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REVIEWS

Gundlagen der Gasdynamik. By K. Oswatitsch. Springer, 1976. 725 pp. DM 296.
Theoretische Gasdynamik. By J. Zierep. G. Braun, 1976. 506 pp. DM 42.

As in his previous book on gasdynamics (Springer, 1952) Professor Oswatitsch aims in this new book at a fairly comprehensive account of the foundations, elementary solutions of the gasdynamic equations, and typical physical features of compressible flows. In order to include recent developments in hypersonic flow, e.g. real-gas effects, relaxation and radiation, section I, on thermodynamics, has been extended compared with the earlier book. Section II, on steady one-dimensional flows, covers flows with shock waves, pipe flows with friction and with energy addition, the Laval nozzle, effects of condensation, and combustion and detonation. Section III covers unsteady one-dimensional flows, e.g. sound waves and shock waves, and reflexion of a shock wave at a wall and at the end of an open pipe. Also the unsteady flows in pipes with variable cross-section are considered, which leads to the treatment of two-dimensional, cylindrical and spherical waves. Interesting is the treatment of shock waves by the 'analytic' method of characteristics. This is derived from the general method of characteristics by assuming weak perturbations in pressure and density, so that some of the acoustic approximations can be retained, but allowance is made for the change in the slopes of the Mach lines over a large distance. So the change in a sine wave into an N-wave over a large distance can be followed through.

Section IV contains the equations of motion in the form of integrals and also as differential equations. Section V is devoted to the momentum equations and their application to Borda flow, flow through a cascade, flow through a nozzle giving thrust, rocket propulsion, and lift. In section VI two-dimensional and axisymmetric inviscid flows are considered, e.g. the hodograph and the Chapligin transformation. Section VII deals with the flow past a slender body (Prandtl–Glauert rule), and section VIII with the inviscid two-dimensional and axisymmetric flow past a given body shape. Numerical methods now in use with electronic computers are mentioned only briefly, since the author prefers perturbation theories, which are developed as far as second-order accuracy.

Section IX, which is the longest of the book, covers the classical supersonic flow problems in two dimensions and in axisymmetric flow, e.g. shock waves and their interaction, the method of characteristics including its 'analytic' version, decay of a two-dimensional and an axisymmetric bow wave, drag on a body and losses in the flow, and entropy distribution in the wake. In the rather brief section X a few examples of viscous flows are considered, e.g. the structure of a shock wave, the laminar boundary layer along a flat plate and the interaction between a shock wave and a laminar boundary layer.

Problems involving three independent variables and the complicated problems of near-sonic and of hypersonic flow are reserved for a separate book by the same author.

The present book reflects the many years the author has spent in teaching and research in this field. It provides a rich source of information for the more serious

student who is able to read German. The book tries to help the reader to obtain a good physical understanding of the many problems treated here.

Professor Zierep's book is a new, revised edition of two of his earlier books, namely *Lectures on Theoretical Gas Dynamics* and *Theory of the Nearsonic and Hypersonic Flows*, which are now combined in one volume (see *J. Fluid Mech.* vol. 16 (1963), p. 160 and vol. 28 (1967), p. 829). Compared with the earlier editions the section on similarity laws has been rewritten and some problems and their solutions have been added.

Just over half of Zierep's book in about 300 pages appears to cover the same subjects as Oswatitsch's book in over 700 pages. Thus the former book will serve as a good introduction to gasdynamics, whereas readers of the latter will find a lot more details which help to give a better understanding of the field.

K. W. MANGLER

La Turbulence en Mécanique des Fluides. By A. FAVRE, L. S. G. KOVASZNAY, R. DUMAS, J. GAVIGLIO and M. COANTIC. Gauthier-Villars, 1976. 411 pp. 390 FF.

