SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

SUBSCRIPTIONS TO ANY PART OF THE WORLD, $3.50 A YEAR.

To any contributor, on request in advance, one hundred copies of the issue containing his article will be sent without charge. More copies will be supplied at about cost, also if ordered in advance. Reprints are not supplied, as for obvious reasons we desire to circulate as many copies of SCIENCE as possible. Authors are, however, at perfect liberty to have their articles reprinted elsewere. For illustrations, drawings in black and white suitable for photo-engraving should be supplied by the contributor. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

ON THE SYSTEMATIC POSITION OF THE DIPTERA.

BY ALPHEUS S. PACKARD, PROVIDENCE, R. I.

WHILE, on the whole, the classification of the insects has become of late years placed on a more scientific basis, there is still some difference of opinion as to the systematic position of the Diptera, a few authors regarding the order as being the "highest," and entitled to stand at the head of the insect series.

Three important steps in the classification of insects have recently been taken. (1) The higher position given to those orders with a complete metamorphosis over those whose development is direct; no doubt the process of metamorphosis is an adaptive, secondary feature, and one not possessed by the more primitive, "lower" orders, such as the Orthoptera and Hemiptera, not to speak of the Synaptera (Thysanura, Cinura and Collembola). (2) The next great advance was the dismemberment of the Pseudoneuroptera into a number of distinct orders, and the separation of the metamorphic Neuroptera from the ametamorphic orders, with which they were formerly associated. (3) The last step in advance was the recognition of the inferior position of the Coleoptera compared with the Lepidoptera, Diptera, and Hymenoptera, the beetles having been during the first half of this century universally placed at the head of the insect class, for no other reason apparently than that they were the favorites of entomologists. Even now Brauer places them above the Lepidoptera and Diptera, but this seems to us to be erroneous, the beetles in their adult structure, especially the Staphylinidæ and Carabidæ being not so far removed from the Campodea-form type as the other metamorphic orders. With Brauer we regard the Staphylinidæ as being the most primitive group of beetles, and near them are the carnivorous groups (Cicindelidæ, Carabidæ, Dytiscidæ, and other Adephaga). Indeed, instead of considering the Rhyncophora as the "lowest," and therefore most primitive group, we are now strongly disposed to regard that group as neither "highest" or "lowest," but as the most highly modified of all beetles, and therefore as a whole probably more recently developed than the bulk of other Coleoptera. We would in classifying the Coleoptera begin with forms like the Carabidæ and Staphylinidæ, because their larvæ are the most primitive of coleopterous larvæ, *i. e.*, most campodea-shaped; and the imagines are more like their larvæ than any other beetles, differing mainly in having wings. Hence the Staphylinidæ and Adephaga are much nearer the ametamorphic Dermaptera and Orthoptera than the Rhyncophora, or beetles like the Lamellicorns, Cerambycidæ, Buprestidæ and other wood-boring Coleoptera, whose larvæ are either footless or tending to become so. Considering the larvæ alone is is evident that the carnivorous and leaf-eating forms, with flattened bodies, and well-developed legs, living a free, active life, neither boring into wood or other vegetable substances, but living under stones, or in the water, or on the surface of leaves—it is evident that these are the earliest forms, and that the larvæ of the Rhyncophora with their cylindrical, apodous bodies are much later, adaptive forms, which have lost their legs by disuse. The links connecting them with the earlier beetles are the Bruchidæ, for example, which in their first larval stages have long, well-developed legs, but which afterwards drop them, in adaptation to their weevil-like life in peas, beans, etc, The terms "high" and "low" are somewhat misleading, and for them should be substituted the expression more or less modified, or differentiated, recognizing the fact that the "lowest" forms are usually the more generalized and least differentiated, and especially least modified. When forms are rendered "low" by parasitism, they may be said to be degraded, retrograde or degenerate.

