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# REVIEWS

**Flow-Induced Structural Vibrations,** IUTAM/IAHR Symposium, Karlsruhe, Germany, 1972. Edited by E. NAUDASCHER. Springer, 1974. 774 pp. DM 140 or $57.20.

The editor begins his preface with a trenchant remark. He asserts, all too truly, that the researchers in fluid mechanics (let us call them the r.f.m.) are getting further and further apart from the practising engineers (p.e.). In an attempt to arrest this tendency the International Union of Theoretical and Applied Mechanics (IUTAM), which has few p.e. in its ranks, and the International Association for Hydraulic Research (IAHR), where theoreticians are rarer still, sponsored the symposium. The Institute of Hydromechanics, University of Karlsruhe provided the organizing machinery. The symposium, conducted entirely in English, was recruited by invitation only.

Some attempt must be made in a rough and ready way to discover how far the immediate aim of the promoters was achieved. A comparison of the list of the 217 participants with the current membership list of IAHR reveals only 32 names in common. Moreover, the address list of the 90 contributors suggests that not more than about 10 are p.e. fully engaged in their profession and compelled to produce, in a limited time, the solutions to problems that cannot be evaded. Can we infer that the p.e. do not usually have the leisure, enjoyed by the r.f.m., to write papers and attend conferences?

About half the submitted manuscripts were rejected, leaving the 49 papers printed in this book. There are also included five general lectures and five 'workshop reports'; the latter term is absurd and quite incomprehensible to the p.e. Nine sessions were held, some simultaneously, and the papers are accordingly grouped under the headings (*a*) Generation of oscillating flows; (*b*) Mathematical models of flow-induced vibrations; Flow-induced vibrations (*c*) of hydraulic structures; (*d*) of beams and bridge-decks; (*e*) of bluff bodies; (*f*) of marine structures; (*g*) of shells and pipes; (*h*) relating to buildings, together with one panel discussion on research priorities in flow-induced vibrations.

Thus the information contained in this book covers a wide field. The booming subject of ocean studies is well represented by new problems, but attention is also paid to hoary matters such as the galloping of electric transmission lines. Even here much remains to be done, for it is a common observation that the super-grid in England, when exposed to a summer breeze, can emit a loud and annoying noise caused by the clash of the four cables forming a phase. One or two distinctly irrelevant papers have been admitted, perhaps to show how far from reality the r.f.m. can stray.

The problem remains how to get this store of knowledge into design offices and put to good use. The time lag is still enormous. It is only recently that the traveller by rail between Cambridge and London will have seen the construction of chimneys protected by spoilers, which are devices that have been known to the r.f.m. for many years. The cause of some at least of the delay must be laid at the door of the p.e. Time and again accounts appear of design studies and model experiments carried out for some great project. One rarely learns whether its behaviour is as predicted, or whether the design was unduly conservative. Only if catastrophe occurs is attention drawn to the matter. The 850 ft chimney recently constructed at Drax is not fitted with spoilers. Instead, reliance is placed on the frictional forces brought into play by the relative movement of the outer shell and the three flues. It is to be feared that, unless the chimney is visibly damaged, if not actually blown down, we shall not learn how effective this interesting development has been.

The book is attractively produced by the publishers in their usual style. The price is very high, too much for most r.f.m., but the p.e. will realize that it is trivial compared with the loss of a cooling tower or a bridge.

A. M. BINNIE

**Atmospheric Waves.** By TOM BEER. Adam Hilger, 1974. 300 pp. £16.00.

Meteorologists and atmospheric physicists have long had an interest in wave motions in the atmosphere. This interest has often been extended to the ocean since in some cases the analysis is quite similar. The interest arises because there is ample evidence in everyday phenomena of wavelike characteristics both in space and in time. Clouds with wavelike features are often seen and condensation trails from aircraft provide markers which often show up wave motions as well as turbulent diffusion. Near well-defined terrain wave clouds can be observed in the lee of the obstacle, quite regular in pattern. There are rhythmic pulsations in the intensity of rainfall with periods of minutes and pulsations in the monsoons of much longer period. Microbarograph traces reveal pressure waves at the ground, winds observed by routine radio-sonde ascents reveal both horizontal and vertical small-scale oscillations in the lower stratosphere, while examination of observed winds in tropical regions reveals stratospheric waves of a different kind of much greater wavelength. Daily analysis of weather observations, especially of wind, temperature and pressure, at the surface and at various levels up to 50 km, shows clear wavelike features, both in space and time, so that weather forecasts speak of waves in the cold front, wave depressions, etc.

