J. Fluid Mech. (1992), *vol.* 238, *pp.* 723–725
Printed in Great Britain

REVIEWS

Magma Transport and Storage. Edited by M. P. RYAN. Wiley, 1990. 420 pp. £125.

In recent years many physical processes by which molten rock (magma) is generated in the Earth's interior, transported towards the surface and then either erupted or emplaced into the crust have been investigated theoretically and quantified. Concurrently, a wealth of observational data has allowed volcanologists to image the spatial and temporal pathways followed by magma batches during their ascent. The present volume represents a collection of reviewed papers from a symposium of the 28th International Geological Congress, 1989, which tried to relate these advances in theory and observation. The articles have been ordered to form a connected account, each includes substantial review material and the style has been harmonized throughout; the result is much more rounded and integrated than most conference proceedings.

The book is divided into two sections of nine chapters each. The first, entitled 'Heat and mass transport in magmatic systems', describes mainly theoretical and experimental investigations of magma production and transport. Seven chapters focus on largely fluid-mechanical problems, giving many fascinating applications of flows in porous media and conduits, two-phase flows, nonlinear waves, buoyant instabilities, gas dynamics and solidification and melting. The second section, entitled 'Transport structure, mechanics and dynamics of magmatic systems', concentrates more on geological evidence. Two chapters review the pattern of melt generation and migration at mid-ocean ridges and beneath Iceland and relate this reasonably well to the theoretical section. Six of the remaining chapters, however, present detailed kinematic descriptions of magmatic movement, deduced from surveying and seismic observations of particular volcanoes, with very little dynamical modelling or relation to the earlier chapters. Despite the broad range of topics covered, I was disappointed not to find articles on mantle convection, fluid-mechanical processes in magma chambers and volcanism in Hawaii.

In summary, this volume divides into overviews of the continuum-mechanical modelling of magma transport and of the geological observations, and faces the reader with the real challenge of bridging the gap. The material is attractively printed, with a uniform style of presentation and many illustrations, including striking colour plates of volcanic eruptions.

J. R. LISTER

Relativistic Fluids and Magneto-Fluids. By A. M. ANILE. Cambridge University Press, 1990. 400 pp. £50.

With this work Anile has set himself an ambitious target, namely the provision of a unified and systematic treatment of the main results and techniques of relativistic fluid dynamics. Concentrating on nonlinear wave propagation in relativistic fluids and magneto-fluids, the book uses covariant mathematics wherever possible in order that the treatment and proofs are both concise and transparent.

Relativistic fluids are central to the investigation of diverse phenomena in the fields of astrophysical and laboratory plasmas, and nuclear interactions. Applications of the theory are numerous, covering topics such as supernovae explosions and impulsive gravitational disturbances, astrophysical jets and accretion processes, through to intense beams and shocks in laboratory plasmas and high-energy collisions among heavy nuclei. The thread linking these research frontiers is the significance of the evolution, propagation and stability of relativistic shocks and nonlinear waves in each medium.

The author has undoubtedly achieved his goal. In a comprehensive and detailed text, he introduces at the very beginning the equations of relativistic fluid dynamics (RFD) and relativistic magneto-fluid dynamics (RMFD) and proceeds to develop the concept of a quasi-linear hyperbolic system and accompanying conservation laws. The reader is persuaded, by means of rigorous analysis and physical insight, that under suitable restrictions the equations of non-dissipative RFD and RMFD can be cast in the form of quasi-linear hyperbolic systems. That they are hyperbolic systems is crucial, since only such systems permit the occurrence of non-smooth solutions from smooth initial data. The restrictions imposed are consistent with relativistic causality, and a detailed discussion of the assumptions and extensions is presented, this being an area to which the author has contributed significantly in the published literature. Principles are illustrated with examples, such as the derivation of the magneto-acoustic and Alfvén waves in a magneto-fluid, in order that the reader is not overwhelmed with mathematical detail. In fact this style is maintained throughout the work, with applications contrasting with the formal mathematical style of presentation of the main results.

