

REVIEWS

Mécanique des Suspensions. By A. FORTIER. Masson, 1967. 176 pp. 45F.

Fluid Dynamics of Multiphase Systems. By S. L. Soo. Blaisdell Publishing, 1967. 524 pp. \$16.

The subject of two-phase or even multiphase flow is one of obvious practical significance. Examples include such diverse phenomena as boiling, gas-liquid flow in pipes, the motion of suspensions and slurries, etc., most of which are generally encountered in many of the standard industrial processes. And yet, owing chiefly to its great complexity, this important area of fluid mechanics has not, to date, been investigated in any very systematic way, the result being that the practicing engineer must still rely by and large on crude and often highly inaccurate empirical correlations to guide his design. Hence, the appearance of the two books by Fortier and by Soo is particularly timely because these should help focus attention on many of the unsolved problems in this exciting and active field.

Professor Fortier's monograph deals exclusively with the fluid mechanics of suspensions. Its value is not as a research book (only two references are cited!) but rather as a carefully written text on a few special aspects of this topic. Particularly valuable are the first three chapters in which many of the main concepts and basic equations are introduced. The presentation is clear and the whole development is easy to follow. The remaining part of the book is devoted primarily to the motion of a single small sphere (or a collection of independent small spheres) in a continuum fluid under various states of motion (e.g. steady uniform laminar flow, turbulent flow, etc.). Again, the style is clear and makes for easy reading but, unfortunately, many of the sections are curiously quite out of date. For example, the appropriate solutions to the creeping flow equations are derived in each case using lengthy and laborious techniques rather than some of the generalized methods developed by Brenner and others for this purpose. Even more serious is the impression given on p. 63 that the high Reynolds number flow past a sphere obeys the Oseen equations rather than the full equations of motion. Also, the lift on a sphere is never taken into account in the various analyses. Finally, many of the more important topics in this area, such as particle migration (e.g. the Segré-Silberberg 'pinch' effect), are not even mentioned, whereas the treatment of the effective viscosity of suspensions is confined to infinitely dilute systems and follows the rather questionable analysis originally put forth by Einstein. Hence, it is this reviewer's opinion, that the author's goal which as stated in the preface, was to bridge the gap between theoretical developments and practical applications in this field, still remains to be achieved.

Professor Soo's book offers an interesting contrast to the monograph just discussed. For one thing, it contains a record-breaking 906 references ranging from highly sophisticated contributions such as Truesdell and Toupin's article

on 'The Classical Field Theories' in the *Handbuch der Physik*, to papers containing mainly empirical correlations. Also, the following topics are considered: transport processes of a rigid particle, transport processes of a deformable particle, pipe flow of a suspension, transport properties of a cloud of particles, basic equations of multiphase systems, gas dynamics of a suspension, hydrodynamics of a suspension, sedimentation, fluidization and packed beds, and, finally, electrostatics of a suspension. Clearly, the value of the book is that it does touch upon many important subjects and does not lack in references; however, its main defect is that it is written not as a textbook or even a research book, but rather in the style of a very uncritical and at times carelessly worded review. For example, the author has made little attempt to differentiate between outstanding contributions or those having only passing value; in presenting his material he appears to have made little effort to follow a reasonable pattern with the result that, often, high Reynolds numbers solutions, low Reynolds numbers solutions, exact solutions, approximate solutions, empirical results are all thrown in together and seemingly treated as one. The text, is also studded constantly with statements, such as 'Jones considered the effect of turbulence on . . . , Smith investigated the influence of . . . on . . . ' etc., which, are not very helpful to the reader and tend to destroy the continuity of the overall train of thought. It is indeed a great pity that, having taken the trouble of collecting all these references, the author chose to treat these pretty much on an equal basis thereby missing an opportunity to present the past accomplishments in their proper perspective and point the way for future work. This is particularly regrettable because the value of the present book seems to lie primarily in the extensive list of references rather than in the body of the text.

A. ACRIVOS

The Wind and Beyond. By THEODORE VON KÁRMÁN with LEE EDSON. Little Brown and Company, 1967. 376 pp. \$10.

This is a thoroughly interesting and enjoyable book—an excellent book.

Von Kármán was born in Budapest in 1881 and died on 7 May 1963, four days before his eighty-second birthday. His long life was full of achievement. He was a leader in many fields, especially, but not exclusively, in aeronautical engineering, fluid mechanics, and solid mechanics, with a deep influence on technology, and on the closing of gaps between theory and engineering practice, and he did much to reduce the gulf between what he considered pure empiricism on the one hand and sterile theory on the other. He was noted as a wit and a raconteur. He was a vigorous proponent of international collaboration in science, and a successful originator and participant in its organization. He was a great and inspiring teacher, who maintained close relations with many of his former students. He had also a wide circle of friends and acquaintances in all walks of life in many parts of the world. From Budapest he went to Göttingen, and then as professor first to Aachen and then to Pasadena. He served as Chairman of the Scientific Advisory Board to the Chief of Staff of the U.S. Air

Force, and later as Chairman of the Advisory Group for Aeronautical Research and Development (AGARD) of NATO.

This brief and incomplete summary was given to explain what is meant by saying that 'it is all in the book'. This is, therefore, a rare kind of book for our times, being the record of a long life of an eminent engineer and scientist, warm-hearted and witty, much-travelled, well-known by many, devoted to international collaboration, who, in his own words, as a scientist found the military 'the most comfortable group to deal with'.

The book tells much of how von Kármán thought and spoke about engineering, science, and research that is of interest to the 'professional' reader, but the book is written for the 'general' reader and the professional will probably find the technical discussions inadequate. Accounts of von Kármán's own professional work may be found elsewhere. (For summaries, see, for example, *Biographical Memoirs of the National Academy of Sciences*, vol. 38, 1965, pp. 345-84, by H. L. Dryden, and *Biographical Memoirs of Fellows of The Royal Society*, vol. 12, 1966, pp. 335-65, by the reviewer. Von Kármán's *Collected Works*—up to 1951—were published by Butterworths Scientific Publications in 1956.)

About one-quarter of the book takes us to the end of the First World War, and the last quarter of the book treats events after the Second World War. Probably for the majority of readers the balance is about right. I would myself have liked to read even more than is in the book about how it all started, but then American critics have been known to complain that it is a pity that so much time is often wasted by biographers on genealogies and beginnings, so I must agree that the division in the book is probably right in general.

Quite generally, Lee Edson seems to have done a fine job of organizing the mass of material supplied to him. He clearly took pains to check the material, and consulted a number of von Kármán's associates; and he has written—or re-written—the material he used, as well as his own introductory chapter, in a way that makes it all very pleasurable to read, and that rings true to those who knew von Kármán.

SYDNEY GOLDSTEIN