Γ for the summation of the γ values which is important in complex spectra? The Γ sum rule and the Γ permanence rule are stated separately in sections 13.14 and 13.15. In this connection it is noteworthy that on pages 704–5 of the fifth edition of Sommerfeld's "Atombau" is found a treatment of these rules which shows that the sum rule can be developed as a consequence or corollary of the more general permanence rule.

In the chapter on x-ray spectra, the x-ray and optical terms of cadmium are shown on the same scale in Fig. 16.11, page 310. If we compare this figure with the optical terms of cadmium, shown in Fig. 11.6, page 179, we find that the configuration to which the wave-number zero is assigned is different in the two representations. In the optical case the wave-number zero is assigned to the configuration in which one of the outermost s-electrons is removed to infinity; on the optical-x-ray diagram the normal state of the cadmium atom is given wave-number zero. The former convention is undoubtedly the most commonly used one in optical spectra, and appears in Bacher and Goudsmit's "Atomic Energy States" for all spectra in which series limits are known. Whether a new convention should be adopted for diagrams showing the relation between x-ray and optical spectra I am not ready to state. If we retain the conventional optical assignment, all the x-ray terms have negative wave-numbers like the upper members of the displaced sequences in calcium, which are shown in an excellent diagram on page 182 of the book.

The application of the Γ permanence and Γ sum rules to x-ray spectra is not brought out, and Russell-Saunders term symbols are used for x-ray terms, which I believe assumes more about their coupling than is warranted by the information at hand.

An excellent feature of the book is the chapter on series perturbations and auto-ionization, which is the best treatment of the subject I have seen in book form. The book closes with an up-to-date account of the breadth of spectrum lines.

This book can be given unqualified approval as a text for graduate courses in atomic spectra. For the labor of its compilation the author deserves the thanks of every teacher and student of the subject.

SAMUEL K. ALLISON

GYMNOSPERMS

Gymnosperms, Structure and Evolution. By C. J. CHAMBERLAIN. Pp. xi + 484, 396 figures. University of Chicago Press, Chicago, Illinois. $4.50.

THIS book by Chamberlain describes the morphology and evolution of the gymnosperms, seed plants whose history extends back into the Paleozoic. The work is not only an excellent morphological treatise, but also includes many other phases of the subject. In it we find first-hand accounts of their geographic distribution and excellent photographs of the growth habit and habitats of these plants. Many restorations of the fossil forms add materially to the clearness with which the author describes the origin, history and evolution of the gymnosperms from the Carboniferous to the present.

In nearly every chapter, we find some of the author's own contributions to the subject, and throughout the book there is evidence that the findings of other investigators have been carefully checked and verified. Moreover, he has filled in many gaps in our knowledge of the morphology. Thus the book has the merit of being written by one who is thoroughly familiar with the material itself as well as the literature of the subject and who has devoted a lifetime to teaching and research in this particular field. A great majority of the excellent illustrations have been prepared by the author himself and about one third of them are entirely new.

The earliest records in the Paleozoic, reaching back at least 300 million years, show us that, included in this group, there are already two distinct lines which the author calls the Cycadophytes and Coniferophytes. The Cycadophytes are traced back to the Cycadofilicales; the Coniferophytes to the Cordaitales. These two lines appear to be distinct as far back as they can be traced in Paleozoic history. The two orders Bennettitales (or so-called "fossil cycads" of our texts on Historical Geology) and the Cycadales were both derived independently from the Cycadofilicales, not the cycads from the "fossil cycads." This last phase of their evolution occurred at the beginning of the Mesozoic. Likewise, the two orders of Coniferophytes, Ginkgoales and Coniferales, both lead back more or less independently to the Cordaitales, which became extinct at the close of the Permian. There is no connection between the Coniferophytes and any of the cone-bearing lycopods which flourished during the Devonian and Carboniferous. The Gnetales are much more recent and their origin is more obscure, though it seems evident that some of them show a definite affinity to the Coniferales, especially when we consider their embryogeny.

