participants discussed their work on the behavioural analysis of sensory function in animals. The book contains eighteen articles, and the emphasis throughout is on the methods by which the animals were trained and tested. Such coherence as the book possesses thus comes from the techniques shared in common by the participants, and not from any of the problems that they are studying by means of these techniques. The book covers a wide range of sensory experiments on animals, including, for example, the detection of ultrasound by bats, of X-rays by rats and monkeys, and of sound by opossums and hedgehogs. In all cases, there are descriptions of how the stimuli were presented and the construction of the apparatus, and details of any idiosyncrasies that make that particular species difficult to work with.

The problems of obtaining accurate behavioural data on the sensory capacities of animals are important; among other things this is the only way in which the significance of physiological experiments on sensation can be assessed. The articles in this book show how well these problems have been solved in a variety of cases, and that it is possible to obtain psychophysical data from animals which are as accurate as those obtained from man. As a whole, however, the book has little unity. The various techniques of animal psychophysics that have been used do not seem to have very much in common with each other, and few general principles emerge. As in other fields of animal behaviour, each species presents different problems which need different solutions, and reading a paper on, for example, how to train and test monkeys helps only a little in designing an experiment for fish. A book this length can also include only an arbitrary and limited selection of the work in this field. The final impression is thus of a fairly random selection of contributions, often interesting in themselves, but only tenuously interrelated.

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Problems Solved

Applied Diffraction Theory. By F. H. Northover. (Modern Analytic and Computational Methods in Science and Mathematics; a Group of Monographs and Advanced Textbooks, No. 28.) Pp. 632. (Elsevier: New York, 1971.) £20.

THIS book provides a mathematical analysis of the solutions to problems involving time harmonic scalar waves and time harmonic electromagnetic waves. The author's selection of obstacles is restricted and the application of his mathematical results to problems in physics and engineering is not always

emphasized. The choice of material is clearly personal and he does not attempt to review the literature relating to diffraction theory. He has, however, succeeded in providing the full mathematical analysis of problems that have interested him for more than twenty years. The mathematical topics are sophisticated and include separation of variables, eigenfunction expansions, special functions, contour integration, asymptotic methods and integral equations.

The early chapters are concerned principally with the propagation of electromagnetic waves around a perfectly conducting sphere embedded in a dielectric medium (a model for very high frequency propagation of radio waves around the Earth surrounded by a nonhomogeneous atmosphere). They reflect the author's interests before 1955. I was astonished and dismayed to read on page 114: "Since 1954 the writer's interest has moved from the subject of tropospheric propagation of radio waves to propagation through ionized gases and laboratory-type microwave diffraction problems. Therefore no attempt is made here to describe work in this field subsequent to 1955."

The next problem to be considered is diffraction of electromagnetic waves by a perfectly conducting cone of finite dimensions. The author published a solution in 1962 and a revised solution in 1965. On reviewing these papers, he found that certain aspects of his earlier solutions were open to criticism. In this book he presents a third investigation, paying special attention to the edge conditions, which were ignored in his earlier papers.

The third and last major topic concerns microwave lenses and the Fabry-Perot microwave interferometer, and is based on the Kirchhoff-Huygens diffraction theory. Fredholm integral equations are used extensively in the solution of some particular problems for interferometers consisting of two curved plates in the form of equal spherical caps.

The introduction to the ideas of diffraction theory in the first chapter is unsound. Insufficient attention is paid to the radiation condition at infinity. The reasoning behind the choice of the velocity potential of the diffracted wave in section 6.1 (the sphere diffraction problem—the acoustic case) is erroneous. There are statements of some possible boundary conditions, but no discussion of these boundary conditions and no mention of impedance boundary conditions. The necessity of imposing edge conditions in certain circumstances receives no attention, even though this is central to the investigation of the finite cone problem in the eighth and ninth chapters.

Also in the first chapter are exact

solutions of some problems involving spherical obstacles. The author obtains some complete solutions using the separation of variables. His solutions by means of the infinite Legendre integral transform method are incomplete and purely formal. It is not clear why the integral transform method is worthy of consideration: the integral representing the solution of even the simplest problem looks intractable and attracts no comment. There is no discussion of the relative merits of the two methods of solution, although an oblique remark appears on page 622.

The third chapter, an account of the WKB approximation, would have been more widely usable (as an introduction) with some worked examples and exercises. The analysis is applied to the Airy equation, but the reader is expected to work through the previous twenty pages of technically difficult mathematics to appreciate the results stated for this particular case. There are three references, the most recent dated 1962. A slightly modified version of the chapter has been published by the author in the *Journal of Mathematical Physics* (10, 715; 1969).

The tenth chapter is devoted to some of the more important properties of linear integral equations. Some knowledge of standard Fredholm theory is presupposed. One reference (to Lovitt's book, first published in 1924) is provided in the sixty-seven pages of analysis written in theorem-proof style. In the author's subsequent use of integral equations (in connexion with the microwave problems) there is only one reference to this chapter. A shortened version of the chapter has appeared in the *Journal of Mathematical Analysis and Applications* (29, 305; 1970).

Much of the detailed analysis is in an appendix (of 142 pages). The mathematical supplement at the end of the book is in two parts, the first devoted to the method of steepest descents and the second devoted to the Watson transformation. This is a useful, well written section. The first part has been published in the *Journal of Mathematical Analysis and Applications* (29, 216; 1970). There are several references in the second part; however, in some cases only authors' names are given.

In my copy, there is a serious omission of the details of references 67–96, and there are two obvious mistakes (on page 18 $r^{-1} e^{ikr}$ appears instead of $r^{-1} e^{-ikr}$ and in section 6.1 of the sixteenth chapter Legendre appears instead of Laguerre).

To summarize, *Applied Diffraction Theory* is a detailed account of the mathematical solutions of a small selection of problems. It will interest a highly specialized readership.

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