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Notes on African Anophelines

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NOTES ON AFRICAN ANOPHELINES

BY

A. M. EVANS

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I. FURTHER NOTES ON THE MARSHALLI GROUP OF ANOPHELES

In a previous paper (Evans, 1929) the larva of *A. marshalli* var. *moucheti* and pupa of this form and also of the varieties *hargreavesi* and *freetownensis* were described, as well as the male hypopygium of *moucheti* and *freetownensis*. More recently, Dr. Barber and Mr. Olinger, of the West African Yellow Fever Commission of the Rockefeller Foundation, have obtained all the stages, including the eggs, of *hargreavesi* and also of a form of *moucheti* differing from the type chiefly in a larval character. From a study of this most interesting material, it appears that at least two of these forms, namely *A. moucheti* and *A. hargreavesi*, should be regarded as distinct species. This conclusion is further strengthened by an examination of a series of *hargreavesi*, including three males, received from Dr. H. P. Fowler, at Ibadan, Southern Nigeria, and a good series of *moucheti*, including larvae and pupae reared from eggs obtained by Mr. E. G. Gibbins, in Uganda. I have also been able, through the kindness of Dr. P. A. Buxton and Mr. H. S. Leeson, to examine the male hypopygium of the type form of *marshalli* from Southern Rhodesia. Other material dealt with in this paper is an interesting collection of specimens of the *marshalli* group made by Mr. Symes in several different localities in Kenya. Amongst this latter collection are a series of females and one male which are here described as a new variety of *marshalli*.

ANOPHELES MARSHALLI Theobald, type form

Male terminalia. Phallosome with about five leaflets on each side arranged as shown in fig. 2, B. Longest leaflets somewhat shorter and broader than those of *moucheti* but narrower, on the whole, than in

freetownensis. Parabasal spines of coxite (side-piece) five in number. Lobe at base of coxite with club less sharply dilated than in *hargreavesi* and with one accessory hair present, rather external to the apical bristle.

***ANOPHELES MARSHALLI* var. *KENIENSIS* n. var.**

This variety differs from the type form from Southern Rhodesia as follows:—

Wings without pale interruption in third dark spot on first longitudinal vein (R1). Outstanding scales of wings (fig. 1, B), considerably shorter and broader than in typical *marshalli* or var. *pitchfordi*. (It should be noted that, in examining these scales, due allowance must be made for the fact that the outstanding scales on the stems of the second and fourth veins appear much narrower than they really are, when turned over into an 'edge on' position, as frequently happens.) Mesonotal scales resembling those of *marshalli* on anterior half but, on posterior half, very narrow, almost hair-like, and scattered among numerous bristles.

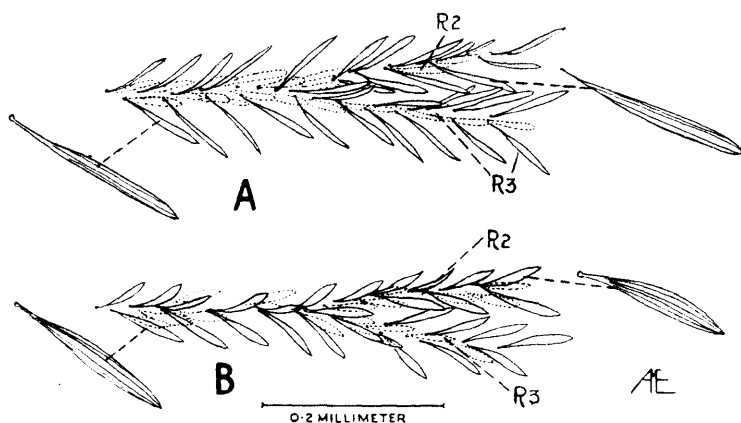


FIG. 1. Part of upper surface of stem and branches of second vein (R2 and R3). A.—*A. marshalli* Theo., type form; B.—*A. marshalli* var. *keniensis* n.var.

