Book Reviews

Protein Synthesis

Ribosomes. Papers from a meeting, Cold Spring Harbor, N.Y., 1973. M. NOMURA, A. TISSIÈRES, and P. LENGYEL, Eds. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1974. xii, 930 pp., illus. $32. Cold Spring Harbor Monograph Series.

The study of protein synthesis has become in the past few years a problem in enzymology. We think we know what goes into (or onto) the ribosome and what comes out, we can identify several functional states of the system that we believe to be intermediates in a cycle (or several cycles), and we understand in principle the nature of the information-transducing system by which the ribosome translates the genetic code from polynucleotide into polypeptide language. This level of understanding of protein synthesis carries enormous biological insight. But it is not entirely satisfying because of the conspicuous blur in the picture where the ribosome itself is concerned and the large number of still unanswered questions about the ribosome and its complexity. And it would be most surprising if there are no further interesting surprises as we attempt to deal with these complexities.

With the separation and characterization of all of the 58 or so molecular components of the (bacterial) ribosome and the advent of techniques by which ribosomes can be reassembled in vitro from dissociated and separated RNA and proteins, it has become possible to extend the resolution of our understanding of protein synthesis from the 200-Å level of a few years ago to 30 Å (the approximate diameter of an average globular ribosomal protein) or so. Progress in that direction is the subject of this book, which, in 39 well-integrated review articles by some 68 authors, successfully pulls together a very large body of diverse data on the structure, function, and assembly of the ribosome, constituting an early stage in the development of ribosome enzymology. What is most striking about this book is, first, the overall coherence, which may be spurious, of all the data and, second, the very small ratio of answers to questions.

Representative of the apparent agreement among diverse experiments is a topographical model of the small ribosomal subunit from *Escherichia coli*, presented by Traut *et al.*, in which each of 20 proteins is represented by a styrofoam ball and the RNA is left out altogether. The model is based on physical data, assembly mapping and reconstitution studies, and chemical cross-linking experiments—the efforts of many laboratories. When it is systematically compared with data on functional properties of the proteins and results of other studies, overall the consistency is quite impressive, with functionally related proteins repeatedly being found grouped together. While it may be premature, since much more relevant information can probably be obtained rather quickly, the model serves two useful functions in that it summarizes and correlates many data and it makes predictions that can be tested. What it does not do is give us any immediate insight into the mechanism of protein synthesis.

There are many more unanswered questions. A basic one is the question of the function of ribosomal RNA. Since the realization that ribosomal RNA is not the genetic message there has been no good explanation for the fact that about two-thirds of the mass of the ribosome is RNA and that the ribosome is the only known ribonucleoprotein enzyme. Views presented in this book (to overstate them somewhat) range from that of Nomura and Held, that the RNA is a cheap filler the purpose of which is to give the particle overall dimensions sufficient to interact with 80-Å-long transfer RNA molecules, to that of Kurland, that the interesting functions are assigned to RNA, with the bulk of the proteins there only to hold the RNA in a proper conformation. Nearly all the functional studies presented in this book have been limited to the proteins, for operational reasons. As Kurland suggests, the fact that one RNA molecule encompasses the whole of each subunit and cannot easily be subdivided for functional studies, whereas the proteins are many, small, localized in the ribosome structure, and separable, has dictated the experimental preoccupation with the proteins and accounts for the relative scarcity of functional assignments to the large RNA's. And indeed this idea seems to be borne out by the fact that the smaller 5*S* RNA appears at least as interesting functionally as any of the proteins. But proteins are so much more intelligent than RNA that we cannot avoid a bias in their favor.

Since these studies are in such an early stage of development, the question arises, as it did for the editors of the book, whether at this time it is wise to canonize current concepts by making them the subject of a monograph in this prestigious series. In spite of the danger that some of the material will find its way into textbooks, I believe this book is extremely useful in several respects. Even with the great simplification achieved by the introduction of a uniform nomenclature of ribosomal proteins, the literature in this field has become so complex as to be utterly bewildering to the outsider and difficult to correlate even for those directly concerned. By bringing together, summarizing, comparing, and digesting masses of fragmentary publications this book makes the field accessible to outsiders (though its 900-odd pages are still formidable to the merely curious) and helps ribosome researchers to frame their questions and design critical experiments.

STEPHEN R. FAHNESTOCK
Department of Biochemistry, Pennsylvania State University, University Park

Colored Substances in Animals

The Significance of Zoochromes. ARTHUR E. NEEDHAM. Springer-Verlag, New York, 1974. xx, 430 pp., illus. $26.20. Zoophysiology and Ecology, vol. 3.

The subject matter of this volume is, as the title indicates, the colored substances in animals. Unlike previous authors of comparable volumes, who have emphasized the chemistry and taxonomic distribution of such substances, Needham has chosen to deal primarily with their functional significance. In the context of the book, he prefers the terms "biochrome" and "zoochrome" to "pigment," which he would confine to use in art and industry. He uses "biochrome" to refer to "a specific chemical substance with a coloured molecule, synthesised by living organisms," and "zoochrome" to refer to a biochrome that is "found in the bodies of animals." The term "pigment" is so well entrenched in the scientific literature, however, that an effort to replace it may prove futile.

Zoochromes have interested humans for many centuries. Even Aristotle described