pression in bacteria. After a general exposition on the *lac* operon, the author considers the comparative anatomy of other bacterial operons. He introduces the subject with a short discussion of the kinds of circuit diagrams expected in positively and negatively controlled inducible and repressible systems and of the genetic predictions for regulatory elements in each case. He then considers translational control and reviews the confusing mass of experiment and hypothesis on polarity and polar mutants. The final section of the book contains three chapters dealing with replication, repair, and recombination in DNA.

The great merit of Lewin's book is that it places the hundreds of recent papers on the molecular aspects of gene expression and replication in bacteria and to a lesser extent bacterial viruses in perspective. One comes away from the book with the feeling that one has finally caught up with the literature. The book should serve not only as a superb primer for the rusty or peripherally interested geneticist but as an excellent text for a second-level course in molecular genetics.

NICHOLAS W. GILLHAM
Department of Zoology,
Duke University,
Durham, North Carolina

Microorganisms

The Yeasts. A Taxonomic Study. J. LODDER, Ed. Second edition. North-Holland, Amsterdam, 1970. xvi, 1386 pp., illus. $65.

Written by 14 specialists, this bulky treatise is based on the studies of a vast number of yeast strains, obtained from individuals and culture collections around the world. The authors have developed an array of standard procedures and media which ensure that their results are strictly comparable and reproducible by others; a precise account of the methodology is found early in the book. The book further contains: an excellent review of the sexual and asexual modes of reproduction encountered among the yeasts and of the complications they engender for yeast taxonomy; determinative keys for the identification of genera and species; and detailed descriptions of the properties of each of the recognized taxa, along with comments on the criteria used for their differentiation. It is therefore an invaluable source of information on yeasts and indispensable to anyone who has a more than passing interest in these organisms.

The classification of yeasts, like that of most other microorganisms, presents problems that stem from the paucity of characteristics that have an incontestable evolutionary significance. Some of the authors seem to believe that it is possible to formulate phylogenetic principles applicable to this group; but, however ingenious, the arguments presented rest on premises that many biologists will be reluctant to accept. I therefore found it refreshing to come across statements by other contributors that reveal a growing awareness of the precarious status of such arguments and unhesitatingly advocate the use of differential properties in a purely pragmatic manner. In the introductory section dealing with the genus *Saccharomyces*, Van der Walt clearly expresses this attitude: "The present demarcation of the genus is thus utilitarian and aims merely at providing a method of reference and communication" (p. 556–57). A scrutiny of the properties used to define the currently accepted genera and species leaves me with the impression that this holds true for most of these taxa. I therefore propose that in future editions such terms as "related" and "relationship," with their phylogenetic connotations, be replaced by less pretentious ones that imply no more than degrees of resemblance ("similar," "similarity").

With one exception, the genera are distinguished by morphological characteristics. Because the study of a yeast usually begins with a microscopic examination of the culture, this seems rational enough. But such features have occasionally been used in a misleading manner. If, for example, a yeast culture is found to contain triangular budding cells, the key to the genera unambiguously leads, by way of 1c, 2c, 6b, and 9a, to *Trigonopsis*; but such cells also occur in *Candida diddensii* (figs. 354 and 172). The genus *Candida*, comprising the non-spore-forming yeasts that produce a pseudomycelium, includes the two species, *C. glaebosa* and *C. melibiosica*, in which this feature is not apparent (figs. 186 and 218), even when they are grown under conditions that favor pseudomycelium formation (slide cultures and Dalmau plates).

The genera *Cryptococcus* and *Torulopsis* are differentiated by a single physiological property, namely the ability or inability to use inositol as a carbon and energy source. Comparable criteria serve to subdivide genera into species; morphological characteristics are no longer considered suitable for this purpose. Again, from a utilitarian standpoint, this practice may be acceptable, but it seems precarious, for it has been noted that a strain propagated over a prolonged period of time on special media may acquire new physiological properties, and it is also known that microorganisms can lose the ability to metabolize a particular substance as the result of a single-gene mutation. These facts imply that an original isolate and its progeny may be classified as different species.

These critical remarks are not intended to depreciate the value of the book as the most extensive compilation of information on yeasts currently available. It occupies a position similar to that which *Bergey's Manual* has attained in bacteriology. And just as consecutive editions of the latter have been improved by criticism of the preceding ones, it is hoped that future editions of *The Yeasts* may benefit from a careful consideration of the misgivings here expressed.

C. B. VAN NIEL
Hopkins Marine Station of Stanford University, Pacific Grove, California

Proteases

Structure-Function Relationships of Proteolytic Enzymes. International Union of Biochemistry Sponsored Symposium No. 37, Copenhagen, June 1969. P. DESNUELLE, H. NEURATH, and M. OTTESEN, Eds. Academic Press, New York, 1970. 310 pp., illus. $17.50.

This volume represents an attempt at a grand survey of information that has been accumulated regarding enzymes that function in the hydrolysis of peptide bonds. Necessarily, because of the diversity of proteins involved in catalyzing this hydrolytic process at differing peptide specificity sites within cells of diverse function, the quality of the available facts varies enormously with the particular enzyme. Therefore, although it contains a number of excellent articles, this symposium volume is very much a mixed bag.

