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

developed, in many respects more powerful and of wider application, called "pulse radiolysis." This book is important to chemistry in that it provides the first coherent, systematic description of this technique and of the results it has produced in its first few years.

In pulse radiolysis, a sample of material is exposed to a very short burst (typically a microsecond) of electrons having enough energy to penetrate the specimen (a few million volts) and enough intensity to build up detectable concentrations of reaction products (0.1 amp or more). Light meanwhile passes through the sample to a detector which through fast electronics can follow growth and decay of a light-absorbing species over times which may be as short as a small fraction of a microsecond.

The first third of the book contains a detailed account of the methodology of pulse radiolysis. The remainder, which should appeal to a considerably broader chemical public, is an account of the results obtained by the method up to the beginning of 1968.

A wealth of new information has been obtained on the properties of free radicals of all kinds. In the organic category are many aliphatic radicals too reactive to have been studied by other methods, as well as aromatic types. In the inorganic category, besides the important radicals derived from water, a particularly interesting group is the unstable metallic ions of low valence, such as monovalent zinc, cadmium, and iron.

The study of transient solvated electrons in water, alcohols, and many other solvents is the most surprising achievement of pulse radiolysis. The well-known solvated electron in liquid ammonia may remain in a metastable state for days, but in oxygen-containing solvents it lasts only for microseconds; in the latter case it disappears by reaction with another solvated electron to form a molecule of hydrogen.

A subject not mentioned in the book is the high cost of pulse radiolysis equipment, which has confined it to a relatively few laboratories. However, high-voltage machines of the field emission type are less expensive by an order of magnitude than the more elaborate accelerators originally used. It is the reviewer's hope that further development in high-voltage machinery during the next decade will bring pulse radiolysis within the reach of every well-equipped chemical laboratory.

This book should impel many chemists to take another look at the influence such exotic subjects as radiolysis, fast electronics, and high-voltage machines may have on the chemical laboratory practice of the future.

A. O. ALLEN
Brookhaven National Laboratory, Upton, New York

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