Int. J. Heat Mass Transfer. Vol. 6, pp. 869–870. Pergamon Press 1963. Printed in Great Britain.

BOOK REVIEWS

High Mach Number Air-Breathing Engines (Proceedings of the Fourth Agard Colloquium on Combustion and Propulsion) (Edited by A. L. JAUMOTTE, A. M. ROTHROCK and A. H. LEFEBVRE, published Pergamon Press 1961; 396 pp. 105*s*.

THE highest flight speeds contemplated for turbo-jet engines are of the order of 2500 m.p.h., and there is then a considerable gap in the flight spectrum before the velocities typical of long range ballistic and orbiting rocket vehicles are reached. The possibilities of flight at sustained speeds within this gap have received less attention than perhaps they deserve. so any authoritative survey of them should be welcomed. Heat transfer will be an obvious problem, since at speeds around 5000 m.p.h. the stagnation temperature of the air relative to the vehicle structure will be about ten times its static value. Heating of the internal surfaces of the engine will be just as serious since a very high operating temperature is needed to produce a net propulsive thrust. It is, therefore, a little surprising that in this AGARD volume on high Mach number air-breathing engines the only really direct reference to heating problems is contained in a single graph—where the impressive figure of 400 Btu/ft^2 s at the nozzle throat is shown—although the complementary subject of heat resisting materials has quite a full treatment.

Of the thirteen papers presented, the first four—by A. Ferri, M. A. Zipkin and L. M. Nucci, J. A. Drake, and G. L. Dugger—deal with theoretical performance. They make it clear that the main openings are for a Mach 7 vehicle powered by a ram-jet engine in which the air-stream is diffused to a subsonic speed before burning takes place; and for a ram-jet-powered satellite launcher, in which supersonic burning is employed. In either case the craft would need boosting to at least Mach 3 by conventional turbo-jet engines.

Ram-jet performance is very sensitive to air intake efficiency, which is discussed in papers by J. F. Connors and L. J. Obery and by G. H. McLafferty; and to the rates of reassociation in the exhaust nozzle, which are considered in papers by P. P. Wegener and by E. A. Lezberg and R. B. Lancashire. All these four papers include experimental results.

There is then a good general review of the properties and possibilities of high temperature materials by A. J. Murphy and A. J. Kennedy, the particular cases of W, Mo, Nb and Ta being considered in more detail in another paper, by P. Duwez. The contribution from J. H. Horlock on compressor and turbine performance problems, although authoritative, is rather on the fringe of the main subject.

Combustion *per se* is not expected to be a problem at high inlet air temperatures. However, the volume contains two papers on supersonic combustion. The first' by H. Behrens and F. Roessler, describes the results of exhausting a partly burnt, under-expanded jet into a still, oxidizing atmosphere. The other, by A. K. Oppenheim, on the development and structure on plane detonation waves, is a masterful treatise on the subject, integrating over 200 references.

It will be appreciated from the above comments that the papers are something of a mixed bag. Only a few of them, including specifically that by Oppenheim, are likely to keep their value for more than three or four years in such a rapidly advancing branch of technology. The whole work commends itself, therefore, more to the librarian or research group than to the individual specialist, who can hardly justify its expense on the grounds of the one or two papers that will interest him.

S. L. BRAGG

Reaction Heats and Bond Strengths. C. T. MORTIMER. Pergamon Press, London, 1962, pp. xii + 230. 35*s*.

THIS book is concerned with thermochemistry for chemists. It is based on a series of lectures given to postgraduate students at the University of Keele, and thus reflects the special interests of the author rather than attempts to cover the whole field of reaction heats and bond strengths systematically and comprehensively. After an introductory section, there are: three chapters on strain energies in organic compounds, on stabilization energies in non-aromatic compounds, and on strain energies and resonance energies in aromatic compounds; one each on polymerization energies and molecular-addition compounds; three on bond energies in organic compounds, organometallic compounds, and on compounds of Si, P and S; and one on ionization energies in aqueous solutions.

The general standard is extremely high, the material up to date and criticisms are few. There is some unevenness in depth of treatment (which sometimes accentuates the subjectiveness of the width of topics chosen); and the author sometimes estimates unknown quantities in a roundabout way, like the Irishman who found the weight of a pig by balancing it against a stone and then guessing the weight of the stone. But, in general, Dr. Mortimer is as stimulating off his own field as on it. All his material is interesting, topical and presented with clarity and skill. This is a good book.

P. GRAY