As of the date when the symposium was held, three-dimensional structures to atomic resolution had been determined for chymotrypsin, elastase,

subtilisin, carboxypeptidase, and papain. The three-dimensional structure of papain is discussed in great detail. The crystallographic determination of the subtilisin and chymotrypsin structures is described only in short abstracts, although the consequences of these three-dimensional structures are commented upon widely by others elsewhere in the volume and discussion of the relationship between structure and function is an important feature of the volume. Fortunately, there is a clear, though incidental, presentation of the subtilisin structure in an article by M. Ottesen and his collaborators. Surprisingly, the three-dimensional structure of carboxypeptidase is not discussed at all, although its principal discoverer was an active participant in the symposium.

Molecular mechanisms of catalysis are considered for a variety of enzymes, notably chymotrypsin, trypsin, subtilisin, pepsin, and papain. The exclusion from the volume of the known three-dimensional structures for the "active-serine" proteases significantly detracts from the readability of many mechanistic discussions which assume this information.

The role of particular amino acid residues in specificity and activity is discussed for the "active-serine" proteases, pepsin, papain, and stem bromelain.

Considerable information on homologies, or the lack thereof, in amino acid sequences of diverse enzymes exhibiting the same catalytic mechanism is presented. Some of the information, for example that on porcine chymotrypsinogens, is fragmentary. On the other hand, the analysis of sequence homologies among a variety of subtilisins and the comparison of these sequences with the catalytically related mammalian serine proteases are among the most interesting features of the volume.

Other topics that receive some attention are the structure of macromolecular polypeptide inhibitors of some of these enzymes and the inferences that may be made therefrom regarding the structure of the site, and the effect of alternate protein environments on the activity of enzymes.

Some contributions to this symposium are excellent and merit particular attention. These are a detailed article on the three-dimensional structure of papain by Drenth and his collaborators, two discussions of the role of amino acid sequence in the structure and function of the various subtilisins in the articles by Smith, Markland, and Glaser and by Ottesen, Johannsen, and Swensen, and a 23-page contribution by E. Katchalski dealing with modification of the microenvironment of enzymes, the resultant catalytic properties, and its potential bearing on the properties of catalysts in membranes.

As must be evident from this review, it is difficult to find an underlying motif for this symposium other than "proteins that catalyze the hydrolysis of peptide bonds." The presentations have been arranged according to type of proteolytic enzyme and may help to provide a first set of references to recent information. Although there is considerable new information on some lesser-known proteases, a good deal of important recent information on the more intensively investigated ones is missing.

SIDNEY A. BERNHARD
Institute of Molecular Biology, University of Oregon, Eugene

Developmental Biochemistry

Molecular-Genetic Mechanisms of Development. ZHORES A. MEDVEDEV. Translated from the Russian edition (Moscow, 1968) by Basil Haigh. Plenum, New York, 1970. xiv, 418 pp., illus. $25.

Analysis of the literature dealing with the regulation of gene activity during development is a difficult task, probably because so much has been published yet so little is known. It is to Medvedev's credit that he has organized this review of the field so well. He begins by examining transcriptional and translational control mechanism in viruses and bacteria, believing that the complicated regulatory events which must occur during eukaryote differentiation are best appreciated in light of how simple organisms solve their regulatory problems. The subsequent chapters are concerned with the biochemical and morphological basis of gene control in higher organisms. Included here are sections on the structural organization of chromosomes, the biochemistry of chromatin, the changes in nucleic acids and proteins during development, and the role of cytoplasm, hormones, and inducers in coordinating morphogenesis. Finally, Medvedev brings everything together in an attempt to construct a molecular model of differentiation.

Within this framework, there still is an enormous literature that could have been covered. Rather than try to be comprehensive, in many instances Medvedev has chosen to analyze a particular area of research or approach in depth. The book is best, for example, when it concentrates on Neifakh's experiments on lethal x-irradiation of loach embryos or Zuckerlandl's scheme to explain thalassemia.

Overall, however, the book should be of limited appeal to workers and graduate students in the field, primarily because the experiments described are comparatively old. Although Medvedev has added to the English version a perfunctory final chapter covering recent experiments, the bulk of the text describes work published prior to 1968. During the intervening years, most of the experiments with which Medvedev deals have been extensively reviewed. Familiarity has taken the excitement out of many of these observations and hypotheses. Hindsight reveals hasty conclusions, significant omissions, and unfruitful approaches.

A second fault limiting the book's appeal is that it is hard to read. The English varies from clumsy to incomprehensible. There are numerous grammatical and typographical errors.

In summary, the book is well conceived, but the hypotheses, experiments, and conclusions it describes are by now well known and thoroughly reviewed. There would seem to be little reason for anyone to labor over these pages when up-to-date articles covering the same material are available.

WILLIAM SOFER
Department of Biology, Johns Hopkins University, Baltimore, Maryland

Chemical Detection

Pulse Radiolysis. MAX S. MATHESON and LEON M. DORFMAN. M.I.T. Press, Cambridge, Mass., 1969. xii, 212 pp., illus. $11.75. M.I.T. Press Research Monographs in Radiation Chemistry, vol. 1.

Many chemical reactions occur stepwise; the first species produced quickly convert to more stable forms. To find out what the transients are and how they behave is obviously necessary for any real understanding of chemistry. Though much may be deduced from detailed study of reaction rates, direct detection of intermediate transients is an obvious step forward. The development of "flash photolysis" in the 1950's provided a method of building up concentrations of transient species that could be followed by fast optics. Then in the 1960's a kindred technique was