

THE EARLY STAGES OF WEST AFRICAN MOSQUITOS—IV.

By A. INGRAM, M.D., C.M., and J. W. S. MACFIE, M.A., D.Sc.,

West African Medical Service.

In three previous papers (Bull. Ent. Res. vii, pp. 1-18; viii, pp. 73-91; and viii, pp. 135-154) we have described early stages of a number of West African mosquitos collected at Accra and at other places in the Gold Coast. The present paper deals with a few more early stages of mosquitos, for the most part collected by one of us (A.I.) in the Northern Territories of the Gold Coast, and thus fills in a gap or two in the knowledge of the life-histories of these insects.

The majority of the descriptions which follow are of pupae. As in our previous paper we have taken for diagnostic purposes more particularly the characters of the paddles, and the hairs or setae at the posterior angles and on the dorsal aspect of the abdominal segments. On the dorsal aspect and at the posterior margins of the segments of the abdomen there are important hairs which form two distinct rows on each side of the body from usually the 3rd to the 7th segments. The one row is situated midway between the posterior angles and the middle line of the body, the other about midway between the posterior angles and the first row. These two rows of hairs do not appear to have received names, we therefore propose to call them respectively the "inner and outer lateral rows."

We have found it advisable to introduce into the descriptions of pupae certain ratios, such as the ratio of length to greatest breadth of the paddles or respiratory trumpets. The respiratory trumpet is composed of two parts, a closed or tubular part which is proximal, and an open part which is distal; the former we propose to call the meatus, and the latter the pinna. The relative length of the meatus varies greatly in different species of mosquito, and this fact we think may be most accurately expressed as the ratio of the length of the meatus to the total length of the respiratory trumpet.

Anopheles pretoriensis, Theo.

LARVA.—The larva of this mosquito is included by Edwards (Bull. Ent. Res. iii, p. 374) in his key to the larvae of the genus *Anopheles*.

PUPA (fig. 1).—The pupa is small, measuring about 4 mm. when extended, and feebly chitinised.

The paddles, which are about 7 mm. long, are oval, the ratio of length to greatest breadth being about 1.6 to 1; they are furnished with a midrib, and an external buttress which does not seem to extend beyond the proximal third of the blade. The hook-shaped hair on the distal edge of the paddle is well developed and about half the length of the paddle; proximal to it, near the end of the midrib, is a short straight hair which is forked almost from its base, and is about one-sixth the length of the hook-shaped hair. The paddles carry a fringe of rather delicate hairs, longest on the distal border; this fringe appears to begin at a point beyond the middle of the external border.

At the posterior angle of the 8th abdominal segment is a stout seta giving off a number of branches; it is about one-quarter the length of the paddle, and its spread of branches is only moderate.

At the posterior angles of the 7th, 6th and 5th segments are long spines, curved and sharply pointed; on the 4th and 3rd segments the corresponding spines are short and blunter; and on the 2nd segment very small and feebly chitinated.

In addition to the spines already described there are numerous hairs on the body of the pupa, the most important being those on the dorsal aspect at the posterior margins of the 3rd to the 7th segments which are arranged in two rows on each side of the abdomen. The hairs of the one row, the outer lateral row, are situated a little internal to the angle; they are branched. The hairs of the other row, the inner lateral row, are situated about mid-way between the posterior angle and the middle line; they are long single hairs on the 7th, 6th and 5th segments, and branched hairs similar to those in the outer lateral row on the 4th and 3rd segments. The dendritic hairs on the 1st segment are well developed.

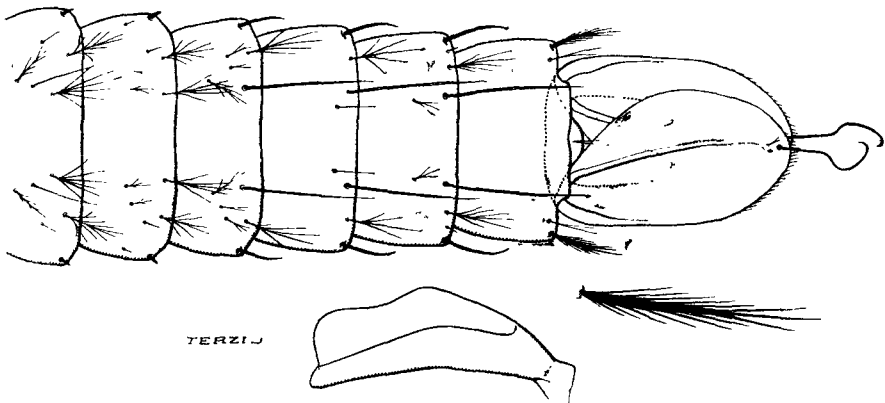


Fig. 1. Pupa of *Anopheles pretoriensis*, Theo.

