courses as well. Sanderson, who believes that students have been expected to memorize far too much material without understanding it, states in the preface the pedagogic philosophy reflected on every page of this book: "My major interest . . . has been to find reasonable, yet relatively simple explanations of common chemistry, and to devise methods of increasing student understanding through visualization."

This is much more than a how-to-do-it book; most of it is devoted to a consideration of the more effective ways in which teachers can use models in lecture, laboratory, and displays. Although such ideas are regarded as directions by novice teachers, they will probably provide points of departure for experienced instructors. The styrofoam models, whose colors vividly depict electronegativity, partial charge distribution, and bond polarity, were originated by Sanderson, and they may be used to predict, verify, and explain not only structures but also physical properties and chemical reactions. When these models are used, students see that many familiar generalizations and "rules of thumb," previously learned by rote, are logical and consistent consequences of atomic, ionic, molecular, or crystal structure.

The final chapter presents specific instructions (including complete details) for constructing more than 400 models with a minimum of materials, time, money, and skill. Thirty-two pages of well-composed photographs of 250 atomic, molecular, and crystal models (half are in full color), 21 tables of data, and a selected bibliography supplement these directions. The order of the plates is confusing, and the tables are reproduced from typewritten copy; both detract from an otherwise superbly organized volume.

Although he is a firm advocate of the use of models, Sanderson readily admits their limitations and provides ample justification for all points that may be considered in the least controversial. His one lapse from this scrupulous objectivity is his failure to note that his own electronegativity scale is only one of several alternatives currently in use.

Teaching Chemistry with Models will be of great value to every instructor interested in making chemistry a meaningful, logical, and exciting experience for his students.

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Magnetohydrodynamics

Radiation and Waves in Plasmas. Morton Mitchner, Ed. Stanford University Press, Stanford, Calif., 1962. 156 pp. Illus. $4.50.

This collection of papers, which were presented at the fifth annual symposium on magnetohydrodynamics (sponsored by the Lockheed Aircraft Corporation) is an unmistakably good buy for the bookshelf devoted to plasma physics. Five of the seven chapters are theoretical, generally useful but of special interest to thermonuclear researchers. The book's title encompasses two principal problem areas in which theory might contribute to the goal of fusion power: loss of plasma energy by radiation and loss of plasma particles (and energy) by interaction with unstable, growing oscillations.

The symposium, which was held in December 1960, marked a climax in understanding the first problem. The clue, recognized first by the Russian theoretician B. A. Trubnikov, is that, contrary to earlier conclusions, a hot, magnetically confined plasma of anticipated densities is transparent to its own (electron) synchrotron radiation. The consequence is greater radiation loss than had been hoped. However, W. E. Drummond has found that, even with the correct radiation formula, the critical diameter of the fusion reactor is only one meter, less with reflectors to feed back radiated power. His calculation is appended to D. B. Beard's review of radiation theory in the Vlasov approximation, but it neglects all but an average interaction among particles. In another chapter, A. Simon lays the groundwork for the first-order correction to this theory by deriving Fokker-Planck equations coupling particles and fields. Since the symposium, Simon has been able, with his more elaborate theory, to confirm Trubnikov's radiation formula in the thermonuclear regime.

The second problem, instabilities, remains a challenge. Two chapters of this book are, in part, aimed at broadening the methodology of stability analysis. I. B. Bernstein attempts to extend conventional modes of analysis to spatially nonuniform cases. O. Buneman obtains a systematic derivation of plasma conservation laws (energy and the like), known, for example, to account for stability of the Maxwell distribution.

In other chapters, J. E. Drummond examines wave propagation in plasmas, with emphasis on the coupling between plasmas and radiation fields. G. S. Kino discusses experiments designed to test the theory of plasmas in thermal equilibrium, and the laboratory observation of Alfven waves is discussed by J. M. Wilcox, A. W. DeSilva, W. S. Cooper III, and F. I. Boley.

The well-made book contains numerous references (an average of 17 per chapter), but, regrettably, no index.

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Observation, Not Speculation

Fact and Theory in Cosmology. G. C. McVittie. Macmillan, New York, 1962. 190 pp. $3.95.

G. C. McVittie's *Fact and Theory in Cosmology* is the third in a series of books edited by Colin A. Ronan and designed to fill the gap between the many elementary astronomy books, on the one hand, and the numerous advanced monographs, on the other. McVittie, an expert in the fields of cosmology and relativity, effectively presents this difficult material on an understandable level. He bases his discussion on observations rather than on airy bubbles of pure speculation, and one gets the impression that he, like Herbert Dingle, prefers "calling a spade a spade and not a perfect agricultural principle." The observables in question are: the red-shift in the lines of the spectra of galaxies; the optical apparent magnitudes of galaxies; the flux-densities of those galaxies which are radio sources; the numbers of galaxies; the diameters of extragalactic radio sources; and the characteristics of clusters of galaxies. The observable data, however, are often all too scanty or imprecise and frequently subject to unknown systematic errors and to errors of interpretation. But McVittie is director of the most powerful radio telescope in this country (the recently dedicated instrument at the University of Illinois), and this instrument, which consists of a parabolic cylindrical reflector 400 by 600 feet, should soon provide accurate new observations of thousands of distant radio galaxies.

