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ENTOMOLOGICAL STUDIES,
STUDIES ON INSECTS OF
MEDICAL IMPORTANCE IN SOUTH AFRICA

BY

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SOUTH AFRICAN SIMULIIDAE. PART I.

Simulium debegene sp. nov.

FEMALE.

A large insect, wing 4mm. *Head*.—Antenna dark with the exception of the two basal segments. Frons and clypeus with fine golden pubescence. Mouth parts black. *Thorax*.—Integument black, evenly covered with fine golden hairs without any trace of a distinct pattern. Scutellum with long golden hairs. No patch of hairs behind the mesothoracic spiracle. A patch of golden hairs on the upper mesepimeron. Halteres pale. Postnotum shining black. *Wing*.—Base of the radius hairy, otherwise as in the genus *Simulium* as defined by Edwards. Patch of hairs at the base of the radius black. *Legs*.—All pale areas on the legs are covered with a fine golden pubescence. Foreleg, femur pale, tibia pale, darkening towards the apex; tarsi all dark, not unduly flattened; first tarsus with a more or less club-shaped style at the inner apical margin (Fig. 1e). There is also a style present on tarsi 2 and 3 where it is smaller and more sickle-shaped (Fig. 1f and g). Midleg, as in foreleg but no style on the 3rd tarsus and two sickle-shaped styles on the second segment (Fig. 1d); 1st segment with a club-shaped style (Fig. 1c). Hind leg (Fig. 2), femur pale, slightly darker towards the apex; tibia pale with the apex darker and but little expanded before the apex; 1st tarsus with the basal half pale, calcipala present, style more or less triangular in shape (Fig. 1a); 2nd tarsus with the basal third pale, pedisulcus present, style present (Fig. 1b); 3rd, 4th and 5th tarsi all dark, no styles present. Claws of all legs with a strong basal tooth. *Abdomen*.—Uniformly covered with golden hairs. Terminalia: Figure 3 is a side view of the terminal segments. The anterior gonopophyses and paraprocts are very well developed and protrude down vertically from their respective segments so that a ventral view was unobtainable without distorting the different structures. Viewed ventrally in clove oil without a coverslip, the 8th sternite was seen to possess a relatively deep sunken area medianally, the depth of this area is shown as shaded in Figure 3. In Figure 4, a ventral view of the furca and 8th sternite is given, here the extent and sculpturing of the sunken area is well shown. In the figure of the side view the cercus is shown as a slender finger-like structure, when viewed from the posterior end, however, it is seen to be actually more club-shaped and only slightly longer than broad in the middle.

MALE.

Darker than the female; the pubescence is more brassy in appearance and often quite black; this applies more specially to the mesonotum, scutellum, halteres, abdomen and clypeus. *Hypopygium* (Fig. 5): The clasper as shown is slightly foreshortened and has one apical black spine. The drawing was made from an unmounted specimen freely floating in clove oil, so that none of the parts are distorted. There are a number of parameral hooks, some of which are large and some small. The expanded portion of the aedeagus bears a number of short thick spines on its lateral margins; these seem to be in contact with the parameral hooks.

PUPA.

About 5mm. \times 2mm. The cocoon is white in colour and hence unlike that of any other South African Simulid we have seen. Because of this white colouring the pupae are very conspicuous objects on the black rocks of waterfalls in the Drakensberg.

The filaments (Fig. 6) are four in number, three of these are of equal length and arise posteriorly, one slightly longer arises anteriorly. The pupae are only found in the swiftest running waters and occur most frequently on the rocky face of waterfalls.

Holotype.—Female, Magoebaskloof, Tzaneen, Transvaal; 3-4,000ft.

Paratypes.—Three females and four males from the same locality.

The holotype and all paratypes were bred from isolated pupae.

In the key to the females of Ethiopian *simuliidae* given by the author¹ *debegene* runs down to *aureosimile* Pom. from which, however, it is abundantly different, especially in the male hypopygium and pupal filaments.

Further Note.—Further examples of this species have since been collected near the type locality. These were of extraordinarily large size, the wing measuring as much as 6mm. in some specimens. In all other respects they were identical with the smaller species described above.

PLATE I.

Simulium debogene sp. nov.

Figure 1.—Styles from the tarsi of the female legs.

- a.* 1st tarsus, hind leg.
- b.* 2nd tarsus, hind leg.
- c.* 1st tarsus, midleg.
- d.* 2nd tarsus, midleg.
- e.* 1st tarsus, foreleg.
- f.* 2nd tarsus, foreleg.
- g.* 3rd tarsus, foreleg.

Figure 2. 5th, 4th, 3rd, 2nd and portion of the 1st tarsus of the hind leg of the female.

Figure 3. Side view of the terminal segments of the female.

- 8t.* Eighth tergite.
- 8s.* Eighth sternite.
- ag.* Anterior gonopophyse.
- f.* Furca.
- pp.* Paraproct.
- c.* Cercus.
- 10t.* Tenth tergite.
- 9t.* Ninth tergite.

PLATE I.

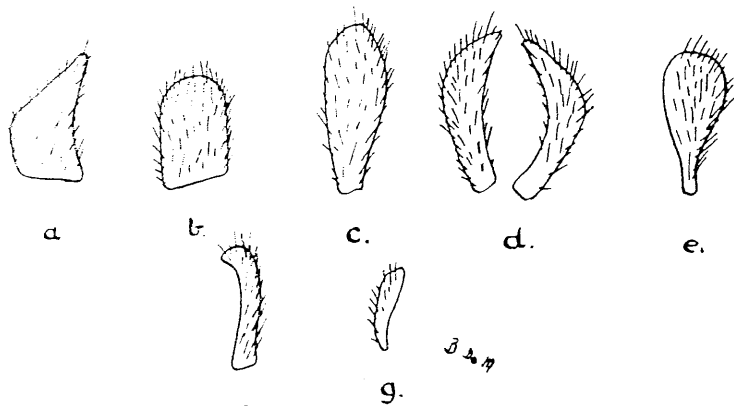


Fig. 1.

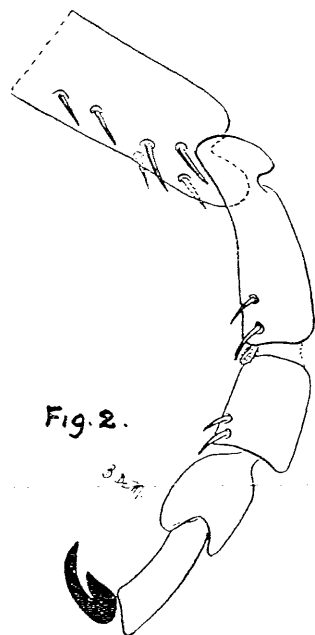


Fig. 2.

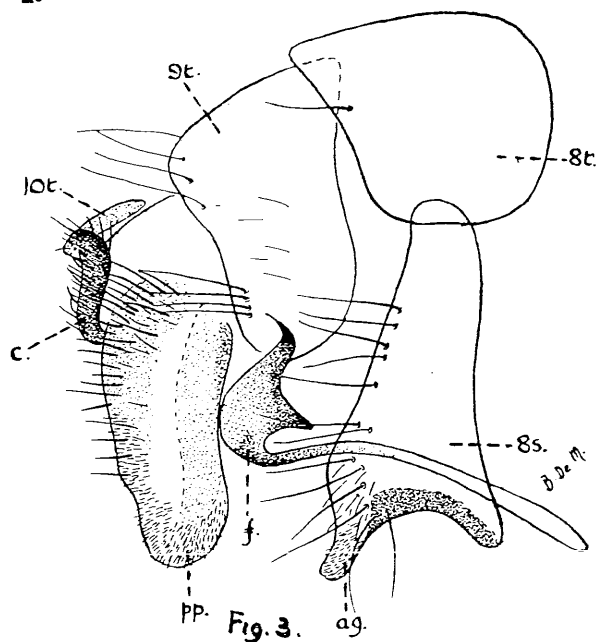


Fig. 3.

PLATE 2.

Simulium debegene sp. nov.

Figure 4.—Ventral view of the 8th sternite and furca of the female.

Figure 5.—Ventral view of the male hypopygium.

- c.* Clasper.
- sp.* Sidepiece.
- p.* Paramere.
- l.* Lateral arm of the ventral plate.
- a.* Aedeagus.
- vp.* Ventral plate.
- ph.* Parameral hooks.

Figure 6.—Pupal filaments of the right side of the pupa.

vp

a--

PLATE 2.

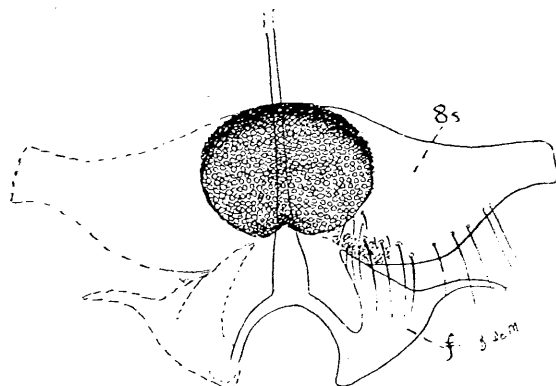


Fig. 4.

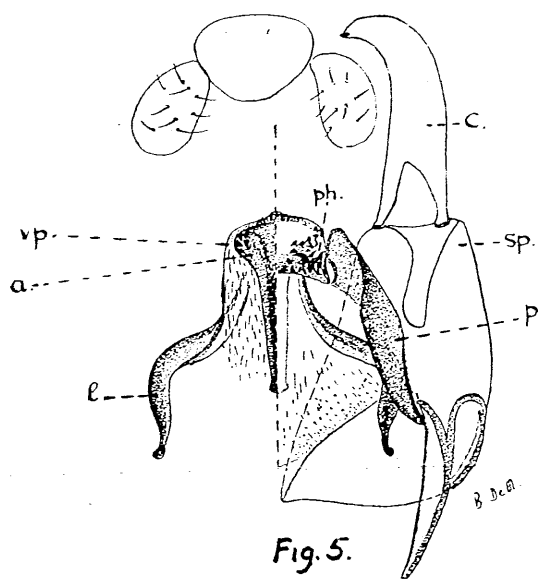


Fig. 5.

