most original and valuable in the book, and the student who does the work outlined in it can not fail to get a much better insight into many things in the world about him. The local distribution of plants and animals is first taken up and the student is set to study plant societies and the particular habitations and habits of the animals of a restricted locality. There is a section on pond life, with directions for the study of the animals found in the pond. Then comes a discussion of symbiosis, parasitism and pollen production as affected by its mode of distribution. The third section of the chapter is devoted to the adaptations of aquatic insects—forms admirably fitted to illustrate adaptation—and a consideration of animal coloration as cryptic, warning and mimetic.

The final chapter deals with the responsive life of organisms. Beginning with the behavior of the protozoa the author proceeds to consider reflex action, the general architecture of the nervous system, instinct and the simpler modes of learning through trial and error. The last part of the chapter is concerned with the natural history of man and various human institutions—a subject which naturally can be dealt with in only the briefest way, although the discussion may serve its purpose of giving a general notion of the relation of man and human society to the rest of the animal creation.

The course of instruction which Dr. Needham's book outlines is quite different from the usual introduction to biology. Morphology is given but a subordinate place. The student is not set to work on a series of forms to acquire a foundation of knowledge whose significance may appear some time in the future; he is plunged at once into a study of biological principles and introduced to the facts upon which they are based. It is a common practise to study several type forms and use them, so far as they are adapted to the purpose, for the inculcation of matters of general biological import. Dr. Needham, on the other hand, starts with the general subject or principle to be studied and rummages through the plant and animal kingdoms for good illustrative material. There is little gathering of irrelevant information. Selecting a number of the most fundamental and significant fields in biology, he sets the student at work in them on concrete facts. "Ecological and evolutionary phenomena," the author says, "are just as available for practical studies as are morphological types," and every teacher of biology can derive many useful suggestions from the way in which the studies of these subjects are outlined.

The relatively large amount of attention devoted to field work is one of the most salient characteristics of the book, and constitutes one of its chief merits. The selection of material for study, so far as the reviewer can judge, is judiciously made, and in the hands of a teacher who knows plants and animals in their natural environment the book will doubtless prove a valuable introduction to the study of animate nature.

The book is well printed on good paper, but very poorly bound. A considerable proportion of the figures are new and the portraits of several eminent biologists add to the general attractiveness of the volume.

S. J. HOLMES

Handbuch der Vergleichenden Physiologie, herausgegeben von HANS WINTERSTEIN in Rostock. Band II. (in part). Physiologie des Stoffwechsels. Jena, Gustav Fischer. 1910.

The day has passed when the study of comparative physiology requires a defense at the hands of its devotees. If one asks, however, why so little organized progress has been made in this field in comparison with related domains, the answer is perhaps to be found in the peculiar associations under which animal physiology and zoology have developed until quite recently. Physiology was long looked upon as a science which could only be fostered successfully in connection with a medical curriculum; as a result of this the more practical ends of the applied science always forced themselves to the front and led as a natural consequence to that splendid development of the study of mammalian functions which is well known. The activities of the lower forms

were neglected despite the attractive opportunity for investigation which they obviously afford. In the zoological institutes, on the other hand, where one might have expected the desired progress to be initiated, attention was centered for the most part upon morphological aspects of study—at any rate, for many years after purely systematic studies gave way to modern experimental methods.

The editor of the new "Handbuch" believes that the time has come to take account of the facts of comparative physiology now established and to review the situation in a more comprehensive manner than has heretofore been attempted. This is the period of "Handbücher" in the biological sciences. We may question whether it is not time for a reaction to set in—for a return from the prevailing expansionist methods of publication to those of the less cyclopædic texts where competent critique eliminates a great mass of antiquated data and gives us less voluminous, but more inspiring, manuals. In the case of comparative physiology, however, it would be unfair to say that the general literature has as yet been overdone. The usefulness of such a book as v. Fürth's "Vergleichende Chemische Physiologie" arouses the belief that the publication of a comprehensive summary of the important contributions, with an attempt at such generalizations as are now warranted, may be decidedly valuable. The names of the collaborators whom Professor Winterstein has selected inspire confidence in the undertaking. They include E. Babák (Prague), S. Baglioni (Rome), W. Biedermann (Jena), R. du Bois-Reymond (Berlin), F. Bottazzi (Naples), R. Burian (Naples), A. J. Carlson (Chicago), L. Fredericq (Liege), R. F. Fuchs (Erlangen), S. Garten (Giessen), E. Godlewski (Cracow), A. Kreidl (Vienna), J. Loeb (New York), E. Mangold (Greifswald), W. Nagel (Rostock), H. Przibram (Vienna), O. zur Strassen (Frankfurt), R. Tigerstedt (Helsingfors) and E. Weinland (Munich).

The plan proposed calls for a division of the subject according to physiological functions rather than by groups and species, thus creating a true *comparative physiology*. In connection with each topic the relations of the various animal subdivisions are to be dealt with by comparison in so far as existing knowledge justifies. The entire field is to be covered in four volumes issued in about thirty parts. The groupings of the chapters comprise The Body Fluids; Respiration; Metabolism of Matter; Reproduction; Metabolism of Energy; Physiology of Form; Physiology of Reception of, Conduction of, and Response to Stimuli.

