reference research standards for interferon.

The other aim of the book is to describe Russian work hitherto unpublished in English. This falls into two main areas—measurement of interferon production by different viruses in a variety of cells and the use of interferon in man. The interferon production experiments are presented at great length and quite uncritically, and their total effect is merely to demonstrate that many factors are responsible for the control of interferon formation. The work on the role of interferon in infection and its use in clinical trials in the Soviet Union is more interesting, and is the only justification for translating the book into English. I am much less competent to assess this data, which seems to me to be interpreted rather optimistically.

In summary, this is not a book to purchase or to recommend for library purchase, unless one has an interest in learning of Russian work on the role of interferon in natural infections.

D. C. BURKE

Technology of insect flight

Insects in Flight. By Werner Nachtigall. Translated by Harold Oldroyd, Roger H. Abbott, and Marguerite Biederman-Thorson. Pp. 150; 32 plates. (Allen and Unwin: London, May 1974.) £5.50.

MUCH that is new has been learned about insect flight in the past fifteen years, and Werner Nachtigall has been one of the most productive workers in this field. He has published a long series of papers in German which provide a detailed analysis of wing movements in the blowfly in free flight, by the use of highly sophisticated experimental methods. A few years ago he conceived the idea of writing a book about the flight of insects which would illustrate the thrills and frustrations of research, and form a tribute to the beauty and ingenuity of the technology of insect flight. The book has now been translated into English and appears in well printed and beautifully illustrated form.

The author writes for students and teachers with interests in technology and engineering, for those engaged in piloting gliders or powered aircraft, and indeed for the general reader. He is wholly successful in putting across the biophysics of the flying insect—though he expects his readers to concentrate! He describes the aerodynamics of flight in terms of instantaneous linear forces and avoids the more demanding aerodynamical approach: bound vortices and the generation of the aerodynamic cross force are passed over and Reynolds numbers appear only in a single caption. The story is varied and enlivened

by literary excerpts; by excursions into locust plagues; the rôle of flight in the life of the honey bee and other insects; insect migration; fuel, temperature and sensors in flight; the technological rivalry between sonar hunting bats and acoustically equipped moths; the contrasts and comparisons of insect and human flight—and much more besides.

The author has a gift for vivid depiction: "to a fly, a cine film must look like a lantern lecture, with long dark pauses in between the slides". The book is admirably translated but in at least one place the popular error in translating 'Schmetterling' leads to the description of the hawk-moth *Celerio* as a 'nocturnal butterfly'.

V. B. WIGGLESWORTH

Exploring evolution

Evolution in the Microbial World. (24th Symposium of the Society for General Microbiology, held at Imperial College London, April 1974.) Edited by M. J. Carlile and J. J. Skehel. Pp. x+430. (Cambridge University: London, April 1974.) £7.50; \$22.50.

THIS volume, in the words of the editors, is believed to represent the first account devoted to the topic of microbial evolution. Such an embracing title would be expected to cover a very wide range of topics indeed and, although there is a great deal of information in this book which bears on the evolution of microbes, it would be useful to indicate what the book does not contain. It does not include, and does not claim to cover, aspects of comparative microbial anatomy nor a discussion of phylogeny based on such evidence. In fact, no indication is given of the wide range of structural diversity found in microbes. Similarly, there is little reference to the possible route of evolution of major groups of microorganisms.

Instead, the emphasis of the text is placed, not upon the apparent path of evolution, but on those special properties of microorganisms which make them such favourable experimental material for exploring the mechanisms of evolution. The sequence of chapters is essentially hierarchical, starting with problems of taxonomy and phylogeny and leading to essays dealing with mutation, recombination and selection. Successive chapters deal with the evolution of molecules, with organisms, and with energy-yielding processes as well as with the evolution of a biological association (symbiosis).

The first chapter (by P. H. A. Sneath) is a lucid summary of current strategies for constructing the phylogenetic relationships of microbes and includes a full discussion of taxonomic principles. The following four chapters deal

with aspects of the evolutionary mechanism. Drake, for example, discusses the role of mutation in evolution and the measurement of mutation rates. Richmond and Wiedeman discuss plasmids in relation to bacterial evolution. Although the significance of plasmid-borne resistance factors is stressed, the basic theme of the essay is recombination mechanisms involving plasmids and their possible similarities to recombination in phages. The wider role of recombination in regulating breeding systems and the formation of new species is considered by Esser. Kubitschek summarises some of the material concerning selection pressures on bacteria grown in the environment of a chemostat.

One of the most powerful analytical techniques yet applied to the study of phylogenetic relationships is the technique of doublet analysis, by estimating the frequency of nearest-neighbour base sequences in DNA. Subak-Sharpe *et al.* give a full account of their studies on the reliability of the technique as applied to the DNA of bacteria and viruses. Experimental approaches to the problems of the evolution of enzymes and the way in which specificity of action is related to enzyme activity are discussed by Hartley. A similar theme is reiterated by Clarke, who summarises her work on the nature of adaptation of bacteria exposed to novel substrates in terms of the evolution of the requisite enzymes needed to utilise the substrate.

Three chapters are devoted to the evolution of energy-yielding processes: photosynthesis (Stanier), sulphur metabolism (Peck) and nitrogen fixation (Postgate). These essays do not merely summarise the salient features of the relevant biochemistry but also discuss the possible origins and evolution of such mechanisms in prokaryotes and eukaryotes. The remaining chapters are devoted to patterns of organisation and association among microbes. As examples of the evolution of organisms two divergent levels of organisation are considered: viruses (Joklik, Skehel) and the haemoflagellate *Trypanosoma* (Baker). The nature of symbiosis and mutualism are discussed by Lewis. Finally, Ponnamburama and Gabel discuss the possible condition of the prebiotic milieu in relation to the formation of complex molecules and the emergence of life.

As a summary of current thinking on problems of evolution among microbes this volume contains much to interest the reader. More importantly the essays included succeed in demonstrating the feasibility of using microorganisms to unravel some basic aspects of the evolutionary mechanism.

I. D. J. BURDETT