

NOTES ON ANOPHELES.

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The following notes were contributed to a discussion of Dr. Theobald Smith's paper upon the mosquitos in the neighborhood of Boston, and are based upon observations made in 1879. At that time I was living in West Roxbury, a town now included within the limits of Boston; and I devoted during several summers much attention to the insect fauna of the fresh water. Among the many forms collected, one was found quite abundantly in the stagnant waters of the neighborhood, which especially attracted attention by its peculiar habit of feeding, for as it lay against the surface of the water, quite motionless, it would suddenly twist its head over, without changing the position of the body, until the head was upside down, — that is, the mouth would be facing the sky instead of the bottom of the pond. Immediately the insect would begin beating the water very rapidly with its oral appendages, which are armed with long, stiff, curving bristles, and thus create a current towards its mouth, and thereby bring particles which were floating on or near the surface to its mouth, where the particles could be seized and swallowed. The larvæ fed, so far as I observed, in no other way. The beating of the water would be maintained for a short time, not many seconds, usually, and the insect then turned its head back to the normal position, and after a short rest repeated the operations as before. Usually after feeding in this way for a few times the larva with a wriggle freed itself from the surface and made its way to the bottom of the dish, where it remained quiet for a while, and thereupon remounted to the surface to breathe and to feed again. The method of respiration is similar to that of the mosquito, there being a respiratory tube on the dorsal side of the ninth (eighth abdominal) segment, with two tracheal openings at its end, — see Plate XXXI., Fig. 2*a*. Sometimes the larva could be observed to thrust its head forward, thus revealing the long

and slender neck, which is hidden under the large first segment, when the animal is at rest. It is this long neck which renders possible the singular rotation of the head. Not knowing what this odd larva was, I designated it in my notes as "*head-turner*," and it seems to me that this would be a satisfactory popular name for it, and I therefore suggest its adoption.

I reared many of these insects to maturity, for they are easily kept in confinement. There should be some mud at the bottom of the dish, and green plants to freshen the water, the surface of which must be free from dust, otherwise the insects will be smothered. It was with no little surprise that I saw my head-turner transform into a mosquito. I took some of these specimens to Mr. Edward Burgess, who, though celebrated as the designer of three yachts of international fame, was equally remarkable for his knowledge of insects, and as a special student of North American diptera had made himself the foremost authority of his time upon this order. Mr. Burgess identified the mosquitos as *Anopheles*, but unfortunately could not then determine the species. As I soon withdrew from my entomological studies to devote myself more to embryology, my observations have remained unpublished. It is to be regretted that the adult specimens actually raised have been lost, so that I cannot now determine the species with certainty. I found two species of larvæ, but my drawings refer to only the commoner of these, which probably belongs to *Anopheles punctipennis*.

I am able by my own observations to confirm the very accurate account of the habits of the larvæ and pupæ of both *Culex* and *Anopheles*, given by L. O. Howard in Bulletin No. 25 (N.S.) of the U.S. Division of Entomology, but cannot add anything important.

Owing to the great interest attaching to the genus *Anopheles* the editor of the *Journal* has considered these notes worth publishing, since they record what are perhaps the earliest observations on the life history of these mosquitos. I am able also with the aid of the accompanying plates to point out certain distinctions between the larvæ and pupæ of

Culex and *Anopheles*.¹ Figs. 1 and 3 represent the larva and pupa of the same individual *Culex*; Figs. 2 and 4 of the same individual *Anopheles*. The *Culex* larva is a very characteristic species, which can, I think, easily be found again and reared for identification. It is green shading into brown, the intestine usually forming a dark band owing to the food with which it is gorged; the band extends through the second to ninth segments; the head is brownish yellow, the eyes a very dark brown; but the most characteristic feature is the *white* antenna, although at its base it is brown, and its terminal joint and setæ are also brown. This larva is a well characterized and easily recognized species. The *Anopheles* is, as said, probably *A. punctipennis*.

