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REVIEWS

The Theory of Rotating Fluids. By H. P. Greenspan. Cambridge University Press, 1968. 327 pp. £5.50.

I undertook this review with some hesitation. First of all, this is a belated review, the book under consideration having been published in 1968. This is a considerable time-lag for any monograph in an active research field. Furthermore, the fact that I had the opportunity to watch at close range the actual writing of this book does not make me an ideal reviewer. In particular, having known the author's intentions and goals, I may perhaps have a tendency to read more in the text than is actually there. To that extent, it is a biased review.

The author's aims, which are stated in the preface, are "to provide a basic foundation for the support and promotion of research in rotating fluids". To that effect, he has focused his attention upon "the motion of a contained, incompressible, viscous fluid" and on phenomena which "occur *only* in a *rotating* medium". Indeed, the modifications brought about by rotation on water waves, convection, MHD flows, etc. are not to be found in this book.

The material is presented in a highly organized manner. Most of the major themes are introduced in chapter 1, §1; the rest of this chapter is devoted to a careful derivation of the basic equations and a discussion of various approximations. Chapter 2, the longest in the book, deals with both steady and transient linearized flows in closed containers. The general initial-value problem serves as a framework for the discussion of Ekman and Stewartson layers, geostrophic flow, spin-up, Rossby and inertial modes. Chapter 3 is devoted to nonlinear flows. Chapter 4 is concerned with flows in unbounded regions and contains an excellent discussion of inertial waves. Chapter 5 is a collection of models of oceanic circulation; this reveals that geophysical rather than astrophysical problems or mechanical engineering applications are of primary interest to the author. Finally, chapter 6 contains a discussion of instabilities in rotating fluids with the greatest emphasis placed on Ekman-layer instability.

From this outline, it is apparent that the presentation is more mathematical than phenomenological. This is necessary in view of the stated aims and is in keeping with the fact that the author was brought up on Cauchy and boundary-value problems. But, and this is the unique feature of the book, the mathematical sophistication of the treatment does not prevent the author from dealing with real fluid flows. Indeed, experiments both as illustration of and as motivation for analytical work are emphasized throughout. Several remarkable pictures, some due to the author, illustrate vividly the problems under consideration. The Taylor column in figure 1.2*a*, the inertial waves in figure 1.3, the spin-up from rest in figure 1.4, the geostrophic contours in figure 2.6 and the Rossby wave in figure 2.16 are outstanding such examples.

The stamp of the author is everywhere. Most of the topics in the book are presented in a novel way, which often differs from the presentation of the original papers. In fact, even the terminology is sometimes changed around by 180° – to the chagrin of the original authors.

The book could be used as a text for an advanced graduate course on the subject. However, it is primarily an excellent reference which makes readily accessible numerous results previously scattered in research papers. The book is in fact already widely referred to and the author has received the unwitting compliment of seeing some of his notations adopted. (This adoption would have been even more extensive were it not for the exotic symbols that are often used.)

Of course, one can always find faults. For instance, the oceanographers and meteorologists may not be entirely pleased with chapter 5 and some purists have objected to the dogmatic treatment of Stewartson layers. However, all the criticisms do not outweigh the order which the book has introduced in the field. All in all, this is an excellent book.

V. Barcilon

Thin Liquid Films and Boundary layers. Published for the Faraday Society by Academic Press, 1971. 269 pp. £5.50 or $16.00.

In 1969 the Council of the Faraday Society set up an Industrial Sub-Committee, its principal purpose being to organize physical-chemistry Discussions which should be both of merit and timeliness and also of industrial significance. The first Discussion on these lines on "Thin liquid films and boundary layers" was held in Cambridge during three days in September 1970 and the present volume is a record of the papers delivered and the ensuing discussions. The organizer Dr B. A. Pethica contributes an introduction which provides a masterly survey of the main papers.

When liquids come into contact with solid surfaces they are subjected to influences which are different from those operating in the bulk of the liquids themselves. First, there is the attraction between the solid wall and the liquid; this is usually due to van der Waals' forces. Second, there is adsorption of liquid molecules which may induce structure in the neighbouring liquid. Third, if the liquid contains free ions there may be preferential adsorption of ions and the formation of an electrically charged double layer. All these factors may clearly influence the rheological properties of the liquid. However, they are also bread-and-butter issues to those physical chemists involved in surface problems and especially colloid chemistry. In this assembly of papers it is indeed clear that most of the participants are old hands in this field with a long history of expertise and specialization in surface chemistry.

