MOSQUITOES OF THE ETHIOPIAN REGION

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ETHIOPIAN REGION

I.—LARVAL BIONOMICS OF MOSQUITOES AND TAXONOMY OF CULICINE LARVAE

BY

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PREFACE

SINCE the publication of the first edition of this volume, knowledge of the larvae of the African Culicidae has increased rapidly and continuously. Ten years ago, a new edition was already needed. A revision, up to 1946, was in fact completed by Mr. Hopkins. Since then, whilst going through the press, the text has been further revised and largely supplemented by Mr. Mattingly, the original author finding himself unable to continue the work. All the additions due to Mr. Mattingly bear his initials. Expansion of the text has been relatively greatest in the genera *Toxorhynchites, Taeniorhynchus* (subgenus *Coquillettidia*) *Aëdes* (subgenus *Stegomyia*, of which Mr. Mattingly has made a special study) and *Eretmapodites*. Much new information and material has resulted both directly and indirectly from Yellow Fever research activities in recent years. The search for reliable diagnostic characters in species of medical, or suspected medical, importance has naturally led to the separation of closely related species and the discovery of further new species. It will be found that 86 more species have been added to the previous total of 248. Though greatly increased in size and, it is hoped, in usefulness, the plan of the work remains unaltered.

N. D. RILEY,
Keeper of Entomology.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, S.W.7 ;
October 4th, 1951.

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IT is my pleasant duty to thank a number of individuals and institutions for assistance in the preparation of this work. In addition to the large amount of material in the collections of the British Museum and of the Uganda Government, other species were generously lent by the London and Liverpool Schools of Tropical Medicine, by Drs. J. Bequaert, B. De Meillon and J. Schwetz and by Mr. J. W. McHardy. Material of a large number of species, many of them previously unknown, and usually accompanied by most valuable notes on the breeding-places, was collected specially for this work by Messrs. T. W. Chorley, J. F. Shillito, C. B. Symes and E. G. Gibbins. Mr. L. C. Beadle collected some interesting material while with the Cambridge Expedition to the African Lakes. To Mr. Gibbins and to Mr. C. G. Hansford I am indebted for numerous drawings of larvae. Dr. F. W. Edwards has given me many valuable suggestions with regard to morhpology and taxonomy. The responsibility for any errors is mine. Last, but far from least, must be mentioned Mr. G. L. R. Hancock, who spontaneously undertook the very tedious and laborious task of acting as my amanuensis in the work of finding, extracting and evaluating published records of larval bionomics, who (in a number of instances) took down descriptions of larvae from dictation and thus saved much time, and who contributed several ideas, and was always willing to discuss and thus help to clarify ideas which occurred to me ; without Mr. Hancock's help the task would have been a much more difficult one.

Owing to the help given me, I have been enabled to see practically all the known Culicine larvae of the region under discussion. In instances where this has not been the case the fact that the larva has not been personally examined is recorded in the text.

G. H. E. HOPKINS.

KAMPALA ; *February 19th*, 1936.

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FOR assistance in connection with this second edition I am indebted to Dr. L. J. Chwatt, Mr. J. D. Gillett, Dr. A. J. Haddow, Mr. H. S. Leeson, Mr. D. J. Lewis, Dr. B. De Meillon, Mr. J. Muspratt, Mr. G. G. Robinson, Mrs. E. C. C. van Someren and Mons. J. Wolfs who have provided material, advance copies of unpublished descriptions, or illustrations, and to whom I take pleasure in expressing my thanks.

I am particularly grateful to Mr. P. F. Mattingly, who took over the work of bringing the volume up to date when I found myself unable to continue it. My revision extended up to 1946, after which Mr. Mattingly most kindly undertook the task of bringing the work up to date (to September, 1951) by the inclusion of new descriptions, revision of keys where necessary, supervision of new drawings, correction of one or two errors, revision of the nomenclature and correction of proofs. Without Mr. Mattingly's contribution this volume would have been largely obsolete even before it was published.

G. H. E. HOPKINS.

TRING ; *October 2nd*, 1951.

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ECOLOGY

A. BREEDING-PLACES OF MOSQUITOES.

As is well known, all mosquitoes breed in water ; in almost all cases the water must be more or less quiescent, since the wave action in large bodies of water is a deterrent unless the larvae are able to obtain shelter among vegetation, while the rapid current of swiftly flowing streams makes breeding impossible to all except a few species. Within the above limits, however, the types of breeding-places vary enormously. Shannon has laid down in this connection a fundamental principle in mosquito biology : " *The larvae of each species are more or less restricted to a special type of habitat ; and further, the natural classification of the habitats is in accord with the natural classifications of the family as based on larval and adult characters.*" There are a certain number of exceptions to this rule, and particularly to the latter half of it, since closely related species do not necessarily frequent similar breeding-places, but in the main the principle is undoubtedly true : each species and often each group of species, subgenus or genus has its own preferred type of habitat.

Shannon divides larval habits according to (1) location, and (2) condition, and this division has been adopted here. With his scheme of subdivision of habitats according to location the present writer is only in partial agreement, and a somewhat different scheme has been adopted.

1. Location.

a. *Ground pools* (including small lakes and the weedy edges of larger ones, swamps, springs, rivers, ditches and hoof-prints).

Dyar was of the opinion that the original mosquitoes were tree-hole breeders, and that the colonization of the type of breeding-places now under consideration has been comparatively recent. The evidence is inconclusive, since the most primitive genus (*Anopheles*) breeds almost exclusively in the pool type of habitat, and in the genera *Culex* and *Aëdes* the more primitive subgenera have for the most part the same larval habitat. The vast majority of species and genera frequent this type of breeding-place, and it is at least convenient (in the absence of definite evidence) to regard those which breed elsewhere as being specialized.

The temporary or permanent nature of a pool has a marked effect in determining the composition of its mosquito fauna.

b. *Rock-pools.*—These form a quite distinct class intermediate in character between (*a*) and (*c*), but with a fauna differing from both. It is necessary here to draw a clear distinction between true rock-pools and pools which happen to be in rock, but ecologically belong to the " ground pool " type. The former are bare of vegetation with the exception of algae (usually the unicellular forms), and have a bottom and sides which are of stone with but a thin coating of mud or none at all ;

the latter, which might better be called rock-edged pools, often have a thick coating of mud at the bottom and, if of sufficiently long standing, contain higher plants rooted in the mud. There is also a difference in size: the true rock-pool is always small, whereas the rock-edged pool may cover several square yards. Although the two types merge imperceptibly into one another, the differences between typical examples of each are great and of much practical importance, since the rock-edged pool, belonging ecologically to the type of ground pools, may contain larvae of any of the forms which breed in such places, while the true rock-pool has its own limited fauna, which includes a very few species of *Anopheles*, some species of *Uranotaenia*, *Aëdes aegypti* (also found in the following class), *A. vittatus* and a few species of *Culex*; the most characteristic member of this fauna is perhaps *A. vittatus*, which is seldom if ever found breeding elsewhere.

c. *Small containers*.—This class has a very constant fauna, most of the members of which are found nowhere else; this fauna does not, in Ethiopia, normally include any *Anopheles*, though one species is found rarely in this habitat. Most of the species show a special preference for one or other of the subdivisions.

(i) *Tree-holes* (including cut or bored bamboos or reeds). The fauna includes the genus *Toxorhynchites*, *Uranotaenia shillitonis*, *Theobaldia fraseri*, many *Aëdes* (including practically the whole of the subgenus *Stegomyia*, the whole of the subgenera *Dunnius*, *Finlaya* and *Diceromyia* and one section of *Aëdimorphus*), and a few species of *Culex*.

The majority of the species detailed above appear to breed with equal facility in tree-holes or in bamboos, but *U. shillitonis* and *Culex hancocki* have so far only been found in bamboos or reeds.

(ii) *Artificial containers* (discarded tins, bottles, motor-tyres, etc., barrels, closed tanks and rain-water gutters).

The fauna is more limited than that of tree-holes but otherwise nearly the same. *Toxorhynchites* occurs in barrels, but the only species which breed really commonly in discarded tins and the like are *Aëdes aegypti*, and a few species of *Culex*; *Eretmapodites* is occasionally found here, though much more common in the next subdivision.

(iii) *Fallen leaves*.—This is the special habitat of the genus *Eretmapodites*; other forms occur here very uncommonly with the exception of *Culex nebulosus*. Judging by their fauna, such breeding-places as large empty snail-shells or the concave tops of fungi appear to belong to this subdivision rather than to any of the others.

(iv) *Plant axils*.—Many species appear to be almost or quite confined to the axils of the leaves of plants such as *Dracaena*, *Colocasia*, wild bananas (*Musa* spp.), etc. The genus *Harpagomyia* has not (in Africa) been found breeding in any other site; *Eretmapodites dracaenae* and *Uranotaenia ornata* appear to be entirely confined to this habitat, while *Aëdes* (*Stegomyia*) *simpsoni* is very much commoner in plant axils than in tree-holes. The genus *Culex* has but few representatives in plant axils, though *C. musarum* is apparently not found elsewhere. A number of the tree-hole breeders have been recorded from plant axils, but their occurrence in this habitat is exceptional.

(v) *Crab holes* (either in the banks of streams or on the sea-shore if the water is not too saline).

Several species of *Uranotaenia,* the only Ethiopian species of *Aëdes* subgenus *Skusea,* one or two members of the subgenus *Aëdimorphus* and a few species of *Culex* appear to be the normal inhabitants of this type of breeding-place. Records from this subdivision are peculiarly liable to error (see p. 11).

2. Condition.

The factors affecting condition of the water are extremely complicated and difficult to measure ; little work on these lines has been done in Africa, though the subject is one of extreme practical importance, and our knowledge is accordingly very limited. In these circumstances it will suffice to mention and make notes upon some of the more obviously important factors.

a. *Salts or other dissolved inorganic substances.*—The presence of dissolved salts in considerable quantities (as in brackish or highly alkaline waters) appears to be inhibitory to the vast majority of species, including nearly the whole of the genus *Anopheles.* Certain species of the subgenera *Ochlerotatus* (*O. caspius*) and *Aëdimorphus* (*A. irritans* and *A. natronius*) and three species of *Culex* (*thalassius, sitiens* and *mirificus*) definitely prefer salt or alkaline water, and a few other species are able to tolerate a fairly high concentration of dissolved salts. MacGregor (1924) has shown that the soap introduced into streams by native washermen is inhibitory to the breeding of mosquitoes even when it is in extreme dilutions ; the present writer is able to confirm this observation.

b. *Dissolved organic matter.*—The work of Harvey and Symes seems to indicate that waters containing Anopheline larvae have higher organic indices than those without, but have a lower ratio of organic to inorganic matter. No other exact work on this point has been done in Africa, but it is common knowledge that a really high degree of organic fouling is deterrent to most species of *Anopheles.* MacGregor (1924) records that the effluent from sugar-factories is inhibitory to the breeding of Anophelines, and the present writer has seen similar effects in the case of sisal and coffee waste. A temporary method of control of *Anopheles* in a pool, which is sometimes used in Africa, is to throw a bundle of grass into the water ; as the grass rots the Anopheline larvae are replaced by Culicines ; township refuse is also sometimes used for this purpose. A very perfect example of the avoidance by Anophelines of water with a high organic content was observed by the writer at Kabale, Uganda. Here two types of "wells" (shallow water-holes) are used by the natives ; they differ from each other only in function, and the wells are almost invariably dug in pairs adjacent to each other. One of each pair is used for obtaining drinking water, while the other is a "beer-well." The beer-well is employed as follows : Millet-seed is tied up in a bundle of grass and thrown into the well, where it germinates and forms malt ; simultaneously the grass covering rots and imparts to the water an unpleasant smell and a high organic content. Practically all of the many drinking-water wells examined contained larvae of *Anopheles christyi,* while no Anopheline larvae were ever found in the beer-wells, which had a teeming population of *Culex pipiens.* The facts are the more striking, since Symes (1928) has shown that *A. christyi* will tolerate a greater degree of organic pollution than will some other species of *Anopheles*, including *A. gambiae*.

Beattie (1932) and Buxton (1934) have investigated a number of physical and chemical factors in connection with mosquito breeding in Trinidad. They find that the only factor which is correlated with abundance or paucity of *Anopheline* larvae is ammonia nitrogen, which is perhaps correlated with organic content. In Trinidad a high figure for ammonia nitrogen is definitely associated with paucity of Anopheline larvae.

Certain species (including *Culex fatigans*) have a definite preference for water containing a high degree of organic matter, and will even breed in the foul water contained in pit latrines. Those species which breed in tree-holes must necessarily be able to tolerate a high organic content in the water.

c. *Suspended mud.*—A muddy suspension in the water seems to be inimical to most species, but *Anopheles gambiae* and *A. maculipalpis* appear to have a definite preference for such water, and several species of the *pipiens* group of *Culex* seem to have no objection to it.

d. *Presence or absence of plants.*—A few species are dependent, as larvae or pupae, on plants for their supply of oxygen (*Taeniorhynchus*, some species of *Ficalbia* and probably *Aëdomyia*), and are therefore never found in the absence of some form of the higher plants. Others (too numerous to mention) find shelter among aquatic vegetation, and the members of the *annulioris* group of *Culex* are seldom or never found breeding except in the presence of masses of filamentous algae among which their larvae hide.*

De Meillon (1931) found that in South Africa pools overgrown with *Lemna minor* and *Wolffia arrhiza* were free from Anopheline larvae, whereas adjacent pools not containing these plants harboured larvae, including those of *A. gambiae.* He suggests that the growth of the plants is so dense that the siphons of the larvae are prevented from coming into contact with the air, thus causing death from asphyxiation. This is certainly not always the case, for the writer has found larvae of *Anopheles coustani* (*mauritianus*) and *A. christyi* in pools overgrown with *Lemna* sp. in Kigezi, Uganda. Plants of the genus *Azolla* (Hydropteridineae) form such a dense carpet in Europe (*e.g.* the Cambridge Fens) that breeding of Anophelines would probably be impossible, but the species found in Uganda is very severely attacked by a Lepidopterous larva of the family Hydrocampidae and, for this or other reasons, has never been observed to form such a carpet.

* Lewis (1948) mentions the following species of aquatic plants as affording protection to larvae "particularly when mingled with plant fragments, pieces of gelatinous brown alga or a thick growth of *Spirogyra*: *Vossia cuspidata* Griff. (small variety), *Echinochloa stagnina* Beauv., *Vetiveria nigritana* Stapf., *Cyperus rotundus* Linn., flooded land grasses and herbs, *Neptunia oleracea* Lour., *E. pyramidalis* Hitch and Chase, *Ipomoea reptans* Poir. and *Jussieua repens* Linn. Plants affording greater protection are said by this author to include *Pistia stratiotes* Linn., *Azolla* sp., *Naias pectinata* Magnus, *Vallisneria aethiopica* Fenzl., *Spirogyra, Ceratophyllum demersum* Linn. and the gelatinous algae. Sedges and other plants are said sometimes to come into this category "if they die and fall on the water or are trodden flat by man, cattle or hippopotamus." *N. pectinata* is said to have been important "in the first years of dam operation when the water was lowered to the level of this plant in the autumn." Larger plants categorized as affording protection from wave action are *Acacia arabica* Willd., *Cyperus papyrus* var. *antiquorum* Clarke, "the large variety of *V. cuspidata* known as "umm suf," *Juncellus alopecuroides* Clarke and various grasses. Finally mention is made of *A. arabica, V. cuspidata, I. reptans* and "the broad leaved *J. repens*" as of importance in hindering the growth of other plants. Certain American authors including Abdel-Malek (1948) have claimed that plant substances play an important part in stimulating the hatching of mosquito eggs in nature.—P. F. M.

e. *Temperature.*—Symes (1932) has published some interesting figures with regard to this factor and Anopheline breeding. He found Anopheline larvae in the following ranges of temperatures: *A. gambiae*, 16·7–26·0° C.; *A. funestus*, 15·7–22·0° C.; *A. natalensis*, 11·3–28·2° C.; *A. christyi*, 15·0–27·5° C.; *A. coustani*, 12·0–24·0° C.; *A. squamosus*, 15·1–26° C.; *A. marshalli* group (presumably *keniensis*), 17·0–21·5° C.; *A. demeilloni* and *A. rhodesiensis*, 22·5° C.; *A. pretoriensis*, 21·5–22·5° C. He is of the opinion that these figures, taken together with the average temperature figures for various types of breeding-place in the area concerned, show no indication that temperature is a limiting factor with reference to breeding of Anophelines in the districts concerned, but there is some evidence to suggest that in Central Africa the temperatures attained by the water in roof-gutters are too high to permit of the existence of mosquito larvae unless the gutters are shaded by trees,* and recent observations seem to indicate that in at least one area in Uganda the temperatures at certain seasons in the more usual breeding-places of *A. gambiae* are too low for this species, which is, therefore, forced to confine itself to the warmer waters of small rock-pools. Mr. Hancock and the writer found that larvae of *Anopheles obscurus* could not be reared in the laboratory until they were placed under a butter-cooler. The recent work of Swellengrebel, Annecke and de Meillon suggests that *A. funestus* may be similarly limited by temperatures in South Africa, and Haddow's work in Kenya (Haddow, 1943) gives strong support to this suggestion.

It is well known that, within limits, increase of temperature hastens development of larvae, but I can find no exact observations on the point so far as Africa is concerned.†

f. *Light and shade.*—Here again we are practically without knowledge except with regard to the genus *Anopheles*. In this genus there is no question that larvae of the groups *Anopheles* and *Christya* prefer shaded conditions, while the members of the subgenus *Myzomyia*, though varied in this respect, do not breed in situations where the shade is very dense (*A. gambiae*, for instance, shows a very definite preference for sunlight). This point has been taken advantage of in the control of malaria: the species belonging to the groups *Anopheles* and *Christya* are not or but little domestic, and swampy areas are being planted with trees on a somewhat large scale in Uganda, not only in the hope that the trees will dry up the swamp, but also with the expectation that if the shade becomes sufficiently dense it will eliminate breeding of all species of the subgenus *Myzomyia*. In swampy natural forest in Uganda *A.* (*Anopheles*) *obscurus* and *A.* (*Christya*) *implexus* appear to be the only species of the genus which can find conditions suitable for breeding. It is probable that the main effect of shade lies in the reduction of the temperature (Haddow, 1943).

g. *Hydrogen-ion concentration* (*pH*).—Very little work has been done on this factor in Africa; it evidently has little or no direct effect on mosquito larvae, but an indirect effect through the micro-fauna and flora (MacGregor, 1929). It is important

* Macfie (1920) has shown experimentally that in the case of *Aëdes aegypti* few recoveries take place after exposure for five minutes to temperature above 46° C. (eggs), 43° (larvae), 45° (pupae) and 44° (adults).

† Haddow (1948) has shown that the mean temperature inside *Colocasia* axils tends to be lower than that of the surrounding air and has suggested that this may have some bearing on the observation of Teesdale (1941) that the period of larval development in this type of habitat is liable to be very prolonged. Garnham et al. (1946) state that, in rain forest, the temperature of the water in tree-holes may be as much as 6° C. below that of the surrounding air.—P. F. M.

to realize, in making observations on pH, that a series of readings of this factor in habitats which contain larvae is entirely valueless without a parallel set of readings from apparently equally suitable places which do not contain them, and *vice versa* ; from neglect of this condition the importance of pH has sometimes been much exaggerated. Kirkpatrick has pointed out that, although it is sometimes truly stated that in Egypt Anophelines breed almost exclusively in waters on the alkaline side of neutrality, the reason is that practically all waters of the types which by reason of their " location " are suited to the breeding of Anophelines are also alkaline, and the determining factor, therefore, may well be the " location " rather than the " condition " of the water. In the only acid waters suitable in " location " for Anopheline larvae which Kirkpatrick was able to examine he found Anopheline larvae to be present ; the pH of these waters was 6·5 to 7·0. In Entebbe, Uganda, Anophelines (*gambiae, funestus* and *coustani*) were found breeding in waters with a pH range of 5·6 to 7·1 (Hancock, 1930), and Pomeroy (1931) has recorded finding larvae of *A. gambiae* in natural waters with a pH range of 4 to 8·5 ; the latter author states that in experimental conditions *A. gambiae* preferred waters of pH 4 and pH 7–8 to alkaline water with a pH of 10, while *Aëdes aegypti* showed no particular preference. Experiments of this kind are unsatisfactory, as it is impossible to decide whether avoidance of a certain water is due to the pH or to a repelling effect of the strong mineral acids or alkalis used to obtain this pH ; further, as MacGregor has pointed out, the importance of pH is not direct.

Symes (1932) has published a series of pH readings of waters in Kenya, some breeding Anophelines and some not. He states : "Anopheline larvae occurred too infrequently to allow of any definite conclusions as to their limits of tolerance. They appear to be able to tolerate practically the whole range of values recorded for natural waters in the Nairobi district. . . . For practical application in the field, the usefulness of pH determination has yet to be demonstrated."

On the other hand, MacGregor (1924) states very definitely that in Mauritius, in places apparently entirely suited to the breeding of Anophelines, he has never been able to find their larvae if the pH was as low as the figures obtained in Uganda, while the optimum conditions were definitely alkaline (pH 8·4 to 9·5*). The discrepancy is perhaps accounted for if we consider the question of the " alkali reserve," with which is bound up that of " residual pH." The Entebbe swamps investigated by Hancock are situated on the edges of Lake Victoria, the pH of whose waters ranges from a minimum of 7·2 at 67 metres depth to a maximum of 9·0 on the surface (Graham, 1929). It is therefore probable that the acidity of the Entebbe swamps is due to carbon dioxide produced by the decay of the swamp vegetation (see Senior-White, 1928).

On the other hand, larvae of *Anopheles coustani* have been found in a Sphagnum bog bordering Lake Nabugabo in Uganda, " which is unlike any other swamp I know of in East Africa, being remarkably acid in constitution " (Worthington, 1932). The alkali reserve of this lake is given by Worthington (*l. c.*) as varying between ·000266 and ·000286 normal, and the present writer finds that the figures

* In Kenya larvae of *A. funestus* occur in small seepage streams along the edges of the soda-lake at Magadi ; the pH of these streams is 8·8 (Symes, 1932), mainly due to sodium carbonate ; in Uganda we have bred both this species and *A. gambiae* successfully in cemented pits in which the water had a pH of 10·0.

for the Sphagnum bog are certainly not higher. The pH of the lake at the point of junction with the bog was found by the writer to be 6·1 at midday, which agrees very well with Dr. Worthington's figure of about 6·0, while at about the same time the pH of the bog itself (in the pool where the larvae of *coustani* were found) was approximately 5·0. Worthington (*l. c.*) states that the alkali reserve of this lake is very low, especially when compared with that of Lake Victoria, which he gives as ·0012.

