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Feeding Mechanism of an Ephemeropteran Nymph

A STUDY of the wood-boring and tubicolous mayfly nymph, *Povilla adusta* Navás. (Ephemeroptera, Polymitarcidae), common in the lakes of East Africa, has shown that it is remarkable in two respects.

Unlike any other Ephemeropteran nymph described, it lives in a tube lined with silk which it secretes¹. It is also unusual in having a complex setal filter-feeding habit. A few other insects having the filter-feeding habit use setæ for the purpose; for example, larvæ of *Simulium* (Diptera), nymphs of *Oligoplectrum maculatum* Fourcroy² and *Brachycentrus nigrosoma* Banks³ (Trichoptera) and *Isonychia* spp.⁴ (= *Chirotonetes*) (Ephemeroptera). But all these forms are rheophilous and rely on the flow of water in which they live to bring their food. The nymph of *Povilla*, on the other hand, lives in the comparatively still water at the edges of lakes, inhabiting burrows in wood and the roots of water-plants and holes in laterite (personal communication from R. H. Lowe), and creates its own feeding current by movements of the gills.

The principal modifications associated with the feeding habits affect the mandibles and the forelegs. The mandible is unusual in possessing on the outer side a brush of filtering setæ, consisting of a U-shaped row of large alveoli from each of which springs a long pinnate seta. The forelegs bear similar brushes on the femora and tibiæ. Each femur bears anterodorsally a narrow oval ring of alveoli bearing the setæ, whereas the tibiæ each bear two brushes, one anterodorsal and the other anteroventral.

The setæ comprising all these brushes point somewhat forwards and practically occlude the lumen of the tube, the dorsal space being filled by a transverse row of pinnate setæ on the frons.

The feeding of the nymphs was observed by encouraging them to enter short lengths of glass-tubing in Petri dishes full of water placed under a binocular microscope. When entering a new tube the nymphs usually spin a silken lining to the tube. The silk is produced from the oral region and drawn out by flicking movements of one of the forelegs. The presence of this lining in the natural burrows of the nymphs was first noted by Arndt¹, but further work remains to be done on this aspect of the insect's

biology. In glass tubes and possibly also in burrows in wood, this lining of silk enables the animal to hold itself firmly in position by means of the short stout setae on the outer sides of the hind femora, which are pressed against the walls of the tube.

During feeding, the gills, which are borne in pairs on the first seven abdominal segments, beat rhythmically for a few seconds at frequent intervals, producing an intermittent current of water from the anterior end. Any floating organisms or pieces of debris which are large enough are caught on one or other of the filtering brushes, from which they are removed by the palps. Food is transferred from the brushes to the mouth by two distinct series of movements. The transfer of particles from the brushes to the palps is accomplished by simultaneous wide sweeping movements: (1) by the maxillary palp of one side, removing food from the mandibular brush of that side; (2) by the maxillary and labial palps of the opposite side, collecting food from the tibial and femoral brushes respectively; this action is accompanied by an inward flick of the leg which brings the brushes within reach of the palps.

These movements alternate from side to side and are separated by the second type of movement of the palps which brings the food to the mouth. Here the maxillary palps move in a transverse plane and push food towards the apices of the labial palps. The latter, swinging up and down on the basal joint, push the particles of food backwards and upwards to the mouth. By these means food is collected from either side of the body according to the following scheme: (1) mandibular brush to maxillary palp; (2) palps to mouth; (3) leg brushes to maxillary and labial palps; (4) palps to mouth.

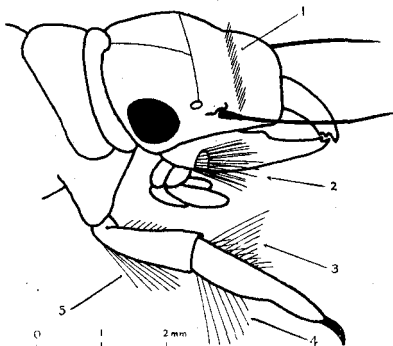


Fig. 1. Positions of filtering brushes in *Povilla adusta*. 1, Frontal brush; 2, mandibular brush; 3, dorsal tibial brush; 4, ventral tibial brush; 5, femoral brush

The only pinnate setæ which are not swept by the palps are those on the frons, and these appear to be neglected. Possibly they serve to deflect the water current towards the other more ventral filtering brushes.

Further details of this work will be published elsewhere, together with results of studies of other aspects of the biology of this species. I wish to thank Prof. L. C. Beadle for his encouragement and advice, and also Mr. D. E. Kimmins for identifying the species for me.

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¹ Arndt, W., *Explor. Parc Albert, Miss. Damas.*, 2, 5 (1938).

² Nielsen, A., *Biol. Medd. Kbh.*, 19, (2), 70 (1943).

³ Needham, J. G., and Lloyd, J. T., "The Life of Inland Waters" (Ithaca, N.Y., Comstock, 1916).

⁴ Needham, J. G., Traver, J. R., and Yin-Chi Hsu, "The Biology of Mayflies" (Ithaca, N.Y., Comstock, 1935).