

from cocoons of Emperor moths (*Samia cecropia*). The probability is that these objects are placed in the cocoons by birds addicted to hoarding. No very definite observations on the agents have been made, the most satisfactory being those of Dr. Alex. Wetmore of the Biological Survey who has seen Bluejays stuff grains of corn and small acorns into large cocoons.—W. L. M.

**Bird Enemies of Tree Hoppers (Membracidae).**—In an admirable paper on the 'Biology of the Membracidae of the Cayuga Lake Basin,'<sup>1</sup> Dr. W. D. Funkhouser discusses the relations of birds to these insects. He presents records of seven definitely named species of birds feeding on tree hoppers, in addition to warblers (various species) and thrushes (various species), which we wish were particularized.

The greatest interest in connection with the records relates to the alleged protective adaptations of Membracids. Dr. Funkhouser states:

"Very few of the local species are molested by birds. A few species of birds have been observed feeding on the nymphs but usually neglecting the adults, the latter being probably sufficiently protected from bird enemies by the hard pronotum and sharp processes. Various species of adult membracids have been thrown to birds in captivity; in general these have been refused but in a few cases they have been picked up only to be dropped again. Evidently the strong pronotal processes, which are often sharp and hard enough to pierce the skin if the insect is seized suddenly, are unpalatable and irritating." (pp. 416-7).

In these remarks Dr. Funkhouser evidently has fallen, probably unconsciously, into the habit of speculation, which selectionist doctrine has almost ingrained in biologists and especially in biological teaching. That Dr. Funkhouser does not accept these views at face value is shown by the following further quotation from his paper: "Poulton \* \* \* has called attention to the fact that it is hard to deny the theory of protective resemblance when the same object is accomplished by both the nymph and the adult but in different ways. In the case of the local forms mentioned above, the nymph imitates the uncurling leaf or the irregular bark by spines on both thorax and abdomen—chiefly the latter—while the adult imitates an entirely different part of the plant by the development of an entirely different part of the body. On the other hand, some of the commonest of the local species of Membracidae in no respect seem to resemble any part of the host on which they live, although their shapes are decidedly peculiar. The high dorsal crest of the *Telamonas*, for example, can only by a stretch of the imagination be made to resemble any peculiarity of the oak twig on which the insects rest, and in fact they are very conspicuous on their host. Likewise the *Ceresas*, perhaps the most widely distributed genus in the basin, are plainly seen when in their natural surroundings, and the two prominent suprahumeral horns do not in the least resemble plant structures with which the insects are associated. The answer of

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<sup>1</sup> Mem. 11, Cornell Univ. Agr. Exp. Sta. June, 1917.

the natural selectionist might be that at some previous time such adaptation had held, and this of course is unanswerable since we have no way of knowing what host plants may have been the home of the insects in bygone periods; but it is interesting to note that the genera *Ceresa* and *Telamona*, which now show little protective resemblance to parts of their hosts, are more numerous and apparently maintain an existence with greater ease than do those species that show very excellent protective resemblances.

"It is unnecessary to take up separately each of the local forms in this respect. For each it is possible to suggest an explanation, reasonable or otherwise according to the degree of imagination possessed. But in general it must be said for the local forms, as for the family as a whole, that such speculation merely lies in the realm of conjecture." (pp. 419-20).

The realm of conjecture is a vast domain, illimitable in fact, otherwise we should have, under the necessity of inventing a new infinity, to accommodate the unrestrained theorizing of the selectionists. Contact with the hard facts of what adaptations do and do not accomplish invariably removes the young and plastic naturalist from the thrall of protective adaptation doctrine. The reviewer has watched the course of this process in a number of cases of men beginning the work of analyzing the contents of bird stomachs. First, surprise is manifested that birds should eat things that college teaching has pronounced protected, then as other cases occur from time to time the old belief is entirely cast aside, and finally long experience leads to the conclusion that in their respective ecological niches birds feed practically indiscriminately.

To return to the Membracids, we must conclude that their protective adaptations have no especial significance in foiling predators. In Biological Survey investigations tree hoppers have been found in the stomachs of more than 120 species of birds, and in numbers up to 26 individuals in a single stomach. They have been found in 15 or more stomachs of each of the following species: Great-crested and Ash-throated Flycatchers, Meadow-lark, Brewer's Blackbird, Bullock's Oriole, English Sparrow, Cliff Swallow, Red-eyed, Solitary and Warbling Vireos, Bush-tit, and Ruby-crowned Kinglet. The tree hoppers identified belong to 21 different genera indicating that no partiality is shown. Membracids with the most prominent horns and spines of any in our fauna, as those of the genera *Campylenchia*, *Platycotis*, *Ceresa* and *Platycentrus* are taken with the rest.—W. L. M.

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