crete plants, an alga and a fungus. This union forms the characteristic lichen unit, described as the thallus, which exhibits as much variability as other plants. Therefore, it is important to have authoritative texts on the anatomy of lichen thalli and on all other structures of the thallus, which will serve to advance knowledge of lichens in general and of lichen terminology pertinent to anatomy. The field of lichenology is far from static; it is attracting the attention of physiologists, biochemists, and others who find in this unique association problems of great interest. These investigators, as well as students of lichenology, will find that Ozenda's volume is the most recent source to present knowlege on lichen anatomy.

GEORGE LLANO
National Science Foundation, Washington, D.C.

Chemical Analysis

Organic Functional Group Analysis. F. E. Critchfield. Pergamon, London; Macmillan, New York, 1963. viii + 187 pp. Illus. $6.50.

This compact volume was designed "to provide a collection of versatile and reliable chemical methods for determining most of the more common organic functional groups." It accomplishes this objective in a very precise and practical manner. The selected material, while largely determined by the needs of the laboratory with which the author is associated, is sufficiently broad in scope to cover the majority of functional groups encountered routinely in most laboratories. The organization and style provide a considerable amount of information in a most concise and clear manner. The scope and limitations of each method are discussed, and the clarity with which the procedures are presented is in accord with the author's statement that they can be performed by competent nontechnical personnel. A praiseworthy feature is the inclusion of directions for preparing the reagents for which directions are needed. Almost all of the references (which are placed at the end of each chapter) are to the original literature and thus give direct access to actual experimental results rather than to the generalities often encountered in secondary references. The index is reasonably complete.

The treatment of acids and bases is exceptionally well done and includes consideration of both aqueous and nonaqueous media. The latter deals mainly, but not exclusively, with acids in pyridine solvent, but considers bases in acetic acid, nitromethane, acetonitrile, and acetic anhydride. The problem of changes in relative acidities, including inversions in order, is discussed. Also included are the determinations of epoxides, esters, anhydrides, and imines by indirect methods, differentiation titrations in water and in several nonaqueous solvents for both acids and bases, and a very readable coverage of indicators, also for both aqueous and nonaqueous solvents.

In summary, this book can be recommended to the chemist who has a considerable number of analyses to perform, with or without the aid of a technician, and also to the chemist who needs to use such methods less often but at that time wants a concise but reasonably complete write-up of well-tested procedures conveniently at hand.

ARTHUR G. ANDERSON, JR.
Department of Chemistry, University of Washington, Seattle

Mathematics

The Teaching of Mathematics. From intermediate algebra through first year calculus. Roy Dubisch and Vernon E. Howes. Wiley, New York, 1963. xii + 124 pp. Illus. Paper, $2.95.

The first draft of this handbook was written during 1951 and 1952 while Dubisch was a Faculty Fellow of the Fund for the Advancement of Education. According to the preface, he intended ". . . to provide the new teacher of mathematics with some general guidelines on the teaching of mathematics and some specific suggestions in regard to classroom procedures. . . . [and furthermore] . . . to provide both the inexperienced and the experienced teacher with an annotated bibliography of articles on the teaching of mathematics from the intermediate algebra level through first-year calculus."

In three preliminary chapters the authors deal with teaching in general, the aims of mathematics teaching, and problems in the teaching of mathematics; they then consider specific suggestions for teaching algebra, trigonometry and logarithms, analytic geometry, and differential and integral calculus. In these latter chapters, an extremely judicious selection of topics is examined in a lucid manner. The pedagogical as well as the mathematical problems associated with each topic are reviewed, and references to sources contained in the extensive bibliography are skillfully woven into the discussion. The bibliography consists of 402 items published during the period 1884 to 1963, of which about 10 percent are post-1958 works.

Throughout the handbook many practical suggestions are provided. The following quotations are typical examples: "A rough estimate [of the time required for homework] can usually be obtained by the instructor if he works the problems himself and multiplies the time it takes him by four"; ". . . rules and methods of algebra should always be first explained from the numerical viewpoint"; and "The instructor should use care, however, that he not make the work too lengthy and boring to the average student by excessive harping on the theory."

Every graduate assistant or instructor at the undergraduate level should have access to this volume. The more experienced teacher will find it extremely valuable, and although it appears to be directed more toward the college instructor, the teacher of advanced secondary school mathematics courses will also find it useful.

DONALD J. DESSART
Department of Mathematics, University of Tennessee

Inorganic Solution Chemistry

Metal Ions in Aqueous Solution. John P. Hunt. Benjamin, New York, 1963. xii + 124 pp. Illus. $5.50.

The resurgence of inorganic chemistry following World War II was due, in large measure, to the careful work done on the nature of species in aqueous solution. In the past few years, such studies have been eclipsed somewhat by the vast amount of preparative work stimulated by the successes of ligand field theory. There has been a definite need for a book to introduce the student to inorganic solution chemistry, particularly for a work that emphasizes the newer theoretical studies and experimental methods. With certain res-

ervations, Hunt's book can be recommended for this purpose. Obviously, the author has given much thought to the subject, and his book treats, from a unified viewpoint, the structure of water and the effect of ions thereon, the hydrolysis of metal ions, complex formation, and also the kinetics and mechanisms of substitution and electron transfer reactions. In addition, the thermodynamics of individual gaseous and hydrated ions is considered.