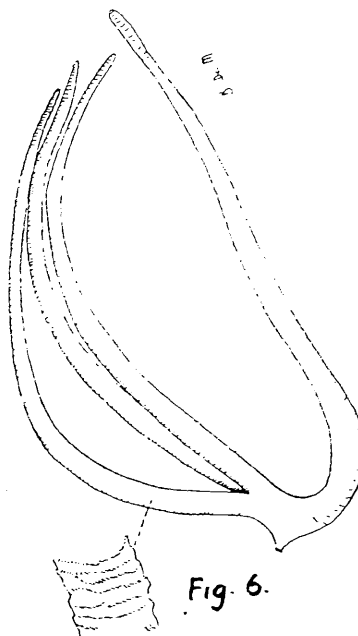


Fig. 6.

THE PUPA AND MALE HYPOPYGIUM OF
Simulium nigratarsis Coquillet, 1901.

Specimens identical with this insect, as re-described by the author,¹ were recently hatched from pupae obtained from the type locality. A comparison of the male hypopygium of one of these insects with a drawing (reproduced here) of a specimen in the British Museum revealed no differences. Several specimens were reared from isolated pupae and we have no hesitation in describing the following pupa and hypopygium as being that of *nigratarsis* Coq.

Pupa (Fig. 9).—Characterized by the long filaments of the respiratory organs. The longest filament exceeds the length of the cocoon. The filaments are, moreover, delicate and fragile and easily broken off at their apices. Each respiratory organ has four filaments which arise, more or less, as an anterior and posterior pair a little way up from the main base. The anterior pair consist of an inner long one and an outer short one, which is shorter than any of the other filaments. The posterior pair consists of an inner about as long as the inner anterior filament and an outer which is longer than any of the other filaments. The cuticle is not distinctly marked.

Male hypopygium (Fig. 7).—As stated above, the drawing shown here was made from a specimen in the British Museum. It remains to be stated that the sidepieces when viewed from the side are slightly expanded apically though not as much as in *diversipes* Edws. (Fig. 8). This last figure was also made from a specimen in the British Museum.

Locality.—A series of males, females and pupae from Fishhoek, Cape Province, January, 1934.

REFERENCE.

- (1) De Meillon, B.: On the Ethiopian Simuliidae. Bull. Ent. Res., 1930. xxi, 191.

PLATE 3.

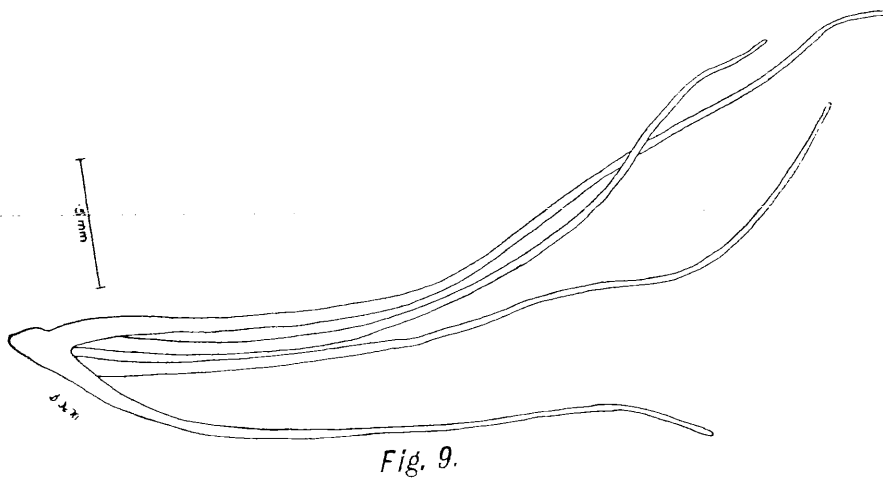
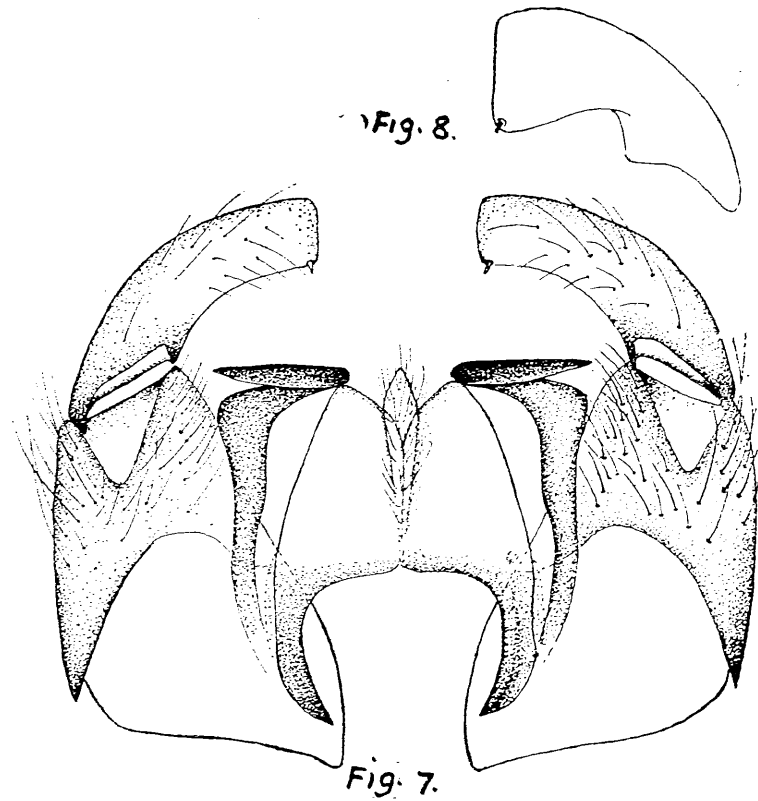
Simulium nigratarsis Coquillet.

Figure 7.—Male hypopygium.

Figure 9.—Respiratory organ of the right side of the pupa.

Simulium diversipes Edw.

Figure 8.—Clasper of the male hypopygium.



A NEW XENOPSYLLA FROM THE TRANSVAAL.

Xenopsylla phyllomæ sp. nov.

This flea belongs to the *X. cheopis* Subgroup, as defined by Jordan¹. It is closely allied to *cheopis* Rothsc., and *aequisetosus* Enderl. From the former it is easily distinguishable by the paramere (Figs. 1 and 2), the apical margin of which is slanting, as in *aequisetosus*. From this species it differs in having the ninth sternite as in *cheopis*, i.e., without the apex turned up.

MALE.

Head.—Rostrum does not reach to the apex of the forecoxa. Bristle in front of the eye only slightly longer than the eye itself. Eye well developed. Occipital groove shallow, outline regular. *Thorax*.—Metepimerum with ten bristles in two rows, an anterior row of six, and a posterior row of four. No bristle behind or above the spiracle. Hind tibia with six dorsal notches bearing stout bristles. Longest bristle on the second hind tarsus reaching to the middle of the fifth tarsus. *Abdomen*.—Sternites with bristles as follows. Only the bristles of one side are counted:—

Abd. seg. no.	...	...	2	3	4	5	6	7	8
No. bristles	...	...	1	3	3	4	4	4	18

The last stout bristle on sternite VIII is further from the apex of that segment than from the preceding bristle. Just beyond the last stout bristle is a very delicate one reminiscent of *X. eridos* Rothsc., but unlike that species it is very much further from the apex (Fig. 1). Antepygidial bristle marginal. Not mounted on a cone. *Modified Segments* (Fig. 2), Sternite IX with dorsal and ventral margins equally chitinized. The apex evenly rounded and not expanded. Paramere feebly chitinized with a dorsal pointed process and the apical margin slanting and very slightly concave. The process P¹ of the clasper nearly three times as long as broad; not expanded apically. The apex is more or less rounded and not truncate. On its outer surface this process bears seven bristles, of which one on the apical margin is the longest. P² of the clasper is slightly longer than P¹ and bears a few delicate hairs. The internal plate of the penis is pointed and slightly turned up at the apex. The spiral of the penis makes one complete turn. The ejaculatory duct bears no dorsal or ventral spines.

One male (type) from *Aethomys chrysophilus Tzaneenensis* (Jameson). Alldays, Zoutpansberg, Transvaal, December, 1933.—Coll. V. Walsh Type in the collection of the South African Institute for Medical Research, Johannesburg.

I am greatly indebted to Mr. Austen Roberts, of the Transvaal Museum, for the identification of the rodent.

REFERENCE.

- (1) Jordan, K.: On *Xenopsylla* and allied genera of siphonaptera, 1926. Verhandl. III. International Entomologen-Kongressen. 593-624.

PLATE *δ. 4*

Xenopsylla phyllomæ sp. nov.

Figure 1.—Terminal segments of the male.

Figure 2.—Portion of the modified segments of the male.

PLATE 5.

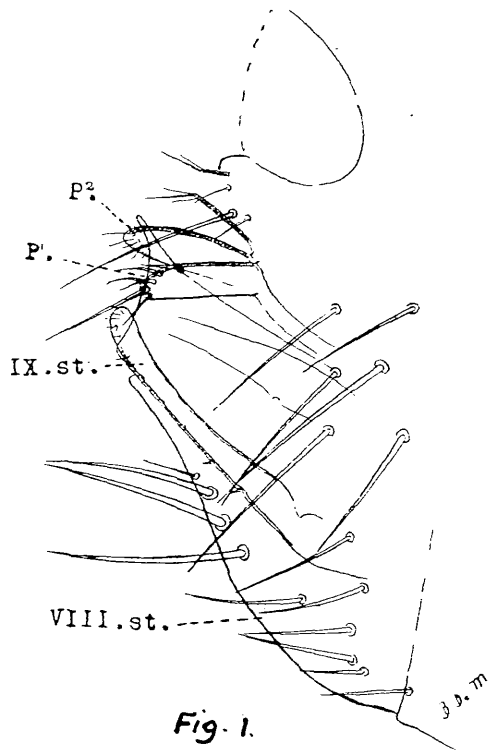


Fig. 1.

