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BOOK REVIEWS

Biotechnology

Principles and Applications

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Biotechnology: Principles and Applications is an anthology of the different disciplines that collectively constitute the field of biotechnology. The chapters are constructed along uses or applications, such as medicine and agriculture, rather than by scientific techniques, such as recombinant DNA or hybridoma technology. Unfortunately, the chapters do not include specific references to original research; however, extensive general references are included.

Each chapter essentially stands alone. Because each chapter covers entirely different material, the book does not suffer from any inconsistencies resulting from multiple authorship. The index could be more extensive. This reviewer noted that many obvious entries were absent; however, because of the arrangement of subject matter, it was usually easy to determine which chapter would probably contain the desired information; although it required some time to confirm that a particular topic was not included in the book.

The book is ideal for anyone interested in the general area of biotechnology. The field is so diverse that no one can be an authority in all areas, especially in the different applications. Although the book provides a good overview and insight into the many areas, its coverage is too broad to permit thorough discussions. The book was not intended to be a laboratory manual and would be of little use in developing programs or designing experiments. Elsewhere, there are several recent review articles that delve deeply into each subject and excellent manuals that describe experimental techniques precisely.

The first chapter defines biotechnology as . . . "the industrial exploitation of biological systems or processes; and it is largely based upon the expertise of biological systems in recognition and catalysis."

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Biotechnology is probably the second oldest profession; with origins in the wine and food industry. However, it is the discovery of genetic engineering techniques using recombinant DNA technology that is largely responsible for the current "biotechnology boom." Significant advances can be expected in the following areas:

Agriculture—breeding techniques, strain selection
Chemicals—organic acids, enzymes in detergents
Energy—ethanol as liquid fuel
Environment—waste treatment
Food—single cell protein, food treatment, and preservatives
Materials—mineral extraction
Medicine—diagnosis and therapy with enzymes, new antibiotics

The difference between the "new" biotechnology and the "old" or classical approaches is a recurring theme in the book. Whereas classical methods frequently involve screening many samples for the desired property, the newer techniques rely on designing the solution after considerable understanding has been achieved by basic research.

The chapter "Medicine and Biotechnology" is a typical example of contrasting technologies. The development of penicillin followed classical methods. First, the useful strains were discovered and then improved for increased production by random mutagenesis employing ultraviolet light and alkylating agents. Then, new analogs were developed that were stable at low pH and therefore were effective when taken orally. These were prepared by semisynthetic routes employing biological synthesis of the penicillin nucleus followed by chemical attachment of the new side chains. Finally, continued screening of other organisms led to the discovery of new antibiotics that were effective against gram-negative bacteria.

In contrast, the approach for producing human insulin involves recombinant DNA techniques. Bovine insulin differs from human at three different sites, whereas porcine is different at only one amino acid. Practically all patients who receive bovine insulin eventually develop antibodies to it and must substitute the more expensive highly purified procine insulin. Human insulin would not elicit any antibody response and therefore is the most desirable type of insulin. Researchers designed and synthesized a gene based on the amino acid sequence of the two chains and inserted them into bacterial expression systems for production. A methionine was added at the terminus to facilitate removal of the desired protein from the peptide linkers. This method requires the careful combination of the two chains into the active insulin molecule and formation of the correct disulfide bridges. This approach was improved by the use of the proinsulin gene so that proinsulin would be produced and subsequently converted into insulin by treatment with the proteolytic enzymes, trypsin and carboxypeptidase.

The fact that new biotechnology may predate old biotechnology was demonstrated in the chapter on agriculture. The development of plant hybrids by protoplast fusion was accomplished several years before the production of monoclonal antibodies by Kohler and Milstein Current efforts to improve plant growth by the nutrient film technique involves many of the traditional empirical approaches.

Overall, the book is well written and would be an asset to any library, whether at home or in the laboratory.

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