aspects of the second and third laws of thermodynamics and of reaction kinetics, respectively. Although the three parts are bound separately, they are to be regarded as portions of a single work, for the paging and the numbering of figures and tables is continuous. They are shortly to be available as a single volume which, although somewhat bulky, will have the advantage of facilitating cross references. The chapter headings in Part II are: "Thermodynamic Principles," "Thermodynamic Properties of Fluids," "Expansion and Compression of Fluids," "Thermodynamics of Solutions," "Physical Equilibrium," "Chemical Equilibrium," and "Thermodynamic Properties From Molecular Structure"; those in Part III are: "Homogeneous Reactions," "Catalytic Reactions," "Mass and Heat Transfer in Catalytic Beds," "Catalytic Reactor Design," and "Uncatalyzed Heterogeneous Reactions."

It should be pointed out, however, that the bare recital of these titles gives but a slight idea of the wealth of material, much of it original and not available elsewhere, that is contained in these books. Among the outstanding features are the worked examples which serve to illustrate the principles developed in the text; these are often given with considerable detail, including graphs and tabulations of results. Somewhat analogous problems, for solution by the student, are provided at the end of each chapter. In general, these are adequate in both number and variety, although a few more exercises on the calculation of thermodynamic properties (Chap. XVII) would be welcome. The usefulness of the books, in this connection, would be enhanced if the excellent table of standard entropies in Part II were supplemented by corresponding compilations of heats and free energies of formation, as well as of heat capacities. The thermal data are mostly in Part I, and free energies are not tabulated; these can, of course, be calculated from the information given.

A notable aspect of Part II is the extensive use of the so-called "generalized procedures," based on the law of corresponding states, for deriving many physical properties of liquids and gases. Although the results are admittedly approximate, they can be very useful, at least as a rough guide, when reliable experimental values are not available. The use of partition functions for calculating thermodynamic properties of gaseous substances is also described in a clear and concise manner.

In spite of the somewhat uneven quality of the paper, which is a sign of the times, the publishers have done their part commendably, the many diagrams being particularly well drawn and printed. The authors have performed the difficult proof reading with care; very few typographical errors have been noted, and, with the exception of those in Table LVI (p. 893), they are of trivial nature. In conclusion, it may be said that *Chemical process principles* is a work which can be highly recommended for study by chemical engineers; physical chemists should read it so that they may become more fully aware of the practical applications of their apparently theoretical studies.

SAMUEL GLASSTONE

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High polymers. Vol. VI: ***Mechanical behavior of high polymers.*** Turner Alfrey, Jr. New York-London: Interscience, 1948. Pp. xiv + 581. (Illustrated.) $9.50.

Theoretical problems of elasticity and viscosity, from the molecular viewpoint, assume special forms in the case of high polymers because of the complexity and randomness of the molecular structure. This peculiarity is at once a severe difficulty, making exact analysis tremendously complicated, and a simplifying feature, permitting certain results to be obtained from approximate statistical procedures. These simplified analyses have been carried to such a point that it is now possible to assemble a coherent theoretical picture of the mechanical behavior of high polymers which is, on the whole, satisfying, even though details are admittedly lacking. In his new book Alfrey attempts with a high degree of success to assemble this over-all picture.

The Alfrey book represents the first large-scale effort to collect and to unify the accumulated results concerning mechanical properties of high polymers and is thus a significant advance in the field of polymer science. The general approach is theoretical. Most topics are introduced by a description of a phenomenon in terms of a mechanical model or in terms of molecular structure. Such experimental evidence as is available generally follows this initial discussion. Thus, in some cases the discussion of experimental results is fitted onto the conceptual scheme of the theory. In view of the still incomplete nature of the theory, some readers might prefer that experimental results be presented independently first, but this procedure would complicate what is already a work of ambitious length. The scheme used has the merit of unifying the material more nearly around central concepts.

The wide range of subjects treated includes plastoelastic behavior of amorphous linear high polymers and of three-dimensional cross-linked polymers, crystallization, plasticization, the behavior of polymers in solution, and ultimate strength. There is a considerable quantity of work previously unpublished, including an original theory of the plastoelastic spectrum of an amorphous linear polymer. An effort has been made to concentrate upon topics which have received both theoretical and experimental attention. Even so, there is sometimes a paucity of relevant experimental work. This is largely unavoidable because the field is new and because a great deal of the recorded experimental effort has been directed toward commercial end-products. The response of high polymers to sinusoidal forces is not treated extensively, probably because few experimental results were available. The volume includes much background material, most of which is closely connected with the central subject matter. Summaries of descriptive elasticity, of the chemical formation of three-dimensional polymers, and of modern theories of liquid flow are included.

