governing the behavior of fluids, with proper emphasis on the more recent advances in the domain of so-called fluid mechanics. Scarcely any of these novel concepts are used or referred to in the book under review. In fact, after an introductory chapter which sets forth in a very clear, although somewhat elementary, manner the basis of old-fashioned hydraulic theory, the volume concentrates on a detailed treatment of certain engineering applications. There again the title *Applied hydraulics* appears to be broader than the actual contents of the volume. In fact, the selection of the subject matter is substantially limited to the requirements of the mechanical engineer specializing in water power. Open channel flow, weirs, and hydraulic structures are omitted. The emphasis is laid on pipe hydraulics, water hammer, and surge tanks, with a closing chapter on hydrometry. In his treatment of these subjects Prof. Dubs avoids general principles and follows mostly what may be termed a semiempirical course, gradually building up his presentation from the most elementary concepts. The author has succeeded well in his limited task. Also, the usefulness of the book is enhanced by the disclosure of valuable experimental data obtained in the Institute for Hydraulics and Hydraulic Machinery of the Zurich Polytechnicum, of which Prof. Dubs is director.

The eventual difference between the modes of apprenticing the engineer for professional work in different countries offers useful material for thought and comparison. Switzerland, with the preponderant role of water power, naturally requires much of its engineering talent to be specially trained for that field. The country, with its highly competitive position, may naturally prefer early and narrow specialization. By concentrating instruction on certain selected fields, a substantial level of professional competence may be reached at the school level, making the graduating engineer ready to perform responsible technical work of a kind which, in other countries, may require years of practical apprenticeship in industry or in the field.

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Heat. Archie G. Worthing and David Halliday. New York: John Wiley; London: Chapman & Hall, 1948. Pp. xii + 522. (Illustrated.) $6.00.

This book, as stated in the preface, is intended as a text for second-year work in physics and for an advance course for college seniors and early graduate students. Unless this reviewer has entirely forgotten his experience in a second-year course in physics, present-day juniors are much better prepared than they were a generation or more ago!

In the 522 pages of this book the authors have covered the field generally considered under "Heat." The subjects treated, with a chapter devoted to each are: Temperature, Thermal Expansion, Theory of Heat, Calorimetry, Specific Heats, Thermal Conduction, Thermal Properties of Gases, Elementary Thermodynamics, Change of Phase, Heat Engines and Refrigerators, Convection, and Radiant Energy. The first chapter is concerned with Laboratory Procedure and might well be a first chapter in any (or all) advanced books on physics. This chapter seems to show some of the experiences of the senior author with younger men in his earlier work in an industrial laboratory.

Each chapter is followed by a number of problems—over 200 in all—that well illustrate some of the principles discussed.

As a help to the student there are four appendices. The first gives a derivation of the Maxwell velocity distribution law for gases, the second consists of a number of tables of data, the third is made up of tables of both natural and common logarithms, and the fourth is a discussion of the properties of determinants.

The authors make their statements exact and precise in order to avoid, as far as possible, the loose usage sometimes found. Following this idea, they have employed, as far as possible, the standard nomenclature that has been adopted by the American Standards Association. In this they are careful to use terms and endings that distinguish between the properties of a body and of a material. However, when they think the gain in ease of understanding and freedom from confusion warrants, they do not hesitate to introduce new terms. An example of this is their use of the word "massing" for weighing for a determination of the mass of a body. Also, since the word pound is used in two senses, *i.e.* as a unit of mass and as a unit of force, they use the abbreviation pd for the mass and lb for the force.

A valuable feature of the book is the combination of theory, practical examples, and methods of measuring the various characteristics. There are many illustrations—about 250 in all—in this well-printed book which is remarkably free from errors.

This book promises to fill a need in the field of second-year physics.

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Chemical process principles. Pt. II: ***Thermodynamics***; Pt. III: ***Kinetics and catalysis.*** Olaf A. Hougen and Kenneth M. Watson. New York: John Wiley; London: Chapman & Hall, 1947. Pt. II: Pp. xv + 437–804 + xlviii. $5.00. Pt. III: Pp. xv + 805–1107 + xlviii. $4.50.

The problems of the chemical engineer fall broadly into three classes: first, developing the process; second, planning the equipment for carrying it out; and third, designing a coordinated plant. The two latter problems are essentially physical and mechanical, but the first involves a thorough understanding of chemical and, in particular, physicochemical principles. The purpose of the work under review is to give "an intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems" and, through recent developments in thermodynamics and kinetics, to integrate these principles "into procedures for process design and analysis."

The first part of *Chemical process principles,* published in 1943, deals with material and energy balances; the second and third parts, recently issued, cover various

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.

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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