The variety also shows a great tendency to darkening of the wing veins, especially the second, fourth and sixth and basal three-fifths (approximately), of the costa, which is uninterruptedly dark in four of the nine specimens, and shows only incomplete interruptions in two others. The hind tarsi show a marked tendency to reduction of the pale rings which are usually very narrow and indistinct and

may be practically absent on all the segments or distinct on the first two segments only.

Male terminalia. The characters of the hypopygium of the one male of this variety examined are as follows:—parabasal spines five in number; lobes of coxites with an inner accessory bristle in addition to the usual outer one. Phallosome with five leaflets, the four shorter ones appearing somewhat narrower than in the specimens of typical *marshalli* examined; relative lengths of the leaflets rather different from the condition in *marshalli*, the two next in length to the longest leaflet being almost equal to each other and the next one approaching these in length (fig. 2, c). The character of the leaflets is markedly different from that of *freetownensis* (see Evans, 1929), which this variety approaches in certain external characters.

Kenya: Co-types 2 ♀♀, Jesereo, 17 January; 2 ♀♀, Simba, 20 January; 1 ♂, 20 January. Also 2 ♀♀ taken Simba, 20 and 31 January, and 2 other ♀♀.

All specimens taken in 1930, by Mr. C. B. Symes.

***ANOPHELES MARSHALLI* var. *PITCHFORDI* Giles**

Several females provisionally referred to this variety were collected in 1930, at Kakamega and Kiambu, in Kenya, by Mr. Symes. These specimens differ slightly from the type series of *pitchfordi* in possessing a patch of narrow whitish scales above the wing base which, in some of the specimens, extended forwards almost to the fossae. Mr. Edwards, who kindly examined the original series of *pitchfordi* agreed that in other respects the Kenya specimens resembled that variety.

***ANOPHELES HARGREAVESI* Evans**

Anopheles marshalli var. *hargreavesi* Evans, 1927 and 1929

As this form is morphologically distinct in the larval, pupal and male characters from the type form of *marshalli* and also from all allied forms, in which these characters are known, it is here considered to be a distinct species. In its most obvious external character, the broad scales extending to the posterior border of the mesonotum, it resembles *A. marshalli* var. *austeni*, the morphological characters

of which are undescribed. The latter form, however, differs from *hargreavesi* at least in the much wider banding of the front tarsi, which is basal as well as apical, in the possession of a well-marked patch of broad scales extending forward from the above wing root at the extreme sides of the mesonotum (Mr. Edwards kindly informed me of the presence of this character in the type of *austeni*), and also its much larger size. Mr. Edwards tells me that the wing of the type measures 3.9 mm., and the body, without proboscis, about 4.2 mm. In *A. hargreavesi* the corresponding measurements are *c.* 1.8 mm. to 3.0 mm. and *c.* 2.0 mm. to 3.3 mm.

Now that Dr. Barber's series of Southern Nigerian specimens and those of Dr. Fowler, both including males, have been examined, it is possible to give a more comprehensive description of the form than those hitherto published.

FEMALE. Palps normally with the broad apical bands separated by a dark band which is narrower than either pale band; sub-apical pale band, in some specimens, considerably shorter than apical and not appreciably longer than dark band. Wings with light and dark areas rather variable in extent. Costa with four main dark areas and usually with two pale interruptions of variable size on the basal third. Pale area proximal to third main dark area sometimes very small (about one-third of dark area); in other specimens larger (half or more than half the length of the dark area). Pale area beyond third dark area also variable, in some cases greater, in others less than the fourth main dark area. First vein with dark areas under the four main dark ones of the costa; third dark area interrupted by pale spot (sometimes very small) which is usually at about the middle of the area but in one wing of the type it is continuous with the proximal pale area. Second dark area with accessory sector spot present and, either continuous with proximal pale area, or separated from this by a dark spot. Second vein with either or both branches often extensively dark, stem with two dark areas of variable extent. Third vein pale with small apical and sub-basal dark spots (an additional one is occasionally present at the base). Fourth vein usually with two dark areas on upper branch and one on lower; stem mainly pale but with dark area before fork and usually one or two more proximally. Fifth vein usually mainly pale with two or three dark spots on upper

branch, one or two on lower branch and two on the stem, one of these often continuous with dark areas on the branches. Sixth vein usually with three dark spots. Fringe with pale spots at apices of third, branches of fourth and fifth and usually sixth veins.

