ducts and sound propagation between two parallel planes with a vertical line source complete this chapter.

Chapter 13 describes radiation from a baffled piston and follows a fairly standard approach to this problem, including the Rayleigh integral, the ring piston, the circular piston, directionality, intensity, sound power and source level, the acoustic field on the axis and radiation impedance. In addition, a section on transient radiation is included and the problem of non-uniform surface velocity is analyzed. Chapter 14 discusses diffraction by a circular aperture and a disk in both the frequency domain and the time domain, and finally Chapter 15 describes sound radiation from arrays of point sources.

This book provides a comprehensive introduction to physical acoustics which will enable students to progress onto more specialized topics, such as underwater acoustics, aeroacoustics, and non-linear acoustics. The extensive teaching experience of the author and his rigorous approach to research is clearly apparent throughout the book. This is a very valuable contribution to the field, and I expect it will be used extensively in both the classroom and as a reference text.

S. A. L. Glegg

INTRODUCTION TO EXPERIMENTAL NONLINEAR DYNAMICS, 2000, by L.N. Virgin. Cambridge: Cambridge University Press. xvi + 256 pp. Price £19.95, US$32.95. ISBN 0-521-77931 6 (paperback), £52.50, US$74.95. ISBN 0-521-662869 (hardback)

The body of literature concerned with non-linear dynamics is already huge and growing steadily. The novice researcher is faced with the serious problem of navigating this corpus. For applied mathematicians, the start of the path is clearly marked by established classics old (comparatively) and new, for example references [1, 2]. For the Engineer, many of these texts present too steep a learning curve and lack practical motivation. There are exceptions e.g. references [3, 4], but these are rather few and far between. Virgin's book is a welcome addition to this select group. As indicated in the title, many of the results in dynamical systems theory are discussed here in the context of mechanical vibrations.

The author follows Moon's approach [3] to an extent, in presenting us with a number of systems which can be built with relative ease in the laboratory. The most versatile experiment is based on a cart and track, and shows the most refreshingly direct approach to the problem that this reviewer has so far seen. Essentially, the shape of the track is prescribed to mimic a given potential energy curve. To an acceptable degree of approximation, it proves possible to construct a twin-well oscillator which can be used to illustrate a vast range of non-linear dynamical phenomena. With a little modification, the same rig can also be used to demonstrate the behaviour of impact oscillators. While the construction of the rig and instrumentation is not trivial, it could certainly be accomplished by judicious use of student projects, and this is another valuable aspect of the book. Other simple rigs include a hardening spring system which can be used to illustrate the behaviour of a system with non-linear stiffness cf. Ueda's oscillator. For those with little inclination for mechanical systems, a non-linear electrical circuit which accurately simulates Duffing's oscillator is discussed.

The range of phenomena illustrated is very broad. The earlier chapters show free oscillations, various bifurcation scenarios including the jump phenomena well known to structural dynamicists, and of course—chaos. Later chapters focus on more specific aspects of the subject for which the author is well known: escapes and impacts. While most of the book is concerned with local dynamics, the final chapter discusses and illustrates some

global issues. Throughout, the responses from the cart–track system show an impressive degree of agreement with numerical simulations.

If this book has a weakness, it is in the presentation of the theory. However, it would be churlish to complain about this. My main regret would be that the author has shown us very little of his mastery of the mathematical basis of the subject. This has clearly been done with the intent of restricting the size of the book and bounding its expense. This course of action means that the book will fit well within the budget of today's students. A slight missed opportunity is the lack of discussion on some of the more essential aspects of the calculations. Indeed, in the appendix on a continuous system, the author alludes to "repeated difficulty (which) was encountered in ensuring convergence in the dimension and embedding calculations" without providing us with the benefit of his experience. However, as I said, I do not regard these criticisms as serious.

In summary, I am very impressed with this book and I would recommend it without reservation as part of the literature for a Mechanical Engineer embarking on the study of non-linear dynamical systems. Because of the de-emphasis on theory, I would recommend that it be read after one of the gentler mathematical introductions, for example the excellent reference [5]. After this, the reader will be better placed to approach the deeper studies.

K. WORDEN

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IMPACT MECHANICS, 2000, by W. J. Stronge, Cambridge: Cambridge University Press. xix + 280 pp. Price £42.50; US$69.95. ISBN 0-521-63286-2

Impact is one of the most universal and widespread mechanical phenomena. Through the centuries impact has played a key role in technology as an intensive and simple source of mechanical influence on materials, structures and processes. Its study influenced the formation of mechanics as a science. The increase in the speed, accuracy demands and environmental protection leads to the more deep penetration into the nature of impact processes with development of new models and analyzing techniques. Nowadays impact studies are basic in damage mechanics, machine dynamics, vibration engineering, and structural mechanics.

In spite of broad research activity in the investigation of different aspects of impact phenomena, there is still a need for some introductory books for advanced students and professionals which give a general state of the art of the subject and a quick route to professional applications. The current textbooks on mechanics offer traditionally simplified presentation of impact, which is far from the real complexity of its applications. The book