REVIEWS

Progress in Aeronautical Sciences. Edited by A. FERRI (vols. 1–4), D. KÜCHEMANN and L. H. G. STERNE (vols. 1–6). Pergamon Press.

The purpose of these more-or-less annual volumes is to provide review articles on specialized topics which are of interest to the aeronautical engineer. With the exception of volume 4 and one paper in volume 1 the topics are concerned with aerodynamics and are therefore of interest to readers of this Journal.

Volume 1, 1961, 280 pp. $12

'On the principles of aerodynamic design', by E. C. Maskell. Some general remarks on the analysis of slender wings discharging appreciable streamwise vorticity.

'Calcul des profils d'aubes pour turbomachines transsoniques', by R. Legendre. The calculation of blade sections for transonic turbomachines. The analysis of two-dimensional homentropic flow past cascades at transonic speeds using hodograph methods.

'La théorie des écoulements à potentiel homogène et ses applications au calcul des ailes en régime supersonique', by M. Fenain. The theory of homogeneous potential flow and its application to supersonic wings. Linearized potential flows at supersonic speeds in which the potential functions are homogeneous of degree n in the co-ordinates (when $n = 1$, the flow is conical). The building of complex flows by superposition.

'Instationäre Grenzschichten hinter Verdichtungsstössen und Expansionswellen', by E. Becker. Unsteady boundary layers behind shock and expansion waves, particularly those in shock tubes and shock tunnels. Laminar and turbulent boundary layers. Theoretical predictions are compared with experiment.

'On the dynamics of an ionized gas', by F. A. Goldsworthy. Laboratory methods for producing ionized gas. Thermodynamics of a pure ionized gas in thermal equilibrium. A discussion of the flow inside the shock itself where equilibrium is doubtful. Ionization of interstellar gas. Magnetic effects are not discussed.

'Structural problems of aircraft pressure cabins', by D. Williams.

'The theory of sonic bangs', by C. H. E. Warren and D. G. Randall. Partially non-linear theory for sonic bangs produced by non-lifting and lifting bodies. Effects in a non-homogeneous atmosphere. The final section on lifting bodies has been revised and rewritten: the corrected version will be found at the end of volume 5.

Volume 2, 1962, 289 pp. $14

'Turbulent boundary layers in incompressible flow', by J. C. Rotta. Incompressible turbulent boundary layers in two-dimensional flow without transpiration. Basic parameters and equations for describing shear-flow turbulence. Similarity near the wall and conditions at the outer edge of the layer. Equili-

brium boundary layers, and finally the calculation of the boundary layer in any pressure gradient. A long article with many references. Watch out for minor typographical errors. Rotta has written again on turbulent boundary-layer calculation methods (General Motors Conference, Detroit, 1965).

'Boundary layers in three dimensions', by J. C. Cooke and M. G. Hall. Three-dimensional compressible laminar boundary layers with heat transfer. 'Exact' and integral methods of solution. Concludes with a short section on turbulent boundary layers.

Volume 3, 1962, 240 pp. £4

'Some aerodynamic principles for the design of swept wings', by J. A. Bagley. An authoritative summary of British contributions, particularly those of the R.A.E., to the design of wings and wing-body combinations at subsonic and low supersonic speeds when the flow is attached.

'Ducted propellers—a critical review of the state of the art', by A. H. Sacks and J. A. Burnell. Not particularly critical, but gives an extensive bibliography of work up to 1960. Propellers are ducted to increase static thrust and this article is concerned with their design and performance at various angles of attack in subsonic flow.

'Experimental facilities for hypersonic research', by R. N. Cox. Laboratory facilities for testing models in dissociated and ionized gases. The scaling laws for correct simulation. The design and the usefulness of wind tunnels, shock tubes and tunnels, gun tunnels, low-density and plasma tunnels and ballistic ranges.

'Meteorological and aeronautical aspects of atmospheric turbulence', by H. A. Panofsky and H. Press. Field measurements of turbulence using towers and aircraft. Their interpretation and a short section on the application of the knowledge to the design of aircraft.

Volume 5, 1964, 313 pp. £5

'The design of low-speed wind tunnels', by P. Bradshaw and R. C. Pankhurst. The aerodynamic and structural design of subsonic wind tunnels with some emphasis on British design practice.