Mesonotum clothed with mostly broad, greyish-white scales (index about 4 to 6, see Evans, 1927, fig. 8, A) some of which extend back to the scutellum; a large proportion often truncate.

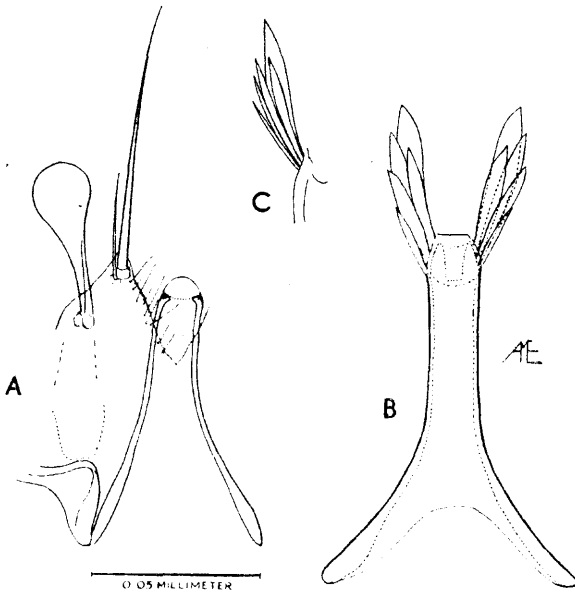


FIG. 2. ♂ terminalia. A.—*A. bargreavesi* Evans, phallosome and basal lobe of one coxite; B.—*A. marshalli* Theo., type form, phallosome; C.—*A. marshalli* var. *keniensis* n.var., tip of phallosome with leaflets of one side. All figs. to same scale.

Front tarsi with well-marked apical pale rings which are often moderately broad (length about one and a half times to twice the apical width of the segment) on first two segments; narrower on the third and often very minute on fourth. Mid tarsi usually with moderately broad apical rings. First four segments of hind tarsi with apical rings which are usually narrow, those on the first two segments normally about equal to the apical width of the segments.

Size. Wing length *c.* 1.8 mm. to 3.0 mm.

MALE. Club of palp with a large apical whitish patch, dorsally, on each segment and with a narrow pale ring at the base.

Terminalia (fig. 2, A). This differs from that of other members

of the *marshalli* group, in which the structure is known, in having the phallosome entirely without leaflets. The parabasal spines are normally five in number, but in one specimen a supernumerary one was present. Ventral lobe of coxite with one fine accessory hair in addition to the apical bristle; club with extremity sharply dilated so that it usually appears almost globular. Phallosome entirely devoid of leaflets, the tubular portion appearing shorter than in *moucheti* or *marshalli* var. *freetownensis*, but this may be due to the fact that the apex is directed dorsally, resulting in considerable foreshortening when viewed as in fig. 2, A.

Fourth stage larva. This small larva closely resembles that of *A. moucheti* var. *nigeriensis*, but differs chiefly in the size of the abdominal palmate bristles.

Inner clypeal hairs (fig. 3, B) long and simple; outer simple and about two-fifths the length of the inner; posterior short and simple. Mental plate, thoracic palmate bristle and anterior submedian thoracic bristles very much as in *moucheti* (see Evans, 1929), but the latter with their bases sometimes separated. Pleural hairs as in *moucheti*, the long bristles agreeing with those of 'Group I, Division B' of Puri (1928).

