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REVIEWS

Environmental Aerodynamics. By R. S. Scorer. Wiley, 1978. 488 pp. £20.

This book is an updated version of the author's twenty-year-old *Natural Aerodynamics*, and it is now published as one of a series on Mathematics and its Applications. Professor Scorer's declared aims are to make mathematicians in particular aware of the many complex dynamical processes in the atmosphere, and to provide background reading for workers in other fields who are becoming interested in environmental problems. There is an enormous range of topics and methods of discussing them, which accurately reflects the author's unusual combination of interests in mathematics and observational meteorology, but which makes it difficult to predict what kind of reader will get most out of the book. I suspect that there will be few who will not find some parts of it very different from their customary way of thinking about the world.

There is certainly a great contrast between the two parts of the book, which are given the headings 'Fundamental Theory, Vorticity, and Waves' and 'Turbulent Phenomena, Clouds, and Dispersion'. In the first part, the treatment is very mathematical, and the author states his outlook here explicitly: 'We shall consider the mathematical argument first because that will establish the precise formula which requires physical explanation'. Chapters entitled 'Fundamental Equations', 'Phenomena of Fluid Flow', 'Secondary Vorticity', 'The Rotating Earth', and 'Waves in a Stratified Fluid' are developed in this vein. But already by chapter 6 (Billow 'Mechanics') the author has partly shifted from this view when he states that 'we are concerned not with the exact criterion for instability but with its mathematical form so that we may study what has to happen in nature to bring the instability about'. Professor Scorer is at his best when he is describing atmospheric phenomena in terms of broad principles, taking many factors into account, so that it is the earlier emphasis on the equations which seems anomalous, rather than this latter statement.

In the second part of the book, the emphasis changes further still, and the discussion becomes much more qualitative and less precise. This is partly due to the inherent difficulties of describing turbulent flows, but mostly, I feel, to the author's attitude. He asserts that we should concentrate on 'learning to live with impossibilities rather than inventing a tractable theory'. He even seems to have lost faith in the ability of simple theory and laboratory experiments (where he himself has made some notable contributions) to give information which is of real value for the atmosphere, and is inclining to the view that 'the situation is so complex in the great outdoors that laboratory concepts are often quite inappropriate'. Again he describes and suggests explanations of a wide range of phenomena, under the chapter headings 'Turbulence', 'Partly Turbulent Flow' (e.g. plumes and thermals), 'Buoyant Convection in the Dry Atmosphere', 'Dispersion of Pollution, Clouds and Fallout', and finally 'The Aerodynamic Environment of Life'. The typical treatment in this second half is more qualitative than it need have been: for example, there is a perceptive classification of the shapes of chimney plumes, but the similarity theories for buoyant convection are not discussed very clearly (in spite of the fact that a table of the results is regarded as important enough to repeat on the inside back cover).

The book is considerably longer than its predecessor, and this increase has been achieved largely by adding completely new material (particularly to the last three chapters) rather than by a thorough rewriting of sections that were previously included. This means that the references, and sometimes the discussion itself, tend to be out of date in many places; publications later than 1970 are rarely mentioned, except in relation to the new topics. The choice of references is also rather personal, and somewhat eccentric in places: the author often prefers to quote his colleagues and students (even their unpublished theses) rather than more accessible sources. As a result, it would be hard for a reader not already familiar with some subjects to get either an up-to-date impression of the stage they have reached or guidance about where to look for more information. There is an entertaining section at the end containing ' Questions and Statements for Discussion ', some of which (such as the cartoon of the spiral staircase reproduced from *Punch*) I remember from the earlier book, whereas others are based on very recent satellite photographs. Few of these are related very closely to the text, but they reinforce the author's belief that one should look more closely at natural phenomena and learn to interpret them in terms of dynamical principles.

