

nisms for other potentially valuable biocatalytic processes. The editors have brought together prominent workers in clostridial biology and molded an informative and timely account (with references up to 1988) of the present status of the field. There is an agreeable crispness to the writing and a consistency in style and organization in the chapters.

The genus *Clostridium* consists of a large number of species of very diverse organisms with a high degree of phylogenetic heterogeneity (Cato and Stackebrandt). Clostridia can convert a large variety of complex organic materials to simple organic acids, alcohols, neutral solvents, CO₂, and H₂. The metabolic capabilities of these organisms are introduced by Andreesen, Bahl, and Gottschalk. Ljungdahl, Hugenholtz, and Wiegel discuss authoritatively the metabolic pathways that generate the wide range of organic acids produced by a large variety of clostridial species, with emphasis on the acetogens.

Many saccharolytic species produce neutral solvents as an alternate mechanism for disposing of excess reducing equivalents generated during fermentation. The species range from thermophilic saccharolytic species, such as *C. thermohydrosulfuricum*, that produce ethanol to mesophilic ABE fermenters in which acetic and butyric acids are converted to alcohols and acetone at the end of the acidogenic, exponential growth phase. This transition in metabolism is associated with the initiation of sporulation; the mechanisms responsible for triggering the change are not understood. The fermentation strategies for solvent production by these and related species are comprehensively reviewed by Jones and Woods, as are physiological aspects of inhibition by fermentation end products.

Clostridia also secrete a variety of enzymes that are potentially valuable, particularly the stable enzymes elaborated by the thermophiles. Saha, Lamed, and Zeikus describe the characteristics of a number of extracellular enzymes that are potentially exploitable, including hydrolases, such as amylases, pullulanase, pectinases, collagenase, proteases, selected oxidoreductases, and the complex of proteins making up the cellulosome of *C. thermocellum*.

Because of their anaerobic life style, clostridia possess a wide range of unusual enzymatic activities. The commercial exploitation of such enzymes for the synthesis of specific chiral compounds, for use in assays or diagnostic kits, and for other bioconversions is proposed by Morris. There is even a use (for therapeutic purposes) for the potent toxins produced by toxigenic clostridia (Shone and Hambleton).

This is an excellent time to review the

birth of genetic analysis in this genus (Young, Staudenbauer, and Minton). Recombinant DNA technology has been used to clone clostridial genes into *Escherichia coli* and to analyze their structure and expression. Development of a reliable method of transformation of intact cells by electroporation and conjugal transfer of plasmids and transposons are important recent advances, as is the construction of *E. coli*/*Clostridium* shuttle vectors. Heterologous genes from other clostridia have been introduced into *C. acetobutylicum*. Eventually recombinant DNA technology should be useful for cloning new genetic capabilities into clostridia.

The handbook will be of great value to its intended readers and is recommended reading for graduate students in microbiology. It certainly belongs in microbiology department libraries.

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A Model in Waiting

The Biology of *Euglena*. Vol. 4, Subcellular Biochemistry and Molecular Biology. DENNIS E. BUETOW, Ed. Academic Press, San Diego, CA, 1989. xvi, 528 pp., illus. \$150.

Euglena gracilis is not the only alga that normally produces colorless (or non-green) plastids in the dark and turns them into chloroplasts in the light, but it is the only alga in which the process of chloroplast development can be readily studied. The initial popularity of *Euglena* as an experimental organism, however, had less to do with chloroplasts than with Seymour Hutner, who determined in 1949 that axenic *Euglena* had an absolute requirement for vitamin B₁₂. Hutner exploited this requirement in a simple and sensitive bioassay for the vitamin and along the way devised several defined media that afforded relatively rapid growth rates (up to three divisions per day) and extremely luxuriant yields (around 15 grams per liter). In the ensuing 40 years *Euglena* became a rewarding subject, mostly for the study of chloroplast development, but also for the study of cell structure, diurnal rhythm, vitamin B₁₂, trace-metal nutrients, and locomotion.

Dennis E. Buetow has been editing *The Biology of Euglena* since 1968 and has himself contributed handsomely to euglenology. This latest volume continues an important tradition that is appreciated by *Euglena* aficionados and should be of profit to all students of phycology, plant biochemistry, and molecular biology.

As is usually true of multi-authored books, volume 4 is uneven. It must be said that the editing is imperfect: citations are in some cases incorrect, and the valuable chapter by S. Kitaoka *et al.* on virtually every enzyme studied in *Euglena* in the last 20 years could have been made more readable. (It was in Kitaoka's laboratory, incidentally, that *Euglena* were first made to yield coupled mitochondria and chloroplasts that could fix CO₂.)

