Chaos, with drastic revisions and extensive additions. The author aims the book at the needs of scientists and engineers but also wishes 'to attract mathematicians'.

The outcome is impressive. The book is beautifully written in a style that seeks not only to develop the subject matter but also to expose the thought processes behind the mathematics. It provides a very readable account of nonlinear bifurcation phenomena and of analytical and computational methods for studying them. Throughout, examples are discussed from an elementary level, which will give comfort to newcomers to the field and casual readers, to a level of sophistication and detail which should be pleasing and useful to experts. The commentary throughout the text and the extensive list of references give evidence of the author's detailed knowledge and understanding of his subject.

The book is mainly aimed at people who are comfortable with computers and who will learn from the text by experimenting with algorithms. Throughout, there are examples and exercises that urge the reader to turn to numerical simulation to gain insight into the nonlinear phenomena. However, the text does not get lost in discussing and explaining numerical techniques. It takes a 'black box' approach, assuming the reader has access to appropriate numerical software to carry out specific numerical tasks (solve equations, integrate numerically, and so on). But even without a background or interest in numerical methods the reader will still find this a stimulating book, both for its analytical content and for the author's ability to make one comfortable with the idea that the computations, while an issue in their own right, need not distract from the flow of understanding.

An excellent summary of the book's contents chapter by chapter appears in the Preface. Chapters 1 and 2 deal respectively with required applied mathematical concepts and basic nonlinear phenomena leading to bifurcations. Chapters 3 to 7 deal with practical aspects of studying bifurcations. Chapters 8 and 9 deal with more qualitative aspects: singularity theory, catastrophe theory and chaotic behaviour. There are guidance notes for those who may wish to avoid the more computational aspects of the text.

A couple of specific comments are worth making. I found the discussion of the Lorenz equations in §2.8 fascinating and much more convincing than other elementary treatments that I have read. Secondly the author is refreshingly candid about the experimental nature of much of the numerical work involved. To quote from the end of Chapter 4: '. . . . a continuation algorithm should offer the option of switching between extrapolation yes or no—that is, between an optimistic view and a more pessimistic view' (a bifurcation problem!) and '. . . a parameter study of a difficult problem is a venturous exploration.'

This book, with its many examples from scientific and engineering sources (usefully listed on page 371), should be of great interest to researchers who have to make practical studies of bifurcation phenomena. It should also be inspirational to mathematicians who wish to develop a knowledge and understanding of nonlinear phenomena from either an analytic or a computational viewpoint.

D. F. McGHEE

DiBenedetto, E., *Partial Differential Equations* (Birkhäuser, Basel–Berlin–Boston 1995), xiv+416 pp., 3 7643 3708 7, £39.

This book is an impressive account of many important aspects of the theory of partial differential equations. As acknowledged in the preface, the extensive nature of the subject matter means that a number of topics are unavoidably omitted, most noticeable being a treatment of some numerical methods. Nevertheless, the material which has been included is sufficiently wide-ranging to be of interest to many involved in the theoretical analysis of partial differential equations.

A substantial part of the book is devoted to linear equations, with the Laplace, heat and wave equations very much to the fore. Chapters II and III deal with the Laplace equation and related

elliptic theory and show how existence and uniqueness of solutions to certain boundary value problems can be proved by several techniques. These include Perron's method involving sub(super)harmonic functions and also the use of single and double layer potentials to reformulate the boundary value problems as integral equations. Following on from this, an account of Fredholm integral equations in L^∞ and L^2 is presented in Chapter IV and applications to eigenvalue problems for the Laplacian are considered.

The heat and wave equations are the subjects of Chapters V and VI respectively. In the case of the heat equation the Cauchy problem receives most attention, with existence and uniqueness results for solutions being established from integral representations involving the heat kernel in conjunction with the maximum principle. Results on nonnegative solutions are also presented. The chapter on the wave equation begins with the usual derivation of d'Alembert's representation of the solution of the one-dimensional Cauchy problem and then goes on to provide a description of the Poisson method of spherical means and the Hadamard method of descent for producing solutions to the N-dimensional Cauchy problem in the cases $N \geq 3$ and $N = 2$ respectively. A brief account of general linear second-order hyperbolic equations in two variables, including the Riemann function, is also given.

Quasi-linear equations are discussed in Chapter I, where the Cauchy–Kowalewski theorem is presented, and also in Chapter VII, which deals with first order equations and conservation laws. In the case of the latter the inclusion of an account of the work of Lax and Kruzhkov on entropy solutions is one of the positive features of the book.

At the end of each chapter is a set of *Complements*, containing problems and supplementary material such as the Ascoli–Arzelà theorem, Jensen's inequality and a brief account of metric spaces and compactness. Numerous footnotes also appear throughout the text, providing interesting information on the historical background of various topics and giving a clear indication of the author's expertise and breadth of knowledge in this field.

One or two aspects of the book are a little disappointing. There are occasions when notation is used before being properly introduced and when proofs of results are explained in a rather terse fashion. A number of typographical and mathematical errors occur. In addition, the author is possibly being optimistic in regarding the text as a 'self-contained, elementary introduction to Partial Differential Equations, assuming only advanced differential calculus and some basic L^p theory'. Newcomers to the subject with little prior exposure to partial differential equations are likely to find this book a difficult read due to the technical nature of the material and the inclusion of only a few elementary examples to illustrate the theory.

Despite these shortcomings the book will undoubtedly serve a valuable role as an intermediate text aimed at graduate students wishing to extend their theoretical knowledge of partial differential equations and as such I recommend it.

W. LAMB

AITKEN, A. C. *To catch the spirit* (with a biographical introduction by P. C. Fenton) (University of Otago Press 1995), 123 pp., 0 908569 99 8, NZ$29.95.

A. C. Aitken's autobiographical memoir, which forms the second half of this book, covers the years 1923 to 1943. Aitken grew up in New Zealand. The University where he had been a student granted him a scholarship to pursue postgraduate studies under E. T. Whittaker in Edinburgh. In July 1923 Aitken left Dunedin bound for Edinburgh and never returned to his native country.

The memoir is compiled from diaries: for the years 1923 and 1924 entries were made almost daily. They give an entertaining account of his voyage from New Zealand to Scotland (he was travelling alone—his wife followed a few months later). This is followed by: a vivid description of his initial impression of Edinburgh; his first visit to Whittaker's house in George Square ('he came from the back, where he had been gardening'); making the acquaintance of other faculty members;