An introductory chapter on the nature of cosmology is followed by a discussion of distance in the universe and then by a chapter on the system of galaxies. The next three chapters, which are the most difficult, deal with cosmo-

logical theories, model universe and the red-shift, and the selection of a model universe. The final chapter is a short summary and conclusion. The author concentrates on general relativity, the steady-state theory, and, briefly, kinematical relativity. He is not a devotee of the latter two theories, but he correctly points out that their controversial natures have forced all cosmologists to refine and to make precise their own ideas.

The book would be improved by illustrations and by a more complete discussion of distance determination technique, such as moving cluster parallaxes and the use of the zero-age main sequence. A second edition should necessarily include a discussion of the exciting new radio data on the numbers, diameters, and duplicity of these strange, incredibly distant sources.

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Encyclopedic, Indispensable

British Prosobranch Molluscs. Their functional anatomy and ecology. *Publication of the British Ray Society*, No. 144. Vera Fretter and Alastair Graham. Published for the Society by Quaritch, London, 1962. xvi + 755 pp. Illus. £8 8s.

Molluscan shells have long been attractive objects to man, but the soft, often slimy, body within is more apt to be greeted with repulsion or indifference by everyone except a few molluscan specialists. This is ironic, for the classification of the whole ancient and important phylum of the Mollusca, and especially the Gastropoda, is based upon anatomical features. The tendency has been, among zoologists, to generalize upon an occasional study of soft parts and to group by analogy or by the use of a few easily seen structures. Paleontologists, of course, are obliged to do this, but now that this book is available, neontologists no longer have an excuse, for this book will stand as a landmark in the interpretation of functional morphology, which may differ rather widely between one species and the next.

In part 1, the introduction, a selected prosobranch, *Littorina littorea*, is used to demonstrate organization and structure of the gastropod body in detail. Then, in the second part, on functional anatomy and development, each of the organ systems is given elaborate treatment, with a review of pertinent literature. One or more chapters are devoted to the shell, the mantle cavity, the skin, the muscular system, the alimentary system and feeding, the vascular, excretory, nervous, and reproductive systems, and spawning, development, and larval forms. Although research on British mollusks forms the primary reservoir of the literature discussed, the work of malacologists elsewhere is not neglected, so these chapters (16 in all) are applicable far beyond the limited area of the title.

Part 3 (6 chapters) deals with the ecology of British mollusks. With the preceding parts as background, the significance of the adaptations to habitat stands out more clearly. The parasites of these prosobranchs are listed and discussed in one unusual chapter.

For the lay malacologist, perhaps the meat of the book is in part 4, on relationships. Here the authors suggest the classification they prefer. No new groupings or terms are proposed, but a different emphasis is reached on the basis of functional morphology and anatomy: Gastropoda are divided into three subclasses—Prosobranchia, Opisthobranchia, and Pulmonata. The Prosobranchia are subdivided on heart and pallial structure primarily, on radulae secondarily. The primary divisions are Diotocardia (which includes Rhipidoglossa and Docoglossa, the equivalent of Thiele's Archaeogastropoda) and Monotocardia. The latter are again divided into two parts, the Taenioglossa (Mesogastropoda of Thiele) and the Stenoglossa (synonym, Neogastropoda). The authors furnish evidence to show that the family Pyramidellidae, formerly considered a prosobranch group, probably should be transferred to Opisthobranchia. There are, it seems, several families in each of these two subclasses which have the morphological characters of the other; hence, differentiation is not altogether clear-cut.

This monumental work will be a great boon to the nonspecialist, for it brings together a wealth of scattered literature on the anatomy and physiology of these organisms. So diverse has the field become that few workers can evaluate the significance of researches outside their immediate domain. Here, however, one sees that histology and biochemistry can contribute to an understanding of molluscan structure and function. The bibliography alone (its content is well summarized in the body of the text) amounts to some 35 pages. The 317 illustrations are original line drawings, well planned to clarify the descriptions of soft parts.

Except for its summary chapters, this book, which is encyclopedic in scope, is not easy reading, but the scope makes it indispensable to all serious students of malacology. The book does not pretend to be a work on nomenclature or taxonomy, but one may easily predict that it will have no little influence in future systematic studies.

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Current Research

Rare Earth Research. Proceedings of the symposium held at Glenwood Springs, Colorado, September 1961. Joseph F. Nachman and Charles E. Lundin, Eds. Gordon and Breach, New York, 1962. xv + 354 pp. Illus. $14.50.

This volume, the proceedings of the second conference on rare earth research, differs from the volume published following the first conference in several respects: the editors and the publisher are different, and the volume is slightly longer and appreciably more expensive.

The five half-day sessions of the conference were devoted to the following topics: chemical properties of the rare earths and their compounds; mechanical and metallurgical properties of rare-earth metals and alloys; thermodynamic properties of rare-earth metals, alloys, and compounds; physical properties of rare-earth metals and their compounds; and rare-earth chalcogens, borides, and nitrides.

In the introductory address it is pointed out that only a few chemists and physicists were interested in these elements during the first 140 of the 160 years that have followed the discovery of the first true members of the rare-earth series. Although the rare earths "represent about one-eleventh of the known naturally occurring elements, the properties of their metals, alloys, compounds, and solutions are relatively unknown." However, the numerous papers