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book reviews

Theory and Application of the Boltzmann Equation. By C. Cercignani. Elsevier, 52 Vanderbilt Avenue, New York 10017. Publication Date, March, 1976. Cost $35.

REVIEWED BY A. S. BERMAN[1]

The book provides an excellent compendium of modern approaches to the Boltzmann equation and to techniques for obtaining exact solutions to approximate forms of the equation, or approximate solutions to the complete equation.

Primary emphasis in the book is on the application of classical kinetic theory to the flow of monatomic neutral gases. The problems considered span the range of Knudsen numbers from continuum flow to free molecule flow. The solution techniques discussed include analytical solutions to model equations, moment methods, perturbation methods, variational methods, discrete velocity methods, and Monte Carlo methods. Of necessity, most of the discussion pertains to problems capable of being represented by a linearized version of the Boltzmann equation or model equation.

Of particular interest is a complete chapter devoted to gas surface interactions and the implications of such interactions relative to boundary conditions for the Boltzmann equation.

The book ends with a presentation of existence and uniqueness results for the Boltzmann equation.

The bibliography is extensive and references pertinent material through 1974.

The book should be of interest to all involved in solution of flow problems requiring the use of kinetic theory methods.

Continuum Mechanics of Viscoelastic Liquids. By R. R. Huilgol. Halsted Press, a division of John Wiley & Sons, Inc., 605 3rd Ave., N. Y. 10016. Publication Date 11/18.75. Cost $27.

REVIEWED BY D. D. JOSEPH[2]

Dr. Huilgol's book is about the flow of viscoelastic fluids which have come to be known as simple fluids. These fluids depend nonlinearly on the first spatial gradients of the deformation. The approximately 350 pages of the book are divided into 11 chapters. The first six chapters are about the general theory of the simple fluid as this theory has come to be defined by the celebrated *Handbuch der Physik* article of Truesdell and Noll. The topics treated in the first six chapters are: (1) kinematics of fluid flow, (2) kinematics of motions with constant stretch history, (3) objectivity and changes of local configuration, (4) balance equations, (5) formulation of constitutive equations—simple fluids, and (6) isotropy and the equations of motion. Though many of the matters treated in these six chapters have appeared in the treatise of Truesdell and Noll or in the recently published book on non-Newtonian fluid mechanics by Astarita and Marrucci, new materials previously unavailable between hard covers are included. Among these are Yin and Pipkin's approach to viscometric flow as well as a discussion and comparison of the different approaches to the subject taken by Truesdell and Noll, Rivlin, Oldroyd and Lodge. Huilgol's attempt to clarify the nature of the differences in these approaches is to be applauded. There is a lot of controversy in this subject and Murphy's law "there are two sides in every controversy except when a man is personally involved," here finds a subject where nearly everyone is personally involved.

The first six chapters of Huilgol's book are perhaps not as valuable as the rest of the book since so much of the material is well known and carefully written in other works. The last five chapters of the book are (7) dynamics of motions with constant stretch history, (8) other constitutive equations and responses in some flows, (9) perturbation about an arbitrary ground state: nearly viscometric flow, (10) perturbations of simple constitutive equations, and (11) experimental measurements—theoretical basis. These five chapters contain nearly all of the materials which relate directly to the solution of problems and to the observed mechanics of the flow of simple fluids. Here Dr. Huilgol has performed a valuable service in bringing together an extensive and hitherto scattered research literature.

Statistical Fluid Mechanics, Vol. II. By A. S. Monin and A. M. Yaglom. The M.I.T. Press, Cambridge, Mass. 1975. Cost $50.

REVIEWED BY T. S. LUNDGREN[3]

This book is translated and revised from the 1965 Russian edition; technical editor J. L. Lumley. Volume 2 like Volume 1 gives an extremely clear and thorough treatment of turbulent flow. Discussion of both experiments and theory is especially complete and up to date. The following topics are covered, among others: spectral functions, homogeneous fields, isotropic random fields, locally homogeneous, and locally isotropic random fields, isotropic turbulence self-preservation hypotheses, spectral energy transfer, the Millionshchikov hypothesis, acceleration fields, equations for higher moments and the closure problem, turbulence in a compressible fluid, general concepts of the local structure of turbulence at high Reynolds numbers, the theory of fully developed turbulence, the propagation of electromagnetic and acoustic waves through a turbulent medium, and the twinkling of stars, the functional formulation of turbulence.

Nonlinear Theory of Elastic Stability. By K. Huseyin. Noordhoff International Publishing. 1975. Pages xi-220. Cost $20.36.

REVIEWED BY K. W. NEALE[4]

This book is one of a series of monographs on "Mechanics of Elastic Stability" (editor: H. Leipholz). It specifically considers nonlinear, discrete, conservative systems; and its stated aim is to provide the reader with insight into the various instability phenomena associated with such systems by presenting a general theory in a systematic manner. The author clearly achieves this objective: the theory is rigorous and the material is carefully exposed. The physical aspects of structural instability are also lucidly presented.

The book is divided into two parts. Part 1 treats one-parameter

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[4] Associate Professor and Chairman, Department of Civil Engineering, Université de Sherbrooke, Sherbrooke, Québec, Canada.

Considerable attention has been given to Kolmogorov's theory of the local structure of developed turbulence and to the theory of turbulence in stratified media. vol. I. Laminar and turbulent flows -- Mathematical description of turbulence. Mean values and correlation functions -- Reynolds equations and the semiempirical theories of turbulence -- Turbulence in a thermally stratified medium -- Particle dispersion in a turbulent flow.