three articles corresponding to my own interests. Chavel and Feldman discuss the Wiener sausage (the tube swept out by a ball undergoing Brownian motion) in the novel context of a Riemannian manifold. Durrett expounds aspects of the theory of reversible diffusion processes, including Brownian motion on manifolds and reversible diffusions in random media. Gray, Karp, and Pinsky discuss the average time at which Brownian Motion escapes from a tube in a Riemannian manifold. In particular they provide a stochastic characterization of minimal embeddings in the 3-sphere.

There is something in this collection for almost every aficionado of probability or harmonic analysis: certainly a useful book to recommend for library purchase.

W. S. KENDALL

FISHER, S. D. *Complex variables* (Wadsworth Mathematics Series, Wadsworth, 1986), xii + 403 pp., $39.90.

Quot homines, tot sententiae! The old Latin adage seems applicable to the teaching of complex analysis to judge by the number of books on the market. Various potential audiences have to be catered for and seeking a book which is just right for a particular group of students can readily lead to a non-existence theorem. For some tastes, the present book may contain too little on certain topics or too much on others. However, there should be enough to keep everybody reasonably happy.

A distinctive feature of the book is the amount of space allocated to applications. There are five long chapters of which the last two could be regarded almost entirely as applications of the theory. Earlier chapters also contain some cultural digressions but these are clearly marked and can be omitted if desired. A prominent role is taken by the topic of conformal mappings and even in the first chapter the seeds are being sown in preparation for a bumper harvest. At the end of the book, in Appendix 2, there is a useful list (an atlas, possibly?) of standard conformal mappings with diagrams for easy reference.

The first three chapters contain most of the standard material which is found in any first course on complex analysis. Indeed the needs of applied mathematicians, engineers *et al.* will probably be completely met. In the case of pure mathematicians, however, one or two ingredients could be missing. A glance at the index reveals the absence of such items as uniform convergence, the Weierstrass M-test and the principle of analytic continuation. To be fair, some of the arguments for which the M-test is often used are developed in the exercises. One of the standard examples to which analytic continuation relates is the gamma function. Surprisingly perhaps, this does not appear until page 332 and then merely in the exercises, where one instance of analytic continuation can be found nestling.

Chapter 4 deals with applications of analytic and harmonic functions. Laplace's equation, the Poisson integral representation and Green's functions for boundary-value problems are discussed. There is also a section showing how Laplace's equation is connected with problems in electrostatics, elasticity, steady-state heat flow and flow of an ideal fluid. The latter develops ideas contained in optional sections of earlier chapters. Conformal mappings including the Schwarz–Christoffel transformation are extensively employed.

Chapter 5 deals with transform methods. The Fourier and Laplace transforms are discussed and there is a mention of the Fast Fourier Transform. There is also a section on the Z-transform with applications to control theory and, in particular, the stability of a discrete linear system. (Stability of solutions of a system of linear differential equations is treated in one of the optional sections of Chapter 3.)

For the most part, the book is well written. Periodically, things go slightly wonky, as on pages 308–9 where the heat kernel has the wrong constant and a number of 2's are missing during the first part of Example 13. Again, a purist may carp at statements that a set has no interior or boundary (pages 25 and 28). Over 220 worked examples are sprinkled liberally throughout the text and there are over 700 exercises, many of which extend the theory by means of a series of simple steps. This is one of the strengths of the book and the conscientious reader will benefit greatly, especially as solutions are supplied to the odd-numbered exercises. To derive maximal pleasure, the reader should perhaps have leanings towards applied mathematics, particularly fluid mechanics.

ADAM C. McBRIDE

FISCHER, P. and SMITH, W. R. (eds.) *Chaos, fractals and dynamics* (Lecture Notes in Pure and Applied Mathematics 98, Marcel Dekker, 1985), viii+261 pp., $71.50.

The paper by Hirsch in this volume begins with a dictionary definition of *chàos* as "a disordered state of collection; a confused mixture". Thus the title of this volume rather aptly describes its contents. It contains eighteen papers, all more-or-less linked to the theory of dynamical systems, but tenuously linked to each other, except where an author has contributed to more than one paper.

The papers themselves were delivered at, or arose from, two conferences held at Guelph, Canada, in March 1981 and in March 1983. Since it has taken over two years to get the proceedings into print, and since the book costs so much, one might have expected a much better product. Yet it is replete with grammatical and typographical errors, some of which really obscure the sense. The index is inadequate, which is a serious flaw for papers of which some exhibit a plethora of picturesque but non-standard terms (see below). And finally the editing has left text with figure numbers that too often do not correspond with the figures themselves.

By and large, the better papers in this collection are the ones with the less trendy titles. W. F. Langford's "Unfoldings of Degenerate Bifurcations" is an interesting if somewhat condensed account of degeneracy in the context of the Hopf bifurcation theorem, with a beautiful numerical example. He is one of the few authors to attempt to relate his work to that of others in this volume. There is an equally enjoyable balance between theorems and numerical results in a paper by Chow and Green on singular delay-differential equations. But for those whose taste for deep-looking theorems is left unsatisfied by those two papers, Ikegami's account of electrical networks may be the answer. He is generalising the theory of the van der Pol relaxation oscillator, I think. One of the editors of this volume, P. Fischer, has a paper on Feigenbaum's functional equation; the solutions he discusses are only differentiable almost everywhere, but the structure of their periodic points is the same as that of smooth solutions.

Two papers which can be read with pleasure and benefit by all are those by Rössler ("Example of an Axiom A ODE") and by Hirsch ("The Chaos of Dynamical Systems"). Actually Hirsch makes his most precise statements about systems which are definitely *not* chaotic, and both authors draw attention to our lack of precision about the nature of chaos in the Lorenz attractor, which Hirsch refers to as "something of a scandal". The Lorenz equations themselves (or, rather, a generalisation of them) feature in another paper, by Alexander, Brindley and Moroz. By introducing aspects of spatial inhomogeneity they show that energy tends to be fed into modes of short wavelength, and conclude that the value of these generalised equations is therefore limited.

Apart from an article by O. Gurel, about which the less said the better, the remaining papers in this collection are the work of two authors, plus coauthors. One group, by B. B. Mandelbrot, consists of papers III to VII of a series entitled "On the Dynamics of Iterated Maps", though the subset in this book is more-or-less self-contained. These papers are of course beautifully illustrated, but the illustrations, and the computations underlying them, are also used as the basis of a number of conjectures, such as a conjecture on the scaling laws underlying the approximately self-similar structure of the Mandelbrot set (here modestly referred to as the "M-set") of a map. This author's conjectures have in the past proved quite fruitful, and no doubt there is substantial material for much further work in each of these short papers.

The last group of papers, five in all, bear the name of R. H. Abraham and four coauthors. They share with Mandelbrot's papers a propensity for coining descriptive terms. In Mandelbrot's case the terms are precisely defined and introduced relatively sparingly, but in Abraham's work