

the life sciences and who is one of the pioneers of biotelemetry. The book contains a selection of material ranging from the principles of physiology to the practical aspects of electronics and bio-instrumentation.

The book opens with introductory material on how radiotelemetry can be used practically in the life sciences. It proceeds with a discussion of semiconductor devices (diodes, transistors, tunnel diodes) and omits introductory material on Ohm's law. Negative resistance, impedance, and the arrangement and function of electronic circuits are discussed nonmathematically. A chapter on modulation techniques is followed by one on the electrical characteristics of materials and their suitability for implantation in the body. Following are chapters on sensors (transducers) for a limited number of physiological events. The choice of radiofrequency carriers and antennae is covered and detectors and display methods are discussed. A presentation on the use of ultrasound, magnets, and radioactivity as means for telemetry is inserted at this point. A chapter is devoted to the use of electromagnetic energy transmitted to energize a passive transmitter or to stimulate irritable tissue. The book concludes with descriptions of a few telemetry exhibits that the author has presented, along with appendices of practical data including the legal factors which pertain to the use of biotelemetry.

Despite some omissions, this book contains much useful information for life and physical scientists. Because a wealth of practical data (circuit diagrams, component values, and the like) is given, it will be possible for the relatively unskilled reader to purchase components and assemble a simple, practical telemetry system for a few physiological events. Many will find that transducers are not covered in adequate depth; those that are described in detail will permit telemetry of only a few physiological phenomena. The utility of the book could have been enhanced by expansion in this area and by presentation of data on the conversion efficiency (output signal for a given size of physiological event) of the transducers that are described.

Because the quality of telemetered bioelectric signals is often determined by the stability and properties of electrodes, this reviewer would have desired a broader treatment of this subject. Another area of omission relates

to a failure to capitalize on the properties of the field-effect transistor. This valuable solid-state device, which has many of the characteristics of the vacuum tube, is mentioned only briefly. Perhaps field-effect transistors were not available in sufficient quantity when the author composed his first manuscript; nonetheless their use offers the opportunity of using a variety of transducers which cannot be connected to ordinary transistors. The many integrated-circuit operational amplifiers, which are becoming available at a very low cost and are ideally suited to miniaturized telemetry devices, were not available when the author prepared his material; hence no discussion of these is presented.

The only other serious omission is in the bibliography. Many papers might have been cited that contain useful ideas on the transmission of physiological events not described by the author. In addition, there are at least two other books in print on telemetry; although these are merely collections of contributed papers, they should have been cited.

These criticisms notwithstanding, Mackay's book is the only comprehensive treatment of the principles of biotelemetry. It covers nearly all aspects of biotelemetry without the repetition that occurs in a book to which many authors have contributed. The engineer or physicist entering the field of biotelemetry will be fascinated by the ingenious use of devices and circuits known to him; the life scientist will be pleased with the nonmathematical descriptions of electronic circuits which are of practical use to him.

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Viruses

Molecular Basis of Virology. H. FRAENKEL-CONRAT, Ed. Reinhold, New York, 1968. xiv + 642 pp., illus. \$18. American Chemical Society Monograph No. 164.

Once more we are presented with a series of review articles masquerading as a "lasting record of our present knowledge of this active field." If we accept this volume for what it really is, some well-written and well-conceived progress reports in molecular virology, interspersed with a few less satisfactory essays, we have little cause to complain. It is the type of book which should be

found in the library of every research institute and university, but not necessarily in the personal collection of the student or investigator. Most of the chapters are written by acknowledged leaders in modern virus research and are remarkably up-to-date as of March 1968. The individual articles reflect the special interests of the particular authors to a large extent, which means that an overall integration of molecular virology and its overwhelming contribution to our present views of life processes is left as an exercise for the reader.

The first article, by J. M. Kaper on the physical properties of small RNA viruses, is the least satisfactory presentation in the entire volume. We are presented in a rambling, leisurely fashion (133 pages) with data and concepts that have been reviewed many times. A cursory discussion of the sedimentation equations is inappropriate to the stated and actual intentions of the remainder of the book. The discussion of tobacco mosaic virus structure is painfully familiar, including several often-reproduced illustrations.

Fraenkel-Conrat's article on the chemical properties of small RNA viruses is more satisfactory. There are some valuable tables of the RNA base composition and the amino acid composition of these viruses and also the coat protein sequences of several viruses, although the latter data can be obtained readily from several other recent sources. This is followed by one of the finest articles in the volume—an extremely well-thought-out and well-integrated chapter on the replication cycle of RNA viruses by Hofschneider and Hausen, experts on bacterial and animal viruses, respectively. The next chapter is a curious and disappointing report of the *in vitro* synthesis of RNA virus components by Fraenkel-Conrat and Weissmann. Particularly the section on viral RNA, presumably by Weissmann, presents a highly biased view which emphasizes the controversial aspects of the detailed structure of the RNA replicative intermediates without quoting any of the recent data published by Spiegelman and his associates. This type of article inevitably appears in such a collection, since so many problems at the forefront of research are open to more than one interpretation. Only through a wise choice of authors or vigorous editing or both can the more controversial issues be fairly presented.

