

Implications of biotechnology

bio-Technology: Changing the Way Nature Works, John Hodgson. Planned and produced by Equinox (Oxford) Ltd, London (Cassell, Artillery House, Artillery Row, London SW1P 1RT). 1989. 130 pp. £7.95

This is no ordinary book. It recounts the story of the control that we are gradually acquiring over the forces of life, the living combination of biology and chemistry. It tells us about the chemical and biological control that is being increasingly applied to agriculture; it tells us about genetic engineering and its myriad applications in medicine; it also discusses in a non-partisan manner the implications of these advances for society. And does it all in such great style. In less than 120 A4-size pages—much of it devoted to superb four-colour illustrations—Hodgson and the Equinox team, which includes Bernard Dixon and Steve Connor as advisors, take the readers from the tiny cells that make up all living matter through the composition and structure of DNA, proteins, enzymes, replication, gene cloning, DNA sequencing, DNA data banks and libraries, genetic conservation, molecular fingerprinting, information processing in cells, structure and function of enzymes and substrates, protein engineering, the immune system, hybridoma cells and monoclonal antibodies, to the tremendous advances being made in the application of biotechnology in agriculture and health care and the social, philosophical and ethical dimensions of this new-found ability of humans to alter the way nature works. Along the way the reader is told how the different advances in unravelling the mysteries of life came to be made and, in the best traditions of science writing, the men (and women) who made these advances are given due credit.

The prose throughout is simple and elegant and can be easily followed by intelligent laymen with some interest in matters scientific. Besides the main text, there are many brief explanatory notes (printed in italic type) on topics such as microorganisms and germs; cellular symbiosis; chromosomes, genes and DNA; predicting protein structure; DNA and evolution; the DNA controversy;

and interconvertible resources in agriculture. These notes in italic not only help the main story get going uninterrupted but also let the author provide some detailed information necessary for the uninitiated reader to appreciate certain difficult concepts and the significance of certain events—events such as Ananda Chakrabarty of General Electric challenging American courts to win the right to patent a living organism.

The book is replete with superb four-colour illustrations. In fact, there is not a single page without a pretty picture. The set of figures illustrating the different stages through which, starting from atomic coordinates, a computer can build up an image resembling the plastic-and-wire model of a protein or the space-filling model of a huge molecule like haemoglobin is extraordinarily good. What is more, many of the figures are photographs taken in actual laboratory/field setting.

Every left-hand-side textual page carries a pithy statement. Here are some examples: 'The cells of all living organisms are similar'; 'DNA, the blueprint of life, is a double spiral'; 'Biological information flows in one direction only'; 'The bacterium *E. coli* can produce a billion copies of itself in half a day'; 'Increasingly, biological materials are becoming functionally interchangeable'.

Among the men and women who figure in this absorbing story are Charles Darwin, Erwin Chargaff, Francis Crick, James Watson, Maurice Wilkins, Fred Sanger, Philip Leder, Stanley Cohen and Walter Gilbert. Also narrated are the escapades of scientists into the world of bulls and bears with the founding of biotechnology companies such as Genentech, Biogen and Cetus.

The book is divided into six chapters, the first three devoted to the chemistry, information and machinery of life, the next two to the role of biotechnology in agriculture and health care, and the final chapter dealing with biotechnology and society. There is a glossary of technical terms and a decent index.

Although the book will give, and rightly, the impression that most of the developments are taking place in the West, the author has taken pains to accord due credit to developments elsewhere. For instance, the use of the

blue-green alga, *Anabaena*, in India to increase rice production massively finds a mention. Also, while discussing gene therapy, the author draws attention to 'societies where male children are preferred'.

On the whole, this is a wonderfully produced book and I have no hesitation in recommending that those who can afford it should buy many copies and give them away to students in particular and others interested in science.

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Biotechnology in India

An issue devoted to biotechnology in India will be published in March. It will include assessments and critiques of biotechnology and molecular-biology research and biotechnology education, articles on biotechnology research at a few institutions, review articles, and original research reports.

Genetics reviews

Annual Review of Genetics 1989. Vol. 23. Allan Campbell, Bruce S. Baker and Ira Herskowitz, eds. Annual Reviews, Palo Alto, USA, 1989. 675 pp. Price: USA \$ 34, elsewhere \$ 38.

Of the twenty-five stimulating articles in the book, covering microbial genetics, plant and fungal genetics, human genetics, developmental genetics, immunogenetics, population and evolutionary genetics, behavioural genetics and molecular genetics, I shall mention only a few that are of general interest.

