Int. J. Heat Mass Transfer. Vol. 13, pp. 655–656. Pergamon Press 1970. Printed in Great Britain

BOOK REVIEW

T. F. Irvine and J. P. Hartnett, **Advances in Heat Transfer,** Vol. 5, 538 pp. Academic Press (1968). Price $22.50

Once again the editors have produced a volume containing well-balanced, critical surveys of important heat transfer topics. In the first, J. R. Howell describes the type of problem which has attracted Monte Carlo enthusiasts. Previous knowledge is not assumed, and he leads the reader into the subject via a simple example of radiation exchange. Applications to radiation problems involving complex geometry, variable directional or spectral properties of the surfaces, and absorbing–emitting media, are then discussed. (Knowledge that variable directional and spectral properties can be handled may encourage the determination of more data for real surfaces.) Two-dimensional transient conduction, coupled modes of heat transfer and turbulent diffusion are also touched on briefly. No extravagant claims are made for the Monte Carlo approach and the author is careful to point out the limitations. The chief advantage appears to be that increasing problem complexity does not lead to disproportionate increase in solution complexity (i.e. computer time) as is the case with conventional methods.

D. P. Jordan deals with film and transition boiling at a useful point in time where much of the subject can be considered well understood. Considering natural convection first, he outlines a theory of film boiling from horizontal cylinders, discusses modifications to cover extremes of cylinder diameter, and shows that there is now a satisfactory general correlation for this case. Vertical and horizontal surfaces are also treated in detail, the correlations being satisfactory for the former and somewhat less so for the latter. There is a helpful appendix on hydrodynamic instability in liquid/vapour systems. Turning to forced convection film boiling, adequate data exists for predicting heat transfer in external flow around horizontal cylinders, but further work is required for internal flow through vertical tubes and annuli. The chapter closes with a brief discussion of transition boiling and of available data on minimum film boiling heat fluxes.

That F. Kreith's review of convection heat transfer in rotating systems is timely, is evident from the 193 references nearly all of which are of post-1950 vintage. The story, well told, is virtually complete for bodies of revolution rotating in an infinite quiescent fluid and almost complete when there is a superimposed axisymmetric flow. When the body is shrouded, however, the picture is very different. Even for the simplest case of a disc, the number of possible flow configurations is very large and it is doubtful whether research will lead to anything more than a series of empirical correlations for particular geometries over limited ranges of the variables. (Incidentally, the work by Iguchi and Maki on discs spinning in cylinders appears to have been overlooked.) The case of rotating concentric cylinders with axial flow receives generous treatment, but here again the number of possible flow regimes makes analysis of results difficult. Much more work needs to be done for this important geometry. Kreith's excellent survey, together with Dorfman's book, will considerably ease the path of newcomers to the field.

C. L. Tien considerately begins his contribution on thermal radiation properties of gases by explaining the concepts necessary for the formulation of these properties. He then reviews the physics of atomic and molecular spectra, and follows this with a discussion of various models and laws relating to line, band and continuum radiation. The last two sections describe the way in which these data on emission and absorption can be used in calculations of energy transfer between a radiating gas and its enclosure. For temperatures up to 2100°K, total emissivity of common gases can now be calculated from spectral emission data to supplement the Hottel charts. At very high temperatures, data are scarce; but theoretical values have been calculated for air and hydrogen (stimulated by the re-entry problem and current interest in plasmas). Methods of approach via the concepts of mean beam length and mean absorption coefficient are discussed briefly, but the value of this section would have been enhanced by the presentation of a simple example.

The book concludes with a major contribution on cryogenic heat transfer by J. A. Clark. A difficulty in this field is that the temperature differences are large and the property variations of cryogenic fluids are marked. Nevertheless, a method of handling this feature in transient conduction problems is described; and it is shown that for forced and free convection the normal correlations apply provided they include a $(T_w/T_b)^n$ parameter or its equivalent. A useful summary of such correlations is provided. That they may be inadequate when the fluid is near its critical state is shown by some data for hydrogen. The other conventional heat-transfer topic dealt with at length is boiling, and here again there is a useful survey of correlations found to be particularly useful for cryogenic fluids. Other more specialized topics covered are low-temperature insulation, frost formation, effect of cryogenic deposits on surface radiation properties, pressurized-discharge processes and effect of stratification on tank pressure and discharge rates, and the properties of the superfluid helium II.

Any suggestion that this book is a volume of review articles does it less than justice. Each topic is dealt with at much greater length than is possible in a review article, and much can be learnt without reference to the original papers. Clearly the editors have encouraged the contributors to produce genuine introductions to their subject rather than disjointed summaries of collections of papers. A uniformly high standard has been achieved. There is no doubt that a most valuable service is provided by this type of book and all concerned are to be congratulated.

G. F. C. ROGERS

Department of Mechanical Engineering,
University of Bristol.