An interesting point has been raised by Pruthi (1931), who has shown that larvae are able to survive in waters having a pH which is unsuitable for their complete development.

h. *Food*.—The majority of mosquito larvae ingest any sufficiently small particles, living or dead, floating in the water in which they dwell or lying on the surface of objects in the water. Some of these particles doubtless pass through the gut unchanged, but a wide variety is known to be digested, including Bacteria, Algae, yeasts, fungal spores and Protozoa. Certain breeding-places are richer in one or another of these types of food, and it is possible that this factor to some extent influences the suitability of a breeding-place for a given species. But that larvae are not so selective in their food requirements as has sometimes been supposed is suggested by the fact that it is possible to breed at least some species to maturity on bacteria (*e. g. B. coli* and *B. proteus*) not normally found in natural waters.

Brewer's yeast has long been known to be a suitable food for larvae of many species, but Golberg, De Meillon and Lavoipierre have now shown that autoclaved yeast alone is not suitable, and that a number of vitamins (thiamin, riboflavin, pyridoxin, pantothenic acid, nicotinic acid, biotin and folic acid) are necessary for successful growth and pupation. They also found that although the period occupied by the larval stage is dependent on the diet, the duration of the pupal stage is independent of it, and at 28° C. (the temperature at which their experiments were carried out) is $2{\cdot}4 \pm 0{\cdot}46$ days (1000 pupae timed). The species which these authors employed in their experiments was *Aëdes aegypti*.*

A spring at its source is often very poor in microflora and fauna, and such a place may be unsuitable for breeding because of the absence of food. On the other hand, too great a concentration of food is fatal to larvae (Buxton and Hopkins), and absence of larvae from some of the fouler waters may perhaps be due to this cause.

i. *Natural enemies*.—This factor, which affords almost the only hope of the control of mosquitoes and malaria over large rural areas in Africa, has been almost entirely neglected. The little that is known is summarized below :

* Further studies by Golberg and De Meillon (1947) have shown that folic acid can be replaced by synthetic pteroylglutamic acid but only in the presence of an adjuvant (4-pyridoxic acid or, to a less extent, the lactone of 5-pyridoxic acid). Lipoids are unnecessary for normal larval growth but are needed for successful pupation and adult emergence. Cholesterol and related sterols and purified lecithin are adequate for the purpose. Fatty acids, tri-glycerides, phospholipides, etc., are not. The best results were obtained with a mixture of cholesterol, lecithin and cephalin (1 : 2 : 1), but optimum growth depended on the presence of a further factor obtained from yeast residue. The presence of the latter also made it possible to replace cholesterol with certain steroids which were otherwise inactive. Among amino-acids glycine, *l*-leucine, *dl-iso*leucine, *l*-histidine, *l*-arginine, *l*-lysine, *l*-tryptophane, *dl*-threonine, *dl*-phenylalanine and *dl*-methionine were all indispensable for growth and these required to be supplemented by other amino-acids bringing the total number to at least 17 for normal growth. Alternatively all protein requirements could be met with casein. By reduction of the phenylalanine or tyrosine below the optimal amounts it was possible to obtain completely unpigmented larvae. For a fuller discussion see Golberg and De Meillon (1948).—P. F. M.

(i) *Fish.*—Scott records two species of larvivorous fish (*Gobius criniger* and *Tilapia nilotica*) reducing breeding in Gerezani Creek, Dar-es-salaam. Hancock (1930) has shown that *Haplochilus* sp. and *Barbus* sp. destroy larvae readily (under laboratory conditions) in the presence of other food, but that *Haplochromis ? nubilus* does so only if no other food is available ; the present writer has observed a species of *Haplochromis* eating larvae of *Anopheles* under natural conditions in Kampala. Hancock also notes that one specimen of *Haplochilus* (perhaps a different species) only attacked larvae when moving, and that if a moving larva stopped suddenly at a distance of more than two inches from the fish the latter also stopped and appeared puzzled, not resuming the chase until the larva again moved. Graham (1911) also records a species of *Haplochilus* (*H. grahami*) preventing breeding of mosquitoes in a swamp where the fish were abundant.*

MacGregor (1924) has stated that larvivorous fish are of little value under natural conditions (*i. e.* except when weed is not allowed to grow). The present writer has, however, seen a number of instances in which the absence or rarity of mosquito larvae found no apparent explanation except the presence of larvivorous fish. An instance which may be recorded is that of two small pools on the edge of Lake Victoria, within a yard of one another and apparently identical in all respects except that in one case the presence of a " bar " of sand prevented communication with the lake, whereas the second pool had no such bar ; wave-action was absent in both. In the first pool fish were absent and mosquito larvae abundant, but the second was continually invaded from the lake by small fish and very few larvae could be found in it. The writer considers that, where the water is not so muddy that the fish cannot see their prey and the cover of weeds is not so dense that they cannot readily penetrate it, larvivorous fish of suitable species may be of great value even under entirely natural conditions.

Vanderplank (1941) has found indigenous species of *Nothobranchius*, *Barbus* and *Pachypanchax* valuable as destroyers of mosquitoes in Tanganyika ; introduced species of fish (*Gambusia affinis* and *Lebistes* sp.) have proved of very considerable value in Kenya (Strangways-Dixon, 1940) and in Uganda (unpublished work by the writer). Mr. P. F. Mattingly makes the very interesting observation that a small fish (? *Epiplatys grahami*) which is abundant in the swamps around Lagos not only devours mosquito larvae voraciously, but (in the laboratory) will jump as much as three inches out of the water to take an adult mosquito held by forceps, this feat being performed with perfect precision and timing. There seems to be no reason to doubt that the fish acts similarly in nature, in which case the selective destruction of ovipositing females must be an important check on mosquitoes.

(ii) *Predacious mosquito larvae.*—Cannibalism in mosquito larvae is somewhat infrequent ; it is obligatory in the genus *Toxorhynchites* and the subgenera *Mucidus* and *Lutzia*. On the subject of facultative cannibalism there is but little information. Graham (1910) states that on the addition of 3% common

* Lewis (1948) suggests *Micralestes acutidens* Peters, *Aplocheilicthys loati* Boulenger, *Epiplatys marnoi* Steindachner and *Haplochromis multicolor* Schoeller as perhaps affording partial control but stresses the importance of the protection afforded by vegetation.—P. F. M.

salt, which precipitates suspended matter and destroys algae, larvae of *A. gambiae* become cannibalistic. The writer has repeated this experiment, using percentages of salt varying between 0·1 and 3·0, and found that in all concentrations above and including 1% the larvae rapidly died, while in the lower concentrations they remained alive. In no case was any evidence of predacity seen, but in one instance a dead larva was definitely devoured by another. Bauer states of the larvae of *Eretmapodites chrysogaster* : " The larvae feed mostly on decaying vegetable matter, but they become definitely cannibalistic when food becomes scarce. Small larvae are then swallowed completely, but from the larger ones, probably on account of the hard chitinous skin, only the contents is sucked out. On numerous occasions we have seen larvae also attack pupae ; seizing them by the tail, they keep their prey under water until drowned. Freshly killed pupae are not eaten immediately, however, but left intact until partly decomposed and then eaten." This observation is, to some extent, confirmed by Bequaert's note on the same species : " I observed one of them devouring a small reddish dipterous larva." Haddow (1946) has shown that the larvae of *Eretmapodites* are definitely predaceous, and this would seem to be a true instance of facultative cannibalism.

(iii) *Other insects.*—Collart records the adults of a Dolichopodid (*Pelastoneurus collarti*, Curran) moving about on the surface of a stream and capturing mosquito larvae on which they fed. Lamborn (1920–21) notes that an Anthomyid (*Lispa* sp.) stands on the surface scum and pulls larvae, pupae and hatching adults out of the water and devours them ; De Meillon (1941) records similar observations on *Lispa afra* Curran and the Dolichopodid *Tachytrechus bracteatus* Wied. Macfie (1923) mentions a tiger-beetle (*Cicindela octoguttata* F.) standing in the edge of the water and capturing larvae of *A. gambiae*, and also records a water-boatman (*Anisops* sp.) capturing them in the water. *Anisops* is probably important as a check on mosquitoes ; both Hancock (1930) and the present writer are able to confirm its attacks on *Anopheles* larvae in natural conditions. On the very important group of predaceous water-beetles there appear to be no published records, but the writer has seen a species of *Copelatus* capture a larva of *gambiae* in nature on one occasion. There can be little doubt that at least some of these beetles have an important influence in reducing breeding. Dragonfly nymphs and Corixidae are recorded outside our area as destroying a certain number of mosquito larvae, and the writer has observed the former to kill pool-breeding larvae in nature in Uganda. Lewis (1943*a*, p. 71) considers dragon-fly nymphs important in the control of *Aëdes vittatus ;* he informs me that the nymphs were those of *Crocothemis erythraea* Brulle.

(iv) *Crustacea and Arachnida.*—McKenzie mentions a fresh-water prawn reducing breeding of mosquitoes, but does not give his evidence. Ingram and Macfie (1917) record a small crab feeding voraciously on larvae of *Culex thalassius*. Various species of Hydrachnids are known to attach themselves to mosquito larvae (including *Anopheles implexus*) ; they are unlikely to be of much practical importance.

(v) *Fungal diseases.*—Not very much is known about this factor in Africa Macfie (1917*b*) has published a certain number of observations on the point, but the Government Mycologist, Uganda, informs the writer that the identifications of the fungi concerned are very doubtful. MacGregor (1927) mentions that larvae of the three species of *Stegomyia* found in Mauritius are often covered with "pseudo-parasitic" fungi, but that these seldom interfere with development. Walker (1939), Haddow (1942*a*, p. 137) and Muspratt (1946) have shown that several species of *Coelomyces*, including *C. africanus* Walker, may cause a very heavy mortality in mosquito larvae, and that the infection may persist into the adult stage and cause sterility in females or death.*

(vi) *Nematode worms.*—Muspratt (1945) found nematode larvae probably belonging to the family Mermithidae and possibly to the genus *Mermis* infesting the haemocoele of mosquito larvae from about 10% of the tree-holes he examined, the proportion of larvae parasitized being sometimes as high as 70–80%. He also records similar larval nematodes from pool-breeding mosquito larvae including *Anopheles gambiae* and *A. rufipes* as well as Culicines.†

(vii) *Protozoa.*—It is not uncommon to find larvae bearing colonies of *Vorticella* externally, though it is uncertain whether these Protozoa are parasitic or merely epizoitic; these larvae are usually more sluggish than usual, and, if the colonies are extensive, are often unable to pupate. Muspratt (1945) has shown that mosquito larvae are also attacked by endoparasitic ciliates of two forms, one of which multiplies so rapidly in the haemocoele that the host is killed.‡

(viii) *Aquatic birds.*—Ducks and other birds are often stated to devour mosquito larvae. There is no doubt that they do so, but their influence in natural conditions appears to be very small. Kingfishers are undoubtedly a factor favourable to mosquito larvae, as they eat large numbers of larvivorous (and other) fish, and in certain circumstances may almost exterminate an introduced fish, which is handicapped by its unfamiliar surroundings.

(ix) *Amphibia.*—Several authors (more especially in America) have recorded destruction of larvae by tadpoles; no African species has been observed to destroy them, and the circumstantial evidence is not conclusive, but I incline to the belief that in some circumstances certain species of tadpoles may be a fairly important check on breeding.§

* Haddow (1948) notes the occurrence of heavy *Coelomyces* infections in occasional larvae of *Aëdes simpsoni* from plant axils, "the body being a bright golden colour and completely packed with spores."—P. F. M.

† The same author (1947*b*) describes the laboratory culture of these worms which apparently belong to the genus *Agamomermis* Stiles.—P. F. M.

‡ Muspratt (1947*a*) states that the two forms of this ciliate almost certainly belong to the same species, probably *Glaucoma pyriformis* Ehrenberg. In nature larvae of *Aëdes* (*Finlaya*) *fulgens* appear to be the most suitable hosts since the actively multiplying form is dependent for its survival on rupturing the anal papillae of its host before the latter dies. Larvae of *Aedes aegypti* are unsuitable as the anal papillae are less easily ruptured and the reproductive power of the ciliates degenerates if they are transferred from larvae to larvae of this species only.—P. F. M.

§ Haddow (1948) notes the occurrence of several species of small "tree-frogs" in banana and colocasia axils and states that "*A. simpsoni* feeds on these freely and *vice versa*." It is presumed that this refers to adult mosquitoes only but there is probably a selective destruction of ovipositing females similar to that suggested for *Epiplatys grahami* above.—P. F. M.

(x) *Reptiles.*—Lewis (1942*a*) found that small water-tortoises (*Pelamedus galeata* Schoepff) are kept in domestic water jars by the Moro tribe in the Nuba Mountains, southern Sudan, and that these reptiles provide efficient control of mosquito-breeding in the jars.

3. Recording of Breeding-places.

Graham (1910) has laid down an ideal for the application of the study of mosquitoes to the needs of medical and sanitary workers in the following words: "To render the study of mosquitoes practically useful to the sanitary officer, it should be made possible on catching an adult mosquito anywhere, to say: 'This mosquito was bred in a water-butt, puddle, bamboo, empty tin, etc.' It would thus be only necessary to find and destroy the breeding-place." It is unfortunate that the mass of uncritically-gathered records with which the literature is burdened has largely obscured the degree to which this ideal can be attained, in spite of the fact that Hill and Haydon, as early as 1907, laid down the characteristics of the breeding-places of many of the commoner species of *Anopheles* with considerable accuracy and completeness.

Some of the more important sources of error are as follows:

(a) *Too great reliance on the African collector.*—In Africa, as in the tropics generally, the observer is usually forced to depend to some extent on native assistance, of very varying degrees of reliability, either for collection of material or for its preparation for examination. An instance of the way in which error may thus creep in may be given: On one occasion tree-holes were being examined, and I looked over the material and especially noted the absence (as usual) of *Anopheles*; after the material had been mounted for examination it included larvae of *A. funestus*—obviously from some other source. Lester's paper on the coco-nut palm has shown the degree to which even a careful observer may be deceived by unscrupulous native collectors in spite of every effort to check their work; few Africans can grasp the object of larval surveys, and unless a most careful check is kept on them, will collect quantity without regard to source, pandering to what they consider the unreasonable whim of the European by stating that they obtained the larvae in the type of breeding-place which they have been instructed to search.

(b) *Transportation*, by man or otherwise.

Records from domestic utensils of species whose more normal breeding-places are in swamps or water-holes are always suspect owing to the great probability that the larvae have been carried up with the water. I have had a number of instances in my own experience where careful inquiries into a find of unusual species in a native pot or in a barrel have resulted in a clear history of recent transportation of the water from a swamp or river. As Dalziel has pointed out, records from crab-holes are suspect for a different reason—that the drying-up of a flooded area may carry into the holes species of larvae which would not normally be found there.

(c) *Errors in ecological description.*—Records from swamps of species which breed in small containers are not uncommon in the literature; in several such instances it has been possible to prove that the author's intention was to indicate a locality and not a type of breeding-place. An excellent example of this type of error is furnished by *Harpagomyia taeniarostris* Theo., which as described from

" Kampala swamp " and which actually breeds there, but in the axils of *Colocasia* and not in the swamp itself.

A further source of error in this class may be exemplified by such an instance as a long-derelict tub lying in a swamp and partly filled with mud, with grass growing in it. This might with equal accuracy be described as a tub or as a swamp pool, but ecologically is undoubtedly the latter, and contains the species of mosquitoes which one would expect to find in such a pool.

For the reasons mentioned above, compilation of records from the literature has been a matter of some difficulty. The principles which have been adopted are as follows :

Records which clearly fall into one of the above classes have been omitted. This includes series of records by certain authors which, as is clear from their papers, are the unsupervised or insufficiently supervised work of African collectors. No records have, however, been omitted merely because they are in conflict with the writer's experience, but when they are also at variance with the records of careful and experienced workers in both tropical and South Africa, he has felt justified in rejecting them. In considering the records of many species the writer has been much assisted by taking into account the associated species (equally unlikely) mentioned by the authors ; *e.g.* a record of *Anopheles* larvae from a barrel, if accompanied by typically swamp-breeding species of Culicines, is clearly due to one of the sources of error mentioned above.

After taking into consideration all the above points there remain a number of records which seem to the writer to be doubtful, but which he has not felt at liberty to reject. In all cases in which he is unable personally to confirm a record a reference to the authority has been given, but it must not be assumed that such a reference necessarily implies any doubt as to the accuracy of the record.

A minor source of error results from the discovery (subsequent to records of breeding-places) that a given species is composite, and doubt as to the true name of the component to which the records refer. This has in some cases necessitated the rejection of early records ; in other cases it has been possible to identify from the description of the larva the actual species concerned, and in these cases the records have been included.

B. LOCOMOTION.

The means of locomotion employed by mosquito larvae vary according to the circumstances in which they are placed. If a Culicine larva which is feeding at the surface of the water is carefully watched it will be noticed to be moving slowly but steadily in a forward direction, but without any motion of the body. This effect is apparently produced by the movements of the mouth-brushes, but it is difficult to understand why, if this be the case, larvae are sometimes observed to lie motionless at the surface of the water, although the mouth-brushes are in use. On the other hand, larvae are able to change their course without any apparent movement, except of the brushes, and this cannot readily be accounted for except as due to independent action of the mouth-brushes of one side.

On disturbing such a larva a quite different means of progression comes into use ; the larva lashes its abdomen from side to side, without any vertical movement, and is propelled rapidly backwards towards the bottom of the container. In this action the ventral brush is no doubt of the greatest assistance and, in cases in which the upper caudal seta is many-branched, this also doubtless adds greatly to the effectiveness of the action. The specific gravity of a larva is usually very close to that of water, and in consequence the result when the lashing movements of the abdomen cease depends largely on the degree to which the tracheae are filled with air—if much air is present the larva slowly rises towards the surface, otherwise it sinks. Ascent to the surface is effected by similar means to the descent.

Many larvae, particularly those with the browsing habit referred to on p. 23, may also be observed to crawl under water over the surface of the container; in such cases the movement is almost certainly caused by the mouth-brushes. Of different causation is the power possessed by some larvae of crawling on damp surfaces out of the water; this latter movement is effected by a wriggling motion of the entire body, and in some cases larvae are able to travel considerable distances out of the water by this means.

Locomotion in Anopheline larvae is very similar but the browsing motion on the surface of the container does not occur, and progression when alarmed, though effected in a similar manner, is somewhat different: the larva, unless seriously alarmed, does not swim to the bottom, but propels itself rapidly backwards on the surface of the water by lashing movements of the abdomen.

c. RESPIRATION.

The vast majority of mosquito larvae normally obtain the greater part of their air from the atmosphere, and therefore rise to the surface of the water at short intervals to breathe. Air is taken in through a single pair of spiracles situated on the eighth abdominal segment and, in the case of Culicines, at the apex of the siphon. The valves which guard the spiracles open out when the larva reaches the air and lie flat on the surface of the water; they close when the larva descends again.

Cutaneous respiration takes place to some degree by the diffusion of dissolved oxygen through the entire skin of the larva (Wigglesworth, 1933). Macfie (1917*c*) showed that in flowing and thus constantly aerated water, but without access to any but dissolved oxygen, larvae of *Aëdes aegypti* can live in comfort and develop normally to the fourth stage. At this stage development was arrested, probably owing to insufficiency of food. His larvae often lived more than 20 days under these conditions. It is of special interest that, in Macfie's experiments, larvae of *Culex thalassius* lived for a fortnight (the experiment then being discontinued), since in this species the "gills," though well supplied with tracheae, are extremely small, and respiration must be assumed to have taken place through the entire cutaneous surface. Larvae of *C. fatigans*, on the other hand, did not survive a day. In water not re-aerated, and still more in water which has been boiled to expel the air, the survival period of larvae is greatly reduced. Larvae confined under these conditions seldom pupate, and if they succeed in doing so the pupae are immediately drowned.*

* Sautet and Audibert (1946) confined larvae of *Culex pipiens* below the water surface at a temperature of 17° C. and with a dissolved oxygen content of 9·6 mgm./litre. Under these conditions the larvae survived for 5 to 18 days during the winter diapause. In spring, apparently as a result of the cessation of diapause, the period of survival was less (7 days in all cases). The temperature at this time was higher (20° C.). The presence of plants and the use of running water tended to increase the time of survival. First and second instar larvae tended to survive considerably longer than those in the third and fourth instars. The figures quoted are, however, small and their significance is difficult to assess.—P. F. M.

It was formerly believed that the "gills" or anal papillae of mosquito larvae were respiratory organs and experiments by da Costa Lima were considered to afford proof of this, but work by Wigglesworth (1933 and 1938) has shown that the main function of the "gills" is the absorption of chloride and that they have little or no respiratory function. Nevertheless I have continued to call these structures "gills" as a matter of convenience.*

In the genus *Taeniorhynchus*, and in one or two species of *Ficalbia*, air is obtained by thrusting the siphon into the air-spaces of submerged plants, and, at least in the former genus, respiration is not normally performed in any other way. A number of other species, particularly of the genus *Ficalbia*, make use of oxygen entangled on the surface of submerged leaves, but in some instances at least (*e.g. Culex poicilipes*) they also obtain air at the surface in the normal manner when transpiration is not proceeding very actively and the supply of oxygen is, in consequence, small. There can be no doubt that this habit is the starting-point from which the very specialized mode of respiration of *Taeniorhynchus* has arisen.

* Lewis (1949) suggests that the importance of these organs for respiration may vary with the species. —P. F. M.

EXTERNAL MORPHOLOGY OF A FOURTH STAGE CULICINE LARVA

A. GENERAL.

LIKE those of *Anopheles*, the larvae of Culicines are obviously segmented and are divided into three main parts—head, thorax and abdomen.

Head.—The head is a more or less globular structure, usually fairly heavily sclerotized and to a greater or lesser extent flattened in a dorso-ventral direction. The dorsum of the head is divided by two sutures into a large central area (known in different nomenclatures as the clypeus or the frons), smaller lateral areas which bear the eyes and are known as the ocular sclerites, and a small anterior sclerite which is variously called the clypeus or pre-clypeus.

The antenna is placed on a small chitinous boss on the side of the head and is generally more or less strongly curved, the inner side being the concave one ; it bears a tuft of setae (often reduced to one small seta) on the inner side (or, rarely, on the outer side), and a pair of strong bristles, called the subterminal setae, near the apex on the inner side. The shaft is usually narrowed beyond the tuft, and if the antenna is spiculate it is common to find that the portion beyond the tuft is smooth or nearly so. The apex of the antenna bears a pair of bristles known as the terminal setae, and in addition a small chitinous peg or prominence known as the papilla ; it is probable that all the setae on the antenna, including the papilla, are sensory in function.

