magnetic impurity in these spin glass systems. This first volume also contains contributions on rare earth metals and alloys and compounds by Legvold, Buschow and Clark. Each of these authorities has worked on these fundamentally important, numerous (Buschow lists details and references to at least 1,000 binary and ternary compounds) and potentially useful materials since the 1960s. The journey through the periodic table is completed by Trzebiatowski's contribution on actinide elements and compounds. Even for many people active in magnetism, these materials are somewhat enigmatic. However, their properties are clearly dealt with and no text could claim to be comprehensive without their inclusion. As might be expected, the chapter on amorphous magnetic materials prepared by rapid quenching from the melt is an especially authoritative and lucid account; Luborsky and co-workers have been pace-makers in the study of the magnetic properties and preparation methods of these alloys, especially those suitable for the application and production of commercially useful material.

The second volume is dominated by contributions from the research and development laboratories of large industrial corporations. This is an important and welcome feature for several reasons. One is that it brings home to the reader, especially in the chapters on bubble domain materials by Eschenfelder, where charts in which interrelated material properties and parameters can be cross-checked are given, the special approach to research which is concerned with designing and using materials in a real application. Another is that articles, such as those by Chin and Wernick on soft magnetic materials and Bate on magnetic recording materials, are extremely comprehensive and are accompanied by exhaustive reference lists — presumably the product of excellent information retrieval systems. On the other hand, the smaller corpus of knowledge on other materials, and perhaps a more selective approach, is evident in some of the other contributions. This also has its advantages in that it can be said that part of the author's responsibility is to guide the reader and select the important contributions to his subject.

The four articles by Gilleo, Slick, Nicolas and Eschenfelder on the magnetic ferrites and garnets cover the ground admirably. The final chapter by Charles and Popplewell is, not surprisingly, the only contribution on materials which are effectively liquids. "Ferrofluids" present a challenge in thought as to what uses can be made of magnetizable colloidal suspensions. Several applications have already been addressed but one severe problem seems to be the rapid departure from liquid behaviour accompanying only modest increases in concentrations and magnetization.

There is no doubt that these volumes should be available in all research and development laboratories concerned with magnetic materials and material properties in general. Their value as sourcebooks to both graduate students and seasoned researchers is obvious, and their appearance will help to promote the important messages that magnetic materials display a bewildering variety of properties and that the applications of magnetism permeate the whole of modern society by providing electric power, communications and information storage. I am sure the international magnetism community awaits with anticipation the volumes yet to appear. □

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Mathematical stimulus for biologists

J.D. Murray

The Geometry of Biological Time. By Arthur T. Winfree. Pp.530. ISBN 0-387-09373-7/3-540-09373. (Springer-Verlag: 1980.) DM 59.50, $32.80.

GENUINE interdisciplinary research can often produce spectacular and exciting results. Winfree, a biologist, knows a lot of mathematics and this book reflects his appreciation of interesting problems in both fields. Amongst other things he gives some excellent case histories of what interdisciplinary endeavour can achieve. There is no doubt that the development of models and model mechanisms as an aid in elucidating biological phenomena with a view to determining basic principles is a flourishing, useful and fascinating area of research. (The interdisciplinary mathematics–biology fields are now recovering from the ravages caused by catastrophe theory.) In many countries the generous support from research funding organizations reflects this growth area.

This book is a major contribution to theoretical biology and will become, I am sure, an essential reference book for those, theoreticians as well as experimentalists, interested in modelling and understanding periodic behaviour in biology. From a pedagogical point of view it does not require much detailed knowledge of mathematics as such, except for selected chapters, but it does require a mathematical appreciation and understanding which most bioscientists do not have. However, those with firmity of purpose, who persevere with most of the more instructive first nine chapters, will reap rich rewards. Those with less time or weaker will can usefully go to those parts of the second half of the book which deal with more specific phenomena. Many of the ideas and concepts described are illustrated with relevant, and often ingenious experiments.

Winfree first discusses periodic behaviour in general, phases, phase singularities and phase resetting. The latter is shown to be an important concept of relevance to experimental observation. The effect of interactions between oscillators is then examined. In particular, where they are spatially distributed they can result in a variety of unexpected wave phenomena. One of Winfree's aims is to try to give a picture of observed events and natural phenomena which are not dependent on specific models. Generally he uses a geometric conceptual approach.

The second half of the book deals mainly with specific phenomena and experiments which exemplify some of the ideas developed earlier, but can be read, more or less, independently from the first half. Here Winfree discusses several major topics of current biological research and among other things gives his personal views on them. For example, such topics as the Belousov–Zhabotinskii reaction (emphasizing the wave phenomenon aspect), slime mould aggregation, circadian rhythms in insect eclosion, the female cycle and the cell mitotic cycle are surveyed and discussed. Researchers in each of these areas, and others covered, will no doubt feel that the views expressed do not give the whole picture of current thinking (and how could they in a single book?) or present a biased picture, and so on. This indeed so, but whatever their views, it will be difficult to ignore many of Winfree's ideas with impunity.

This book exhibits a remarkably wide spectrum of biomedical problems of current research interest. With Winfree's talent in presenting succinctly the essential interesting features of a phenomenon, it is accessible to most mathematicians, physical scientists, and with somewhat more effort, bioscientists who believe in the use of models in biology (and few can now admit to a contrary view). Parts of it can be usefully given to both undergraduates and graduate students. I strongly recommend it for those seriously or casually interested in modelling and understanding biological oscillators and their role in nature: the book is full of unanswered questions and research ideas. As an introduction for the uninitiated, and a stimulant for the cognoscenti, it is excellent, lucidly and anecdotally written, and has a well-vetted bibliography. □

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