nature of the bond in the above case which leads to unusual bond strength we also offer the result of the structure analysis of Rb_3MoWCl_8H. The latter compound was prepared as described previously for Cs_3MoWCl_8H[15] and found to be isomorphous and isostructural with $Rb_3Mo_2Cl_8H$.[16] Whereas the Mo–Mo triple bond in the latter compound has the distance 2.38 (1) Å, the Mo–W triple bond in the heteronuclear $MoWCl_8H^{3-}$ anion (Figure 2) has the distance 2.445 (3) Å.[17] This result not only confuses the role of heteronuclearity in determining the net metal–metal bond strength but is doubly enigmatic because this distance is also greater than that in $K_3W_2Cl_9$, 2.41 Å.[18] By contrast we see that, when one bridging H atom is substituted for Cl in $Mo_2Cl_9^{3-}$ to generate $Mo_2Cl_8H^{3-}$, there is a decrease from 2.66 to 2.38 Å in the Mo–Mo distance. Contraction of the metal–metal distance upon substitution of the smaller bridging H atom for the larger Cl atom is the expected result. To complete this comparison it would be desirable to obtain structural data for the presently unknown anions $MoWCl_9^{3-}$ and $W_2Cl_8H^{3-}$. Attempts to prepare compounds containing the anions are underway in this laboratory.

References and Notes

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(12) Intramolecular M–O bond distances of 2.090 (7), 2.092 (6), 2.091 (7) and 2.106 (6) Å were obtained for the four crystallographically independent O atoms. The nearest intermolecular M–O distance of 3.05 (1) Å indicates extremely weak axial interactions of the type discussed recently by Cotton et al.[13]
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Book Reviews

Gas Chromatography of Polymers. By V. G. BEREZKIN, V. R. AL-ISHOYEV, and I. B. NEMIROVSKAYA (Institute of Petrochemical Synthesis, Academy of Sciences of the U.S.S.R.). Elsevier North-Holland, Inc., New York, N.Y. 1977. xiii + 225 pp. $41.95.

Both gas chromatography and polymer science are comparatively recent additions to the field of chemistry, and both have had major impacts on the subject. This book brings them together in a generally well-balanced and highly readable account. Extensive references are presented, particularly to the Russian literature, with some as recent as 1975.

The last two chapters, dealing with pyrolysis and inverse chromatography, respectively, are the high points of this book. Pyrolysis has long been recognized as a valuable technique for the identification of polymers. This discussion goes well beyond that aspect to include such applications as determining polymer crystallinity, degree of cross-linking, tacticity, and other topics.

Inverse chromatography is the technique in which the sample (a polymer) is used as the stationary phase in the column. Its structure is then examined by the manner in which various "probe" molecules are retained. An enormous amount of information can be obtained by this technique, and the authors present a wide-ranging account of many investigations in which it has been used.

Anyone involved in the study of polymer structure and reactions will find a great deal of thought-provoking material in this book. The discussion of any given technique is necessarily brief, but the reader is constantly confronted by ingenious applications and adaptations of the chromatographic separation process.

I feel that I must include one warning, however. Chapter 1, "Basic Principles of Gas Chromatography", should be carefully avoided. It is filled with factual errors, omissions, misleading statements, and inconsistencies. Several of the figures are mislabeled. This chapter has all the traits of something written hastily, edited poorly, and inserted at the last moment. It is of a totally different nature from the rest of the book and should not deter the reader from reading the remaining chapters, which are of very high quality.

Fred W. Rowland, *Hewlett-Packard, Avondale Division*

Thermal Analysis of Minerals. By DUMITRU N. TODOR. Translated by SERGIU MARCUS. Abacus Press. Tunbridge Wells, Kent, England (distributed by ISBS, Inc., Forest Grove, Oreg.). 1976. 256 pp. $32.50.

This book is a translation of the Romanian language edition which was first published in 1972. The first four chapters survey in about 100 pages the basic principles of thermal analysis, pertinent experi-

mental methods, and the interpretation of resulting measurements in terms of physical and chemical processes. The uniqueness of this book lies in its fifth chapter (150 pp) which discusses composite thermogravimetric (TG and DTG) and differential thermal analysis (DTA) curves for a wide variety of minerals. A very short chapter on the thermal analysis of some representative complex rocks concludes this book.

This book suffers from some severe limitations of its translation as well as its context. Uneven sentence structure, unusual terminology, and confusing statements are abundant throughout the book. TG, DTG, and DTA are almost exclusively used as the methods of thermal analysis. However, procedures such as thermoluminescence, calorimetry, determination of thermal conductivity, and pyrolysis provide an important additional basis for the examination of the thermal characteristics of minerals. Most methods of geochemical analysis advanced manifold in sensitivity, understanding, and applicability with the return of lunar samples by the Apollo missions, but less than a quarter of all references are from the last decade (since 1966), and most of these pertain to the work of the book's author. As a contemporary review of the thermal analysis of minerals, this book produces many misconceptions of a discipline which is much wider and more quantitative than the aspects covered therein.

Henry D. Schreiber, _Virginia Military Institute_

Introduction to Ceramics. Second Edition. By W. D. KINGERY, H. K. BOWEN, and D. R. UHLMANN (Massachusetts Institute of Technology). John Wiley & Sons, New York, N.Y. 1976. xii + 1032 pp. $34.95.

The authors of this book define ceramics as "the art and science of making and using solid articles which have as their essential component, and are composed in large part of, inorganic nonmetallic material." As such, the study of ceramics comprises an important aspect of applied inorganic chemistry. Written as a text for undergraduate and graduate ceramic courses as well as a general reference for chemists and engineers working within the field, this edition serves its purpose admirably.

