For the engineering student the book will fall into two parts. If he is not specialising in fluid mechanics, chapters 17–22 dealing with turbulent flow will be too detailed, requiring more of his time than he can give. If, however, he is taking a special course in fluid mechanics (not fluid machinery), he will have in these chapters one of the most lucid accounts of Stability, Transition and Turbulence that is at present available to the perceptive and able undergraduate. For a postgraduate student these chapters would form an admirable preparation for more specialised reading.

The book has many incidental pleasures. Diagrams and photographs are especially well chosen and almost all serve other purposes in addition to the one which is their main reason for display. The Bibliography is classified in a helpful way to the learner and the Reference section is exceptionally full. The collection of 75 problems following the text will be challenging to an engineering student.

In a second edition of the book, there is one clear improvement which could be made. Throughout the book much use is made of forward and backward referencing; so it would be of great help to the reader if the page headings, which carry the chapter titles, could also carry the section numbers appearing on that page. It is a tedious process looking through the pages of the text to find the required item.

R. G. TAYLOR

Measurement of Unsteady Fluid Dynamic Phenomena. edited by B. E. RICHARDS Hemisphere/McGraw-Hill, New York (1977). Price $35.00.

THIS book is based on notes from a Von Karman Institute lecture series with the same title, held in January 1975. The 13 contributors have written 12 chapters on experimental techniques, with, in some cases, an introduction to the physics of the phenomena to be measured. Techniques for measurement of force, velocity, heat transfer, temperature, density and pressure are described, necessarily in the context of particular applications. The main applications are to shock-tunnel flows and turbulence studies, and in the latter case the rather specialised data-reduction procedures and results of space–time correlation and conditional sampling are discussed in some detail. It is a pity that room could not be found for a chapter on measurement of unsteady flows over aerofoils or behind bluff bodies; the techniques used have something in common with shock-tunnel practice while the data processsing has affinities with conditional sampling. However almost any reader with an unsteady-flow problem would be able to find techniques of value to him, though only someone wishing to use hot-wire and laser anemometry for conditional sampling of turbulent combustion in a shock tunnel would benefit equally from all the chapters! Most of the shock-tunnel chapters have been written by authors from VKI and most of the turbulence chapters by the Lyon group, but there are contributions from several other universities and the treatment is by no means parochial.

The book is generally of high quality. This reviewer found the two chapters on data handling somewhat unsatisfying and a better treatment might have been achieved if the authors had collaborated on one long chapter. Of course, most of the chapter topics could be, and have been, treated at book or monograph length: however the compact treatment given in the present volume is ideal for the beginner, and has the further advantage of introducing shock-tunnel and turbulence experts to each others' problems and solutions. The references are extensive and, as of 1975, up-to-date.

The editing and production of the book are both good. The topics are sufficiently self-contained that extensive cross-referencing is not necessary, although a little more tidying up would have been helpful (for instance one author refers to "Raman scattering", another to "Raman spectroscopy", and the index refers to both; they are of course the same thing in this context). The text has been typeset—as distinct from the prevalent "instant book" technique of offsetting from unjustified typewriter scripts—and the only blemish is the presence of hand-drawn diagrams in one or two of the chapters.

The highest compliment one can pay the editor, contributors and publishers, and the most useful guidance one can give the prospective reader, is to say that the book's origin as lecture course notes is not apparent from the text: it is a well-planned and well-executed review of an important and rapidly-developing field.

P. BRADSHAW

Two-phase Steam Flow in Turbines and Separation. Edited by M. J. Moore and C. H. Sieverding Hemisphere McGraw Hill, New York (1976).

HEAT-TRANSFER specialists are much concerned with two-phase flows of steam and water; but, for the most part, their attention is concentrated upon flows internal and external to pipes, in apparatus in which the change of phase is desired, and essential. It is therefore interesting to observe the same subject from the different point of view of the contributors to the present volume; for they, for the most part, wish that they had only single-phase flow to deal with; and when two-phase mixtures do appear, they try to separate them.

In steam turbines, two-phase phenomena arise from expansion to pressures permitting condensation. Heat-transfer phenomena play a part; but those of nucleation, friction and relative motion between the phases, and impingement on solid surfaces, dominate the scene. In separators, the inability of the droplets to follow the strongly curved streamlines of the vapour phase is relied upon by the designer; and thermal effects can be neglected in comparison with fluid-mechanical ones.

