ligand atoms X or Y, whether they occur as parts of separate ions in salts and solutions or within the endless structures of crystalline solids or glasses, acting there as spectroscopical units, *i.e.*, as chromophores. M may be any element of positive oxidation number, comprising not only all the metals, but also hydrogen, the heavy halogens, and even some of the noble gases (*e.g.*, in the xenon compounds). The ligands range from fluorine all the way down the electronegativity scale to certain metallic elements in intermetallic compounds. Only the true organometallic compounds with alkyl and aryl groups σ-bonded to metals are outside its scope.

The author is, of course, particularly interested in the spectroscopic and magnetic behavior of these complexes. He gives innumerable positions of absorption bands and their interpretation. When the spectra have not been taken, at least the color of the compound in question is stated. Furthermore, the book gives an interesting account of the solution stabilities of complexes, including chelates, polynuclears, and even simple ion pairs, not only in water, but also in strong HCl (chloro complexes) and nonaqueous solvents. Whenever possible, the kinetic characteristics are also stated. Related phenomena of solid-state chemistry and physics are also discussed. The many literature references make up a bibliography with 1176 citations.

In only 180 pages, this book contains an almost complete review of that part of inorganic chemistry that has been the outstanding field of research during the past 20 years. In spite of the condensed form of presentation of a huge amount of experimental facts, the text is easy and entertaining to read. Every chemist will profit in doing so.

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Radiolysis of Hydrocarbons. Edited by A. V. TOPCHIEV, Director, Petroleum Institute, U.S.S.R. Academy of Sciences, Moscow. English Edition edited by R. A. HOLROYD, Mellon Institute, Pittsburgh, Pa. American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York 17, N. Y. 1964. xii + 232 pp. 15.5 × 23 cm. Price, $11.00.

This book, organized in seven chapters, is the English translation of a report of the Radiation Chemistry Laboratory of the Institute for Petrochemical Synthesis in Moscow. Acadamician Topchiev, who directed and edited this notable effort, died shortly after its completion. Although it may not be his *opus magnum*, it will certainly contribute to his good reputation.

It cannot be denied that language difficulties make for poor scientific communication between the U.S.S.R. and the rest of the western world. Thus, a book of this type serves two useful functions. Its bibliography reveals to us which of their own national works the Russians consider important in a particular field. On the other hand, it also reveals, by its omissions, a failure to appreciate or to understand, or even to know of the existence of, pertinent non-Russian literature. For Americans, this book is a very good introduction to texts which we might otherwise have overlooked.

The book itself is concerned to a very high degree with the radiation chemistry of heptane and closely related aliphatic hydrocarbons in the liquid and solid states. The mechanistic portion of the interpretation of the chemical facts is largely free-radical orientated, a not unnatural situation in view of the dominant position of Semenov in Russian reaction kinetics. Certainly, many fresh ideas are introduced, but the impression is given in the early chapters, at least, that the pertinence of the literature on the reactions of ions and excited species is not fully appreciated. However, it is clearly apparent that the essentially theoretical portion is intended to be sufficiently broad in its conception and presentation to cover the behavior of charged and excited species.

Certain facts emerge clearly from the presentation. In the work of the Institute, much attention was addressed to establishment of the chemical nature of the products which they presumed to identify. Also, there seems to have been some considerable use of e.s.r. techniques, in a preliminary way to be sure, in the identification of free-radical species present, particularly in solid systems. Further, as indicated mainly in the last chapter, the members of the Institute are very much concerned with the practical employment of radiation chemistry—for example, in what they identify as radiation thermocracking. In the experiments in the latter area, they have examined a number of compounds and mixtures not too closely related to heptane. It is also clear that the people doing the actual practical work concerned with the practical utilization of radiation chemistry have been very much supported in their efforts by people with primarily theoretical interest—although certainly it is difficult to understand how the theorists have permitted survival of an almost religious faith in the log–log method (pp. 55 and 56) for the establishment of precise reaction order.

Theoretical concern shows in the extensive use of free-radical theory in the interpretation of the kinetics, in the limited remarks on the radiation chemistry of hydrocarbons adsorbed on catalysts and on energy transfer in the radiolysis of hydrocarbons, and, very importantly, in Chapter 6 entitled "Some Aspects of the Theory of Hydrocarbon Radiolysis." The theoretical conceptions attempt to be rather general. There is an effort toward mathematical rigor which can encompass the behavior of a wide variety of chemical species. The treatments provide an excellent introduction to papers which are not generally read or whose existence is not even appreciated in this country. Although they reveal to some extent a lack of appreciation of some of the concepts which have been current outside Russia, the freshness of approach resulting from that fact is itself very stimulating to the reader. One gathers the impression that Russian scientific workers are rather generally acquainted with many of the ideas current in the United States, and even with the terminology employed—but not necessarily acquainted with the details or the authorship.

In Chapter 6, there is a clear attempt to develop all-encompassing generalized statistical theory of reaction kinetics applicable to the special case or cases of radiation chemistry. There is heavy emphasis on the theory of collective phenomena and a time criterion of a collective effect is clearly stipulated. Much of the discussion is given over to time and distance details of deposition of energy by a fast-moving charge particle.

Topchiev's "Radiolysis of Hydrocarbons" is a book which ought to be readily accessible to anyone working in the field of radiation chemistry, because it will put him in touch with many features of the Russian literature important both in radiation chemistry and in kinetics generally, which he might otherwise miss. On the other hand, the makeup is not esthetically pleasing; the book seems to have been printed by the photo-offset method and it contains a rather a large number of typographical errors as well as crudities of expression, again a reflection of semantic difficulties, which can result in misinterpretations. *In toto*, however, this book reveals that scientific communication does, in a curious way, surmount language barriers; it, itself, will do much to improve communication and understanding between radiation chemists in the Russian- and English-speaking worlds.

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Physical Properties of the Steroid Hormones. International Series of Monographs on Pure and Applied Biology. Edited by LEWIS L. ENGEL, Associate Professor of Biological Chemistry, Harvard University Medical School. Pergamon Press, The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. 1964. viii + 488 pp. 18.5 × 25.5 cm. Price, $15.00.

Neither the title of this book nor the editorial note give any indication as to the reader for whom the book was primarily intended. Furthermore, there is no indication that there are any subsequent volumes to follow. It is distinctly surprising, therefore, that a book entitled "Physical Properties of the Steroid Hormones" should include no data and not even a single reference concerning mass spectrometry, circular dichroism, or nuclear magnetic resonance spectroscopy. Understandably, the editor does refer to available authoritative compilations of infrared, optical rotatory dispersion, and specific rotation data for steroids. Apart from a fine chapter on ultraviolet absorption spectroscopy by a group of authors from the Lederle Laboratories (almost half the book), this volume contains mainly data on the less well-studied physical properties of steroids—partition coefficients, chromatographic mobilities, fluorescence spectra, and absorption spectra in concentrated sulfuric acid. Thin layer chromatography receives minor mention. The choice of topics does give the reader access to information which is not gathered

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 17β-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 17β-hydroxy-Δ^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 mμ for the ultraviolet absorption maximum on introduction of a γ-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 × 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 to 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 exits 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 nongaseous 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_n 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 × 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-