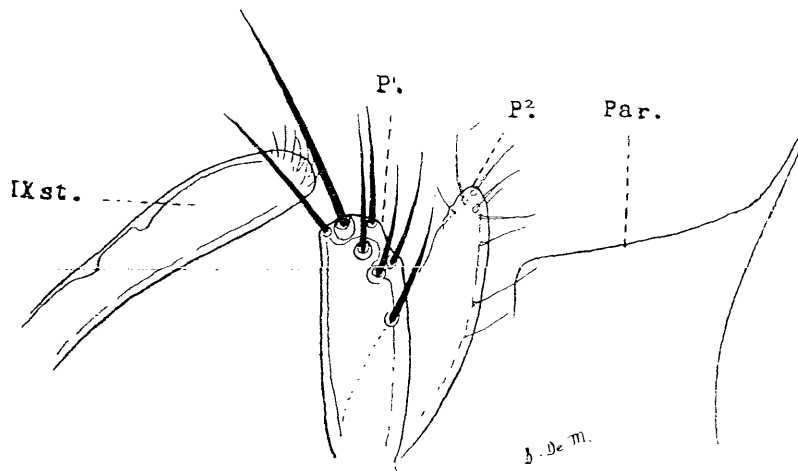


Fig. 2.

A NEW VARIETY OF *ANOPHELES NATALENSIS* Hill & Haydon**A. natalensis** var. **puselis** var. nov.

While examining the pupal pelts of *A. natalensis* one specimen was found which obviously differed from the normal. On referring to the adult, which had been bred out from this pelt, it was found that it too presented some striking differences from the normal type *natalensis*.

Adult Male.—Differs most obviously from the type form in the following manner (Fig. 1). *Legs*.—Basal third of the fourth hind tarsus, dark; basal half of the second hind tarsus, pale; apices of the first, second and third tarsi of the midlegs with very prominent pale bands. *Hypopygium*.—A slight difference has been detected here, namely, the delicate inner hair on the harpago of the type form is not present on that of the variety. It is quite possible, however, that if sufficient material is examined the type form itself will exhibit this variation.

Pupa.—Bristle C of the seventh abdominal segment is much branched instead of being simple. On the whole, this bristle is more branched on all segments than in the pupa of the type form.

Larva.—No difference could be detected between the associated larval pelt of this specimen and that of the type form.

Distribution.—Tzaneen, Northern Transvaal.

Type.—In the collection of the South African Institute for Medical Research, Johannesburg.

I am greatly indebted to Dr. Evans, of the Liverpool School of Tropical Medicine, for comparing this variety with closely related species. According to Dr. Evans, it resembles *A. multincinctus* Edw., from which it mainly differs in having only a third of the second hind tarsus dark instead of a half or more. Since the larva and pupa of *multincinctus* are unknown, it is quite possible that the two species are identical and further material may reveal that the extent of the dark banding on the second hind tarsus is variable.

Dr. Evans further informs me that the pharynx of *multincinctus* is inseparable from that of *natalensis*. It may well be, therefore, that the two species are identical, in which case *multincinctus* must be regarded as a variety of *natalensis*, probably closely related, if not identical, to var. *puselis* described here.

PLATE 45

Anopheles natalensis var. **puselis** var. nov.

- Figure 1.*—*a.* Portion of the foreleg.
b. Portion of the hind leg.
e. Harpagone.

Anopheles natalensis Hill & Haydon.

- Figure 1.*—*c.* Portion of the foreleg.
d. Portion of the hind leg.
f. Harpagone.

PLATE 4.

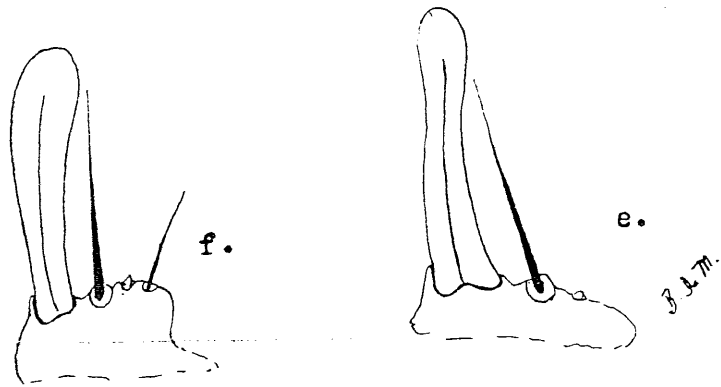


Fig. 1.

THE EGGS OF SOME SOUTH AFRICAN ANOPHELINES.

The eggs here figured have all been drawn to the same scale. They were obtained from adults that were isolated in test tubes and, with the exception of those of *A. gambiae*, several batches from different individuals were examined.

An important fact that has come to light is that the eggs of *A. funestus* and *A. funestus* subsp. *leesoni* are easily separable. This fact has enabled us to distinguish between the adult females caught in habitations or outdoors of these species, as it was found that fully developed eggs, dissected from the female, could be identified with certainty. Up to the present moment, we have taken it for granted that *A. funestus* subsp. *leesoni* is not a house-frequenter, because of the absence of males from dwellings. Now, however, we have a direct method of testing the part played by the subspecies in the epidemiology of malaria. Work on those lines is in progress but the numbers dissected up till now do not warrant any definite conclusions. There is also the problem of the *funestus*-like female found roosting out of doors. The above method will provide a ready means of ascertaining what percentage of such adults are *funestus* and what the subspecies.

Anopheles cinereus Theo.

Length, .6mm. ; greatest width, .14mm.

The author¹ has already shown that the larva of this species is closely allied to that of *A. turkhudi* Liston, according to the pleural hairs. It is now found that the eggs of these two species are also very similar.

The eggs have no floats in the ordinary sense of the word and hang attached to the surface film of the water, in a perpendicular attitude, by the micropilar area which is greatly enlarged. Viewed dorsally (Fig. 1), the micropilar area is seen to have a differentiated central area the micropile, the exact structure of which is difficult to make out. In certain lights, however, it appears that there is a delicate glistening membrane covering the micropile which suggests that it is filled with air and therefore acts as a float and so keeps the egg suspended from the surface of the water film. An enlarged lateral view of the egg (Fig. 2) appears to support the view that the micropile is covered by a thin membrane. On the dorsal third of the egg nearest the micropilar area, is an arrow, flat, white, glistening area demarcated from the general egg surface. This appears to be a frill and the enlarged lateral view of the egg bears this out, although Christophers and Stephens² regard it as representing the dorsal surface of other anopheline eggs. In certain lights the frill is seen to continue right up to and slightly beyond the micropile. Viewed dorsally (Fig. 3), the white glistening area appears to have a central darker zone which might well be the remains of the dorsal surface.

The general surface of the egg is seen to have a very fine network of polygonal markings and scattered and irregular patches of black pigment which is usually more intense on the basal third (Figs. 3 and 4).

Anopheles longipalpis Theo.

(Figs. 5 and 6.)

Length, .44mm. ; greatest width, .16mm.

Rather similar to the egg of *transvaalensis* but having a more extensive dorsal surface. The frill, too, appears more evident. The ventral surface is finely marked with black dots and there is much irregularly scattered black pigment present visible in certain lights.

Anopheles funestus Giles.

(Figs. 7 and 8.)

Length, .48mm. ; greatest width, .14mm.

The floats occupy more or less the middle two-thirds of the egg. They touch the dorsal margins of the ventral surface and each float has about sixteen corrugations.

The ventral surface is marked with very coarse black granular spots. There is a very narrow frill present, which does not extend on to that region of the dorsal surface which is in contact with the floats.

Anopheles marshalli Theo.

(Figs. 9 and 10.)

Length, .46mm. ; greatest width, .14mm.

The floats occupy more or less the middle two-thirds of the egg ; they do not quite touch the dorsal margin of the ventral surface, which is unbroken on the middle third of the egg. Several batches of eggs have been examined and on no occasion was the variation in the extent of the dorsal surface, as figured by Gibbons,³ noticed.

The stippling on the ventral surface is not nearly as coarse as in the egg of *funestus*.

The ventral surface, where broken, is edged by a narrow frill which, however, is more evident than in *funestus*.

Anopheles funestus subsp. *leasoni* Evans.

(Figs. 11 and 12.)

Length, .4mm. ; greatest width, .16mm.

The floats occupy about five-eighths of the length of the egg. They do not touch the dorsal margins of the ventral surface, there being some considerable space between the two. There are approximately twenty corrugations to each float.

The ventral surface is very finely stippled, much more so than in *marshalli* and *transvaalensis*. There is a prominent frill present which runs the whole length of the dorsal margin of the ventral surface. In some lights the ventral surface appears irregularly marked with patches of black pigment.

Anopheles demeilloni Evans.

(Figs. 13, 14 and 15.)

Length, .5mm. ; greatest width, .16mm.

Very similar in general appearance to the egg of *funestus*. The frill, however, is more evident and the dorsal surface appears to be slightly larger. The stippling of the egg-shell is much finer than in *funestus* and resembles *marshalli* in this respect.

Anopheles theileri Edwards.

(Figs. 16 and 17.)

Length, .43mm. ; greatest width, .18mm.

Very similar to the egg of *var. hancocki* described by Gibbons³ except that the floats are longer, having up to twenty corrugations, whereas in *hancocki* there are only thirteen to fifteen. Further, the ventral surface shows some presence of definite polygonal aggregations of pigment, the rest of the ventral surface exhibiting rather coarse, evenly distributed stippling.

