

Comprehensive Biotechnology

The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine

Editor in Chief Murray Moo-Young

Pergamon Press; Oxford, 1985

Volumes 1-4, £695

According to the Executive Summary, this four-volume work addresses the underlying scientific fundamentals, engineering considerations and governmental regulations dealing with the development and applications of biotechnological processes and products. It is a substantial publication, as one might expect from its cost, with contributions from 250 authors who cover the field in 187 chapters and over 3000 pages of text.

Each volume is provided with a summary of the contents of all four volumes in the set, and its own subject index. The inclusion of a cumulative subject index in volume 4 helps to integrate the contents of the text.

We have used *Comprehensive Biotechnology* as a source of information for teaching undergraduate and postgraduate courses in Biotechnology and Microbial Physiology Applied to Biotechnology, and in our research, and have found many of the articles to be an excellent starting point for launching out into the background literature. The emphasis in these four volumes is broadly that of industrial microbiology and comparatively little attention is given, rightly in our minds, to detailed consideration of the techniques of genetic engineering and the production of monoclonal antibodies on which there is a substantial specialist literature. Rather, the work provides a comprehensive view of the context in which these new and exciting developments are taking place.

Our comments on the individual volumes are given below but in general we feel that *Comprehensive Biotechnology* fills an important niche in publications on biotechnology and largely succeeds in its objective of integrating information on this interdisciplinary subject. At first sight the cost of the work may seem alarming but it is after all the cost of a few oligonucleotide probes or a single seven-residue peptide synthesized chemically.

Volume 1 - The Principles of Biotechnology: Scientific Fundamentals. Volume Editors - Alan T. Bull and Howard Dalton

This volume is divided into two sections, the first dealing with Genetic and Biological Fundamentals and the second with Chemical and Biochemical Fundamentals. This volume might easily have been given over to a reiteration of material to be found in standard textbooks of microbiology and biochemistry but for the most part this has been avoided. Individual chapters are focused on fundamental topics of interest to

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those intent on processing or producing materials by biological methods. Examples from Section 1 are the chapters on The Organisms of Biotechnology, Isolation Methods for Microorganisms, Nutritional Requirements of Microorganisms, Modes of Growth of Bacteria and Fungi and Microbial Growth Dynamics. Animal and plant cell cultures are dealt with in a single chapter, however, and both these increasingly important topics would have benefitted from individual treatment and more space.

Section 2 is composed mainly of chapters on microbial metabolism, with for example, articles on Aerobic, and Anaerobic Metabolism of Glucose, Methanogenesis, Bacterial Respiration and Microbial Metabolism of Aromatic Compounds. However, with the exception of the chapters of Enzyme Kinetics and Mechanisms of Enzyme Catalysis there is little that could be regarded as covering the chemical fundamentals of biotechnology.

The articles in this volume vary immensely in scope, from first lessons for the uninformed to the skilled interpretation for the informed reader, and consequently the presentations are rather uneven in style. There is also a tendency to present unsuitably brief and oversimplified summaries of the subjects. A more serious criticism concerns the chapter on Microbial Growth Dynamics, which lacks rigour, is often confusing and in several places conveys incorrect information. In general, we felt that the volume would make better reading if the readership was more clearly identified. Nevertheless, this volume is a useful source of reference to the microbiological aspects of biotechnology.

Volume 2 - The Principles of Biotechnology: Engineering Considerations. Volume Editors - Charles L. Cooney and Arthur E. Humphrey

Section 1 of this volume covers Bioreactor Design, Operation and Control in thirteen chapters which include Transport Phenomena in Bioprocesses, Fermenter Design and Scale-up, Dynamic Modelling of Fermentation Systems, and Systems for Fermentation Process Control. Section 2 deals with Upstream and Downstream Processing in a further 14 chapters, including for example those on Solids and Liquids Handling, Gas Compression, Media Sterilization and Heat Management in Fermentation Processes and a variety of chapters on filtration processes, liquid-liquid extraction, and ion-exchange, molecular sieve, hydrophobic and affinity chromatography techniques applicable downstream from the bioreactor.

This volume presents comprehensive and stimulating accounts of the major areas of biochemical engineering and the practitioner should regard it as a first source of reference to the state of the art and fundamental science in each area. Fermentation dynamics and engineering inevitably occupy much of the stage since fermentative production of biochemicals is the core of biotechnology and the leading experts in this field have produced a collection of thought-provoking articles.

