cluded. The second part deals with a description of phases (solid, liquid, and vapor) and their interactions. The theory regarding the approach to equilibrium condition in both elements and compounds, and with both native and foreign atoms, is outlined in some detail and presented in graphic form. Several chapters present experimental results from the literature on defect crystals of compounds, relating Hall effect, conductivity, optical properties, and self-diffusion to the chemistry and past treatment of the specimen. A detailed comparison of theory and experimental results is discussed, with particular emphasis on PbS, alkali halides, BaO, and Cu_2O. Special cases of cation disorder-order relations in compounds such as spinels and doped ice are considered, and an excellent chapter on relaxation deals with the kinetics of precipitation and diffusion.

The final part (five chapters) is concerned with chemical and physical effects of point defects. Sintering, oxidation rates, the photographic process, the electrochemistry of cells of imperfect crystals, and phase transitions are the principal applications discussed.

Dislocations and their effect on chemical or physical properties are only briefly mentioned; reference is made several times to a companion book, *Imperfection in Crystals*, written by the author's colleague, H. G. van Bueren (Philips Research Laboratory, Eindhoven). With the exception of the first chapters, there is little discussion of experimental problems or instrumentation; however, the copious references (including some papers published in 1962) will lead the reader to such information.

This book is characterized by the unity that can be attained when one author treats a subject rather than by the disorder that one so frequently encounters in "edited" volumes produced by several contributors. This work should become a standard textbook for advanced solid-state courses, and it should be widely used by ceramists engaged in basic studies, particularly about phase theory, sintering, oxidation, and electrical properties. Although it is priced rather high, it is well bound, printed on excellent paper, contains excellent author and subject indexes, and does cover a tremendous amount of material.

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Zoology

Molluscs. J. E. Morton. Hutchinson University Library, London; Hillary House, New York, ed. 2, 1963. 232 pp. Illus. $3.

Morton's little book is a welcome addition to the zoological literature. The text, written in a simple and lucid style, is aimed to a broad audience of persons who have only elementary knowledge of zoology; at the same time the book contains a wealth of information that will be useful to biology teachers and malacologists. General features and habits of molluscs are rather briefly discussed in the first three chapters. Greater emphasis is placed, however, on the functional morphology of the following systems of organs: mantle and gills; feeding and digestion; blood and excretion; sex and reproduction; and the nervous system. The major structural features of the organs are discussed together with their function and evolution. Unfortunately, the major role of the mantle in the formation of shape and sculpture of the shell is only briefly mentioned, and no reference is made to geometrical regularity of the shape of the shell and its growth.

The last three chapters deal with evolution and classification. These chapters are an expansion of, and an addition to, the material presented in the preceding five chapters. The evolution of cephalopods is discussed vividly and interestingly. By reconstructing the life and habits of fossil *Nautiloidea* and *Ammonoidea*, the author arrives at the conclusion that "the advent of the ammonoids *saved* [my italics] the Cephalopoda from decline." This is an intriguing speculation, but it is very probable that some other line of evolutionary process would have developed, if ammonoids had not appeared. The evolution of cephalopods provides fascinating reading. The author wisely reminds the reader, however, that the philogeny of fossil cephalopods must be approached as cautiously as their ecology.

Regrettably, certain facts of great interest to the general public are not mentioned—for instance, Li's recent findings of antimicrobial agents in molluscan tissues; poisonous shellfish and poison conch shells; the role of tropical freshwater snails in transmitting schistosomiasis; Gabet's work on neurosecretory cycles in bivalves; the important role of squid nerve cells in neurophysiological research.

The "second edition" is in reality a reprint of the 1958 edition without additions or changes. This explains the absence of references to such an excellent book as *British Prosobranchia* (1962), by V. Fretter and A. Graham, and the monograph on Neopalina, (1959), by H. Lemche, in volume 3 of the Galathea Report. Only the preliminary note of 1957 to the latter, a major zoological discovery, is mentioned in the text.

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Mathematics

Structure of Algebra. Vincent H. Haag. Addison-Wesley, Reading, Mass., 1964. vi + 154 pp. Illus. $5.

What a wealth of books on algebra —elementary, intermediate, advanced, college, modern, and abstract algebra —are available today! However, it is probable that Haag's *Structure of Algebra* is close to unique; certainly it meets a definite need.

Haag seeks to explain the "why's" and the "wherefore's" of elementary algebra and in doing so he dips into the foundations of analysis and of modern abstract algebra. Although a student of modern algebra does study the ring of polynomial forms, for example, it is questionable whether he makes the connection with elementary manipulations or places "variable" and "indeterminate" in their proper relationship.

This book is not a treatise; it does not attempt to cover all aspects of a given topic. It does give considerable insight into mathematical systems; the concepts of finite, infinite, and countability; the apparatus of algebra, such as mappings and functions; and the language and applications of sets and basic logic. It treats real numbers as a model of a complete ordered field, beginning with a development of the properties of such a system and its principal subsystems. The reader should have a meaningful grasp of real number concepts by the time he finishes this volume, a grasp that he can put to effective use. The status and importance of complex numbers receive a thorough elementary treatment; the

discussion of "algebraic numbers" should open vistas. Haag's exposition of the relationship between points on a line and real numbers should clarify a "take-for-granted" set of concepts.