Anopheles ardensis Theo.

(Figs. 18 and 19.)

Length, .5mm. ; greatest width, .25mm.

The floats occupy almost the whole length of the egg, each having twenty-three to twenty-six corrugations. The ventral surface is finely, and the dorsal coarsely, stippled. The dorsal surface is broad and the floats reach up to the edge. A rather prominent frill is present which runs the whole length of the egg.

Anopheles gambiae Giles.

(Figs. 20, 21 and 22.)

Length, .47mm. ; greatest width, .17mm.

The eggs of only two individuals were examined, one having been taken in November and the other in December. The extensive dorsal surface is characteristic of this egg. The frill is rather delicate ; it runs the whole length of the edge of the ventral surface. The frill with up to thirty cells occupies the centre half of the egg, and does not adjoin the dorsal surface. The ventral surface is finely stippled, the characteristic pattern described by Gibbons being absent in one batch and present in the other. The dorsal surface is more strongly and coarsely pigmented.

Anopheles pretoriensis Theo.

(Figs. 23 and 24.)

Length, .44mm. ; greatest width, .16mm.

Differs from eggs of other South African anophelines except *rufipes* in that the floats are joined dorsally. The dorsal surface is therefore divided into three regions, the central one being completely surrounded by the floats. The anterior and the posterior portions of the dorsal surface are edged by a definite frill.

Anopheles rufipes Gough.

(Figs. 25 and 26.)

Length, .48mm. ; greatest width, .16mm.

Very similar to the egg of *pretoriensis* but differing in the following respects : 1, frill very narrow ; 2, dorsal surface marked with pale cross bands. Usually there is one band on the anterior and posterior regions, sometimes, however, there may be more than one band and the central portion of the dorsal surface may also be banded.

REFERENCES.

- (1) De Meillon, B. : Notes on the larvae of some South African *Anopheles*. Bull. Ent. Res., 1931, xxii, 237.
- (2) Christophers and Stephens : The classification of Indian *Anopheles* into natural groups. Reports of the Malaria Comm. Roy. Soc. 1902, 7th Series.
- (3) Gibbins, E. G. : Eggs of some Ethiopian *Anopheles*. Bull. Ent. Res. 1903, xxiv, 261.

PLATE 6.

Anopheles cinereus Theo.

Figure 1.—Dorsal view of the micropilar area.

Figure 2.—Enlarged lateral view of the apex of the egg.

Figure 3.—Dorsal view of the egg.

Figure 4.—Side view of the egg, showing reticulation near the apex only.



FIG. 1.

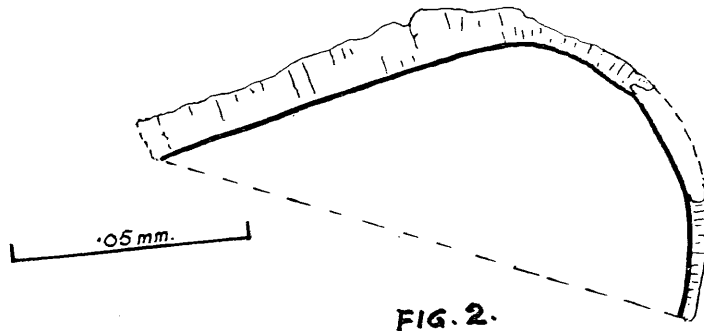
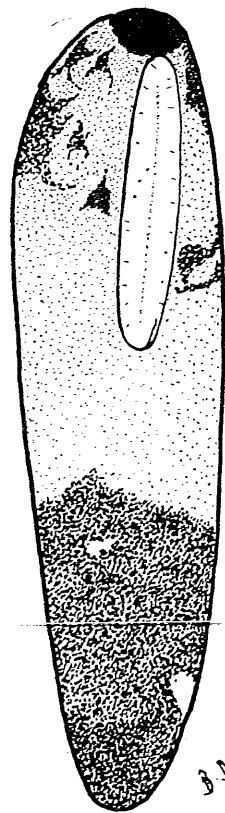


FIG. 2.



B. de M.

FIG. 3.

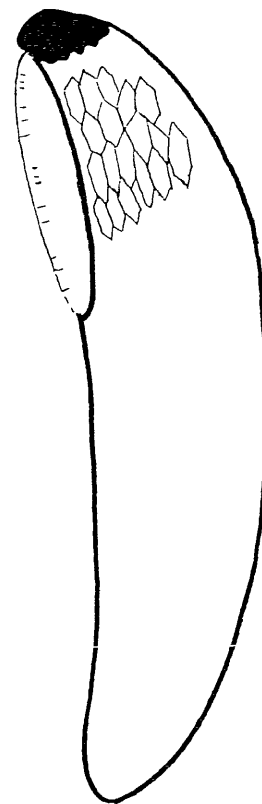


FIG. 4.

PLATE 7.

Anopheles longipalpis Theo.

Figure 5.—Dorsal view of the egg.

Figure 6.—Side view of the egg.

Anopheles funestus Giles.

Figure 7.—Dorsal view of the egg.

Figure 8.—Side view of the egg.

PLATE 7.

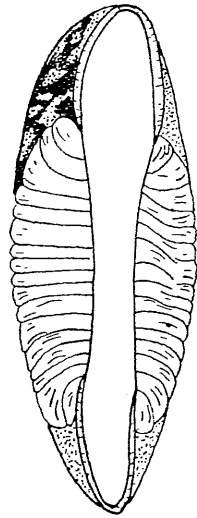


FIG. 5.

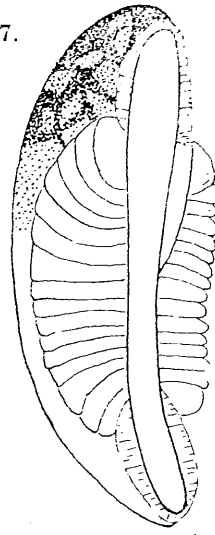


FIG. 6.

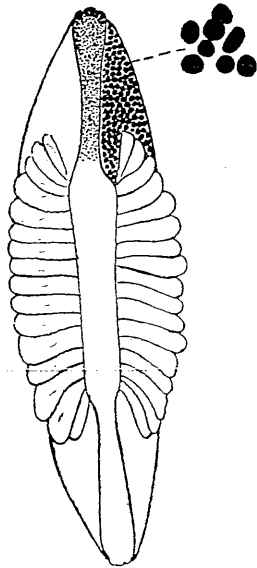


FIG. 7.

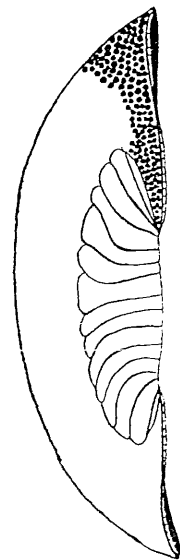


FIG. 8

PLATE 8.

Anopheles marshalli Theo.

Figure 9.—Dorsal view of the egg.

Figure 10.—Side view of the egg.

Anopheles funestus subsp. **leesoni** Evans.

Figure 11.—Dorsal view of the egg.

Figure 12.—Side view of the egg.

PLATE 8.

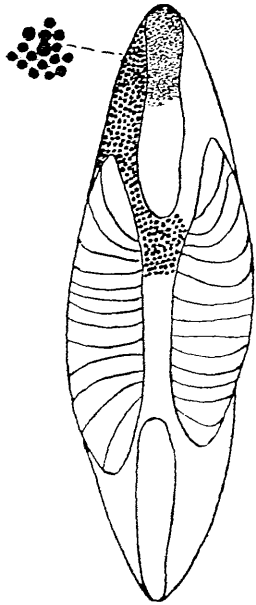


FIG. 9.

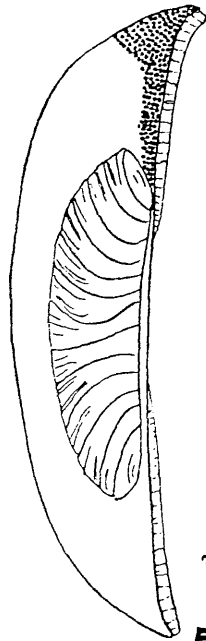


FIG. 10.

J. De M.

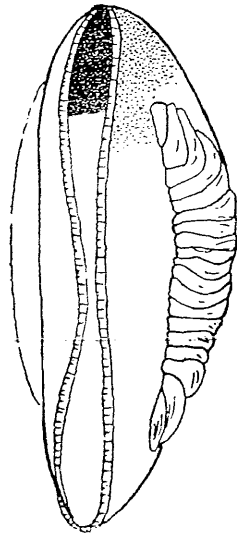


FIG. 11.

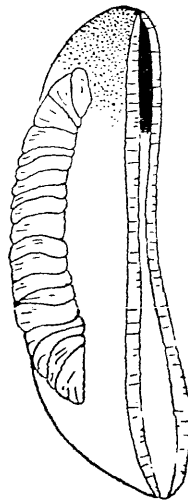


FIG. 12.

J. De M.

PLATE 9.

Anopheles demeilloni Evans.

Figure 10.—Dorsal view of the egg.

Figure 14.—Side view of the egg.

Figure 15.—Dorsal view of the egg, showing variation.

Anopheles theileri Edw.

Figure 16.—Dorsal view of the egg.

Figure 17.—Ventral view of the egg.

PLATE 9.

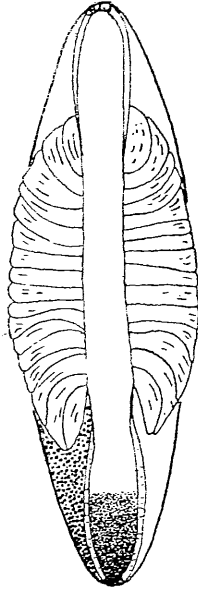


FIG. 13.