The anterior sclerite (clypeus or pre-clypeus) bears the clypeal spines, a pair of short strong spines, usually peg-like and heavily sclerotized.

The lateral sclerites bear (in addition to the eyes) three pairs of setae which are usually small, and of which one pair is situated on each side of the " imaginal " eye and one pair placed, usually somewhat ventrally, on the side of the head between the eye and the antenna. The eyes consist of two pairs, a large pair of kidney-shaped structures usually called the imaginal eyes and a small circular structure placed posterior to the imaginal eye, often broken up into individual spots of pigment, and known as the larval eye. The central area of the head (clypeus or frons) bears no structure in a fourth-stage larva except five (occasionally six) pairs of setae. In the first stage it bears the " egg-breaker," a structure used in emergence from the egg (see Fig. 64, I).

The mouth-parts are all ventral, though portions of the labrum and its appendages are visible when the larva is examined in dorsal view. The labrum consists of a central portion and two small lobes ; the central portion is the palatum and usually bears long hairs on its dorsal surface ; it is particularly clearly shown in the figure of *Culex guiarti* (p. 329) ; the lateral lobes bear the mouth-brushes. The mouth-brushes themselves are collections of long curved setae ; by their movements a current, which sweeps food-particles into the mouth, is set up in the water ; these brushes and the remainder of the mouth-parts do not differ in essentials from those of Anophelines.

Thorax.—The three segments of the thorax are not clearly differentiated and can be distinguished only by their setae, particularly the pleural groups. The more important setae of the thorax are: the pleural groups, three groups of four setae each, placed somewhat ventrally on the prothorax and laterally on the other two segments and stated by Puri to represent in the larva the legs of the adult; a series of setae—the "shoulder-hairs"—on the anterior margin of the prothorax; and tufts, which are sometimes stellate, on the central area of the dorsum.

Abdomen.—The abdomen consists of nine apparent segments, of which the eighth bears the breathing-tube, or siphon, and the ninth is the anal segment; but it is considered that the apparent eighth segment is formed by a union of the true eighth and ninth, and that the anal segment is the tenth. In the following pages the word "apparent" is omitted.

The first seven segments resemble one another more or less closely, and each bear lateral tufts of long setae and a varying number of paired dorsal setae.

The eighth segment is more or less triangular when seen in lateral view and has the siphon attached to its dorso-apical aspect. It bears (in typical larvae) three large tufts of setae (known, in order from above downwards, as the siphonal, subsiphonal and anal tufts), and between these, smaller setae, which are usually single. The names of these tufts are definitely misleading, and the writer proposes to refer to them as tufts A, B and C of the eighth segment. Proximal to these setae is the comb, a row or patch of teeth the function of which is not definitely known; it is believed to be employed in cleaning the setae and particularly the mouth-brushes. The siphon is a tubular structure, usually heavily sclerotized, which contains a pair of tracheae opening on a common orifice at the apex. This orifice is guarded by five valves, an unpaired median valve placed on the dorsal side, a pair of small lateral valves and a much larger pair of posterior valves on the ventral side. The siphon may or may not possess at the base an acus—an anvil-shaped chitinous projection whose function is presumably to obtain a firmer attachment of the siphon to the eighth segment.* Towards the base of the siphon on each side is a longitudinal row of teeth, which is called the pecten. There is on the siphon, in all genera, at least one pair of subventral tufts of setae, and one or more pairs of lateral and subdorsal tufts may also be present. Setae are commonly present on the valves at the apex of the siphon, but are usually small and inconspicuous.†

* Sautet and Audibert (1946) in a detailed study of the structure and function of the larval siphon state that most of the muscles employed in opening and closing the valves and raising and lowering the central funnel which receives the paired tracheal openings are attached at their anterior ends either to the wall of the eighth segment at the level of the comb or to the "basal chitinous appendage" of the siphon (presumably the acus). That portion of each trachea which opens onto the central funnel is smooth, i.e. devoid of spiral thickening. It is linked to the spirally thickened portion by a thin membranous region. When the larva leaves the surface film occlusion of the tracheae is effected by drawing down the central funnel towards the base of the siphon. This movement accompanies the closing of the valves and results in occlusion of the spirally thickened portions of the tracheae by folding of the thin membranous portion between them and the attachments to the funnel.—P. F. M.

† Lewis (1949) associates the slight forward curvature of the siphon in *Culex sinaiticus* and *Culex argenteopunctatus kingi* and the more pronounced curvature in *Culex poicilipes* and *Aedes argenteopunctatus* with the habit of feeding in an inverted position on the bottom. In this position the siphon is bent forward and points towards the head and the curvature may help to prevent damage to the tip while the subventral tufts, which are very long in *C. poicilipes*, *C. a. kingi* and *Aë. argenteopunctatus*, help to keep the siphon as a whole clear of the bottom. The short siphon of *Aë. argenteopunctatus* has a large area of flexible cuticle at the base at least in the specimens examined by Lewis and he suggests that this may assist in the forward flexure.—P. F. M.

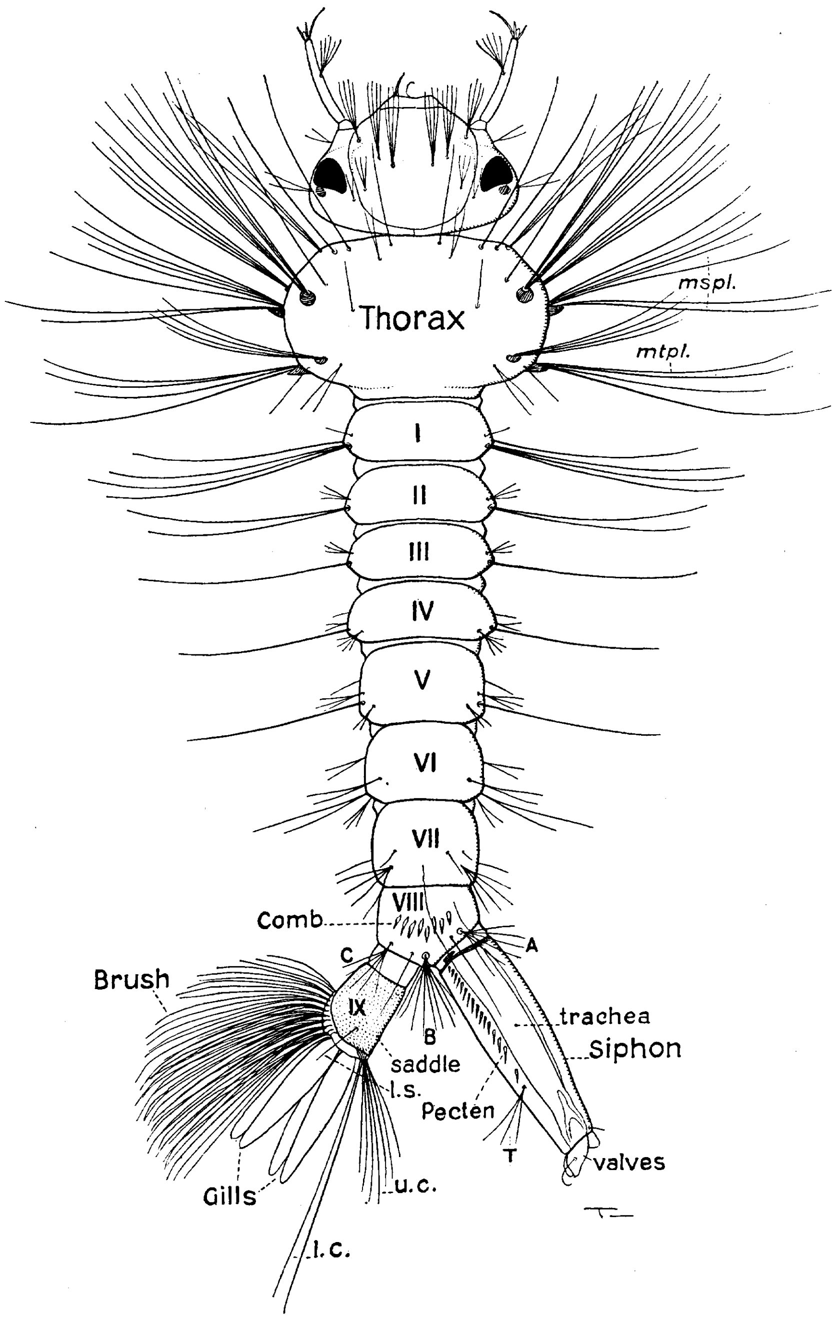


FIG. 1.—General morphology of a Culicine larva. *Mspl.*, *Mtpl.*, mesopleural and metapleural tufts. I–IX, the nine apparent abdominal segments (IX is also called the anal segment). A, B, C, "siphonal," "subsiphonal" and "anal" tufts of eighth segment. T, subventral tuft of siphon. *u.c.*, *l.c.*, upper and lower (or inner and outer) caudal setae.

The ninth or anal segment always bears a large dorsal chitinous plate, which usually covers the greater part of the segment and is known as the saddle ; towards its posterior margin is a tuft or single seta known as the lateral seta. At the dorso-apical angle of the segment (but not on the saddle) there are two pairs of strong setae (often multiple tufts) known as the caudal setae, and at the ventro-apical angle a series of tufts (usually many-branched) termed collectively the ventral brush, fin or beard. The ventral brush is typically composed of a double row of tufts arranged in a zig-zag ; they commonly possess long triangular, highly sclerotized bases, which together make up the " barred area." To the posterior margin of the segment are attached two pairs of thin-walled sacs, known as the " gills," which surround the anus.

B. STRUCTURES CHIEFLY USED IN DETERMINATION.

Head.—The most useful points with regard to the antenna are its shape, the presence or absence of spicules on the shaft and the position and nature of the tuft. The terminal and subterminal setae are of minor importance for specific determination, since they are somewhat more uniform within the limits of a genus. The position of the tuft is indicated by a fraction representing the length of the portion of the shaft proximal to the tuft divided by the total length of the antenna excluding the apical setae and papilla. Gillett (1945*a*) has introduced the term " pedicellus " for the portion of the antenna proximal to the subterminal setae in such larvae as those of *Taeniorhynchus*, and this term has been adopted here.

The setae on the dorsum of the head are of the greatest value in determining the species of a larva ; unfortunately their nomenclature has not been entirely stable. The system chiefly employed has been that of Lang ; as pointed out by Edwards and Given, this nomenclature was devised primarily for Anophelines, and its use for Culicines suggests homologies which may or may not be correct. For this reason, and also for the sake of brevity, the authors quoted suggested the nomenclature shown in Fig. 2. This has the special advantage of being entirely non-committal, and therefore not requiring alteration with altered interpretations of the structure of the head. For similar reasons the writer has dropped the term " clypeal setae " for these tufts and uses the non-committal term " head setae " ; some of the more important terminologies which have been used for these setae are shown in Table 1.

TABLE 1.—*Showing Principal Nomenclatures in Use for Head-setae of Mosquitoes.*

Lang.	Patton and Evans.	Edwards and Given.
Pre-clypeal hair	Pre-clypeal bristle	Clypeal spines
Outer post-antennal	Outer frontal	A
Middle post-antennal	Middle frontal	B
Inner post-antennal	Inner frontal	C
Pre-antennal	Anterior frontal	*d*
Vertical	—	*e*
Trans-sutural	Vertical	*f*

The mouth-brushes are of use in classification only in the cases of predaceous species ; of the other mouth-parts the only part thus utilized is the mental plate (for the sake of brevity referred to in the descriptions below, somewhat incorrectly, as the mentum). Features of taxonomic interest doubtless occur in the mandibles and maxillae, but these parts have not been studied in the case of the African species.

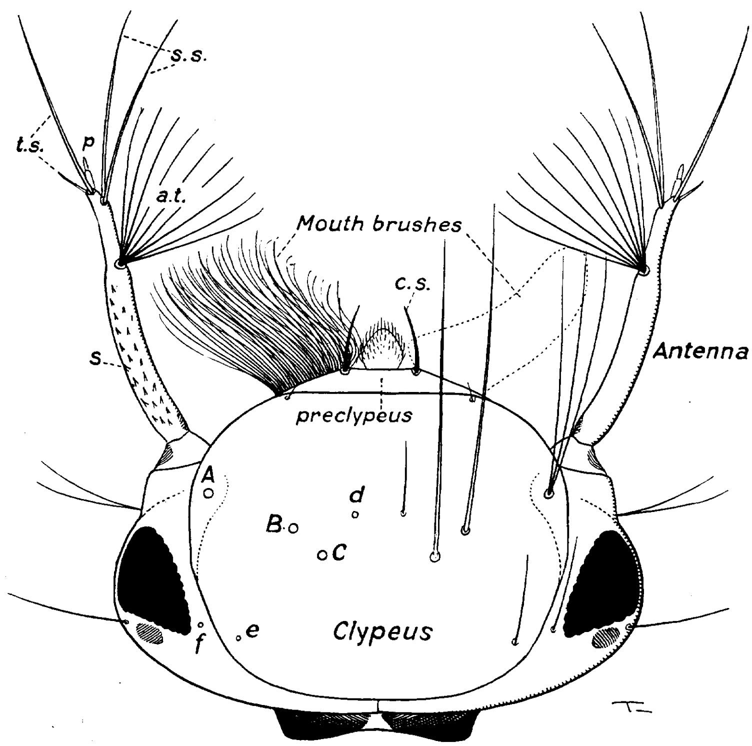


FIG. 2.—Head of a Culicine larva. A, B, C, *d*, *e*, *f*, setae of dorsal surface (referred to in text as the head-setae ; A–*e* are the clypeal or frontal setae). *c.s.*, clypeal (or preclypeal) spines. *s.*, spicules on shaft of antenna. *a.t.*, antennal tuft. *s.s.*, *t.s.*, subterminal and terminal setae of antenna. *p.*, papilla.

Thorax.—The most useful thoracic structures are the pleural groups of setae These frequently have thorn-like spines at their bases, and the presence and shape of these spines is very helpful in separating closely-allied species of *Aëdes*. The relative lengths and number of branches in the four setae comprising the propleural group and the three or four comprising the meso- and metapleural groups, as well as the form of the chitinous plates from which the setae arise, often provide indications of specific or generic value.

Abdomen.—The structures chiefly employed are those of the last two segments. On the eighth segment the comb is of prime importance. The elements composing the comb (and also the pecten) of Culicine larvae have been variously referred to as "teeth," "spines" and "scales"; some authors have kept a clear distinction between spines and scales, while others have used the terms indifferently; the term "tooth" has usually been employed to include both types.

The writer proposes to retain this broad meaning of the word tooth, and to define scales (of the comb or pecten) as follows: *A scale is a tooth which has a thin, flattened, rounded apex bearing a regular fringe, none of the apical denticles of which are markedly longer than the remainder.* Teeth which do not fall under this definition of a scale are termed "spines"; in the great majority of cases the apex is formed by one or more thorn-like terminal denticles, which are markedly larger than the lateral and basal denticles. In the few instances in which the spines are not of this type (*e. g. Aëdes africanus*) the apical portion is not (or only slightly) flattened, and is obviously of considerable thickness. In the vast majority of cases the above definitions will present no difficulty. Except in the genus *Uranotaenia* the teeth of the pecten are invariably spines, but those of *Harpagomyia* are somewhat intermediate in character, and in *Uranotaenia* the pecten is usually composed of scales. With regard to the comb there is a general rule, with few exceptions, that in species with the comb composed of numerous teeth the latter are scales, and that when the teeth are few they are spines.

The siphon varies greatly in length and structure; its length is expressed by the "siphonal index"—a figure representing the result of dividing the length of the siphon (excluding the valves and acus) by its width at the basal ring. The extent of the pecten and shape of its teeth are of great value, and of still greater importance are the tufts of setae on the siphon. In the great majority of genera there is only one pair (a subventral pair) of such tufts; its position is defined by a fraction obtained by dividing the length of the portion of the siphon proximal to the base of the tuft by the length of the whole siphon (again excluding valves and acus). In *Culex* and *Harpagomyia* there is more than one pair of subventral tufts, and they are arranged in a more or less zig-zag line. In many cases there is little evidence of the fact that these tufts are paired, but it is an accepted convention to consider them as being so. *Harpagomyia* is peculiar in that one of the subventral tufts is much larger and of different character than the others, and it seems clear that this is the original subventral tuft and that the remainder are secondary. The lateral and subdorsal tufts are usually of less importance. In the descriptions it is commonly stated that the tufts are, or are not, as long as the diameter of the siphon; the reference is invariably to the diameter *at the insertion of the tuft.*

On the anal segment the main points of importance with regard to the saddle are its size, the presence or absence of spicules on its posterior margin, and the character of the lateral seta. The saddle may be a mere plate covering a comparatively small area of the dorsum and the sides of the segment, or the two lateral flaps may be fused in the mid-ventral line, thus forming a complete tube of chitin; in the latter case the saddle is said to be complete. The dorsal setae of this segment are known variously as the upper and lower or the inner and outer caudal setae, depending on whether the larva is assumed to be examined from the side or from above. As it is impossible to examine the anal segment of a Culicine larva satisfactorily except in lateral view, the present writer much prefers the terms "upper" and "lower" for these setae.

The ventral brush is often much reduced, and has in such cases been recorded as absent. In one instance only (*Culex moucheti*) both brush and barred area are completely absent ; absence of the barred area is commonly of generic value. In some genera a mid-ventral row of tufts, similar to, but smaller than, those arising from the barred area, is sometimes present proximal to this area ; these median tufts are never paired. The " gills " are often very variable in size within a given species, but the relative proportions of the two pairs and their shape are often of considerable assistance in detecting the species to which a larva belongs.*

General.—In the descriptions below " size " and " colour " are given when possible. Size is, of course, variable even in full-grown larvae of one species, but the writer finds it of some assistance to know the approximate size of the full-grown larva. Colour is also extremely variable, but is often of assistance in sorting mixed batches of living larvae. In a few instances (*Ficalbia perplexens* and *Culex grahami*) this single character will at once separate the larvae from all others in a mixed batch.

c. ADAPTATIONS TO SPECIAL HABITS OR ENVIRONMENTS.

The external morphology of typical Culicine larvae has been described above. Peculiarities of habits, or of the type of breeding-places chosen, are often associated with deviations, sometimes considerable, from this type. In the notes given below these modifications have been considered under two main headings, (1) in connection with habits, (2) in connection with peculiar types of breeding-places ; the generalizations made do not necessarily apply to any but Ethiopian species. It is important to remember that in larvae which have both peculiar habits and specialized breeding-places the modifications associated with one may be incompatible with those associated with the other ; in such cases one set of modifications is found to preponderate, but not to the entire exclusion of the other. It has here been assumed that the typical larva is one which breeds in places of the " ground pool " type, which obtains its food by ingesting micro-organisms swept into its mouth by the action of the mouth-brushes, and which obtains at least the major portion of its supply of oxygen from the air at the surface of the water.†

* Kettle (1948) has studied the growth of the " gills " of *Anopheles sergenti* in water of various salinities. He concludes that the size of the " gills " is related to the chloride content of the haemolymph and that the two are probably controlled by the same factor and states that in nature a large proportion of breeding places of this species were found to contain water in the range of salinity where small changes produce large differences in the length of the " gills." He concludes, therefore, that, although under certain circumstances the length of the " gills " in *A. sergenti* may prove to be a useful specific character, it is unlikely to be a critical one. It is clear therefore that such a character must be employed with reasonable caution. The same applies to comparative measurements of other organs or regions which may undergo quite different types of growth during larval life. Thus Kettle (1948) has shown that in *A. sergenti* the head shows discontinuous growth with sudden increases in size at each ecdysis while the thorax grows continuously but its growth is heterogonic, its length increasing faster than its breadth, and the second abdominal segment grows continuously and uniformly, the length-breadth index remaining constant. In this species the growth of the " gills " shows a mixed pattern, slow continuous growth being combined with sudden increases at ecdysis. In *Aëdes aegypti* and three North American mosquitoes Abdel-Malek and Goulding (1948) have shown that discontinuous growth occurs in the case of the siphon as well as of the head capsule and these authors claim that both the head width and siphon length give a reliable criterion for determination of the instar.—P. F. M.

† Cutaneous respiration has been proved (see p. 13) to occur in many mosquito larvae, but this appears to play a comparatively minor part in the physiology of the insect.

1. Modifications Associated with Habits.

a. *Respiration.*—The main modifications which call for comment are those which accompany association with plants for the purpose of obtaining the oxygen which adheres to the surface of the stems or leaves, or is contained in the tissues. Modifications of this type appear to be confined to the genera *Ficalbia*, *Aëdomyia* and *Taeniorhynchus*, and apply almost exclusively to the siphon and perhaps the antenna. In the genus *Ficalbia* the association with plants appears in most cases to be compulsory, since no member of the genus except *plumosa* has been found in places devoid of living vascular plants. The less specialized members of the genus are undoubtedly capable of obtaining oxygen from the atmosphere, but in some instances at least (*e. g. F. splendens*) they obtain it with equal facility from the film of air on the lower surface of the leaves of aquatic plants. As, in these less specialized species, the habit is not obligatory, but facultative, we find that the modifications associated with it are small or even absent, but in *F. splendens*, which appears to be associated solely with *Pistia stratiotes*, and in some other species (*e. g. uniformis*), the lateral valves of the siphon form strong, curved, forwardly directed hooks, which are doubtless of great assistance to the larva in maintaining its position while obtaining air from the surface of the leaf. In *F. perplexens* the modifications are greater, since the siphon is tapered to a fine point in such a way as inevitably to suggest that it is thrust into the tissues of the plant ; unfortunately, there are no observations on this very rare species to support this suggestion. In *F. pallida* we find the extreme form of modification within this genus, the siphon is very strongly modified for piercing the tissues of plants, and it seems beyond doubt that this species does not normally obtain its oxygen in any other way. *Culex poicilipes* has the valves exceptionally large, and has been shown to be capable of obtaining oxygen from the film on submerged plants, and in *Hodgesia* the size of the valves suggests such a habit though no observations have been made.