Enough has been said to indicate that this is a very individual book. It is rather uneven in its coverage and frequently controversial, but it is never dull. The publishers have probably been rather optimistic about the breadth of the readership who will find the whole book useful, but all readers will be introduced to a large number of fascinating phenomena in the atmosphere and made to think about them. Those who are more expert will undoubtedly disagree with some of the detailed explanations given (particularly in the light of recent work) but it should be stimulating to them nevertheless. The book is full of quotable (though often dogmatic) remarks, and I shall end with another passage from chapter 10 which seems to sum up the author's philosophy: 'There is no substitute for lively and perceptive observation... and for an intelligent application of simple principles of natural aerodynamics.'

J. S. Turner

Fluid Mechanics: A Laboratory Course. By M. A. Plint and L. Böswirth. Charles Griffin, 1978. 186 pp. £5.95.

While laboratory experiments in fluid mechanics play an important role in research and development, there is a regrettable lack of textbooks which deal with experimental techniques. The appearance of this book by two engineers is, therefore, welcome.

The book is written for engineering students and is intended for use as a supplement to a lecture course presenting theoretical aspects of the subject. There are thirteen experiments which cover the free air jet, flows around a circular cylinder and aerofoil, laminar and turbulent boundary layers on a flat plate and flows through pipes and nozzles. There are also four experiments on compressible flow, of which two require the use of a supersonic wind tunnel. The final chapter describes two experiments on hydrodynamic lubrication.

The layout for each experiment is the same. The theoretical background to the experiments is given, the apparatus and experiment are described, followed by examples of actual measurements and their analysis. Each chapter closes with some discussion of the results and some suggestions for further experiments. The apparatus described for each experiment was used by the authors and the results they give as examples were taken in the apparatus. There are also examples of sheets which might be used to write up the results. The purpose of this, as the authors state in the preface, 'is to attempt to reduce the teacher's preparatory labour to manageable proportions'.

In spite of this, I feel that its scope is quite limited. Much of its potential value lies in using apparatus almost identical to that described in the text. This is possible, as quite detailed drawings are provided, but much of the hardware is quite sophisticated. Furthermore, many of the experiments are classical and most laboratories would have their own (different) equipment. There do not seem to be many new ideas in the book, so a reader seeking to extend his present course will not find it very helpful.

Students who carried out only the prescribed experiments would not be exposed to many laboratory techniques. Measurements consist mainly of taking pressure data. Hot wires, standard equipment in most laboratories, are not mentioned. Flow visualization is hardly discussed, though it is a simple technique for revealing details of the basic flows which are being investigated. Surely this is one of the simplest ways of giving the students a feel for the subject. However, the experiments described give insight into the use of dimensional analysis for grouping experimental data, a technique of value to practical engineering.

P. F. LINDEN

Waves in the Ocean. By P. H. LEBLOND and L. A. MYSAK. Elsevier, 1978. 602 pp. $98.50.

To most of us, the ocean is an object of endless wonder and delight; occasionally of travail. To the mediaeval mariner, it was a capricious pathway to riches and it still is, for the modern oil driller. To the geophysical fluid dynamicist, however, the oceans are shallow bodies of almost incompressible stratified fluid with a free surface contained in a basin of variable depth on a rotating planet. Professionally at least, he cares not for its colour in the evening, the life in its depths nor the sighing of surf on a beach, but only for its currents, eddies and oscillations. Rarefied though his view may be and restricted his range of concern, the variety of things to be found is still astonishing.

This book is concerned only with the oscillations – not only surface waves and tides but internal and inertial waves, planetary waves that arise from the earth's sphericity and their dynamical cousins, the topographic waves that are governed by variations in ocean depth. Many of these occur in a bewildering variety of subclasses and special cases. Within this range, the book can be described, fairly I think, as encyclopedic, offering both the usefulness and inherent limitations of an encyclopedia. Look for a specific topic, such as the trapped oscillations about an asymmetrical seamount, and you will find it, together with a useful number of references. If, however, you seek a more general understanding of, for example, the dynamical significance of the Rossby radius of deformation, a quantity that crops up many times, you may have some difficulty putting the pieces together.

