Int. J. Heat Mass Transfer. Vol. 14, pp. 1879–1880. Pergamon Press 1971. Printed in Great Britain

BOOK REVIEWS

MIKHAIL N. KOGAN, **Rarefied Gas Dynamics.** Computer Center, Academy of Sciences of the USSR, Moscow, translated from Russian. Translation Editor Leon Trilling, Department of Aeronautics and Astronautics, M.I.T., Cambridge, Massachusetts. Plenum Press, New York (1969).

WITH an extraordinary combination of personal research and exhaustive scholarship, Professor Kogan provides a smoothly connected account of the theory of rarefied gas dynamics, as it has developed over the past sixty years, up to about 1968.

He defines his subject as coinciding with the theory of the Boltzmann equation and of various models of that equation, with applications largely in the field of aerodynamics and heat transfer. A constantly and successfully emphasized theme is elucidation of the role of the hydrodynamic approximations (Navier–Stokes equations, etc.). The emphasis is nicely balanced between mathematical deduction and physical intuition. The range of topics and special problems will be quite familiar to any follower of the International Symposia on Rarefied Gas Dynamics.

The book makes three very strong impressions on me.

First it is *the* book to which the serious, and mathematically inclined, researcher can turn to prepare himself for work in this field. It is, however, not for the casual reader or the absolute beginner who hopes to skip through, to pick out a few results of special applied interest. This is not the fault of Professor Kogan, who argues with unusual clarity. It is simply that one's personal understanding of the Boltzmann equation depends on a gradual and patient assimilation of a great many special results and subtle concepts.

Second, its flavour is absolutely international. Professor Kogan is obviously completely at home with the work of Americans and other "foreigners", and his writing and style of analysis will seem not at all foreign to English-speaking readers.

Third, this book must survive as a classic of technical translation and meticulous editing. I am not competent to judge the linguistic accuracy of the translation, but it seems clear that we owe to Professor Trilling a final smoothness and clarity which could only be the product of a deep personal interest in the subject, perfect fluency in both languages, and an unusual empathy with the thoughts of the original author.

The book seems also to have been written at just the right time. Although research continues fairly actively in this field, the general theoretical picture appears, with one major exception, to have changed little since publication of the Russian edition in 1967. The exception, in this reviewer's opinion, is the remarkable development of the Monte Carlo "direct simulation'. method, pioneered by G. A. Bird. (See, for example, G. A. Bird (1969), *J. Fluid Mech.* **36**, Part 3, 571–576.)

F. S. SHERMAN

Two-Phase Flow Instrumentation. Published by A.S.M.E. $9·50, 101 pp. 1969.

THIS paper-bound volume contains eight papers presented at the 11th National ASME/AIChE Heat Transfer Conference in 1969. Together they form a useful review of methods of measuring the properties of two-phase, particularly liquid–vapour, flows.

Six of the eight papers were intended as reviews of particular experimental techniques. The exceptions are the papers by N. Miller and R. E. Mitchie and by G. E. Walmet and F. W. Staub. The former describes the operation of a 'universal' probe for the local measurement of void fraction and the latter specific measurements of pressure, temperature and void fraction in non-equilibrium two-phase flows. Both papers describe specific and useful extensions of techniques referred to in the review papers and are not out of place in this volume.

The review papers are concerned with Optical Techniques, Radiation Attenuation Techniques, methods of measuring the properties of liquid films and particularly wall-shear stress, Sampling Devices for phase-flow rate determination, Hot Film Anemometry and the Application of Electrical Probes to void fraction, bubble size and film thickness measurement. The authors are authorities in their subjects and have taken this opportunity to provide explanations of the principles of operation and hardware required for the various measuring techniques; applications, experimental difficulties and possible precision are also discussed.

The purpose of the volume is commendable and is well expressed in the foreword: "It is hoped that the papers contained in this volume will not only provide guidance to workers using presently available instrumentation as a tool in two-phase flow studies, but will also aid and inspire development of new and improved instruments and techniques to meet these challenges." This assembly of clearly written papers with their large and up-to-date bibliographies will undoubtedly go a long way towards the former aim and, hopefully, may provide a foundation for the latter. It is to be hoped that, to these experimental aims, might be added the need for experimental work in two-phase flow situations to be directed towards assisting the formulation and testing of prediction methods possessing considerably greater generality than many of those presently found in the literature.

J. H. WHITELAW

HOLLAND, MOORES, WATSON and WILKINSON, **Heat Transfer.** 612 pp. Heinmann Chemical Engineering Series, London (1970). £6.00 net.

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