Acoustic Systems in Biology

Neville H. Fletcher
Oxford U. P., New York, 1992. 333 pp. $65.00 hc ISBN 0-19-506940-4

In the preface, Neville Fletcher, a well regarded and broadly published physicist, assigns two purposes to this work: It should function as an introductory textbook in acoustics for physics or engineering majors, and it should be suitable as a textbook for those graduate students in the biological sciences interested in auditory and vocal systems. While I am not sure of its potential utility as a standalone text for either of these populations, I am very confident that both would benefit immensely from *Acoustic Systems in Biology*.

Indeed, the more I read this book the more I wished that it had been available as a supplemental text the last time I taught acoustics. Its strength for physics and engineering majors is its physical analysis of the problems that it poses. The author does a superb job of making his readers feel the physics underlying the mathematics of acoustics. However, the book is much less mathematical and has less depth across the range of topics than standard acoustics texts such as *Fundamentals of Acoustics* by Lawrence Kinsler, Austin Frey, Alan Coppens and James Sand (Wiley, New York, 1982). The biological examples used throughout the book are both clear and likely to be interesting to most physics and engineering majors. But to work as a text, it would require supplementing with nonbiological examples. However, I strongly recommend that this book be available (in the library or elsewhere) to physical science students taking acoustics courses. The book schools students well in the vocabulary of thought and expression in acoustics.

I am not sure that this text is well suited to students in the biological sciences for, in my experience, there is not enough biology in the first ten chapters to keep students of biology motivated. I can guarantee, however, that acquaintance with and study of this book will prove of exceptional value to biologists and audiologists active in hearing and sound-production research. These researchers must both communicate with colleagues from the physical sciences and have a good understanding of the various transformations of sound energy from its production to its detection and analysis. The author's effective communication of the vocabulary of acoustics is likely to be of exceptional use to these biologists.

Acoustic Systems in Biology is implicitly divided into three parts. The first ten chapters are basically a one-semester acoustics course where the applications come from the biology of sound detection and generation. The focus of these chapters is more acoustics than biology. The next four chapters focus more on the biology than on the physics. The eleventh chapter, on high-frequency auditory models, is an excellent application of the previous chapters to the biology of sound detection. Students and professionals in the field will benefit from studying the clear-headed analysis presented here. The next three chapters analyze in some detail several interesting topics in bioacoustics. I found chapters 11 to 14 to be well thought out and well written and a pleasure to study under the author's guidance. Indeed, for those interested in either acoustics applications or the biology of sound, I highly recommend the book for these chapters alone. The third part, consisting of only the last chapter, is on signals, noise and information. With the exception of a nice discussion on the degradation of acoustic information with distance and in noise, this chapter seemed a bit outside the theme of the book.

Acoustic Systems in Biology will certainly work as the text for a one-semester undergraduate course in introductory acoustics. However, I would rather recommend it as a supplement to the more mathematical texts used in introductory acoustics courses at the advanced undergraduate or graduate level. Furthermore, this book is likely to be of considerable value to biological and audiological researchers of sound generation and detection.

PAUL FAHEY
University of Scranton
Pennsylvania

Supermanifolds

Bryce DeWitt
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Supersymmetry, a symmetry relating fermions and bosons, may or may not exist in nature; but it surely is all over the place in current theoretical attempts to describe matter. Even if no partners of the known particles show up in experiment—as supersymmetry implies they should—there is a point to understanding supersymmetry. The reason (if this reviewer has diagnosed the current atmosphere in theoretical physics correctly) is that the existing schemes for a unified description of elementary particles leave most people dissatisfied. Although superstring theory represents an important step forward, it is currently valued more for the hints it may give about a future grand synthesis than for its intrinsic worth. Nevertheless, for those who aspire to an understanding of the laws governing matter, the road currently leads through superstring theory and supergravity. To follow this path, a command of the basic descriptive machinery of supersymmetry is indispensable. Thus, one must welcome the second edition of a book on supermanifolds that, in its first edition, has been tried and found useful.

As the author remarked in the introduction to the first edition, this book was originally intended to be an appendix to a book on supergravity. Then it evolved into the first volume of a planned two-volume work on supermanifolds and supersymmetry. The second volume has not yet appeared; in the meantime, here is a second edition of the first volume. Compared with the first edition, it contains an essential addition: a chapter on applications involving topology. The first five chapters are essentially the same.

One feature of the material covered in the book should be mentioned: its mathematical character. The theory of supermanifolds originated in physics but the ideas were taken up by a number of mathematicians. The author offered the following statement in the preface to the first edition: "Mathematicians will find much of this book incomplete and expressed in language that nowadays they have passed beyond, but it is probably pitched about right for the average physicist." The reviewer agrees with this statement, but ventures the following additional opinion: The work on the mathematical theory of supermanifolds has not reached consensus on the basic definitions. Thus, the reader who wishes to supplement the account in DeWitt's book with a mathematically rigorous treatment of the basic ideas faces a bewildering variety of choices. This is regrettable but appears to be the state of the art.

The starting point of DeWitt's account is the replacement of a real or complex variable by an element of a Grassmann algebra. Recall that to define the Grassmann algebra of a vector space V, one first forms monomials v, $w \wedge x$, $y \wedge z \wedge b$ and so on,