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[Reprinted from the 'Entomologist's Monthly Magazine,' 3rd ser., vol. v.]

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SOUTH EAST ASIA MOSQUITO PROJECT  
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WASHINGTON, D. C. 20560

THE LARVA AND PUPA OF *TAENIORHYNCHUS RICHIARDII* Fic.  
(DIPTERA, *CULICIDAE*).

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Mosquito-larvae of the genera *Taeniorhynchus* (*Mansonia*) and *Mansonioides* have now been known for some time from North and South America and West Africa, but up to the present the early stages of the European species (*T. richiardii*) have not been described.

am now able to state that the larvae of this species have the same remarkable structure and habits as the North American *T. perturbans* Wlk., *i. e.* they live among the roots of water-grasses, from which they obtain their supply of air by the aid of a highly modified spiracular apparatus.

The larva of *T. perturbans* was well described and figured, and its habits largely elucidated by J. B. Smith; all who may be interested should consult his paper (Ent. News, xix, 1908, p. 22), and that by Grossbeck on the pupa in the same volume (p. 473); also the condensed account in Howard, Dyar, and Knab's "Monograph of the Mosquitoes of North America" (vol. iii, part 1, p. 508). The early stages of *T. richiardii* prove to be so nearly identical with those of *T. perturbans* that by comparing specimens of the former with figures and descriptions of the latter I have been unable to discover any points of difference.\* Any detailed description of *T. richiardii* would therefore be superfluous; nevertheless several points have come under my notice with regard to our British species which have apparently been overlooked by earlier writers and yet seem worthy of being placed on record.

*T. richiardii* abounds, in the winged state, round a pond near my house at Letchworth, Herts, during June and July; males and females, the former greatly preponderating in numbers, hovering among bulrushes and grasses round the water's edge. After a number of fruitless attempts, I succeeded in obtaining about a dozen full-grown larvae, in June 1918, by pulling up some of the water-grass (*Glyceria fluitans*) and shaking out the roots into a white dish. The *Typha* roots, as well as roots of other water-plants, were examined in the same way, but never yielded any larvae. Later, in November 1918, a few half-grown larvae were found among the roots of *Glyceria*,† so that it may be presumed that, as in the case of *T. perturbans*, our British species spends the winter in the larval state; probably there is only one generation in the year.

A number of the larvae were kept under observation in small glass bottles containing some *Glyceria* roots, to which they could be observed to attach themselves. They would remain for long periods attached in one spot, but nevertheless made frequent moves. Occasionally, especially when disturbed, they would rise to the surface of the water and hang suspended there in the manner of an ordinary mosquito larva. Whether they would ever do this in nature, and whether they could obtain atmospheric air by this means, may be doubted.

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\* It would be quite reasonable to regard these two forms as geographical races rather than as true species, since the male genitalia, as well as the larvae and pupae, appear to be identical in structure. The two can, however, be sharply separated by the coloration of the hind legs.

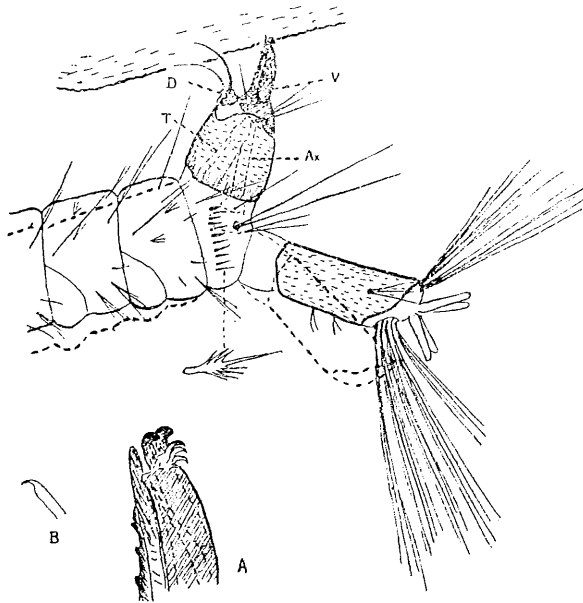
† One of these specimens lived without moulting until January 10th.

It was possible to observe in some detail, under a strong lens, the movements by which the larva effected its attachment to the grass-roots; these are perhaps worth describing, but in order to do so it will be necessary to give some account of the structure of the breathing-tube. This organ is shorter than in most other culicine mosquitoes, and far more complex. It consists of broader basal portion (corresponding to the air-tube of *Culex*) and a narrower, black apical portion. This latter is quite obviously homologous with the valvular closing apparatus of the ordinary culicine larva, though this fact does not appear to have been recognized by previous writers on this group of mosquitoes. In *Taeniorhynchus* the dorsal pair of valves (always smaller than the ventral) is considerably reduced in size, but the stout curved bristle which they carry is, on the other hand, very strongly developed. The ventral pair of valves are large and elongate, and form the black apical portion of the air-tube; they are joined together by membrane, and in this way are modified to form an immovable sheath for the protection and support of the complex internal organs. These last comprise a flat piece with a saw-like dorsal keel, and a pair of sharply pointed pieces on either side of it, attached to the end of the common hollow space formed by the conjoined tracheal tubes; also a pair of more ventrally placed pieces, each with two very strongly chitinized hooks at the tip, hinged on to a stout axial rod, which again is fixed to the junction of the tracheal tubes. Finally, there are three pairs of sharp hooks in the membrane at the apex of the ventral valves.