A short introduction includes not only the usual dynamical preliminaries but also a very terse summary of Whitham's variational approach, to which little further reference is made. Throughout most of the book, the mathematical level is elementary and the ocean regarded as a linear non-dissipative mechanical system. Two extensive chapters treat the characteristics of free waves with wavelengths that are, respectively, short and long compared with the ocean depth. In the first, we have internal and inertial waves, ideas of normal-mode structure, gravity and capillary waves together with a little about nonlinear effects in surface waves. When the horizontal wavelength is large compared with the ocean depth, the vertical pressure gradient is, in essence, hydrostatic and the motions governed by the unsteady geostrophic equation. Within this context, the authors consider long waves in both homogeneous and stratified fluids, topographic waves, tides, planetary waves and equatorial trapping, again with a brief account of the role of nonlinearity, this time governing transition from nonlinear planetary waves to two-dimensional planetary 'turbulence'. Over 100 pages are devoted to a consideration of lateral boundary and topographic effects: wave reflexion at escarpments, shelf waves, trapping at ridges, escarpments and islands, diffraction effects and oscillations in closed basins and channels.

The direction changes abruptly with chapter 5, on statistical and probabilistic methods. It offers a short account of the ideas of time series analysis and their application to spectral methods of description of oceanic motions and of stochastic differential equations. To have a useful knowledge of these areas would require, I believe, a greater depth of understanding than is offered here; the chapter stands oddly as a boundary between the earlier chapters on the 'simple' linear characteristics of free waves and those which follow, where the interactive properties are taken up. Waves interact not only with one another but also with variations in the mean state. The chapter entitled 'Wave interactions' includes many examples of the resonance theory from capillary waves to those on a planetary scale, as well as the rectifying effects pointed out by Longuet-Higgins and Stewart in which surface waves on shoaling water produce set-up, set-down and longshore currents. Analogous effects in other contexts certainly exist but are still largely unexplored; they may well keep a whole generation of graduate students busy! The same chapter includes a discussion of wave refraction by shear flows which would possibly fit better into the following section on wave–current interactions, though this goes on from critical-layer absorption to matters of stability of stratified shear flows, barotropic and baroclinic instability. The final chapter, 'The generation and dissipation of waves', again takes up each of these wave types in turn: surface waves, storm surges, tides, internal, planetary and finally coastally trapped waves. The different array of physical processes involved in each makes the chapter somewhat disjointed. We leap from whitecaps to bottom friction to the equilibrium tide to the wind stress generation of planetary waves in only a few pages. The book concludes with a very extensive and valuable bibliography.

A notable addition to the text and one that will be welcome to students is the extensive set of exercises and problems appended to each major section. Less helpful is, I believe, the organization of the subject matter in the book, though this is certainly a matter of taste. The authors have chosen to arrange the material by categories of geometry (in the early chapters) or process (in the later ones) which cut across the wave types. Although this has considerable appeal as an abstract conception, the variety of specific characteristics of each wave type reflecting the different physical balances involved makes the implementation of it sometimes less happy. Except that each involves a rate of energy loss, the process of viscous dissipation of capillary waves has little in common with those responsible for attenuation of internal waves, yet each fits easily and naturally into a development of the dynamics of the waves themselves. Again, if one is interested in finding out about topographic shelf waves, in this book one learns their basic linear dynamics in § 20, more specifically with varieties of topography in § 25 and how they are generated in § 54. Nevertheless, I do not want to make too much of this. The range of subject matter is extensive and this book is the first to try to encompass it. The authors are to be commended for their efforts to give it at least some element of unity.

The standard of production of the book is generally excellent but I was delighted to discover what was to me an entirely new kind of misprint. Page 557 is completely reversed, so that you must read it either from the back or in a mirror! The price is astronomical. Were this not so, the book would be extraordinarily useful to the student of dynamical oceanography or geophysical fluid dynamics, for whom it is so clearly intended.

O. M. Phillips