The respiratory trumpets are about 4 mm. long; they are, as usual, composed of two parts, a closed part or meatus which is proximal, and an open part or pinna which is distal. In the pupa of *A. pretoriensis* the meatus is short; the ratio of its length to the total length of the trumpet being about 1 to 3. The pinna as it expands forms a slight angle a little beyond the distal margin of the meatus; this angle is much less acute than that shown by *A. costalis*.

Diagnosis.—The pupa of *A. pretoriensis* has to be separated from the other known pupae of this genus which have long, sharp and usually curved spines at the posterior angles of the 7th, 6th and 5th segments, that is, from those of *A. costalis*, *A. funestus*, *A. marshalli* and *A. pharoensis*. *A. costalis* is distinguished by having on the paddle a well developed buttress and a fringe which begins at a point proximal to the middle of the external border, and by the characters of the respiratory trumpet to which reference has already been made; *A. funestus* by having a spine of considerable size at the posterior angle of the 4th segment, and by hairs in the inner lateral row on the 7th, 6th and 5th segments, which are often sub-divided; *A. marshalli* (if the specimen examined by us was typical) by

having a curved, but not hook-shaped hair at the end of the paddle, and by the hairs in the inner lateral row on the 7th, 6th and 5th segments, which are often subdivided; and *A. pharoensis* by the large hair on the end of the paddle not being hook-shaped.

Habitat.—The larvae of this mosquito were captured in shallow pools in outcrops of quartzite at Winduri, Tong Hills, in the Northern Territories of the Gold Coast, 18.vi.1918. They were associated with larvae of *Stegomyia vittata*, Bigot (*sugens*, Theo., *nec* Wied.).

***Anopheles rufipes*, Gough.**

LARVA.—The larva of this mosquito is included by Edwards (loc. cit., p. 374) in his key to the larvae of African species of the genus *Anopheles*.

PUPA (fig. 2).—The pupa is small, measuring about 3.5 to 4 mm. when extended, and very strongly chitinated.

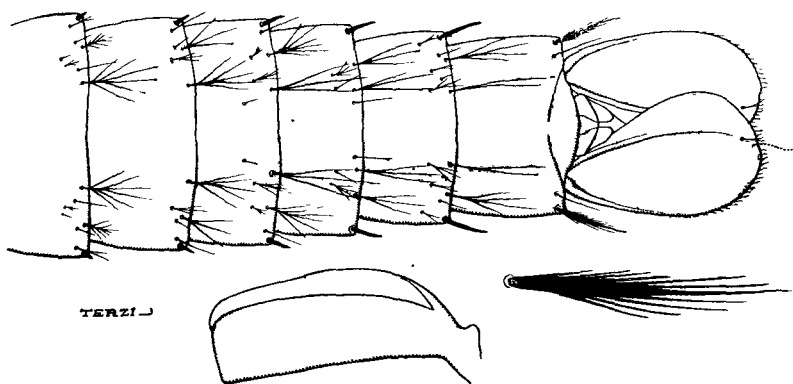


Fig. 2. Pupa of *Anopheles rufipes*, Gough.

The paddles, which are about .6 mm. long, are oval, the ratio of length to greatest breadth being about 1.5 to 1; they are supported by a well-developed midrib and an external buttress, which is not so well developed as that of *A. costalis*. The hair on the distal edge of the paddle, which in some other species resembles a boot-hook, is unfortunately missing from the two pupae examined. On each paddle, near the end of the midrib, there is a short hair divided towards its tip. This splitting towards their tips of the small hairs of the paddles is not a character of specific importance, as it occurs occasionally in *A. costalis*. The paddle bears a fringe which begins at a point a little proximal to the middle of the external border.

At the posterior angle of the 8th abdominal segment is a stout seta giving off branches, which resembles the corresponding seta of the pupa of *A. funestus*; it measures about one-quarter the length of the paddle.

At the posterior angle of the 7th segment is a curved and pointed spine; on the 6th, 5th and 4th segments the corresponding spines are straight and shorter. These angle spines are smaller the more anterior the segment to which they are attached; those on the 3rd and 2nd segments being minute.