The approach is to use basic chemical principles to understand what was once a largely empirical art. Chapters on crystal structure, glass structure, structural imperfections, surface chemistry, and atom mobility provide an atomic foundation for the characteristics of ceramic solids. The microstructure in ceramic material is then developed from a thermodynamic treatment which includes chapters on phase diagrams, phase transformations, glass formation, solid-state reactions, and grain growth. Within the context of the background advanced in these two sections, the book then discusses various properties (thermal, optical, flow, elasticity, stress, electrical conductivity, dielectric, and magnetic) of ceramics. Inclusion of problem sets and sources for further reading at the end of each chapter signify this treatise as a blend of textbook and reference work.

With the interest in materials science in general and ceramics in particular as an important interdisciplinary field, this book illustrates the integral role that physical, analytical, and inorganic chemistry can play in this science. The major strength of the book rests in its updated organization of an extremely diverse field. Recent advances in the interpretation and application of fundamental ceramic properties are furnished along with a lucid, comprehensive account of ceramics.

Henry D. Schreiber, _Virginia Military Institute_

The Enzyme Molecule. By W. FERDINAND (The University, Sheffield). John Wiley & Sons, London. 1976. viii + 289 pp. $22.00 (cloth); $10.95 (paper).

The author aims to provide the reader a single source in which students "can find all they need to know about the biological, structural, and kinetic facets of the study of enzymes." The author aims to describe the study of enzymes, not for their own intrinsic interest, but as important biological entities. Accordingly, the author has attempted to set the study of enzymes in the context of cellular metabolism. The book is directed at undergraduates and requires little formal knowledge of biochemistry or mathematics.

The first chapter introduces enzymes in a brief discussion of the role of enzymes in the cell. The topics of bioenergetics and kinetics of enzyme-catalyzed reactions are introduced in the second chapter. Al-

though the presentation of these topics is adequate, these chapters lack specific examples indicating the biological importance of these studies. To his credit, the author has developed the mathematical models in a lucid fashion, including each step so the mathematical argument may be readily followed by the uninitiated. However, by first introducing mathematical models, the author presents enzyme kinetics in a pedagogically dangerous way. At times, the author fails to make the distinction between the experimental kinetic behavior of an enzyme-catalyzed reaction and the kinetic behavior derived from a mathematical model clear.

The next chapter dealing with the structure and properties of proteins is excellent, demonstrating the author's prior research experience in this area. The descriptions by a seasoned experimentalist of the approaches including their pitfalls were particularly appreciated. The next chapter dealing with enzyme structure and function assumes too much knowledge of the intended audience in the physical techniques used to study enzymes. Furthermore, this section is severely lacking in clear illustrations showing the interplay of the enzyme's three-dimensional structure with that of the substrate. The black and white photographs of enzyme models were not very helpful.

Although the book's objective is to study enzymes in a biological context, the largest portion of the book is devoted to the description of the derivation of rate equations for enzyme reactions. The presentation of this kinetic theory is in an easily digestible form. As is the case of numerous enzyme kinetics works, considerable space is devoted to the mathematical formulations of models with little emphasis on the practical details of the execution and pitfalls of kinetic experiments. My main complaint within the context of the author's goals is that one finds a rather limited description of the biological problems that these kinetic methods have solved. The final chapters deal with the role that enzymes play in the control of metabolism. Although the discussions from a theoretical standpoint are good, these sections are, again, lacking in specific biological examples demonstrating the described principles.

Paul van Eikeren, _Harvey Mudd College_

Thermodynamics of Polymerization. By HIDEO SAWADA. Marcel Dekker, New York and Basel. 1977. xiii + 403 pp. $39.50.

The first ten chapters of this book (ceiling temperature, heat of polymerization, anionic polymerization, cationic polymerization, radical polymerization, equilibrium polymerization, copolymerization) are verbatim reprints of reviews which appeared in _J. Macromol. Sci., Chem._ (_Rev. Macromol. Chem._). Previously unpublished are two short chapters dealing with polymer degradation, stereospecific polymerization, and polymerization under high pressure and in the solid state. The book furthermore contains a list of papers published after the chapters were written, with references up to 1975.

The book is basically a compilation of results and references and I can thus recommend it as a reference book for those interested in the field. I take a dim view, however, at the publishers' suggestion that the book may serve as a classroom text. It is, for example, axiomatic that an equilibrium is independent of the route leading to it. But this is nowhere mentioned in the book, and its organization may lead the uninitiated to believe that the thermodynamics of polymerization depends on the mechanism. The molar mass distribution of a polymer/monomer system in true equilibrium is the same for addition and condensation polymerizations and again, the issue is confused in the book. There are other indications that the author made no attempt to homogenize literature findings. He otherwise must have noticed that eq 3 on p 122 is dimensionally wrong and that its originator is G. V. Schulz and not P. J. Flory. The Tobolsky statistical approach to equilibria should also have deserved a more critical treatment because some unjustified mathematical simplifications lead to physical nonsense. Students may also get confused because elaborate treatments of activation parameters are discussed in a book on thermodynamics.

To summarize: This is the first book on the thermodynamics of polymerization. Some 85% of its contents have been published before in a review journal. The book does come in handy as a practically complete source of references and data, but I am still waiting for a scholarly monograph on the thermodynamics of polymerization.

Hans-Georg Elias, _Midland Macromolecular Institute_