Basic processes in protein biosynthesis

Molecular Mechanisms of Protein Biosynthesis. Edited by Herbert Weissbach and Sidney Pestka. Pp. 720. (Academic: New York and London, 1977.) £39.05; $55.

In the mid-1960s, the genetic code had been solved and most of the basic processes in protein biosynthesis defined. During the past ten years, knowledge of the detailed mechanisms has grown enormously by contributions from different disciplines and this is reviewed in the collection of 13 articles edited by Weissbach and Pestka.

As Lipmann remarks in his introduction, the pairing of nucleic acid bases represents the driving force in genetic information transfer. The actual mechanism of protein biosynthesis, however, depends to a larger extent on interactions between nucleic acids and proteins. Of the components involved, the structure of only one, transfer RNA, is known. Consequently, ingenious indirect methods have been used to study molecular interactions in protein biosynthesis and many of the chapters are concerned with these.

The complexity of the ribosome, which in *Escherichia coli* is assembled from 54 different proteins and three RNA molecules, poses formidable problems. These are clearly defined in a stimulating article by Kurland, which serves as an essential introduction for many of the other chapters. The use of cross-linking reagents in determining the relative locations of ribosomal components is also discussed here.

Stöffler and Wittmann describe the ribosomal proteins and studies of their location on the ribosomal surface by electron microscopic visualisation of the attachment of antibodies to individual proteins. This very ingenious method is at present somewhat limited by the resolution of the ribosome in the microscope. The statement that "figuratively, the structure of the 30S subunit resembles an embryo or a telephone receiver" is an attempt to convey an impression of the shape, but it underscores certain ambiguities in resolution. Knowledge of ribosome structure may soon improve, probably from studies of crystalline arrays.

More than 200 genes are involved in the specification of the protein synthetic apparatus, and genetic analysis has played a key role in identifying these components. I. Smith gives an excellent discussion of the genetics and control of biosynthesis of the translational system. Pestka contributes a comprehensive review of protein synthesis inhibitors, principally antibiotics. The use of the latter, in conjunction with genetics and biochemistry, has been the most powerful method in discriminating individual steps in protein biosynthesis. Even in such a complicated system, affinity labelling has been successful in exploring the functional topology of components, and the critical review by Pellegrini and Cantor will interest anyone using these techniques.

Other chapters discuss transfer RNA and synthetases, messenger RNA and individual steps in protein synthesis. Unfortunately, the volume does not include an account of the *in vitro* assembly of the ribosome, which has played an important role in understanding its structural function.

With all this information, it is remarkable that many of the basic mechanisms in protein synthesis still elude us—notably, the fundamental translocation process by which the mRNA moves relative to the ribosome. The answers to this and other questions depends on a still more difficult task—study of conformational changes in the ribosome.

In their choice of topics, the editors have skilfully encompassed the field. The chapters overlap to some extent, and cross-referencing would have been useful. Because they are simply designated by numbers, the ribosomal proteins are particularly difficult to follow in discussion, and a tabulation of their properties as an appendix would have greatly helped. In most of the chapters the discussion is set in a good conceptional framework although a few are simply reviews.

The book is a unique presentation of the present situation in this complex field and fulfills an essential need for those involved.

J. D. Smith

J. D. Smith is on the staff of the MRC Laboratory of Molecular Biology, Cambridge, UK.

Classic work of modern physics

Quantum Mechanics of One- and Two-Electron Atoms. By Hans A. Bethe and Edwin E. Salpeter. Pp. 369. (Plenum/Rosetta: New York, 1977). $8.95.

This work by Bethe and Salpeter first appeared in 1956 in the *Encyclopaedia of Physics,* edited by S. Flügge, and was re-issued in 1957 as a separate book published by Springer. The present paperback edition is changed only by the correction of a few misprints and by the addition of new references where they correct actual errors. The publishers describe it, quite correctly, as "one of the classic works of modern physics", and they are to be congratulated on making it available at a very reasonable price.

The theory of the hydrogen atom, in the Schroedinger and Dirac forms, provides one of the exactly soluble problems of quantum mechanics. Comparison of the theory of radiative corrections with precision measurements (Lamb shift) provides crucial tests of quantum electrodynamics. The theory of the helium atom presents problems which are not exactly soluble; treatment of these problems lays the foundations for the development of the theory of many-electron atoms. The work of Bethe and Salpeter is particularly valuable in the discussion of relativistic effects, which are treated in an unsatisfactory way in many textbooks on atomic structures. The book also contains important sections on atoms in external electric and magnetic fields, and on interactions with radiation.

In their preface to the present edition, the authors say that they have left the book unchanged not because so little has happened, but because so much has happened. This will, I am sure, be welcomed: it is best that there should be no tampering with classics, even by the authors themselves! The book as it stands is of enduring value.

Yet the reviewer is tempted to ask: what *has* happened in the past 20 years? I would say, first, the development of the theory of continuum states of two-electron systems. Bethe and Salpeter do not exclude discussion of continuum states, in that they give a full discussion of the continuum states of hydrogenic atoms and some discussion of photo-ionisation of two electron atoms. There have, however, been major advances in the theory of electron collisions with one-electron atoms, including studies of elastic and inelastic scattering; doubly-excited states which auto-ionise; and very fundamental problems in the theory of electron-impact ionisation, giving two electrons in the continuum. There are also the problems of radiation by one-electron atoms in external fields due to an added electron, that is to say the theory of spectral line broadening by a perturber electron.

Secondly, there are multi-photon problems. Bethe and Salpeter discuss multi-photon processes such as the H 2s $\rightarrow$ 1s decay with emission of two photons but not problems, such as the ionisation of atoms by intense coherent radiation fields, which have become of interest due to developments in laser technology.

Who, I wonder, will write reviews of the later developments with a mastery approaching that of the book by Bethe and Salpeter?

M. J. Seaton

M. J. Seaton is Professor of Physics at University College, London, UK.