In addition to the spines already described there are numerous hairs on the body of the pupa, especially along the posterior margins of the segments; the

most important are those which form the outer and inner lateral rows on each side on the dorsum of the abdomen. The hairs forming the outer lateral row are branched. Those forming the inner lateral row are long single, double, or triple hairs on the 7th, 6th and 5th segments, and branched hairs, similar to those in the outer lateral row, on the 4th and 3rd segments. The dendritic hairs or tufts on the 1st segment are well developed.

The respiratory trumpets are about .36 mm. long; the pinna, the open part, extends nearly the whole length of the trumpet, the ratio of the length of the closed portion, the meatus, to the total length of the trumpet being nearly 1 to 5. There does not appear to be any angle formed by the pinna a little above the distal margin of the meatus, such as there is in *A. costalis*.

Diagnosis.—The pupa of *A. rufipes* has to be distinguished from that of *A. mauritianus* (neither having long sharp spines at the posterior angles of the 7th, 6th and 5th segments), and this may be done by the spine at the posterior angle of the 7th segment, which is long and curved in *A. rufipes*, but short and straight in *A. mauritianus*. The harp-shaped form of the dendritic seta on the 8th segment of *A. mauritianus* is not a good character, as it is inconstant.

Habitat.—The two pupae on which the above description is based were found in pools of clear water collected in the dry bed of a stream near the garden at Bawku in the Northern Territories of the Gold Coast, 11.vi.18. With them were associated pupae of *A. funestus*.

Ochlerotatus hirsutus, Theo.

LARVA.—The larva of this mosquito has not yet been identified.

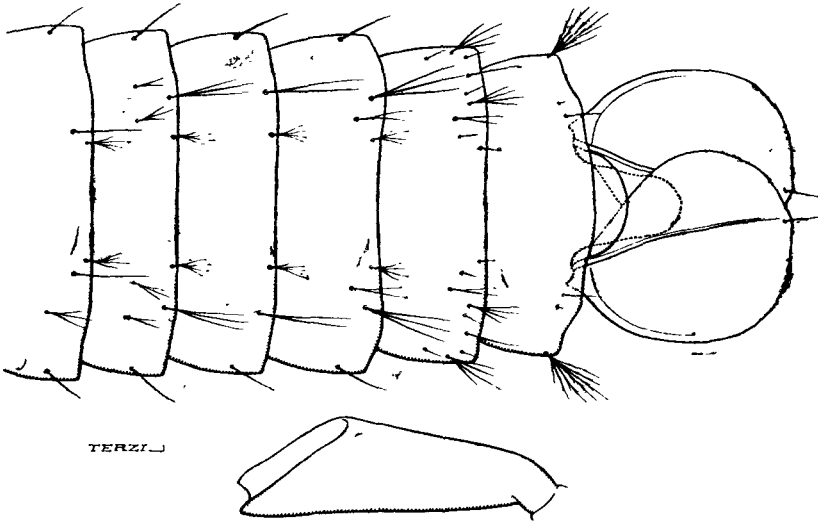


Fig. 3. Pupa of *Ochlerotatus hirsutus*, Theo.

PUPA (fig. 3).—The pupa is large, measuring about 6 to 7 mm. when extended, and well chitinised.

The paddles, which are about 1 mm. long, are broad, the ratio of length to greatest breadth being about 1·2 to 1; they are supported by an external buttress and a moderately well developed midrib. At the end of the midrib is the usual long single hair, which is about one-eighth the length of the paddle. The paddles are devoid of a fringe.

At the posterior angle of the 8th abdominal segment is a tuft of 7 to 8 subplumose hairs, of which one or two may be branched. This tuft is short, about one-fifth the length of the paddle.

A little above the posterior angle of the 7th segment is a tuft of 3 or 4 pubescent hairs; this tuft is about one-sixth the length of the paddle. In a similar position on the 6th, 5th and 4th segments there is a single hair, sometimes divided.

In addition to the tufts and hairs, already described, there are on the dorsal aspect of the abdomen numerous small and delicate hairs, most of which are quite inconspicuous; those situated in the positions corresponding to the outer lateral row on the 4th to the 6th segments are, however, better developed, and are long double or triple hairs. On the same segments in the positions corresponding to the inner lateral row are small tufts of delicate hairs. The hairs on the posterior margins of the 7th segment are all small. On the posterior margin of the 3rd segment is a small tuft in line with the inner lateral row, and a single hair of moderate length a little above and external to it. The dendritic hairs or tufts on the 1st and 2nd segments are moderately well developed.