Abdominal tergal plates very slightly larger, on the whole, than in *moucheti*. First to seventh segments with palmate bristles, those on first segment small and closely resembling those of *moucheti*. Typical palmate bristles distinctly smaller than in *moucheti*, that on fifth segment (fig. 3, C) with leaflets measuring *c.* 0.06 mm.; while on the corresponding segment in *moucheti* the length is *c.* 0.8 mm. to 0.9 mm. The filaments of the leaflets are relatively shorter than in *moucheti*, the ratio of length of filament to total length of leaflet being about 1 : 3 to 1 : 4 or more in *hargreavesi* and *c.* 1 : 2.4 to 1 : 2.9 in *moucheti*. Lateral comb with long and short teeth somewhat variable in number and arrangement; not distinguishable from that of *moucheti*.

Pupa. No marked differences were observed between Dr. Barber's pupal pelts and the one collected by Dr. Schwetz, near Stanleyville. In my description of that specimen, however, it was noted that the respiratory trumpet appeared to possess a short meatus and, while this is the case in the majority of the Nigerian specimens, in one or two of them the opening was continued

practically to the base of the trumpet. A further small variation concerns the number of branches in the sublateral bristle on the fifth abdominal segment which had four branches in one of the specimens so that the number varies from two to four.

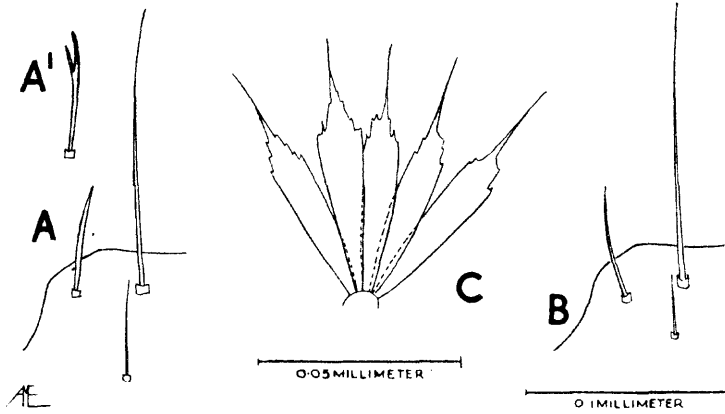


FIG. 3. *A*.—Clypeal bristles of *A. moucbeti* var. *nigriensis* n.var.; *A'*.—Outer clypeal hair of same, atypical. *B*.—Clypeal bristles of *A. bargreavesi*; *C*.—A few leaflets from median part of palmate bristle of fifth abdominal segment of *A. bargreavesi*; *A* and *B* to same scale.

Eggs. Dr. Barber and Mr. Olinger have studied the eggs of this form in both the immature and mature condition and have discovered that they show well-marked characteristics. The egg is of the usual boat-shaped form, with a pair of large dorso-lateral floats each showing about 14 to 18 major striations. It also bears, at each

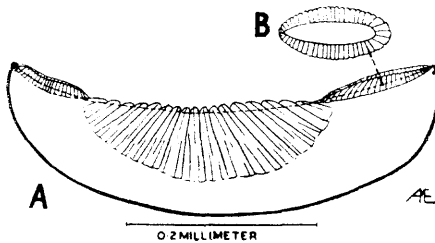


FIG. 4. *A*.—Mature egg of *A. bargreavesi*, lateral view; *B*.—Anterior frill, dorsal view.

pole, on the dorsal surface, a smaller, oval frill, as shown in fig. 4. These frills do not project markedly from the surface and are most obvious when the egg is viewed from the dorsal surface. They are

conspicuous in immature eggs and Dr. Barber tells me that he finds them of considerable use in identifying ♀♀ dissected to determine the infectivity.

