and sources outside North America are well represented. Students interested in further reading on specific topics will have to depend mainly on the captions to the figures for references. A handful of general references are provided at the end of the book, but none follow the individual chapters. Many authors are mentioned by name in the text, but rarely is so much as a date given to aid the student who wishes to read further. Many specific studies are mentioned, but the name of the investigator responsible is often omitted.

The text is clear and readable but not very well edited. Incorrect spellings and misprints are conspicuous. The sections on igneous and metamorphic rocks apparently owe much to *Igneous and Metamorphic Petrology* by F. J. Turner and J. Verhoogen (McGraw-Hill, New York, 1960), but the story has lost a great deal in the retelling.

In the preface the author states that: "Modern petrology has become physical chemistry applied to the crust of the earth." This is perhaps true, but this book does little to advance the cause. In the discussion, for example, of the calcite-wollastonite-quartz–carbon dioxide equilibrium curve (p. 355), the author reveals an ignorance of the distinction between homogeneous and heterogeneous equilibria, of the significance of a univariant curve, and of the nature of catalysis. Most instructors will undoubtedly conclude that the labor involved in setting students straight on such matters will more than offset the strong points of this text. It is, in general, a rather disappointing book, not up to this publisher's usual standards.

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Paleobotany

Morphology and Evolution of Fossil Plants. Theodore Delevoryas. Holt, Rinehart, and Winston, New York, 1962. ix + 189 pp. Illus. $4.50.

This excellent book is true to its title. Most chapters, or subdivisions of large chapters, consist of descriptions of the internal and external morphology of important members of the groups considered, followed by a discussion of the evolution of the groups and the evolutionary principles illustrated. Each chapter is terminated by a well-chosen bibliography, but literature citations are not made in the text.

The book is distinguished by beautiful illustrations, including many reconstructions, a large number of which were prepared by Delevoryas and his associates. The text, although comprising only 182 pages, is remarkably comprehensive. The writing is concise. Every sentence is important. Emphasis is placed on significant morphological features, such as the order of maturation of primary xylem, nodal and petiolar anatomy, the nature of the pitting of the secondary tracheids, branching patterns, vascularization of both vegetative and reproductive structures, and the structure of fructifications. The treatment of all groups is not equally comprehensive, however. For example, Devonian plants, especially psilophytes, and angiosperms are given relatively brief treatments, whereas Pennsylvanian plants, especially lycopsids, sphenopsids, coenopterid ferns, and pteridosperms are given a more intensive coverage.

The book is organized around a traditional classification. The initial chapter, on the preservation of fossil plants, is followed by a discussion of fossil algae, fungi, and bryophytes. The remainder of the book consists of ten chapters on vascular plants, a final chapter of summary and conclusions, and an index. Under the division Tracheophyta, subdivisions Psilopsida, Lycopsida, Sphenopsida, and Pteropsida are considered in sequence. Classes of pteropsids included are Pterophyta, Cycadophyta, Coniferophyta, and Angiospermophyta. Subdivisional and class endings do not conform to the current *International Code of Botanical Nomenclature*, but are, instead, those that have been commonly used in the morphological literature. Some confusion may result, since all except the latter of the class names have also been used as the names of divisions or phyla in several recent textbooks. Among the most interesting are several short transitional chapters entitled "The appearance of land vascular plants," "Seed plants," "Problematical cycadophytes," and a section of one chapter called "Problematical and transitional ferns."

Morphological paleobotany today is a dynamic and rapidly progressing field. Many significant discoveries and interpretations have been made during the past decade which have added to our knowledge of plant evolution. Delevoryas has prepared a book which, more than any other in English, emphasizes the evolutionary aspects of paleobotany. Furthermore, where interpretation and speculation are encountered, they are the thoroughly considered opinions of one who combines the best of classical theory with modern evolutionary thought.

Every biologist interested in plant evolution should own this book. There is not a better book on morphological paleobotany available, no matter what its size.

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Autobiography of a Science

Fifty Years of X-ray Diffraction. P. P. Ewald, Ed. Oosthoek's, Utrecht, Netherlands, 1962. ix + 717 pp. Illus. $11.25.

In July 1962 a commemoration meeting was held in Munich, Germany, to celebrate 50 years of x-ray diffraction. The principal actors in the beginnings of that drama, which took place in 1912, were Max von Laue, W. Friedrich, P. Knipping, and P. P. Ewald. Appropriately enough, the president of the International Union of Crystallography, under whose auspices the 1962 meeting was held, was P. P. Ewald who, looking ahead to the meeting, had been working on a history of x-ray diffraction to be published in time for the meeting.

This book contains eight sections of widely differing lengths, an appendix consisting of biographical notes on the authors, and a subject index. The first three sections are entirely Ewald's work. A five-page introduction is followed by a section consisting of four chapters that describe the early days of x-ray diffraction: Röntgen's work on the physics of x-rays, classical crystallography prior to x-ray diffraction, Laue's discovery of x-ray diffraction, and a chapter devoted to the very early work of the pioneers—the Braggs, Darwin, Moseley, Debye, Hull, and others. In the third section (two chapters), Ewald tells about the principles of x-ray diffraction and discusses the methods and problems of determining crystal structures.

