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REVIEWS

Mécanique des fluides. By E. A. BRUN, A. MARTINOT-LAGARDE and J. MATHIEU. Dunod, 1968. Vol. I, 519 pp., 86.40F; Vol. II, 367 pp., 63.75F.

This multi-volume textbook is a second edition, the first edition having been published in 1960. It is entirely revised, and extended in some parts. According to the preface, the book is intended for students of the 'Facultés des Sciences' following a third course in fluid mechanics, and also for those academically trained engineers who want to refresh their knowledge of the basic principles of fluid flow. Finally it may be also useful as a reference book.

The authors stress the instructional character of the book, and this is reflected in their way of presenting the subject matter. In this respect the authors believe in the idea of going from the elementary and particular to the general. Integral relations precede differential relations. The reader will, for instance, miss the complete equations of Navier–Stokes, even for a fluid with constant properties, at least in the first two volumes. Of course this is a matter of taste. It may certainly have its advantage from an instructional point of view in a book of an introductory nature for students who are confronted for the first time with the subject. However, the reviewer doubts whether this attitude is still to be preferred in a more extended, third, course in fluid mechanics. For the basic disadvantage is clear. By a special elementary treatment the student will not gain insight into whether the results obtained have a more general application, or whether they are restricted only to the special elementary case considered. Also assumptions which are often unnecessary are introduced to keep the treatment simple.

The first volume contains three parts. Part I (200 pages) gives a recapitulation of the relevant mathematics, mechanics, physics and thermodynamics. In part II (80 pages) hydrostatics is considered, and in part III (200 pages) one-dimensional flow without and with friction, heat transfer and compressibility.

The second volume has two parts. The first part (200 pages) considers incompressible flow, the second part (160 pages) incompressible potential flows.

The announced third volume has again three parts, dealing respectively with: transient, unsteady flows and acoustics; boundary layers, friction and natural convection; supersonic flows. A fourth volume is envisaged, containing short monographs on special subjects such as rheology, turbulence, measuring methods, flow of rarified gases, aero thermo-chemistry, etc.

The present review refers to the first two volumes, the third volume not being available yet. In discussing in detail the contents of the two volumes under review, the reviewer wishes to point out that he is not familiar with the education in France at high-school and college levels, so that some of his criticism given in the following has to be seen with this reservation.

The recapitulation of mathematics given in the first part of volume I deals mainly with vector analysis, Cartesian tensor, Green's and Stokes's theorems, single and multi-connected regions, and co-ordinate transformations. The parts

recapitulating basic notions on mechanics and physics discuss the idea of continuity, definition of fluids, forces and stresses, linear and angular momentum integral relations, internal and external work, kinetic theory of gases. Some of these treatments are kept very elementary indeed, as, for example, Newton's concept of viscosity. The propagation velocity of small pressure disturbances or the velocity of sound is treated almost at high-school level. In the definition of stresses the inclusion of the sign of the stress is missing.

The recapitulation of thermodynamics covers the gas laws, first and second law of thermodynamics, entropy and irreversibility. Here the reviewer has noted that the isentropic gas law is referred to as Laplace's relation, instead of Poisson's relation. Also the authors prefer the name of Vaschy to be connected to a theorem given in the chapter on dimensional analysis, and which theorem usually is referred to as Buckingham's Π-theorem. A welcome chapter is the one discussing, and in a very satisfactory way, the use of optical methods, their principles, pros and cons.

In the part on hydrostatics, much attention is correctly paid to the basic law that pressure as a normal stress is independent of the orientation of the surface element. Here again, because of the desire to keep the treatment elementary, the one given is not watertight. This part contains the usual subjects, including the equilibrium of floating bodies, and for compressible fluids the application to the atmosphere and to airships. The introduction of the notion of surface tension is done again at high-school level.

In the chapters on one-dimensional flows, the latter have to be interpreted as *almost* one dimensional. Though, after considering the momentum-balance equation for a flow tube, an extension is given to the three-dimensional Eulerian equations. Bernoulli's equation is considered for a flow tube, and extended to include frictional effects (a disputable point). Due to the set-up of the book, no general treatment is given of Bernoulli's equation from the equations of motion through the condition of irrotational flow. In the case of compressible flows the one-dimensional momentum balance equation is given and later the energy equation, assuming frictionless flow. In the application to the Laval tube, the one-dimensional, momentum-balance equation is used, which is properly speaking no longer permissible considering the geometry of such a tube. The energy-balance equation would have been a better starting point. This chapter further considers supersonic flows and normal shockwaves.

The compressible flow with friction and heat-effects is then considered. When the effect of choking is discussed the equation for a perfect gas is used, which is an unnecessary restriction.

The first volume closes with a chapter on incompressible flows of fluids with free surface, surface waves and the hydraulic jump.

The first part of the second volume, on flows through conduits and in confined spaces with inclusion of the effect of viscosity, begins with a chapter on laminar flows. A point which does not appeal to the reviewer is that, obviously following a treatment customary for practical reasons in hydraulics, energy losses per unit of weight of the fluid are introduced in addition to pressure losses. So gravitational acceleration g is introduced also in those cases where gravity plays no

role at all, as, for example, in the flow through a horizontal tube. The discussion of the circular Couette flow is extended to the application to rotary viscometers, and followed by a section on non-Newtonian behaviour of fluids.

Then follows a chapter on the turbulent flows through a circular tube, including the discussion of basic concepts in turbulence and the nature of flow in the vicinity of a wall, leading to the concept of the law of the wall. The logarithmic distribution for the mean velocity in this region is given without proof. The usual correlations for the flow resistance in a straight tube are given, followed by a chapter on energy losses in discontinuities as expansions (Borda–Carnot) and sudden contractions, and in bends.

The first part of this volume contains still another three chapters, dealing respectively with the applications of jets to propulsion, rockets, ejectors, etc.; with the flow in turbomachinery, restricted to the one-dimensional Euler treatment; and with the application of one-dimensional viscous flow to the fluid dynamics of lubrication.

The second part of volume II starts with two chapters on irrotational potential flows, where only the basic equations are given. The third chapter discusses the dynamics of non-viscous barotropic fluids, including the theorems of Thomson and Helmholtz on vortex flow. It should be noted that the inverse problem of calculating the velocity field from a given vortex field (Biot–Savart) is not considered. This chapter is written at a higher level than most of the other chapters, and rather surprisingly goes from the general to the particular.

In chapter 5 irrotational flow is again considered, but now showing the method of sources and sinks in a rather conventional way. The paradox of d'Alembert is mentioned without proof. Chapter 6 is a continuation where the use of complex variables in two-dimensional irrotational flows and conformal mappings are considered. The last chapter is on electrical analogies with the application to plane flow patterns.

So the two volumes considered here contain a lot of material, covering a wide field of fluid mechanics. Certainly owing also to the clear manner of presentation the book will be a valuable aid when used for studying fluid mechanics without an instructor. The appreciation by the student will largely depend on his attitude with respect to the way of treatment discussed above. A student who likes and prefers to have the material presented according to the authors' philosophy will enjoy using this book. But the reviewer also believes that a student at an already more advanced level of thinking may get bored when starting the study of the book, and disinterested in finishing it, which then would be a pity, since eventually the book contains a lot of valuable material as a textbook.

J. O. Hinze