Germany, 1984, pp. 613, DM 245.

Several excellent books which summarise the knowledge of wood chemistry as current at the time of their publication have appeared. English-knowing wood chemists and wood scientists are familiar with the following books on wood chemistry: (1) E. Häggglund, *The chemistry of wood*, Academic Press, New York, 1951; (2) L. E. Wise and E. C. Jahn, *Wood chemistry*, Reinhold, New York, 1952; (3) B. L. Browning, *The chemistry of wood*, Wiley, New York, 1963.

For two decades no new volume appeared on wood chemistry in general and this book is therefore a welcome addition. It does not claim to treat exhaustively on individual components of wood like cellulose, hemicellulose, lignin and extractives. Even in the general field of wood chemistry, the authors “present a comprehensive account of progress and current knowledge in wood chemistry, drawing on specialist literature from 1960 to 1982. For earlier publications the reader is generally referred to summarizing articles and books.”

The book has 18 chapters. They fall into three main sections. The first section describes the fundamentals of wood structure, analysis and components, the second deals with the reactions of wood and its components, the third with the utilization of wood and wood components isolated by various chemical processes.

Each chapter has several sub-divisions and some have been further divided. A number of tables, line diagrams, graphs, photographs, scanning and transmission electron micrographs are included. They add to the usefulness of this book.

It is authored by the faculty of the University of Munich Institute for Wood Research and it is understandable that many of the woods studied and the literature references pertain to western woods and western periodicals.

The English of the German authors in spite of the "conscientious revisions" by Mr. J. B. Robinson is not of the standard of the American and British authors to whose writing style we are accustomed to. The following sentence on page 430 is an example: "Semichemical pulping processes are characterised in principle by a chemical treatment preceded by a mechanical refining step." "Preceded" should evidently have been "followed by." Cross-referencing is one of the many useful features of this excellent book; however, some minor mistakes have crept into it ("16.7" should have been "16.6").

The price is rather too high for students and it is suggested that the publishers bring out a cheaper student edition soon. It is high time that we, in India, introduce wood science and technology as a subject in our undergraduate and post-graduate courses in our universities. A knowledge of the chemistry of wood is essential for a scientific study of wood utilisation. It is unfortunate that even our premier institution, the Forest Research Institute, Dehra Dun, does not have a separate branch for a study of the chemistry of Indian woods.

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The Story of the Earth by Peter Cattermole and Patric Moore, Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, England, 1985, pp. 224, £12.95. Indian orders to: Affiliated East-West Press, 6, Roselyn Gardens Apartments, 20/1A Barnaby Road, Madras 600 010.

In the past few decades the Earth shrank considerably – not in physical size, but in our conception. Not only has it become possible to behold the whole of the Earth in view, but millions of people now go round the globe in a few days time. The jets and the satellites have made it possible to learn more about the Earth in the last thirty years than in the past hundred years. We have also learnt that we no longer live in a planet of infinite resources but, instead, in a planet in which the life support system is very delicately balanced. And, worse still, that in our ignorance and stupidity, we might even

destroy the unique character of the Earth. Probability considerations and science fiction apart, the Earth is the only planet of its kind known to man.

This is a book about our Earth. It is exactly what the title says it is: the story of the Earth. It has four parts.

Part 1 considers the origins of the Earth so far as conjecture, geological evidence and scientific methodology can be brought together to evolve a consistent theory. When we come to think of it, piecing together five billion years of history – for, that is roughly the age of our planet – must draw heavily upon intuition and heuristics.

Part 2 describes the constitution of the Earth, the generation of heat inside the Earth and the dynamical processes that are still going on in the Earth. In spite of its apparent solidity and the immutability of its mountains and seas, when viewed on a geological time scale, the Earth is constantly changing.

Part 3 deals with the recorded history of the Earth. Rocks are the main historical records of the Earth and radiometric dating is the most powerful tool we possess in dating the records. There is a short account of the continents. It seems the continents have been there for 3500–3800 million years, though certainly not in the same shape and in the same position. One of the most fascinating discoveries of recent years is the plate tectonics and the continental drift. The concepts involved in these theories, *viz.*, that the continents are being carried on huge plates (the lithographic plates) and that these plates are slowly drifting relative to each other, explain many geological phenomena. These notions are explained and illustrated beautifully in Chapter 13 and elsewhere. The movement of the plates apparently is such that the Pacific ocean is slowly shrinking in area while the Atlantic and Indian Oceans are expanding.

Part 4 deals with the relatively more recent periods, the development of mammals and man. Man, the *Homo sapien*, we are reminded, has been on the Earth for about 3 million years, which is a very short period in terms of the age of the Earth. The book concludes with a hint at the responsibilities that rest on him in dealing with his space-ship.

The book is so beautifully illustrated that it can be almost called a book-size photographic essay. It can be read by any intelligent high school student. In fact, if one were to understand the history of mankind that is destined to live on this Earth, the story of the Earth must be told to every educated person. This book fulfills this need admirably.

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