Aëdomyia shows modifications of the siphon which are not dissimilar from those found in the less specialized species of *Ficalbia*. The siphon has the lateral valves transformed into very large hooks ; it is peculiar in other ways, but there is little to suggest that these further peculiarities have anything to do with the habits of the larva. The larvae of *Aëdomyia* have numerous other peculiarities, including the enormous size of the antennae and palps, the presence of a peculiar bladder-like organ at the base of the antenna, and the extreme hairiness of the whole larva. The writer is inclined to believe that the large size of the antennae and the palps may be correlated with the somewhat sedentary habits of the larvae, since these appendages seem to be used to direct into the mouth the water currents set up by the mouth-brushes ; other suggestions have been mentioned in the description of the genus (p. 72). Mr. J. Muspratt kindly informs me that in certain swamp-breeding Culicines, including *Aëdes argenteopunctatus* (atypical larva), *Culex argenteopunctatus* and *Culex weschei*, he finds bladder-like organs, similar to those present in *Aëdomyia* but smaller, on the underside of the head, coupled with a remarkable development of the tracheal system which extends into the bladder-like organs (Fig. 3) as well as into the anal papillae (" gills "). He notes that these larvae, like those of *Aëdomyia*, are able to submerge for long periods (at least 40 minutes), and suggests, probably correctly, that the bladders may be an oxygen-absorbing apparatus.*

The greatest modifications of all are found in the genus *Taeniorhynchus*, in which the siphon is highly modified and extremely uniform throughout the genus. The hook-like valves mentioned above are still more developed in this genus, and we find the whole tip of the siphon transformed into a complicated apparatus, which includes a highly developed saw, for piercing plant tissues. A detailed description of these structures is given below (p. 100).

In all the species which obtain part of their air supply from plants the " gills " are notably small and wedge-shaped ; the reason for this is not known.

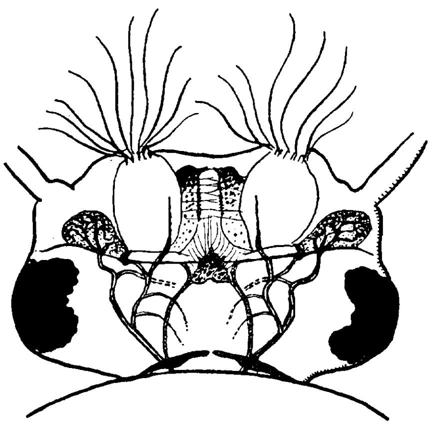


FIG. 3.—*Culex* (*Culex*) *argenteopunctatus* Ventrillon. Ventral surface of head showing bladders and the tracheal system supplying them. (Drawn from a freshly killed larva).

Species which breed in small containers typically have very long sausage-shaped " gills." Da Costa Lima has shown that such " gills " have much more complicated tracheal ramifications than the lanceolate type which is typical of pool-breeders ; it is interesting to note that the genera mentioned by him as having this sausage-shaped type of " gill " are all breeders in small containers. This type of " gills " is presumably an adaptation to the low chloride concentration in such places.

b. *Feeding*.—The normal type of mouth-brush is composed of a very large number of rather long soft setae, which function purely as an apparatus for setting up currents which carry food-particles to the mouth. Throughout the genus *Aëdes* a somewhat different mode of feeding is found, though the mouth-brushes are also used in the normal way. Disregarding for the moment the subgenus *Mucidus*, larvae of this genus (and of one or two others) obtain a large proportion of their food by browsing over the surface of the bottom or sides of their breeding-place, or over that of any

* Lewis (1949) describes large thin-walled " papillae " arising on the ventral surface of the head in the region of the antennal peduncle in larvae of *C. argenteopunctatus kingi* and *Aë. argenteopunctatus* from the Sudan. He notes that larvae of *C. poicilipes*, *decens*, *perfuscus*, and *sinaiticus* have well-developed superficial tracheoles in this position and that these are bathed in a current of water produced by the mouth-brushes. He suggests that they may assist in respiration and associates their development with the habit of feeding for considerable periods on the bottom.—P. F. M.

dead or living vegetation which may be present. The only modification obviously correlated with this habit is that the setae composing the mouth-brushes tend to be rather short, somewhat coarser than usual, and slightly reduced in number, at least the inner ones are finely serrated at the tip. This is clearly the basis from which the type of mouth-brush found in predaceous species has been derived; in the course of browsing, corpses of deceased comrades are frequently encountered, and these, if sufficiently decomposed, are often wholly or partially devoured.

Predaceous larvae are well exemplified by *Toxorhynchites*, *Aëdes* subgenus *Mucidus*, and *Culex* subgenus *Lutzia* (Fig. 4, p. 35; Fig. 55, p. 121, and Fig. 141, p. 250). The most obvious modification is a great increase in size of the entire larva. The setae of the mouth-brushes are short, stiff and much reduced in number (in *Toxorhynchites* to about ten on each side) and they are strongly serrated at the tip in *Mucidus* and *Lutzia*, while in *Toxorhynchites* the tip, though not serrated, is armed with two small teeth. In connection with this modification of the brushes the lateral lobes of the labrum, from which the brushes arise, are greatly enlarged, and are set wide apart so as to provide a wider gape. The remaining mouth-parts tend to be large and strongly sclerotized and the mandibles are very strongly toothed. The antenna is very short, and both the antennal tuft and the other setae of the head are much reduced. The siphon is greatly reduced in *Lutzia*, but not in *Mucidus*; *Toxorhynchites* has a very short siphon, but this is perhaps correlated rather with its breeding-places than with its predaceous habits. The "gills" are very short in all the predaceous forms, and this is particularly significant in the case of *Toxorhynchites*, which, from the nature of its breeding-places, might be expected to have long "gills." The explanation of this anomaly is evidently that predaceous larvae obtain a sufficient supply of chloride from the bodies of their victims, and thus do not require large "gills" wherewith to absorb it independently.

Ficalbia (*Mimomyia*) *plumosa* (p. 95) shows many of the modifications which we associate with predacity, but there is no evidence that it has adopted a predaceous mode of life, nor are its mouth-parts of a type suitable for such a method of feeding. Its size is enormously greater than that of any of the other members of the genus, and the antenna and head setae are greatly reduced. On the other hand, the mouth-brushes are very small and weak, and the other mouth-parts are notably feeble and lacking in sclerotization; in particular the mentum entirely lacks the sclerotized plate found in all other known mosquito larvae. The writer believes that this larva feeds on the soft mud in which it is commonly found; for such a mode of life long antennae and mouth-brushes and a highly developed head chaetotaxy would be very inconvenient, while strongly sclerotized mouth-parts would be quite unnecessary.

2. Modifications in Connection with Habitat.

a. *Life in small containers*.—Larvae which may be considered typical of this habitat show a very characteristic facies: the antenna, head chaetotaxy, siphon (and therefore also the pecten) and ventral brush are all considerably reduced, conceivably as an adaptation to the small amount of swimming-space available. The "gills" are very large and sausage-shaped; the reason for this shape has been discussed above. The presence of numerous large tufts of setae on the thorax and abdomen, giving the larva a hairy appearance, is common but by no means universal. The reduction of the ventral brush is accompanied by the development in many species of a habit of crawling over the surface of the container—a habit specially developed in those larvae (*e. g. Eretmapodites* and *Harpagomyia*) which breed in fallen leaves or in plant axils.

It is difficult to decide to what extent the characters detailed above are true adaptations to life in small containers, and to what extent they are survivals of primitive characters which happen to be suitable for such a mode of life, since in several of the more primitive genera of Culicines (*e. g. Uranotaenia*) the pool-breeding species have a facies quite similar to that of larvae which breed in small containers. For this reason I have refrained from discussing those larvae of the more primitive genera which breed in small containers unless they show important deviations from the hypothetical type indicated above. On the other hand, it is difficult to believe that in *Culex*, which is usually considered the most specialized genus in the larval state, these characters can be primitive, and it is in this genus that divergence from the generic type has proceeded to the highest degree.

In the primitive genus *Toxorhynchites* the "gills" are extremely atypical. I have suggested above that this feature is correlated with the predaceous habits of the larva.

The genus *Harpagomyia* is usually considered primitive and is therefore not discussed here; it has all the characters detailed above, as also has *Eretmapodites*.

In *Aëdes* we find that a short siphon is usual throughout the genus, so that the presence of this character in the forms which breed in small containers means little; the siphon in such forms is perhaps slightly shorter on the average than in those which breed in pools, even omitting *Aëdes* (*Aëdimorphus*) *ochraceus*, which has the abnormal siphonal index of 6–8. The head chaetotaxy and antenna are reduced in the majority of the species which breed in small containers, and in many of them the ventral brush is also greatly reduced (the *apicoannulatus* group of *Aëdimorphus* and *Finlaya longipalpis* are very atypical in this latter respect). The "gills" are sausage-shaped throughout the subgenera *Stegomyia* and *Dunnius*, and they tend to be so in the section of *Aëdimorphus* which breeds in small containers, whereas in all the known pool-breeding species of the entire genus (except those which breed in salt water) the "gills" are lanceolate. *Aëdes vittatus* is an interesting exception to the statements just made with regard to the subgenus *Stegomyia*. Unlike the other members of the subgenus it does not breed primarily in small containers, and its structure is in many respects not that of a typical *Stegomyia*; the ventral brush is in no way reduced and the "gills" are lanceolate.

The differences between species which breed in pools and those which breed in small containers are most marked in the genus *Culex*. Of the seven species which are definitely known to breed in small containers five have a reduced head chaetotaxy, short antennae, a very short siphon, reduced ventral brush and sausage-shaped "gills"; the other two are atypical in all of these respects except that *C. horridus* has more or less sausage-shaped "gills." In the five species mentioned the highest siphonal index is about 3, while in the pool-breeding species (except the predaceous *C. tigripes*) it is never less than about 4, and in the great majority it is 6 or more. The reduction of the ventral brush is especially marked in *C. hancocki*, in which the barred area (present in all the pool-breeding forms) is absent, and this reduction reaches its maximum in *C. moucheti*, which, unlike every other known species of mosquito, lacks all trace of either barred area or ventral brush. It can hardly be argued that in these two cases the modifications are primitive. Of the pool-breeding species of *Culex* none has sausage-shaped "gills," but those of *C. duttoni* are intermediate. The case of *C. fatigans* is of peculiar interest: the writer once found a number of larvae (in some discarded motor tyres) which were quite unfamiliar to him; when bred out they produced typical specimens of *C. fatigans*. These larvae differed from normal *fatigans* in having a very much shorter siphon, the index of which was less than 3, whereas in specimens from pools it is usually quite $3\frac{1}{2}$.

Wesenberg-Lund, working largely with the limited European fauna, has published remarks on the facies of those larvae which breed in small containers; his conclusions are in very close agreement with the observations of the present writer. It is possible that Wesenberg-Lund's suggestions with regard to the characters of bottom-feeding larvae are due to the very limited number of genera at his disposal.

b. *Saline waters*.—The only character which we can associate with life in saline or alkaline waters is a reduction of the "gills," which are found to be much shorter than usual and very rounded. A comparison of the figures of *Aëdes irritans*, *A. natronius*, *Culex thalassius* and *C. mirificus* with those of their near relatives will immediately demonstrate this feature. Larvae of *Anopheles christyi* and *Culex decens* which were collected by Mr. Gibbins in alkaline waters and examined by the writer had "gills" much shorter than in normal larvae of the same species.

TECHNIQUE

A. COLLECTION.

MANY methods have been used for the collection of larvae, and those mentioned below are merely those which the writer has found most successful ; it is not to be assumed that other methods are not equally good or even better in other hands.

For large areas of water the writer uses a white enamel dish, preferably of the type known as a " latex dish," which has straight sides without an overhanging edge and is similar to a full-plate photographic developing dish ; an ordinary rectangular pie-dish is a fairly good substitute. The dish is dipped into the water rather sharply, usually at an angle of about 45°, though it is very desirable to vary the angle in order that different species may be collected. Under banks, and where there is vegetation, deeper dipping is necessary in order to capture larvae hiding among the vegetation or resting under the banks. Larvae are readily seen against the white background of the enamel and can be removed by means of a small pipette, made of ordinary glass tubing (not greatly narrowed at the end or larvae will be killed) fitted with a rubber teat and similar to a fountain-pen filler. The larvae are then transferred to wide test-tubes or small bottles, the mouths of which are loosely plugged with cotton-wool. If larvae are not numerous it is sometimes convenient to transfer each dishful of water to a large enamel basin and to use the pipette only when the basin is full ; this method also enables several rapid consecutive dips to be made without waiting to collect the larvae from the dish, and is therefore very useful in collecting those species which, if given time, would sink to the bottom and hide among vegetation. The basin is also sometimes useful for dipping, as it enables large areas to be worked in a short time, and the inrush of water is great enough to draw in larvae which are hiding among vegetation, but it is inconvenient to carry.

It is often advisable, after dipping with the dish, to stir up the mud in the pool and dip again after waiting a few minutes ; many larvae which were previously hiding on the bottom are thus brought to the surface.

Those larvae which attach themselves to plants present a special problem since they are not captured by ordinary dipping. The method which has been advocated for these species is to pick the plants out of the water and wash them thoroughly to dislodge the larvae, but this is a slow and laborious process. The writer has found that stirring the plants thoroughly and then using a water net is much more rapid and productive for these species ; the net is inverted into a dish of clean water and the larvae washed off it into the water. Gillett (1946) found another very successful method of obtaining these larvae to be to uproot handfuls of the aquatic vegetation, suddenly thrust a large basin in under the roots, allow the water to settle for half a minute, and then decant it off slowly until only about half an inch of water remains, when larvae of *Taeniorhynchus* will begin to show themselves.

For small pools a large white enamel ladle is most useful ; it can be used for places, such as hoof-prints, which cannot be worked by means of the dish, and from which, without a ladle, the larvae must be captured one by one by means of the pipette ; the use of the latter is much facilitated by stirring up the mud beforehand.

Larvae from small containers can often be collected by means of the ladle, but for bamboos, plant axils and the smaller tree-holes this is too large. For these the writer commonly uses the pipette mentioned above, but for the larger breeding-places of these types a larger and more elaborate pipette is required. This is made of a glass cylinder, about an inch in diameter, to the top end of which is attached the rubber bulb from a motor-horn ; the other end is narrowed by means of a cork, and a short piece of fairly wide-bore glass tubing is thrust through a hole in the cork ; to the lower end of the glass tube is attached a length of about six inches of rubber tube. The flexibility of the rubber tube enables it to be pushed down to the bottom of such places as a bamboo-joint holding water, and if a greater length of rubber tube be attached, the same pipette can be used for crab-holes and obviates the labour of digging these out. This pipette is similar to that used for testing the specific gravity of acid in car batteries. Another method, suitable for very large cavities, is to siphon the water out into a basin by means of a length of rubber tube. It is necessary to stir the debris at the bottom while doing this or many larvae will be left behind.

B. BREEDING.

Several authors have recommended the use of shallow vessels, open to the air, for breeding out the larvae collected. The writer finds small wide-mouthed bottles, loosely plugged with cotton-wool or covered with a small sheet of glass, entirely suitable if attention is paid to the subject of food-supply. For the purpose of providing food a small rooted piece of grass put into the water is very convenient ; in the case of Anophelines it must not be allowed to rot, but with many Culicines this point is immaterial. Dried yeast, finely powdered and sprinkled on the surface of the water, is excellent for almost all species ; care must be taken to avoid giving too much yeast or the larvae will die. Predaceous larvae are usually very easily reared if kept well supplied with other larvae on which to feed ; the time they spend in the larval stage is more or less inversely proportional to the amount of food given, since most of them are able to live for long periods with little or no food.

In the case of such larvae as those of the genus *Taeniorhynchus* it is necessary to provide a source from which they may obtain air without coming to the surface. For this purpose *Pistia,* while quite suitable, is rather too large for convenience, and fine floating grasses have been used with satisfactory results ; Gillett (1946) considers plants of *Commelina africana* even more suitable for this purpose, and Wanson (1944) has used with success strips of thick, coarse packing-paper, in the pores of which air becomes entangled.

C. IDENTIFICATION OF LARVAE.

In the past it has too often been assumed that, if larvae and pupae are collected from a given breeding-place and part of the material preserved and part bred out, it is safe to describe the preserved larvae as those of the species to which the adults belong. Not only are mixed batches of larvae the rule, but it has not uncommonly been the writer's experience to breed out adults of one species only from a batch, and to find that the larvae also all belonged to one (but a different) species. This is brought about partly by different rates of growth of larvae and partly by differential mortality (*e. g.* in a mixed batch of *Culex grahami* and another species it is quite probable that all the larvae of *grahami*, which are very delicate, would die, and that the other species would breed out in pure culture).

The only safe method of identifying an unknown larva or pupa is to isolate single specimens and retain the pelt shed when they change into pupae or adults. Larvae may conveniently be isolated in test-tubes, in which the adults can readily be chloroformed without removing them from the tube, thus reducing the danger of error. It is very desirable to preserve whole larvae from the same batch, since these can be compared with the skins, and often show characters which the latter do not (*e. g.* the general shape, particularly of the head). Through failure to use the isolation method a number of wrong ascriptions of larvae have been made in the past, and in some cases the true species to which a larva belongs is still in doubt.

A method by which larvae can be identified without injury, so that undescribed forms can be recognized and bred in isolation, is obviously of great value; such a method has been described by Gillett (1942). He first partially asphyxiates the larva by placing it in a tube of water covered by a glass slide in such a way as to exclude all air. The larva is next placed in a cell made by cementing together four microscope slides, portions having been cut away from the two inner slides so as to form the required cell; the size of the cell is of great importance, and the optimum size for fourth-stage larvae of most genera is 15 mm. square with a width of 2·75 mm. When the partially-asphyxiated larva is placed in the cell, which is filled with water, its need for oxygen is so great that it will remain motionless at the surface for a considerable period, permitting of easy examination with a microscope in a horizontal position. The narrowness of the cell not only ensures that the larva cannot get badly out of focus, but forces it to present its terminal segments to the observer in the desired lateral aspect.

Downs (1943) describes a method for examining living larvae in a "stock solution" of polyvinyl alcohol: "The stock solution is prepared by adding PVA (Grade RH-349) powder slowly to cold water, stirring it in thoroughly. The powder goes into solution with difficulty, but the process can be hastened by heating in a steam bath until the solution becomes about as viscous as thick molasses. At this time the solution appears milky, owing to the inclusion of small air bubbles. Upon further heating, or if left to stand for several hours, it becomes water clear. Any undissolved material can be strained off. The stock can be stored and preserved indefinitely and diluted with water to any consistency desired. . . . The stock solution has . . . been found useful for the examination of mosquito larvae. Live larvae are placed on two or three drops upon a slide. The larvae are quite firmly held by the viscous solution and can be examined most minutely for as long as half an hour. Upon completion of examination the larvae can be washed off into a container of water and soon recover."

Errors may arise even when the isolation method has been faithfully followed, the most fruitful cause being misidentification of the resulting adults, and particularly the not infrequent discovery that a well-known "species" is composite.

Ficalbia hispida is a good instance of this, having recently been shown to include at least three separate species, all with larvae which are readily separable.

In order to avoid such errors in the future, or rather to make their elucidation possible, the term "paedotype" is here proposed for the type of any of the early stages of an insect and is defined as follows: *A paedotype is the type of any of the immature stages of an insect. It consists, in the case of larva or pupa, of the larval or pupal skin, together with the adult insect bred from the same individual larva or pupa; in the case of the egg it may be either the whole egg together with the female which laid it, or the egg-shell and the adult bred from it.* It will, of course, commonly happen that egg, larva and pupa are described at different times; in such cases there should be one paedotype for each stage. It is suggested that paedotypes should be indicated by a small circular green label attached to the specimen of each of the stages which make up the paedotype, and that this label should be inscribed to indicate whether the paedotype is of egg, larva or pupa. When possible it is, of course, desirable to make the same adult serve as part of the paedotype for more than one of the early stages, and it is also clearly desirable that this adult should belong to the sex which is most readily identifiable. *Neo-paedotypes* may be designated when the original description of an early stage was not made from material procured by the isolation method, or when it is no longer possible to associate the larval or pupal skin with the adult bred from it.

D. PRESERVATION OF LARVAE.

For preserving larvae in the field alcohol or formalin have frequently been used and are fairly satisfactory, provided, in the case of alcohol, that it is not stronger than 70%; both have the disadvantage of being insufficiently viscous to prevent the larvae losing setae, "gills" and other structures by being shaken about in transit. To improve the viscosity glycerine is often added to the alcohol, but it has a strong tendency to cause shrinkage, particularly of the "gills." To avoid this difficulty Buxton and Hopkins have described a method of transferring the larvae gradually from 70% alcohol to strong glycerine; this method is very effective but takes more time than is commonly convenient.

For field work the writer much prefers to use lactophenol, which is prepared by mixing 20 c.c. phenol (absolute), 20 c.c. lactic acid, 40 c.c. glycerine and 20 c.c. water. Living larvae can be transferred direct into lactophenol, and the small amount of water which is inevitably added with the larvae has no ill effect. The lactophenol is sufficiently viscous to prevent much damage by shaking, and such damage, when it occurs, is usually restricted to the "gills"; in addition, the larvae are cleared by the solution and are ready for immediate examination.

All the writer's routine examinations are made in this medium, into which larvae preserved in spirit may be transferred direct. For rapid examination a cover-slip may be dispensed with if the higher powered objectives of the microscope are not to be employed. This has the advantage, in the case of Anophelines, of permitting manipulation of the larva to show lateral structures. In the case of Culicines, where a lateral view of the terminal segments is essential, it is necessary to cut the larva in two across the abdomen, and to mount the terminal portion in side view and the anterior portion with the dorsal side up.

These lactophenol mounts can be made so that they will last for a few years by ringing the coverslip with a mixture of dry canada balsam and a paraffin wax of a high melting-point ; this mixture is prepared by heating the wax in a crucible, adding the balsam gradually, and continuing heating until all smell of turpentine disappears. The ringing material is applied hot and not too sparingly ; it is important to ensure that the slide and the top of the coverslip are perfectly dry, as otherwise the seal will be incomplete. To avoid crushing the larvae hollow slides can be employed, or narrow strips of rather thick blotting-paper or celluloid may be put between coverslip and slide ; this should be done for temporary as well as permanent mounts, otherwise the shape of the head and the siphonal index are often entirely altered.

Mounts made by the above method have the very great advantage that the refractive index of the lactophenol is such as to make readily visible the minute structure of setae ; the mounts, however, are somewhat untidy, and experience has shown that they are insufficiently permanent for use in a reference collection. Permanent mounts may be made in canada balsam, and larvae from lactophenol are quite suitable for this purpose if transferred to water for about half an hour before dehydration. Balsam mounts are definitely permanent, but they take longer to make than those in lactophenol, and have the further disadvantage that after a short period the clearing becomes excessive, and it is difficult to distinguish with certainty the finer structure of the setae.

Permanent mounts can also be made in " euparal," a substance somewhat similar to canada balsam, but with a more suitable refractive index. Mounts are dehydrated in a similar way to those in balsam, but are transferred to the euparal direct from absolute alcohol.

