BOOK REVIEWS

Applications of Maths

Mathematical Techniques and Physical Applications. By J. Killingbeck and G. H. A. Cole. Pp. xiv+715. (Academic: New York and London, July 1971.) \$15; £7.

THE material is well organized and the presentation lucid. Although there is no easy path to mathematics the authors have admirably succeeded in balancing rigour with comfort. The title is very representative of the content, comprising nearly all the conventional techniques required by a present-day theoretical physicist or applied mathematician. The chapters are introduced with relevant motivation and from there on the reader is directly led to the heart of the subject. The applications follow either on their own or interwoven with further mathematics. The text is supplemented by methodically evolving exercises at the end of each chapter. Learning mathematics is a gradual process, and the authors are not in a hurry to tell us once and for all what they have to say about a given topic, but prefer, after dealing to some extent individually with a subject, to interrelate it with other items when the opportunity profitably arises. This definitely enhances the pedagogical virtue of the book.

The physical argument rather than the formal procedure plays the dominant role in the derivations. The applications range from classical particle dynamics and fluid mechanics to electromagnetic theory and quantum and statistical physics. Also, engineering and astrophysical problems are treated. The book is divided into ten chapters: "Vector Analysis", "Matrices", "Tensor Analysis", "Sequences and Series", "Complex Variables and Analytic Functions", "Variational Calculus", "Group Representations", "Some Differential Equations of Physics", "Integral Equations", and "Probability Theory".

Even with a book of this size, exceeding the 700 page mark, the diversity and range of the material covered have made the treatment of certain items less tentative than that of others. Thus, the Feynman path integral appearing in

chapters 6 and 9, in connexion with the "Variational Calculus" and "Integral Equations", is presented in a very introductory fashion. However, the creeping of devices like the path integral into the general literature seems encouraging. On the other hand, the general character of the book has not prevented the authors from elaborating on not so frequently encountered items such as Lie Algebras and Padé Approximants. In the treatment of the Liouville equation (chapter 8: "Some Differential Equations of Physics" and elsewhere), the impression is gathered that the equation is of a statistical nature rather than a dynamical one with a statistical interpretation.

The book presupposes a working knowledge of calculus and would be useful to the student of mathematics, theoretical physics and the mathematically-minded engineer or chemist. In addition, the analysis-oriented mature reader would find its group theoretic part an excellent introduction and very beneficial. In general, the qualities of the book are such as to merit a good welcome to the mathematical literature.

G. J. PAPADOPOULOS

Systems in Solution

The Chemical Statics and Kinetics of Solutions. By E. A. Moelwyn-Hughes. Pp. xiv+530. (Academic: London and New York, December 1971.) £9.75; \$29.50.

AN understanding of the kinetics of chemical reactions depends heavily upon what is known, experimentally and theoretically, about systems at equilibrium. A necessary condition for the validity of a kinetic treatment is that when applied to reactions in forward and reverse directions it must give rise to the correct thermodynamical or statistical-mechanical expression for the equilibrium constant. The theories of reaction rates that are most widely useful do, in fact, satisfy this condition by involving the assumption of a type of equilibrium between initial and activated states. In view of this, a book which deals in a unified fashion with both the statics and the

kinetics of reactions is particularly welcome. This is especially the case when systems in solution are involved, since the kinetics of these are very difficult to deal with, and the support provided by equilibrium studies is most valuable.

As was to be expected from a research worker and author of his calibre, Dr Moelwyn-Hughes has produced a work of high quality which will be of considerable value to workers in the field. The material is presented very explicitly and with great clarity, and the relationships between the static and kinetic aspects are clearly brought forward.

A few criticisms can be offered. The most serious of these relates to the author's treatment of bimolecular reactions in solution in terms of a formula involving the number of normal modes of vibration in the reactant molecules; the theory of this is presented on page 92 and applied later (page 383) to the hydrolysis of sucrose. There is surely no theoretical justification for the use of this formula except for processes in which there is formed a long-lived complex which must undergo many vibrations before passing into products. Modern work on potential-energy surfaces has indicated that this is most unlikely except for unimolecular reactions. The high frequency factors found for certain solution reactions must be explained in other ways, and it is a pity that these were not critically explored in this book.

Another criticism relates to the name and subject indexes, which are very poorly prepared. Many authors whose work is referred to in the text (for example Lennard-Jones and Kassel) do not appear at all in the name index, and there are numerous inexplicable omissions with respect to those who do appear (for example Bonhoeffer, 349). Diffusion-controlled reactions and ionic-strength effects are well treated in the text, but readers who look for these topics in the subject index will look in vain.

It is highly regrettable that the price will put this useful book outside the range of many who would profit greatly by possessing it. K. J. LAIDLER