could copy with advantage his method of writing books. He has set himself a clear objective, and resisted the temptation to display his knowledge of topics which are irrelevant to it; the argument is marshalled logically and with full consideration for the reader's interests; and the auxiliary material, such as examples, nomenclature, diagrams, and references, is organized impeccably. Finally, the publishers have given the book a handsome appearance, uniform with that of the latest edition of H. Schlichting's *Grenzschicht-theorie.*

D. B. SPALDING

The Proceedings of the 1967 Heat Transfer and Fluid Mechanics Institute, 468 pp. Stanford University Press, Stanford, Calif. (1967).

THE PROCEEDINGS of the Heat Transfer and Fluid Mechanics Institute can generally be relied upon to contain a number of papers of fundamental as well as of specialist interest and this volume presenting the papers of the 20th annual meeting is no exception. The host institution was the University of California at San Diego, and in consequence the main fields of interest there, namely post-Apollo re-entry phenomena and propulsion fluid mechanics and heat transfer figure prominently in the fields discussed. However, in addition a selection of papers were presented covering vortices, wakes and boundary layers.

Two general invited lectures, one on atmospheric entry in the post-Apollo Era by L. Roberts and one on analytical studies of two-phase flow in propulsion systems by F. E. Marble are presented in abstract only; the remaining papers are given in full.

A paper on the aerothermodynamic problems of the Apolo by R. B. Erb, D. B. Lee, K. C. Weston and D. H. Greenshields discusses the theoretical and experimental techniques that have been adopted to investigate and solve these problems and the flight tests that have so far shown encouraging agreement with the predicted results. The practical importance of heat transfer in the region of the stagnation point and the effects of radiation are reflected in all the six papers that follow. S. Y. Chen, J. Baron and R. Mobley examine theoretically the effectiveness of transpiration cooling in that region in hypersonic flight, and P. R. Nachtsheim examines multi-component diffusion in chemically reacting laminar boundary layers with particular reference to the flow at the stagnation point of an axi-symmetric body. D. B. Olfe and R. J. Cavalleri are concerned with shock structure as affected by non-grey radiative transfer, N. A. Macken and J. P. Hartnett discuss the interaction of convection and radiation in stagnation point flow and include the effects of suction and blowing. R. B. Dirling, W. S. Rigdon and M. Thomas develop an approximate technique for determining the flow field and heat transfer in the radiating shock layer under conditions where atomic-line radiation is important and requires detailed spectral calculations, and much the same problem is considered by G. T. Chapman who includes the effect of mass transfer.

The section on propulsion fluid mechanics and heat transfer displays a strong interest in the effects of acoustic fields and other forms of vibration on fluid jet-flows. One of the problems which gives rise to such studies is the need to understand high frequency combustion instability in liquid-propellant rocket motors. F. G. Buffam and F. A. Williams describe investigations of the response of a turbulent liquid jet to transverse acoustic fields and show that the coupling can be large; R. J. Schoenhals, E. R. F. Winter and E. I. Griggs present results showing that longitudinal structural vibrations can produce a flow retardation effect; H. G. Keith and K. R. Purdy investigate analytically the effects of an intense longitudinal acoustic field on forced convection heat transfer and show that these effects can be important. Other papers in this section include a study of convective heat transfer in the base region of large space boosters with clustered engines by R. A. Taylor and P. P. Tou, an interesting optical technique of measuring turbulence in a supersonic jet by M. J. Fisher, D. W. Prosser and J. M. Clinch, and a parametric solution of the one-dimensional flow equations with heat addition by S. S. Penner and W. Davidor.

The final group of eight miscellaneous papers include an interesting paper on vortex breakdown by M. G. Hall, a simple model by F. Fendell and D. Coats to describe the structure of a rotatory flow associated with a heat source of relevance to geophysical phenomena (e.g. tornadoes), a basic paper on the application of heated films to the measurement of skin friction by G. L. Brown, an analysis of the effects of free stream acceleration on base flows at supersonic speeds by A. F. Charwat, G. H. Burghait and W. H. Nurick, a theoretical and experimental investigation by Y. T. Chin, J. Hulsebos and G. H. Hunnicutt of the effects of lateral curvature on a turbulent boundary layer in air, including the effects of helium injection, an important investigation of the effects of free stream acceleration on flow and heat transfer in a turbulent boundary layer by L. H. Back and R. A. Seban, valuable shock tunnel measurements of heat transfer and skin friction in the turbulent boundary layer on a flat plate over a useful range of the main parameters by J. E. Wallace, and finally an investigation of non-equilibrium air dissociation and ionization in the merged layer regime in the region of the stagnation point of a blunt body.

It is clear that any active worker in the fields of heat transfer and fluid mechanics will find much of long term value to him in these Proceedings, even if the applications with which he may be concerned are well remote from the Apollo and post-Appolo programmes that have evidently inspired many of the papers.

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