In order to explain these oscillations we often set up simple mathematical models which take into account only the physics which we think is important for the particular phenomenon and the linear simplicity that we assume leads naturally enough to wavelike solutions. And so part of the armoury of those studying the atmosphere is a knowledge of a selection of possible atmospheric wave motions. Meteorologists divide them into three classes, which are, in increasing order of importance, sound waves, gravity waves and the large-scale quasi-horizontal meteorological waves which are important in the formation of weather; electromagnetic waves in the upper atmosphere and signalling through the atmosphere are the province of specialized groups.

Interest in sonics and sound waves exists for many practical purposes, e.g. in problems of aircraft noise and location and in instrument design. Meteorologists have a particular interest in gravity waves. First, they are important in explaining motions in the vicinity of mountains which may be dangerous to aircraft. Second, they are part of the mechanism for the mutual adjustment of wind and pressure fields, so that the formulation of mathematical models widely used for prediction of these fields must provide for their existence. On the other hand, the inclusion of fast-moving gravity waves complicates the numerical solution of the model equations, either by limiting the duration of the unit time step by which the integrations advance or by calling for more complex integration schemes; a knowledge of the behaviour of gravity waves allows for the optimization of computing effort without lack of accuracy. Meteorologists also have a great interest in Rossby and planetary waves, which exhibit some of the properties of the horizontal features which are observed in extra-tropical atmospheric motions. But perhaps their deepest interest is in barotropic and baroclinic wave motions and the conditions for their instability, because the essence of weather systems lies in the unstable wave. Many of the wave motions that occur in geophysics have been given specific names, associated with the physicists who investigated the type, so that we have Stokes waves, Kelvin waves, etc., or with the particular phenomenon in which the waves were first revealed, such as edge waves, cnoidal waves, etc. What has been needed is a connected account of the various types of waves which arise which would form a reference for anyone whose problems led to wave solutions.

Dr Beer writes about many of these wave types in his monograph and so attempts to provide a reference text for a very wide audience from undergraduate to advanced research worker. He starts with an introductory chapter that sets the scene for the later developments, describing the different wave types and some of the observations that require explanation, and sets up the equations for a compressible fluid. There are one or two points that require further explanation. The author states that the geostrophic wind is too idealized to be of significant use in predictive meteorology, but the first filtered models used for prediction advected the geostrophic vorticity with the geostrophic wind and this approximation is still basic to some operational models. Again, his statement that, if there were no convective motions, the temperature distribution would fall very rapidly near the ground, where the water vapour and carbon dioxide predominate, requires further explanation; as written, it does not agree with observations of the temperature structure near the earth's surface immediately before convection sets in.

The second chapter gives the elements of the perturbation method, and applies it to obtain properties of Rossby waves, sound waves and gravity waves for simple background atmospheres. This is an important basic chapter which contains good explanatory matter and a lot of ground is covered, the detail being well presented without being hidden in the mathematical derivation. Chapter 3 introduces the additional complications due to viscosity, attenuation and the effects of vertical stratification in the background fields and critical layers, with the consequent reflexion, refraction and ducting of wave energy. This is good pedagogic material with references to recent work.

The following chapter deals with waves in the lower atmosphere and is likely to be that most closely scrutinized by meteorologists. I found it disappointing because the balance seems tilted towards simplicity and elegance rather than depth. Plane planetary waves appear in a previous chapter and although their usefulness is more conceptual than actual, the theory is extended to a spherical surface, calling for an excursion into spherical harmonics which scarcely seems called for. The effect of allowing for divergence in the vorticity equation, introduced by Cressman and necessary in some practical applications of prediction, is not dealt with except by a single reference. Barotropic and baroclinic instability receive rather cursory treatment and recent work extending the realism of the background atmospheric fields and seeking the associated conditions of instability are only hinted at without a summary of the results. Similar rather cursory treatment is given to tropical wave disturbances, although much analysis is available. The effects of mountains both on the large-scale horizontal flow and on the production of lee disturbances and clear-air turbulence are also dealt with.

The treatment of atmospheric tides in the next chapter is indeed competent with the essential observational evidence at different levels being followed by a well-chosen summary of the recent literature. The chapter on waves in the ionosphere reads well and seems to cover the main areas of interest. There is a short final chapter on nonlinear motions which does little more than recall that they exist.

On the whole the book is successful, even though it is aimed at a very wide audience. There are many minor irritations of expression, which should have been picked up in proof-reading, and occasional obscurities, where the author seems not to have a very clear idea of what he wants to write. An example occurs in the remark about the Stokes derivative at the top of p. 30, and the equations at the top of p. 51, both of which arise out of avoiding defining $\mathbf{U}.\nabla\mathbf{A}$ although it appears undefined on p. 134. The details of computing $\mathbf{U}.\nabla\mathbf{A}$ in non-Cartesian orthogonal co-ordinates are standard bookwork. Nevertheless, Dr Beer has presented the main results of modern work in a digestible way and has picked a well-judged way through the mathematics, avoiding the plethora of algebraic manipulation that can so easily veil the physics.

