techniques (spray drying and drum drying), as well as the different fermentor designs devised to handle what essentially is a foam instead of the usual liquid. The LaFrançois fermentor is mentioned in passing but the reader is not told that it is a pulsed system designed to optimize yield. Some of the newer SCP systems, such as the Pekilo system in Finland are described, but the economic savings gained from filtering the fungus rather than from centrifuging it are not mentioned.

The alkane and C_1 chapters evaluate different fermentor designs that have been devised to handle them. Figure 10 in the chapter on C_1 compounds by Uwe Faust and Paul Prave from Hoechst in Frankfurt am Main is particularly informative since it lists operational parameters used to recover SCP from the fermentation system.

About half of the volume is devoted to primary microbial products. (Secondary products will presumably be covered in Volume 4 of the series.) I was disappointed to see that about half of this section is devoted to ethanol, particularly to the bioconversion of lignocellulose as a feedstock to ethanol. The primary products covered are: acids (acetic, lactic, citric, gluconic, and amino) as well as exocellular polysaccharides and emulsifiers. A chapter by Karl Buchta from Boehringer in Ingelheim, West Germany, includes the lesser organic acids such as itaconic, malic, fumaric, and kojic. Conspicuously absent are the acetone-butanol fermentations.

Volume 3 of *Biotechnology* is the latest book that covers primary microbial products. One of the standards has been a now out-of-print two-volume set originally published in 1954 by Underkofler and Hickey, *Industrial Fermentation*, (Chemical Publishing Co., New York). The present work agrees favorably with it, but the Underkofler and Hickey volumes focused more on actual plant design and data than the present volume does. The 1954 treatise did not cover amino acids, and this is quite nicely done by Kenji Soda, Hiderhiko Tanaka, and Nobuyoshi Esaki from Kyoto University in Japan. In addition to describing microbial production, a substantial section is devoted to the enzymatic synthesis of amino acids.

Recently, much attention has been devoted to the use of lignocellulose, or biomass, as a feedstock, particularly for ethanol production. Volume 3 of *Biotechnology* also devotes a substantial section to this topic in two chapters, one simply entitled "Ethanol Fermentation" and the other, "Energy from Renewable Resources." I was annoyed and disappointed to find overlap in the two chapters. Energy balances in ethanol production are discussed. This was of some interest since the argument was made that more energy was used to produce a liter of ethanol than is in a liter of ethanol. Thus, energy input data is given, e.g. how many kilojoules per liter is needed to grow corn. Regrettably, the information is supplied by proponents of the argument, and they state, "this analysis is one of the most optimistic." If this were to be discussed (and I do not think it should be detailed in a chapter on ethanol as a primary product), comparative energy studies would need to be presented.

Economic considerations of ethanol production from lignocellulosic materials are also discussed in both chapters. Again, suspect economic data is given, and it is difficult to relate it to nonhypothetical cases. Ethanol plants exist; a more informative approach would have been to analyze actual plant costs. Of the two chapters, the one by Geoffrey Barnard from Earthscan and David Hall from King's College, both of London, on energy from renewable resources was the better of the two. However, conversion of the polymer lignocellulose to a fermentable sugar solution was not covered; it was treated instead in the ethanol fermentation chapter. The coverage is informative, but it mixes up laboratory experimental work with actual plant data. Recent advances in acid hydrolysis processes are not included. Ethanol recovery is detailed, focusing on recent and readily accessible literature but omitting the German and French dehydration processes used earlier in this century.

A minor section of the volume deals with special applications: starter cultures in the dairy industry, soil conditioners, bacteria for nitrogen fixation, and insecticides. This section should have been expanded since it represents an important area of biotechnology. Ectomycorrhizal fungi grow in the roots of a tree host and many conifers cannot live without symbiosis of the mycorrhizal fungi. This has great applications in developing nonfertile land. Nitrogen fixation is another scantly covered area which has been quite important; only the microbial ecology aspects are covered using *Rhizobium* without even mentioning all the work in the molecular biology in nitrogen fixation, both in leguminous and nonleguminous plants.

Ian Sutherland of Edinburgh University covers his usual topic of exopolysaccharides, and a group from the University of Western Ontario, Canada (Nain Kosaric, Neil Gray, and William Cairns) cover, in a small chapter, the rapidly expanding field of biosurfactants.

Volume Three of *Biotechnology* is informative but it suffers from the typical overlap of having chapters written by different authors. It is a useful reference, however, coming at a time when the field of biotechnology is surging. I was pleased by some sections, and disappointed in others. Hopefully, future volumes will omit some of the repetition, excise the extraneous information, and give more attention where it is needed.

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BOOKS RECEIVED

***Methods in Enzymology*. Vol. 70: *Immunochemical Techniques Part A*. H. Van Vunakis and J. J. Langone eds. Pp. 525. ISBN 0-12-181970-1. (Academic: 1980) $55.00**

Vol. 73: *Immunochemical Techniques Part B*. J. J. Langone & H. Van Vunakis eds. Pp. 739. ISBN 0-12-181973-6. (1981) $65.00

Vol. 74: *Immunochemical Techniques Part C*. Pp. 729. ISBN 0-12-181974-4. (1981) $64.00

Vol. 84: *Immunochemical Techniques Part D*. Pp. 707. ISBN 0-12-181984-1. (1982) $65.00

These four volumes are part of the well-known series, *Methods in Enzymology*, Sidney Colowick and Nathan Kaplan, eds. Part A (Vol. 70) covers basics and radioimmunoassays. Part B (Vol. 73) covers immunoassays in gels, those dependent on radio-labeled and enzyme-labeled tracers, and immunoglobins. Labeling of antigens and antibodies is included. Part C (Vol. 74) discusses the use of antibodies to study enzymes and receptors as well as fluorescence immunoassay methods. Data analysis and immune complexes are also included. The last part, Part D (Vol. 84) covers miscellaneous topics: oncofetal proteins, peptides involved in blood clotting, nucleic acids, toxins, etc. A final section discusses the radioimmunoassay of drugs and environmentally important compounds such as nicotine.

***Genetic Engineering, DNA, and Cloning: A Bibliography in the the Future of Genetics*. J. Menditto and D. Kirsch ed. Pp. 783. ISBN 0-87875-241-2. (Whitston: 1983) $50.00**

This is a bibliography of aspects of biotechnology, covering bioethics and genetic engineering with an emphasis on risks, moral aspects, and control. Books and scientific literature are included. A useful reference.