Volume 3 - The Practice of Biotechnology: Bulk Commodity Products. Volume Editors - Harvey W. Blanch, Stephen Drew and Daniel I.C. Wang

In a sense this volume, which has sections on Healthcare Products, Food and Beverage Products, and Industrial Chemicals, Biochemicals and Fuels, represents the present heartland of biotechnology. Section 1 has chapters on Anticancer Agents as well as Products from Recombinant DNA in addition to several chapters on antibiotics. In Section 2 the menu includes chapters on Whisky, Cheese Starters, Traditional Fermented Soyabean Foods and Fermented Dairy Products, in addition to those on Production of Biomass by Filamentous Fungi, Modern Brewing Technology and six chapters on the production of specific amino acids. The third section takes us, in eighteen chapters, through the production of carboxylic acids, Starch Conversion Processes, Ethanol, Acetone and Butanol and 2,3-Butanediol, to Microbial Flavours and Fragrances, Fats and Oils. There are also chapters on Proteolytic Enzymes, Hydrolytic Enzymes, Glucose Isomerase and Enzymes in Food Technology.

The quality of the articles varies from satisfactory to very good. Those on cephalosporin C, penicillin and tylosin in the Health Care Section are particularly well written. It is clearly impossible to cover the whole field completely but some choices are rather surprising, such as the omission of articles on the economically and therapeutically important antibiotics, tetracyclines and macrolides. In the section on Food and Beverage Products, the articles on polysaccharides, enzymes, and organic acids were particularly informative and well

written. Those on amino acids were of varying depth and substance and in some cases we would have welcomed more detailed discussion of biochemical and physiological aspects of the production processes.

Volume 4 – The Practice of Biotechnology: Speciality Products and Service Activities. Volume Editors – Campbell W. Robinson and John A. Howell

This volume, which is divided into three sections, is the largest of the four, comprising 67 chapters. Section 1, Specialised Activities and Potential Applications, contains articles on currently fashionable areas of biotechnology such as Monoclonal Antibodies, Use of Liposomes as Drug Delivery System, Nitrogen Fixation, Metabolites from Recombinant DNA Modified Plants, Biotechnology Applied to Raw Minerals Processing, Microbially Enhanced Oil Recovery, and Enzyme Probes. Section 2 is a useful collection of articles, and brings together information on Governmental Regulations and Concerns with chapters on Patenting Biotechnological Processes and Products, Acceptance of New Drug Products in the United States and Canada, and The Role of International Organizations in Biotechnology, Cooperative Efforts, for example, making highly informative reading.

We are brought back to some basic but nonetheless important considerations in the final section which deals with Waste Management and Pollution Control. There are subsections on the Chemistry of Waste Treatment, Microbiology and Ecology, Activated Sludge Processes, which are covered in seven chapters, Fixed Film Systems, Anaerobic Reactors, Solid Wastes, and Control and Instrumentation.

The chapters in this volume are also of mixed quality, and the role of the editors should have been more evident here. Biodegradation of Celluloses and Lignins is out of date and Microbiology of Treatment Processes contained far too much basic microbiology of the sort covered in volume 1, such as classification and growth dynamics, and not enough on the topic. Neither of these chapters contained much biotechnology. In the article on Nitrification in the Activated Sludge Process, quantitative relationships between nitrification rate and environmental variables are pulled out of thin air and there is little in the way of references. On the other hand, Computer Implementation of Control and Monitoring of Waste treatment is well written, brief and to the point.

With a few exceptions we found the chapters we have studied in depth, to be informative and concise although it was noticeable that in some of them the references were not as up to date as we expected. Perhaps this is inevitable, however, in the production of such a large work, with authors who have produced manuscripts promptly, appearing to be less up to date than their counterparts who only just make the deadline for publication.

We have been able to mention only a sprinkling of the topics covered in this work, chosen mainly to give the flavour of the publication, and it is clearly an impossible task to review them in detail here. Our overall impression is that Comprehensive Biotechnology largely succeeds in its intention to be the standard reference work in the field.

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Biotechnology is a broad area of biology, involving the use of living systems and organisms to develop or make products. Depending on the tools and applications, it often overlaps with related scientific fields. In the late 20th and early 21st centuries, biotechnology has expanded to include new and diverse sciences, such as genomics, recombinant gene techniques, applied immunology, and development of pharmaceutical therapies and diagnostic tests. The term biotechnology was first used by Karl Ereky in August 1919.

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Application of Biotechnology in Medicine. Have you ever come across a diabetic who needs regular insulin injections? Where do you think this artificial insulin comes from? It is a product of biotechnology applications in the field of medicine.

Biotechnology Applications In Medicine. You may have already learnt about Recombinant DNA (rDNA) technology. This biotechnology application is very important in healthcare because it allows for the mass production of safe and more effective medicines.

The basic principle of ELISA is antigen-antibody reactions. ELISA can diagnose infections by detecting the presence of antigens (proteins of the pathogen) in the patient serum or by detecting the antibodies produced against the pathogen.

iii) In Situ Hybridisation.