

BOOK REVIEW

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ZEHNDER, J. B. A. [ED.] 1988. **Biology of anaerobic microorganisms**. John Wiley & Sons, Inc., New York. 872 p. \$89.95

This book is the fifth volume in the Wiley series in ecological and applied microbiology and covers the physiology, ecology, biogeochemistry, and applied aspects of anaerobic microorganisms (prokaryotes). The emphasis placed on each of these aspects shifts from chapter to chapter depending on the expertise of the author, but with few exceptions each subject is covered to some extent thanks to the editor's organizational efforts. The book includes 14 chapters by many of the leading researchers on anaerobic microorganisms in Europe and the United States.

The first chapter by Zehnder and Stumm serves as an introduction to redox processes mediated by bacteria and their energetics. Thermodynamic considerations are presented as a guide to determining the feasibility of reactions and to provide additional insights into catalysis. The energetics of the now classical example of syntrophic growth of hydrogen producers and consumers is given as an example of how seemingly endergonic processes (under standard conditions) can become exergonic by removal of one of the reaction products.

Most of the remainder of the book is organized around major physiological types of anaerobes, whereas three chapters concentrate on the degradation of specific classes of compounds to highlight the differences between aerobic and anaerobic degradation pathways. Two chapters each are devoted to phototrophs, dissimilatory nitrate-reducing bacteria, sulfate-reducing bacteria, and methanogenic bacteria. One chapter concentrates on the ecology, microbiology, and biogeochemistry of each physiological group of bacteria and the other chapter deals with enzymology, biochemistry, and energetics.

Madigan discusses the microbiology, physiology, and ecology of phototrophic bacteria. There are numerous descriptions of the phototrophic communities in lakes, hot springs, marine microbial mats, and wastewaters. Media and techniques for isolating specific phototrophs are given. Amesz and Knaff review pigment biochemistry, cyclic and noncyclic electron flow, and photophosphorylation. Tiedje's chapter on dissimilatory nitrate-reducing bacteria provides a nice background on the microbiology, physiology, and environmental factors regulating denitrification, but does not include thorough discussions of the ecology or biogeochemistry of this important process. The enzymology, regulation, and energetics of dissimilatory nitrate reduction are discussed by Stouthamer. A short but stimulating chapter on the microbial reduction of manganese and iron is presented by Ghiorso. Surprisingly little is known about the role of microorganisms in the reduction of manganese and iron oxides in nature or the energetics of these processes.

Midway through the book, chapters 7 and 8 deal with the anaerobic degradation of specific groups of

compounds. The anaerobic degradation of cellulose, lignin, and lignin-derived phenols is presented in an objective review by Colberg. Discussions about the occurrence of the anaerobic degradation of aromatics, and in particular lignin, have sparked some lively debates. Enough information is now available to conclude that under anaerobic conditions lignin-derived monomers are completely mineralized by microorganisms, cleavage of common intermonomeric linkages in lignin occurs, and polymeric lignin is partially mineralized. The anaerobic degradation of fats and proteins is described by McInerney. Biochemical pathways of degradation are emphasized, and very few examples of the degradation of these substrates in natural environments are given.

The microbiology, energetics, and physiology of acetogenic bacteria is covered by Dolfig. This diverse group of bacteria has an important influence on carbon and energy flow in anoxic environments by the formation of acetate—a key intermediate in anaerobic metabolism. Widdel's chapter on the microbiology, physiology, and ecology of sulfate-reducing bacteria is an informative review of a wide variety of topics. The diversity of substrates known to be utilized by sulfate reducers has expanded substantially, but they are still considered terminal degraders dependent on fermentation-derived, low-molecular-weight substrates. Relatively little discussion of sulfate reduction in estuarine and marine sediments is included, considering the extensive literature on the subject. The enzymology, energetics, and biochemistry of sulfate reduction is detailed by LeGall and Faugue.

The microbiology, physiology, ecology, and biogeochemistry of methanogenic bacteria are presented in a particularly interpretative chapter by Oremland. There are several discussions on methanogenesis in aquatic environments, and the geochemical aspects of methanogenesis are highlighted. The biochemistry and energetics of methanogenic bacteria are described by Vogels, Keltjens, and van der Drift. The final chapter by Schink discusses the potentials and limits of anaerobic degradation with emphasis on applied technologies. Anaerobic biodegradation of certain xenobiotics, such as haloaromatics, may prove to be superior to aerobic breakdown for detoxification. The potential of small-scale anaerobic digestors for waste treatment and energy recovery makes this technology well suited for rural and developing areas.

The book is well illustrated with figures, tables, and micrographs. Numerous references, with thorough coverage through 1984, are listed with full citations at the end of each chapter. In summary, this book represents one of the few comprehensive treatments of anaerobic microorganisms in a single volume; undoubtedly it will serve as a valuable reference text and possibly as a textbook for advanced courses.

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