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REVIEWS

Solving Problems in Fluid Mechanics. By J. F. DOUGLAS. Longman, 1986. Vol. I, 263 pp; vol. II, 264 pp. £7.95 per vol. (paperback).
Exercises et Problemes de Mecaniques des Milieux Continus. By J. OBALA (2nd edn). Masson, 1988. 227 pp. FF 124.00 (paperback).

The two volumes by Douglas are textbooks on fluid mechanics for engineering students in Universities, Polytechnics and Colleges of Higher Education in the UK, although they would be suitable for comparable institutions in North America. They are updated editions of volumes first published in 1970 by Pitman. The material is presented entirely in question and answer form, an old-fashioned catechism in fact, on the grounds that many students fail to learn properly from conventional textbooks because they do not work through all the steps in detail. In addition to the basic material there are numerous exercise questions, posed similarly to those in the text, so that the student can copy the method of solution directly. Although the derivation of formulae is sometimes asked for, every problem requires a practical, numerical solution too.

The level of volume I is extremely elementary, covering hydrostatics and one-dimensional hydrodynamics and hydraulics, i.e. steady flow in pipes and channels, including flow measurement devices, with brief and passing mention of unsteady effects, boundary layers, lubrication and the Reynolds number. Most chapters are based on the integral equations of conservation of mass, momentum and energy (Bernoulli's equation, used several pages before it is derived!), with empirical constants introduced to cope with frictional head losses etc. Volume II is more advanced, dealing well with dimensional analysis and dynamical similarity, but less well with non-one-dimensional flow (vortices, sinks, etc.). There is also material on compressible fluids (gas flow in nozzles; water-hammer), flow in non-uniform channels, flow past bodies, and a variety of types of pump.

The author is concerned to impart facts first and understanding later, if at all, so it is difficult for students to assess the validity of the necessary assumptions, which are often here presented as axioms. There are numerous examples where the material is misleading, and sometimes it is totally wrong. Lubricated bearings are discussed, but only from the point of view of frictional resistance not the generation of high pressures and hence thrust. A 'free vortex' is defined as a flow with circular streamlines in which there is no variation of total energy with radius, but no indication is given of when, where or why such a flow might arise. The drag on a bluff body is correctly calculated in terms of the velocity profile in the wake, but is applied using an antisymmetric wake profile. The flow and pressure fields round a cylinder at zero Reynolds number are stated to agree closely with those predicted theoretically for a zero-viscosity fluid, which questioning students must find extremely confusing. Poiseuille flow does not come until half-way through volume II, presumably because volume I students are not supposed to be able to cope with second derivatives. The mathematical requirements are not demanding: partial derivatives creep in to the discussion of stream functions for two-dimensional flows, but they are banished again in the discussion of water-hammer (e.g. '$\mathrm{d}h/\mathrm{d}t = -(a^2/g)(\mathrm{d}v/\mathrm{d}x)$', where h and v are both functions of x and t). Moreover, the notation can be surprising. In volume I, density is treated sometimes as specific weight, w, and sometimes as mass density,

ρ (the latter prevails in volume II). The phrase 'viscous flow' is used for 'laminar flow', while the viscous sublayer of a turbulent flow is called the laminar sublayer. The phrase 'shock loss' is used for pipe flow losses at sudden expansions, etc., but shock waves are not discussed. Nor are water waves, although there is a (correct) treatment of supercritical channel flow, hydraulic jumps, etc. The indexer (though not the author) has put an apostrophe in the name of Reynolds.

However, while the books leave a lot to be desired from the point of view of an expert in fluid mechanics, the approach to teaching the subject to students who are relatively ill-prepared, and probably not able to think very deeply about what they learn, is to be commended. Provided they receive lectures from someone who can point out the inadequacies, they should find this treatment helpful.

The French book is designed as a companion to *Introduction à la Mécanique des Milieux Continus* by Paul Germain and Patrick Muller, and is aimed at a much more advanced audience: students of the Maîtrise de Mécanique or the Maîtrise de Mathématiques et Applications Fondamentales. Familiarity with vector and (Cartesian) tensor calculus, complex variable theory, and the solution of certain partial differential equations is assumed, as are the basic equations of fluid and solid mechanics. However, the aim is essentially the same as in Douglas's books: to present the student with large numbers of examples, short ones presumably based directly on the text (exercises) and long ones which are more in the nature of applications (problèmes). In both cases full solutions are given. There are seven chapters, with the following titles: 1, Kinematics of continuous media. Deformations; 2, Stresses in a continuous medium; 3, General problems in elasticity. Energy theorems; 4, Curvilinear elastic media (wires, rods, beams); 5, Flows of ideal fluids, compressible or incompressible; 6, Two-dimensional, steady, irrotational flows of incompressible ideal fluids; 7, Flows of incompressible viscous fluids. I shall not discuss chapters 3 and 4.

