voted to the *Passeriformes*, which nearly equal in number of species the rest of the class, only a few pages being allotted to even the larger families; and the various generic groups are mentioned, as a rule, only by their technical generic names. The book is thus evidently not really adapted to beginners, nor wholly suited to the general reader, though apparently designed 'not only for the tyro in ornithology, but also for the traveller or resident in foreign parts interested in the subject.' The woodcuts that quite fully illustrate the text are, for the most part, excellent, and prepared especially for the work by G. E. Lodge; others are familiar through frequent previous use. Considering the limitation of space imposed for the subject, the author has, perhaps, supplied all that could be rightfully expected, and has certainly shown himself to be 'up to date' in all of the essentials of his subject.

J. A. A.

Experimental Morphology. By CHARLES B. DAVENPORT. New York and London, The Macmillan Company. 1899. Part Second. Pp. 228.

The second part of Davenport's Experimental Morphology that has just appeared deals entirely with phenomena of growth. The first volume described the effects of chemical and physical agents upon protoplosm, and it is intended to devote the third volume to cell-division and the fourth to differentiation. The author states that it is the aim of this series 'so to exhibit our present knowledge in the field of experimental morphology as to indicate the direction for further research.'

The present volume gives a clear, brief statement of what is known in regard to growth in plants and animals. Most of the illustrations are taken from plant physiology, and it may, therefore, be questioned whether a zoologist is in position to summarize so large and important a field of botanical research, but in justification it should be stated that Davenport has attempted to deal with the subject from a common biological standpoint.

In reading this volume one cannot fail to be impressed by the enormous difference in our knowledge of growth-phenomena in plants and animals. The subjects dealt with cover one of the most interesting fields of biological study—the responses of organisms to their surroundings and the relation of these responses to the conditions of life under which the form is living or has lived in the past. The introductory chapter is intended to give an idea of normal growth. Organic growth is defined as increase in volume—'it is not development, not differentiation and not increase in mass.' A broad definition of this sort, while convenient to include a large number of changes resulting in 'an increase in volume,' may lead to difficulties if an attempt is made to find a common explanation of all the phenomena included in the definition, for the processes that take place in plants and animals that produce an increase in volume may be entirely different in their nature. The author has skillfully avoided this pitfall in most cases, although at times one cannot but feel that a most heterogeneous collection of facts has been included in the same category.

The first chapter (XI.) deals with the effects of chemical agents on growth, and gives in compact form a large amount of useful information. In most cases the action of the substance seems to be purely physiological and only secondarily formative. It is not obvious why so much space should be given to pure plant physiology. It is, no doubt, difficult to draw the line between substances that act as foods and others that produce growth, since the latter often (but not always) depend on the former.

An admirable account of the rôle of water in growth is given in Chapter XII. Here the author has some new facts that bear on the problem. In the next chapter, dealing with the effect of density of the medium on growth, the results are summed up as showing that 'the diminution or growth is proportional to the osmotic action of the medium.' It is possible, however, that the effect is due also, in part, to the direct injurious action of the salts used to increase the density of the fluids. If due to osmotic action alone, then, the results that follow when different substances are used should be in proportion to their osmotic equivalents, but the few facts that are given do not entirely support this general conclusion.

In Chapter XIV. the effect of molar agents is

dealt with. The effects of rough shaking on bacteria and of tensions and torsions on plant tissues are described. Nothing is said in regard to the changes that take place in bones, as a result of displacement, etc. The closing of wounded surfaces (in Stentor and Hydra) is said to 'be grossly mechanical.' I may add from observations of my own that, in some cases at least (in Tubularia and in the embryo of Rana), the closing of the wound after injury cannot be explained as grossly mechanical, but is due rather to a movement of the living cells in response to a stimulus.

The action of parts of plants in response to contact and the general phenomena of bending in seedlings, etc., can scarcely be included in a definition of growth, even as broadly defined by the author, for while there is an increase in volume on one side there may be a corresponding decrease on the opposite side, the volume of the whole plant or part remaining approximately the same.

A brief account of the effect of gravity is given in Chapter XV. Two classes of effects are distinguished, the first mechanical, "due to gravity, acting on the growing organ as it might on any other heavy body. The second is a vital effect, having no immediate, direct physical relation to the cause." It seems a little obscure to state that a vital effect has 'no immediate, direct physical relation to the cause.' That the connection is a causal connection, even if a remote one, few will be bold enough to deny. The distinction that the author wishes to make is, perhaps, fairly clear, but the words may easily lead to a misconception of what is meant by vital effects. Again, on page 417 (in Chapter XVII., dealing with the effect of light upon growth), the author concludes, after showing that the eggs of many (but not all) animals are sheltered from sunlight, 'that, in general, growth does not take place in nature in full sunlight.' It is obvious that in many cases the eggs deposited in the dark are better concealed, and it is not improbable that this may account for their development in the dark. Under these conditions they would become attuned to the absence of light. The more rapid growth of plants in the dark is described in detail, the effect of colored light on the growth of animals and plants, and the direction of growth in reponse to light, are discussed at some length.