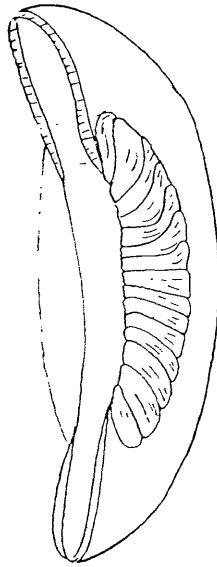


FIG. 14.

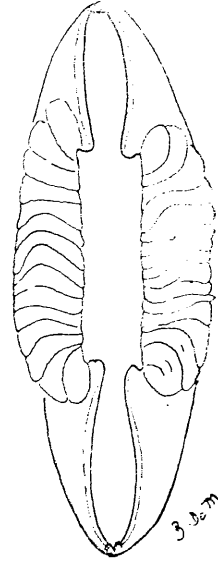


FIG. 15.

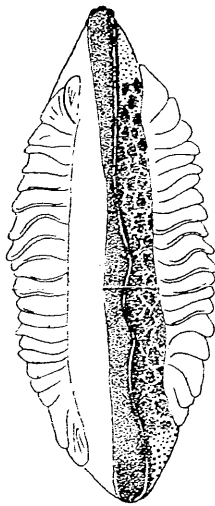


FIG. 16.

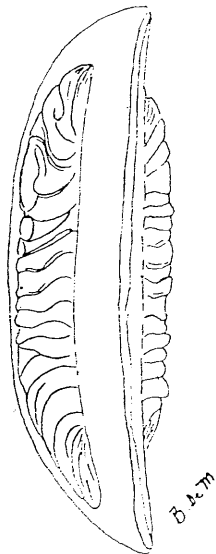


FIG. 17.

PLATE 10.

Anopheles ardensis Theo.

Figure 18.—Dorsal view of the egg.

Figure 19.—Ventral view of the egg.

Anopheles gambiae Giles.

Figure 20.—Dorsal view of the egg.

Figure 21.—Side view of the egg.

Figure 22.—Side view of the egg. The polygonal markings which were present in one batch are not shown here.

PLATE 10.

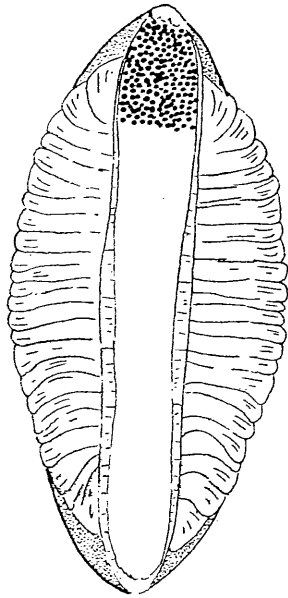


FIG. 18

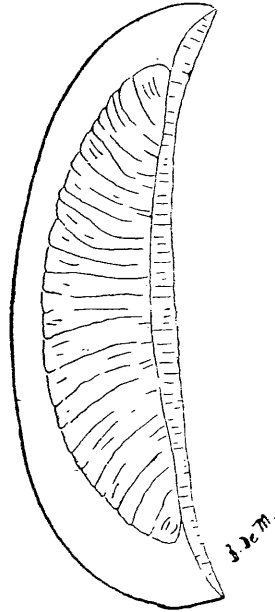


FIG. 19.

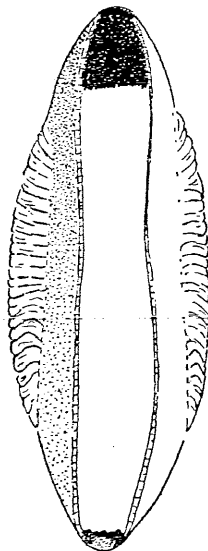


FIG. 20

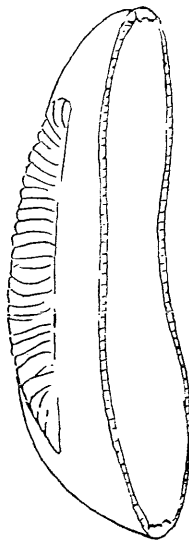


FIG. 21.

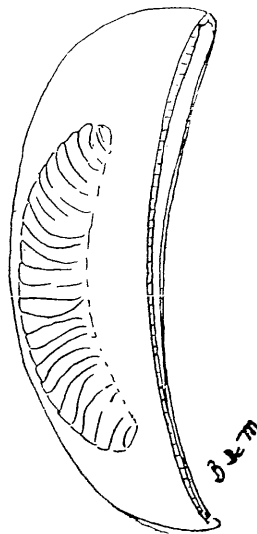


FIG. 22

PLATE II.

Anopheles pretoriensis Theo.

Figure 23.—Dorsal view of the egg.

Figure 24.—Side view of the egg.

Anopheles rufipes Gough.

Figure 25.—Dorsal view of the egg.

Figure 26.—Side view of the egg.

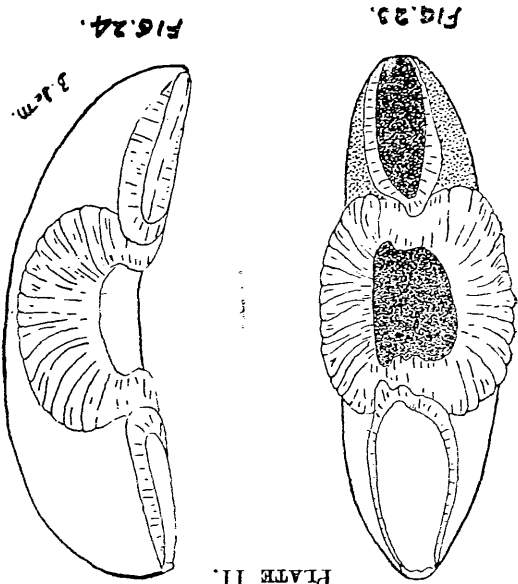
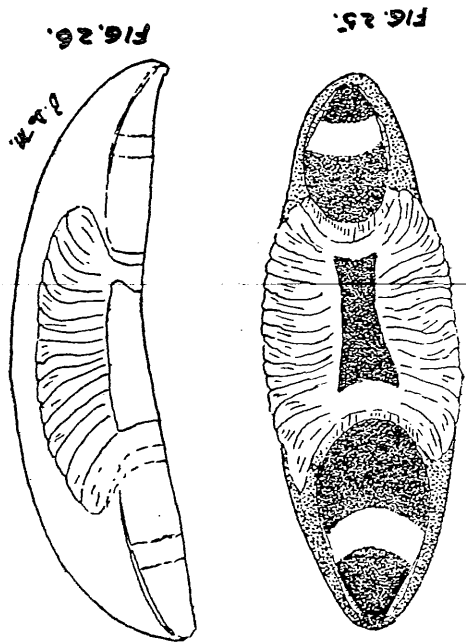


PLATE II.

B. DE MEILLON

THE PUPAE OF SOME SOUTH AFRICAN ANOPHELINES
HITHERTO UNDESCRIBED.

The terminology here employed is that initiated by Macfie¹ and since developed and modified by Senevet² and Evans.³

The pupa of *A. natalensis* H. & H. was partly described by Ingram and De Meillon.⁴ Here we give a full description of both ventral and dorsal surfaces.

It is interesting to note that the pupa of *A. cinereus* Theo. is very closely allied to those of the *turkhudi* group as recently defined by Edwards.⁵

A. cinereus Theo.

DORSAL SURFACE (Fig. 1).

Metathorax.—O., long, bifurcate near apex; strongest and longest of the three metathoracic hairs; P., much smaller, bifurcate; R., as O., slightly more delicate and shorter.

1st Segment.—H., simple; K., as long, six branches; L., as long, much branched, brush-like; M., longer than H., tri- or bifurcate; S., shorter than M., much branched; T., longest of first segment hairs, four to six branches; U., as S., two to three branches.

2nd Segment.—A., small, weakly chitinized, baton-like; C., six to eight branches; I., much branched; I', three-branched; II., three branched; II', three branched; III., long, strong, bifurcate or simple; IV., three branched; V., very small, simple.

3rd Segment.—A., slightly larger, not pointed; B., four to five branched; C., larger, three to four branched, not quite as long as segment 4, about as big as B.; I., seven branched, delicate; II., much smaller, four branched, brush-like; III., long, strong, bifurcate; IV., four branched, delicate as I.; V., very small as II., but simple.

4th Segment.—A., much larger, about half as long as the segment, sharp pointed; B., five branched, about as long as the segment; C., simple or bifurcate or trifurcate, about as long as the segment, strong; I., five branched; II., three branched; III., four branched, more delicate and smaller than on the third segment; IV., two to three branched; V., very small, simple.

5th Segment.—A., about half as long as segment; B., four to five branched; C., simple or split, longer than segment, strong, longer bifurcate; I., three-branched; II., delicate, four branched, brush-like; III., small, bifurcate; IV., three branched; V., very small, delicate, simple.

6th Segment.—A., more than half as long as segment; B., two to four stout branches, about as long as segment; C., delicate, simple or trifurcate, longer than segment, strong; I., three branched; II., delicate, three branched; III., absent; IV., long and three branched; V., very small, simple.

7th Segment.—A., more than half as long as segment; B., two to five branched, about as long as segment; C., single, longer than segment, strong. On this segment this bristle reaches its maximum length. I., delicate, simple or bifurcate; II., simple or bifurcate; III., branched; IV., three to four branched; very small, simple.

8th Segment.—A., about a quarter or less length of paddle, end split, two to five lateral branches on each side. Accessory hair delicate, smaller than A., bifurcate.

Paddles (Fig. 2).—Index 1.5. External border dentate, apical border indented with delicate unchitinized hairs as far as the terminal hair, internal border bare. Terminal spine, en crochet (Senevet) long; may be straight. Accessory hair, small, delicate, bifurcate.

VENTRAL SURFACE (Fig. 3).

2nd Segment.— β , bifurcate, small, delicate. No trace of other hairs.