'Low-speed flows involving bubble separations', by I. Tani. Laminar separation bubbles (*not* cavitation bubbles) involving turbulent reattachment at incompressible speeds in two-dimensional flow. The importance of scale effect.

'Ergebrisse der Theorie schallnaher Strömungen', by I. Teipel. A review of the theoretical papers presented at the I.U.T.A.M. Symposium on transonic flows held at Aachen in 1962. Topics include both steady and unsteady, external and internal, flow fields. Magnetic effects are also discussed.

'Écoulements transsoniques homogènes', by P. Germain. Hodograph solutions for transonic flow with and without weak shocks. A long article with emphasis on the mathematical development of the subject.

'Rarefied gas dynamics. A report on the Third International Symposium in Paris', by I. Estermann and A. Roshko. About half the papers delivered at the 1962 Symposium are discussed. Kinetic theory, high-speed molecular beams, surface interactions, ionization effects and drag measurements.

Volume 6, 1965, 366 pp. £7 or $20

'The evolution of the equations of gas flow at low density', by J. J. Smolderen. An *ab initio* development from the kinetic theory for gases with mean free path not small compared with body dimensions. A long article with many references.

'Magnetohydrodynamic shocks and their stability', by E. G. Broadbent. Shock waves and their stability when formed in an electrically conducting gas in the presence of magnetic fields.

'Nonequilibrium expansion flows of dissociated oxygen and ionized argon around a corner', by I. I. Glass and A. Takano. Prandtl–Meyer expansion for non-equilibrium flows of dissociating oxygen and ionizing argon. Numerical solutions using the method of characteristics.

'The role of spatially growing waves in the theory of hydrodynamic stability', by M. Gaster. Linearized small disturbance theory for two-dimensional unseparated and separated flows with emphasis on the growth of the disturbance in space rather than time. Aim is to get a more realistic comparison with vibrating ribbon and similar experiments.

'Hypersonic aircraft and their aerodynamic problems', by D. Küchemann. Aircraft flying at Mach numbers between 5 and 12, including those with integrated lift and propulsion systems. This is an important article for anyone who wishes to do research in hypersonic gas dynamics in support of future aeronautical applications. Topics include three-dimensional non-homentropic flows with both subsonic and supersonic regions, boundary layers with injection and shock interaction, and mixing flows with energy release.

Volume 7, 1966, 217 pp. £4. 10*s*.

This volume contains seven articles on vortex flow and are an outcome of the I.U.T.A.M. Conference in Ann Arbor in 1964. They therefore supplement Küchemann's review in *J. Fluid Mech.*, vol. 21.

'On the rolling-up of the conical vortex sheet above a delta wing', by M. Roy.

'Vortex sheets rolling-up along leading-edges of delta wings' by R. Legendre. A comparison of conical and slender-body theories for modelling the flow over delta wings with rolled-up vortex sheets.

'Theoretical work on the formation of vortex sheets', by J. H. B. Smith. A more physical discussion of the above problem, and the additional problems of spiral vortex sheets in two-dimensional flow and isolated vortex filaments in the form of rings or helices in three-dimensional flow.

'The structure of concentrated vortex cores', by M. G. Hall. In contrast to the above a discussion of the viscous and to some extent the turbulent nature of vortex cores. Existing solutions for nearly cylindrical flow with compressibility effects. The changes in core structure due to stagnation of the axial flow, instability, or transition to a conjugate flow.

'Boundary layers and their interactions in rotating flows', by N. Rott and W. S. Lewellen. Similar solutions for laminar rotating boundary-layers as the basis for a discussion of momentum integral methods. Applications to a driven

vortex in a cylindrical container, the flow between a rotating and a stationary disk, and in a tornado.

'Geophysical vortices', by B. R. Morton. A physical discussion of vortices in both the lower and higher atmospheres. Theoretical and experimental models and doubts concerning their validity.

'On unsteady flows and transient motions', by R. Wille. A rather incomplete review of vortex street flows in two dimensions but including the effect of a vibrating body. The emphasis is on papers not written in the English language.

Volume 8, 1967, 417 pp. £7

'Calculation of potential flow about arbitrary bodies', by J. L. Hess and A. M. O. Smith. Application of numerical methods to the analysis of inviscid, incompressible flow where the disturbance flow due to the body is irrotational. The direct Neumann problem is analysed using a distribution of sources on the surface of the body. Lift effects are added only when the flow is two-dimensional. Permitted complications in the analysis include non-rigid boundaries, unsteady flow, area suction and the presence of a nearby free surface. Comparison with other methods and experiment. A long and welcome review.