Now the same views will, we would suggest, apply in dealing with the Diptera. Compared with the Hymenoptera they are certainly more highly modified, but in a more or less special direction. The Hymenoptera are, it is now generally admitted, the most complicated or specialized and most differentiated group of insects; while, on the other hand, the Diptera appear to be a side branch of the insect tree, and both degenerate in important characters, and very much modified in others.

In the Hymenoptera there is a wonderful differentiation of the mouth-parts. Instead of the abolition of mandibles (Simulium excepted) and a reduction and modification of the maxillæ, which we witness in the Diptera, the three pairs of mouth-parts are not only very equably developed, but the parts are further elaborated with different portions specially adapted for special functions. In the Diptera the jaws are wanting, the maxillæ usually much reduced, while the labium is enormously developed and highly modified. The trunk of Hymenoptera is divided into three equally developed regions, while in Diptera the mesothoracic segment is enormously developed, the prothorax being aborted. In the Hymenoptera the wings of both pairs are well developed, in the Diptera the hinder pair have lost their function, as wings, and are greatly reduced and modified with the minute balancers, and more useful, perhaps, as organs of sense than of motion.

If we take into account, also, the differentiation of the brain of Hymenoptera, their social life, nest-building habits, the differentiation of the sexes, their high intelligence and very complete metamorphosis, the Hymenoptera certainly overtop the flies.

The larvæ of Hymenoptera are, except those of the sawflies, very much modified, but the simplest more modified ones, those of ants, wasps and bees, are less modified than the maggots of the Muscidæ and allied groups.

And here we should, as in the case of the Coleoptera, reverse the usual arrangement of the Diptera. It is evident that a form like Simulium, in which the jaws are retained (though microscopic and in a rudimentary or reduced condition), is nearer what must have been the original, primitive Diptera than any other forms, usually in our systems placed above this genus. For a stronger reason the mosquito, especially the female, with its equably developed mouth-parts, the mandibles and maxillæ being well developed, is nearest to what was probably the earliest, most primitive, most equably differentiated Diptera. In classifying the Diptera, therefore, we should prefer to begin with the Culicidæ as being the most primitive unmodified Diptera, and end with the

house-flies and their allies, together with the sheeptick (Pupipara) as being the most highly modified, and the last to appear, of the dipterous series.

In the Hymenoptera there is nothing of this kind, we do not have entire groups of this order which have become so reduced, degenerate and modified, largely the result of parasitic life, as in the flies. The Hymenoptera are a normal blossoming or branching out of the topmost portion of the tree of insect life, while we should regard the Diptera as a degenerate, retrograde, downfallen branch.

If we look at the larvæ of Diptera we shall see that the most perfectly developed or highly differentiated forms are those of mosquitoes, black flies and the Tipulidæ, etc., (Encephala); then we pass on to a series in which the body becomes more and more maggot-like, the head being so reduced in the Muscidæ (in the old sense) that it is difficult to make out the homologies of the antennæ and parts of the mouth. The internal organs, as the tracheæ, share in this alteration and extreme modification of parts, adapting the maggot for its parasitic or otherwise peculiar mode of life and surroundings. Indeed, below the families embraced in the Orthorapha (Culicidæ, Simulidæ, etc.), the great group of Diptera now consists of very degenerate, highly modified forms.

Now under what canons of taxonomy are we to act in considering what forms are "high" and what are "low," unless we take into account the facts we have considered? It seems to us that the few entomologists and other naturalists who advocate placing the Diptera at the head of the insect series, disregard the fact that the processes of degeneration, reduction, with specialization in limited directions, and of adaptation to unusual modes of life, their habits being, in many groups, parasitic, or partially so, have brought about a modification of larval and adult structure, such as we do not find in any of the other larger orders of insects.

