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REVIEWS

General Mechanics. BY HENRI CABANNES. (Translated from the second French edition by S. P. Sutera.) Blaisdell, 1968. 426 pp. $11.50.

This is an interesting book, especially because of its differences from more conventional textbooks. It contains two chapters on fluid mechanics, one deriving the equations of gas dynamics from kinetic theory, and the other deriving the equations of continuous or discontinuous motion for a fluid from the conservation equations. But these are side issues; the main subject is the mechanics of particles or rigid bodies.

A remarkable number of topics off the beaten track are considered. The treatment of friction is altogether different from the usual $F = \mu N$ approach; there are discussions of internal stresses, choronologies, relativistic corrections, motion of a child on a swing, Jacobian elliptic functions, supersonic bangs, orbits for Maxwellian molecules, electromagnetic focussing, astronomical time, and so on; an outline is given of some of the methods and results of non-linear mechanics; and one of four text problems at the end discusses the Störmer theory of the polar aurora. All these are mixed in among the discussions of more conventional topics, to such an extent that one is never sure what is coming next.

The author's stated purpose is 'to give assistance to students and practitioners of engineering and physics by presenting well-known problems clearly and precisely'. I would not, however, regard it as a textbook suitable for students. This is partly because the variety of topics treated, and their uneven difficulty, militate against a systematic treatment—one sometimes even suspects that the author is trying to demonstrate that mechanics is not a tidy subject, tidiness being introduced only in books not concerned with applications to real life. Partly, too, it is because the author discusses many elementary and advanced topics in detail, but dismisses in a somewhat cavalier fashion several points which I have regularly found to give difficulty to students. Lastly, though the book develops mechanics *ab initio*, some important topics are glossed over; for example, mass is defined simply as an additive parameter, and the fundamental law of mechanics is then introduced in the form 'There exist certain frames of reference and chronologies called absolute, relative to which the motion of the material leaves the vector difference $\mathbf{\Omega}$–$\mathbf{I}$ invariant' (where $\mathbf{\Omega}$ is the resultant momentum and $\mathbf{I}$ the time-integral of the resultant force).

As this example illustrates, the book is not an elementary one; but it is both interesting and novel. I would recommend teachers of mechanics to read it and ask themselves why the exposition differs from their own. At some points the answer will be trivial; at others it may stimulate a change to a more exciting presentation.

T. G. COWLING

Mixing: Theory and Practice, Vol. 1. Edited by V. W. UHL and J. B. GRAY. Academic Press, 1966. 340 pp. £6 4*s*.

Mixing of inert liquids and solid particles into liquids is a common process in the chemical industries. To date the technology of it has been developed by practising engineers working on full-scale equipment in operating plants. This book is the first part of a two-volume set designed to summarize the technology for the benefit of designers and operators. The subject has been split into topics and each is treated in separate chapters written by different specialists. A common result of such an approach is lack of continuity between chapters and this book suffers particularly from it. The authors adopt varying levels of sophistication and terminology so one must be versed in the subject to appreciate the relationship between the topics.

Chapter 2, by R. S. Brodkey, provides a review of the areas of fluid mechanics pertinent to mixing. A fundamental and rigorous approach is adopted so the material is different from any other chapter in this volume. No reference is made to either the equations or conceptions in the other chapters. In the first half a review of turbulent flow is given, with the emphasis on homogeneous isotropic turbulence. Equations for correlation and spectral tensors are derived and Kolmogoroff's theory of locally isotropic turbulence is explained. These ideas, which are central to the statistical description of a turbulent field, are then used to describe a field of mixed fluids. For example, an intensity and scale of mixing can be defined for use in laboratory studies; and correlation and spectral equations developed. The last part of the chapter is devoted to analyses and experiments which have been made on real fluid flows. These illustrate the current state of development of the subject. All the analyses are speculative and involve drastic assumptions. In no case has comparison been made with experimental results.

In the writer's opinion this review of turbulence and turbulent diffusion accurately reflects the current literature. It is to be recommended to anyone seeking a concise, up-to-date review. There are, however, many defects which make interpretation difficult. The most serious is the treatment of the convective transport of a scalar property by the mean flow. This is considered in a section entitled 'Bulk diffusion' which the author defines as 'a catchall term to include those forms of diffusion other than molecular and turbulent'. It is apparent that he intends this to describe the accelerated diffusion produced by the interaction of the convective and diffusion terms in the scalar transport equation. This process described by Taylor in his analysis of the spread of a dye spot in pipe flow is also widely called 'dispersion'. The author describes the convection processes but does not state the mass-conservation equation. The impression is thus given that the various forms of bulk diffusion are different mechanisms. In fact they all are the result of the convection by the mean flow. A similarly vague description of dispersion is found in the sections on diffusion packed and fluidized beds.

The other three chapters of this volume present descriptions and characteristic data for machines and processes of mixing. In each one engineering problems are answered specifically on the basis of test results. Chapter 3, 'Impeller characteristics and power', by R. L. Bates, P. L. Fondy and J. G. Fenic, contains descriptions of the shapes of impellers used in closed tanks to promote circulation and the production of turbulence. Power required to drive the impeller is related to the shaft speed through dimensionless parameters determined from similarity criteria. Experimental measurements are used to give the specific relationship.

The flow pattern and time required to mix two constituents in a cylindrical vessel are discussed in the chapter by J. B. Gray. Velocities and streamlines observed in vessels are described and it is shown that these cannot be determined analytically from the impeller shape and speed. Mixing is described and evaluated by the time of mixing defined as the time required for concentration variations to become less than 0·1 % of the average. These data are also presented in terms of dimensionless parameters.

In the last chapter, 'Mechanically aided heat transfer', by V. W. Uhl, the dimensionless heat transfer coefficients pertinent to cylindrical vessels are defined. These are presented in plots for various heating schemes such as external jackets or internal coils and for various types of agitation. Details of heating device construction are also given. It is clearly demonstrated how performance of any construction can be predicted from model tests.

Although this book is not written for applied mathematicians and physicists it is recommended for their perusal. The material as presented shows the state of development of the field and within it many unsolved problems of an analytical nature are apparent.

W. D. Baines