

method constituted the chief characteristic of the book, we should have but little to say in its favour. The curvature method undoubtedly possesses many obvious advantages, but the loose and in places quite inaccurate manner in which the elementary theory of mirrors and lenses is here set forth does much to obscure the merits of the system.

The definition "The curvature of a circle is the angle through which a curve turns per unit length" gives an early suggestion of the lack of logical clearness which is throughout apparent. As an instance of more serious inaccuracy the following attempt at an explanation of the formation of an image by a concave mirror may be quoted (p. 18):—

"To explain the formation of the virtual erect image we may imagine the mirror to consist of an infinite number of plane surfaces (Fig.). Each of these is capable of producing a virtual and erect image (as previously explained) identical in position behind the mirror with the object in front. As the object is moved from the mirror more of these supposed innumerable facets take up the reflection for the eye to view, and so the image increases rapidly in size. . . ."

The attempt at a formal proof, for the spherical mirror, of the relation connecting conjugate foci is given later (p. 38). With no guidance as to the conditions limiting the truth of the statements made, and with a misleading figure, we venture to think that the intelligent student would find this hopelessly bewildering.

In fact, however, no real attempt is made to establish, by the curvature method, the principles of elementary geometrical optics. Apart from the statement in the preface one would have judged the aim of the book to be quite different from this. It would appear clearly to be intended for the use of those actually engaged in optical workshops, and especially those concerned with the practice of spectacle making and of sight testing. It would seem to aim, not at providing a logical exposition of elementary principles on any system, curvature or other, but at furnishing a reader of the kind suggested with a sufficient modicum of information about many points likely to be brought under his attention in the course of his practice, to enable him to deal with these not unintelligently. From this point of view it may fairly be held to have achieved some measure of success. Evidently written by practising opticians, it does contain, in small compass, a good deal of practically useful and important information not to be found in the ordinary elementary text-book, more especially in regard to the characteristics of the eye as an optical instrument and the problems involved in the correction of its defects. The fact that the discussion of such questions is more readily carried on in terms of curvatures and focal powers than of radii of curvature and focal lengths may, perhaps, be held to account in some measure for the sentence quoted from the preface.

The book has some features of value to those for whom quick reference is essential: a useful summary at the end of each chapter; a few tables and data, including a table of aberrations in lenses and their

remedies, from a paper read by Prof. Silvanus Thompson before the Optical Society; a list of optical works; and, following the index, a list of articles useful in spectacle work and sight testing, with approximate prices.

As a text-book on elementary optics the book needs much careful revision. We think well enough of it to express the hope that it may receive this treatment without delay.

ECONOMIC ZOOLOGY.

Economic Zoology, an Introductory Text-book in Zoology, with Special Reference to its Applications in Agriculture, Commerce and Medicine. By Prof. Herbert Osborn. Pp. xv+490; 269 figures. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1908.) Price 8s. 6d. net.

A Manual of Elementary Forest Zoology for India. By E. P. Stebbing. Pp. xxiii+230+xxxiv; 422 figures. (Calcutta: Superintendent Government Printing, 1908.) Price 15s.

THE teacher of zoology to students whose chief interest in the science depends upon its relations to some branch of human industry has often to decide whether he shall give the more prominent place to general principles or to special and technical applications. The rival points of view are well illustrated in these two works. Prof. Osborn, in the introduction to his handy "text-book," rightly advocates the claims of sound general principles.

"Inasmuch," he writes, "as economic zoology is simply an application of our knowledge of animals which affect human interests, it is easy to see that almost any phase of the study will have some bearing on the problems that concern us. Economic zoology, if studied thoroughly, must of necessity be based on accurate knowledge . . . so that it involves a study of the whole animal and all that can be learned regarding its activities."

In agreement with these principles, the author has, in the work before us, neglected no groups of the animal kingdom, even though, like the Echinoderms and the lower Chordata, they have little or no "economic" importance, so far as we know at present. A knowledge of the structure of these groups is essential to any real training in zoology; and who, a dozen years ago, could have foreseen the vast economic importance of such groups as the Hæmosporida, the Culicidæ, and Ixodidæ? The students now in our colleges require training not only for the known needs of the present; they are entitled to be equipped so that they can grapple practically with the unknown problems of the future.

But while the principles that have guided Prof. Osborn are thoroughly sound, it is doubtful if he has made the best possible use of the space at his disposal in thus applying them. He has given clear descriptions of the great animal phyla from Protozoa to Vertebrata, and the leading classes and orders, illustrated by well-chosen figures culled from trustworthy sources. Such descriptions are, however, already available in many zoological text-books. The special text-book for the student of economic zoology should

contain summaries of those detailed accounts of families and species, injurious or useful to man and his domesticated plants and animals, at present to be found only in scattered original papers or in expensive advanced treatises. In this respect the book must be pronounced disappointing. Prof. Osborn is well known for his original work on insects parasitic on domestic animals, yet here he dismisses the Anoplura in seven lines, the Mallophaga in a single short page, and refers to the Oestridæ only by reproducing two figures of horse bot-fly and its larvæ, not even mentioning this most important family in his text. Similarly, in the section on the Hymenoptera there is no special account of the saw-flies. Such omissions are not compensated for by outlines of morphology and classification, which, though the economic student ought indeed to know them, and know them well, he can find in half-a-dozen good elementary manuals.