It should be noted, however, that Dr. Barber dissected out immature eggs without well-developed frills from at least two females of *A. hargreavesi*. These eggs, appear to be somewhat younger than the immature eggs in which the frills are developed, and it seems possible that these structures may be still undifferentiated in these apparently aberrant specimens.

Described from specimens collected within 15 miles of Lagos, 1930, by Dr. Barber and Mr. Olinger :—Three larval and pupal pelts, Ebute Metta, 5 September ; three larval and pupal pelts, Otta, 1 and 2 October ; also a larval and pupal pelt, Jebba St., 13 September, and several larvae collected at Jebba Pool and immature and mature eggs obtained from ♀♀.

Breeding places. Dr. Barber informs me that he and Mr. Olinger have found larvae of this species in the following types of water :—(1) foul, sewage-contaminated water covered with *Pistia*, both in the sun and in partially shaded places ; (2) in *Pistia* in clear water in more open jungle areas ; (3) in grass growing in open swamps.

ANOPHELES MOUCHETI Evans

Anopheles marshalli var. *moucheti* Evans, 1925, 1927 and 1929.

The discovery by Dr. Barber of the larva of *A. hargreavesi* shows that that form and *A. moucheti* are rather closely related in larval characters but, as there are distinct differences in this stage and very marked differences in all the other stages, there seems to be no doubt that the two are distinct species. The larva, moreover, differs markedly from those of the type form of *marshalli* and var. *freetownensis*, and the adults differ in wing markings and hypopygial characters from both these forms and in wing and tarsal markings from var. *domicolus* so that there seems no doubt that it is specifically distinct. Dr. Barber has also discovered the early stages of a form of *moucheti* occurring near Lagos, differing in a larval character and also, to some extent, in wing markings, from the type form of *moucheti*. The specimens with typical larvae collected in Uganda by Mr. Gibbins agreed closely with the Congo form in all adult and larval characters.

A short diagnosis of the adult characters of the type form of the species is given below :—

FEMALE. Palps with two very broad equal or subequal white bands distally, one involving the apex and a narrow proximal white ring ; distal bands separated by a dark ring which is usually less than the pale bands and often about half the length of these ; it may be considerably narrower than this and in two specimens seen it was absent.

Wings. White areas of costal region reduced and third main dark area very long, relative lengths of the light and dark areas usually about as shown in the illustration of a co-type wing (Evans, 1925 and 1927), but a few specimens show a slight lengthening of the pale areas on the outer half of the costa. No pale interruption in third main dark area on first vein. Third vein mainly pale with two small dark areas at and near the base and a larger one at the apex ; the sub-basal dark area, in a few specimens, about twice as long as shown in my figure. Other veins with dark and light areas much as illustrated for the co-type, the lower branch of the second vein being mainly dark and upper branch lighter in nearly all the specimens ; stem of fourth vein sometimes darker and sixth vein sometimes with dark areas more extensive, especially on outer half, which may be entirely dark. Fringe spot at end of sixth vein usually absent, rest much as in figure of co-type (Evans, 1927). Outstanding scales of wing shorter and broader than in the type form of *marshalli*.

Mesonotum with scales on anterior half either broad (index 4 to 6) with many scales truncate, or rather narrow (index 6 to 8) and all finely pointed (all the Uganda specimens and some of those from Stanleyville) ; on posterior half, scales mainly very narrow (about as in *funestus*), but a few rather broader ones sometimes present laterally.

Legs. Tibiae and first three tarsal segments of front legs and first four of mid and hind legs with apical whitish rings ; those on front tarsi generally slightly wider than on hind tarsi, where they are about equal to the apical width of the segment.

MALE. Palps as in *A. hargreavesi*.

Terminalia. Phallosome with about four narrow leaflets on each side (see Evans, 1929).

Size. About as *funestus*.

Distribution. Belgian Congo, various localities; Uganda: Jinja (Mr. E. G. Gibbins).

