

chemist with the necessary scientific insight, who would take the time and pains required to become master of the method, would find in it a weapon of research of no mean value.

Some misprints, one or two of which may at first sight rather puzzle the reader, occur. The collection of the whole of the plates at the end of the volume is a great convenience, as the same plate is frequently referred to in different parts of the text. One suggestion we should like to offer in this connection, and that is that the author should provide some key to these very beautiful reproductions of his photographs. It is sometimes extremely difficult for one not versed in the art of reading positive ray photographs to pick out the particular lines referred to in the text from the considerable number which often appear on the corresponding plate. We hope that Sir J. J. Thomson may be prevailed upon to make this concession to human weakness when, at some date which cannot be very far distant, he makes a further revision of the book for its next edition.

J. A. C.

### Metamorphoses of Insects.

*Insect Transformation.* By Prof. G. H. Carpenter. Pp. xi + 282 + 4 plates. (London: Methuen and Co., Ltd., 1921.) 12s. 6d. net.

**M**ETAMORPHOSIS in the animal kingdom may be approached from two angles of vision. We may regard it solely as a preparation for the adult condition that follows upon it, or we may consider it from the point of view of recapitulation of racial ancestry. In reality it is the result of the working of both those factors. Among insects, the higher one ascends among the orders of that class, the more the evidence of recapitulation becomes obscured by secondary changes. Divergence in evolution has occurred between the preparatory and final stages of life. The more highly specialised the perfect insects become the more their larvæ degenerate. It is the inert, legless, eyeless, and often headless maggot that gives rise to the highest expression of insect life. The active "intelligent" type of larva, endowed with limbs and well-developed organs of special sense, is destined to produce an imago lower in the scale of evolution than that which arises from the degenerate larva previously mentioned.

In the springtails there is no metamorphosis. In the locust and the plant-bug metamorphosis is clearly evident, although the young are not very different from their parents. Such insects pass through no pupal stage, and their wings are formed externally.

In the majority of insects, however, whether they be beetles, butterflies, bees, or flies, the young or larvæ are vastly different from their parents and a pupal stage has become intercalated in the ontogeny. In insects of this kind the wings arise as impushed imaginal buds and reveal themselves outwardly only when the pupal stage is assumed.

In Prof. Carpenter's book we have a lucid account of the various aspects of the above phenomena. It is elementary, but not unduly so, and there are few biologists who will not benefit by assimilating its contents. The author devotes about two dozen pages to describing the essential features of the morphology of an adult insect. These pages contain nothing that is new to the entomologist, but they enable the more general reader to obtain a better understanding of the book as a whole. The following chapter is devoted to the discussion of the metamorphoses of insects with the open type of wing-growth. This is succeeded by a detailed treatment of the higher orders of insects the wings of which develop from concealed imaginal buds. The remaining chapters treat of wingless insects, the significance of metamorphosis in classification, the surroundings of developing insects, and the various problems of metamorphosis.

The author has marshalled his facts into a continuous whole with conspicuous success. He leads the reader, step by step, through the increasing complexities of metamorphosis in what we believe to be their true evolutionary sequence. He attempts no new theories nor does he throw fresh light on existing theories. He prefers to draw extensively upon the results of recent research and show them in their true perspective. The book consequently represents very completely the present-day point of view. The discussion of larval and nymphal stages naturally occupies a large part of a work of this nature. Prof. Carpenter evidently does not concur with Comstock in his use of the term nymph, and rather adopts the definition that applies it to all exopterygote insects when the latter are in a stage in which the wing rudiments can be distinguished clearly by the naked eye. The expression nymph, however, is a conventional one, and in reality all nymphs are, in the zoological sense, larvae.

The book is one which imparts a true appreciation of how the details of the life-histories of different types throw light on the development of insects as a class. It is well printed and adequately illustrated with figures largely borrowed from the writings of contemporaries, or from Prof. Carpenter's own publications. Few scientific works have been issued since the war at so reasonable a price, which is a matter for congratulation to the author and publishers alike.

A. D. IMMS.