Many of the flows under consideration are kinematically very complex but most are dynamically rather elementary (the only viscous flow in which convective inertia is important is the suction boundary layer on a porous flat plate, the penultimate problem in the whole book). The treatment is much more mathematical than physical, and several of the problems are highly artificial. Nevertheless a number of old favourites make their appearance (e.g. the spherical bubble, unsteady flow in a narrow tube under gravity, a jet impinging on an oblique wall, one- and two-dimensional shock waves, sound waves in a non-uniform tube, the Joukowsky aerofoil, Rayleigh and Stokes layers), and some of the less familiar ones might make good examination questions. The level is roughly comparable with that of a first fluid mechanics course in a British applied mathematics department, although as implied above the mathematical complexity of many of the problems would not be popular there.

We all know that students cannot really learn a subject without working through large numbers of problems. A lecturer will always provide sheets of them, gleaned from a variety of sources, and these can be supplemented by reference to previous years' examination questions. Books of examples are therefore not necessary, but they can be a useful source of ideas. Whether they are of direct value to the students themselves will depend on how well they are matched to the course they are taking.

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SHORTER NOTICES

Chambers Science and Technology Dictionary. Edited by P. M. B. WALKER. Chambers and Cambridge University Press, 1988. 1088 pp. £30 (hardback), £16.95 (or $39.50) (paperback).

New terms are being introduced rapidly in science and technology and old terms are being used in new ways. *Chamber's Technical Dictionary* has been enlarged and revised several times since it was first published in 1940, and in this new edition has acquired a new name. The General Editor points out that it is intended to use in a non-specialist way and that it gives equal weight to science and to the technologies. The *Dictionary* would not be the place in which to look for understanding, but a journal reader who encounters a strange technical term may find it explained here. The entries in the *Dictionary* were compiled by 42 contributors and each of them looked after one or more of the subject categories listed in the preface. Fluid mechanics is represented in these subject categories only by its applications, and so an entry for a basic fluid mechanical term (e.g. anemometer, boundary layer, vorticity, flux) may have been written by an aeronautical or chemical or hydraulic engineer or a meteorologist or a physicist; and sometimes there are two or more entries for the same term written by different specialists, with differences which reflect these different origins. It would have been useful for someone familiar with the principles of fluid mechanics to have checked entries which give too special an interpretation of a term (like that for 'free-falling velocity', which is said to be the steady velocity of the fall of a particle of powder through fluid) or which fail to point out a general significance (like that for 'Reynolds number') or which are confused (like that for 'static pressure'). But dictionaries are not much used for scientific purposes, and this one will be of value, like its predecessors, mainly as a source of information about technical terms which can be defined unambiguously in a few lines.

Les Méthodes de l'Homogénéisation: Théorie et Applications en Physique. Eyrolles, 1985. 400 pp. FF 190.00.

This is a collective work, recording the texts of courses of lectures given at a summer school on 'Homogénéisation' in France in 1983. The authors and their titles are as follows:

D. Bergman, Bulk physical properties of composite media.

J. L. Lions, Remarques sur les problèmes d'homogénéisation dans le milieux à structure périodique et sur quelques problèmes raides.

G. Papanicolaou, Macroscopic properties of composites, bubbly fluids, suspensions and related problems.

F. Murat & L. Tartar, Calcul des variations et homogénéisation.

E. Sanchez-Palencia, Un problème d'écoulement lent d'un fluide incompressible au travers d'une paroi finement perforée.

All the authors are concerned with the determination of the bulk properties (thermal, electromagnetic, elastic or hydrodynamic) of a medium with small-scale inhomogeneities which may be spatially periodic or random. The approach is very mathematical in every case. The five articles appear not to be coordinated, and there are both some repetition of material and some notable gaps in the coverage. In particular there is no discussion of the important problem – which is peculiar to the case of hydrodynamic bulk properties – of the effect of bulk motion of the composite medium on the microstructure.

Encyclopedia of Fluid Mechanics, vols. 1–6. Edited by N. P. CHEREMISINOFF. Gulf Publishing Co., 1986. $165 or £140 per volume.

This mammoth work is an ambitious attempt to provide an up-to-date survey of the whole field of applied fluid mechanics. The contributors are mostly chemical, mechanical or hydraulic engineers, and the emphasis in the selection of topics is on fluid mechanical processes in chemical engineering. Multiphase flow systems in particular are well represented. Each volume is divided into several sections, and within each section there are numerous articles on different topics, some fundamental but mostly practical and application-oriented in character. The articles vary widely in subject matter, length, style, clarity and degree of authority, as one would expect, but the overall impression is that the volumes are purposeful and workmanlike and essentially practical (well, mostly – the article in volume 6 on hydromagnetic free-convective flow through porous media looks more like a contribution to the author's publication list than to anything practical). The print is perhaps a trifle small for eye-comfort, but has the advantage that the volumes are manageable in size despite the enormous contents of each of them. There is a consolidated subject index at the end of each volume. Two further volumes are announced: volume 7 on 'Rheology and non-Newtonian fluids', and volume 8 on 'Theory and application of compressible flows'.