It seems to savor somewhat of a violation of the principles of classification, which in these days is based not only on comparative anatomy, but on morphology, paleontological history, and the facts of adaptation to changed conditions of existence, to give the highest rank to a group in which disuse of certain parts leading to degeneration, and the modification of other parts adapting them for quite peculiar uses, are so marked. And it is this wonderful amount and variety of modification and adaptation to this or that mode of life which makes the group one of such striking interest to the philosophic student. We see how much at the mercy of the environment the group has been exposed, and this is especially striking when we compare the Diptera with the great group of Lepidoptera, where there is a striking persistence and fixity of structural features, both in larva and imago, as well as in the modes of life, and the nature of the food.

BOOK-REVIEWS.

British Locomotives, their History, Construction and Modern Development. By C. J. Cooke. Whittaker & Co., London and New York, 1893. 376 p. 12mo. $2.00.

An interesting and very instructive account of the rise and progress of the locomotive, especially in Great Britain, including important details of construction and dimensions, as well as performance. It is written in a sufficiently popular style to be readable by any one having an interest in its subject, and is yet sufficiently technical to satisfy the specialist desiring information in relation to the proportions and the work, or even the general plans, of locomotives, old and new, including, of course, the now familiar "compound engine." The book is addressed, and most suitably, to all who take an intelligent interest in the working of the locomotive and of railways, and to practical railway mechanics as well. It is written by an employe of the London and Northwestern Railway, and is therefore reliable and accurate; its illustrations are from working drawings, and are supplied by the great locomotive designers of the United Kingdom, and are, therefore, valuable to the professional, as well as useful to the casual, reader. The early history of the engine, of the struggles in which George Stephenson and his contemporaries engaged to make steam a successful railway motor, and the later account of the modern compound engine are likely to prove most interesting to the average reader; but no one should omit the careful perusal of the last chapter, on the duties of the locomotive engine-driver, in which he will find much to impress him with the wonderful combination of courage, skill, intelligence, foresight, knowledge and readiness, in times of emergency, which is demanded of that humble and rarely appreciated craftsman.

Negative Beneficence and Positive Beneficence: Being Parts V and VI of the Principles of Ethics. By Herbert Spencer. New York, D. Appleton & Co. 12mo. $1.25.

This volume completes Mr. Spencer's ethical treatise, so that all who wish to know the final views of the philosopher of evolution on questions of conduct and duty are now enabled to do so. In the opening chapter Mr. Spencer draws a very sharp distinction between beneficence and justice, as he understands these terms, and then proceeds to show that beneficence has two forms, the positive and the negative. He then discusses various forms of negative beneficence, which consist in refraining from acts that would be injurious to others or to society at large, and afterwards those forms of positive beneficence which he deems most important. He confines himself almost entirely to private and industrial life, and we look in vain in these pages for any recognition of that beneficence that shows itself in advancing human knowledge and human virtue. Indeed, with the exception of certain passages in which the author's excessive individualism shows itself, the book is of a commonplace character; and whoever takes it up with the expectation of having his moral ideas clarified or his moral sentiments quickened and elevated, will be disappointed.

But what is more remarkable is that Mr. Spencer, as we learn from his preface, is himself disappointed; for, after congratulating himself on the completion of the work, he says:

"My satisfaction is somewhat dashed by the thought that these new parts fall short of expectation. The doctrine of evolution has not furnished guidance to the extent I had hoped. Most of the conclusions drawn empirically, are such as right feelings, enlightened by cultivated intelligence, have already sufficed to establish. Beyond certain general sanctions indirectly referred to in the verification, there are only here and there, and more especially in the closing chapters, conclusions evolutionary in origin that are additional to, or different from, those which are current." For our part, we can see no connection between the law of evolution as propounded by Mr. Spencer and the moral law; and we cannot perceive that he has shown the existence of such a connection. Both in this volume and in the preceding one on "Justice" evolutionary principles are brought in only occasionally and incidentally; and, when they are brought in, they are generally irrelevant to the discussion. Indeed, how can the study of a merely natural process like evolution teach us what we ought to do? How can we even know whether evolution itself makes for good or for ill unless we already have a moral ideal by which to judge its results? We fear that those who have been expecting evolutionism to furnish a guide of life will have to look in some other direction.