Feeding Mechanism of the Fairy Shrimp

IN a recent paper[1] Mr. Lowndes has put forward a new view as to the filtratory feeding mechanism of the fairy shrimp, *Chirocephalus diaphanus*. Hitherto all workers (Storch[2], Lundblad[3], Naumann[4], Borradaile[5], Wagler[6] and Cannon[7]) have agreed that the long setæ on the edges of the basal endites of the trunk limbs constitute the filter, or at least a retaining wall by which particles are abstracted from a current of water.

Mr. Lowndes maintains that water enters the inter-limb spaces between successive limbs, past the endopodites and exite series, which hitherto have been accepted as valves preventing the inflow of water, and that some of this water is then forced into the deep food groove running along the mid-ventral line of the body. Here it is filtered by patches of setules on the food groove walls, which he calls the "filter processes".

In a recent paper[8] I described and figured these 'filter processes' in the three orders of Branchiopoda in which they occur, and showed that they are comb setules which comb the residue off the filter setæ on the basal endites. That the latter are actually filters is shown by the two facts: (1) the water current can be seen to pass through them from the mid-ventral space, as I described in 1928, and (2) they have the typical structure of filter setæ. In all those numerous forms where, either experimentally or by the position of the food in sections of the fixed animal, it can be shown that a limb acts as a filter, the same type of seta is found (Cannon[8], p. 275) and this is the type found in *Chirocephalus*.

In all filtratory setæ the ultimate meshes of the filter are formed by fine setules regularly arranged on the edges of the setæ. If further evidence is required beyond direct observations that the water current passes from the mid-ventral space through the filters, it is found in the position of its setules—they always face the direction from which water to be filtered comes, and in *Chirocephalus* they all face the median plane.

The only point previously on which workers have been unable to agree is as to the mechanism by which the filtered food is transported to the mouth. Storch[2] (p. 387) maintains that it is swept forwards by the action of the most proximal setæ on the basal endites, while I maintained[7] (p. 811) that there is a definite oral current in the food groove. This is the only current which cannot be observed directly, and so I demonstrated it experimentally. I injected a coloured solution so as to fill completely one of the inter-limb spaces of a captive *Chirocephalus*, and was then able to show that at the end of the backstroke of the limb forming the anterior wall of this space, a spurt of the solution was forced along the food groove. Mr. Lowndes has now repeated my experiment and confirmed my results.

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[1] Lowndes, *Proc. Zool. Soc. Lond.*, 1093; 1933.
[2] Storch, *Intern. Rev. Hydrobiol.*, **12**, 369; 1925.
[3] Lundblad, *Arkiv. Zoolog.*, **13**, 16; 1920.
[4] Naumann, *Act. Univ. Lund.*, **17**, 4; 1921.
[5] Borradaile, "The Invertebrata", Cambridge, p. 320; 1932.
[6] Wagler, Kukenthal's "Handbuch der Zoologie", 1926, p. 366.
[7] Cannon, *Trans. Roy. Soc. Edin.*, **55**, 807; 1928.
[8] Cannon, *Phil. Trans. Roy. Soc. Lond.*, **222**, 267; 1933.

Mimicry among Insects

THERE has just come to hand (*Entomologica Americana*, 13, No. 3, published (as stated on cover) Nov. 29, 1933, but dated on every page December 1932) a most admirable review of the Polybiine wasps of the Nearctic region, by Dr. J. Bequaert. Unlike many taxonomic papers, it treats not only of the structures of the insects, but also, at considerable length, of their biology, everything being set forth in the most interesting way. There is a good account of the cases of 'mimicry' involving these wasps. Thus the wasps of the genus *Nectarina*, in the neotropical region, belong to an assemblage of diverse insects of similar appearance, of which no less than twenty-eight are cited. Dr. Bequaert recognises the objections to the term mimicry as applied to these cases, and proposes to speak of homeomorphy and homeochromy instead, these terms merely referring to the observed facts, without suggesting any explanation. This seems to be an advantage, though perhaps the shorter words isomorphy and isochromy would be preferable.

In discussing the probable meaning of these resemblances, as related to natural selection, I think Dr. Bequaert takes too narrow a view. Thus he refers to the American *Pachodynerus nasidens*, which has been accidentally introduced into the Hawaiian Islands, where it has become extremely abundant. Now the Hawaiian Eumenid wasps have a totally different appearance; and so, he argues, *P. nasidens*, removed from the protection of its mimetic group, ought, according to the current theory, to be severely handicapped. This argument I think has no validity, in view of the great difference in the vertebrate fauna. *P. nasidens*, along the Hawaiian coasts, is not only without the natural enemies it left in tropical America, but also is relatively free from enemies of any kind, as will be readily appreciated by anyone who has travelled in both regions.

There is, however, another aspect of these matters which is not generally considered. Insects are extremely prolific, and the balance of Nature, under normal conditions, provides for the destruction of by far the greater part of each generation before the period of reproduction. This destruction is necessary for the insect itself, in order to avoid over-population and resulting starvation. Hence the normal survival rate, according to the species, may be only ten per cent, or five per cent, or even less than one per cent of the offspring hatched from the egg. It is astonishing that, working on such a narrow margin, insects in general survive as well as they do. I recall some observations on Coccidæ (scale insects) made in New Mexico many years ago. Certain species occur on the mesquite and other shrubs which exist in great abundance over many thousands of square miles of country. Yet the coccids are only found in isolated patches here and there. They are destroyed by their natural enemies, but the young larvæ can be blown by the wind or carried on the feet of birds, and so start new colonies which flourish until discovered by predators and parasites. This game of hide-and-seek doubtless results in frequent local extermination, but the species are sufficiently widespread to survive in parts of their range, and so continue indefinitely.

We may suppose, then, that neither 'mimicry' nor any other mode of protection prevents the destruction of the larger part of each generation of insects; and such prevention, were it possible, would result, not in stable conditions, but in over-production and