Mathematics applied

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A Biologist's Basic Mathematics.
By David R. Causton.
Edward Arnold: 1983. Pp.216. Pbk £7.50.

Differential Equations and Mathematical Biology.
By D. S. Jones and B. D. Sleeman.
George Allen & Unwin: 1983. Pp.339. £15, $35.

Introduction to Dynamics.
By Ian Percival and Derek Richards.
Cambridge University Press: 1983. Pp.228. Hbk £18.50, $35.50; pbk £7.95, $14.95.

LOOKING at this collection of books as a biologist, it rapidly becomes apparent that they divide into three steps of mathematical complexity. D. R. Causton is a biologist who has written an introductory text containing material for a first-year biology undergraduate who has an average pre-university education in mathematics. The second step is D. S. Jones and B. D. Sleeman's text: this book is a mathematical introduction to differential equations with biological applications, clearly written by mathematicians with biologists in mind. Finally, I. Percival and D. Richards's book is mathematical, with few concessions to the biologist. Biology features in it purely as one area of the application of stability theory.

Many topics are considered in *A Biologist's Basic Mathematics*: numbers, indices, logarithms, a whole diversity of straight line and curved functions (including the exponential curve and plant growth curves), calculus and matrix algebra. The text is generally clearly written and, section by section, there are worked examples of the application of the mathematical techniques in some area of biology. I would, however, criticize the lack of biology in some of the explanations. For example, first and second derivatives are introduced by considering a marble rolling following acceleration (a) given by $a=3(T-2t)$, where t is time and T is the position where the marble comes to rest. The reason for this particular acceleration in a non-biological example is not mentioned when the example is introduced. The book contains no statistics, instead concentrating on the models underlying many biological concepts.

The introductory chapter of *Differential Equations and Mathematical Biology* contains examples of three areas of the application of differential calculus — growth of cells in culture, growth of populations and metabolism of drugs. The second chapter, which is particularly well written, then explains much of the terminology. The remaining 12 chapters each address either a topic in differential equation theory (first-order systems, partial differential equations, evolutionary equations), or an application in biology (heart beat, tumour growth, nerve impulse transmission, epidemic spread, predator–prey interactions). For most biologists, this is a reference book where a selection of four or five chapters (introductory, technical, and in their research area) will suffice.

Although it was with some trepidation that I looked at *Introduction to Dynamics*, the first chapter was reassuring. Here, Percival and Richards give a beautifully clear introduction to dynamics, discussing why scientists should be interested in the stability properties of their equations, and explaining the terminology. Although short, it provides a useful education for many non-numerate biologists. The following two chapters are also introductory, dealing with transformations, including rotations, and second order autonomous systems. Thereafter, the going becomes tougher — Hamiltonian dynamics come to the fore, and the fourth chapter introduces such systems with one degree of freedom. A collection of five chapters then deal with the more mathematical topics — Lagrangians, the theory of transformations and perturbation, angle-action variables, oscillation — and the two concluding chapters are more applied, covering linear systems and chaos, the latter making reference to the work of R. M. May in the mid-1970s.

Despite their different mathematical levels, all three books follow the common pattern of having a collection of exercises at the end of every chapter, and of making virtually no reference to other published sources (except for Chapter 3 of *Differential Equations*). This latter point makes it more difficult to delve deeper into the subject, and in particular mars Causton's introductory book. The treatment of the exercises also reflects the levels of the book: Causton gives reasonably complete notes and solutions, Jones and Sleeman give rather bare answers, whilst Percival and Richards provide no solutions at all. □

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Nervous comparison

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Test Your Understanding of Neurophysiology.
By R.W. Murray.
Cambridge University Press: 1983. Pp.291. Hbk £25, $49.50; pbk £8.95, $16.95.

Neurobiology.
By Gordon M. Shepherd.
Oxford University Press: 1983. Pp.611. Hbk $49.50, £35; pbk £15, $24.95.

Physiology of the Nervous System.
By David Ottoson.
Macmillan Press, London/Oxford University Press: 1983. Pp.527. Hbk £30, $45; pbk £15, $27.95.

The Structural Basis of Neurobiology.
Edited by Edward G. Jones.
Macmillan Press, London/Elsevier, New York: 1983. Pp.417. Pbk £12, $19.95.

WE ARE rapidly approaching the situation where students may justifiably claim to be overwhelmed by the choice of neuroscience textbooks. This abundance of riches is misleading, however. With some exceptions, even quite standard neuroscience texts have a notably different emphasis; indeed, certain of them are of very limited appeal and can only be considered for specialist courses.

The new book by R.W. Murray falls into the latter category, despite its wide-ranging invitation to *Test Your Understanding of Neurophysiology*. This unusual, and in its early chapters rather archaic text, covers a restricted range of topics derived from the course given in the author's department at the University of Birmingham, U.K. The approach is somewhat biophysical, but lacks depth and coherence.

The unique feature of this book is its subdivision into an initial set of introductory chapters, followed by a section which poses problems based on specific experimental situations which challenge the application of the knowledge acquired by the student. Whilst all this is very laudable, the result is a rather dry and inconsistent presentation which is unlikely to stimulate the interest of any but the most dedicated of students. On the other hand, the book may be useful to course organizers seeking to utilize some of the tests so thoroughly analysed in its latter part.

In contrast to the limited scope of Murray's book, Gordon M. Shepherd's *Neurobiology* attempts the daunting task of constructing a unified overview of the functional organization and development of vertebrate and invertebrate nervous systems. Anyone who has read Shepherd's *Synaptic Organisation of the Brain* (Oxford University Press, 2nd Edn 1979) will turn to this new work with high expectations; they will not be disappointed. The comparative information, so lucidly developed, provides a perspective which has not been attained by anyone else writing at this level; it certainly goes some way to fulfilling the author's stated objective of encouraging the synthesis of a body of basic principles in neurobiology. This is not a book that loses its instructive impact in a morass of generalities, the material being covered in sufficient depth for it to be more than adequate as a basic text for many undergraduate neuroscience courses. The information on higher vertebrates and man is not only well elaborated and up to date, but is presented in a way