The respiratory trumpets are about 7 mm. long; they are rather broad, and have wide apertures. The ratio of the length of the closed portion, the meatus, to the total length of the trumpet is about 1 to 1·5.

Diagnosis.—See *O. nigeriensis* (p. —).

Habitat.—The two pupae on which the above description is based were found in a collection of rain-water in a disused kerosene tin at Accra, Gold Coast, 11.xii.17. The tin was partly concealed by vegetation.

***Ochlerotatus nigeriensis*, Theo.**

LARVA.—The larva of this mosquito is included by Edwards in his "Revised Keys to the Known Larvae of African Culicinae" (loc.cit., pp. 376 and 377), and is figured by him.

PUPA (fig. 4).—The pupa is of moderate size, measuring about 5 to 6 mm. when extended, and is very strongly chitinised.

The paddles, which are nearly 1 mm. long, are broad, the ratio of length to greatest breadth being about 1·2 to 1; they are supported by a midrib and by an external buttress, which, however, is not conspicuous. Near the end of the midrib is the usual long single hair, measuring in this species about one-eighth the length of the paddle. The paddles have no fringe, but may show a few minute teeth, especially about the middle of the external border; these teeth are too inconspicuous to show in the figure.

At the posterior angle of the 8th abdominal segment is a tuft of about six (5 to 7) hairs which are subplumose at their bases and sometimes branched towards their tips. This tuft is short, its length being about one-fifth the length of the paddle.

Near the posterior angle of the 7th segment is a tuft of three or four (2 to 5) hairs which are subplumose towards their tips. This tuft is a little shorter than the tuft on the 8th segment, measuring about one-sixth or one-seventh the length of the paddle. Near the posterior angles of the segments anterior to the 7th there are, as a rule, single hairs, occasionally double hairs.

In addition to the tufts and hairs already described, there are on the dorsal aspect of the abdominal segments a number of other hairs which are for the most part feebly developed; the most notable are those occupying positions corresponding to the hairs of the outer lateral row, which on the 4th to the 6th segments are long and usually single or double. The hairs corresponding to those of the inner lateral row on the 4th to the 6th segments are quite insignificant tufts or hairs; a similar tuft is present on the 3rd segment, with a single hair of moderate length above and a little external to it. The dendritic hairs or tufts on the 1st and 2nd segments are rather feebly developed, those on the 2nd segment being small and poorly chitinised.

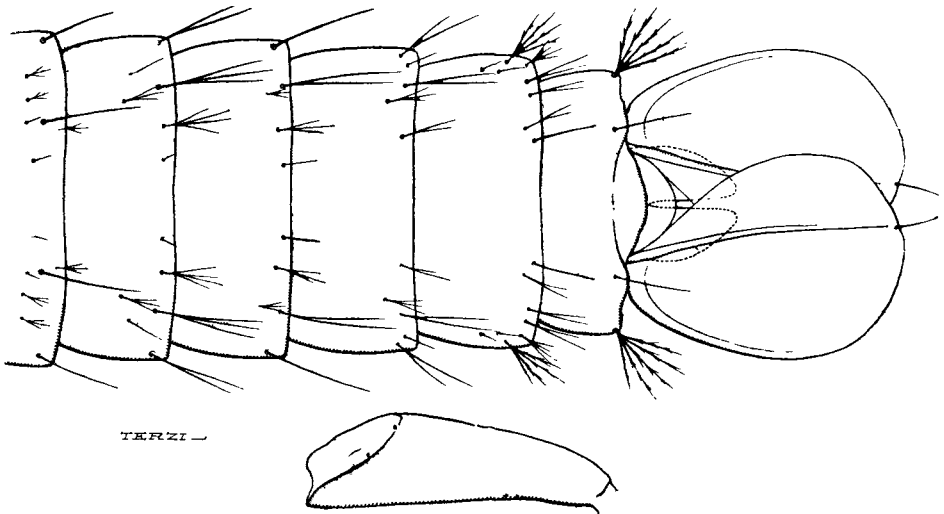


Fig. 4. Pupa of *Ochlerotatus nigeriensis*, Theo.

The respiratory trumpets are about 6 mm. long; they have wide mouths. The ratio of the length of the closed portion, the meatus, to the total length of the trumpet is about 1 to 1.5.