The effect of heat on growth, as well as on the direction of growth (in plants), is dealt with in Chapter XVIII. The interesting fact is pointed out that under certain conditions the bending of a plant towards the source of heat cannot be explained as the direct result of the heat causing growth on the warmer side, since the concave side is the one turned towards the source of heat. This experiment may well make one question whether or not these phenomena of bending are growth phenomena in the ordinary use of the terms.

In the concluding chapter the cooperation of several factors in normal growth is analyzed. A clear summary of the work of Semper and de Varigny on the growth of water-snails in a confined space is given. There is some excellent matter in the few pages of this chapter, although here and there one may find fault with the expression rather than with the general sense. The attunement or acclimatization of an organism to its surroundings is emphasized. A tentative hypothesis to account for the attunement is offered. This attempt to construct a possible explanation brings clearly to light that the author pictures to himself these 'vital phenomena' as chemical responses to external agents. The contrast, therefore, so often made in the text between physical and vital effects would seem to be a difference between physical and chemical reactions. If anything more than this is intended it is not included in the final attempt at an explanation, although it is stated on a preceding page that the 'specific effects' cannot at present be accounted for by known chemical processes, 'but result from peculiarities of the specific protoplasms which depend largely upon the past history of each kind of protoplasm.'

If we have taken issue with the author on a few points it is only because in these the book appears incomplete or imperfect. Taken as a whole it is a valuable addition to our text-books, and the author is to be congratulated on having performed so difficult and arduous a task with success. The careful and exact summaries that are given will be of use to those not having access to the original papers.

The book contains many tables compiled from various sources. The data are generally given in the form of curves so that a large amount of information may be comprised in a single diagram. The clear and judicial discussion of the topics makes the book a model of its kind. Especially praiseworthy is the absence of the rash speculation so predominant in biological literature of recent years.

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General Physiology. By Professor Max Verworn. Translated and edited from the second edition (1897) by Professor F. S. Lee. New York, Macmillan & Co. 1899. Pp. xvi+616. 285 figures.

The subject-matter of this book is arranged in five chapters with headings as follows: The aims and methods of physiological research, living substance, elementary vital phenomena, the conditions of life, stimuli and their action, and the mechanism of life. The English edition is very happily rendered, and is characterized by an extremely small residuum of Teutonic idioms, while the privileges of the editor have been very skillfully but sparingly exercised.

The book is chiefly concerned with the cell as such and as organism, and it seems to the writer that it hardly justifies the resounding title of 'General Physiology, or the Science of Life.' It is usually unfair to pass judgment upon the nature of a work from any single paragraph which may be required in a review, but the closing sentences of the volume are fairly indicative of the author's conception of his subject. "The cell is the element of living substance. All living substance exists in cells, and all of the functions of living substance originate in the elementary vital phenomena of cells. Hence, if the task of the physiologist lies in the explanation of vital phenomena, general physiology can be only cell-physiology." These sentences are faultlessly rhetorical, but they do not exhibit an unassailable logic, at least from the point of view of the botanist, or the physiologist interested in the general properties of organisms.

The work of investigators upon the physiology and organization of the protoplasm of plants has been somewhat more uniformly developed, and the results attained have been given a wider interpretation than similar efforts in the animal world; hence the value of this volume as a reactionary protest against the minute and profitless specializations which have absorbed so much of the energy of the animal physiologist is not so apparent to the plant physiologist. The latter feels no need for a return to investigations in cell-physiology, since his researches upon all the more important activities of vegetal protoplasm have been extended to cover material of the widest range of morphological and physiological differentiation, and have been an investigation of principles rather than a study of the functions of special tissues.

Without reference to the above, the book is a very valuable and welcome addition to the library and laboratory accessories of the plant physiologist, not for what it contains about plants, for the paragraphs devoted to these organisms are teeming with errors and omissions, or are badly antiquated, but for its comprehensive treatment of the composition and elementary activities of protoplasm, and the metabolic and directive reactions to stimuli, and the sections devoted to these subjects are well executed. The historical sketch of the development and methods of physiological research, as well as the metaphysical discussions of the conditions of life properly belong here, although they do not constitute the most valuable or striking part of the book.

It appears to the reviewer that the physiological aspects of the form and size of the cell are but scantily touched upon; that the rôle and distribution of inorganic matter in the cell does not take into account the greater mass of the available information on that subject, while secretion, absorption and election of food do not receive deserved attention. The fatuous distinction of ferments into 'organized' and 'unorganized' bodies bids fair to be immortal, since it is continued here and in many other prominent texts recently issued, although yeast, the well-worn example of the 'organized ferments,' has been found to secrete definite enzymes, as is doubtless the case with all ferment organisms. It is certainly antiquated to quote Sachs to the effect that starch is the first 'visible product' of the