Breeding places. Schwetz (1930) records larvae of this species from amongst weeds at the edges of streams and ponds sometimes in association with *funestus*, *nili* and *mauritanus*. In a previous paper (1929), I stated that Dr. Schwetz had found larvae in 'ruisseaux, herbes a sol'; this should have been 'herbes à sel' which, Dr. Schwetz informs me means 'salt grass,' a plant from which the natives make salt.

A. MOUCHETI var. NIGERIENSIS n.var.

This variety differs from the type form as follows:—Wing markings more variable; upper branch of second vein usually much darker, often with only a very small pale spot; lower branch frequently much paler than in type form; third vein with apical dark area much shorter and sub-basal dark area usually longer than in typical specimens of the type form. The scales on the anterior half of the mesonotum are of the narrower type seen in *moucheti* and, as usual, those on the posterior half are narrower still. Leaflets of phallosome exactly as in *moucheti*.

Larva. The larva differs from that of the type form in the character of the outer clypeal bristles (fig. 3, A), which are simple or, occasionally bifid, but in the type form show at least four branches. Whether simple or bifid these bristles appear rather blunt pointed, their extremities not being drawn out into long fine points.

Pupa. The pupa resembles the type form in the main features of the chaetotaxy, but the trumpet seems to differ slightly in that the opening does not reach to the base as is the case in *moucheti*, but this character is often a difficult one to determine exactly.

Eggs. As Dr. Barber has observed, this egg differs from that of *A. hargreavesi* (fig. 4) in the absence of well-developed terminal frills. In the positions where these occur in *hargreavesi*, very rudimentary frills are present which are so slightly developed as to appear as oval lines when viewed from above, even with the one-sixth objective. As Dr. Barber also notes, the 'network which is formed by the outer layer of the eggs, is relatively coarse as in *funestus*.'

Southern Nigeria. Co-types, 2 ♀♀ Yaba, 29 September and 4 October; 1 ♀ and 2 ♂♂ reared from larvae, Ebute Metta, near Lagos and larval and pupal pelts of these. Several larvae taken at Ebute Metta and mature and immature eggs from ♀♀, Yaba. All specimens and 4 ♀♀ (dissected and mounted on slides) collected by Dr. Barber and Mr. Olinger, 1930. 1 ♀, Lagos, November, 1928, Mr. C. B. Philip.

Breeding places. Dr. Barber and Mr. Olinger found numbers of larvae of this variety in clear, grassy water near Railway shops, Ebute Metta, and also in clear water with *Pistia* and other vegetation, as well as among grass growing in open swamps with clear water.

II. THE EARLY STAGES OF *ANOPHELES OBSCURUS* Grünb.

Larvae of this species have been collected by Dr. Barber and Mr. Olinger, near Lagos, and adults reared from isolated specimens. I find that the hypopygium of a male reared by Dr. Barber agrees with that of *obscurus* in having the very large leaflets as discovered by Christophers. In addition, four pupal pelts, collected in Uganda, which agree with that taken near Lagos, have been received from Mr. Hopkins. Dr. Barber and Mr. Olinger also obtained eggs of this species which are described below.

Fourth stage larva (fig. 5). Inner clypeal bristles long and simple; outer dendroid but with relatively few (about 10 to 20) branches, clypeal bristles very short and apparently simple. Antenna with well-developed spicules; hair on shaft arising well before middle, sometimes at about one-third of the distance from the base; hair at apex of antenna with several branches, many of which divide again so that numerous ultimate branches (18 to 25) are formed, the branches are often seen foreshortened in whole specimens of larvae, so that the appearance differs from that shown in fig. 5, A. Posterior frontal and vertical bristles (see Patton and Evans, 1929, p. 242), relatively large, with about 8 to 10 branches. Mental plate with teeth very uneven, those nearest to the apical tooth much smaller than the next teeth, their apices not reaching as far, distally, as those of the latter. In this character they resemble the larva of *moucheti* (see Evans, 1929, fig. 1, B) but the sub-apical teeth are even shorter, relatively than in that form.