The breathing-tube of *Mansonioides africanus*, well described and figured by Ingram and Scott Macfie (Bull. Entom. Research, viii, 1917, pp. 137-140), has a closely similar structure, only differing in certain minor details, such as the general shape of the air-tube and of the ventral valves, and the number of teeth in the saw (about 14 instead of about 7).

When the larva approaches a rootlet with the object of affixing itself, which it does tail-foremost, the first movement which can be observed is that the strong bristles on the ventral valves are waved about, and their sharp tips inserted into the spot chosen. Doubtless, as suggested by Ingram and Macfie, these bristles are sensory, and may "transmit a stimulus enjoining the larvae to attach themselves." The tips of the ventral valves are then brought into contact with the root, and the three pairs of hooks, which are normally inside the tips of the valves, are everted. These hooks are directed posteriorly, the points of the stout bristles anteriorly, so that between them they can obviously afford the larva a tolerably firm preliminary "foothold." The hooks, it should be said, act quite independently of the other internal structures.

The larva then commences a series of violent jerks; the body, at first held in a curved position, is suddenly straightened out (without being lengthened), and at the same moment the anal segment is bent rapidly downwards. The first position is then more slowly resumed, and after a brief moment of rest the movement is repeated; this continues until the tip of the air-tube is firmly embedded in the grass root. The position immediately after the jerking movement is indicated in the



End of abdomen of larva of *Taeniorhynchus richiardii* to show method of attachment to *Glyceria* roots. (Considerably diagrammatic.)

D, dorsal (or anterior) valves, bearing stout curved bristles; V, ventral (or posterior) valves forming a sheath for the saw; T, main tracheal trunks; Ax, axial rod; A, extreme tip of breathing-tube further enlarged, to show three pairs of hooks in the membrane, and the two strong black hooks at the tip of one of the internal pieces; B, tip of the stout bristle on the dorsal valves enlarged to same scale as A.

figure by dotted lines, but the anal segment should have been shown as having moved considerably further. The effect of this movement is probably to force the contents of the air-tube, including the whole of the apparatus at the end of the tracheal tubes, outwards.

During or immediately after the jerk the axial rod can be seen to sway to and fro. This action probably has the effect of "approximating the terminal elements, so as to form a sharply-pointed cone for thrusting into the root," a function which was suggested for the axial rod by

Ingram and Macfie. Perhaps also the muscles producing the deflection of the anal segment may be attached to the swollen end of the axial rod, but this I have not been able to observe.

*T. richiardii* has another remarkable adaptation, apart from those found in the air-tube, which has not been previously observed, though it may be expected to occur in the other species of the group. This is the presence in the thorax of a pair of large air-sacs, formed by dilatations of the small tracheal branches which arise from the main trunks in the first abdominal segment and project forwards into the thorax. No trace of any such dilatations can be seen in any other British mosquito larva, and they are not indicated in the published figures of any American species. They can only be compared with the thoracic air-sacs of *Chaoborus* (*Corethra*) and *Mochlonyx*, though it is unlikely that they are the same either in origin or function. I think there can be little doubt that the air-sacs of *Taeniorhynchus* act as storehouses for the oxygen which is obtained with so much difficulty; perhaps they may be necessary for hibernation, since there can only be a very slight gaseous circulation in the grass roots during the winter.

The pupa of *Taeniorhynchus*, like the larva, is adapted to a sub-aqueous existence, the tips of the breathing-trumpets being drawn out into sharply pointed processes which are inserted into the grass roots. Although I have not found a living pupa, and all my larvae died before pupating, a balsam mount of one specimen shows the pupal breathing-tubes very clearly. The terminal portion, which is presumably inserted into the root, has a beautiful structure, being finely ridged or barbed, somewhat like a feather, the tip corresponding to the feather's base.

The mode of emergence of the adult *T. perturbans* has not been made known, and it will therefore be of interest to record that several specimens of *T. richiardii* hatched out in a pail which I had brought home with pond-water and sods of the grass. The empty pupal skins were found floating on the surface of the water, and the pupae must therefore have risen to the surface for the emergence of the adult. An examination of these skins showed that in every case the terminal portions of the breathing-tubes were missing, hence it must be inferred that they had been left behind in the roots. Most likely their barbed structure, while facilitating their insertion, would prevent their being withdrawn. There seems to be a line of weakness at the base of the barbed portion which might render its detachment easy.

In conclusion, it may be briefly mentioned that several other Dipterous larvae were found in the same conditions as *T. richiardii*,

some of them showing interesting spiracular modifications for obtaining their air from the *Glyceria* roots. These larvae include a *Notiphila*, an *Eristaline*, and an *Erioptera*; they are being investigated by Dr. D. Keilin.

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*February 1919.*