

## BOOK REVIEW

**Fundamentals of Heat Transfer.** H. GRÖBER, S. ERK and U. GRIGULL (translated by J. R. Moszynski), McGraw-Hill, New York, 1961, 527 pp. 116s. 6d.

THE reviewer may well be tempted to sigh at being confronted with yet another general work on heat transfer. The present volume, however, is no newcomer as it has an honourable history dating back to 1921. It is a translation of the well known *Die Grundgesetze der Wärmeübertragung*, by Gröber and Erk, the third edition of which was revised and considerably extended by Grigull. Since this edition was published in 1955, one cannot expect it to be completely up to date now in such a rapidly expanding subject; but the translator has made a number of changes and additions in an attempt to meet this criticism.

The book essays to cover virtually the whole field, including mass transfer, and even within 500 pages only a small proportion of the available material can be included. The plan adopted, in keeping with the title, is to deal with first principles at considerable length, and then give little more than a summary of more advanced aspects of the subject, indicating in outline the methods used, the results obtained and sources of further information. The space devoted to fundamentals is well used and the exposition is of unusual clarity, so that the book should be of great value to the student who is trying to learn the subject unaided. He will, however, soon find the need for recourse to other works if he wishes to pursue his studies at all deeply, or if he wishes to apply his knowledge to practical problems.

This emerges very clearly in the first section of the book, dealing with conduction, which occupies the unusually high proportion of 30 per cent of the whole. It contains an introduction to Fourier series methods which could hardly be bettered, but does not introduce the Laplace transform at all. Numerical methods are dealt with cursorily, and the novice will need to learn much more before he can claim a mastery of the subject as it is now practised. The translator has added short sections dealing with heat sources and fins. There are three pages on conduction in rarefied gases.

The section on convection—as usual much the longest in the book, with about 270 pages—follows a similar pattern. There is an excellent general chapter on fluid motion and energy transport but the level is rather elementary: the Navier-Stokes equations, for example, are presented but not derived. Twenty pages are devoted to an admirable account of the principle of similarity, both the standard approaches being considered at length. In the chapter on laminar forced convection, the “Graetz” problem, the boundary layer approximations and integral equation methods are discussed in some detail, but topics such as the flat non-isothermal plate, the flat plate with

variable fluid properties, experimental results and working formulae are dealt with much more briefly. There is a useful section on the effect of dissipation in lubrication problems.

Turbulent forced convection starts with the various analogies, expounded with the same clarity, including a good account of Reichardt’s work; the remainder of the chapter consists of a dozen pages on working formulae, mostly concerning pipe flow. There is a brief chapter on transverse flow—single tube, tube banks, normal flat plate—the material being largely of a descriptive type, giving references and some of the usual formulae and tables; there are ten pages on high speed flow. The chapter on free convection provides an excellent survey of the vertical flat plate problem, covering a wide variety of sources, but oddly enough omitting any reference to Ostrach’s computer solution; there is a very good section on free convection in enclosed spaces.

Condensation starts with the Nusselt theory, dealt with at some length, but other matters are covered descriptively, though the picture is comprehensive and includes turbulent film condensation, superheat, forced convection, dropwise condensation and non-condensable gases. Evaporation has substantial sections on nucleate and film boiling, with the usual wide coverage at an elementary level, affording a valuable introduction to the subject. There is a short chapter on mass transfer, dealing mainly with the mass/heat/momentum analogies and their limitations but concluding with a brief account of mass transfer cooling.

The section on radiation also keeps to an elementary level and is best in its clear accounts of the fundamental laws; the more complex aspects of the subject are only lightly touched upon, though there is a good chapter on the radiation behaviour of gases, with a useful selection of references.

The original tables of conversion factors and physical properties have been retained, and short appendices added on the network analogue method of calculating radiative heat transfer, heat exchanger calculations and Bessel functions. (That on heat exchangers reminds us that the book is primarily concerned with fundamentals: in 500 pages we have not previously encountered a heat exchanger, nor been introduced to a logarithmic mean temperature difference.) A collection of over 100 problems has been added (without solutions). The table of symbols and nomenclature has been omitted, which is a pity, but the useful list of books on heat transfer has been included and brought up to date. References generally are given at the end of each chapter; there are nearly 700 of them all told.

The translation has been admirably carried out and slips and misprints are negligibly few (with a notable

exception in the publisher's blurb). The diagrams have apparently all been redrawn and seem to the reviewer to have been considerably improved in the process. The British system of units is used consistently throughout.

The book should, therefore, be a useful addition to the library of works in English which are primarily intended

for tuitional purposes, and offers the advantages of great clarity at an elementary level and an unusually comprehensive collection of references to European publications. The high price will be a handicap.

A. J. EDE