Unfortunately, although the author has attempted to adopt a critical attitude (and for this he is to be commended), the final result seems to present a rather pessimistic outlook. This is regrettable, for many interesting, unsolved problems are noted in this book. The arrangement of the material also seems somewhat erratic, especially in chapter 4. Polymerization of conjugate bases is treated in section 4-2, where it is noted that "very few data on the nature of the species or the reaction mechanisms are available." Section 4-6 treats polycondensed species again, and it is noted that data have been reported for some 23 polycations. Although the suggestion (p. 119) that sexavalent vanadium can be produced by using Tl(III) as an oxidizing agent is presumably a misprint, the book seems relatively free of typographical errors.

A student who has completed the undergraduate course in physical chemistry should find this book interesting and relatively easy reading. It could even be read profitably following the completion of an honors course in general chemistry. Hopefully, this reading will be done under the guidance of someone who will take a slightly more enthusiastic view of the study of metal ions in solution.

R. STUART TOBIAS
Department of Chemistry,
University of Minnesota

Mathematics

Linear Differential Equations in the Real Domain. Kenneth S. Miller. Norton, New York, 1963. viii + 193 pp. Illus. $5.75.

This monograph contains everything of the theory of linear differential equations that one would expect it to contain and then some. A list of the nine chapter titles will give some idea of its scope: "Fundamental properties," "The adjoint operator," "The one-sided Green's function," "The algebra of differential operators," "Distribution theory," "The classical Green's function," "Sturm-Liouville theory," "The constant coefficient case," and "Infinite series solutions."

Some amplifying and some critical comments seem in order: The treatment is restricted to the case of linear differential operators with continuous coefficients (with one exception), and it is based on the concept of the Riemann integral (in chapters 5 and 7 where this is relevant). Existence and uniqueness of solutions are established in the customary manner in chapter 1. The case where the coefficients of the linear operator may be sectionally continuous is dealt with in chapter 5, but the application of the theory of distribution to this case appears to be of questionable merit. Although it is comforting to know that the function pieced together from solutions in the sub-intervals, where all coefficients are continuous, is a solution in the sense of distributions, and although this may enhance the prestige of this "solution," it does not really make it a better solution. Mathematicians lived with this and similar situations (Green's function) for years before the advent of the theory of distributions. As a genuine application of the theory of distributions, Dirac's "sifting function" is introduced, discussed, and used. The Pruefer method is utilized to establish the existence of infinitely many eigenvalues of the Sturm-Liouville boundary value problem. The treatment of the Sturm-Liouville problem is carried as far as is possible under the restriction to the Riemann integral—that is, the uniform convergence of a Fourier series of a continuous function with a sectionally continuous derivative and the convergence in the mean of the Fourier series of an integrable function are established. In chapter 8, Jordan's theorem on the canonical form of a constant square matrix is derived in preparation for the solution of the general case of a linear equation with constant coefficients. It is regrettable that the author did not introduce the matrix function exp(At), where A is a constant square matrix, and thus lend greater elegance to the solution.

There is great merit in divorcing the theory of linear differential equations from the general theory of differential equations and presenting it in a self-contained form. "Differential equators" and applied mathematicians in general will study this monograph with a great deal of interest, and certainly will derive profit from such a study, but the book does not seem particularly suitable for use as a textbook. The level of presentation fluctuates, instead of increasing monotonically in depth and degree of difficulty, and no problems or exercises are included. It is doubtful that students with only "Advanced Calculus through uniform convergence and a rudimentary acquaintance with matrix theory" will have the mathematical maturity required for studying the material as it is presented here without major frustrations. The typography is excellent.

HANS SAGAN
Department of Mathematics,
North Carolina State University,
Raleigh

Note

Geology

Stratigraphy and Sedimentation (Freeman, San Francisco, ed. 2, 1963. 676 pp. Illus. $10.50), by W. C. Krumbein and L. L. Sloss, is an extensively reworked second edition of a well-known textbook by masters of the field. It treats the nomenclature, practices, and principles of stratigraphy, and of sedimentation as it applies to stratigraphy, with examples from the geologic record. It is not, however, a synoptic review or sequential sampling of the rock column; instead, the authors emphasize methods of stratigraphic analysis and data presentation. It is a candid, open-minded, and charitable book which occasionally seems about to bog down in terminology (for example, the treatment of facies and geosynclines) or even in downright nonsense (stratigraphic relationships and stratigraphic maps) but which rather consistently winds up with sensible recommendations. The exposition of the authors' predilections is counterbalanced with appreciative references to divergent views. Although not without inaccuracies (for example, precipitation of anhydrite) and typographical errors, this book is as nearly current and error-free as any I have examined critically. It is attractively printed, rewarding reading, and the drudgery involved in ploughing through the preliminary sections is compensated by an absorbing exposition of stratigraphic analysis in the last and longest of its 13 chapters. It contains an ex-