scattering of neutrons by hydrogen is quite appreciable; so neutrons may be used to locate the hydrogen atoms in substances where these are present alongside heavy atoms. A second application of neutron diffraction is the investigation of chemical ordering in compounds or alloys which contain elements that are near neighbours in the Periodic Table. Such elements have similar scattering properties for X-rays but are often quite different for neutrons.

Applications of Neutron Diffraction in Chemistry by Prof. G. E. Bacon is devoted in the main to a description of these two classes of experiments.

The first chapter gives the principles and general experimental methods of neutron diffraction. Then follow chapters on the investigation of hydrogen in various inorganic and organic compounds, and also of carbon, nitrogen and oxygen in certain heavy element compounds. Experiments on alloys of transition metals and on spinel structures, which have been extensively studied by neutron methods, are further described.

The neutron has a magnetic moment and so, in addition to being scattered by the nucleus, it is scattered by the electrons in those atoms that have a resultant magnetic moment. This property means that neutrons can be used to study the ordering of the spins that occurs in ferro-, antiferro- and ferri-magnetic materials. Although not primarily of chemical interest, a chapter on such investigations is included. This particular field has proved a triumph for neutron methods. We now know that, in addition to the relatively simple magnetic structures mentioned here, other more complicated structures, such as spiral structures (Mn Au_2) and what might be called an alternating umbrella structure (Cr Se), occur in Nature.

The book is written by one who has done much work in the field. The text is straightforward, the diagrams are clear and helpful and there are copious references to the original work. The book is well produced.

G. L. Squires

GENETICS OF BACTERIA AND BACTERIOPHAGE

The Genetics of Bacteria and their Viruses

Studies in Basic Genetics and Molecular Biology. By Dr. William Hayes. Pp. xii + 740 + 25 plates. (Oxford: Blackwell Scientific Publications, 1964.) 84*s*. net.

ONLY some twenty years have passed since the discoveries which ushered in the era of intensive investigation of the genetics of micro-organisms—the demonstration by Avery and his colleagues that the active principle in the type-transformation of the *Pneumococcus* was deoxyribonucleic acid; Luria and Delbrück's fluctuation test, and, a little later, Tatum and Lederberg's discovery of sexuality in bacteria.

Yet bacteria and their viruses are now perhaps the most fruitful experimental material for fundamental investigation in genetics, and Dr. Hayes has needed more than 600 well-filled pages to provide what he rightly describes as a moderately advanced text-book of the genetics of bacteria and bacteriophage. In his preface, Dr. Hayes states that in teaching microbial genetics to graduates in a variety of subjects, including the physical sciences, he found the main barrier to their perception was their ignorance of classical genetics and of genetical terminology. For this reason, among others, he provides in the first section of *The Genetics of Bacteria and their Viruses* a brief account of the observations and ideas of classical genetics, including Mendel's laws, and of the theory of genetical analysis.

He next proceeds to the examination of recombination and mapping, especially as applied to bacteria and phages; and to a short account of the specialized genetical systems of fungi. Part 3 deals with biochemical genetics, with some examples drawn from higher organisms illustrating the generality of the phenomena under consideration. Part 4 is devoted to the analysis of genetical fine structure, considered theoretically and taking as examples the transductional analysis of the loci concerned in synthesis of tryptophan and of histidine in *Salmonella* and Benzer's analysis of the r_{II} locus of phage *T*4. Part 5 concerns bacterial mutation and the expression of mutations. Part 6, of some 140 pages, is devoted to the physico-chemical mechanisms of heredity, including the structure and function of DNA and RNA, and the evidence of how they function to embody, and express, genetic information—in fact the genetic aspects of 'molecular biology'.

In his preface, the author says that his limited knowledge and experience of the methods of chemistry and physics have necessitated an approach which may appear naïve to the expert; be this as it may, I, as a non-expert, found the account here, as elsewhere, admirably clear and comprehensible. The second half of the book deals systematically with various genetic systems; bacteriophage, including physiology and the phenomenon of lysogeny; the structure of the 'chromosome', in phage and bacteria; recombination systems (transformation, transduction, conjugation) occurring in bacteria; genetic aspects of control mechanisms; and sex factors and other episomes.

The style throughout is pleasant and easy to follow; in those sections in which I felt competent to judge, the material was well chosen, all the more important facts, including those only very recently published, being included, so far as space permitted. The book is illustrated with numerous text figures, in many of which the use of red ink clarifies the representation of, for example, crossing-over; and also by 25 well-chosen and well-reproduced photographs. In the bibliography, of some 900 items, the citations include the titles of the papers and the text page numbers where they are cited; features which should greatly enhance the value of the book.

Dr. Hayes has performed a most valuable service in selecting and collating the essentials from the vast number of publications on this subject; and his book can be cordially recommended.

B. A. D. Stocker

ANIMAL NOISES IN THE SEA

Marine Bio-acoustics

Proceedings of a Symposium held at the Lerner Marine Laboratory, Bimini, Bahamas, April 11–13, 1963. Edited by William N. Tavolga. Pp. xii + 413. (London and New York: Pergamon Press, 1964.) 100*s*.

IN spite of the rapid development of air transport, the Atlantic Community still depends very largely on sea transport to carry its food, oil and raw materials. This fact is not lost on our potential enemies, who have built large submarine fleets. This in turn has stimulated the Western countries to put a great deal of effort into developing anti-submarine systems. Unfortunately the sea is a very difficult medium to work in, particularly with regard to the detection of underwater objects at long range. Electromagnetic waves (including light) are rapidly attenuated, and the only wave motion which travels reasonably well is sound, and then only at comparatively low frequencies. The problem is further complicated by the presence of reflecting boundaries at the surface and sea-bed, and by refraction of the sound by gradients of temperature and salinity, mostly in the vertical plane.

Marine animals are important to this problem in two ways. First, they make sounds which interfere with our systems. Secondly, they encounter similar problems themselves, and many of the more advanced vertebrates have evolved highly sophisticated detection systems