Another mounting medium strongly recommended by Dr. I. M. Puri has the following formula :

Water	10 c.c.
Gum acacia (picked)	8 g.
Chloral hydrate	70 ,,
Glycerine	5 c.c.
Acetic acid (glacial)	3 ,,

" The ingredients are dissolved on a water-bath (at about 80° C.) in the order named and the fluid passed through three or four thicknesses of clean muslin. If gum has been carefully picked, the resultant fluid will be perfectly clear and ready for use " (Puri). Living larvae may be placed directly in this fluid ; those which have been preserved in spirit or formalin are best transferred to water for a short time before mounting. The resulting mounts show every detail to perfection, but it is necessary that they should be carefully ringed with a strong cement (*e. g.* canada balsam), as the gum is liable to shrink very greatly ; the time needed for the mountant to become sufficiently hard for ringing may be some days or weeks. Cell slides should be used whenever possible to avoid distortion by pressure of the cover-slip.*

* Mr. D. J. Lewis informs me that he has had very unsatisfactory results from the use of canada balsam for ringing as it tends to blacken the mounting medium. It is desirable therefore to employ some other substance such as asphalt varnish or gold-size.—P. F. M.

It seems likely that the lactophenol-polyvinyl alcohol mountant described by Downs (1943) will replace all others if claims made for its permanence are confirmed. This mountant is made by mixing 56% (by volume) of stock polyvinyl alcohol solution with 22% phenol and 22% lactic acid. The larvae are mounted direct from water (excess water being roughly dried off) and clearing takes place automatically. I have tested this method and find that, not only is it far quicker and less troublesome than making mounts in canada balsam or euparal, but the finer structure of the setae is visible to perfection. The mounts set firm in a couple of days and it is claimed that they are permanent. For routine work it is essential that a mountant should be easily removed, and Down's mountant fulfils this condition at least so far as recently mounted material is concerned, for it is easily dissolved by soaking in cold water or a brief immersion in hot water.

TAXONOMY

In the following pages descriptions are given of all the known larvae of Culicine mosquitoes occurring within the Ethiopian region—this term being used in the sense in which it is commonly employed by zoologists, to include the whole of Africa south of the Sahara, as well as Aden and South-west Arabia, Madagascar and the adjacent small islands, and the islands of the Gulf of Guinea.

In many cases species have not been reared, and in other instances although the species have been reared, no description of the larva has been published and no specimens preserved. Such instances are referred to in the text.

Key to Genera of Fourth Stage Ethiopian Mosquito Larvae.

1. Siphon absent . . . . *Anopheles*.
   Siphon present . . . . 2.
2. A large lateral chitinous plate present on eighth abdominal segment . . . 3.
   No such plate present . . . . 6.
3. Mouth-brushes modified (for predacity) into strong curved spines; comb absent . . . . *Toxorhynchites* (p. 34).
   Mouth-brushes not so modified, slender; comb present, set on the edge of the plate . . . . 4.
4. Comb consisting of a double row of long slender spines; additional (dorsal) large chitinous plates usually present on abdominal segments VI–VIII *Orthopodomyia* (p. 82).
   Comb a single row of which the teeth may or may not be long and slender; no such dorsal plates present . . . . 5.
5. Antenna very large, much flattened; a pair of strong curved spines preset at apex of siphon . . . . *Aëdomyia* (p. 71).
   Antenna not very large nor flattened; no such spines at apex of siphon *Uranotaenia* (p. 50).
6. Siphon highly modified for piercing aquatic plants; head setae all much shorter than head . . . . *Taeniorhynchus* (p. 99).
   Siphon not modified thus, or if so, setae B and C about twice length of head . 7.
7. Siphon with a dorsal or subdorsal row of 4 or 5 multiple-branched tufts of setae *Harpagomyia* (p. 42).
   Siphon with at most 2 such tufts, of which one is subdorsal and the other lateral* . . . . 8.
8. Siphon usually with numerous subventral tufts, always with more than one such tuft (these tufts may be very small and inconspicuous or consist of single hairs) . . . . *Culex* (p. 245).
   Siphon with only one such tuft . . . . 9.
9. Subventral tuft of siphon placed very near base, much before $\frac{1}{3}$ . . . . 10.
   This tuft at or beyond $\frac{1}{3}$ . . . . 12.
10. Comb a patch of numerous teeth . . . . *Theobaldia* (p. 77).
    Comb a single row of not more than about 10 teeth . . . . . . 11.

* But see *Culex arbieeni* (p. 251).

11. Head-setae A, B and C large and very conspicuous, B much longer than head; pecten of only 2 spines; lower caudal seta 3-branched *Ficalbia*, subgenus *Ficalbia* (p. 84).

Setae A, B and C all small and rather inconspicuous, B much shorter than head; pecten of about 6 spines; lower caudal seta with about 6 branches *Hodgesia* (p. 45).

12. Lower caudal seta single or (rarely) double . . . . 13.

This seta with at least 3 branches . . . . 14.

13. Ventral brush reduced to 4 pairs of setae, which are usually single, and whose bases do not form a barred area; pecten reduced, with 0–4 spines *Eretmapodites* (p. 224).

Ventral brush often composed of more than 4 pairs of setae, which are usually branched, and whose bases always form a conspicuous barred area; pecten of at least 8 spines . . . . *Aëdes** (p. 112).

14. Head-setae all very small and inconspicuous; tufts of ventral brush arising from a large rounded prominence, their bases not forming a barred area; trachea of siphon much narrowed proximally and to a less extent distally *Uranotaenia shillitonis*† (p. 68).

Head-setae A, B and C all conspicuous and usually very large; tufts of ventral brush not arising from a prominence, their bases forming a conspicuous barred area; trachea of siphon tapering gradually from base to apex *Ficalbia*, subgenera *Mimomyia* and *Etorleptiomyia* (p. 84).

TOXORHYNCHITES Theobald.‡

Larvae of this genus can readily be separated from any others by their relatively enormous size, the modified mouth-brushes, the complete absence of comb and pecten, and the presence of a large chitinous plate (from which setae arise) on the eighth abdominal segment.

Head heavily sclerotized. Antenna with smooth cylindrical shaft; tuft beyond middle, minute and composed of a few simple branches; terminal and subterminal setae all very small. Mouth-brushes each composed of very few (about 10) strongly curved flattened setae which are not serrated, as in the other predaceous forms, but have 2 small teeth at the apex. Clypeal spines set very far back, long and slender; anterior sclerite of dorsum of head (preclypeus of some authors) bearing, in addition to the clypeal spines, 2 pairs of small simple setae which closely resemble them. Setae A, B, C and *d* all small and arranged more or less in a row. Mentum much broader than long.

Thorax with a pair of large air-sacs in the metathorax as in *Taeniorhynchus*, *Orthopodomyia* and one subgenus of *Theobaldia*. Larger setae of thorax of moderate length, stout and shortly plumose, either simple or split into 2 or 3 branches near base, all set in chitinous plates. Each of the three pleural groups includes 3 longish setae, one or two of which are stout and plumose, fourth seta distinct in propleural group, minute or absent in the others.

Abdomen.—Main setae of first 7 segments arising, like those of thorax, from large chitinous plates; the eighth segment bears a single very large lateral plate, presumably formed by the fusion of the three which are found on the other segments,

* Some species of *Stegomyia* (*simpsoni*, *demeilloni*) may have l.c.s. trifid and others (*amaltheus*, *unilineatus*) may have the barred area reduced or absent.—P. F. M.

† This larva is so unlike all other African *Uranotaenia* that it demands individual treatment.

‡ For change of name from *Megarhinus* Robineau-Desvoidy see Stone (1948).—P. F. M.

this plate bears setae similar to those on the other segments, but there is no trace of a comb. The siphon is very short, and entirely lacks both pecten and acus ; it bears a single pair of large subventral tufts.

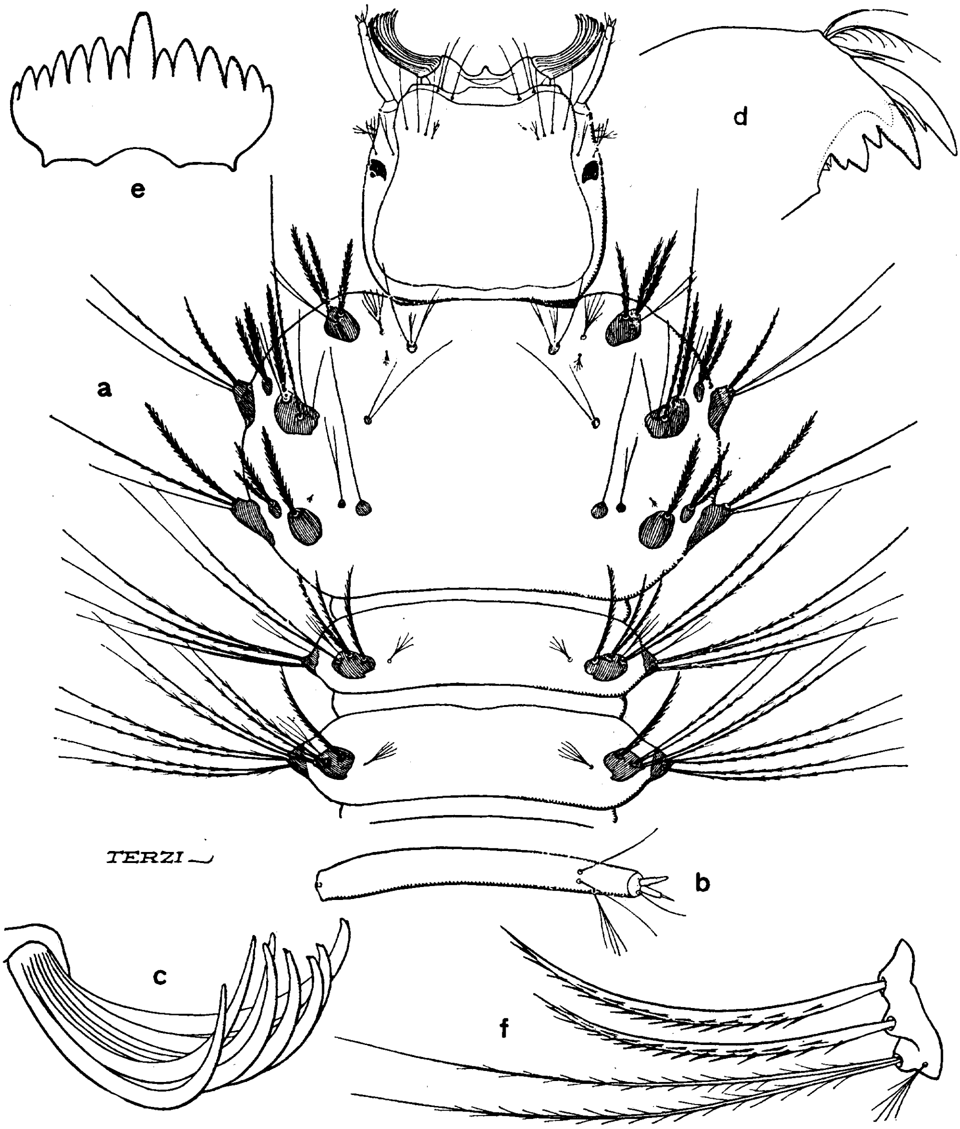


FIG. 4.—*Toxorhynchites brevipalpis* Theo. var. *conradti* Grünb. *a*, head, thorax and first two abdominal segments. *b*, antenna. *c*, mouth-brush (the figure should show ten elements instead of eight). *d*, tip of mandible. *e*, mentum. *f*, lateral setae of abdomen.

Breeding-places and habits.—The larvae of six of the Ethiopian forms of this genus have been described and the breeding-places of three of the others are known to some extent. The larvae can be divided easily into two groups, but some of the members of each group appear not to be separable from one another. All known larvae of the genus are exclusively predaceous, and all our forms breed in tree-holes and similar small containers. Because of their predaceous habits it is unusual to find more than one *Toxorhynchites* larva unless the breeding-place is large (a very large tree-hole or a barrel).

KEY TO THE KNOWN LARVAE OF THE GENUS.

1. Head seta B simple . . . . 2.
   This seta with 2–4 branches . . . . *aeneus* and *viridibasis* (p. 41).
2. Subventral tuft of siphon with 3–6 branches ; distal edge of saddle with long and short spines alternating throughout
   brevipalpis (p. 36), *barbipes* and *phytophagus** (p. 38).
   Subventral tuft of siphon with 1–3 branches ; distal edge of saddle usually with a patch of long spines (only) on each side of the lateral seta
   nairobiensis (p. 39), *ruwenzori* (p. 40) and *kaimosi* (p. 41).

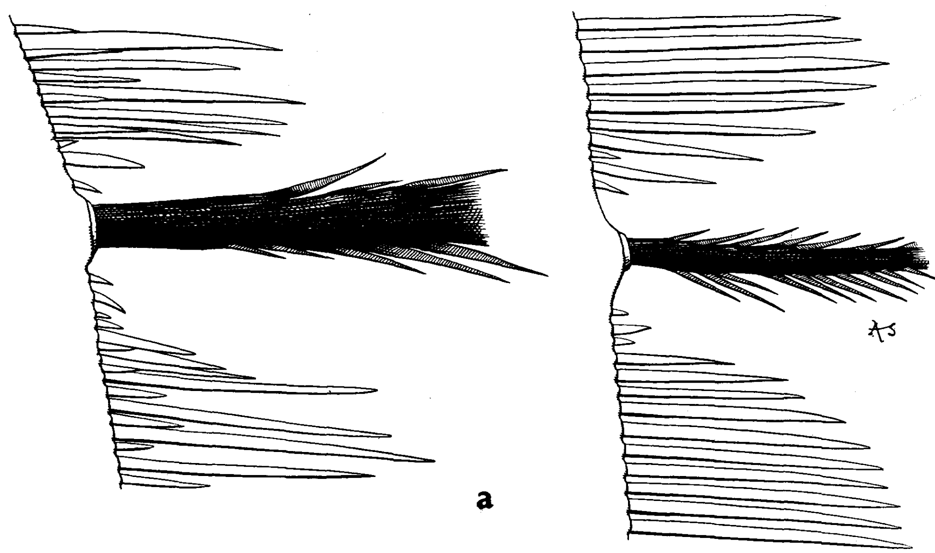


FIG. 5.—Lateral seta and distal edge of saddle. *a*, *Toxorhynchites brevipalpis* Theo. *b*, *Toxorhynchites nairobiensis* E. C. C. van S.

Toxorhynchites brevipalpis Theobald. (Figs. 4, 5, 6.)

Length about 15 mm. ; *colour* usually mahogany red. Macfie and Ingram (1922–23) record dark grey larvae, and state that the colour corresponds to that of the debris at the bottom of the water in which the larvae are found.

Head.—Almost quadrangular in shape, about as long as broad. Antenna less than half length of head ; tuft at about $\frac{4}{5}$, with about 4 simple branches ; subterminal spines at about the same point on the antenna but on the outer aspect, very minute. Setae A, B and C single, simple and slender, distinctly less than half length of head,

* I am indebted to Mr. Wolfs for unpublished information regarding the condition of the saddle in *T. phytophagus*.—P. F. M.

† Wolfs (1947*a*) states that in Belgian Congo larvae of *brevipalpis* ssp. *conradti* seta *d* sometimes has 10–15 branches. He informs me that the designation of this seta was omitted from his " *Remarques* " in consequence of a printer's error.—P. F. M.

d very small, trifid;† all these setae are set very far forward (just posterior to the base of the antenna), and their bases are almost in a straight line. Mentum with about 13 very coarse teeth, of which the middle one is considerably longer than the others.

Abdomen.—Siphon with index about 2, conical; subventral tuft of 3–5 plumose branches at about $\frac{1}{6}$. Anal segment completely sclerotized, posterior margin of saddle fringed with a row of two series of strong spines, of which the smallest alternate with the larger; the latter are themselves of two alternating sizes. Upper and lower caudal setae with 3–6 and 3–4 simple branches respectively; lateral seta placed almost on the posterior margin, single, very stout and coarsely plumose. Ventral

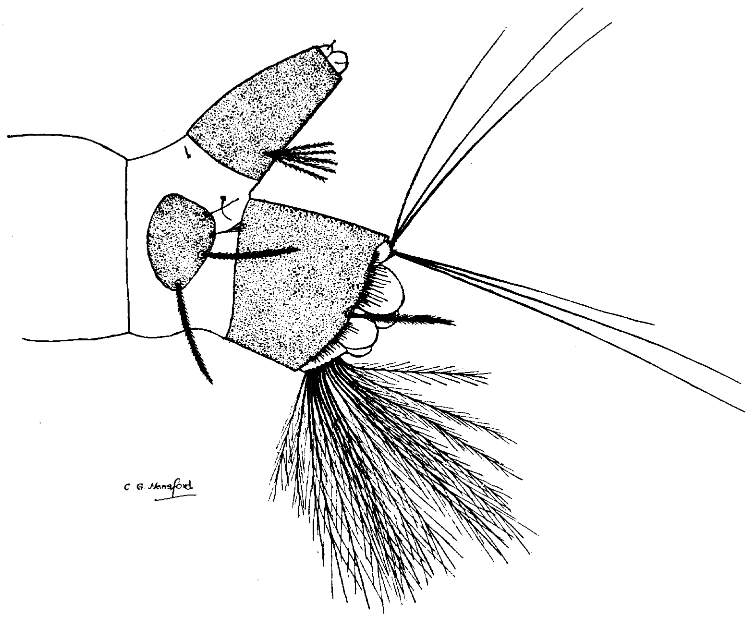


FIG. 6.—*Toxorhynchites brevipalpis* Theo. var. *conradti* Grünb. Terminal segments.

brush composed of 8 or 9 pairs of tufts, each of which consists of a single strong coarsely plumose seta. " Gills " subequal, very short and rounded.

Breeding-places and habits.—The most usual breeding-places for this species are in tree-holes, but usually only in the larger ones. Larvae are frequently found in barrels, and occasionally in tins or pots; Theobald records them from a metal water-tank and an iron drum. In suitable places they may be found in considerable numbers; I once took a dozen nearly full-grown larvae from one large tree-hole in which the other mosquito-fauna had been almost exterminated.

The larva is exclusively predaceous, and finds its main food-supply in the very large numbers of larvae of *Aëdes* and *Culex* usually to be found in the type of breeding-place in which it occurs. I have found larvae of *Toxorhynchites* very reluctant to eat members of their own species, though they will do so if no other food is available. Should the food-supply fail they are able to survive long periods with little or no sustenance. Schwetz (1930*b*) records survival for ten weeks without food, and

Wigglesworth (1929*b*) mentions having kept one alive (at 24° C.) for five months by limiting the food-supply. The latter author points out the possible practical application of this if it were desired to import them into countries in which they do not occur in order that they might act as a check on other mosquitoes which breed in tree-holes ; they have recently been successfully imported into Fiji for this purpose (Paine).

The larva spends most of its time at the surface of the water, where its attitude is somewhat less horizontal than that usually adopted by *Culex* (*Lutzia*) *tigripes*. On being disturbed, however, it at once seeks the bottom, where it is able to remain for at least two or three minutes without coming to the top to breathe (Macfie and Ingram, 1922–23).

The description and figures are of ssp. *conradti* Grünberg, but the larva of the typical form is not distinguishable (E. C. C. van Someren, 1946*b*). The breeding-places of the two forms are similar.

Toxorhynchites phytophagus Theobald.

The following description is translated from Wolfs (1947*a*) :

"This description is based on four larvae reared in isolation. These larvae were found at Coquilhatville in a large barrel. On emergence we obtained two males and two females. The larvae have a mahogany red colour and closely resemble the larvae of *M. brevipalpis* ssp. *conradti*. The antennae are less than half the length of the head. The tuft is situated at about $\frac{5}{6}$ and has 4 simple branches. There are two terminal bristles a little below the tuft and on the outer side of the antenna. Head setae A, B and C are simple and less than half the length of the head. Seta *d* is very small and has about 15 branches. The four hairs lie in a straight line. Seta *f* is simple. We do not find any difference between the mentum of *M. brevipalpis* ssp. *conradti* and the mentum of *M. phytophagus*. The siphonal index is 1 : $\frac{1}{2}$. The subventral tuft is situated at $\frac{1}{6}$ and has 4–6 stout plumose branches. The siphon is strongly chitinized. The saddle is complete and has a row of spines in the posterior border as in *M. brevipalpis* ssp. *conradti* Grünberg. The upper caudal bristles have 5 branches and the lower caudal bristles 7 branches. The saddle hair is stout and plumose. The ventral brush has 9–11 tufts, each tuft comprising a stout, strongly plumose bristle. The gills are short and rounded."—P. F. M.

Toxorhynchites barbipes Edwards.

Larva not distinguishable from that of *T. brevipalpis* (E. C. C. van Someren, 1946*b*). Breeds in tree-holes, artificial containers, and pools in boulders (Garnham, Harper and Highton, 1946).

Toxorhynchites evansae Edwards.

Larva not preserved. The type was bred from a larva found in a tree-hole, and is the specimen (Evans, 1926) doubtfully referred to *T. aeneus*.

Toxorhynchites lutescens Theobald.

Larva and breeding-places unknown. Doubtless breeds in tree-holes.

Toxorhynchites nairobiensis E. C. C. van Someren. (Figs. 5, 7.)

The following description of the larva is quoted from E. C. C. van Someren (1946*b*):

" The larva is a clear purple colour when alive.