3rd Segment.—*a*, small, end much branched; β , longer, simple; ϵ , longer, simple or branched; γ , as β .

4th Segment.—*a*, β , ϵ , γ , as in third segment.

5th Segment.—*a*, with less branches; ϵ , simple or split; other hairs as above; no trace of δ .

6th Segment.—*a*, with end split or simple; β , apparently absent; δ , apparently absent; ϵ , simple or bifurcate; γ , simple.

7th Segment.—*a*, two to four branched; β , apparently absent; δ , longer, split or simple; ϵ , simple or bifurcate; γ , end split into three.

Up to fifth segment, ϵ most prominent, on sixth and seventh, especially the latter, δ most prominent.

A. natalensis Hill & Haydon.

DORSAL SURFACE (Fig. 4).

Metathorax.—O., long, simple; P., smaller, end split; R., longest of three, four to six branched.

1st Segment.—H., delicate and simple; R., long, slender branched; L., short branched; M., long, four branched; S., short branched; T., very long, simple; U., small, simple.

2nd Segment.—A., minute, baton-like; C., six branched, almost as long as segment; I., long, slender, simple; I', shorter, five branched; II., six branched; II', smaller, three branched; III., long, strong, simple; IV., long, six branched but delicate; V., very small, simple.

3rd Segment.—A., small, baton-like; B., six to ten branched, about half the length of the segment; C., four to five branched, about as long as the segment; L., long, slender, simple; II., delicate, simple, small; III., long, stronger, simple; IV., six to seven branched; V., very small, simple.

4th Segment.—A., about quarter-length of segment; B., five to six branched; C., five to six branched, nearly as long as segment; I., long, slender, simple; II., small, end branched; III., much smaller than on preceding segments; IV., smaller than on preceding segments, four to five branched; V., very small, simple.

5th Segment.—A., about quarter-length of segment; B., six to seven branches; C., three to four branches, about as long as segment or slightly shorter; I., long, slender, simple; II., delicate, bifurcate or simple; III., small, end split; IV., small, branched; V., very small, simple.

6th Segment.—A., about quarter-length of segment; B., five to six branches; C., bifurcate or simple, about as long as or slightly shorter than segment; C', delicate, split at end or simple; I., long, slender, simple; II., delicate, simple; III., absent; IV., delicate, four branched; V., very small, simple.

7th Segment.—A., nearly half-length of segment; B., five branched; C., simple, nearly as long as segment; I., small, delicate, simple; II., small, delicate, simple; III., small, end branched; IV., small, end branched; V., small, simple.

8th Segment.—A., with about eight lateral branches. Accessory hair small, delicate, end branched.

Paddles.—Index 1.7; terminal hair straight or with very end hooked. Accessory hair small, delicate, simple. Two-thirds of the external, the whole apical and about half the internal borders of the paddle with delicate fringe of unchitinized hairs.

VENTRAL SURFACE (Fig. 5).

3rd Segment.— α , small, end branched; β , small, simple; ϵ , slender, simple; γ , slightly longer, simple.

4th Segment.—As above, but somewhat longer.

5th Segment.—As in 4th Segment. No trace of D.

6th Segment.—As in 5th Segment. No trace of D.

7th Segment.—As in 6th Segment, but α longer, end may be split.

No trace of D, although it is difficult to say whether the hair here given as γ is not really D and that it is the former that has disappeared.

The dorsal and ventral surfaces of the abdomen are evenly adorned with a scallop-like sculpturing. These scallops are directed towards the paddles of the pupa and at the apex of each are situated one or two or three microtrichae (Fig. 6).

A. ardensis Theo.

DORSAL SURFACE (Fig. 7).

Metathorax.—O., small, end branched; P., small, single; R., largest of the three hairs, four to five branches.

1st Segment.—H., small, delicate, simple; K., as H., but branched; L., as K., but smaller; M., larger, but still delicate, four to five branched; S., about as long as M., branched; T., smaller, simple; U., smaller than T., simple.

2nd Segment.—A., a minute unchitinized spine; C., shorter than the segment, ten to twelve branches; I., short, end branched; I', slightly longer, simple; II., small, four branches; II', about as long as II, branched or bifid; III., long, strong, simple; IV., large, but shorter than III., with four to six branches; V., minute, simple.

3rd Segment.—A., larger than in foregoing segment, unchitinized; B., smaller than segment, ten to twelve branches; C., as B., but with less branches; I., long, delicate, bifurcate; II., small, end branched; III., long, strong, simple; IV., smaller, with seven to nine branches; V., minute, simple.

4th Segment.—A., much longer, end curved; B., as in foregoing segment, with less lateral branches; C., as in foregoing segment; I., small, bifid; II., small, end branched; III., larger, seven to eight branches; IV., smaller, three to five branches; V., minute, simple.

5th Segment.—A., nearly half as long as segment, end curved ; B., as in foregoing segment, main branch stronger, lateral branches more delicate ; C., as in foregoing segment ; I., small, bifid ; II., small, simple ; III., slightly longer, simple ; IV., small, four branches ; V., minute, simple.

6th Segment.—A., as in foregoing segment, in some specimens actually shorter, end curved ; B., as in foregoing segment ; C., main stem stronger than in foregoing segment, lateral branches more delicate ; C', about half length of C., delicate end trifurcate ; I., almost as long as A., delicate, simple or bifid ; II., as long as I., end trifurcate ; III., absent ; IV., small, branched ; V., minute, simple.

7th Segment.—A., nearly half as long as segment ; B., as in foregoing segment, lateral branches more reduced ; C., as in foregoing, lateral branches more reduced, may be quite simple ; I., long, simple or bifid ; II., long, end trifurcate ; III., shorter, end bifurcate ; IV., six to eight branches ; V., minute, simple.

N.B.—In one specimen, C. was quite simple on Segments 5, 6 and 7.

8th Segment.—A., with ten to twelve lateral branches ; accessory hair delicate, end branched.

Paddles.—Index 1.7 ; terminal hair straight or end curved ; accessory hair about half as long, much more delicate and branched ; two-thirds of the external, the apical and about half internal borders with a delicate fringe of unchitinized hairs.

VENTRAL SURFACE (Fig. 8).

3rd Segment.— α , small, single or split ; β ., small, single or split ; ϵ ., longer, simple ; γ ., small, simple.

4th Segment.—As in the foregoing segment.

5th Segment.—As in Segment 4 : all hairs, however, simple or split ; no sign of D.

6th Segment.—As in foregoing segment, E bifurcate.

7th Segment.—As in foregoing segment.

The ventral and dorsal surfaces of the abdomen are sculptured as in *A. natalensis* (see Fig. 6).

Anopheles listeri De Meillon.

DORSAL SURFACE (Fig. 9).

Metathorax.—O., moderately strong, bifid; P., weaker, bifid; R., longer, delicate, simple or split at end.

1st Segment.—H., small, simple; K., small, branched; L., small, branched; M., larger, bifid or trifurcate; S., much smaller, branched; T., very long, delicate, simple; U., very long, as T., simple.

2nd Segment.—A., small, unchitinized, baton-like; C., with eight to ten branches, delicate; I., very long, simple; I', much smaller, end branched; II., small, branched; II', smaller, branched; III., stronger than others, end trifurcate; IV., with five to six branches; V., (?).

3rd Segment.—A., as in preceding segment; B., delicate, five to six branches; C., as B.; I., smaller than in preceding segment, branched; II., small, branched; III., as in preceding segment, but simple or with delicate lateral branch; IV., as in preceding segment; V., minute, simple.

4th Segment.—A., only slightly larger than in preceding segment; B., larger, five to six branches; C., longer than segment, simple; I., as in preceding segment; II., small, branched; III., slightly longer, four to five branches; IV., large, four to five branches; V., minute, simple.

5th Segment.—A., much larger than on preceding segment; B., as in preceding segment, slightly larger and averaging less branches; C., longer than segment, simple; I., long, bifid; II., small, branched; III., longer, trifurcate; IV., as in preceding segment; V., slightly larger than in preceding segment, very delicate, simple.

6th Segment.—A., about half or more length of segment; B., as in preceding segment; C., longer than segment, simple; C', delicate, simple; I., long, bifid or trifurcate; II., long, delicate, simple; III., absent (?); IV., as in preceding segment; V., as in preceding segment.

7th Segment.—A., more than half the length of the segment; B., as long, or longer than segment, simple, or with one or two lateral branches; C., longer than segment, simple; I., long, bifid or trifurcate; II., long, simple; III., long, simple; IV., as in preceding segment; V., as in preceding segment.

8th Segment.—A., with three to five lateral branches; accessory hair; delicate, simple.

Paddles.—Index 1.2; terminal hair straight or en crochet. Accessory hair small, delicate, bifid. External border, to near apical border, with short chitinized spines, rest of the external and the apical border as far as the terminal hair with delicate unchitinized hairs.

VENTRAL SURFACE (Fig. 10.)

- 3rd Segment*.— α ., small, end branched; β ., longer, end bifid; E., longer, end with three branches; γ ., about as long, simple.
- 4th Segment*.— α ., as in preceding segment; β ., as in preceding segment; E., much longer, about half length of segment, simple; γ ., as in preceding segment.
- 5th Segment*.— α ., much longer than hitherto, end split; β ., as in preceding segment; E., as in preceding segment; D., absent; γ ., as in preceding segment.
- 6th Segment*.— α ., long, simple; β ., as in preceding segment; D., absent (?); E., small, simple; γ ., as in preceding segment.
- 7th Segment*.— α ., long, simple or end split; β ., absent (?); E., small, simple; D., very long, about as long as segment, simple.

A. squamosus var. **cydippis** De Meillon.

DORSAL SURFACE (Fig. 11).

