SCIENCE:

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

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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