

## Book review

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*Chemical Recognition in Biology*: Volume 32 in the series *Molecular Biology, Biochemistry and Biophysics*, edited by F. CHAPEVILLE AND A.-L. HAENNI, Springer-Verlag, Berlin, Heidelberg, and New York, 1980, ix + 430 pages, US \$57.90, D.M. 98.00.

This book collects papers presented at a symposium held in 1979, honoring the 80th birthday of Fritz Lipmann. An enormous range of subjects throughout biochemistry and molecular biology is discussed, many of which were studied by Lipmann at one time or another in the course of his long, diverse, and productive career. The general bias of each article remains fairly close to the symposium title, namely, the chemical basis of biological recognition. Most articles focus on the detailed physical biochemistry of the molecular interactions associated with a particular biochemical system. Chapters are segregated into five sections: A, Recognition of Ligands — Enzymic Catalysis; B, Enzyme Regulation; C, Nucleic Acid-Protein Interactions, Mutagenesis; D, Protein Biosynthesis; and E, Philosophical Reflexions. In each chapter, the ratio of experimental data to discussion is about the same as in the average scientific paper, and most articles are up-to-date and rather personal summaries of what the authors consider to be the most important features of their own work. This certainly makes for more interesting and understandable reading than the usual pontifical review.

The first section (Ligand Recognition) leads off with a typically scholarly article by Jencks, entitled: "What everyone wanted to know about tight binding and enzyme catalysis, but never thought of asking". Although all biochemists have at least a nodding acquaintance with the subject matter and think it is of fundamental importance, few probably understand it in depth, and only about half of these dream of having a free week-end when they could finally wade through such a chapter in detail. In the next chapter, Kamen describes the features of cytochrome C, primarily the stereospecific positioning of lysine residues, which makes it recognizable by cytochrome oxidase. Perutz summarizes the molecular basis by which different heme proteins (hemoglobin, cytochrome C, and peroxidases) have such widely different chemical and biological action. Wolfenden discusses the influence of solvent water on protein folding and enzyme catalysis, and points out an interesting correlation between hydrophobicity of amino acid side-chains and their cognate genetic code. (This chapter is worth reading if only for the sentence that: "enzymes share with midwives . . . a remarkable talent for easing the difficult passage of substances from one metastable condition to another".) In the next chapter, Walsh describes suicide substrates for different classes of enzymes, and both their potential and actual therapeutic uses. Ninio and Chapeville argue that geometric concepts, which usually

dominate thinking about recognition problems, are, in many cases, inadequate to explain biological specificity, but rather, the kinetics of correct binding relative to incorrect binding must also be considered. Williams and Fox propose a "Coupled Oscillator Theory of Enzyme Action"; this is the weakest chapter in the book. The last chapter in the section, by Cori *et al.*, concerns some stereochemical aspects of terpenoid biosynthesis.

The second section, on "Enzyme Regulation", begins with a chapter by Nishizuka on certain aspects of cellular regulation that might be ascribed to different multifunctional, protein-kinase systems, in particular, a calcium-activated kinase that requires phospholipid. Koshland and Anderson provide a delightful chapter on the effect of catabolite repression on chemotaxis in *Salmonella typhimurium*. This system has already gone a long way toward establishing a paradigm for future neurobiologists, namely, that sensations can ultimately be described in molecular terms. Stadtman *et al.* describe subunit interactions in glutamine synthetase, and provide an excellent example of the enormous complexities and subtleties of regulation that can be provided solely at the enzyme level when the activity of individual subunits in a multisubunit enzyme can be modulated by covalent modification, in this case, adenylylation, a process whose kinetics are in turn regulated. The chapter by Hess *et al.* on "Dynamic Compartmentation" describes the production of spatial regularities (dissipative structures) in glycolyzing yeast extracts. This is a fascinating, experimental demonstration of the type of mathematics long speculated to be important in morphogenesis. Ebashi *et al.* describe diverse aspects of the regulation of muscle contraction by calcium. Bretscher, in the shortest chapter in the book, congratulates Mother Nature on her intelligent use of phosphate. Sy reviews what is known about the synthesis and degradation of ppGpp, the "magic spot" signal-molecule produced in response to bacterial starvation. Kleinkauf and Koischwitz provide a fascinating description of the multienzyme gramicidin S synthetase. This is the best example of nucleic-acid-free protein-synthesis, and echoes the early models for general protein synthesis, one of which was proposed by Lipmann. In the final chapter of this section, Boman describes an unusual but interesting study on insect immunity to bacteria.

The third section, on "Nucleic Acid-Protein Interactions; Mutagenesis", begins with a chapter by McPherson *et al.* describing the X-ray structure of bacteriophage gene 5 product, a protein that binds to single-stranded DNA. Helene discusses mechanisms (*i.e.*, electrostatics, hydrogen bonding, and stacking interactions) by which a protein or peptide could recognize either normal or damaged DNA. Egami *et al.* review a great deal of diverse evidence concerning the mechanisms by which ribonucleases T1 and U2 interact with model substrates. Knorre and Vlassov summarize evidence for the multiplicity of recognition sites on tRNA. Leib *et al.* compare the recognition of different promoter sequences by the RNA polymerases isolated from two different bacteria (*Micrococcus luteus* and *Escherichia coli*), and show that the specificity is a property of, and can be transferred by, the sigma subunits. Goldberg *et al.* describe the physical properties of the antitumor antibiotic neocarzinostatin and its ability to break DNA. The section ends with the most understated chapter

of the book, a short account by Nathans of his pioneering use of *in vitro* genetics to investigate the molecular biology of SV40.

The fourth section concerns protein synthesis and begins with a chapter by Kaziro, discussing some of the GTP- or GDP-induced changes in conformation and/or reactivity of protein factors involved in ribosome functions. Grosjean and Chantrenne consider the detailed architecture and thermodynamics of codon-anticodon interactions, with the aim of understanding the impressive accuracy of normal protein synthesis. Wintermeyer *et al.* describe the use of fluorescent derivatives of tRNA to monitor conformational changes associated with binding to ribosomes. In the final chapter, Wittman summarizes the heroic amount of effort which has been spent in characterizing ribosome proteins, but which has so far yielded rather few molecular details of how a ribosome actually works.

The last section, on "Philosophical Reflexions", seems out of place, and does not add nearly as much of Lipmann's personality as it could have done. Perhaps it was more interesting to listen to than to read. I found approximately one typographical error per 3-4 pages (but no "howlers"). Like the other volumes in this Springer-Verlag series, the book is well made and has easily survived a week in a backpack without shedding pages (a marvel among current symposia volumes).

The length of this review should testify that I thoroughly enjoyed reading the book. Forced exposure to studies of intricate biological mechanisms is a relief from popular molecular biology's current obsession with gene expression and information transfer. The frustration comes when I consider who might buy this book. Experts in individual topics will undoubtedly go to the original literature. The subjects seem too wide-ranging and disconnected, and there is too little emphasis on overall principles, to make it a good text-book. If it were one third the price, many biochemists/molecular biologists might buy it, if only to put it on their shelf of books set aside for virtuous evenings of self-improvement. Perhaps the only individuals fortunate enough to own this excellent book will be librarians and book reviewers.

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