- Metathorax*.—O., simple; P., slightly shorter, simple; R., longer, bifid.
- 1st Segment*.—H., small, end bifid; K., as long, two to three branches; L., small, bifid; M., longer, split; S., about as long, three branches; T., very long, simple; U., shorter, simple.
- 2nd Segment*.—A., small, baton-like, unchitinized; C., four to five branches; I., long, simple; I', shorter, with three branches; II., much smaller, bifurcate; II', still smaller, bifid; III., longer, simple; IV., six to seven branches; V., ?.
- 3rd Segment*.—A., only slightly longer than on preceding segment; B., about half length of segment, three to four branches; C., slightly longer, four to five branches; I., shorter than on preceding segment, end split; II., as on preceding segment; III., as on preceding segment; IV., as on preceding segment, three to five branches; V., minute, simple, hair.
- 4th Segment*.—A., only slightly longer than on preceding segment; B., as in preceding segment; C., as in preceding segment; I., as in preceding segment, simple; II., as in preceding segment; III., with four to five branches; IV., as in preceding segment; V., as in preceding segment.

5th Segment.—A., much longer than hitherto ; B. and C., as before, but on the whole showing less branches, in one specimen they were both bifid ; I., long, simple ; II., long, bifid ; long, simple or split near end ; IV., with three branches ; V., minute, simple.

6th Segment.—A., slightly longer than before ; B., as in preceding segment ; C., simple, not as long as segment ; C', delicate, simple ; I., long, simple ; II., simple ; III., ? ; IV. and V., as before.

7th Segment.—A., as before, or slightly longer, about quarter length of the segment ; B., as before ; C., as before, slightly longer, sometimes long as the segment ; I., shorter than in preceding segment ; II., as before ; III., delicate, simple ; IV. and V., as in preceding segment.

8th Segment.—A., three to five lateral branches ; accessory hair, delicate, simple.

Paddles.—Index 1.5 ; outer border bearing chitinized spines, the apical border with unchitinized hairs as far as the terminal hair. Terminal hair straight or curved. Accessory hair, delicate, simple or split.

VENTRAL SURFACE (Fig. 12).

3rd Segment.— α ., delicate, bifid ; β ., delicate, simple ; E., longer simple ; γ ., simple.

4th Segment.— α ., sometimes simple ; β ., E. and γ ., as in third segment. In one specimen there was an extra delicate split hair between α and β , shown in the drawing as α' . This hair was present on both sides.

5th Segment.— α ., β ., E. and γ ., as in preceding segment, though somewhat longer. No sign of D.

6th Segment.— α ., β ., E. and γ ., as in preceding segment. No sign of D.

7th Segment.— α ., longer than hitherto, simple or split ; β ., apparently absent ; E., very long, strong, simple ; D., delicate, simple ; γ ., small, branched.

This pupa differs mainly from that of *squamosus* in that the setae B. and C. are on the whole more branched. In *squamosus* it is quite common to have C. simple on Segments 5, 6 and 7, as shown by Senevet⁶. Further, the spines on the outer border of the paddle in this species are much smaller than in *squamosus*, as shown in Figures 13 and 14 which are drawn to the same scale.

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PLATE 12.

Anopheles cinereus Theobald.

Figure 1.—Dorsal view of one-half of the pupa.

Figure 2.—Enlarged view of the outer apical angle of the paddle.

Figure 3.—Ventral view of one-half of the pupa.

PLATE 12.

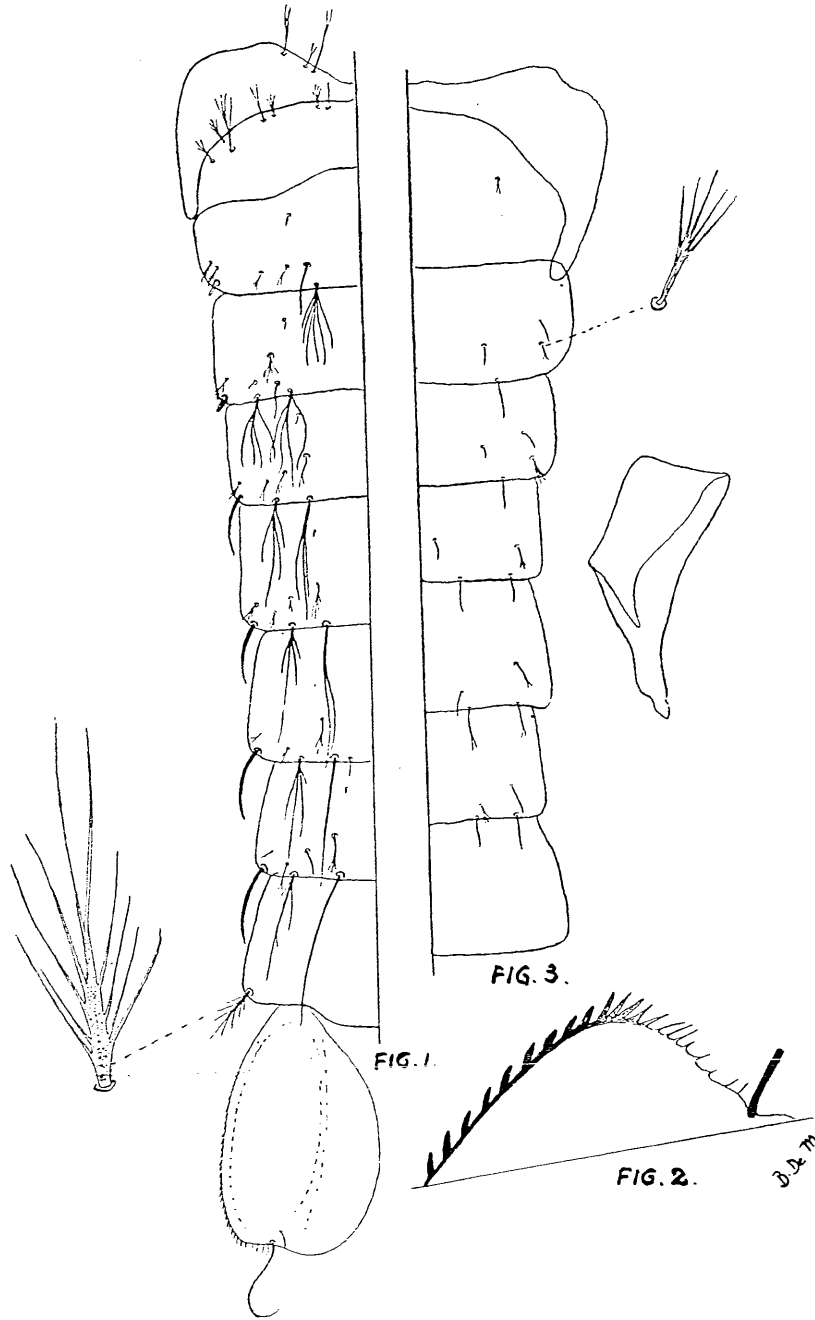


PLATE 13.

Anopheles natalensis Hill & Haydon.

Figure 4.—Dorsal view of one-half of the pupa.

Figure 5.—Ventral view of one-half of the pupa.

Figure 6.—Showing the scallop-like sculpturing on the dorsal surface of the abdomen.

PLATE 13.

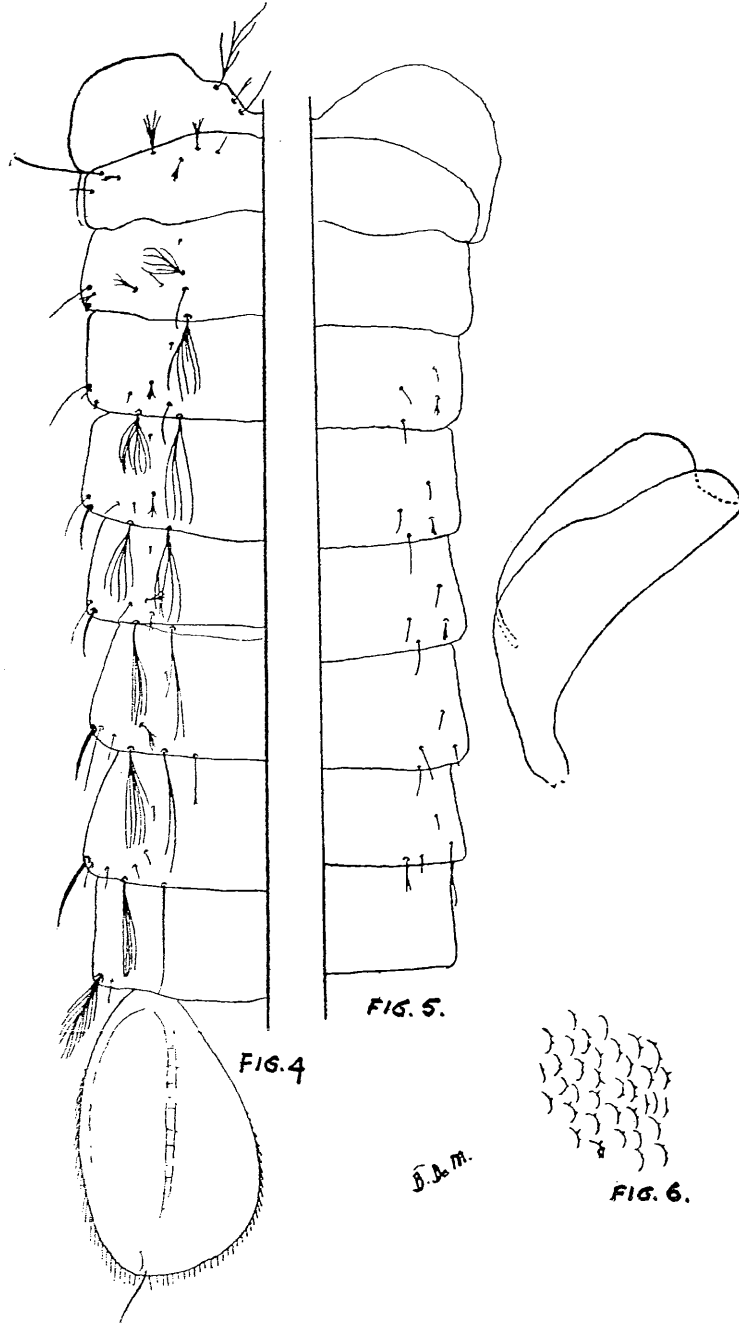


PLATE 14.