" *Head.*—Antenna smooth, cylindrical, and less than $\frac{1}{2}$ the length of the head; tuft at about $\frac{5}{6}$ and composed of 2–3 dendroid branches; sub-terminal seta

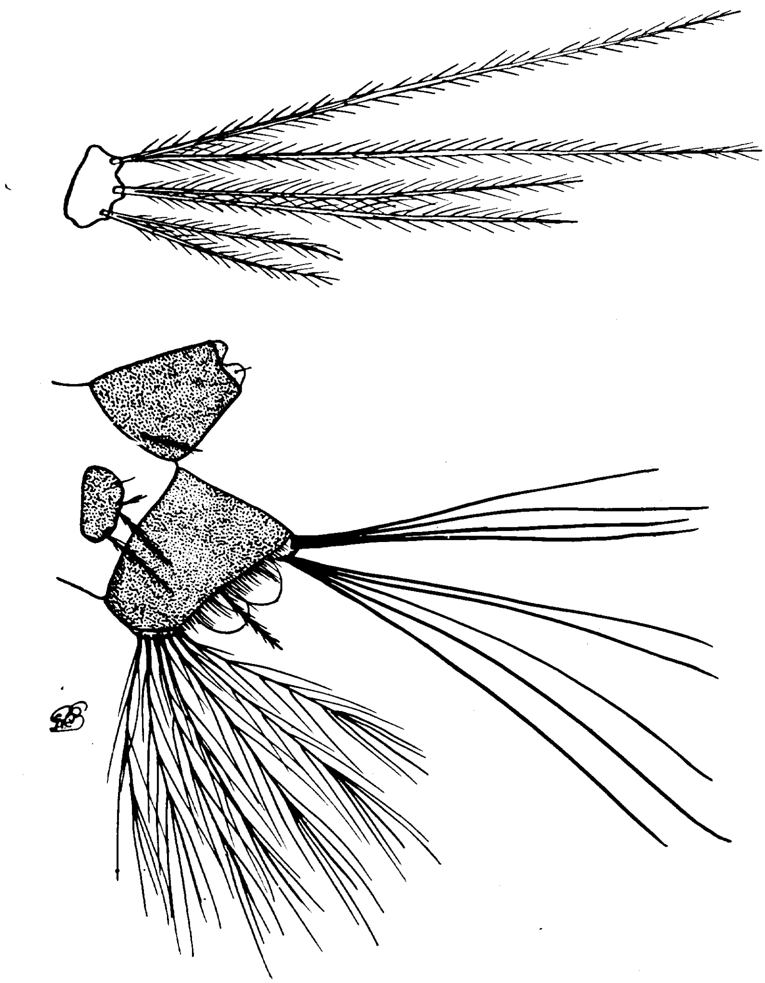


FIG. 7.—*Toxorhynchites nairobiensis* E. C. C. van Someren. Terminal segments and lateral abdominal setae.

a single, long, simple hair, about $\frac{1}{3}$ the length of the antenna, and placed outside and a little below the tuft. Setae A, B, and C fine, simple setae, all less than $\frac{1}{2}$ the length of the head, placed close together, and with their bases almost in a straight line. A is either a single seta or split beyond the base into 2–3 fine branches, B is split beyond the base into 3–6 branches, and C is a single seta; *d* is a single seta with 2 dendroid branches and placed out of alignment with, below, and inside

c. Mentum with 7–8 coarse uneven teeth on either side of the central tooth ; the central tooth long, followed on either side by one short tooth, followed by a large tooth which is a little longer than the central tooth, the following 3–4 teeth short, and the 2 basal teeth large.

"*Thorax*.—Setae of thorax like those of the *brevipalpis* group but slightly shorter.

"*Abdomen*.—Lateral setae (Fig. 7) differ from those of the *brevipalpis* group in that none of the setae of the lateral groups are stouter than the others. Siphon conical, heavily chitinized, and dark to tip ; index $1\frac{1}{2}$ in crushed specimens. The subventral tuft, placed very near the base of the siphon, is usually a single, fairly stout, coarsely plumose seta, but in one specimen it is bifid on one side of the siphon. Saddle heavily chitinized and complete. The distal edge of the saddle is fringed with strong spines ; on the upper and lower edges there is a group of alternating long and short spines, but on either side of lateral seta the short spines are irregularly spaced, dividing the long spines into patches of varying size, but usually a fairly large patch of long spines only, on either side of the lateral seta. Lateral seta, placed on the distal edge of the saddle, is a single, stout, coarsely plumose seta, about $\frac{1}{2}$ the length of the saddle. Lower caudal seta with 3–5 branches ; upper with 5–7 branches. Ventral brush composed of 7–8 pairs of single, long, coarsely plumose setae. Gills sub-equal, round, and about $\frac{1}{3}$ the length of the saddle."

Breeding-places.—Tree-holes.

Toxorhynchites ruwenzori E. C. C. van Someren.

Larva indistinguishable from that of *T. nairobiensis* (van Someren 1948).

Breeding-places and Field Notes.—The larvae from which the type series was bred out were taken from bored bamboos on Kizimba (7–8000 ft., A. J. Haddow) and Bwamba Pass (8–8500 ft., E. C. C. van Someren). The following account is taken from van Someren (1948).

"About a dozen larvae were collected from bored bamboos on the Bwamba Pass, but owing to their extremely slow growth and the fact that they had to be transported 600 miles soon after collection, only one was brought alive to Nairobi and eventually bred out. It is interesting to note that the larvae appear to be only in bamboos, which contain larvae of *Uranotaenia* species (probably mainly *U. shillitonis* Edwards), none being found in bamboos which contained *Culex* larvae. Many of the bamboo *Culex* larvae were given to the *Megarhinus* as food ; these were hunted and killed, but none seemed to be eaten. In the space of about fifteen minutes one *Megarhinus* larva attacked and killed three *Culex*, but after holding them for a moment dropped them and took no further interest in the prey. The one larva that was eventually bred to adult was fed on larvae of *Aëdes aegypti* Linnaeus, and many of these were killed but not eaten. This may be due to a habit noted below of the late fourth stage larvae. The Bwamba Pass larvae were pale creamy-white below and pinkish purple above and rather transparent. Dr. Haddow tells me that the Kizimba larva was white when collected, and developed a faint brick red marbling on the thorax as it grew. Both larvae were fourth stage when collected, and remained in the larval stage for 16 (Kizimba) and 20 (Bwamba Pass) days before pupating. The pupal stage lasted 9 (Kizimba) and 11 (Bwamba Pass) days. The larvae did not become sluggish before pupating but remained active, the Kizimba larva killing 10–20 larvae of *Aëdes simpsoni* per hour though not eating them (Haddow private communication)." Mrs. van Someren kindly allowed me to take this extract from her MSS. while her paper was still in the press.—P. F. M.

Toxorhynchites erythrurus Edwards.

Larva unknown. Breeding-places not recorded.

Toxorhynchites kaimosi E. C. C. van Someren.

Larva indistinguishable from that of *T. nairobiensis*. Breeds in tree-holes (E. C. C. van Someren, 1946*b*).

Toxorhynchites aeneus Evans.

The following description is translated from Wolfs (1947*a*):

"This description is made from a larva found in a tree-hole at Coquilhatville, Belgian Congo. The larva was reared in isolation and on emergence yielded a female. The larva has a mahogany red colour. The antennae are less than half the length of the head. The antennal tuft is a little longer than in *M. viridibasis*, but its branches are less numerous. It is situated at $\frac{5}{6}$. There are two terminal bristles a little below the tuft. These bristles have their bases separate but very close together. Setae A and C are simple. C is longer than A. Seta B has 4 branches. Seta *d* is very small and has numerous branches. Seta *f* has 3 branches. The siphonal index is 1 : $\frac{1}{2}$. The subventral tuft is situated at $\frac{1}{10}$ and has 3 stout, plumose branches. The siphon is strongly chitinized. The saddle is complete. The saddle hair is stout and plumose. The upper caudal bristles have 6 branches and the lower bristles 9 branches. The ventral brush comprises 8 strongly plumose bristles. The gills are short and rounded. On the chitinized plate of the 8th segment are two stout, plumose bristles of which one is bifid."—P. F. M.

Toxorhynchites viridibasis Edwards.

The larva is described by Lewis (1945), and appears to be distinguishable from that of other members of the *aeneus* group by the fact that the base of head-seta *d* is almost in a straight line with the bases of B and C, by the arrangement of the teeth in the mentum, and by the arrangement of the spines on the posterior margin of the anal segment. It differs from the *brevipalpis* group by the smaller number of setae in the subventral tuft on the siphon.* Lewis's description is as follows:

"*Head*.—Almost quadrangular in shape, about as long as broad. Antenna less than $\frac{1}{2}$ length of head; tuft at 0·8, dendroid; subterminal spines at 0·7 on lower surface, each about 0·5 length of antenna. Setae A, B and C slender, distinctly less than 0·5 length of head, A and C simple, B with 2 or 3 branches near its tip, *d*

* Wolfs (1947*a*), describing two larvae of this species from a tree-hole at Coquilhatville, Belgian Congo, adds the following details:
Colour mahogany red. Antennal tuft very small with about 15 branches. Terminal setae of antenna with their bases separate but very close together. Head seta B with 4 branches, *d* with 20-25 branches, *f* with 4 branches. Subventral siphonal tuft with 4 branches. Upper caudal setae with 9 and lower with 6 branches. Ventral brush with 6 tufts. It appears therefore that the larva of *viridibasis* cannot be separated with certainty from those of the *brevipalpis* group on the character of the siphonal tuft and that its most reliable distinguishing character is the branching of head seta B.—P. F. M.

small with dendroid branching; all these setae are just posterior to the base of the antenna, and the bases of B, C and *d* are almost in a straight line. Mentum with very coarse teeth, 7 or 8 on each side of the central tooth which is directed ventrally; 2 large teeth lie on each side of the central group of 3.

"*Thorax.*—Mesothoracic setae in order from centre of dorsum outwards: 2 slender setae on minute tubercles; 2 slender setae, the outer one with about 3 branches from near base, on small plates; dorso-lateral plate bearing a long slender seta, a stout plumose seta and a seta with about 4 branches; lateral plate with a stout plumose seta; a small branched hair on a minute or a small plate; ventro-lateral plate bearing a minute seta, a stout plumose seta and 2 long setae. Metathoracic setae: 2 setae on small plates with 3 smaller setae on tubercles or plates, anterior to them; stout plumose seta on dorso-lateral plate; stout plumose seta or branched hair on lateral plate; ventro-lateral plate bearing minute hair, stout plumose seta and 2 long slender setae; stout plumose seta on ventral plate.

"*Abdomen.*—Siphon with index about 2, conical; subventral tuft a single rather stout plumose seta at 0·2; this seta may have 1 or 2 branches near its tip. Anal segment completely chitinized, posterior margin of saddle with spines as in *M. brevipalpis*; upper and lower caudal setae with about 3 and 5 simple branches respectively; lateral seta placed almost on posterior margin, very stout and coarsely plumose. Ventral brush and gills as in *M. brevipalpis*." Mr. Lewis has kindly re-examined his larvae, at my request, and finds that the spines on the distal edge of the saddle are not quite as in *brevipalpis*; on each side of the lateral seta there is a patch of moderately long spines mixed with a few irregularly-arranged very small ones.

Breeding-places.—Mr. Lewis kindly informs me that his larvae were found in tree-holes.

HARPAGOMYIA De Meijere.

The mid-ventral and subdorsal tufts of the siphon render larvae of this genus unmistakable; the genus is also unique among African mosquito genera in the reduction of the ventral brush to a single pair of setae.

Head.—Antenna short and smooth; only one very small subapical seta present in place of the usual two; apical setae extremely small.

The chaetotaxy of the head is very peculiar, and is rendered difficult of interpretation by the fact that the clypeal sutures are very indistinct, only a small portion in front of the eyes being easily visible. The main setae tend to be placed far forward, near the anterior margin of the head; my interpretation of them is shown in Fig. 8.

Thorax.—Prothorax with a rather large, dorsolateral, chitinous plate, which bears 3 setae, 2 of which are many-branched and form large conspicuous tufts. Propleural group of setae placed immediately below these large tufts and including 3 long setae and 1 short; mesopleural group apparently similar; metapleural group comprising 3 setae, 2 long and 1 short, and an articulated spine which represents the fourth seta.

Abdomen with strong lateral tufts on the first 2 segments only. Siphon wth one pair of true subventral tufts, and distal to these a row of half-a-dozen smaller unpaired midventral tufts; in addition there are a number of pairs (usually 4 or

5) of subdorsal tufts which are variable in position and number. The saddle of the anal segment is small and weak, and in both the known Ethiopian larvae bears a patch of rather large scales; the upper caudal seta has numerous branches and the lower caudal seta is single; the lateral seta is greatly more developed than in any other genus known to the writer. The ventral brush is reduced to a single pair of small setae and the barred area is absent. In several of the most important characters the terminal segments closely resemble those of the Oriental and Australasian genus *Tripteroides* (*Rachionotomyia*).

Within each species the number and arrangement of pecten teeth vary greatly.

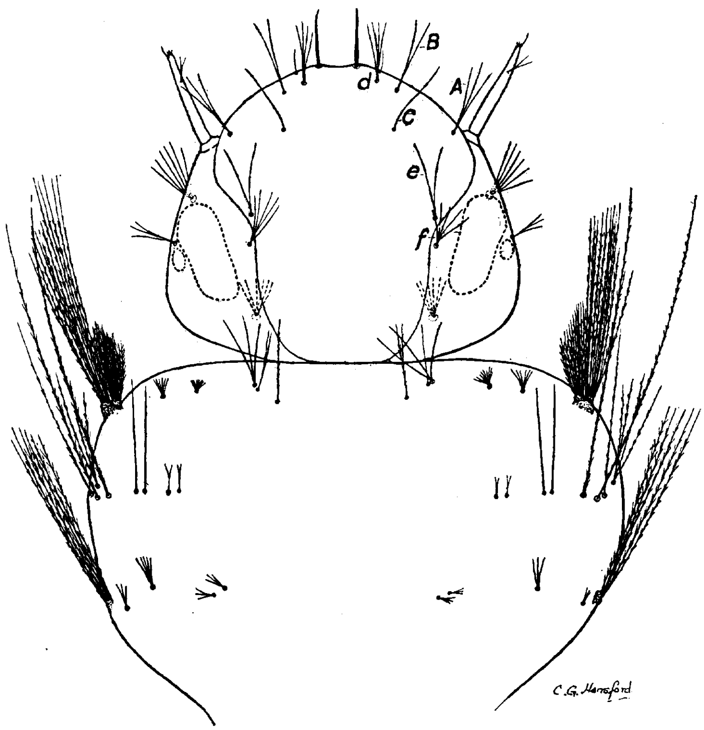


FIG. 8.—*Harpagomyia taeniarostris* Theo. Head and thorax.

Breeding-places.—The larvae and breeding-places of two of the four Ethiopian species are known; both appear to be found exclusively in plant axils.

KEY TO KNOWN LARVAE OF THE GENUS.

1. Head setae A, B and C with 2, 1 and 1 branches respectively; "gills" cylindrical *taeniarostris* (p. 43).
   These setae with about 8, 6 and 7 branches respectively; "gills" spatulate *farquharsoni* (p. 45).

Harpagomyia taeniarostris Theobald. (Figs. 8, 9.)

From *H. farquharsoni* this larva is readily distinguished by the smaller number of branches in the head setae, by the fact that setae *e* and *f* (placed one behind the other in the present species) are more or less side by side in *farquharsoni*, and by the different shape of the "gills."

Length about $6\frac{1}{2}$ mm. ; *colour* whitish, chitinized portions pale yellow-brown.

Head somewhat broader than long (as 1·2 : 1), weakly sclerotized. Antenna about $\frac{1}{3}$ length of head ; tuft of 2 simple branches at $\frac{2}{3}$. Clypeal spines rather long and slender. Head setae all simple, A with 2–3 branches, B 2-branched, C single, *d* almost as long as the others and with about 4 branches, *e* long, 2-branched, *f* placed almost directly behind *e* and with about 5 branches.

Abdomen.—Comb an irregular patch of about 40 rather narrow scales. Siphon weakly sclerotized, more particularly towards the base, where it is not sharply demarcated from the rest of the segment ; index about 3 ; subventral tuft of 4–5 slightly

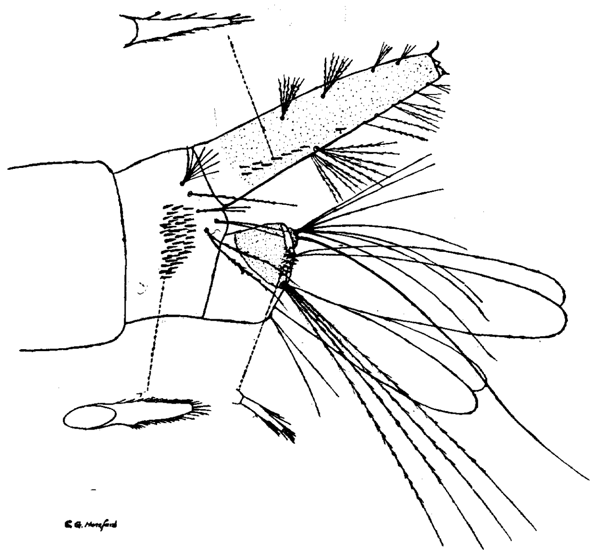


FIG. 9.—*Harpagomyia taeniarostris* Theo. Terminal segments.

plumose branches at $\frac{1}{2}$; proximal 4 midventral setae single or double and slightly plumose, distal 2 each composed of 3 simple branches ; subdorsal tufts with 3–6 plumose branches ; pecten composed of slender, sparsely-fringed spines, which are extremely variable in number and arrangement. Saddle of anal segment bearing distally an irregular patch of peculiar scales with a tufted fringe ; upper caudal seta with about 7 simple branches ; lateral seta about 7 times length of saddle, with 4–6 plumose branches. Setae of ventral brush single. "Gills" cylindrical, dorsal pair about five times length of saddle.

Larvae from Kampala agree exactly with Ingram and de Meillon's description (as *H. trichorostris*).

Breeding-places and habits.—The larvae described by Ingram and de Meillon were obtained in the axils of *Bilbergia mutans* and of an arum lily ; in Uganda the larvae occur not infrequently in the axils of *Colocasia* sp. (Araceae) ; there is one record from the axils of a wild banana (Garnham, Harper and Highton). Dr. Haddow has bred the species from dry material collected from plant axils, which indicates that the egg is resistant to drying. (This author (1948) gives records from the " Gonja " variety of cultivated banana, two species of colocasia and *Pandanus chiliocarpus*.—P. F. M.) In common with other larvae found in small containers those of *taeniarostris* spend a large part of their time at the bottom of any vessel in which they are placed, and they have been particularly noted to glide over the sides and bottom of the container, browsing on the surface of the vessel and progressing by means of the mouth-brushes.

Harpagomyia trichorostris Theobald.

Larva and breeding-places unknown, the adults from the larva described by Ingram and de Meillon proving to be *taeniarostris*. The breeding-places are probably in plant axils.

Harpagomyia farquharsoni Edwards.

Length about 6 mm.; *colour* apparently similar to that of *taeniarostris*.

Head broader than long, rounded in front and widest along posterior border. Antenna with tuft of 2 short simple branches at $\frac{4}{5}$. Clypeal spines short and stout, concealed beneath the anterior margin of the head. Setae A, B and C with 7–9, 5–7 and 7–8 subplumose branches respectively, *d* 2–3-branched, not much shorter than A, B and C, placed between and slightly posterior to B and C, *e* 2-branched, *f* with about 5 branches. Mentum similar to that of *taeniarostris*, with 12 teeth on each side of the centre.

Abdomen.—Comb an irregular patch of about 30 delicately fringed scales. Siphon weakly sclerotized, index about $3\frac{1}{2}$; subventral tuft composed of 3–4 plumose branches a little before $\frac{1}{2}$; midventral tufts with 1–3 branches; pecten extremely variable in number and arrangement of scales; more distal scales elongate, with a fine fringe, proximal much shorter and broader with a coarser fringe. Upper caudal seta usually with 7 branches; lateral seta about four times length of saddle, 6-branched; saddle with a patch of scales similar to that of *taeniarostris*. Setae of ventral brush long, double or triple. " Gills " very broad, more than twice length of saddle.

Breeding-places.—Axils of pineapple plants in bush (Evans, 1929).

Harpagomyia fraseri Edwards.

Larva and breeding-places unknown. Likely to occur in plant axils.

HODGESIA Theobald.

No other known Ethiopian larvae except the genus *Theobaldia* and the subgenus *Ficalbia* have the subventral tuft of the siphon placed at the base as in the present genus. From the groups mentioned *Hodgesia* differs in numerous characters, of which it is only necessary to mention the peculiar head-chaetotaxy and the midventral row of single setae on the anal segment.

Head.—Mouth-parts, except maxillae, not specially modified; maxillae (as in *Aëdomyia*, *Taeniorhynchus* and most species of *Ficalbia*) with a stout apical spine, which resembles the clypeal spines. Antenna curved, spiculate; tuft large and placed exceptionally near the tip ; terminal and subterminal setae placed together at apex, subterminal and one of terminal setae long, the other terminal seta much shorter. Seta B comparatively long and simple, C placed almost directly behind B, short and branched, A small, *d* almost as large as A or C.

Thorax.—Inner and outer shoulder-hairs of prothorax very long and strong, set in rather large plates. Propleural group of setae set in a small plate, 1 seta very long and stout, 2 short, fourth minute ; mesopleural group set in a larger plate, 2 setae very long and branched from base, 1 short ; metapleural group on a still larger plate, which bears a spine, otherwise similar to mesopleural.

Abdomen.—Lateral setae of first 2 segments much more strongly developed than the others, and set in plates which are produced backwards for some distance. Comb a single row of few teeth. Siphon very short ; pecten present ; subventral tuft large and placed very near the base ; postero-ventral valves exceptionally large. Anal segment with saddle forming a complete ring ; upper and lower caudal setae both multiple ; lateral seta short and stout, simple or nearly so. Ventral brush composed of few pairs of multiple tufts ; proximal to these is a midventral row of single setae ; there is no well-developed barred area.

Breeding-places and habits.—Records exist of the breeding-places of three of the four species ; all breed in swamps or marshes.

The great size of the posterior lateral valves of the siphon in all the known Ethiopian larvae of this genus suggests some degree of association with plants for the purpose of obtaining air (*cf. Ficalbia splendens* and *Culex poicilipes*), but unfortunately no observations have been made on the living larva. The " gills " are very small, and of the wedge-shaped form characteristic of larvae with this habit.

KEY TO THE LARVAE OF THE GENUS.

1.	Comb-spines fringed all round apex	2.
	Comb-spines unfringed, at least apically	3.
2.	Head-seta B nearly as long as head ; seta C with 3–4 branches	*cyptopus* (p. 48).
	Seta B considerably shorter than head ; C with about 8 branches	*nigeriae* (p. 47).
3.	Comb-spines sharply pointed	*psectropus* (p. 47).
	Comb-spines with blunt apex	*sanguinea* (p. 46).

Hodgesia sanguinea Theobald.

This larva is distinguished from those of *cyptopus* and *nigeriae* by the apically unfringed comb-spines ; its blunt-ended comb-spines distinguish it from *psectropus*.

Described from 2 skins and 4 whole larvae from Namanve swamp near Kampala, Uganda.

Length about 4 mm. ; *colour* not noted, head black, siphon not very dark.

Head.—Antenna $\frac{7}{9}$ length of head, strongly infuscate at base and apex ; tuft at about $\frac{9}{10}$, composed of about 30 simple branches. Setae A and C each with about 10 simple branches, B very sparsely plumose, *d* 4-branched. Mentum triangular, with a very large central tooth, on each side of which are 5 small teeth.