For some 15 years the Institut de Mécanique Statistique de la Turbulence at Marseille, under the direction of M. Favre, has been involved in fundamental research into basic turbulent flows. Few laboratories have been able to marshal this degree of effort directed towards such a specialized field and their contribution on an experimental level has been important.

The present monograph has been assembled by Favre and his team along with Prof. Kovasznay, who has had a continuing close association with the Institute. The material is divided into seven sections. The first three chapters serve to introduce the topic generally and the last four describe special areas in turbulent flows which reflect fields of interest at the Institute.

Chapter I, by Favre and Kovasznay, provides an excellent introduction. It is fast paced and somewhat compressed but understandable to a student of fluid mechanics having more than a casual appreciation for the nuances of the turbulence problem. The emphasis here is on the physics of the motion rather than the theory, in keeping with the basic experimental approach at IMST.

Chapter II, by Favre, is an intensive and thorough development of the general equations for turbulent motion. The approach is precise and the attention to detail is greater than one would expect to find in most texts. This preoccupation with the formal structure of the equations illustrates a basic difference between the French and English approach to the subject and the anglophone reader may well feel that much of the detail which Favre includes in this chapter obscures the main issue. Nevertheless, as a basic reference this detail does have a place. For example, I think this is the first time 'Method B', i.e. the mass-weighted velocity approach of Favre, which effects some economy of presentation for density-varying flows, has appeared in text-book form. Generally, this section is demanding, and requires more than a casual reading if one wishes to trace one's way through the formidable array of equations.

Chapter III is entitled 'a review of theories of turbulence'. One will recognize the pragmatic style of Kovasznay and although he states in a quotation attributed to Boltzmann, 'il vaut mieux laisser l'élégance chez le tailleur', he proceeds to present his material with characteristic *élan* if not *élégance*. It begins with a broad description of the mathematical tools employed such as correlation and spectral techniques, and

continues with a brief examination of various closure schemes. In particular some of the latest triple-correlation methods which use heat as a passive scalar contaminant to identify features of the outer boundary-layer flow are documented.

In chapter IV Dumas addresses himself to the problem of incompressible turbulent flows. This has been a main feature of the work at IMST and an area in which Dumas has made a considerable contribution. His style is lucid. The survey of material is comprehensive and this leads to a difficulty. Because of the scope of the text, space is limited and there is no chance for in-depth discussions. As a result we have a satisfactory cataloguing of the phenomena but not as much interpretation as one might have wished. A reader reasonably knowledgeable in this field will recognize most of the English references. The listing of the lesser-known French publications will be valuable however.

Chapter V, by Gaviglio, on supersonic flows, jet noise, etc., is a good treatment of a specialized field although again the reader may be overwhelmed by the painstaking development of the basic equations.

The increasingly popular field of atmospheric turbulence is treated by Coantic in chapter VI. As with the previous two sections, this represents an area of specialization at the Institute. The large air–sea interaction facility of Luminy permits direct experimental observation of phenomena that are impossible to control in the 'laboratoires naturels géants'. Coantic had a difficult task in summarizing the important aspects of so broad and complicated a problem in one short chapter. In the main he has struck a nice balance between the amount of material and the detail in which it is treated. As an introductory survey, it should be interesting.

A final short chapter by Coantic on some special problems and an appendix by Dumas on statistical methods complete the monograph.

In a field where some very good speciality texts exist, I feel that the present monograph has its place. It is clearly directed towards the francophone scientific community and its style and manner of presentation reflect this. Although it does not purport to cover the whole of experimental turbulence, its range nevertheless is extremely broad and as a result the treatment at times is light. There are repetitions, especially in the development of the equations of motion, which I think were presented in at least three different ways. Also, the notation is confusing, changing from chapter to chapter throughout the text, an inevitable consequence of any such collaboration perhaps.

Not everyone will find this monograph to their taste. Nevertheless, the text as a whole provides a point of view sufficiently different that I recommend to my colleagues that they dust off their French vocabularies and wade in.

J. F. KEFFER