'Theory of aerodynamic design for swept-winged aircraft at transonic and supersonic speeds', by R. C. Lock and J. Bridgewater. An extension of Bagley's article in volume 3, again with emphasis on British contributions. The design of swept-wing fuselage combinations using the pressure distribution of a suitably chosen two-dimensional wing as target. Linearized theory is used to determine the changes in wing thickness, camber and incidence, and in fuselage waisting to achieve this objective. The design procedure is conveniently summarized.

'Hypersonic air-breathing propulsion', by J. Swithenbank. The performance of hypersonic engines with emphasis on the ramjet with supersonic combustion. Application to both cruise and boost vehicles. More detailed consideration of the intake, the combustion region and the exhaust nozzle of a 'scramjet' Of particular interest to engineers, but may suggest worthwhile research to others.

'Boundary layers in rarified gas flow', by W. Wuest. The application of theories for near-continuum laminar flow with slip and free molecular flow to special problems. These include the plane shock wave, plane Couette and plane Poisseuille flow, flow in tubes and in boundary layers with pressure gradients.

'Magnetohydrodynamic channel flow', by R. R. Gold. Incompressible steady laminar viscous flow down closed uniform ducts in the presence of strong transverse magnetic fields. Developing, as well as fully-developed, flow. The use of a generalized Ohm's law to describe Hall effect.

The editors are clearly experimenting with this series and are to be commended for doing so. Review articles on rapidly developing topics are always to some extent out of date. Those articles which describe experimental facilities and, at the other extreme, those which are mathematical developments based

on well-established physical principles, are probably the most definitive, but other articles like those of Morton, Küchemann and Rotta may be more useful to the research worker. The review articles on conferences are also useful. As a passing observation it is surprising how few of these articles were written by engineers from industry, people who are very often in a strong position to assess progress and who are sometimes contributing to it. In this connexion a volume on the increasing use of computers in applied aerodynamics comes to mind.

The price of these books is rather too high for their purchase to be recommended to the individual. It may be more economical for him to photocopy those articles of particular interest. Indeed sometimes the list of references may be all that he needs. On the other hand it is clear that the volumes should be held by any serious technological library serving aerospace engineers and, in the case of certain volumes, by libraries serving other engineers and physicists with an interest in fluid mechanics.

B. G. NEWMAN

Führer durch die Strömungslehre. BY LUDWIG PRANDTL. 6th edition. Friedrich Vieweg u. Sohn, Braunschweig, 1965. 523 pp. DM. 38.

Prandtl's famous *Abriß der Strömungslehre* (Compendium of Fluid Mechanics) underwent various modifications between 1913 and 1948. It appeared in English in 1930 in the series 'Physics of Solids and Fluids' published by Blackie and Son Ltd. When Prandtl died in 1953 he left behind as his greatest monument two or three generations of scientists and devoted co-workers, whose contributions to fluid mechanics, at Göttingen and abroad, are well known. Thus it is possible that Prandtl's publisher, Vieweg at Braunschweig, offers a new *Prandtl: Strömungslehre*, a substantial book of well over 500 pages which on the outside cover discloses that the original text has been revised and edited by K. Oswatitsch and K. Wieghardt. It is remarkable that these two editors, who have contributed so richly to our science by their own papers and books, have been able to maintain the approach and style of the original in their numerous additions to Prandtl's chapters. The same may be said for the six contributors Dettmering, Kleinschmidt, Küchemann, Ludwieg, Rotta and Schuh. The result is that the new posthumous 'Prandtl' is, like all its predecessors, an enlightening approach to numerous segments of fluid mechanics, emphasizing the physical model more than the mathematical formalism.

The division of the chapters has remained practically the same. Strikingly new is that diagrams and tables now have explanatory captions. It is difficult to judge whether all of the equations which have been inserted without their derivation can be understood and applied by the reader. Among the many additions the following may be mentioned as most significant: the influence of the Mach number on pipe flow, the continuation of stability and turbulence theory up to about 1962 and including Kolmogoroff's theory, boundary layer flow at high speeds, and the thorough modernization of the chapter on airfoils.

On the whole the new Prandtl is a praiseworthy improvement of the older editions. Engineers and physicists will find the book a valuable source of information and stimulation.

R. WILLE