Mathematical theory of elasticity

Introduction to Rational Elasticity. (Monographs and Textbooks on Mechanics of Solids and Fluids.) By C. C. Wang and C. Truesdell. Pp. xii+556. (Noordhoff: Leyden, 1973). Dfl. 130.

FOLLOWING the precedent created by his joint work with Noll in presenting the non-linear field theories of mechanics Truesdell has now collaborated with C. C. Wang to bring together recent work in the mathematical theory of elasticity. As Truesdell points out in his introduction, there has been a dearth, until recently, of rigorous theoretical work on the existence and uniqueness of solutions to problems of elastic materials. With completely new techniques in pure mathematics becoming more generally understood, however, the stage is set for advances in many branches of applied mathematics. If this book inspires pure mathematicians to embark upon the application of rigorous mathematics to problems in applied mathematics and, in particular, elasticity then the authors' aims will have been vindicated and the colossal price of the book perhaps justified.

For those readers not familiar with the recent advances in pure mathematics, the book opens with a chapter which present the concept of a finite dimensional vector space, the concept of a manifold, and a section on Lie groups. This chapter is, as the authors admit, an outline of ideas, and many readers will need to study more deeply the topics covered before feeling confident to proceed further. Chapter II considers the more general subject of continuum mechanics, of which elasticity is one aspect. It is suggested that a reader whose interest lies solely in elasticity may ignore this chapter—that would be very unwise because in chapter II is the development of the ideas of constitutive relationships upon which modern elasticity theory is based. These relationships are further developed in the context of elasticity in the third chapter, which also contains a number of the inequalities satisfied by an elastic body, together with an introduction to the uniqueness and stability of solutions of elastic problems.

Homogeneous and inhomogeneous bodies are studied in the following two chapters, and chapter VI contains a discussion of wave propagation. In that chapter the less mathematical reader will recognise many familiar results and it could be argued that a good introduction to rational elasticity might be obtained by a superficial reading of chapters IV–VI before embarking upon a detailed study of these and the earlier sections of the book.

The final chapter presents a unified account of the present state of knowledge of the existence, uniqueness and stability of the boundary-value problems of elasticity. This is the climax of the book for the mathematician and should leave him in no doubt that there are still many problems worthy of his skilled attention.

A. H. Craven

Crystal behaviour

Dislocations and Plastic Deformation. By I. Kovacs and L. Zsoldos. (International Series of Monographs in Natural Philosophy, Vol. 60.) Pp. xii+343. (Pergamon: Oxford and New York, February 1974.) £3.50.

THIS book aims to provide an introduction to dislocation theory, followed by an account of the mechanical properties of crystals, including the yield stress, work hardening, creep, and effects of heat treatment. It covers much the same ground as Cottrell's famous book *Dislocations and Plastic Flow in Crystals*, but attempts to update and enlarge upon that work, now 20 years old. It is a difficult task, for the boundary between dislocation theory and plasticity is as much of a no-man's land as ever, and Kovacs and Zsoldos can only list the conflicting theories of work hardening without leaving the reader much wiser; a student will find this chapter heavy and demoralising.

It is unfortunate that the treatment is so exclusively devoted to tensile stress–strain curves of pure face-centred cubic metal single crystals: a wider discussion of the experimental observations would be rewarding. Another general criticism of the book is that it omits many recent developments: there is no mention of Foreman and Makin's computer experiments on yielding, which have greatly clarified the subject; no mention of weak-beam measurements of stacking-fault energy and no mention of diffusion creep. Finally, the book contains a number of errors, perhaps the most glaring being the expression for the energy of a straight dislocation on page 48, which leads to erroneous expressions for the line tension on page 64, and this in turn, together with the omission of weak-beam results, leads to a rather unbalanced assessment of the current value of stacking-fault energies.

In spite of these defects, the book is more comprehensive and up to date than any now available, and provided the graduate student has read Cottrell's book referred to earlier, this book can be used as an introductory text in a field where few are available.

L. M. Brown