Review
Reviewed Work(s): Energy and the Evolution of Life by R. F. Fox
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theory, vector spaces, calculus, and so on, with each topic given a simple introduction so that it can either be used as a preliminary excursion into the ideas or a review to look closer at the role played by proof in university mathematics.

There are chapters on proof by induction, limits and convergence, counting, functions, real-life problems, before focussing on the axiomatic nature of logic and the complementary role of mathematical insight. An appendix alludes briefly to the need to consider the logic of computer programs and how programs might be developed that can be proved to be error-free. It is all done with a light, deft touch that whets the appetite without dulling the enthusiasm through giving too big a helping of anything. I know my colleagues in Computer Science are concerned that students are not coming forward with a feeling for the nature of mathematical proof and the need to get their software provably correct. This book has the propensity to begin to redress the balance.

My only concern is: where does this text fit into the scheme of things? In the sixth form we are so busy covering all the topics that might come up in A-level, and in university every course is devoted to a specific topic. Where do we cope with proof? This is a fault of the system. Without taking a serious in-depth look at the fundamental idea in mathematics we are deluding our students and ourselves. There are so many pressures that the delusion becomes reality. So we concentrate on the latest edict from the government: GCSE National Curriculum. TVEI, GRIST, Student Profiles, IT, and we become overwhelmed by a sea of national initiatives. No—the time is ripe to look to the fundamental nature of what we are doing in teaching and learning mathematics. This pragmatic and essentially elementary book on the nature of proof is a definite step in the right direction.

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Energy and the evolution of life, by R. F. Fox. Pp 182. £21·95. 1988. ISBN 0-7167-1849-9 (Freeman)

This challenging and thought-provoking book is highly unusual in its breadth of treatment. The author, a professor of physics at the Georgia Institute of Technology, ranges far outside the realms of physics and mathematics, for much of the book concerns biology, biochemistry and chemistry. In the preface among the many scientists to whom a debt is acknowledged are Fritz Lipmann and Christian de Duve from whom the author had the 'good fortune to learn biochemistry and bioenergetics', and George Uhlenbeck and Mark Kac under whom he studied nonequilibrium thermodynamics. The wide contacts with authorities in different disciplines have helped to make possible the present exciting synthesis and to justify the comment on the dustcover that 'the book will inevitably raise debate among the cognoscenti'.

A recurrent theme is what is called the uroboros puzzle, the uroboros being symbolised in Greek mythology by a serpent with its tail in its mouth, representing 'an entity that is self-generating and self-sustaining'. Throughout, the key to the evolution of life is argued as energy flow, particularly mediated through phosphate bonds. In a wealth of examples, the effects of changes in energy flow are discussed from the origin of elements, the synthesis of macromolecules, to the storage of energy, the origin of nervous tissue and even the behaviour of human societies which is stated as 'predicated on energy flux'. The consensus view, for example of the nature of the primitive atmosphere, is not necessarily followed, but the author indicates that 'putative facts are clearly differentiated from explicit hypotheses'.

Of the five chapters, only one, the fourth and longest, is essentially mathematical, entitled 'Nonlinear dynamics'. Here the main topic is the mathematical character of driven, nonlinear dissipative systems, involving equations which usually have no closed-form solutions and need computer modelling. Aspects developed here include reaction-diffusion equations for morphogenesis, dimensionality, Liapunov exponents and 'mathematical chaos', Poincaré maps, the concept of attractors in phase-space pictures, closed-form solutions. Feigenbaum universality and predictability for nonlinear dynamics. The relevance of these various approaches to evolution is at least indicated; for example, it is argued that the biological significance of the nervous system is that it can predict and that predictability requires rapid simulation.

The final chapter entitled 'Biological predictability' draws on the basic concepts of the earlier chapters focussed on biological and chemical aspects and the mathematics of driven dissipative systems in an understanding of biological evolution. Indeed it is contended that energy flow implies the existence of mechanisms for biological evolution that transcend Darwinian selection and its mechanism found in molecular genetics, and it is finally questioned whether the energy flow parameter has now increased to a point that could drive 'the nonlinear, dynamical process called civilisation to chaos'.

References are given to a wide range of literature and a glossary defines many of the terms used. This will be especially useful to readers not well versed in some of the many disciplines incorporated here. The presentation is clear and arguments are persuasive, ilustrative of the value of an interdisciplinary approach. Mathematicians and physicists interested in the wide application of studies of nonlinear dynamic systems should find food for thought in this forward-looking book.

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Do-it-yourself astronomy, by S. G. Brewer. Pp 137. £8·95. 1988. ISBN 0-85224-573-4 (Edinburgh University Press)

This little book explains some fundamental terms in astronomy and describes some experiments undertaken by the author, a retired public school head of mathematics. In reproducing these experiments, which are claimed to be original, the reader, if he is fanatical enough, will learn the hard way about finding one's latitude and the distances of the nearer planets, about Kepler's laws, how to determine the radii of the Earth and Moon, about the Astronomical Unit and soemthing about the remote background. There are also a couple of appendices, one on spherical trigonometry.

It is not a very complicated book and could easily find itself amongst the library of any keen amateur astronomer. It is also suitable for anyone just starting on astronomy, such as a sixth former or undergraduate, providing he is competent to A-level maths standard.

Most of the maths in the book is, fortunately, kept to a minimum and quite simple and traditional, although hard-going if you are not entirely smitten. There are two short programs written in BASIC to bring the text right up to date.

Even if you do not wish to do the experiments there is alot of education in this book and it is worth a read if only to re-discover many of the things we learnt about years ago and have since forgotten.

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A mathematical history of division in extreme and mean ratio, by Roger Herz-Fischler. Pp 191. \$65 (Canada)/\$75 (Elsewhere). 1987. ISBN 0-88920-152-8 (Wilfrid Laurier University Press)

This is a work of serious scholarship which surveys the primary source material and secondary assessments in a convenient chronological order. The central topic is treated with sufficient clarity to make it readily understandable by those unfamiliar with it or the context in which it developed. As in the best historical writings, insight into the general is achieved via a detailed study of the particular. The book provides a useful introduction to the mathematical corpus of the Greeks and their Arab and European epigones, not of course comprehensively, but because it succeeds in evoking the spirit of classical geometry.

The key source material comes from Euclid's *Elements*; most of the later work takes what Euclid preserved as its starting point. Nowadays, Euclid is alive and well only in the ongoing