Abdomen.—Comb of 7–8 large spines, which are not fringed except towards the base. Siphon with prominent acus, index nearly $2\frac{1}{2}$, pecten and subventral tuft as in *nigeriae*. Saddle of anal segment more than twice as long as broad ; caudal and lateral setae as in *nigeriae*. " Gills " short, subequal, fusiform.

Breeding-places.—Schwetz (1930*b*) mentions rearing an adult from a larva found at the grassy edge of a marsh ; the larvae described above were found in small pools of dark-coloured water in a papyrus swamp ; some of these pools had a pH as low as 4·4.

Hodgesia psectropus Edwards.

This larva is very like the other larvae of the genus, but is separable from *cyptopus* and *nigeriae* by the unfringed comb-spines. It differs from that of *sanguinea* in one or two small points, but there is insufficient material to indicate whether these are constant ; the most reliable appears to be that the comb-spines, bluntly pointed in *sanguinea,* are sharply pointed in *psectropus.*

Described from three not very perfect specimens from Stanleyville, Belgian Congo. No isolations were done, but Dr. Schwetz bred *psectropus* in pure culture from the batch to which these belonged.

Length about 4 mm. ; colour not noted, but abdominal segments II–III and V–VI with dark bands.

Head.—Similar in most respects to that of *nigeriae* ; antennal tuft with about 25 branches ; seta *d* with 3–4 branches.

Abdomen also similar to that of *nigeriae* ; comb-spines (9 in the one specimen in which they can be counted) apparently without any fringe ; subventral tuft of siphon with 6 branches.

Breeding-places.—The type series was bred from larvae found at the edge of a marsh (Edwards, 1930*a*).

Hodgesia nigeriae Edwards. (Fig. 10.)

In the present species and in *cyptopus* the comb-spines are fringed all round the apex, whereas in both the other larvae of the genus there is no fringe on the apical part of the spine. It appears to differ from that of *cyptopus* by the characters given in the key.

Head.—Proportions not determinable ; cuticle infuscated posteriorly. Antenna almost as long as clypeus, of nearly uniform thickness, infuscated at base and apex ; tuft of about 15 rather short simple branches at $\frac{9}{10}$. Clypeal spines long and stout. Head setae all composed of simple branches, A and C each with about 8 branches, *d* 3-branched, *e* minute, bifid or trifid. Mentum almost rectangular, with 4 teeth on either side of the much larger central tooth.

Abdomen.—Comb consisting of a row of 7 teeth, largest towards the dorsal end of the row, each with a delicate fringe which envelops the whole tooth except the extreme base. Siphon cylindrical, short (index nearly 2) ; acus apparently absent ; subventral tuft composed of about 8 simple branches, which are $1\frac{1}{2}$ times as long as the diameter of the siphon ; pecten of 6 stout simple spines extending to a little beyond $\frac{1}{2}$; posterior lateral valve-flaps very large ($\frac{1}{3}$ length of siphon), but normal in structure. Chitin of anal segment (and of siphon) showing a scale-like development ; caudal setae with numerous flattened branches ; lateral seta stout, single, not quite $\frac{1}{2}$ length of saddle. Ventral brush composed of 3 pairs of tufts, each with

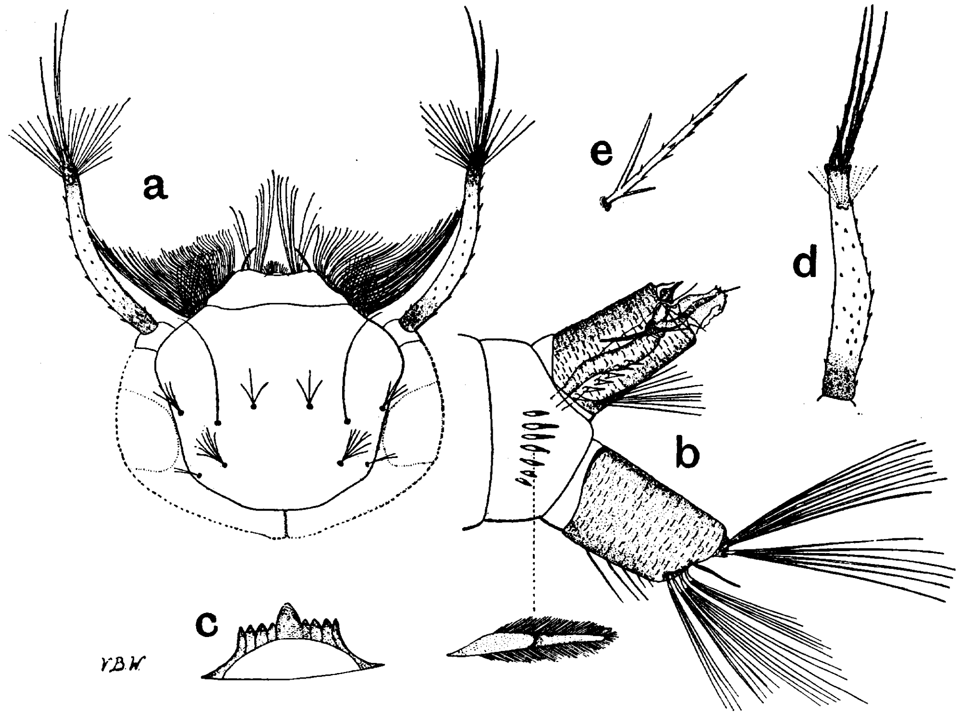


FIG. 10.—*Hodgesia nigeriae* Edw. *a*, head. *b*, terminal segments. *c*, mentum. [*d*, antenna, and *e*, lateral seta of anal segment, of *H. malayi* Leic., an Oriental species.] Seta A has more numerous branches than shown in the figure.

3–4 simple branches, and anterior to these a single row of 5 short simple setae. " Gills " missing in the available specimen.

Breeding-places.—Wigglesworth (1929*a*) found the larva in a small shady residual pool of a dried swamp.

Hodgesia cyptopus Theobald. (Fig. 11).

The larva apparently differs from that of *nigeriae* mainly by the greater length of head-seta A and the smaller number of branches in head-seta C. It is described (De Meillon, Parent and Black) as follows :

" *Head.*—Antenna shorter than head and of almost uniform thickness ; spiculate and slightly infuscated at base and apex. Tuft situated at $\frac{11}{12}$ and composed of about 26 sparsely plumose branches. Head seta A with 6 simple branches, B single, minutely pectinate and nearly or as long as head ; C with 3–4 simple branches and *d* with 3 simple branches. Mentum with 1 central tooth and 4 teeth on each side of the central tooth, almost rectangular in shape.

" *Abdomen.*—Comb a row of 9 teeth which are delicately fringed, the fringe enveloping the whole tooth except at the base. The teeth are somewhat variable in size. Siphonal index 1·5. Pecten of 4–5 stout, simple spines extending to just beyond $\frac{1}{3}$. Subventral tuft near the base of siphon and consisting of 5–6 simple branches which are nearly $1\frac{1}{2}$ times the diameter of the siphon at the point of attachment. The cuticle of the siphon and anal segment is reticulate. Upper caudal seta with 6 flattened, simple branches and the lower caudal seta with 5 similar branches. The lateral seta is very short, black and barbed and is ½ the length of

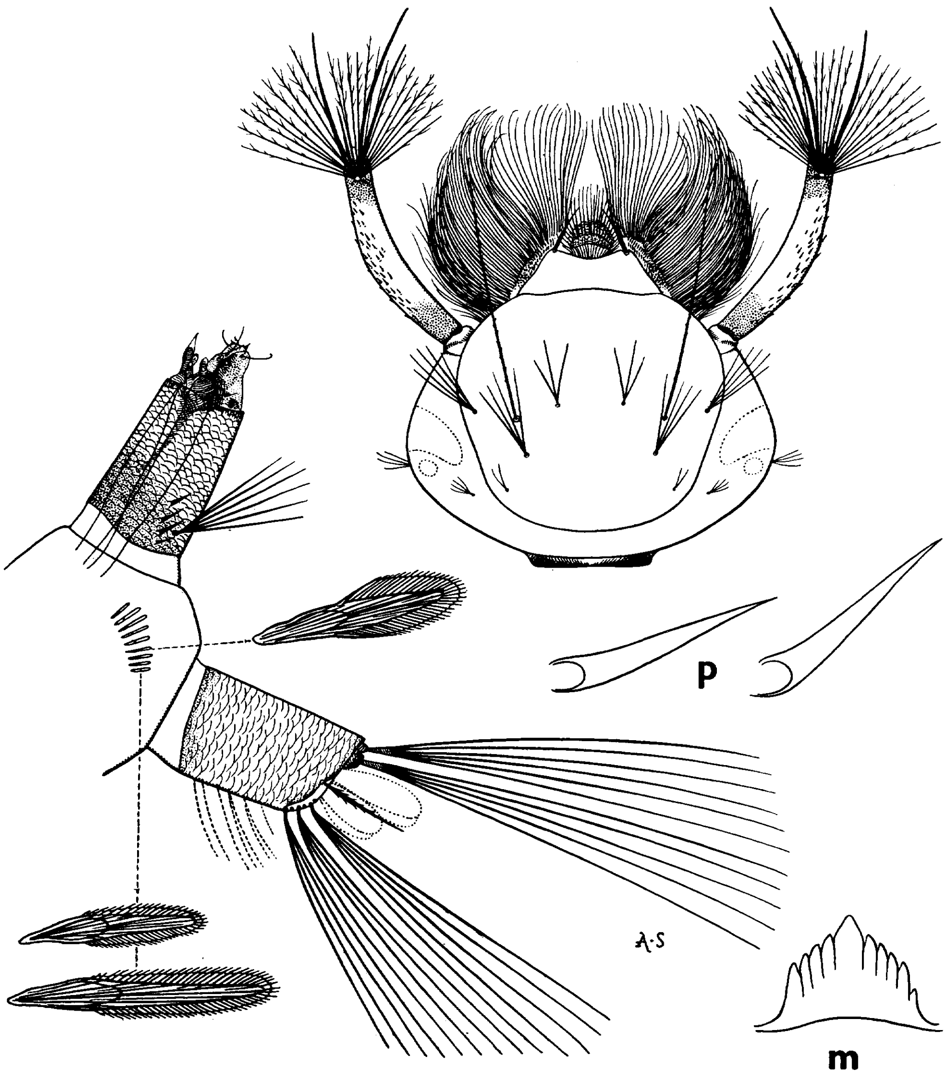


FIG. 11.—*Hodgesia cyptopus* Theo. Head and terminal segments. *m*, mentum. *p*, pecten spines.

the saddle. Ventral brush of about 3 pairs of tufts. Ventral margin of anal segment with 5 single or bifid tufts."*

Breeding-places.—Not recorded. The species is likely to breed in swamps.

* The pelt used for preparing Fig. 11 has four teeth on one side and five on the other. It also differs from the above description in having only 5 branches in head seta A, and 6 setal rings instead of 5 on the ventral margin of the anal segment. The comb scales are peculiar. They appear to consist of a solid chitinous tooth with an overlying membranous portion bearing delicate striations and fringed at the edges (Fig. 11).—P. F. M.

URANOTAENIA Lynch-Arribalzaga.

The presence of a comb-plate bearing a single row of teeth, coupled with the fact that head setae B and C are single, is diagnostic of the genus. The spine-like type of head-seta was formerly thought to be peculiar to the group of species with bluish thoracic markings in the adult (*Uranotaenia s. str.*), but several members of the unornamented group (*Pseudoficalbia*) are now known to possess such spines, whereas *U. mashonaensis* and *U. montana* are somewhat intermediate in this respect.

One species, *U. shillitonis* (Figs. 23, 24), differs in numerous important characters from all the other Ethiopian species, and has not been included in the description given below; if the larva alone were known it would certainly not be attributed to this genus. It can be distinguished from any other known Culicine larva in the region by two unique characters—the peculiar form of the trachea in the siphon, and the fact that the ventral brush, which lacks a barred area, is set on a rather highly sclerotized rounded boss. The ventral brush itself is of very peculiar form and both the caudal setae are branched from near the base.

Head usually small, often elongate and frequently very heavily sclerotized and therefore dark-coloured. Antenna short, smooth, cylindrical; tuft always very small, and generally reduced to a single minute seta; terminal and subterminal setae placed together at apex, very small. Clypeal spines set on conical projections of the anterior sclerite, which are sometimes very prominent; in all the Ethiopian species, except those closely related to *U. annulata* (which have them spatulate) and *U. chorleyi*, the spines are short, stout and peg-like. Setae B and C invariably single, and in many of the species exceptionally stout and spine-like.

Thorax.—Propleural group usually small and with only one long seta, which is single. Meso- and metapleural groups without conspicuous plates.

Abdomen.—Comb always a single row of teeth, which may be scales or spines, set on the edge of a large but often weakly sclerotized plate.* Siphon short, acus present; the single pair of subventral tufts is placed near the middle; the pecten teeth, which are almost always weakly sclerotized scales, are always set very close together, sometimes overlapping. Squamoid markings, the distal margins of which bear minute spicules, appear to be present on the comb-plate, siphon and saddle of all species, but are very indistinct in some; such markings are not uncommon in other genera, and may possibly indicate the origin of the comb and pecten. Both upper and lower caudal setae usually with 2 or more branches but sometimes single.

Breeding-places and habits.—The majority of members of this genus breed in various types of ground pools, particularly weedy pools in swamps; one species (*ornata*) apparently breeds exclusively in plant axils, and *shillitonis* has only been found breeding in the hollows of large reeds or of bamboos; *U. nigripes* has only been found in rock-pools. We have never found larvae in Uganda in any situation devoid of vegetation and fully exposed to the sun.

The larvae, on account of the shortness of the siphon, adopt a horizontal position at the surface of the water (where they spend most of their time), and because of these characters are often mistaken for those of *Anopheles*; the resemblance is particularly

* This plate is only present in fourth-stage larvae.

deceptive because several species occur in places suitable for the latter genus, though usually the water has rather too high an organic content for Anophelines.

In habits, as in structure, *shillitonis* is anomalous, since it does not adopt the horizontal position and feeds mainly at the bottom of the water.

KEY TO THE KNOWN LARVAE OF THE GENUS.

1. All the main thoracic and abdominal setae long, single or double, stout black bristles . . . . ? *nepenthes* (p. 64).
These setae not as above . . . . 2.
2. Eighth abdominal segment without comb-plate ; ventral brush arising from a prominent sclerotized boss . . . . 3.
This segment bearing a large sclerotized plate on the edge of which the comb is placed ; ventral brush not arising from a boss . . . . . . 4.
3. Comb composed of spines . . . . *shillitonis* (p. 68).
Comb composed of scales . . . . *garnhami* (p. 70).
4. Head setae B and C stout spines . . . . 4A.
These setae slender hairs or at most stout bristles . . . . . . 12.
4A. Head seta A stout, single, serrated . . . . *dumonti* (p. 56).
Head seta A slender, with at least 2 branches . . . . 5.
5. Head setae B and C moderately stout *plumose* spines . . *mashonaensis* (p. 65).
These setae very stout *serrated* or *simple* spines . . . . 6.
6. Head markedly longer than broad . . . . 7.
Head about as broad as long or broader . . . . 9.
7. Comb-spines graded, those at ends of row much smaller than those in centre ; head black . . . . *balfouri* (p. 54).
Comb-spines fairly uniform in size ; head paler . . . . 8.
8. Subventral tuft of siphon with 12–14 branches . . . . . *alba* (p. 54).
This tuft with about 8 branches . . . . . *alboabdominalis* (p. 53).
9. Comb composed of *scales*, more or less uniform in size . . *bilineata* (p. 54).
Comb of *spines*, markedly unequal in size . . . . 10.
10. Head seta A double, *d* long and single ; distal edge of saddle of anal segment strongly spiculate . . . . *chorleyi* (p. 57).
Seta A with at least 5 branches, *d* short and multiple ; distal edge of saddle smooth or with only minute spicules . . . . 11.
11. Seta A 5-branched ; subventral tuft of siphon with about 10 branches ; pecten composed of *scales* . . . . *hopkinsi* (p. 57).
Seta A 8-branched ; subventral tuft of siphon with about 20 branches ; pecten composed of *spines* . . . . *pallidocephala* (p. 52).
12. Pecten composed of few (3–6) *spines* . . . *pandani* (p. 63), *pauliani* (p. 64).
Pecten composed of many (15–46) *scales* . . . . 13.
13. Pecten scales round, as broad as long . . . . *ornata* (p. 60).
Pecten scales longer than broad . . . . 14.
14. Comb of more than 15 *scales* . . . . 15.
Comb of less than 15 *spines* . . . . 18.
15. Pecten extending the whole length of siphon . . . . *yovani* (p. 62).
Pecten not extending beyond subventral tuft . . . . 16.
16. Spicules on distal edge of saddle small . . . . . . *annulata* (p. 58).
These spicules much larger . . . . 17.
17. Head-seta *d* single, B and C stout bristles ; subventral tuft of siphon 2-branched *montana* (p 58.).
Seta *d* with at least 2 branches, B and C much more slender ; subventral tuft of siphon 5-branched . . . . *candidipes* (p. 59).
18. " Gills " nearly three times length of saddle of anal segment . *nigripes* (p. 62).
" Gills " nearly four times length of saddle* . . . . . . *fusca* (p. 67).

* It is extremely unlikely that this difference is constant.

Uranotaenia pallidocephala Theobald. (Fig. 12.)

The possession of pecten-spines instead of scales appears to be peculiar to the present species (and the very aberrant *U. shillitonis*). Apart from this the larva is very similar to that of *U. hopkinsi*, but differs by having more numerous branches in head-seta A, and many more branches in the subventral tuft of the siphon.

Described from 2 skins and 6 whole larvae from Kampala, Uganda.

Length about 6 mm.; *colour* light brown, abdominal segments III and V dark, head pale.

Head much broader than long (as 1·4 : 1). Antenna spiculate; tuft of 1 or 2 minute branches at $\frac{1}{3}$. Seta A with about 8 delicately plumose branches, B and C

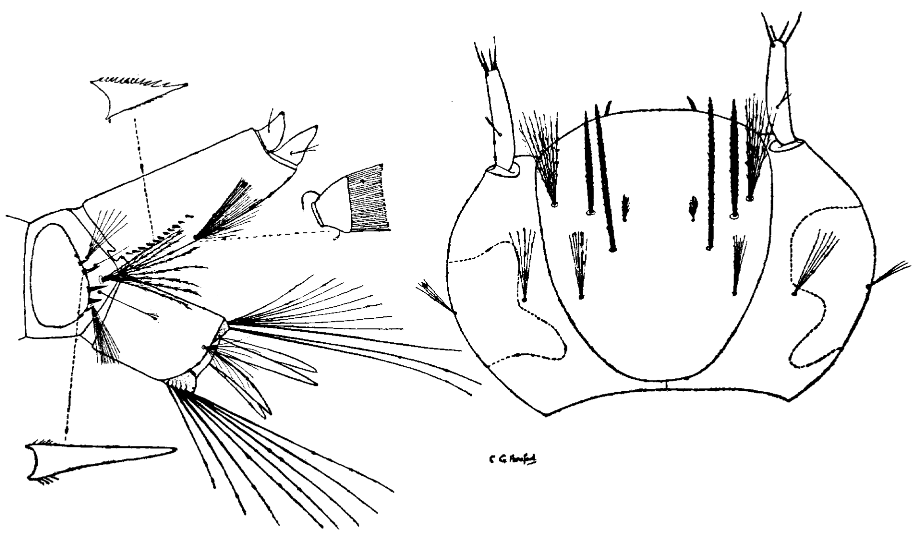


FIG. 12.—*Uranotaenia pallidocephala* Theo. Head and terminal segments. The antenna should be spiculate.

stout serrated spines, *d* with numerous branches. Mentum a regular triangle, with about 18 small subequal teeth on each side.

Abdomen.—Comb-plate rather well sclerotized, bearing 6 or 7 spines, which are delicately fringed at the extreme base and markedly unequal, those in the centre being much larger. Siphon with index about 3; pecten of 9–11 fringed spines extending to about $\frac{1}{2}$; subventral tuft situated at about $\frac{2}{5}$ and composed of about 20 simple branches, which arise independently from a large, flattened base. Anal segment longer than broad (as 1·4 : 1), posterior margin of saddle smooth or with excessively minute spicules; upper caudal seta with about 10, lower with 2 branches; lateral seta situated about midway between dorsal and ventral margins of segment, with about 10 simple branches. Ventral brush composed of 5 pairs of simple setae, of which the anterior are single and the posterior 2- or 3-branched. "Gills" subequal, slightly less than length of saddle.

Breeding-places.—Ditches on the edge of a papyrus swamp, overgrown with vegetation and containing swamp-water, also in small comparatively open areas in the swamp itself. The water in all these places contained a red flocculence, which appears to indicate the presence of decomposing vegetable matter.

Uranotaenia philonuxia Philip.

Larva and breeding-places unknown. Likely to breed in ground pools.

Uranotaenia coeruleocephala Theobald.

Larva and breeding-places unknown. Breeding-places unlikely to differ markedly from those of *pallidocephala*.

Uranotaenia alboabdominalis Theobald. (Fig. 13.)

This is the only known larva of the genus except *U. alba* which has a combination of the following characters : Head-setae B and C stout serrated spines, head markedly longer than broad, comb-spines more or less uniform in size ; from *U. alba* it appears to differ only in having fewer branches in the subventral tuft of the siphon.

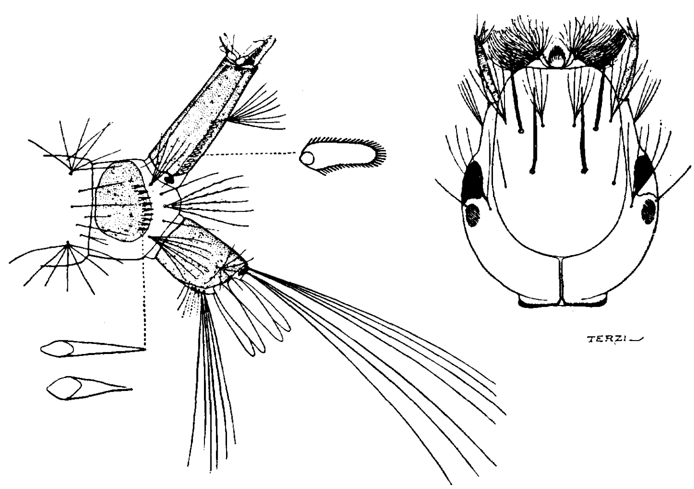


FIG. 13.—*Uranotaenia alboabdominalis* Theo. Head and terminal segments. At higher magnifications the comb-spines are seen to be very delicately fringed.