A detailed study of singular hypersurfaces in space time follows, with a full derivation of the compatibility relations among the jumps in the field variables in the cases of weak (first-derivative discontinuous) and strong (shock wave) discontinuities. This serves as a foundation for exploring the topics of later chapters, which are concerned with the propagation of relativistic simple waves and the Reimann problem, relativistic geometric optics with applications to electromagnetic waves propagating in cold plasmas, asymptotic wave analysis and the 2-timing method, and the thermodynamics, damping and stability of propagating relativistic shocks.

Written as a formal mathematical text, the book is concise and well designed. Each chapter begins with a short summary of the preceding one and a brief description motivating further developments in context. Throughout the author is uncompromising in the use of tensor calculus and relativity theory, so the reader must be familiar with these concepts and practices. A background knowledge of basic hydrodynamics is also a prerequisite. Each fundamental principle is stated in a Theorem or Proposition, and established by a rigorous proof. Where relevant, physical examples and applications are presented in detail, and the motivation behind each advance is clearly stated. Extensive references to research literature and other texts are provided at every stage in order that the reader can seek a different perspective. The author clearly has a comprehensive grasp of the material presented, and offers the reader additional insight into the available publications. Consequently, this book is a valuable reference work for anyone in the field seeking a wide-ranging and thorough treatment of RFD and RMFD.

D. A. Diver

Shorter Notices

Kavitation, 3rd Edn. By W. H. Isay. Schifahrts-Verlag 'Hansa', 1989. 441 pp. DM 64.

The first and second editions of this comprehensive treatise on cavitation in liquids were published in 1981 and 1984. This third edition maintains the well-chosen balance between the basic physics of cavitation and its practical consequences in water channels and on rotating propellers. The printing is clear and attractive. The economical small-page format is a little inconvenient, although the low price is undoubtedly welcome.

Practical Fluid Mechanics for Engineers and Scientists. By N. P. Cheremisinoff. Technomic, 1990. 274 pp. S Fr. 99.

It says in the preface that this book 'is intended to provide a convenient summary of fundamentals for engineers, scientists, technicians, plant operations personnel', but the last two of these groups are likely to be more appreciative of the author's elementary approach and his choice of subject matter. Dimensional analysis and simple rheology and empirical hydraulic resistance factors are included, but boundary layers and shock waves are not. The explanations are careful, and in style are like those prepared for engineering undergraduates. Some of the terms used are unconventional, for instance the dimensionless group commonly called the Strouhal number is referred to here as the homochronicity number, and the 'Kirpichev–Gukhman theorem' appears to be the principle of mechanical similarity. People engaged in hands-on fluid flow processing and transport might find the book useful as a ready reference. A clearer lay-out of the table of contents and a more systematic division of the large chapter headed 'Hydrodynamics' would help.

Multiphase Science and Technology, Vol. 4. Edited by G. F. Hewitt, J. M. Delhaye and N. Zuber. Hemisphere, 1989. 795 pp. £67.

This latest volume in a series begun in 1982 continues the policy of publishing extensive review articles which are too short to be suitable as books and too long for a journal. As the common series title indicates, the articles range in subject matter from the science of multiphase systems to technological applications (although the classification of an article may be subjective – one man's science is another man's technology). The articles in this volume and their authors are as follows.

A scientific approach to the design of continuous flow dryers for particulate solids, by D. Reay (102 pp.).
Vertical annular two-phase flow, by G. F. Hewitt and P. B. Whalley (79 pp.).
On the analysis of various instabilities in two-phase flow, by R. T. Lahey and M. Z. Podowski (188 pp.).
Industrial crystallization, by R. A. W. Shock (211 pp.).
Some theoretical results for the motion of solid spherical particles in a viscous fluid, by F. Feuillebois (207 pp.).

In general the articles are careful accounts of the present state of knowledge by acknowledged specialists. An unfortunate omission is a table of contents for any of the articles. Some editorial restraint on the tendency by some authors to reproduce equations (one sub-section of one article has 405) instead of describing the relevant physical processes would be welcome. The lengthy tables of nomenclature at the ends of articles remind one of the pressing need for a rational system of notation in two-phase flow.