Comparison of the larvæ shows that the type is similar in the two forms, but there are many minor differences. The larva of *Anopheles* is larger than that of any *Culex* I have seen.

The head is much larger and broader in *Culex* than in *Anopheles*; the length is about the same in the two forms. *Culex* has a tuft of hairs at the base of the antenna, which project forward, and are nearly as long as the antennæ.

The antennæ in *Culex* are long and curving; in *Anopheles* they are shorter and straight.

The eyes in *Culex* are large and broad; in *Anopheles*, narrow and oblique.

*The first*² *segment* in *Culex* is nearly as long as broad; in *Anopheles* the breadth is much greater than the length, and as shown in the figures the lengths and the arrangement of the bristles borne by this segment are very unlike in the two genera.

The second to ninth segments are relatively broader in *Anopheles*, and the lateral bunches of long hairs which they bear gradually diminish in length from the second to ninth segment in *Anopheles*, while in *Culex* the hairs on the second to seventh segments are about of the same length, those on the eighth and ninth being much shorter.

¹ Whether the differences enumerated are all strictly generic must be determined by more extended observations.

² The segments, for convenience, are counted only as they appear in the drawings.

The respiratory tube is long, slender, and tapering in *Culex*, and in *Anopheles* is a short cylinder terminating in a blunt cone.

The tenth segment ends squarely in *Culex*, while in *Anopheles* it is rounded, and bears in addition a straight terminal spine beset with lateral hairs.

Many of these differences are clearly shown in Howard's figures, but his representations of the spines and hairs differ from what I have seen.

In regard to the pupæ, we have to do chiefly with differences in proportion, the pupa of *Culex* being much smaller and with a slenderer abdomen than *Anopheles*. The last abdominal segment in *Culex* is small, that of *Anopheles* forms a much larger cone. The respiratory tube arises from the thorax much higher up dorsally in *Culex* than in *Anopheles*. Possibly the differences in shape and length of the tubes are also of generic value.

In regard to the color of the *Anopheles* pupa figured, I give my notes, as they may assist the future identification of the species:

"Upper side of thorax and abdomen brown; lower side of thorax and abdomen, and anterior end of thorax, green. Seen from above, the pupa shows on each side of the thorax a glistening triangle, caused by air contained under the wing and between the legs; in the middle of the glistening triangle is a reddish brown dot; the middle lines of the thorax and abdomen are brown, but the edges of both parts appear green from above."

In regard to the malarial host I am able, then, to state that it was common in the stagnant waters of that part of Boston known as West Roxbury, according to observations, in 1878, '79, and '80. It is presumably equally common in that district at the present time. I found it in several localities, all low, swampy lands, in the neighborhood of Forest Hills. There may be specified as habitats the ditches at Woodbourne, and on the next estate, then belonging to Richard Olney, Esq., on the Bussey estate, now part of the Arnold Arboretum, and in one of the ponds of Mount Hope cemetery.