For microbial geneticists the article 'Genetic control of bacterial virulence' by V. J. DiRita and John J. Mekalanos would be of great, topical interest. It discusses the various random and non-random means by which pathogenic microorganisms control the expression of virulence factors. The 1989 volume of the *Annual Review of Microbiology* has

a review. The mounting interest in bacterial and viral pathogenicity, that would complement the article by Di Rita and Mekalanos 'Rhizobium genetics' by S. R. Long highlights recent progress in the field and points out opportunities for genetic studies both on symbiosis with plants and on fundamental questions of bacterial function and inheritance. Proteolysis has now been recognized as an important phenomenon in regulation of genetic expression in microorganisms. Genetics of proteolysis in *Escherichia coli* by S. Gottesman reviews our present knowledge on the subject. An equally fascinating area, Multipartite genetic control elements: communication by DNA loop has been competently reviewed by S. Adhya. Recent discoveries in some regulatory systems show that, even in the *lac* operon, the DNA control elements are multipartite in nature and are located at sites distant from the promoter. 'Mechanisms that contribute to the stable segregation of plasmids' have been reviewed by K. Nordstrom and S. J. Austin.

In the area of human genetics an important article, 'The isochore organization of the human genome' by G. Bernardi, discusses the identification of a small number of families of DNA fragments characterized by similar base compositions, by fractionating DNA fragments by equilibrium centrifugation in preparative caesium-sulphate density gradients in the presence of sequence-specific DNA ligands. The results discussed in the review suggest a novel experimental approach in human genome research—compositional mapping. A review of great topical interest is 'Molecular structure of human chromosome 21' by G. D. Stewart, M. L. Van Keuren, J. Galt, S. Kurachi, M. J. Buraczynska and D. M. Kurnit. The small size of chromosome 21, coupled with its clinical relevance, ensure that it will continue to be the subject of intensive study.

'Structure and function of telomeres' by V. A. Zakian deals with telomeres defined in molecular terms: simple repeats at DNA termini of eukaryotes and the proteins which bind specifically to these sequences *in vivo*. Determination of the mechanism of telomere replication will continue to be a crucial area of research. Other areas of future research on telomeres are also discussed

in this review. Transposable elements, originally discovered in maize, continue to be a topic of intense interest. 'Maize transposable elements' by A. Gierl, H. Saedler and P. A. Peterson and 'The population genetics of *Drosophila* transposable elements' give the latest advances in this area in representatives of plants and animals. 'Alternative splicing in the control of gene expression' discusses a phenomenon which has emerged in recent years as a widespread device for regulating gene expression. Whereas in lower organisms the classical, constitutive, splicing is more prevalent, in higher metazoans alternative splicing appears to be more prevalent. The review focuses upon the mechanistic, functional and evolutionary aspects of alternative splicing.

'Homologous recombination in mammalian cells' by R. J. Bollag, A. S. Waldman and R. M. Liskay focuses on three approaches currently used to study recombination in cultured mammalian cells. These approaches are useful in targeting foreign DNA into host cells. Current targeting schemes in mouse embryonic stem cells appear to allow the generation of mutant mouse lines for many cloned genes.

'Mechanism and developmental program of immunoglobulin gene rearrangement in mammals' by T. K. Blackwell and F. W. Alt clarifies many aspects of the recombination mechanism of the immunoglobulin heavy-chain regions and discusses how our understanding of the switching of the immunoglobulin-variable-region gene assembly and heavy-chain class switching are controlled during B-lymphocyte differentiation.

In the area of plant genetics the review 'Habituation heritable variation in the requirement of cultured plant cells for hormones' by F. Meins, Jr., discusses plant cells that have lost their requirement for auxin and cytokinin (habituation). There are hints that habituation may have a causal role in morphogenesis. The review discusses the evidence that habituation results from reversible modifications of heredity, known as epigenetic changes, and discusses possible mechanisms for these changes.

Other subjects dealt with in this volume relate to alcoholism, rDNA redundancy in *Drosophila*, self-incompatibility in *Brassica*, adenovirus E1A transactivator, protein stability and func-

tion, prokaryotic signal transduction, evolutionary quantitative genetics, 21-hydroxylase deficiency, and nematode muscle.

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Earth science reviews

Annual Review of Earth and Planetary Sciences 1990. Vol 18. G. W. Wetherill, A. L. Albee, Francis G. Stehli, eds. Annual Reviews, Palo Alto, USA, 1990. 472 pp. Price: USA \$ 53, elsewhere \$ 57.

Space scientist James Van Allen, in the first, autobiographical, article in the volume, writes about the liberal and pioneering atmosphere that prevailed in America in the early part of this century. This spirit permitted the gradual flowering of a genius who had a knack of providing mechanical gadgets. Allen's later work was under conditions where imagery was the motto, multiple approaches to a problem were the rule, and money was no object. We get to know the development of high-altitude research and early satellite work in military or quasimilitary laboratories. The dramatic changes that followed the landing of man on the Moon and his return safe and sound and the mission to outer planets are then traced. These make fascinating reading. We get an intimate picture of a life full of purpose and achievement.

The volcanic activity of the Valles Toledo Caldera Complex, which has been continuously active since the last 13 million years, forms the subject of a review which summarizes the results of research since 1980. Dahlen, in another article, provides a model for the development of fold and thrust belts and submarine accretionary wedges at compressive plate boundaries. The soft-bodied fauna (the Ediacaran fauna) and the pre-Ediacaran medusoids at the Precambrian-Cambrian boundary are the subject of a review by Conway Morris. The biotic discontinuity across the Precambrian-Cambrian boundary and the possibility of mass extinction of