The titles of the volumes and of the sections within a volume are as follows:

Vol. 1: *Flow Phenomena and Measurement*, 1522 pp.
- I. Transport properties and flow instability (9 articles).
- II. Flow dynamics and frictional behaviour (26 articles).
- III. Flow and turbulence measurement (6 articles).

Vol. 2: *Dynamics of Single-Fluid Flows and Mixing*. 1506 pp.
- I. Channel and free surface flows (11 articles).
- II. Mixing phenomena and practices (22 articles).
- III. Fluid transport equipment (14 articles).

Vol. 3: *Gas–Liquid Flows*. 1536 pp.
- I. Properties of dispersed and atomized flows (15 articles).
- II. Flow regimes, hold-up, and pressure drop (16 articles).
- III. Reactors and industrial applications (18 articles).

Vol. 4: *Solid and Gas–Solids Flows*. 1418 pp.
- I. Properties of particulates and powders (7 articles).
- II. Particle–gas flows (13 articles).
- III. Fluidization and industrial applications (19 articles).
- IV. Particulate capture and classifications (5 articles).

Vol. 5: *Slurry Flow Technology*. 1488 pp.
- I. Slurry and suspension flow properties (10 articles).
- II. Unit operations of slurry flows (23 articles).

Vol. 6: *Complex Flow Phenomena and Modeling*. 1503 pp.
- I. Special topics in complex and multiphase flows (16 articles).
- II. Transport phenomena in the environment (11 articles).
- III. Flow simulation and modeling (9 articles).

The volume and section titles do not give a very clear indication of their contents (for instance, one would not know that liquid-fluidized beds are discussed in vol. 6, section I), and the group of articles within a section are not always coherent. Finding one's way around in this great work may be a problem. Anyone contemplating purchase is recommended to write to the publisher asking for a brochure giving the full list of titles and authors of articles in all six volumes (Gulf Publishing Co., P.O. Box 2608, Houston, Texas 77001, or, in Europe, Kogan Page Ltd., 120 Pentonville Road, London N 1).

Multiphase Science and Technology, vol. 3. Edited by G. F. Hewitt, J. M. Delhaye & N. Zuber. Hemisphere, 1987. 501 pp. DM 158.00.

Publishers like to dress up their books, and this one is described on the jacket as 'a wonderfully practical aid for students, researchers, physicists ...' and professionals in a whole host of technologies. More annoying than this kind of flatulence is that one has to dig inside the book to discover that there is no separate title of this particular volume in a general series and that the volume contains the papers presented at an international workshop on 'two-phase flow fundamentals' held in the USA in September 1985 under the chairmanship of J. Kestin. (And even that is insufficiently specific, since the participants were connected with the power-generation industry, in which 'two-phase' appears to mean a gas–liquid mixture.) It is a strange book, which is intended to prepare the ground for a second workshop to be held in 1987. Part I consists of four shortish authoritative articles, by Bouré, Ishii, Wallis, and Yadigaroglu & Bensalem, describing different aspects of theoretical models of gas–liquid flow systems, mostly concerned with estimates of the mean transfer of mass, momentum and energy across the interface between the two phases. Part II, forming over half the book, consists of 18 'data sets' for particular flow systems against which theoretical models can be tested, and Part III lists 14 benchmark theoretical problems on which numerical methods may be tested. The results of testing the various theoretical models and the numerical methods of using them will presumably appear in the proceedings of the 1987 workshop.

Tribology in Particulate Technology. Edited by B. J. Briscoe & M. J. Adams. Adam Hilger, 1987. 472 pp. £55.00.

Tribology is about solids in contact and in relative motion, and the genesis of this attractively produced book was the idea that tribologists and those concerned with the bulk handling of particulate materials may be able to contribute to each other's problems. Four one-day meetings were held in the UK during 1985 and 1986 on different topics of interest to the two groups under the general heading of 'tribology in powder processing and conveying', and the book records the papers presented, but prepared for publication subsequently, at these meetings. The four parts of the book, corresponding to the four meetings, have the titles:

Friction in powder flows (6 papers).
Adhesive forces in powder flow (6 papers).
Powder compaction and interface shear (7 papers).
Attrition and wear (9 papers).

The two groups found that they did indeed have common interests, and that ideas developed in tribology to account for observations of friction, adhesion, wear and damage processes can usefully be applied in particle technology. The book suggests that both groups were stimulated, and that future progress requires more information about conditions at the point of contact between two particles.