All in all, this is a well-constructed, well-written book. It has ample sets of problems, the problems being nontrivial, nonstandard, and integrated into the flow of textual material. It is unusually free of errors, typographical and otherwise. My criticisms are minor: the statement that essentially there is only one model of a complete ordered field is delayed almost to the point of missed impact; the 1-1 relationship between points on a line and real numbers is stated, "to every point there corresponds a unique real number" is proved, but the status of the converse of this last theorem does not seem to be covered.

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Chemical Technology

The Properties of Glass Surfaces. L. Holland. Wiley, New York, 1964. xvi + 546 pp. Illus. $15.

Because scientists working in different fields use glassware, in a variety of shapes and at different temperatures, in contact with gases and liquids, there is a need for reliable information about the surface properties of glasses. Much work has been done on this subject, but the data are scattered, frequently in journals not readily available. Thus, Holland's book will be welcomed by chemists, physicists, and engineers.

The author's many years in research concerned with the deposition of films on glasses in high vacuums has given him wide experience in the field. Experimentation with high vacuums requires a thorough understanding of the properties of glass surfaces, of the methods of cleaning glass, and of the phenomena of adhesion and friction. One of the major difficulties is that glass surfaces are not defined by the composition of a glass but depend strongly on the way they are obtained. Polishing an optical glass changes its chemical and physical properties, and the phenomena that occur during this process are not yet fully understood. A short discussion of the composition and the structure of glasses precedes the author's excellent description of the methods used in polishing optical glasses and the different chemical and physical methods used in cleaning the surface of a glass. He also discusses the various sources of contamination.

The physical properties of glass surfaces are divided into chapters on optical, electrical, and mechanical properties involving friction of glasses in contact with liquids and metals. Among the chemical properties of glass surfaces, corrosion phenomena are of greatest importance to those who use glass. The chemical interaction between glass surfaces and gases and vapors is discussed from several points of view. Those who use glass for vacuum equipment will find much valuable information on the sorption and desorption of gases, especially water vapor, on the diffusion of helium through different glasses, and on the effects of electrical discharges on these interactions.

Surface chemistry encompasses several processes that improve the surface properties of glass or make the surface an electrical conductor. The wetting properties of glasses by different liquids and the adhesion of metals and organic polymers are thoroughly discussed. In all cases the author has balanced practical and theoretical aspects so well that his book is most stimulating to anyone interested in the behavior of surfaces.

The reader can easily follow the progress made in this field and obtain a good picture of the present status of theory. Workers in the field of glass will welcome the numerous well-chosen references that enable one to follow up details.

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Research Résumé

Osmotic and Ionic Regulation in Animals. W. T. W. Potts and Gwyneth Parry. Pergamon, London; Macmillan, New York, 1964. xiv + 423 pp. Illus. $9.

This is the first monograph devoted to the broad subject of osmotic and ionic regulation in animals since Krogh's book in 1939. Potts and Parry review this rapidly advancing field from the viewpoint of general biology. The first chapter is an excellent summary of the physical principles necessary for understanding the mechanisms of osmotic and ionic balance. This chapter will be particularly useful to students of zoology who lack background in physical chemistry and cellular physiology. Chapter 2 deals with excretory organs in general and includes some useful new figures of the excretory systems of various animals. Unfortunately, there is little mention of the extensive information afforded by electron microscopy, particularly of Malpighian tubules, flame cells, and vertebrate kidney, and no mention of Bodil Schmidt-Nielsen's useful correlations of ultrastructure with the direction of active transport.

Then follow chapters in which the authors survey osmotic and ionic conformity and regulation in animals from marine, brackish, and freshwater environments. After initial statements of the problems associated with each habitat, specific animal groups are discussed. However, the physical principles developed in the first chapter are scarcely used in these three important chapters. For example, the numerous papers on *Necturus* kidney tubules (by Solomon, Whittenbury, and others) are not much discussed, and much new information on the cellular mechanisms of frog-skin and toad-bladder potentials is omitted. Evidence for volume regulation in supunculids (Gross) is omitted in favor of the older idea of lack of such regulation (Adolph).

Chapters 6 and 7 consist of very good surveys of regulation in terrestrial animals and in hypo-osmotic regulators. In few areas of the subject has there been so much change with respect to basic concepts as in mammalian renal physiology, and zoologists will find here a clear and concise discussion of these advances. Cellular mechanisms are described, particularly concerning ionic fluxes, and some of the unanswered questions are presented. One fails to find any new explanation of the meaning of hypo-osmotic regulation in certain marine crustaceans.

The final two chapters deal with the relation between respiration and electrolyte metabolism and with control of electrolyte balance. The interesting facts are that the total oxygen consumption of many osmoregulators increases in dilute media but isolated tissues often show reverse effects, and that the increase in organismic respiration is too great to be due to the regulating tissues alone but some regulators fail to show the increase. No explanations of these paradoxical observations are available.