After the 220 pages devoted to the small RNA viruses, most of the other viruses pass in rapid review. The two articles by Robinson and Duesberg on myxoviruses and RNA tumor viruses are good examples of pedagogical systematization combined with very recent data—what Fraenkel-Conrat refers to as hard and soft facts. Crawford's article on the adenoviruses, papilloma, and polyoma reflects his major interest in the physical properties of these viruses to the neglect of the important and exciting data on viral replication. Finally, the two articles on the T-even bacteriophages of *Escherichia coli* are both well written but are remarkable for their overlap. It is surprising to find the same diagram of the morphogenesis of T4 bacteriophage in both articles. Again, some editorial activity should have been evident here.

Both the expert and the student of virology should find some data and viewpoints of value in this monograph. It is definitely not a book for the beginner, however, or for those who wish to obtain a superficial overall view of molecular virology.

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Ocean Travelers

Fish Migration. F. R. HARDEN JONES. Illustrated by H. E. Jenner. St. Martin's, New York, 1968. viii + 325 pp., illus. \$21.

Harden Jones has set himself a formidable task. He describes the migrations of selected kinds of fishes and attempts to use animal behavior and the physical and chemical environment to explain these migrations.

Data are taken from the literature on salmon and trout, eel, herring, cod, and plaice and subjected to rigorous analysis as evidence for fitting the life histories of these species into the framework of a model of fish migration. The particular species chosen for inclusion are of commercial importance in the Northern Hemisphere, and a considerable quantity of data on them is available. The chapter on herring is of special interest. The literature on this fascinating and tasty animal is a veritable jungle, and Harden Jones has tried to hack a trail. The concise chapter on eels is delightful; Johannes Schmidt's long-accepted account of the life history of

the common European eel has been challenged recently, and the controversy is nicely described. Considering that Harden Jones was a party to the fray, this chapter is a tour de force of English fair play.

In three chapters that review the literature on the reactions of fishes to stimuli and discuss homing and other movements, the author attempts to explain some of the migrations described earlier in the book. That the result of this study is not a general theory of fish migration is hardly surprising; indeed, the author remarks in the preface that his book is an interim report. Overall, however, it is a painstaking synthesis of data from fishery biology, animal behavior, and oceanography.

A brief but important part of the book is devoted to discussing the biological advantage to fishes of migration. The author favors the idea that the migratory habit, along with evolution of seasonal spawning races, aids a species to become abundant by insuring maximum use of biological and spatial resources and by allowing a wide field for selection in a changing environment. These are sensible conclusions for the species considered. Yet could there be other reasons for fish migration? Harden Jones's study is based chiefly on species from a region with a small fauna which is recent within its present geographic range; hence one would assume little competition. The region also has a relatively unstable long-term climate. Surely an adequate comprehension of fish migration will require information about tropical species and ideas from the field of historical zoogeography.

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Magnon Theory

Spin Waves. A. I. AKHIEZER, V. G. BAR'YAKHTAR, and S. V. PELETMINSKII. Translated from the Russian by S. Chomet. S. Doniach, translation editor. North-Holland, Amsterdam; Interscience (Wiley), New York, 1968. viii + 369 pp., illus. \$21.50. North-Holland Series in Low Temperature Physics, vol. 1.

In the past ten years there has been a steady stream of papers on spin waves from the Kharkov school. Now, in this excellent book, three of the main contributors have given a very readable

and coherent account of magnon theory. This is, in fact, essentially the first textbook on the subject and, as such, complements an encyclopedic article such as Keffer's in the *Handbuch*.

Spin-wave theory may be developed macroscopically or microscopically. In the former method one characterizes the magnetic medium by suitable energy densities, determines equations of motion, and derives spin waves as small signal disturbances of a time-independent state. This is the approach used initially here. Within this framework a very adequate discussion of uniform and nonuniform resonance is given. Standing spin waves, parametric excitation, and the coupling of spin waves to elastic waves are also treated, the last in rather considerable detail.

The second half of the book develops the microscopic treatment, working from a spin Hamiltonian, through the Holstein-Primakoff representation, to a quadratic boson Hamiltonian and hence to magnons. There is inserted here an unusually detailed discussion of two-magnon bound states. Then thermodynamic problems are taken up and a Green's function treatment is given of the temperature dependence of magnetization and fluctuation phenomena. Magnon-magnon and magnon-phonon interactions, relaxation processes, and thermal conductivity are adequately treated. In the last chapter the so-called Dyson-Maleev representation of spin operators is introduced as a preliminary to a very complete exposition of Dyson's analysis of the low-temperature behavior of ferromagnets and a more sophisticated approach to the susceptibility of ferromagnets.

The treatment throughout is impeccably formal, and it is this which gives the book a flavor of its own. There are no comparisons with experiment, no order-of-magnitude estimates. When, for example, after 11 pages, an expression is found for the gain of a spin-wave amplifier driven by a charged-particle beam, the authors put no numbers into it. That is evidently the reader's affair. But the analysis generally is straightforward and not recondite; it should not discourage experimentalists. The scope of the book and its clarity of treatment make it very useful to have at hand. It is a great pity that it has been published at a price which makes ownership unlikely for most physicists.

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