This handsomely produced volume is the outcome of a course of lectures at the Von Karman Institute for Fluid Dynamics. The contributors are:

G. Gyarmathy, with 58 pages on Basic Notions:
M. J. Moore, the Course Director, with 68 pages on Gas Dynamics of Wet Stream and Energy Losses in Wet-Steam Turbines;
G. Gyarmathy, with 64 pages on Condensation in Flowing Steam;
M. J. Moore and A. Ederhof, with 70 pages on Instrumentation for Wet Steam;
A. Smith, with 30 pages on Experimental Development of Wet-Steam Turbines;
W. Engelke, with 28 pages on Operating Experience of Wet-Steam Turbines; and
G. C. Gardner, R. L. Coit, P. D. Ritland, T. F. Rakas and P. W. Viscovich, with 54 pages on External Water Separators.

Judged from the viewpoint of one concerned with advancing the development and application of heat-transfer science to engineering problems, what impression does the volume give?

First, it is that the authors know what they are talking about, and have taken the trouble to present their knowledge in an understandable and attractive manner. There is a certain amount of over-lapping between the contributions; but it is not excessive; and the editors have been successful in giving coherence to the collection of individual lectures.

Secondly, the standard of application of science to the engineering problems appears to be high, a conclusion that is not always apparent in areas of technology which, like this one, have a long history.

Thirdly, however, it can be deduced that recent advances in two-phase flow analysis, particularly by numerical methods, have not yet penetrated to specialists in this area. For example, about corrugated-plate separators, it is stated: "there is no theory completely describing the separating

performance...". True: but there *could* be; for methods now exist for solving simultaneously the equations governing the linked motion of the two phases, and so of predicting the influence of plate geometry on performance. Such methods are especially economical when the flow fields are two-dimensional, as in the present case. Perhaps, somewhere, mathematical modellers are applying modern numerical methods of two-phase flow analysis to turbines and separators; but, if so, they are not given prominence in the present book. Heat-transfer specialists, who now use numerical methods more extensively, may like to give the matter some attention.

D. B. SPALDING

K. R. CRAMER and S. I. PAI, **Magnetofluid Dynamics for Engineers and Applied Physicists.** McGraw-Hill, New York (1973) 350 pp.

THIS book evolved from class notes presented to graduate students in the Mechanical Engineering and Physics Departments of the USAF Institute of Technology. The authors' intention is to prepare the advanced student for professional activity in the field of magnetofluid dynamics. The subject matter is approached from the continuum viewpoint, and includes material on viscous flows and wave phenomena.

The fact that rates of heat transfer may be influenced by magnetic fields is mentioned in several contexts; for example, in the use of a magnetic field to reduce the heat transfer at the surface of a blunt body moving at hypersonic speed. The final chapter, which deals with several advanced topics, introduces the theory of radiative transfer, and gives an example of thermal radiation effects on a magnetogas-dynamic flow. The best and most interesting sections concern engineering applications; notable amongst these are the magnetofluid-dynamic submarine and aerofoil.

All the important non-dimensional magnetofluid-dynamic parameters are introduced and discussed in the first chapter; these parameters are later used to specify the complete m.f.d. equations in non-dimensionalized form. The particular forms taken by these equations under several types of simplifying circumstances, for example the ideal plasma approximation, are given explicitly.

The clarity and usefulness of the book suffers from the inclusion of too much material in too little space. The authors spend only sixty pages presenting the fundamentals of electromagnetism and fluid mechanics, starting from Coulomb's inverse square law, and ending with the general magnetofluid-dynamic equations. As a result the more demanding topics, such as magnetostatic energy relations and the rate-of-strain tensor of a Newtonian fluid, are treated poorly. The authors have adopted this approach, i.e. of including basic material, because in their experience students are often inadequately prepared in either electromagnetism or fluid mechanics; but this book will do little to remedy this situation.

No account is given of turbulence, nor is reference made to numerical solution methods; these are serious omissions in a book designed for future engineers and applied physicists.

The advanced student may not find this book useful as a text book; for too little verbal explanation is given of the underlying physics. However, he will find it of use for reference material.

H. I. ROSTE