There is another branch of zoological inquiry which, though most fundamental and important to the economic student, is superficially dealt with in most elementary text-books—the branch that deals with the factors of evolution. A fairly full and critical summary of modern developments of the theory of descent would be of vast benefit to the scientific agriculturist, for example. Prof. Osborn discusses these questions in eight pages, and the summary is necessarily so condensed as to be practically useless to a beginner. It were surely better to make no mention at all of the Darwinian and Mendelian theories than to describe them in ten and fourteen lines respectively.

A word of praise is due to the clear printing of the book and to the illustrations, which, with a few exceptions—printed so darkly as to be almost unrecognisable—are very well reproduced.

While Prof. Osborn's book is written mainly from the standpoint of the North American worker, Mr. Stebbing's deals almost exclusively with Indian forest zoology. After a general introduction, in which the principles of structure are illustrated mainly from the Vertebrata, the invertebrate phyla—except the Arthropoda—are dismissed in six pages. The Arthropoda are described in 148 pages, and of these 136 are devoted to an account of the Insecta. The chapters included in this section form the original and valuable part of the book. The author states in his preface that it could not have been written seven years ago, and the number of life-histories of forest insects, especially among the Curculionidæ and Scolytidæ, described and figured bears testimony to the industry and power of observation displayed by Mr. Stebbing. Unfortunately, many of his drawings have been very coarsely reproduced; our Government publishing departments—both at home and “beyond the seas”—have much to learn, for the heavy, unattractive appearance of too many scientific works marks their “official” origin at a glance. In some cases, however, Mr. Stebbing's photographs and figures have been treated with full justice; for example, the stages of *Hoplocerambyx* in a sal tree (Figs. 193, 194) form a beautiful and instructive picture. In following Dr. Sharp's volumes of the “Cambridge Natural History,” it is unfortunate that Mr. Stebbing should have copied

the antiquated arrangement of insectan orders now abandoned by Dr. Sharp himself. It is disappointing also to find that both Mr. Stebbing and Prof. Osborn retain the unnatural “Class Myriapoda.”

The concluding section of Mr. Stebbing's book comprises short accounts of the classes, orders, and leading families of Vertebrata, with special reference to the Indian fauna, illustrated with cuts mostly reproduced from the volumes of the “Fauna of British India.” The most valuable feature of these summaries is in the accounts of damage done to forests by various mammals and birds. Indeed, in Mr. Stebbing's book, as a whole, we have prominence given to the practical and technical aspects of zoology rather than to those general facts and principles on which Prof. Osborn lays the greater stress. G. H. CARPENTER.

OBSERVATION, STUDY, AND NAMING OF PLANTS.

Nature Rambles in London. By Miss K. M. Hall. Pp. xviii+325. (London: Hodder and Stoughton, n.d.) Price 3s. 6d. net.

Life Histories of Common Plants. By Dr. F. Cavers. Pp. xvi+363. (Cambridge: University Tutorial Press, Ltd., 1908.) Price 3s.

The Young Botanist. By W. Percival Westell and C. S. Cooper. Pp. xxxix+199. (London: Methuen and Co., n.d.) Price 3s. 6d. net.

PUBLIC gardens and parks provide better facilities for the observation of trees and shrubs than it is possible to obtain on rambles in the country, so that dwellers in London have full opportunity for pursuing the study of these objects. Unfortunately, many of the numerous visitors who frequent the parks have not the necessary knowledge or lack the training required to make the best use of their opportunities. For these Miss Hall has prepared the notes on nature rambles, written in non-technical language, and arranged according to the seasons' changes. Apart from the discourses on trees, a considerable amount of space is devoted to the descriptions of the birds that reside in or frequent the parks, and not the least interesting pages tell of the bee-hive that is located under Miss Hall's charge in the Stepney Gardens. The descriptive text is set off by the illustrations supplied by Mr. H. Irving, who has established a reputation for his photographs of natural history specimens.

The title of Dr. Cavers's book may suggest a series of short monographs on selected types; it furnishes, however, a compendium of the morphology and physiology of the flowering plants, followed by chapters on special orders or allied groups of plants. For the study of elementary botany the course delineated is both natural and practicable. The early portion of the book follows somewhat similar lines to the author's “Plant Biology,” but is not so full, and is written in a more direct, *i.e.* less interrogative, form. Physiology provides the fundamentals of the training, and a full set of experiments is outlined to enable the student to gather his principles from personal observation or from attempted experiments, as some are too uncertain for the student to manipulate.