

together elsewhere, but certainly omits almost all the major physical analytical methods, several of which await review. It would be interesting to know just how this particular collection of topics was decided upon.

Individually, the chapters contain much which is of value to those working in the field of steroids. Collectively, they suffer three serious defects. The first is the fact that more than 4 years have elapsed since certain chapters were completed! It is incredible that a book sent for review in 1964 should contain chapters in which post-1959 literature is summarized in a section "added in proof"! This fault leads to a second—the nomenclature employed. The IUPAC nomenclature report on steroids appeared in 1960. Thus, there *is* an internationally recommended system of nomenclature which should have been adhered to in a book appearing 4 years later. Failure to do so has inevitably led to the third defect, namely the index. Obviously, a book of this sort requires most careful and complete indexing. Unfortunately, there is no general formula index and, because of the lack of standardization in nomenclature, it was necessary to include a page listing the variations in the systems of naming steroids. (Testosterone is indexed as 17 $\beta$ -hydroxy-4-androsten-3-one. Based on the Index, it appears under that name on two pages only; as testosterone, on 7 pages; and as 17 $\beta$ -hydroxy- $\Delta^4$ -androstan-3-one, on several other pages. The index refers the reader to pages 45, 342, 350, and 377 for this compound, but, in the Reviewer's edition, the compound was not mentioned on these pages. On page 294 the compound is mentioned but is not indexed.)

These faults are all the more unfortunate since there is truly a mine of valuable information hidden in this volume. In particular, the chapter of ultraviolet absorption is to be recommended since it constitutes a vital addition to the earlier review by L. Dorfman. What a pity that this excellent collection of data could not have covered the literature at least until the end of 1962. As it is, this chapter with almost 600 references summarized will still be a great attraction to the steroid chemist. One mistake, however, which will cause problems for the unsuspecting user of the book is the erroneous assignment of a bathochromic shift of 38 m $\mu$  for the ultraviolet absorption maximum on introduction of a  $\gamma$ -alkyl substituent into a dienone system.

If the book were up-to-date, the price would not have deterred would-be purchasers. As it is, many may be tempted to wait for the appearance of reviews which cover the recent literature also.

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**Theoretical Evaluation of Chemical Propellants.** By ROGER LAWRENCE WILKINS, Aerospace Corporation. Prentice Hall Space Technology Series. Edited by C. W. BESSERER and FLOYD E. NIXON. Prentice-Hall, Inc., Englewood Cliffs, N. J. 1963. ix + 463 pp. 15  $\times$  23.5 cm. Price, \$11.95.

More than half of this book is comprised of appendices. The value of these appendices to the rocketeers is attested by titles: Appendix 1, "Thermodynamic Functions of a Monochromatic Oscillator with . . . Anharmonic Correction"; Appendix 2, "Thermodynamic Properties of Some Atomic Species in the Ideal Gas State"; Appendix 3, ". . . for Diatomic Species"; Appendix 4, ". . . for Some Polyatomic Molecules." These tables in a shelf copy will be most valuable to those interested in high temperature gaseous reactions, although the list is necessarily a curtailment of the mass of knowledge that now exists in the world on this subject.

There is less to recommend in the rest of the book. The author proposes to teach those with a knowledge of thermodynamics the methods of calculating thermodynamic information from spectroscopic data and of application of the results to combustion problems, especially those involving the movement of hardware through space. He has gone to great detail, evidently assuming that the prerequisite would be elementary, but the consequence cannot be recommended. Perhaps because of page limitation, the text reads like a catechism rather than an explanation.

Typical on page 12 is the section on Russell-Saunders coupling. In 43 lines the author has confused this relatively simple method by vector summation so thoroughly that the 43 lines in W. S.

Moore's third edition of his "Physical Chemistry" (p. 510) are strongly recommended to the neophyte as a means of rising out of the morass.

Nor is the detail consistently applied. On page 164, gas-flow velocity is designated as  $v$ , while on page 169 it is called  $u$ . Admittedly this duplicity is found in the literature, but it is all the more reason for an explanatory footnote quite different from the one given, which is learned before thermodynamics by every student in first year chemistry or physics.

However, the author is authoritative in Chapter 5, "Performance of Chemical Propellants for Rocket Engines." He limits himself clearly and severely to the theoretical aspects but without discounting the practical aspects of rocketry. He points out that calculation must be made with assumptions either that composition of the gas mixture does not change during expansion through the orifice (frozen flow) or else that equilibrium is established continuously during the expansion (equilibrium or shifting flow) although neither of these conditions actually exist. The prevalent situation (nonequilibrium flow) could be calculated only from reaction rate data, but these are not for the most part available.

When such approximations supplement the deviation from ideal behavior due to turbulence, erosion, and the presence of non-gaseous phases, there is temptation to use the added simplifying assumption that the heat capacity of the working fluid is invariant with respect to temperature. The author describes calculation both by use of exact relationships and by the assumption of an average  $C_p/C_v$  but he leaves no doubt in the mind of the reader that the latter approximation could only be approved in a fool's paradise. The mistakes of early gunnery need not be repeated in the development of rocketry. If the author impresses others as much in this respect as he has impressed the reviewer, then publication of this book is amply justified.

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**Thermodynamik der Irreversiblen Prozesse. Band 8. Fortschritte der Physikalischen Chemie.** By ROLF HAASE. Dr. Dietrich Steinkopff Verlag, Darmstadt, Saalbaustrasse 12, Germany. 1963. 522 pp. 15  $\times$  23 cm. Price, brosch, DM 90; ln., DM 95.

Previous writers on nonequilibrium thermodynamics have been theoretical chemists or physicists. Rolf Haase is an active experimentalist as well, and hence the present volume has a distinctive style. Rather than simply writing down equations and deriving mathematical consequences, Haase explores in depth their physical significance and experimental implications. Throughout the volume he gives examples of how fundamental principles are applied to actual experimental situations. Thus "Thermodynamik der Irreversiblen Prozesse" will be of value to those physical chemists who wish to learn the thermodynamic theory of irreversible processes in relation to its experimental verification.

With admirable Germanic thoroughness, Haase starts at the beginning of his subject and proceeds to a logical end. The first chapter contains an excellent presentation of basic principles. In particular, it is worthwhile noting that a whole section is devoted to the concept of heat transfer in open systems. The second chapter is concerned with homogeneous systems. Here thermodynamic coupling of chemical reactions is examined critically, and relaxation processes are studied. In the third chapter, nonequilibrium phenomena in heterogeneous systems are considered. Electrokinetic effects, thermomechanical effects, and thermo-osmosis are given special emphasis. In the fourth chapter, continuous systems are treated. Among the topics discussed are isothermal diffusion, thermal diffusion, thermocells, external gravitational and electromagnetic fields, and anisotropy. The fifth and final chapter is concerned with the theory of stationary states. The chapter closes with a brief qualitative section on stationary states in biological systems.

Perhaps the most important criticism of the volume is that Haase does not mention the paper by Coleman and Truesdell (*J. Chem. Phys.*, **33**, 28 (1960)) which has occasioned considerable interest. Some of the discussion of the Onsager reciprocal relations and the phenomenological relations would have been improved if he had taken their conclusions into account. Other-