The book is sumptuously printed, but I wonder if it can reach the wide audience at which it is aimed, especially the student part of it, at its very high price.

E. Knighting

## Shorter Notices

**Proceedings of the 1974 Heat Transfer and Fluid Mechanics Institute.** Edited by Lorin R. Davis and Robert E. Wilson. Stanford University Press, 1974. 364 pp. £10.00.

This volume contains the Proceedings of the twenty-fourth in this well-known series of now biennial meetings. There were six invited lectures (of which the volume includes only the abstracts) and 22 contributed papers, chosen from among 115 submitted and reproduced in full in the Proceedings. The editors are to be congratulated on making these Proceedings available within 6 months of the meeting, which was this year held at Oregon State University, Corvallis.

The following titles, selected among the 22 contributed papers, will give an indication of the scope of the meeting.

Analysis of the geometry of the liquid film during annular flow condensation inside horizontal tubes.

Heat transfer in turbulent flows under mild and strong adverse pressure gradient conditions for an arbitrary variation of the wall temperature.

Stability of natural convection in an oscillating vertical slot.

Transport processes induced by a heated horizontal cylinder submerged in quiescent salt-stratified water.

Prediction of the flow field of supersonic turbulent jets.

The effect of electrodynamic secondary flow on the performance of electrostatic precipitators.

Thermal plumes for industrial cooling water.

Time scale and molecular weight distribution contributions to dilute polymer solution fluid mechanics.

This is an interesting and useful selection of papers; but some are undoubtedly of transitory interest, and others will find their way in more complete form into the regular journals of the subject. In these circumstances, librarians on shrinking budgets will perhaps think twice about the case for purchasing this volume (or indeed any volume such as this), whose cost per page is high, and whose standard of production, though excellent within the limitations of the photo-offset process, cannot compare with that of printed publications.

**Annual Review of Fluid Mechanics.** Volume 7. Edited by M. VAN DYKE, W. G. VINCENTI and J. V. WEHAUSEN. Annual Reviews Inc., 1975. 398 pp.

Back to its usual size after last year's rather slim issue, the present volume contains fourteen specialized reviews preceded by a personal history. The titles and authors of the various contributions are as follows.

Some memories of early work in fluid mechanics at the Technical University of Delft, J. M. Burgers.

Pressure fluctuations beneath turbulent boundary layers, W. W. Willmarth.

Nonlinear thermal convection, E. Palm.

Relaxation methods in fluid mechanics, H. Lomax & J. L. Steger.

Experiments in granular flow, K. Wieghardt.

Flow lasers, W. H. Christiansen, D. A. Russell & A. Hertzberg.

The structure and dynamics of vortex filaments, S. E. Widnall.

Fluid mechanics of heat pipes, C. L. Tien.

Fluid mechanics of waste-water disposal in the ocean, R. C. Y. Koh & N. H. Brooks.

Hemodynamics, H. L. Goldsmith & R. Skalak.

Mathematical analysis of Navier–Stokes equations for incompressible liquids, O. A. Ladyzhenskaya.

Experiments in rotating and stratified flows: oceanographic application, T. Maxworthy & F. K. Browand.

New trends in experimental turbulence research, J. Laufer.
The effect of waves on rubble-mound structures, F. Raichlen.
Hydrodynamics of large lakes, G. T. Csanady.

**Strömungen mit Energiezufuhr.** By J. Zierep. Braun Verlag Karlsruhe, 1975. 94 pp. DM 14.20.

The English-speaking reader will find Zierep's treatise on flows in compressible media with heat addition as *AGARDograph* no. 191. The author begins by introducing various possibilities of energy addition to a flow field, and then applying these ideas to one-dimensional and two-dimensional flows. The heat can be distributed continuously in the flow field or added at fronts. The book is both a lucid introduction to and a review of the research work in this field of heat addition to flows, discussing the main aspects of the phenomenon, which provides the basis for a possible propulsion mechanism of the nineties.

**Singularitätenverfahren der Strömungslehre.** By F. Keune and K. Burg. Braun Verlag Karlsruhe, 1975. 384 pp. DM 34.00.

This book discusses the method of singularities in fluid mechanics and is based on lectures given by the first author to students of aerodynamics and applied mathematics over many years. The teaching experience is evident in the structure and presentation of the seven chapters, five of which are provided with a subsection of examples, with hints on how to solve the problem and the solution itself. Following the introduction of the basic equations, the second and third chapters deal with singularities and the flow fields and forces generated by them. The fourth chapter describes the simulation of actual wings and bodies at incidence by the method of singularities. The next chapters deal with wing theory and an analysis of flow around slender wings and bodies of rotation, in both subsonic and supersonic flows. About 300 references provide an indication of the wide scope of the method.