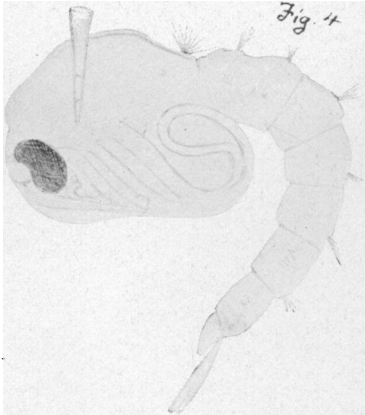
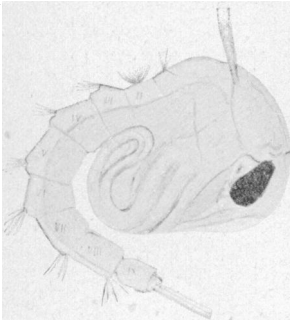
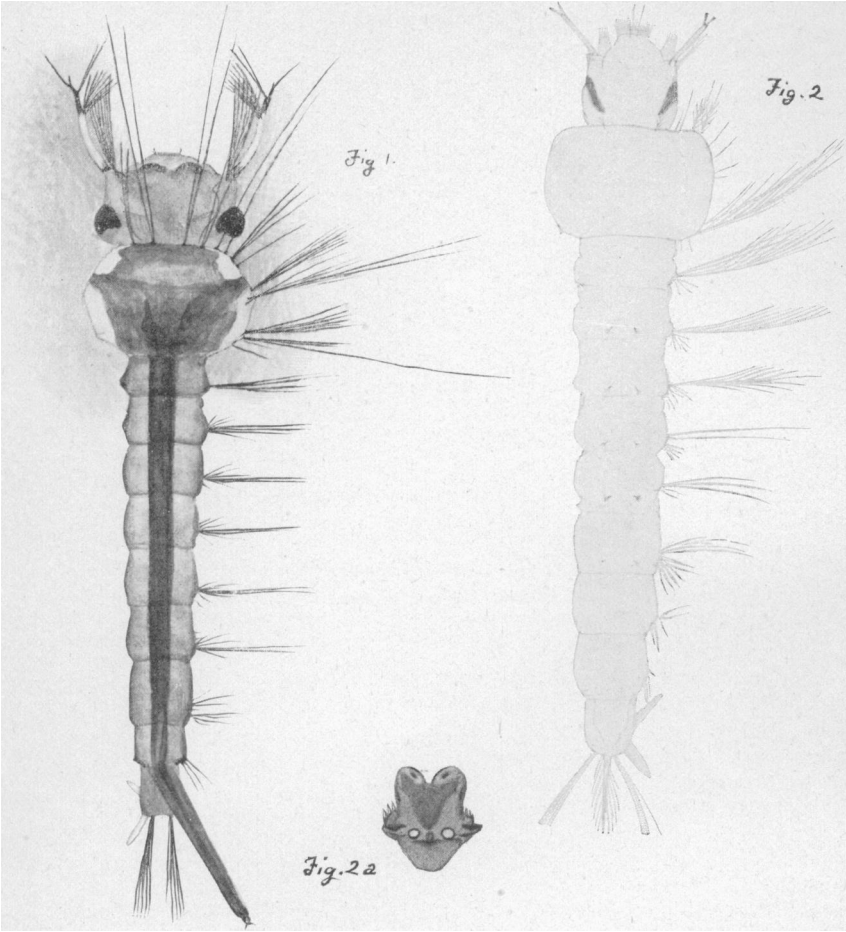


PLATE XXXI.

All the figures are magnified fifteen diameters, except Fig. 2*a*. They are reproductions of the untouched original pencil sketches, except Fig. 1, which is from a water-color drawing.

- Fig. 1. Larva of *Culex*, sp.?
- Fig. 3. Pupa stage of the larva of Fig. 1.
- Fig. 2. Larva of *Anopheles* (? *punctipennis*).
- Fig. 2*a*. More highly magnified view of the end of the respiratory tube of the same larva.
- Fig. 4. Pupa stage of the larva of Fig. 2.

To raise the larvæ it is convenient to use small dishes, perhaps three inches in diameter and an inch and a half deep. If each larva is kept in a dish by itself, the identification of the stages and species can be made certain. The pupæ both of *Culex* and *Anopheles* hatch into the adult quite suddenly. The pupa rises to the surface when the time for transformation arrives, and remains quite motionless; the shell splits down the middle dorsal line of the thorax and spreads open; the perfect insect immediately slips out from the shell, and reposes upon it, resting its feet thereon, but usually remains only a few instants before flying off. Its first flight is apparently a perfect performance. The whole transformation occupies only a few seconds. To prevent the escape of the imago, the dish with the pupa should be covered with muslin or fine netting. If this is not done, the observations are likely to end in final disappointment.