As its title implies, the Discussion is concerned primarily with the properties of thin liquid films, especially as influenced by the presence of a solid surface. Fluid-mechanicians will be interested in the way this is viewed by surface chemists. Professor Dukhin quotes Derjaguin's views and defines the boundary layer as that in which "anomaly of structure and the structural-sensitive properties of the liquid are observed" and adds "The fact that within a layer of some thickness the liquid loses fluidity and does not participate in hydrodynamic processes is only one of the many manifestations of this anomaly of liquid structure". A majority of the papers deal with the non-hydrodynamic "manifestations", especially those concerned with the rupture and stability of soap-films, froth flotation and colloidal stability. About a quarter of the papers deal specifically with the viscous properties of boundary films. Derjaguin *et al.* show by their "blow-off" technique that with certain silicone fluids there is a boundary layer 30 Å thick which has a viscosity 40 % less than the bulk. These experiments are carried out at very low shear stresses. Churayev *et al.* show that the viscosity of water in quartz capillaries a few hundred Å in diameter is 40 % greater than that of bulk water (shear rate *c.* 100 s^{-1}); the anomaly disappears above 60 °C. Smith & Cameron show by an ingenious technique that typical lubricating liquids can form surface films several thousand Å thick but only if chemical reaction, accompanied by soap formation, takes place. In the discussion they confess that these thick films are very fragile and are disrupted by very small shear stresses. Dyson describes typical "engineering" experiments between loaded rolling disks which suggest that down to a film thickness of a few 100 Å the films show no anomalous shear properties. His shear rates are of order 10^6–10^7 s^{-1}. Finally, Roberts & Tabor describe experiments between smooth rubber and glass surfaces where thin aqueous films forming electrically charged double layers can support normal pressures of the order of an atmosphere. Although these films may be structured, when sheared they show a viscosity scarcely greater than that of bulk water down to a thickness of about 100 Å (shear rate *c.* 10^4 s^{-1}).

These papers suggest that in fluid mechanics it is safe to assume that at shear rates greater than a few powers of 10 s^{-1} no anomalous viscosity need be assumed because of the presence of a solid boundary.

The papers are of a high quality: the discussions lively and penetrating. However, the industrial significance of the Discussion as a whole will almost certainly be restricted to areas populated by professional surface chemists. Engineers and hydrodynamicists will, on the whole, find the papers tough going for if one thing is clear it is surely that most scientists have not yet learnt the art of communicating with workers in other disciplines – as a participant I too must confess *mea culpa*.

D. Tabor

Shorter Notices

Fluid Mechanics for Engineers. Third Edition. S. I. Version. By P. S. Barna. Butterworths, 1971. 409 pp. £3.90.

This is a straightforward adaptation of the original text, which has already been reviewed in the *Journal of Fluid Mechanics* (1957, **6**, 313–6). All numerical examples, graphs and data have been converted directly into S.I. units.

Fluid Power for Technicians.. By D. G. Newton. Prentice-Hall, 1971. 173 pp. £5.50.

This small but extensive text is a simple and practical account of engineering fluid mechanics intended for technicians. It describes various theoretical or empirical relationships and their use in practice, and a number of fluid machines and working procedures. The illustrations are good. This is an unusual type of book which may meet a need.

Shock Tube Research. Edited by J. L. Stollery, A. G. Gaydon and P. R. Owen. Chapman & Hall, 1971. 928 pp. £10.00.

This volume records in full the papers presented at the eighth in the series of biennial symposia on shock tubes; this one being held in London during July 1971. Seven of the papers were invited addresses by leading workers in the field and 57 were contributed papers. As in the case of previous symposia, the breadth of the research associated with shock tubes is remarkable.

Fluid Mechanics for Civil Engineers. S. I. Edition. By N. B. Webber. Chapman & Hall, 1971. 340 pp. £2.50.

The first edition of this book was published in hard covers in 1965 and a paper-covered edition appeared in 1968. Both were reviewed in the *Journal of Fluid Mechanics* (1965, **23**, 826–7; 1970, **43**, 842). The present edition adopts S. I. units and according to the preface has been updated and revised where considered necessary or desirable.

Research in the Antarctic. Edited by L. O. Quam. American Association for the Advancement of Science, 1971. 768 pp. $24.95 or $19.95 (A.A.A.S. members).

This book represents a partial record of the Antarctic Research Symposium held at Dallas, Texas, in December 1968. It aims to provide a single-volume report of the scientific research conducted in the Antarctic since the IGY. The headings of the seven parts to the work are: Introduction to Research in the Antarctic; Biology; Glaciology; Cold Poles and Heat Balances; Conjugate Phenomena; Ocean Dynamics; and Gondwanaland. Of these, the penultimate part will probably be of most interest to readers of this journal. Fifty-three pages long, this part consists of a short introduction and four papers which, although greatly varying in quality, make quite interesting reading.