The book should be of interest and of value to all theoretical and experimental research workers concerned with high polymers. Extensive bibliographies at the ends of the chapters increase the usefulness of the work (although graphs and data tables are not always clearly

labeled as to source). A body of admittedly speculative material is included, but in the present state of the art some speculation may be allowed in an effort to produce a coherent work and to stimulate further research. This volume is not intended to constitute a textbook or handbook of the properties of available polymeric materials; rather, it is intended for those readers whose aim is to understand the mechanisms of high polymer behavior.

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Frontiers in chemistry. Vol. V: ***Chemical architecture.*** R. E. Burk and Oliver Grummitt. (Eds.) New York-London: Interscience, 1948. Pp. 202. (Illustrated.) $4.50.

This volume is a continuation of the publication of the annual series of lectures, under the general title "Frontiers in Chemistry," sponsored by the Graduate School of Western Reserve University. Two series of lectures have been given in the spring of each year. Series I and II were given in 1942, and Volumes I and II were published the year following their presentation. Volumes V and VI, however, are appearing nearly four years after the presentation of the lectures, presumably because of the difficult conditions created by the late war. The reviewer earnestly recommends to the editors and publishers of this series that every effort be made to have the volumes appear not later than one year following presentation of the lectures. This will preserve the timeliness of the topics and enhance the importance of the material discussed. Since the beginning of these lectures in 1942, several similar projects have been started at various other universities and institutions. In the words of the editors, this is "both encouraging and flattering, and we hope that the trend will continue. Continued success depends upon the quality of the lectures and on well-organized programs."

In this volume, the several topics are presented by masters in their respective fields, as follows:

In "Application of Molecular Geometry in the Field of Reaction Mechanism," by Hugh S. Taylor, we find a discussion of the concept of activation energy, and the influence and effect of molecular geometry in homogeneous reactions, in heterogeneous reactions, and in homogeneous liquid systems.

"Dipole Moment, Resonance, and Molecular Structure," by Charles P. Smyth, considers the molecule as an electric dipole, experimental determination of dipole moments, use of dipole moment in determining molecular structure, movable dipoles and restricted rotation, and the dipole moment as a measure of resonance.

The subject "Structure of Coordination Compounds" is taken up by W. Conrad Fernelius. In the field of inorganic compounds, Fernelius discusses fundamental definitions, the nature of coordination linkages, and methods for deducing the structure of inorganic molecules.

"X-Ray Studies of Randomness in Various Materials," by Bertram E. Warren, deals with the structures of ideally crystalline materials and randomness in the structure of other materials.

In "Light Scattering in Polymer Solutions," H. Mark discusses a few principles of light scattering, the scattering of light from a pure liquid, from solutions of small molecules, and from solutions containing particles comparable with the wave length of light, the depolarization of scattered light, and experimental methods for measuring turbidity and disymmetry.

Miroslav W. Tamele, in "The Nature of Inorganic Gels," discusses the definition of gel, the formation of inorganic gels, inorganic sols, sol-gel transformation, structural changes on drying of gels, the solid framework of dried gels, and the porosity of gels.

Adequate references are given at the end of each chapter. The reviewer wishes that one additional subject had been included in this volume, namely, "molecular architecture in the statistical calculation of thermodynamic functions."

A copy of this book should be available in the library of every scientific or technical laboratory, so that its chemists and chemical physicists may see how important is the concept of molecular architecture in the analysis of the diverse problems discussed by the authors of this volume.

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National Bureau of Standards

Topics in physical chemistry: a supplementary text for students of medicine. W. Mansfield Clark. Baltimore: Williams & Wilkins, 1948. Pp. xv + 738. (Illustrated.) $10.00.

The purpose of this book is best described in the author's own words in the preface: "This book is not designed as a text for a formal course. It is written to meet the diverse needs of medical students and to be drawn upon as the student of elementary biochemistry and the maturing student of medicine may find occasion." The reviewer may add this: the book shows the mark of an experienced teacher of biochemistry in a medical school, whose personal interest is especially inclined to the physicochemical aspects, and whose own line of research is not so much concerned with new discoveries, such as new vitamins or enzymes, which have to wait for a rational understanding, as with the advancement of his science by the application and extension of acknowledged fundamental principles of physics and chemistry under the guidance of both a clear ideology and a scrupulously devised technique.

In order to give the reader a useful presentation of the matter, the author clearly recognizes that there are certain things that must be dealt with from the very bottom, and for which a profound understanding of the fundamental definitions and principles is the most necessary requisite. He recognizes also that there are many other things which are just as important, but of such a nature that the medical student, who, after all, is not a physicist or mathematician, cannot be expected to be sufficiently prepared to follow all the steps of argumentations from what the physicist would consider the bottom. Also, the mathematical part of the exposition, which is, of course, not entirely avoidable in a book on physicochemistry,