Diagnosis.—The pupa of *O. nigeriensis* resembles very closely that of the preceding species, *O. hirsutus*, and both fall into the group in our key which includes *O. minutus*, *O. punctothoracis*, and *O. caliginosus*, species hitherto described in insufficient detail to be differentiated. *O. nigeriensis* may show a few minute teeth on the external border of the paddle which might be regarded as a fringe, but the tufts at the posterior angles of the 8th and 7th segments are sufficient to separate this species from *O. albocephalus*. No very satisfactory means has been found for distinguishing the pupae of *O. hirsutus* and *O. nigeriensis*, but perhaps the hairs of the inner lateral row on the 7th and 6th segments would serve, although they are inconspicuous.

Habitat.—The pupae of this mosquito were found in a borrow-pit containing slightly muddy water outside the village of Ulu, Lorha District, Northern Territories of the Gold Coast, 7.vii.1918.

***Culex ager*, Giles, var. *ethiopicus*, Edw.**

LARVA.—The larva of this mosquito has been figured by Edwards (loc. cit., p. 380) and has been included by him in his "Revised Keys to the Known Larvae of African Culicinae." One feature, however, which is not referred to by him and which is not shown in the figures, may be mentioned because it is unusual, that is, the shape of the mental plate. In the larva of *C. ager* var. *ethiopicus* this structure is shaped like an equilateral triangle, and its margin when viewed at a moderate magnification ($1/6$ objective and No. 3 ocular) appears to be crenated but devoid of teeth (fig. 5, *a*); when examined with higher powers, however, the crenated margin is seen to be composed of a large number (about 60) of minute teeth, which increase in size slightly as they recede from the apex.

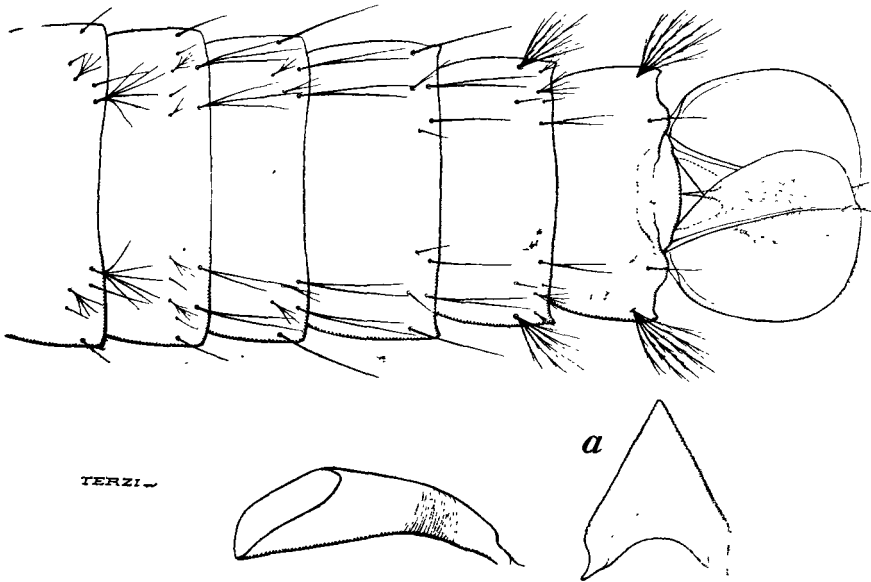


Fig. 5. Pupa of *Culex ager* var. *ethiopicus*, Edw.; *a*, mental plate of larva.

PUPA (fig. 5).—The pupa is large, measuring about 6 mm. when extended, and well chitinised, the sockets of the hairs, even minute ones, being marked by a thickened darkened ring. The paddles are infuscated. The trumpets have wide apertures, which are directed anteriorly in the living pupa.

The paddles, which are nearly 1 mm. long, are broad, the ratio of length to greatest breadth being about 1.1 to 1; they are supported by an external buttress and a well developed midrib. Near the distal end of the midrib are two minute hairs, the one considerably larger than the other; the larger hair is sometimes divided towards its tip. The paddle is infuscated at its distal end and over almost the whole of the inner lobe, and has no fringe.

At the posterior angle of the 8th abdominal segment is a tuft of 5 to 7 subplumose hairs, which are usually branched. This tuft is about one-quarter the length of the paddle.