In his chapter on Cycadofilicales (often called the Pteridosperms), the author presents a very clear account of the structural features of this fossil material. Many excellent restorations are shown among the figures. Chamberlain also includes a series of hypothetical reconstructions of the essential steps in the evolution of the seed, based on a study of the seeds of Cycadofilicales. He defines a seed as a megasporangium which retains its megaspore and emphasizes the fact that the steps in the evolution of this structure

can not omit the stage of heterospory, as some eminent paleobotanists have suggested. The genetic line must have been: homosporous ferns; heterosporous ferns; seed plants. This thesis is very ably defended on morphological grounds.

The Cycadales, the only living representatives of the Cycadophytes, are presented in five chapters, including their geographic distribution, their life history, their gametophytes and fertilization, their embryogeny and seedling anatomy and their phylogeny and taxonomy. It is well known that Chamberlain has made notable contributions to the morphology of this group and in his chapter on their habitat and geographic distribution, he speaks with the authority of one who has studied them carefully in the field in various parts of the world. We find many new details on stem and leaf anatomy, on their gametophytes and on other structural features not previously included in similar books. In a discussion of hybrids among cycads several species crosses are described. A feature which should be of considerable interest to geneticists is the fact that generic hybrids have been obtained in the cross: *Ceratozamia mexicana* × *Zamia monticola*.

The chapters on Cordaitales and Ginkgoales indicate that there has been no great research activity in these groups in recent years. The author shows some excellent restorations of Cordaitales, and he has included some new figures and descriptions of features of the vegetative anatomy of Ginkgo.

Six chapters are devoted to the conifers, which include about four fifths of the genera of living gymnosperms. Here we find much new material selected from the literature which is reviewed, as well as original contributions. Many problems which remain are pointed out, so that the investigator of gymnosperms will find this book indispensable as a ready reference. There is much new material on the embryo, and the introductory chapter on the geographical distribution and habits of conifers shows that the author has also studied this group extensively in the field.

The Gnetales are treated in three chapters, including not only an excellent summary of the literature, but also some original studies on the details of floral organography in *Welwitschia*. Very little attention is given to the Caytoniales, whose phylogenetic position is still uncertain.

The final chapters are devoted to a discussion of phylogeny and the alternation of generations. The latter chapter is broadly inclusive—algae to seed-plants—and shows why the author holds strictly to the antithetic theory of alternation. A bibliography of 719 titles is included. The book is written in an attractive style and serves as an excellent text-book covering the morphology of gymnosperms, suitable for advanced courses in botany. For paleobotanists and students of historical geology, it presents the background essential to the interpretation of fossil seed plants and ferns. The investigator, if he is a beginner, will find this book indispensable as a ready reference; if he is an experienced investigator in the group, he will still find it essential for the numerous new and original contributions which it contains.

J. T. BUCHHOLZ

UNIVERSITY OF ILLINOIS

STATE ACADEMIES

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE thirty-fourth annual meeting of the North Carolina Academy of Science was held at the Woman's College of the University of North Carolina, Greensboro, North Carolina, on May 3 and 4, 1935. About 265 persons, members and visitors, attended the meeting. Sixty-three papers and two exhibits were on the program. (The Proceedings and abstracts of most of these papers and several complete papers will appear at an early date in the *Journal of the Elisha Mitchell Scientific Society*.)

The first day was set aside for the presentation of papers before the General Section, after which was held the annual business meeting. The evening meeting was taken up with an address of welcome by Dean Geneva Drinkwater and the presidential address, "The Caprifoliaceae, or the Honeysuckle Family, in the Southeastern States," by the retiring president, Dr. H. R. Totten, professor of botany at the University of North Carolina. The addresses were followed by a social hour in Society Hall. The forenoon of the second day was set aside for the meetings of the following sections: General Section, Chemistry Section, Mathematics Section and Physics Section.

During the business meeting, a resolution of respect was read, honoring the memory of Dr. Collier Cobb, for many years professor of geology and chairman of the same department at the University of North Carolina.

The academy elected to life membership Dr. E. W. Gudger, of the American Museum of Natural History, and Professor R. N. Wilson, of the department of chemistry, Duke University. The executive committee reported the election of forty-three new members during the year and the reinstatement of seventeen former members.

In the high-school science essay contest, sponsored by the academy, first prize was awarded to Miss