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# BOOK REVIEW

**Handbook of Mathematical Fluid Dynamics, Volume 1.** Edited by S. FRIEDLANDER & D. SERRE. Elsevier. 2002, 816 pp. ISBN 0-444-50330-7. $160.00.

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This book is the first in a three-volume series which will give an overview of the mathematical aspects of fluid dynamics. The series is a collection of review articles written by experts in various subfields of fluid dynamics; these reviews range from about 50 to more than 200 pages in length. With the exception of the last, the articles in the first volume deal with compressible fluids.

The first two articles are concerned with kinetic theory. The first one, written by C. Cercignani with the title 'The Boltzmann equation and fluid dynamics' provides an introduction to the subject, focusing on physical, modelling and numerical aspects. It begins with an introduction pointing out the variety of applications in which rarefied gas dynamics is important, ranging from space travel to micromechanics. The rest of the article describes the molecular origin of the Boltzmann equation and its basic properties and discusses issues such as simplified model equations (the BGK model), boundary conditions, asymptotic and linearized situations including the continuum limit, applications to mixtures and polyatomic gases, effects of chemistry and radiation, and Monte Carlo simulations.

C. Villani's article, titled 'A review of mathematical topics in collisional kinetic theory', focuses on the mathematical analysis of Boltzmann's equation; it is the longest article in this volume. It is divided into five main sections. The first introductory section discusses the modelling leading to the Boltzmann equation and gives an overview of the mathematical questions which arise. The subsequent sections are concerned with the Cauchy problem, the approach to equilibrium, and the special case of Maxwellian collision kernels. The final section discusses open problems and new questions arising in granular media and quantum kinetic theory.

The next article, by E. Feireisl, is titled 'Viscous and/or heat conducting compressible fluids'. The question addressed here is that of global existence of solutions to initial-value problems. The article places particular emphasis on barotropic flows (this means the pressure depends only on the density) for which some global existence results for large data were recently obtained.

The article by H. Fan & M. Slemrod, titled 'Dynamic flows with liquid/vapor phase transition' is concerned with gas dynamics assuming a non-monotone constitutive relation such as that of van der Waals. The article discusses specifically the Riemann problem for the isothermal case and admissibility conditions for shocks. Recent results on existence of solutions by the authors are presented.

G. Q. Chen & D. Wang's article discusses 'The Cauchy problem for the Euler equations for compressible fluids'. As is well known, the main difficulty is that solutions generally develop discontinuities (shocks) in finite time; in addition, vacuum states may appear. The main part of the article discusses various approaches to obtaining global discontinuous solutions in the one-dimensional case. Two concluding sections discuss progress in the multi-dimensional case and Euler equations with source terms resulting from relaxation or chemical reactions.

The article 'Stability of strong discontinuities in fluids and MHD' by A. Blokhin & Y. Trakhinin is concerned with the linearized stability of solutions involving step discontinuities in hyperbolic conservation laws. The equations governing linear stability are derived and stability is related to a Lopatinski condition. The results are applied to gas dynamics, relativistic gas dynamics and MHD.

The final article 'On the motion of a rigid body in a viscous liquid' by G. P. Galdi is concerned with two topics: sedimentation and self-propulsion. The free fall of a rigid body is analysed in Newtonian and second-order fluids. Self-propelled motion is studied under the assumption that the shape of the body does not change, i.e. the body either inhales and expels liquid or its boundary moves tangentially to itself.

The book is addressed to research mathematicians with an interest in fluid mechanics. It is a valuable reference as well as a useful introduction to the field. The articles are carefully prepared, well written and accompanied by extensive lists of references. Volume 2 of the series has been recently published.

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