Maths with context

A Guided Tour of Mathematical Methods for the Physical Sciences by Roel Snieder, 2001, Cambridge University Press, 442pp, pbk, 0521787513.

A common complaint among undergraduate students studying physical sciences is that they often feel they are taught mathematics without any context to applications in physics. As a teacher, I often hear "but why do I need to know that?" The other complaint is that they are often expected to understand mathematical techniques in physics lectures before they have been taught them in maths lectures. I myself remember using ordinary differential equations in a first-year physics course and then being taught them in a second-year maths course. Many of us found ourselves thinking retrospectively "so that was what he was talking about". This book integrates mathematical theory with a wide range of applications in physics.

The result is a tour through the standard undergraduate mathematics syllabus for students in the physical sciences in a slightly unconventional way. The presentation is problem-based, with a plethora of examples from a range of fields, allowing the reader to draw on physical intuition in the learning process.

Roel Snieder is a geophysicist who is well known for his contributions to inverse theory and seismology. He is particularly impressive in his ability not only to develop theory, but also to apply it to the analysis of real data. While he presently holds the Keck Foundation Chair in Basic Exploration Science at the Colorado School of Mines, the book stems from lectures developed during Snieder's time as Professor of Seismology at Utrecht University. His diverse research background, which ranges from fluid dynamics to exploration seismology, is apparent in the many examples here.

The book would be useful to physicists, including astrophysicists and geophysicists. Succinct summaries of power series, co-ordinate transformations and Cartesian tensors provide basic tools. The book has a good treatment of div, grad and curl, including common applications. The theorems of Gauss and Stokes and the Laplacian are each covered in chapters. The fundamentals of time-series analysis, of which Fourier analysis is central, are presented in such a way that the reader derives many of the basic signal-processing tools such as convolution and correlation through the problem sets. Green's functions are an often-esoteric concept to students and a useful chapter is devoted to examples of their application. Other chapters are devoted to normal modes and spherical harmonics, potential fields and their role in gravity and electromagnetics, and perturbation theory, including the Born and WKBJ approximations.

Mathematical descriptions of physical systems are often too complex to solve even with the most powerful computers, and this complexity usually masks the system's sensitivity to individual parameters. Snieder has an interesting chapter on scale analysis, illustrating how simplifications can be applied to gain better physical insight into mathematical systems. Applications include convection theory and ray-based approximations to the wave equation. This chapter and others (e.g. perturbation theory) serve to introduce the reader to the "art of approximation", a valuable skill to an applied mathematician or physicist. It is a shame that undergraduates are seldom exposed to such concepts.

I would recommend the book as a general textbook for undergraduate students in the physical sciences. It could be a stand-alone textbook for an upper-year undergraduate course, but would also provide a good accompaniment to undergraduate maths courses. Teachers may also be more generally interested in this book for its many examples that may serve as useful supplements to physics or geophysics courses. A basic knowledge of linear algebra and calculus is assumed from the reader.

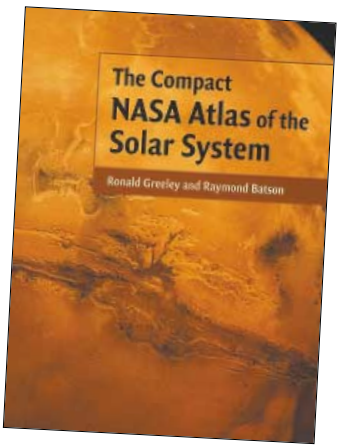
By its own admission, the book is not a replacement for the more standard texts in mathematical physics, but rather serves to compliment them. While it may seem a bit excessive to buy yet another textbook, which may not be central to a given course or module, it could be very helpful to students struggling to see the relevance of their maths lectures to their degree programmes. The paperback version is reasonably priced and affordable on most student budgets. In summary, I can highly recommend this book to students and teachers in the physical sciences.

Mike Kendall.

Books received

The solar system in compact form

The outstanding book received at *A&G* for this issue is ***The Compact NASA Atlas of the Solar System*** (Ronald Greeley and Raymond Batson, Cambridge University Press, 2001 0 521 80633X, £39.95). This is not a new book, exactly; it is based on the very well-received *Atlas* reviewed in these pages in 1997 (*A&G* **38.3** 32). It retains the spectacular images of the original, ranging from examples of planetary phenomena to the superb topographic and geological maps of Mars and Venus, for example, derived from recent NASA



explorations, and the text has been updated. Just like the larger (and costlier) original, this is a comprehensive summary of the state of knowledge of our planetary system, together with concise descriptions of the means of producing the information, such as the geological maps. It provides valuable source material for discussions such as comparisons between planets (including Earth), or examination of map projections and different remote sensing methods.

Although it is certainly smaller than the original, it is not exactly pocket-sized, still larger than A4 in both dimensions. But at less than half the price of the original, it certainly fits the pocket a lot better, and this excellent volume should find a home on personal bookshelves as well as in any library.

There are many ways to study the solar system, of course; one of them is to have a good look at those bits of it that make their own way to Earth, as meteorites. A colourful introduction to the study of meteorite comes from editors Brigitte Zanda and Monica Rotaru in ***Meteorites: their Impact on Science and History*** (translated by Roger Hewins, CUP, 0 521 79940 6, pbk, £11.95). The book arose from an exhibition at the *Muséum Nationale d'Histoire Naturelle* in Paris and is designed to summarize and explain international research on meteorites. It is a comprehensive overview, complete with a glossary. The extensive colour images, figures, explanatory boxes and lists of keywords make for a very lively appearance. But a great deal of information is covered in this genuinely pocket-sized book; I feel that the concise text in places raises more questions than it answers.

A scholarly overview of a phenomenon related to meteorites comes in ***Tektites in the Geological Record: Showers of Glass from the Sky*** by Joe McCall (Geological Society Publishing House, 2001, 1 86239 085 1, pbk, £65). This is a rigorous and comprehensive account of the history, occurrence, composition and origins of these once-obscure pieces of glass, associated with asteroid and comet impacts. In this much-needed volume, McCall brings together the various strands of astronomical and geological evidence about these objects, known and collected for more than a millennium.

Light Pollution: Responses and Remedies is a different sort of volume altogether (Bob Mizon, 2001, Springer-Verlag, 1 85233 497 5, pbk, £22). This is in part a practical guide to observing astronomical objects under the sort of skies to which UK amateur astronomers have had to become accustomed. There is discussion of techniques to make the most of murky skies, as well as suggestions for observing projects and targets visible wherever you set up your telescope.

But the book has another role, of wider interest. It is a very useful source book and strategy guide for diminishing light pollution. There are examples of good and bad lighting, information about relevant legislation, concerned bodies and effective strategies. It is a very down-to-earth guide with the emphasis firmly on getting something done, where you live, now. The concerned reader is urged to fight for darkness on all fronts and this is the appropriate manual for the battle.

Sue Bowler.