Inner anterior submedian thoracic bristles relatively well developed, with about ten branches; middle ones with about twelve branches (fig. 5, D). Thoracic palmate bristles with about ten narrow, pointed, shoulderless leaflets. Pleural bristles showing the main characters of the sub-genus *Anopheles*, but posterior

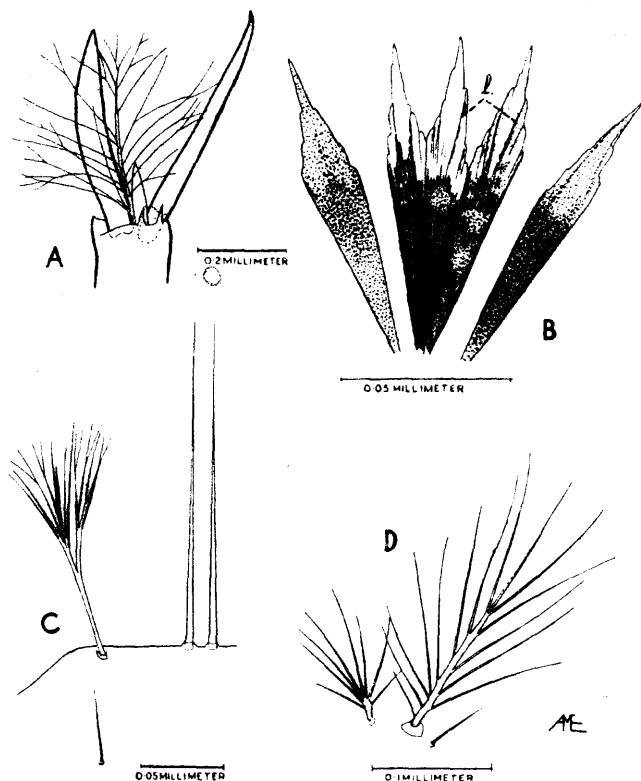


FIG. 5. *A. obscurus* Grüb., larva. A.—Tip of antenna showing branched hair (The measurement of the scale should be .04 millimeter); B.—Leaflets of palmate bristles of fifth abdominal segment showing variation in markings in three different specimens; C.—Clypeal bristles; D.—Right anterior submedian thoracic bristles.

ventral bristle of metathorax usually divided into three branches. Thoracic clinging organ, 'contractile thoracic appendage' of Iyenger, 1928, very large and prominent in most of the specimens, the membraneous portion, 'cuticular wing,' much less delicate than in other species such as *mauritanus* and *sinensis* and often showing

brown pigmentation which is strongly developed in some examples. Lateral plumose bristles on first three abdominal segments well developed. First and second abdominal segments with rudimentary palmate bristles very similar to those on metathorax, that on second segment larger than that on first. Palmate bristles of third to seventh abdominal segments well developed, leaflets usually pigmented, but those on sixth and seventh segments sometimes colourless. Leaflets very similar to those of *mauritianus*, but distal part with serrations rather less angular. Outer portion clear or less deeply pigmented than basal half, and often showing an appearance of fine lines (as shown in fig. 5, B, l.). Lateral comb with about nine long teeth, alternating in most cases with a single short tooth.

This species was formerly thought to be identical with the Oriental *A. umbrosus* but, by an examination of the male hypopygium Christophers demonstrated that it was a distinct species. This conclusion is amply supported by the characters of the larva which, as Dr. Barber noted, differs markedly from that of *A. umbrosus* in possessing well-developed palmate bristles. The branching of the outer clypeal bristles resembles that of *umbrosus* more than that of *mauritianus*, but there are fewer branches in *umbrosus*, usually only six to eight. Other marked differences are the larger hair on the shaft of the antenna, with more numerous branches in *obscurus*; the much greater number of branches of the apical antennal hair (18 to 25 in *obscurus*, but only about five or six in *umbrosus*); the larger and more branched posterior frontal and vertical bristles and the well-developed inner submedian thoracic bristle of *obscurus* which, in *umbrosus*, is very small and shows only two or three branches.