(C572)

A little above the posterior angle of the 7th segment is a tuft of 3 to 6 subplumose or pubescent hairs, which are usually branched. This tuft is almost as long as the one on the 8th segment, measuring about one-quarter the length of the paddle. Near the angles of the segments anterior to the 7th are single hairs, those on the 6th and 5th segments being strongly developed and the others more feebly.

Of the other hairs on the abdominal segments the most important are those forming the inner and outer lateral rows. On the 4th to the 6th segments the hairs in both these rows are long single, double, or triple hairs, those on the more anterior segments being usually but not invariably more sub-divided than those on the more posterior segments: on the 7th segment the hair belonging to the outer lateral row is small, that belonging to the inner lateral row a small double or single hair. These hairs, which are rather variable, are shown in the figure; it will be observed that they differ from the corresponding hairs of the pupa of *C. quasigelidus*. On the 3rd segment the most conspicuous hairs are a small tuft in line with the inner lateral row, a single hair above and a little external to this tuft, and a second small tuft above and external to the single hair. The dendritic hairs or tufts on the 1st segment are fairly well developed and have about 8 or 9 primary branches.

The respiratory trumpets are long, averaging nearly 1 mm. in length, and have wide apertures. The ratio of the length of the closed part of the tube, the meatus, to the total length of the trumpet is about 1 to 1·7.

Diagnosis.—This pupa may readily be distinguished from the pupa of *C. quasigelidus* (see p. 67), the only other *Culex* (*sens. str.*) pupa known to have infuscated paddles, as follows.

	<i>C. ager</i> var. <i>ethiopicus</i> .	<i>C. quasigelidus</i> .
Paddles.	Infuscation most notable on the inner blade, and extending almost to the base on this blade.	Infuscation not extending more than half way down the paddle at any point.
Tuft at the posterior angle of 8th segment.	8-9 hairs.	5-7 hairs.
Hairs at the posterior angles of 6th and 5th segments.	Single.	Triple or quadruple.
Trumpets.	Not unusually narrow, wide-mouthed.	Very long and narrow.

Habitat.—Larvae and pupae of this mosquito were found during June and July in swamps or in pools of clear water containing algae (*Spirogyra*) at many places in the Northern Territories of the Gold Coast, *e.g.*, at Gambaga, Bawku, Navara, Tumu, Wa, Bole, etc.

***Culex quasigelidus*, Theo.**

LARVA.—The larva of this mosquito has been described by Wesché (Bull. Ent. Res. i, pp. 38 and 39), and Edwards (*loc.cit.*, p. 383) has noted some age differences. Two fully developed larvae examined by us showed the following characters, which supplement the previous description: the mental plate small and composed of a median tooth with about six (5 to 6) teeth on each side; the comb of about six (6 to 7)

teeth arranged in a single row or in two short rows; the pecten of about nine (8 to 10) teeth; and the hairs on the dorsal border of the anal segment a fan-like arrangement of about five hairs above and a long hair below on each side.

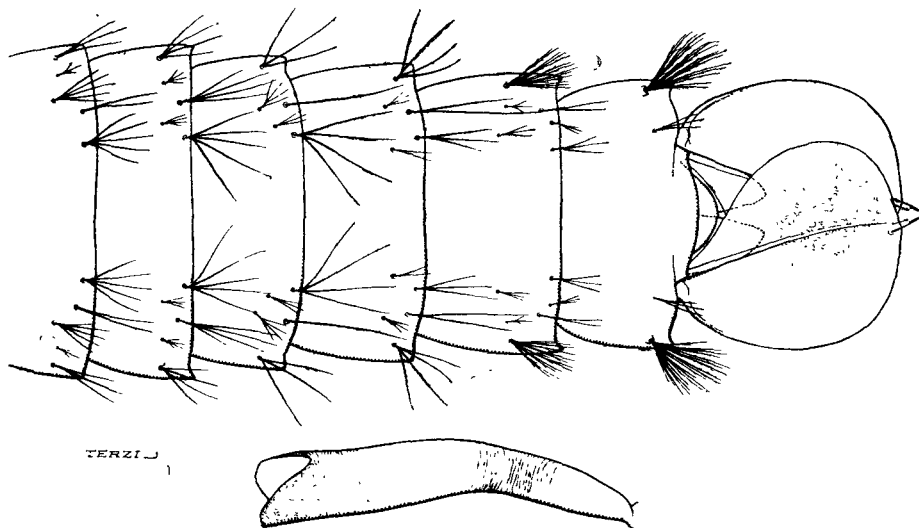


Fig. 6. . Pupa of *Culex quasigelidus*, Theo.

