

The Movements of Copepoda.

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SINCE the time of Brady it has been generally supposed that amongst the Copepoda the most important locomotor organs were the antennules. This belief is categorically stated in Huxley's text-book on 'The Anatomy of Invertebrated Animals,' p. 235.

During a stay of several weeks in the Plymouth Biological Station I had almost daily opportunities of examining the numerous Copepoda captured in the tow-net, and my observations are by no means consonant with the popularly accepted idea. The movements of the species I examined were of two kinds; there was a slow gliding movement, and a sudden dart of lightning swiftness. During the prosecution of movements of the first description the antennules, or first antennæ, are held rigidly extended at right angles to the long axis of the body, and their appearance suggests the idea that one of their functions may be to act as hydrostatic sense-organs. Movement is effected principally by means of the second antenna, the gnathites likewise assisting, notably the second maxilla. It seems probable that feeding is carried on during these slow movements.

The quick movements are effected, on the other hand, entirely by the simultaneous action of the thoracic feet. A sudden blow executed by all the four powerful pairs of paddles is sufficient to propel the animal for a very considerable distance. The animal moves so quickly during the longer darts that it is

impossible to see exactly what happens to the antennules, but by carefully examining the shorter darts, which are carried out at a more moderate speed, it is seen that the antennules are held as rigidly as during the slow movement, and there is therefore no ground for attributing any share in the production of the movements of these animals to the first antennæ. Naturally when the animal is suddenly propelled forward the tips of these appendages will be mechanically dragged back by the resistance of the water; and a careless observation of this phenomenon, joined to the undoubted fact that in the freshwater Cyclops the first antennæ do assist in the slow movements of the animal, may have given rise to the belief that it was the rule among Copepoda to propel themselves by means of the first antenna.

In a paper published some years ago (Sedgwick's theory of the embryonic phase of ontogeny as an aid to phylogenetic theory, 'Quart. Journ. Micr. Sci.,' 1895) I put forward the view that the progressive development of the Crustacea was correlated with a passing of the function of locomotion backwards along the series of appendages. Thus, in the ancestor represented by the Nauplius, the first, and more especially the second antennæ were the main locomotor organs; in the stage represented by the Zocæa the maxillipeds had acquired the function; whilst in the ancestral condition corresponding to the Mysis larva, motion was effected chiefly by the hinder thoracic legs, as is still the case with Schizopoda; finally, the lower Macrura swim by means of the abdominal appendages alone. The result of this process has been that the appendages of the anterior segments have been one by one relieved of the function of locomotion, and have become specialised for masticatory and sensory purposes. Now in the Nauplius the main brunt of the work of locomotion is borne by the second antenna; the first is already mainly a sensory organ, and if the Copepoda really did propel themselves chiefly by the first antennæ they would have retrograded from the condition represented by the Nauplius. It is interesting to note that not only is this not the case, but that the second antenna is still an important locomotor organ. Func-

tionally, indeed, Copepoda seem to stand on pretty much the same plane of development as the Protozoa larva.

Phylogenetic hypotheses have too often been based on mere resemblances in form, apart from a consideration of function. This seems to me to be a wrong method of attacking the problem. Function is the all-important thing—that which determines structure; and I hold that if ever we are able to sift the primary from the secondary elements in ontogeny, it will be by the recognition of the fact that the persistence of ancestral structure is caused by the retention of ancestral habits, and that the habits at all periods of the life-history demand the closest study.

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