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REVIEW

Hydrodynamique Physique. By E. GUYON, J.-P. HULIN and L. PETIT. Inter-editions/Editions du CNRS, 1991. 506 pp.

Fluides en Écoulement. By J. PADET. Masson, 1991, 359 pp. 180 F.

Mécanique des Fluides Fondamentale. By R. K. ZEYTOUNIAN. Springer, 1991. 615 pp. DM96.

The fact that three books of very different character but all concerned with basic aspects of fluid mechanics should appear in France within the course of a single year is a measure of the vitality of the subject in that country at the present time. Much of this vitality is associated with the remarkable migration of physicists led by Pierre-Gilles de Gennes into fluid mechanics during the last 20 years. *Hydrodynamique Physique* by Guyon *et al.* contains a preface by de Gennes which signals the revolutionary (for France!) emphasis on the underlying physics of the subject and the attempt of this book to impart a physical understanding of the behaviour of real fluids, rather than to follow the hallowed path of formalism which has so constrained earlier generations of French fluid dynamicists. The authors pay tribute in their Introduction to the influence of the 'G. I. Taylor tradition' in Britain, and to the American school of chemical engineering which has kindled interest in so many fundamental problems in 'physical and chemical hydrodynamics'; and these influences are indeed evident in the choice and ordering of subject matter.

The book contains 10 chapters progressing from the microscopic physics of fluids, through the theory of deformation and stress, and conservation laws treated first globally, then in local form. The book then progresses through flow at low Reynolds number with application to the theory of suspensions and flow through porous media, then through boundary layer theory, and finally to a discussion of various hydrodynamic instabilities that appear at high Reynolds number. Each chapter is copiously illustrated, and the book contains reproductions of many photographs of flow phenomena, including some from the fine collection of the Palais de la Découverte. The photographs are well selected and provide a continual reminder of the authors' preoccupation to treat fluid flow as actually observed rather than as an elegant mathematical abstraction. In this respect, the book makes an outstanding and original contribution to the French literature of fluid dynamics.

Fluides en Écoulement, Méthodes et Modèles, by J. Padet is a pedagogical treatment of the basics of laminar and turbulent flow, aimed at engineering students at the level of the French '2^{me} et 3^{me} cycles'. The author seeks to bridge the gap between the traditional formal presentation of fundamentals and the fluid mechanics of real engineering systems. Turbulence is of course unavoidable in such an endeavour, but Padet restricts his treatment to what he describes as 'pseudo-laminar' (i.e. eddy viscosity) models and local models typified by the k–ϵ model. The discussion of the micro-structure of turbulence is superficial and there is little attempt to address the fundamental problems involving the structure of turbulence, the cascade of energy, and the manner in which this cascade may be affected (e.g. by rapid distortion). The author aims to prepare students for subsequent studies in thermo-convection, and chapter 2 on 'Similitude criteria' provides a catalogue of dimensionless numbers (Reynolds, Prandtl, Péclet, Rayleigh, Nusselt, Lewis, Stanton, etc.) arising from a consideration of conservation and diffusion processes. The Boussinesq approximation

is conspicuous by its absence in this discussion. The book generally has a distinctly dated character in terms of content, although redeemed by a more lively style than that characterizing many earlier treatments.

Zeytounian's *Mécanique des Fluides Fondamentale* provides an exhaustive discussion of questions relating to the 'well-posedness' of problems arising from the Navier–Stokes equations and the Euler equations for compressible and incompressible flow. The reader is advised in the Foreword to come with 'a good knowledge of continuous media' and 'a sufficient training in modern functional analysis', requirements that may deter many students. They will be further deterred by the poor quality of the printing – 600 pages of fairly dense mathematics, many pages being nothing but equations, typed and corrected by hand, camera-ready, and printed by Springer-Verlag on see-through paper. This author deserves better treatment by his publisher! I notice that Springer's guidelines for the production process say that 'As a special service, we offer free of charge LaTeX and TeX macro packages to format the text according to Springer-Verlag's quality requirements. We strongly recommend authors to make use of this offer, as the result will be a book of considerably improved technical quality... Manuscripts not meeting the technical standard of the series will have to be returned for improvement'. Zeytounian did not take advantage of the offer; and Springer's acceptance of the manuscript sets a deplorably low technical standard for their new series! They do however encase it in a handsome hard cover; it will look good on bookshelves, and after all it need not be often consulted.

The major preoccupation of this book with questions of existence, uniqueness and insensitivity to initial conditions severely limits its scope despite its considerable length. Much of the fascination of fluid mechanics lies in those peculiar circumstances where solutions of a specified form (e.g. steady or time periodic) *do not exist*, or where they *are not unique*, or where they *do depend sensitively on initial conditions*. A voluntary restriction to problems that are well posed in the sense of Hadamard is perhaps mathematically convenient, but seems out of touch with the reality of real fluid behaviour. This is dry hydrodynamics in more senses than one; yet, as a compendium of results on existence, etc., the book may serve a useful referential purpose.

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