PUPA (fig. 6).—The pupa of *C. quasigelidus* has been described very briefly by Wesché (loc.cit., p. 39), with figures of the respiratory trumpet and of the terminal segments of the abdomen. So long as this *Culex* pupa was unique in having a "distinct dark cloud" on the paddle Wesché's description sufficed for identification, but as the pupa of *C. ager* var. *ethiopicus* (see p. 66) has also an area of infuscation on the paddle it is now necessary to amplify the earlier description. The pupa is of medium size, measuring about 5 mm. when extended, and is well chitinated.

The paddles, which are about .8 mm. long, are broad, the ratio of length to greatest breadth being about 1.1 to 1; they are supported by a well developed midrib and an external buttress. Near the end of the midrib are two small hairs, the one larger than the other; the larger hair, which measures only about one-twelfth the length of the paddle, is sometimes divided towards its tip. There is a patch of infuscation at the distal end of the paddle which involves both the inner and outer lobes but does not extend far down towards the insertion of the paddle. There is no fringe on the paddles.

At the posterior angle of the 8th abdominal segment is a tuft of 8 or 9 subplumose hairs, which are also branched. This tuft is about one-quarter the length of the paddle.

Near the posterior angle of the 7th segment is a tuft of 4 or 5 subplumose hairs, which are also branched. This tuft is almost as long as the one on the 8th segment, measuring about one-quarter the length of the paddle. Near the posterior angles of each of the anterior segments, the 6th, 5th, 4th, and 3rd, is a delicate tuft of 3 or 4 hairs.

(C572)

Of the other hairs on the abdominal segments the most important are those forming the inner and outer lateral rows. The outer lateral row is composed of a minute divided hair on the 7th segment, a long single or double hair on the 6th and 5th segments, and a tuft of three or more hairs on the 4th segment. The inner lateral row on the 7th to the 4th segments is composed of tufts which are larger in the more anterior segments. These rows are shown in the figure. On the 3rd segment the most conspicuous hairs are a tuft in line with the inner lateral row, a double hair above and a little external to this tuft, and another tuft above and external to the double hair. The dendritic hairs or tufts on the 1st segment are well developed and have about a dozen primary branches.

The respiratory trumpets are long and narrow, about .9 mm. in length. The ratio of length to greatest breadth is, in a mounted specimen, 5 to 1. The trumpet is banded, the proximal end being pale and the distal end dark, and the middle zone is divided into two portions, the upper being pale and the lower dark. The ratio of the length of the closed portion, the meatus, to the total length of the trumpet is about 1 to 1.16, that is the meatus is very long.

Diagnosis.—See *Culex ager* var. *ethiopicus* (p. 66).

***Culex univittatus*, Theo.**

LARVA (fig. 7).—The head is large, nearly as wide as the thorax. The brushes are well developed. The antenna is dark and covered with prominent spicules, the hair-tuft being situated just before the middle point of the shaft. The mid-frontal hairs are multiple, the constituent hairs being lightly subplumose; the ante-antennal tuft is also composed of lightly subplumose hairs. The mental plate is triangular in shape; it has a central tooth with about ten to twelve teeth on each side, the lateral teeth being small, but gradually increasing in size towards the base of the plate.

The thoracic plumes, which are formed of subplumose hairs, are well developed.

The lateral abdominal hairs are multiple on the first two segments, triple on the third segment, and thereafter single on each segment.

All the plumes on the 8th abdominal segment are formed of simple or only slightly subplumose hairs. The comb consists of about 8 spines arranged irregularly. The siphon is about seven or eight times as long as its width at the basal ring, and tapers regularly from base to apex. The pecten extends about two-fifths of the length of the siphon from the basal ring; it consists of 13 to 16 teeth of which the two or three furthest from the base are more detached and have no secondary spines. There is a slight tuft of a few simple hairs some distance beyond the last tooth of the pecten, namely, at a point about three-quarters of the length of the siphon from its base.

The anal segment carries very long papillae, three times the length of the segment, the dorsal pair being slightly longer than the ventral. The beard is well-developed. The hairs on the dorsal end of the segment are peculiar, consisting of a fan-like collection of 8 or 9 hairs above and an extremely long hair below on each side. The long hairs are nearly twice as long as the anal papillae.

