

constitute the organism. This is beautifully illustrated in a description in this volume of the fate of the diapausing pupa of the silkworm when given an overdose of molting hormone. Metamorphosis is accelerated and cuticle deposition outstrips other processes until the reorganizing elements which should form the adult moth are frozen in place and a nonviable monster is produced. Elsewhere in the volume we are entertained with fact and theory about the emergence of order from a prebiotic soup, the coordinated synthesis of macromolecules during bacterial growth, interplay between domains in single plant and animal cells, chemical communication between cells by means of all types of chemical messengers, and finally environmental cues eliciting developmental responses.

There are several lessons to be extracted. One is that although differential gene action may set the direction and boundary conditions for developmental processes, many or most of the steps involved in coordination of these processes operate at other levels. Several of the contributors dwell upon the immediate steps in communication, particularly reception and primary processing of messages. Another lesson is that the messenger (word, hormone) can often be arbitrarily chosen, the meaning of the message being determined by the rules of syntax of the language, and we can understand the choice of messenger only by considering the history of the language. The history of biological communication is a part of evolution. Thus we must imagine "phylogenetic trees" for communications systems. From this point of view we might expect important differences between *E. coli* and elephants.

This volume will be useful to teachers and graduate students and to developmental biologists who want to know the gist of what is happening in other sectors of their multidisciplinary field. It might even serve as the foundation for a graduate seminar course, but as such it would have its shortcomings. Coverage of this broad a subject is unavoidably spotty. Furthermore, unifying principles of communication phenomena do not spring from the individual contributions. Although the editor supplies some interpretation and overview in an epilogue, the volume begs for more. Thus, to create a coherent seminar course would require judicious supplementation and a great deal of thinking. (One might argue that this is

a hidden asset.) On the positive side, the volume offers a refreshing perspective on development and leaves the notion that a deeper understanding of developmental processes will issue from this line of thought.

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Marine Techniques

In-Water Photography. Theory and Practice. LAWRENCE E. MERTENS. Wiley-Interscience, New York, 1970. xviii, 392 pp. + plates. \$19.95. Series on Photographic Science and Technology and the Graphic Arts.

Advanced techniques in most professions are a mix of art and science. Although several excellent books are available on the art and purpose of photography in the water, this book is unique and welcome because it emphasizes theoretical and practical aspects. The author's technically correct choice of "in-water photography" as the title rather than the more familiar but inexact "underwater photography" properly sets the analytical tone of the book.

The nearly 400 pages of this book contain a well-balanced combination of text, equations, curves, pictures, and references. It should therefore be readable and useful both to serious amateurs and to professionals, whether users or designers. Chapters are devoted to light transmission, contrast, filters, supplemental lighting, lenses and optical ports, cameras and housing, films and image tubes, biological effects, systems and application, new photographic techniques, and diving techniques. The individual chapters, with their somewhat textbook-like format, have considerable breadth and provide considerable information in each of the subfields. The legibility of print, of the line drawings, and of most of the figures is excellent.

This reviewer was impressed by the compilation of so much pertinent information between two covers. Reading this book, and particularly those chapters that deal quantitatively with the optical problems, should upgrade the understanding and work of "in-water" photographers and designers.

In sections devoted to equipment and suggested field techniques different readers might choose somewhat differ-

ent examples or procedures, but such points are debatable, and criticisms that might be made are certainly minor in relation to the overall presentation of typical problems and a rationale for their solution. The author is on his firmest ground when dealing with optical problems, which he does well indeed. The price of the book may seem high for an individual photographer but is commensurate with the cost of specialized photography.

Photography in the water has long needed a comprehensive book devoted to the technical and optical aspects of the problem. This is such a book and should be a welcome addition to the libraries of all who are seriously interested in the subject.

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Extending the pH Scale

Acidity Functions. COLIN H. ROCHESTER. Academic Press, New York, 1970. x, 300 pp., illus. \$13. Organic Chemistry, No. 13.

Since the original work by L. P. Hammett and A. J. Deyrup in 1932, acidity functions have been used with ever-increasing sophistication to extend the aqueous *pH* scale empirically well beyond the limits set by dilute aqueous solutions. It has thus been possible to measure the strength of very weak acids and bases, to interpret the kinetics of catalyzed reactions in super-acid or super-basic media, and to infer reaction mechanisms and modes of proton transfer. The literature on acidity functions is vast, and there have been important changes in point of view since the publication, in 1957, of the classic review by F. A. Long and M. A. Paul.

The present book by Colin H. Rochester is a well-organized, comprehensive, up-to-date review of the subject. It begins with a brief chapter on the theory of *pH* and acidity functions. Then there are two chapters, unique in their completeness, and with many tables of data, about the Hammett acidity function and about acidity functions for solutes other than neutral Hammett bases. These are followed by lucid chapters on acidity functions in acid-catalyzed reactions, in nonaqueous and mixed solvents, and for concentrated solutions of bases. Throughout the book, the discussion is essentially impartial: Where different laboratories

have worked on the same problem, Rochester tabulates all sets of results; where differences exist—of fact or opinion—he tries to be fair to all sides. His coverage of the literature is remarkably complete, and I found no serious errors. The index is well done. Indeed, my only criticism is minor and subjective: Since the success of acidity functions depends on the existence of certain linear free energy relationships, I was disappointed that almost nothing is said about linear free energy correlations in general.

