Mathematical conversion kit

Mathematics Applied to Continuum Mechanics. By Lee A. Segel. Pp.xviii +590. (Macmillan: London and New York, 1977.) £14.25.

ALTHOUGH the general tradition of mathematics departments in the US had been rather specialised towards pure mathematics, the best American universities have recognised for many years now the need for Applied Mathematics Programs. These have been aimed, especially, at helping those who, although brought up in the pure mathematics tradition, would like to consider the possibility of transferring their interest to fruitful areas of application of mathematics.

For example, one of the finest and oldest of the world's technological universities, Rensselaer Polytechnic Institute in Troy, New York, has given an introductory applied mathematics course to its mathematics students for ticity theory contributed by G. H. Handelman initiated it. It was later developed by Dr L. A. Segel, whose book *Mathematics Applied to Continuum Mechanics* in 12 chapters (with the material of chapters 4–6 on elasticity theory contributed by G. H. Handelman) has grown out of the course.

Applications of mathematics fall into two main areas. One involves the discernment and utilisation of laws of nature, as illustrated by Dr Segel's book or by its more elementary predecessor *Mathematics Applied to Deterministic Problems in the Natural Sciences* (C. C. Lin and L. A. Segel (Macmillan: London) A contrasting area of application is to statistical treatments of observed regularities and variabilities in systems where no underlying laws are known. Both are of immense practical utility, and it is important that mathematical education should make students aware of both.

In Britain, those taking mathematics in the immediate pre-university years have commonly had that advantage, being exposed both to mechanics and statistics as well as to pure mathematics, and their university course has built on that background and developed considerably within the area of mathematics applied to engineering and the natural sciences, as well as within statistics and operational research. More recently, in gross neglect of the country's needs, many schoolteachers have taken away from students the uniquely valuable example of elementary mechanics as an area illustrating mathematics applied to problems in engineering and the natural sciences, where natural laws are discerned and utilised. Consequently, students enter university mathematics departments without any knowledge of this great division of applied mathematics, and with an educational background based on pure mathematics with some leavening of statistical distribution theory.

For the first time, then, British universities may be facing the problem which has long existed in the US, and which the best American universities have been seeking to counter with books like those of Dr Segel. Such books, directed rather explicitly at students with a good modern background in pure mathematics, but with little or no idea of classical applied mathematics or the uses of mathematics in engineering science, are aimed at capturing the interest of such students, and at bringing them to begin thinking in ways valuable to such applications.

Exercises abound throughout this excellent book and are effective (with or without use of the 'hints' section at the end) as a major method of exposition of material. Part A gives a good grounding in vector and tensor algebra and calculus, with particularly clear explanations of why all the definitions are appropriate. Part B gives a good introduction to rate-of-strain, viscosity, vorticity and boundary layers; and to strain, elastic constants, energy and uniqueness principles, bending, buckling, torsion, plane strain, generalised plane stress, and elastic waves.

Part C, on water waves, is concerned mainly with the deep-water case. There is a good introduction to group velocity. For example, the crest pattern is found not only for gravity waves generated by a large obstacle in steady motion (ship waves) but also for the limiting case of a very small obstacle making capillary waves. The author calls these 'beetle waves' in reference to a pretty frontispiece photograph! Part C concludes with a brief but interesting treatment of second-order effects. For me, only its opening chapter, deriving the free-surface condition and other basic equations, seemed to me to adopt an unnecessarily cumbersome approach based on excessive adherence to 'scaling' doctrines.

Finally, Part D is concerned with setting out the calculus of variations and its important applications in mechanics, and continues the excellent practice of getting the reader to work out the details in most of the really interesting examples. Wherever universities are faced with 'converting' students grounded primarily in pure mathematics to the great variety of its exciting and important applications in the mechanics of solids and the mechanics of fluids, I believe that they will find this book a most valuable conversion kit.

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Physical variability of the oceans

Variability of the Oceans. By A. S. Monin, V. M. Kamenkovich and V. G. Kort. Pp.xiii+241. (Wiley-Interscience: New York and London, 1977.) £14.95; $25.35.

THIS monograph by three well-known Soviet oceanographers is a survey of the physical variability of the oceans on widely varying space and timescales. Although the writing is clear and the errors few, I suspect that the book will have a limited readership.

The major shortcoming is that the most recent reference to the Western literature is 1973, and only 6% of all Western references are dated after 1970. Soviet citation runs a bit later, as one would expect. As any casual observer of physical oceanography will have noticed, ocean variability has probably been the area of greatest advance since 1970, and understanding of many parts of the spectrum has improved markedly since then. Furthermore, oceanography is a very technologically dependent subject, and it is in technology that the Soviet Union most obviously lags behind the West. Thus the more recent Soviet references do not make up for the dated discussion of Western work to the extent that one might otherwise have expected. The commonly remarked Soviet strength in theory does not compensate in this field for their missing observational strength, but does lend a formal tone to much of the book.

A good textbook need not be fully modern, and oceanography painfully lacks such textbooks. Students trying to enter oceanography, however, will find the subject matter here too terse. For those already conversant with the field, the obsolescence will be a serious defect. Perhaps the book is best used as an annotated bibliography of material through 1970. It also has historical value, as it provides insight into the thinking of some of the most prominent Soviet oceanographers in the early 1970s. In many ways, the book reads like the type of overall summary of a field that has become a commonplace in recent years as a preamble to and justification for large cooperative national and international field programmes. I suspect that is its origin.

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