Diagnosis.—Edwards includes the larva of this mosquito in his key to the larvae of the genus *Culex* (Bull. Ent. Res. iii, p. 381), but states that there are six teeth in the pecten, whereas our specimens had 13 to 16. This discrepancy does not, however,

confuse the identification of this species or its differentiation from those whose larvae have a siphon about half as long as the abdomen.

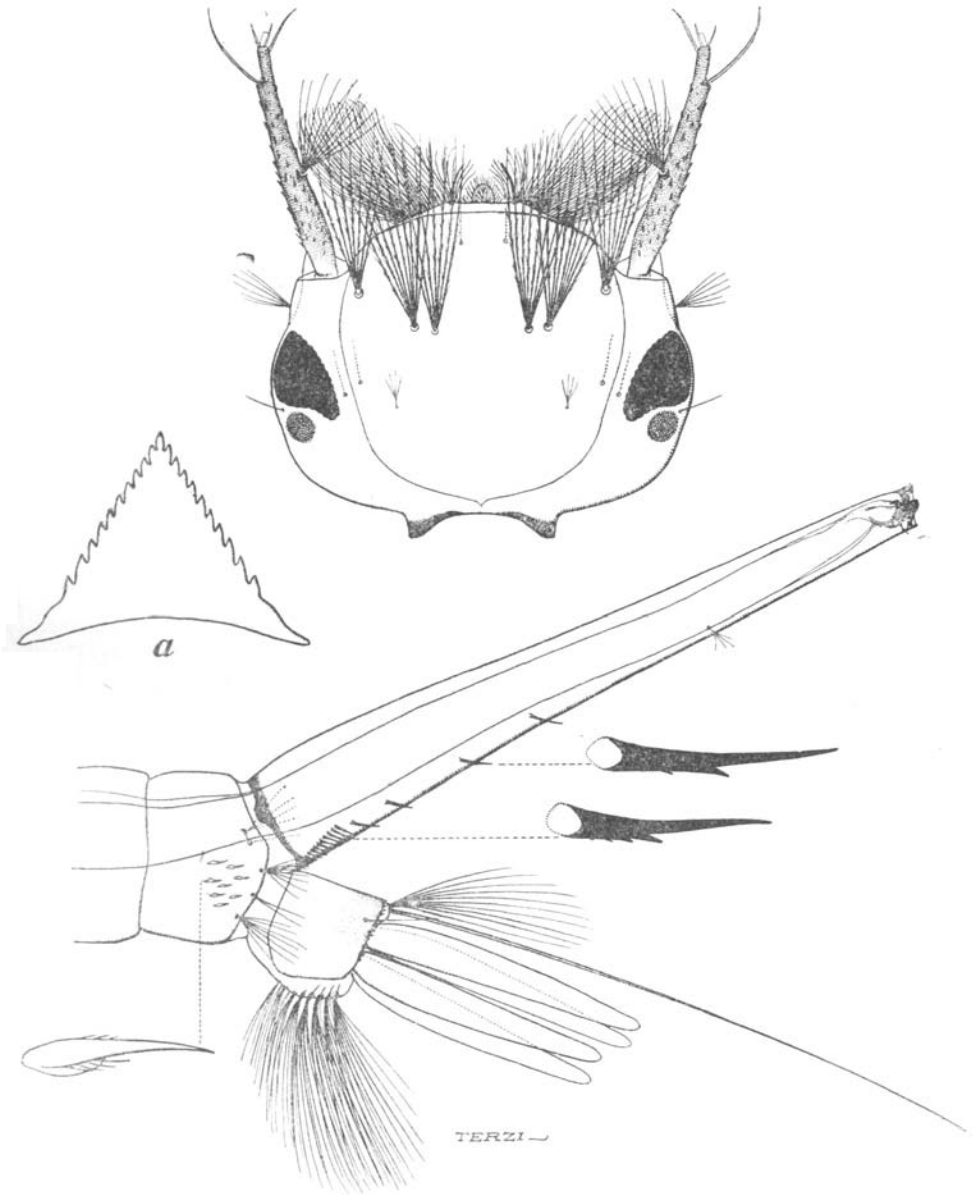


Fig. 7. Head and terminal segments of larva of *Oulex univittatus*; a, mental plate.

Habitat.—The larvae of this mosquito were found in a grass-grown pool containing clear water at the edge of a swamp at Navaro, Northern Territories of the Gold Coast, 23.vi.18.