Anopheles ardensis Theobald.

Figure 7.—Dorsal view of one-half of the pupa.

Figure 8.—Ventral view of one-half of the pupa.

PLATE 14.

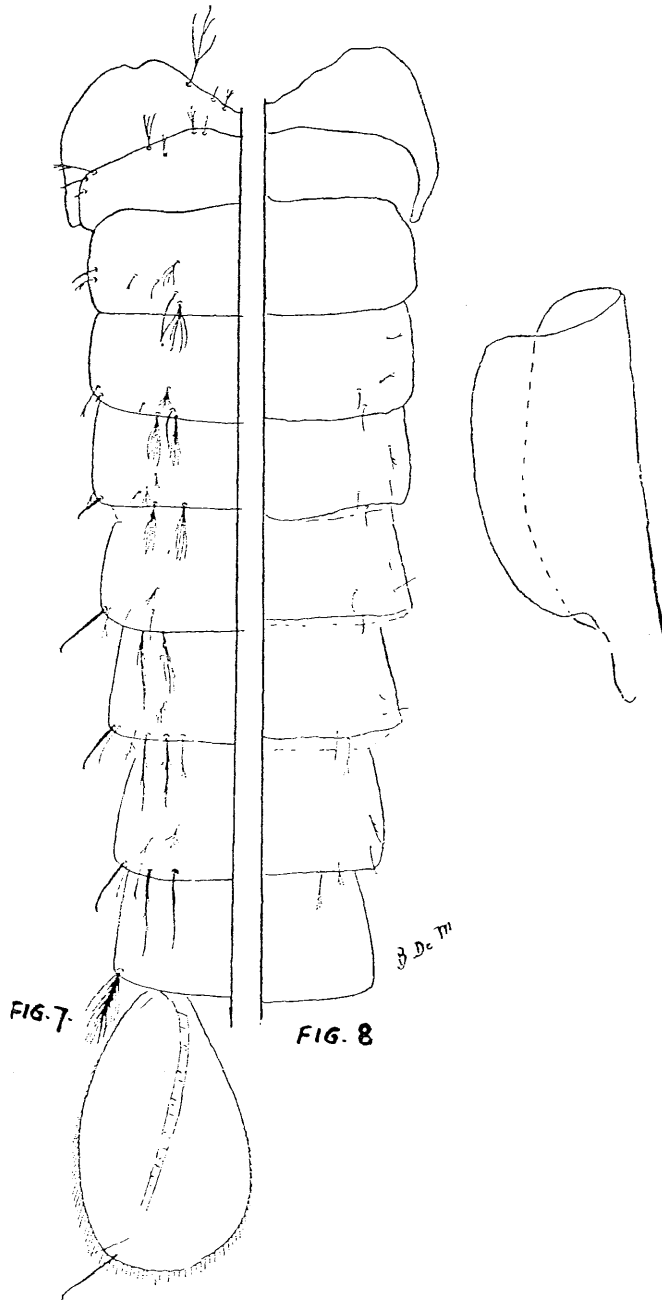


PLATE 15.

Anopheles listeri De Meillon.

Figure 9.—Dorsal view of one-half of the pupa.

Figure 10.—Ventral view of one-half of the pupa.

PLATE 15.

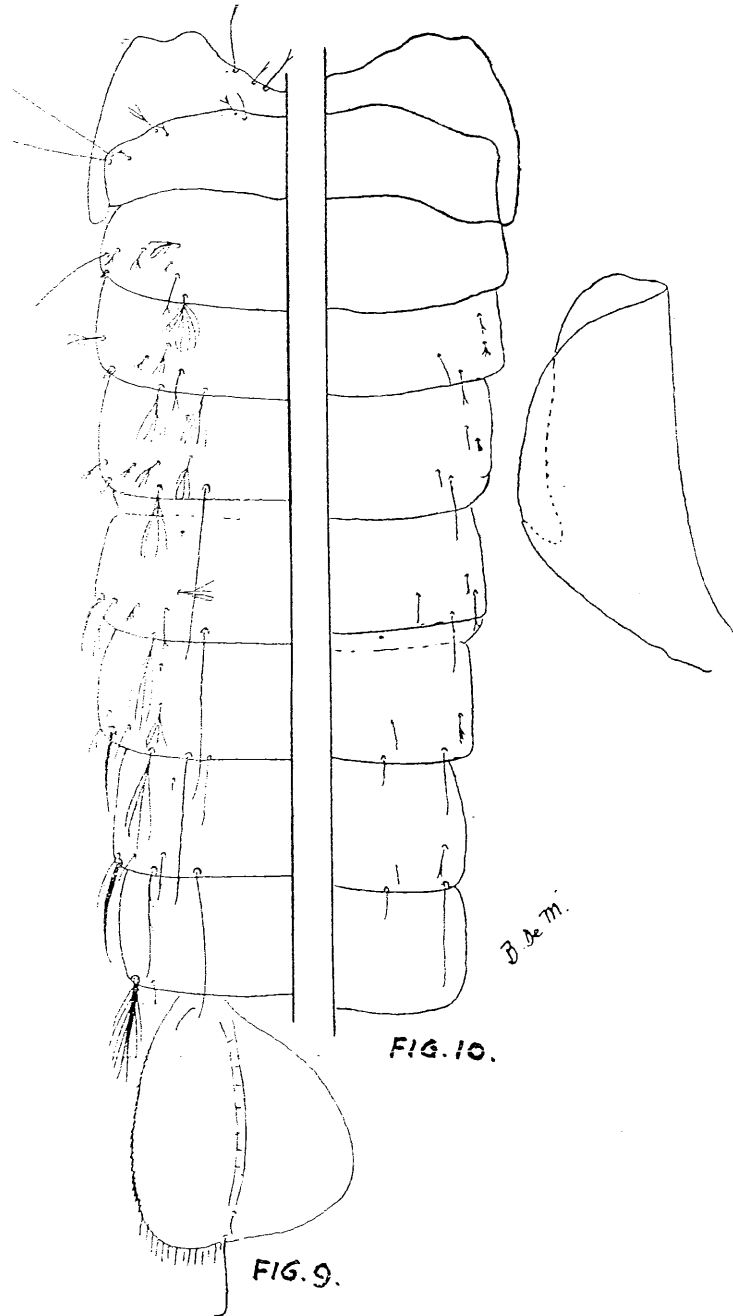


PLATE 16.

Anopheles squamosus var. **cydippis** De Meillon.

Figure 11.—Dorsal view of one-half of the pupa.

Figure 12.—Ventral view of one-half of the pupa.

Figure 13.—Enlarged view of a portion of the outer apical angle of the paddle.

Anopheles squamosus Theo.

Figure 14.—Portion of the outer apical angle of the pupa enlarged to the same extent as Figure 13.

PLATE 16.

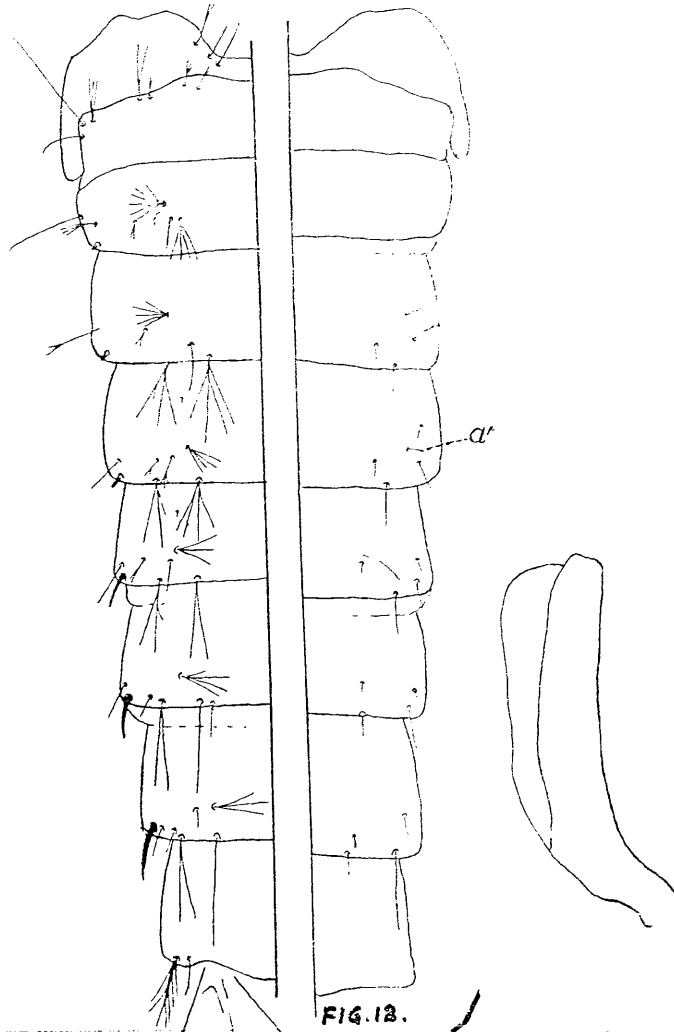


FIG. 12.

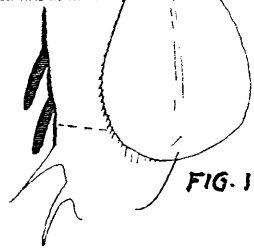


FIG. 11.

FIG. 13

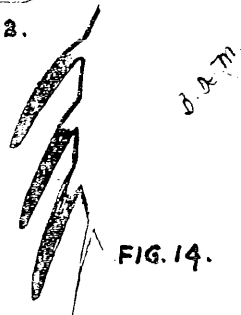


FIG. 14.