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Organic Compounds

Nonbenzenoid Aromatics. Vol. 1. JAMES P. SNYDER, Ed. Academic Press, New York, 1969. xii, 372 pp., illus. \$17.50.

A theoretical basis for investigating the structures of nonbenzenoid aromatic compounds was provided by E. Hückel in 1931 at the time of the formulation of the pi-electron theory of aromaticity, but in a real sense the subject developed after World War II and is thus relatively new. In the space of approximately 20 years a wide variety of molecular species containing from 2 to 30 pi electrons and existing as cyclic cations, anions, radicals, or zwitterions, in complexes, or as more ordinary neutral conjugate unsaturated systems, for the most part previously unknown, have been synthesized and studied. This work has evoked an impressive total of theoretical interpretation and prediction aimed at understanding the general structure-properties relationship for this class of compounds.

Although there have been a number of review articles, especially in the past ten years, the only previous major survey of the field is *Non-Benzenoid Aromatic Compounds*, edited by David Ginsburg, which appeared in 1959. Thus the present work, which (reflecting the large increase in the literature that has occurred) will consist of several volumes to be published over a period of several years, is timely and will provide when complete an authoritative picture of, one hopes, all the significant areas. The size and complexity of the task precluded the appearance of all the volumes in the same year and also made it impracticable to have the contents of the individual volumes

organized so as to be homogeneous, or fairly so. This is quite apparent in this first volume, which contains chapters, following a historical introduction by the editor, treating biphenylenes, cyclo-decapentaene, sydnones, azepines, oxapins, thiepins, and aromatic oxocarbons.

The authors of this volume have achieved a good balance between experimental results and theoretical interpretation. The scope and detail of the chapters are adequate, but do not give the impression of including a reference to every paper that has appeared. An author index makes the search for a topic by this route possible. The subject index would be more useful if it were more detailed. The format, type, drawings of chemical structures, paper, and binding are excellent.

It may be expected that this book and its companion volumes will become the principal general source in the field.

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Magnetic Properties

Magnetism and Metallurgy. AMI E. BERKOWITZ and ECKART KNELLER, Eds. Academic Press, New York, 1969. 2 vols. xxviii, 838 pp., illus., + indexes. Vol. 1 (pp. 1–512), \$29.50; vol. 2 (pp. 513–838), \$17.

Magnetism and Metallurgy is a two-volume treatise on how structural properties affect magnetic phenomena, and to a lesser extent it explores the use of magnetism in the science of metallurgy. It is not the intent of the work to be a comprehensive treatise on the physics of magnetism. Introductory sections dealing with the principles of magnetism and experimental techniques provide the desired degree of self-containment. These sections are generally well referenced so that the reader can readily pursue topics that are outside the scope of the work.

The main purpose is to examine the effects of composition and a wide range of defects on the magnetic properties of materials. In particular the effects on magnetization curve parameters are dealt with extensively. Although the introductory section refers to some aspects of magnetism as a phase transition and mentions that interesting thermodynamic and transport anomalies exist near the Curie or Néel temperature, treatment of the role of composi-

tion and defects is confined almost exclusively to saturation magnetization, coercive force, remanence, energy products, and the like. These structural effects are considered primarily for ferromagnetic systems and in particular for transition metals and alloys. Complicated spin structures such as the screw types found in the rare earths, their alloys, and intermetallics are mentioned only briefly. In any work of this nature there exists the danger of merely cataloging behavior observed in a wide range of elements, alloys, and intermetallics. Only four of the chapters are of this nature, however. The remaining 13 are quite descriptive and oriented toward the phenomena. Of course sometimes significant results are not well understood and one must catalog or omit.

Discussion of the role of composition in binary and ternary solid solutions and intermetallics is confined to susceptibility and magnetization curve parameters, primarily in noble-transition metal, simple-transition metal, transition-transition metal, and transition-metal-rare-earth systems. Discussion of the role of defects is also confined primarily to magnetization curve parameters. The types of defects considered include finite size, dilute concentrations of nonmagnetic impurities, dislocations, stacking faults, point defects, agglomerates of both magnetic and nonmagnetic species, and atomic disorder especially near an intermetallic stoichiometry. In addition, the production of defects by working and the introduction of directional order by heat treatments in fields are discussed, as is the kinetics of defect recovery and recrystallization.

Several chapters are excellent. S. H. Charap provides a compact introduction to the range of magnetic behavior that occurs throughout the periodic table, introducing molecular field and band approaches. The main aspect of each type of behavior is clearly described, and reference to more thorough works is made straightaway in each instance. The chapter by P. E. Seiden on magnetic resonance is a model of succinct presentation of an intrinsically complex subject. A chapter by T. R. McGuire and P. J. Flanders provides an extremely handy survey of how to measure susceptibility, magnetization, magneto-optical, and galvanomagnetic properties. Immediate reference to an appropriate review article is made for each topic. How to determine transition temperature, effective number of magnetons, and exchange integrals is clearly