These columns will not permit a detailed review of the four parts which have already appeared, further than to indicate their scope. Professor Biedermann has written the subdivision on the ingestion and assimilation of food. The descriptions applicable to animal forms are preceded by a rather comprehensive account (272 pp.) of nutrition in plants, primarily of the lowest types. In this the author has evidently drawn largely from such works as Czapek's "Biochemie der Pflanzen" and Lafar's "Handbuch der technischen Mykologie." The first 75 pages deal with the sources of nutriment for plants; the remainder of this introductory portion is essentially a review of the rôle of enzymes in the metabolism of plants. One might differ with the author as to the desirability of devoting so many pages to a subject which seems at first glance rather foreign to the main purpose. Professor Biedermann evidently feels that its importance has not been adequately appreciated. "Man darf wohl sagen," he writes, "dass kaum auf einen anderen Gebiete der Physiologie die *cellular*-physiologische Forschung so glänzende Resultate aufzuweisen hat, wie gerade auf dem der Pflanzenverdauung. In geradezu schematischer Klarheit tritt uns hier schon bei den Bakterien und den niederen Pilzformen die fundamentale Tatsache entgegen, dass es Enzyme gibt, welche ausserhalb der Zellkörper (extracellular) wirken (*Ektoenzyme*), wie auch solche deren Wirksamkeit nur *intraplasmatisch* (*intracellular*) zur Geltung kommt (*Endoenzyme*)" (p. 254). After a review of the literature on the comparative chemistry of nutrition, Biedermann concludes: "Es darf als sicher gelten, dass die intra- und extra-

cellulare Verdauung bei Pflanzen und Tieren Vörgange darstellen, zwischen denen kein Wesensunterschied besteht" (p. 385).

In the chapters devoted to animal forms, the nutrition of the protozoa and metazoa is considered in orderly sequence. The probable form in which nutriment is ingested is discussed, followed by a consideration of the physiological equipment of each group for the digestive disintegration of the food material and its transport within the organism. Incidentally it may be noted that the author does not accept Pütter's contention that some of the lower marine forms derive their nutriment from organic compounds dissolved in the water. Some attention is devoted to the possible significance and origin of the chlorophyll granules and so-called yellow cells (Zooxanthellen) in protozoa. References to the literature are supplied at the end of each chapter.

The first instalment of the monograph by Léon Fredericq on "Die Sekretion von Schutz- und Nutzstoffen" begins with Lieferung 4. This contains a distinctly unique compilation of the protective and defensive excretions of lower forms arranged in the sequence of the zoological system. Where possible the structural relations of the parts involved in the secretion of the fluids and substances included are described and illustrated with drawings. These chapters are certain to be very useful for reference. Among the topics included are such as the protective coverings and slimy secretions of animals, the poisons and pigments produced by them, and the relation of these to the production of pathological conditions in other animals and man. The poison in the sting of insects, the toxins of the Actinia, the acid secretion of molluscs, the melanin production of *Sepia,* the hemolysins of intestinal parasites (worms), the anticoagulant hirudin, the formation of silk, the production of waxes—are scattered illustrations of the diversity of topics included in the physiology, chemistry and toxicology of this hitherto inadequately investigated domain.

In the preface to the "Handbuch" the editor formulates the policy that in addition to a complete review of the literature there must be an effective separation of established facts from untenable speculations and inadequate observations. In the two specimen monographs already available these aims have been followed faithfully in so far as the omission of uncertain hypotheses are concerned. If the subsequent installments of Winterstein's "Handbuch" maintain the standards here set, its place as a desirable reference work for biological investigators is assured.

LAFAYETTE B. MENDEL
SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY

The Elements of the Science of Nutrition. By GRAHAM LUSK. Second edition, revised and enlarged. Philadelphia and London, W. B. Saunders & Co. 1909. 8vo, 402 pp. Cloth $3.00 net.

During recent years the American literature has been rich in dietary studies which have added much to our knowledge regarding accounts of nutrition. The publication of these studies by Atwater, Benedikt, Langworthy and others in public documents has awakened a wide-spread interest among others than students of nutrition. It is not the purpose of the reviewer to criticise adversely such publications, for their value is unquestioned, and this value lies chiefly in the attention they have attracted at the hands of readers who have not made a study of nutrition and whose reading must therefore be to a large extent superficial.

The first edition of the present book appeared in 1906. Its purpose was to treat of the fundamental principles of nutrition. The introductory chapter, which occupies 53 pages, gives a concise and well-arranged historical statement of the development and results of nutritive studies. The succeeding chapters treat of the subject under well-chosen topics. The book is of value as a reference manual to students of nutrition. It is presented in readable form, so that it is also readily available to popular readers in whom the articles referred to above have awakened a somewhat superficial interest in the subject of nutrition. It is primarily intended, however, to encourage