J. Fluid Mech. (1996), *vol.* 323, *pp.* 410–411

REVIEWS

Mechanics of Mixtures. By K. R. Rajagopal and L. Tao. World Scientific, 1995. 195 pp. ISBN 9 81021 585 1. £39.

This book deals with continuum theories of materials that are microscopically heterogeneous. It would appear to be directed at a rather limited audience. As the authors remark in their *Preface*, it is not intended to be a textbook on the theory of mixtures because it does not develop the theory from first principles with sufficient detail to make it clear and understandable to beginning graduate students. Furthermore, there are no examples or exercises. Results from the current literature are sometimes presented with a minimum of explanation or justification.

The book contains a total of eight chapters. A short introduction in the first chapter is followed in chapter 2 by brief discussions of kinematics, the balance laws for mass, linear momentum, angular momentum, and energy, and various expressions for the entropy inequality. The next three chapters deal with flows of fluids through porous solids and in particular the case in which the solid experiences large deformations. Some attention is given to the prescription of appropriate boundary conditions for mixtures. The governing equations of unsteady diffusion processes involving moving fronts, including the evolution equations for singular surfaces are derived. The authors say that the focus of the book is on applications, but I found only a few instances where specific boundary value problems were solved to completion. These include the steady-state problem of one-dimensional diffusion of a fluid through a rubber slab, unsteady diffusion of a fluid through a nonlinearly elastic slab, and the axisymmetric counterparts of these problems. There is only one graph in the whole book that compares analytical predictions with experimental data.

Chapter 6 deals with wave propagation in solids infused with fluids and is based upon the constitutive modelling formulated in the earlier chapter 3. Biot's equations for wave propagation in a compressible-fluid-saturated, porous, compressible, elastic solid are recovered. Two analogues of Biot's equations are derived: (*a*) when both the solid and the fluid are regarded an incompressible, and (*b*) when an incompressible viscous fluid fills the pores of a nonlinearly elastic solid that undergoes finite homogeneous deformations as a result of absorption and swelling.

Chapter 7 treats mixtures of two immiscible, incompressible, Newtonian fluids and performs constitutive modelling for the continuum mixture. This formulation is based on many assumptions which have not been verified. The authors point out that it may not be possible in many situations to measure the physical quantities associated with each constituent.

The last chapter considers mixtures of solid particles and a fluid. The balance equations for the mixture components are set down and constitutive relations are obtained. Again, the approach is speculative, pays little or no attention to the microscopic details of the flows, and awaits experimental determination of numerous coefficients that arise.

While the book may interest researchers specializing in mixture theory, it is unlikely to have a wider readership. It does contain an extensive bibliography of 402 references.

S. B. Savage

The Centenary of a Paper on Slow Viscous Flow by the Physicist H. A. Lorentz. Edited by H. K. KUIKEN. Kluwer Academic Publishers, 1996. 305 pp. ISBN 0 7923 3958 4. $164 or £110.

This book is a reprint from the *Journal of Engineering Mathematics*, Vol. 30, Nos 1–2 (1996). The bulk of the volume (p. 25 onward) consists of 15 invited contributions related in some way to Lorentz's seminal paper of 1896. The paper itself appears in English (for the first time?) translated from the Dutch by the editor, who notes that in just 6 pages, Lorentz not only established the reciprocal theorem for Stokes flow, but also derived the stokeslet singularity, the boundary integral formulation and the image system for a plane boundary. The correct attribution for some of these ideas has not always been made.

The editor also provides a brief biographical note on Lorentz and his involvement with fluid mechanics. A fascinating section concerns his chairmanship, late in life, of a committee investigating the possible enclosure of the Zuiderzee, a massive feat of civil engineering, completed after his death but for which much of the oceanographic modelling work was done by Lorentz himself.

It is not customary to review papers published in a sister journal, but a list of topics covered in the book may be appropriate. Contributions are offered on arrays of stokelets; on microorganism locomotion and feeding; on boundary integral calculations of low-Reynolds-number Newtonian and non-Newtonian flows; on image systems for spheres and planes; on reciprocal theorems in related areas; and on matched asymptotic expansions for unbounded flows having small inertia.

The principal motivation for reprinting the journal in book form is to invite a reappraisal of Lorentz's achievement in fluid mechanics. The case is well-made.

J. M. RALLISON