The differences from the larva of *A. mauritianus* are not quite so marked, but the outer clypeal bristles are very much less branched than in that species in which the ultimate branches may be fifty or more. The lateral comb shows only one small tooth between successive long teeth in *obscurus*, whereas in *A. mauritianus* there are two or three short teeth between at least some of the adjacent long teeth; this character was first noticed by Mr. E. G. Gibbins. Further distinct differences are that the branched hair on the shaft of the antenna in *mauritianus* has less and shorter branches than in *obscurus*,

and the apical antennal hair also shows many less branches (10 to 12) in *mauritanus*. The well-developed inner submedian thoracic bristle of *obscurus* also differentiates it from *mauritanus* in which this is very short and three- to five-branched. The mental plate of *mauritanus* differs in having the teeth of regular size, much as in *A. marshalli* var. *freetownensis* (see Evans, 1929, fig. 1, c). The leaflets of the palmate bristles have the serrations more angular in *mauritanus* than in the larvae here described.

Pupa. Since going to press a further collection of material has been sent by Dr. Barber, including three pupal pelts of *obscurus* which show marked differences from those examined before. The description of this pupa has, therefore, been withdrawn from the present paper and will be included in a later publication dealing with the pupae of several species of mosquitoes recently received from Mr. Hopkins.

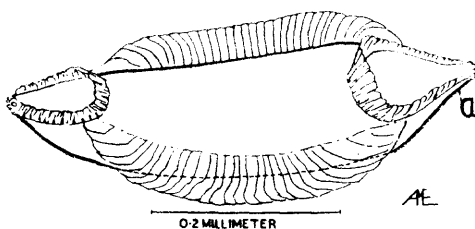


FIG. 6. *A. obscurus*. Egg, dorsal and slightly lateral view; a.—anterior end.

Eggs (fig. 6). The egg, as usual, is boat-shaped and widest at the anterior end, but both ends are produced dorsally into a narrow rounded projection. The dorso-lateral floats are very long and show about 27 striae. Dorsally there is a conspicuous frill at each pole, enclosing a roughly triangular area. The frills project at right-angles to the surface, and the anterior one, which is the longer, is of considerable length proximally.

Described from twelve larvae and a larval pelt taken in a ditch, adjoining a cocoa tree nursery in woods, and also several eggs from ♀♀, near Lagos, 1930, Dr. Barber and Mr. Olinger

REFERENCES

- EVANS, A. M. (1925). A new variety of *Anopheles marshalli* Theobald, from the Belgian Congo. *Ann. Trop. Med. & Parasitol.*, **19**, 211.
- (1927). A short illustrated Guide to the Anophelines of Tropical and South Africa. *Liv. School Trop. Med. Memoir*, New series, No. 3, p. 1-78.
- (1929). Notes on certain varieties of *Anopheles marshalli* Theobald. *Ann. Trop. Med. & Parasitol.*, **23**, 415.
- IYENGAR, M. O. T. (1928). Structure and Function of the Contractile Thoracic Appendages of the Anopheles Larvae. *Ind. J. Med. Res.*, **16**, 281.
- PATTON, W. S., and EVANS, A. M. (1929). Insects, Ticks, Mites and Venomous Animals of Medical and Veterinary Importance. Part I: Medical. Liverpool, 8vo. Published by Professor Patton. pp. i-ix, 1-786.
- PURI, I. M. (1928). The relationship of certain morphological characters of Anopheline Larvae to the classification of Indian Anopheline Mosquitoes. *Ind. J. Med. Res.*, **16**, 519.
- SCHWETZ, J. (1930). Les Moustiques de Stanleyville (Congo Belge). *Ann. Soc. Belge Med. Trop.*, **10**, 1.