It would be impractical to describe in detail the remaining sections, which were written by some 40 authors. Sec-

tion 4, "The growing field" (about 150 pages), contains nine contributions. Of particular interest is W. L. Bragg's comparatively short account of the early days of x-ray diffraction. Section 5 contains biographies of 12 of the pioneers in x-ray diffraction. Noteworthy is the first one—Max von Laue's "Autobiography," which was written some years ago.

Section 6, "Schools and regional development," contains accounts of the development of crystallography in Great Britain, France, the United States, Germany, the Netherlands, Scandinavia, Japan, and the Soviet Union. Section 7, "Personal reminiscences," contains contributions from some 35 early leaders in the field. These are of mixed interest; some are very formal but some are delightful, intimate accounts of the early days of crystallography. Section 8, "The consolidation of the new crystallography," is essentially historical and brings the account up to date.

So much for a formal list of the contents of this most important book—and important it undoubtedly is. In the introduction Ewald indicates that he hopes the book will be of service to future historians of science. From this point of view the volume is a tremendous accomplishment, for this is probably the only account of the first half century of a science which has been so thoroughly documented during the lifetime of the individuals whose work is described. However, some questions can be raised: How reliable is the information contained in the volume? Will this book interest scientists other than crystallographers and historians? To the first question, I can say that most of the information seems to be reliable and accurate, but there are some errors and some omissions. Thus (p. 8) reference is made to the wonderful work of Bäcklin who, by measuring the diffraction of x-rays by gratings, was able to revise the value for the charge of the electron. The date given is 1935, but Bäcklin's thesis at Uppsala was published in 1928. The history of the phase problem is mentioned in nine different places, but nowhere is the pioneer work of Ott and Avrami mentioned, although Ott's work was done in 1927 and Avrami's in 1938; Banerjee's contribution, dated 1933, is mentioned in one place only—in the historical account of x-ray crystallography in India which Banerjee himself wrote. Chapter 13, "Problems of biochemical structures" by Ralph W. G. Wyckoff, is certainly most incomplete. From this chapter one would never learn that important research has been done on such materials as starch, viruses, and vitamin B_{12}.

In the section on schools and regional development, 56 pages are devoted to Great Britain, 16 to the United States, and only 5 to the U.S.S.R. Despite the great importance of the English schools, a more even coverage is surely indicated. A name index of the volume would have been most welcome, for so much of the text is tied closely to the individual scientists concerned. Ewald indicates that he hopes to issue a revised edition and would welcome criticism, corrections, and the like. (Such comments should be sent to him at 19 Fordyce Road, New Milford, Conn.)

The second question, whether noncrystallographers will find this book of interest, is one that I cannot answer. I find it a fascinating book, and I hope noncrystallographers will have a similar reaction.

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Contrasting Points of View

Introduction to Theoretical Physical Chemistry. Sidney Golden. Addison-Wesley, Reading, Mass., 1961. xi + 307 pp. $9.75.

Dynamic Physical Chemistry. John Rose. Wiley, New York, 1962. xii + 1218 pp. Illus. $12.50.

Two very different approaches to physical chemistry are presented by the authors of the books reviewed here.

In *Introduction to Theoretical Physical Chemistry*, Sidney Golden has furnished a graduate text dealing with the development of the fundamental theory underlying thermodynamics, statistical mechanics, and quantum mechanics, together with the interrelationships that exist among them. As each of the major divisions is covered in about 100 pages of text, a considerable body of material usually included in treatises on the individual disciplines is here omitted. This condensation is accomplished by holding historical material to a minimum, by giving very little physical interpretation and no numerical examples, and by committing the detailed proofs of many of the equations to exercises at the ends of chapters. There is not a single figure in the entire book, and there are no specific references to the original literature. Each chapter concludes with a helpful summary containing an excellent statement of the logic underlying the presentation.

The author's technique of presenting much of the fundamental material in a postulatory and sometimes cursory manner results in the overuse of the phrases "it should be apparent that . . . ," "clearly . . . ," and "it is evident that . . . ." The student who is not able to leap ahead with the author's admirable facility will soon feel that much of the rigor he expects of a theoretical discipline is lacking. Nor is the author's writing always clear and lucid. For example, he defines a replica in the following terms: "Each replica is such in a precise and formal sense: they all have identical mechanical descriptions, but the values of the mechanical properties may vary from one replica to another." It will be difficult for the uninitiated to determine the author's intent from such an apparently contradictory statement.

It is not easy to determine the audience for which this book should be recommended. The few students that approach the subject of theoretical physical chemistry with considerable mathematical background and facility and with the ability to fill in adequately the lacunae in Golden's sophisticated but precipitate development are also likely to desire the greater comprehensiveness found in a number of existing books on the separate subjects. The book is certainly not for those students who desire a step-by-step treatment of the evolution of the material together with a close coupling of the theory with physical situations.

Dynamic Physical Chemistry, by John Rose, is a comprehensive single-volume "textbook on thermodynamics, equilibria and kinetics." Each of the subjects is developed from certain primary assumptions and experimental or theoretical relationships. In most cases a large number of examples are then presented and used ably for illustration. Within each area the author has included an impressive range and variety of individual topics. For the specific examples presented, numerous references to the original literature are given; others are notably absent. There are no problems or exercises for the student, although some numerical examples are worked out in the text.