Four chapters on organelles and subcellular particles illuminate the virtual uniqueness of *Euglena*: I know of no other microorganism from which nuclei, mitochondria, microbodies, lysosomes, autophagic vacuoles, and chloroplasts have all been isolated, albeit with varying success. Buetow's chapter on mitochondria is an excellent survey and includes some beautiful three-dimensional reconstructions of the changes that occur in the reticulate mitochondria with changes in nutrition and development. Unfortunately little research at the molecular level has been reported on *Euglena* mitochondria. The situation with microbodies, lysosomes, and autophagic vacuoles is worse, since the latest relevant reference in M. J. Merrett's chapter on those topics is 1981. The chapter by O. Bertaux *et al.* on the *Euglena* nucleus, however, is doubly disappointing. The treatment of the organization and structure of nuclei is drawn almost entirely from literature that is 10 years out of date, and the composition and transcriptional activities of isolated nuclei are presented without reference to what has been learned in contemporary studies on other organisms.

The last third of the volume bears most strongly on the problem of light-induced chloroplast development. The thoughtful analysis by Edelman and Kahana on protein synthesis in plastids marshals evidence on plastid development at three different levels: in vivo, in organello, and in vitro. Again, the versatility of *Euglena* is demonstrated. The paper by Hallick and Buetow on chloroplast DNA is a summary of gene maps, gene sequences, genome organization, and DNA replication. With some 60% of the genome sequenced, the *Euglena* plastid genome is easily the most thoroughly understood outside of higher plants. The final chapters by N. G. Avadhani and G. Freyssinet on ribosomes and M. Nigon *et al.* on messenger RNAs are strongly weighted, as is the literature, toward clues to plastid development gleaned from the analysis of these elements.

As much as I enjoyed reading the book, I was also troubled: in chapter after chapter the bulk of the discussion centered on the literature of the '70s. It is not that the authors were negligent in including current references, although some were at fault in

not employing contemporary models in the analysis of older data; the fact is that few laboratories currently work on *Euglena* and the number of papers on *Euglena* has decreased sharply. The cause of the decline in the popularity of *Euglena* is obvious: no one eats *Euglena*; no one gets sick from it; and—unlike *Chlamydomonas*—it has no sex. *Euglena* remains nonetheless one of the best organisms for the analysis of plastid development on the levels of molecular genetics, biochemistry, and physiology. *Euglena* is an organism waiting for a good paradigm.

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Concerns of Stratigraphy

Quaternary Type Sections. Imagination or Reality? JIM ROSE and CHRISTIAN SCHLÜCHTER, Eds. Balkema, Brookfield, VT, 1989. viii, 208 pp., illus. \$48. From a symposium, Zurich, Switzerland, Oct. 1985.

Type sections are the fundamental reference points of geological stratigraphy—quarry exposures, road cuts, sea cliffs, or even cores from borings (drill holes) in which formal litho-, bio-, and chronostratigraphic units are defined and to which newer field discoveries must be related. Original type sections are rarely perfect, because they commonly derive their status through pragmatic considerations. A type section may have been merely the first or only section discovered, the best preserved, or the closest to a research center. Such accidents do not necessarily provide truly representative lithologies, complete suites of fossils, and the absence of internal hiatuses (unconformities). Geologic correlation nevertheless requires reference points, and such points should be fixed by convention and should not be changed casually.

The title of this volume promises a discussion of such considerations, which could be of broad interest. Only a few of the papers address the concept of type sections, however, and many of them make no mention whatsoever of a type section, let alone evaluate the role of type sections in Quaternary stratigraphy. Nor is there an introduction or overall summary putting the question raised in the title into some perspective. This is not to say that the contributions are not interesting and valuable in their own right, but for those attracted by the title *caveat emptor*.

In part 1 (Basic References), R. G. West briefly reviews the type sections used for the subdivision of the British Quaternary, including a historical perspective and a useful

table of the type sites for all the "stages" of the British Quaternary stratigraphic column. He concludes with a strong pitch for detailed descriptions of formally defined sections in order to improve terrestrial Quaternary stratigraphy, and he insists that "a framework should not be placed on the marine isotope stages." Next, more than equal space is given to N. J. Shackleton, who convincingly argues for a marine isotopic framework but does not address the concept of a type section.

J. Rose addresses finer scale subdivisions, stades or stadia, in the British Quaternary, concluding that only a few of them have been formally defined. Rose reviews the concept of type sections, including unit stratotypes, holostatotypes, lectostatotypes, and hypostatotypes. So far, so good, but he then goes on to make it clear that there is a "preference for a stadial stratotype to show direct evidence of glaciation," thus building climatic and genetic interpretation directly into what should be strictly a descriptive classification. Charles Turner also (p. 42) raises the issue of climatic classification, specifically in the form of "geologic-climate units," as defined by the 1961 American Code of Stratigraphic Nomenclature. It seems to have escaped all the contributors that a newer North American Code of Stratigraphic Nomenclature exists that was published two years prior to their symposium and explicitly excludes "geologic-climate units."

Rose clouds the issues even more by stating that "at present chronostratigraphy has no role" (p. 58) in defining British stadials. This statement is comprehensible only when it becomes clear that Rose does not utilize "chronostratigraphy" in the sense of the 1961 American Code or the Hedberg *International Stratigraphic Guide*, both of which he cites as authorities. In fact, chronostratigraphy is not treated correctly anywhere in this volume. Rose has the cart before the horse in defining chronostratigraphic boundaries by their absolute dates in years. In the terminology of the current North American Code, such "stadials" would be "chrons"—chronometric, not chronostratigraphic, subdivisions.

The remaining two-thirds of the volume has essentially nothing to do with type sections, but does contain some very interesting papers on lithostratigraphy, biostratigraphy, and paleosols of the circum-Alpine region, the French Massif Central, the Pyrenees, the Netherlands, and Poland. Three papers are especially noteworthy. M. Reille and J.-L. de Beaulieu describe long pollen sequences from the volcanic basins (maars) of the French Massif Central, which rival that of Grande Pile so often cited these days.

Helmuth E. Stremme discusses the correlation of paleosols between northern Europe and the Alps, which leads him to a correlation of the (northern European) Holsteinian with the (Alpine) Günz/Mindel interglacial, both dated at more than 350,000 years, although this conclusion is not universally accepted. Finally, R. Hantke reviews the probable course of early and pre-Quaternary climatic development on both the north and south slopes of the Alps, going back to Oligocene and Miocene glaciation.

In conclusion, the question raised in the title of this book is never answered. It appears that the symposium that spawned the volume was based on an interesting problem, but none of the participants came to grips with it.

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Books Received

Animals in Primary Succession. The Role of Fauna in Reclaimed Lands. J. D. Majer, Ed. Cambridge University Press, New York, 1989. xii, 547 pp., illus. \$100.

An Annotated List of the Birds of Bolivia. J. V. Remsen, Jr. and Melvin A. Traylor, Jr. Buteo Books, Vermillion, SD, 1989. 79 pp. Paper, \$15.

Biochemistry. J. David Raw. Patterson, Burlington, NC, 1989. xi, 1105 pp., illus., + index. \$49.95.

Engineering Rock Mass Classifications. A Complete Manual for Engineers and Geologists in Mining, Civil, and Petroleum Engineering. Z. T. Bieniawski. Wiley-Interscience, New York, 1989. xiv, 251 pp., illus. \$54.95.

Evolution of the Global Biogeochemical Sulphur Cycle. Peter Brimblecombe and Alla Yu. Lein, Eds. Published for the Scientific Committee on Problems of the Environment, International Council of Scientific Unions, by Wiley, New York, 1989. xxiv, 241 pp., illus. \$104. SCOPE, vol. 39. From a workshop, Tallinn, Estonia, 1984.

The Great Scientists. Jack Meadows. Oxford University Press, New York, 1989. 256 pp., illus. Paper, \$18.95. Reprint, 1987 ed.

Individual and Small Group Decisions. K. J. Radford. Springer-Verlag, New York, and Captus University Publications, North York, Ontario, 1989. xiv, 175 pp., illus. Paper, \$45.

Land Filled with Files. A Political Economy of the Kalahari. Edwin N. Wilmsen. University of Chicago Press, Chicago, 1989. xviii, 402 pp., illus. \$60; paper, \$17.95.

Mechanisms of Chromosome Distribution and Aneuploidy. Michael A. Resnick and Baldev K. Vig, Eds. Liss (Wiley), New York, 1989. xviii, 400 pp., illus. \$96. Progress in Clinical and Biological Research, vol. 318. From a meeting, Reno, NV, Jan. 1989.

Preventing AIDS. The Design of Effective Programs. Ronald O. Valdiserri. Rutgers University Press, New Brunswick, NJ, 1989. xvi, 304 pp. \$38; paper, \$15.

Radioactive Waste Forms for the Future. Werner Lutze and Rodney C. Ewing, Eds. North-Holland (Elsevier), New York, 1988. xiv, 778 pp., illus. \$247.50.

The Recurring Silent Spring. H. Patricia Hynes. Pergamon, Elmsford, NY, 1989. x, 227 pp. \$27.50; paper, \$12.95. Athene Series.

Risk Assessment in Setting National Priorities. James J. Bonin and Donald E. Stevenson, Eds. Plenum, New York, 1989. xii, 686 pp., illus. \$125. Advances in Risk Analysis, vol. 7. From a Meeting, Houston, TX, Nov. 1987.

The Science and Practice of Gerontology. A Multidisciplinary Guide. Nancy J. Osgood and H. L. Sontz, Eds. Greenwood, Westport, CT, 1989. xvi, 192 pp. \$42.95.