Length 3½–4 mm. ; *colour* light brown throughout, head brown.

Head long and narrow (length : breadth as 1 : 0·7). Antenna pale, about ¼ length of head ; tuft a single minute seta at about ½. Seta A with about 5 branches, B and C stout serrated spines, *d* unusually large (nearly as large as A, and with a similar number of branches), *e* rather long, simple.

Abdomen.—Comb composed of 8–9 very delicately fringed subequal spines, comb-plate unusually large. Siphon with index about 3⅓ ; pecten extending to the tuft, composed of 12–15 fringed scales, which are longer than broad ; tuft just beyond middle, composed of about 8 simple branches. Anal segment completely sclerotized ; upper and lower caudal setae with about 4 and 3 branches respectively ; lateral seta situated about midway between the dorsal and ventral margins of the saddle, with about 7 branches. Ventral brush composed of 3 or 4 pairs of tufts, each with 3 branches. "Gills" subequal, bluntly pointed, equal in length to saddle.

Specimens from the West Coast agree with those from Uganda.

Breeding-places.—The recorded breeding-places are: the grass border of a marsh (Schwetz, 1930*b*), and marshy ground along the banks of a stream (Macfie and Ingram, 1916*a*); in Uganda it has been bred from a stagnant ditch containing clean water and overgrown with grass.

Uranotaenia alba Theobald.

Described from 2 skins from the Toro district, Uganda.

Resembles very closely *U. alboabdominalis*, from which it seems to differ only in having 12–14 branches in the subventral tuft of the siphon as against about 8 in *alboabdominalis*.

Breeding-places.—Bred from the weedy edge of a crater lake.

Uranotaenia mayeri Edwards.

Larva and breeding-places unknown. Likely to occur in ground pools.

Uranotaenia bilineata Theobald.

This is the only species, except *mashonaensis*, which has head-setae B and C spiniform, the head as wide as long and a comb composed of scales; it differs from *mashonaensis* in having head-setae B and C stouter and serrated instead of plumose, fewer branches in seta A, a shorter siphon and other respects.

The only records and description available are those of the variety *fraseri*, Edw.; the writer has not seen the larva, and the following notes are taken from the description and figure published by Ingram and de Meillon.

Head about as long as broad. Antenna cylindrical, $\frac{1}{4}$ length of head, dark; tuft consisting of a delicate single or double simple seta at $\frac{1}{3}$; subapical and apical setae short and stout. Clypeal spines short, stout and slightly curved. Seta A composed of 3 or 4 branches, B and C stout serrated spines, *d* minute with branched tip. Mentum with 4–5 pointed teeth on each side of a larger and more bluntly-pointed central tooth.

Abdomen.—Comb-plate large, but weakly sclerotized, comb composed of 6–8 fringed scales. Siphon almost cylindrical, index a little more than 3; tuft of 4–8 simple branches at about $\frac{1}{2}$; pecten extending to the tuft, composed of 9–11 poorly sclerotized fringed scales which are longer than broad. Anal segment with small spicules at distal edge; upper and lower caudal setae both single; lateral seta placed near the dorso-apical angle, 5-branched. Ventral brush poorly developed. "Gills" subequal, bluntly pointed, about length of saddle.

Breeding-places.—Ingram and de Meillon found the larvae in grass-grown pools; the only other record is that of Dalziel, who found the species once in a crab-hole.

Uranotaenia balfouri Theobald. (Fig. 14.)

This larva is separable from other known species by the following combination of characters: Head-setae B and C stout serrated spines, head longer than broad, comb-spines markedly unequal in size.

Length about 3 mm. ; *colour* grey, head and siphon black.

Head elongated, length : breadth as 1 : 0·8. Antenna sparsely spiculate, very dark brown ; tuft a single small seta a little before the middle. Seta A a tuft of 3–5 rather long hairs, B and C stout serrated spines, *d* a tuft of about 3 rather long branches, *e* rather long, single or double. Mentum with 5 or 6 teeth on each side of the centre.

Abdomen.—Comb composed of 5–9 large, pointed, basally-fringed spines, which are graded, the longest being the third or fourth from the ventral end of the row. Siphon

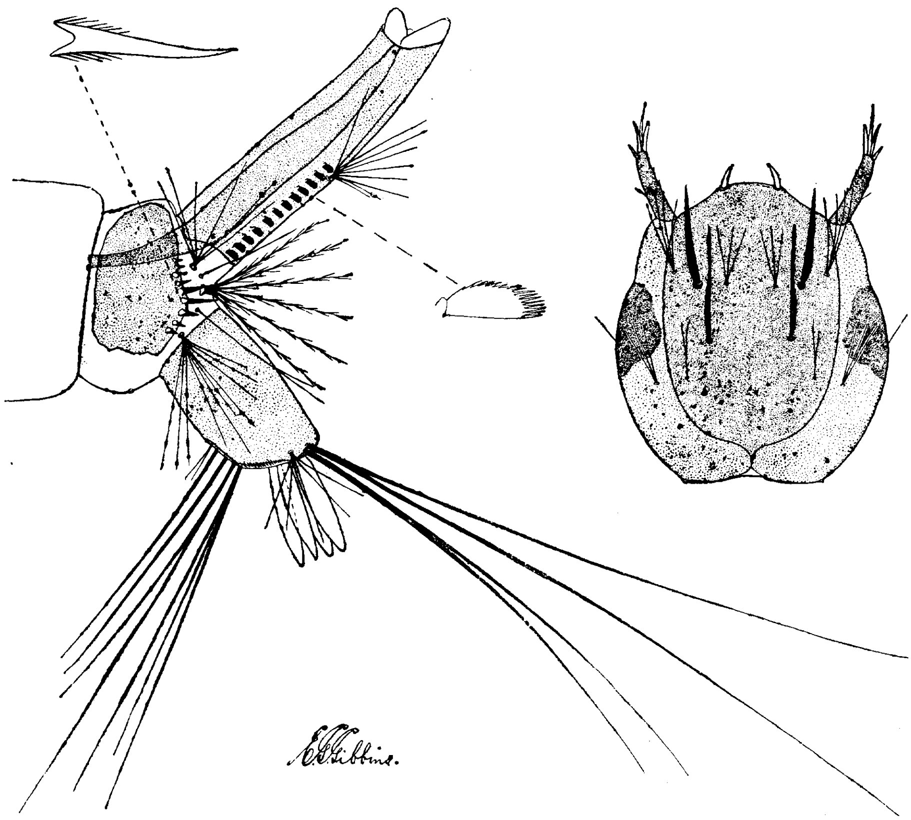


FIG. 14.—*Uranotaenia balfouri* Theo. Head and terminal segments.

with index $3\frac{1}{2}$; tuft of about 12 branches situated at about $\frac{1}{2}$; pecten composed of 9–12 delicate fringed scales, which are longer than broad and extend to slightly beyond $\frac{1}{2}$. Anal segment with a complete saddle, almost twice as long as broad, posterior margin very delicately spiculate ; upper and lower caudal setae with 2–4 and 2 branches respectively ; lateral seta with 4–6 branches. Ventral brush composed of about 5 pairs of few-branched setae. " Gills " subequal, short, tapering, bluntly pointed.

Larvae from Uganda agree in all respects with those from the West Coast.

Breeding-places.—All the records are from pools ; these include borrow-pits (Wesché), water-holes " containing water of a yellowish tinge and often having an iridescent surface film" (Ingram, 1912), pools covered with *Pistia* (Macfie and Ingram, 1922), clay-pit (Hancock, 1930), grassy border of a marsh (Schwetz, 1930*b*), a swamp (Philip, 1931), and "a marsh with much floating and upright vegetation" (De Meillon and Rebêlo, 1941). In the Toro district of Uganda it occurs not uncommonly in old craters filled with papyrus swamp, in open patches amongst *Riccia* (a floating liver-wort).

Uranotaenia caliginosa Philip.

Larva and breeding-places unknown. Probable breeding-places ground pools.

Uranotaenia neireti Edwards.

Larva and breeding-places unknown, latter likely to be similar to those of *chorleyi*, which is very closely related to *neireti*.

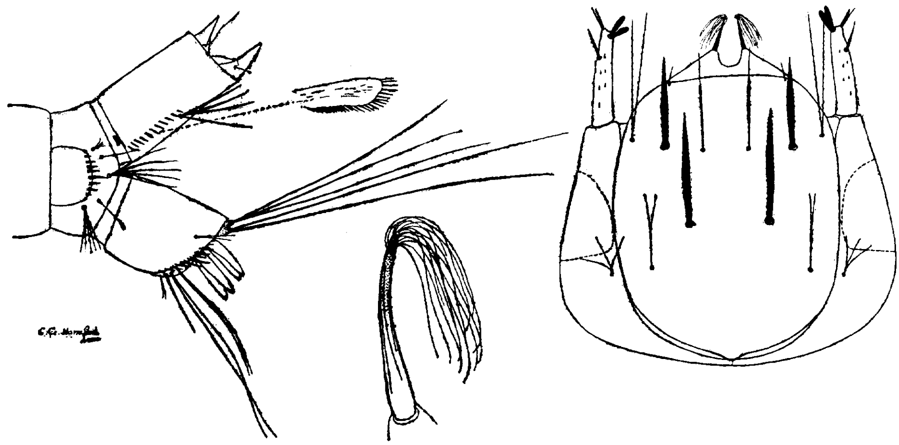


FIG. 15.—*Uranotaenia chorleyi* Edw. Head, terminal segments, and detail of clypeal spine.

Uranotaenia dumonti Doucet.

This species, recently described from Madagascar, is known from the larva only. It should be noted that *U. neireti* Edw., which also occurs in Madagascar, has unknown early stages. The description which follows is translated from Doucet (1949*b*):

"This species is near *U. bilineata* Theobald and *U. mashonaensis* in having head setae B and C thickened and spinelike and a comb composed of scales; it can be separated at sight by the fact that head seta A is spinelike and that the siphonal tuft is formed of setae which are plumose at their tips only.

"*Length* about 5 mm.; general colouration blackish, head and siphon dark black.

"*Head* about as long as broad. Antennae smooth, brownish black; antennal seta, fairly stout, inserted slightly beyond the middle of the antenna on the outer side. Setae A, B and C stout, spinelike and covered with fine spicules; *d* long and stout, single, and inserted at the edge of the clypeus in front, its length approximately equal to that of the antenna; *e* single and three times as long as *f*; *f* trifid and very small. Mentum pentagonal with 4 teeth (the last but one prominent) on each side of the very conspicuous central tooth.

"*Abdomen*.—Comb of 8th segment composed of 7 to 8 broad scales fringed at their extremities, of equal size. They are inserted on a well developed chitinous plaque. Siphonal index $2\frac{1}{2}$. Tuft of 10 to 12 branches, plumose at their tips, inserted at about the middle of the siphon. Pecten composed of 10 to 12 scales delicately fringed at the tip, longer than broad and inserted on the proximal half of the siphon. The anal segment has a complete chitinous ring. It is about two and a half times as long as broad, its posterior margin is finely spiculated ; the upper caudal seta has three branches, the lower caudal seta 2 branches. Lateral seta with two branches, finely plumose. Ventral brush composed of five pairs of setae of which the first four have four branches each, the last has only two extremely short branches. The gills are lanceolate and subequal, their length about equal to that of the anal segment.

"*Site of collection*.—The larvae were captured on the 30th May, 1948, in a shady water hole dug in a reedbank on the course of a stream on the side of Mt. Ambohiby. . . . The temperature of the water was 22° centigrade (temperature outside : 25°). The pH of the water was about 7 (I.D.)."—P. F. M.

Uranotaenia chorleyi Edwards. (Fig. 15.)

Easily separated from any other known Ethiopian species of *Uranotaenia* by the spatulate subterminal setae of the antenna and by the unique character of the clypeal spines.

Described from 4 skins and 5 whole larvae from Uganda.

Length about $4\frac{1}{2}$ mm. ; *colour* not noted, but head not particularly dark.

Head about as long as broad. Antenna short, straight, with a few moderately large spicules ; tuft a rather stout short seta at $\frac{3}{5}$; subterminal setae distinctly spatulate. Clypeal spines rather slender, tips with very fine brush-like branching ; this structure appears to be unlike that of any other known mosquito larva. Seta A rather long, double, slightly plumose, B and C stout serrated spines, *d* long, single, simple, *e* long, 2-branched.

Abdomen.—Comb-plate rather weakly sclerotized, bordered by about 8 almost simple spines, which are not highly sclerotized, and of which the central is decidedly larger than the rest. Siphon with index a little more than $1\frac{1}{2}$; tuft at about $\frac{1}{2}$, composed of about 4 simple branches ; pecten extending somewhat beyond tuft, composed of about a dozen rather long scales, which are fringed ventrally and apically. Anal segment with a complete saddle, which bears on the ventral part of the posterior margin a row of very large spicules ; upper and lower caudal setae with 3 and 2 branches respectively ; lateral seta about $\frac{1}{3}$ length of saddle, with 2 or 3 simple branches. Ventral brush very poorly developed, tufts each with 2 branches. "Gills" subequal, about half length of saddle.

Breeding-places.—Stagnant water in native water-holes, ditches and sedge-swamps, always with a certain amount of shade, which may be heavy.

Uranotaenia hopkinsi Edwards.

Described from 2 skins and 2 whole larvae from near Fort Portal, Uganda.

Length about 4 mm. ; *colour* pale brown, abdominal segments III and V darkish brown, head and siphon brown, not very dark.

Resembles *U. pallidocephala* very closely in general appearance. The main differences are as follows : Head seta A with only 5 branches ; comb-spines without a basal fringe ; subventral tuft of siphon with only about 10 branches, which arise from a much narrower base ; pecten composed of fringed scales ; upper caudal seta 5-branched ; lateral seta with about 7 branches.

Breeding-places.—More larvae of this species were found in a large weedy ditch containing fairly clean water than elsewhere, but it was also bred from a weedy pool in swampy ground and from among floating debris at the edge of a crater lake.

Uranotaenia montana Ingram and de Meillon.

Resembles very closely *U. annulata* and *U. candidipes* ; from the former it is most readily separated by the greater size of the spicules on the posterior margin of the saddle ; from the latter by the much stouter nature of head-setae B and C and by the 2-branched subventral tuft of the siphon.

Described from a single pelt from the Johannesburg district (B. de Meillon).

Head distorted, apparently longer than broad. Antenna about $\frac{1}{4}$ length of head ; tuft a single very small seta slightly before $\frac{1}{4}$. Seta A with about 6 branches, B and C moderately stout simple bristles, distinctly longer than the antenna, *d* single. Mentum with about 6 rather coarse teeth on each side of the centre.

Abdomen.—Comb-plate weakly sclerotized, bordered by about 20 very long scales. Siphon crushed, index $3\frac{1}{2}$ in this skin, probably decidedly more in uncrushed specimens ; subventral tuft at about $\frac{1}{2}$, 2-branched (broken beyond base) ; pecten extending nearly to $\frac{1}{2}$, composed of 17 scales, which are much longer than broad. Anal segment apparently about as broad as long, posterior margin of saddle with a row of very large spicules and also with a few minute ones ; upper and lower caudal setae apparently similar to those of *U. annulata* (but displaced in the specimen examined) ; lateral seta single, apparently long (broken). Ventral brush with about 5 pairs of few-branched tufts. " Gills " subequal, about length of saddle.

Breeding-places and habits.—The larva described was collected from a crab-hole ; Dr. de Meillon informs me (*in litt.*) that the larva lived in captivity for $4\frac{1}{2}$ months before pupating.

Uranotaenia annulata Theobald. (Fig. 16.)

The very long and more or less equal, fringed comb-scales of this species are very characteristic of a group which also includes *candidipes* and *montana* ; from both these species *annulata* is readily separated by the much smaller spicules bordering the distal edge of the saddle of the anal segment. The three species mentioned also differ from all others which I have seen in the very pale-coloured and spatulate clypeal spines.

Length about 6 mm. ; *colour* light grey, head and siphon very dark.

Head with length and breadth approximately equal. Antenna with tuft represented by a single very small seta at before $\frac{1}{3}$. Seta A with about 8 branches, B and C single simple hairs, *d* moderately large with about 4 branches. Mentum triangular, with about 7 teeth on either side of the centre, very similar to that of *candidipes*.

Abdomen.—Comb of 15–18 narrow scales, which are about equal in size. Siphon with index about $3\frac{1}{2}$; pecten extending to about $\frac{1}{2}$, composed of 18–20 scales which are not unlike those of the comb ; tuft situated just beyond pecten and composed of 5 simple branches. Anal segment with a complete saddle, posterior edge with a row of slender spicules ; upper and lower caudal setae bifid ; lateral seta single, simple, nearly thrice length of saddle. Ventral brush composed of 4 or 5 pairs of tufts,

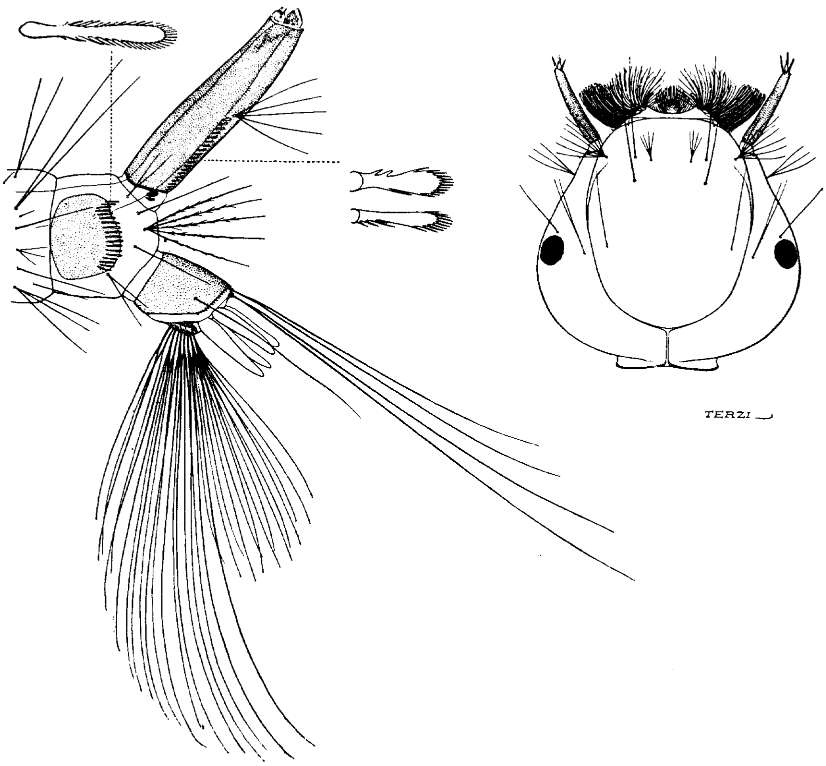


FIG. 16.—*Uranotaenia annulata* Theo. Head and terminal segments.

each with about 4 branches, last pair of tufts much shorter than those immediately preceding them. " Gills " subequal, about length of saddle.

Breeding-places.—The preferred type of breeding-place appears to be in crab-holes (Dalziel and others). Dalziel also records the species from pools, twice from wells, and once abundantly from the axils of *Pandanus veitchii* ; the last breeding-place is so different from the others as inevitably to raise a suspicion that the specimens were incorrectly determined.

Uranotaenia candidipes Edwards. (Fig. 17.)

Most readily separated from *U. annulata* by the much larger size of the spicules on the posterior margin of the saddle, and by having the lateral tuft of the anal segment double and about as long as the saddle, instead of single and nearly thrice the length of the saddle ; from *montana* by the fact that head-setae B and C are distinctly more slender, and that in the latter species seta *d* is single and the subventral tuft of the siphon 2-branched.

Length about 6 mm.; *colour* apparently pale, head not dark.

Head broad and rounded, length and breadth approximately equal. Antenna short and dark; tuft a single minute seta at about $\frac{1}{4}$. Seta A composed of 4–5 short simple branches, B and C rather stout simple setae about as long as the antenna, *d* with 2–3 branches. Mentum triangular, sides slightly longer than base, 7 or 8 teeth on each side of the median tooth.

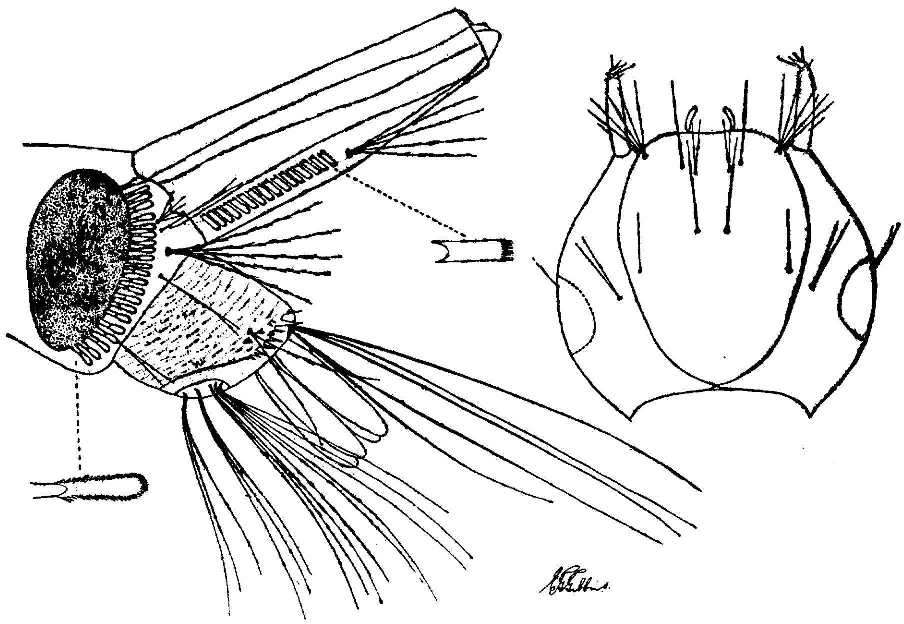


FIG. 17.—*Uranotaenia candidipes* Edw. Head and terminal segments.

Abdomen.—Comb of about 20 long narrow and feebly sclerotized scales, comb-plate weakly sclerotized. Siphon with index about 3; pecten of about 20 weakly sclerotized scales, which are longer than broad, extending to $\frac{1}{2}$; tuft of 5 branches, placed just beyond pecten. Anal segment short and broad, distal margin of saddle with a row of large spicules similar to those of *U. montana*; upper and lower caudal setae triple and double respectively; lateral seta double, about as long as saddle, branches subplumose or simple. Ventral brush of about 5 pairs of tufts, each with few moderately long branches. " Gills " subequal, about length of saddle.

Breeding-place.—" Crab-hole at the edge of a stream " (Ingram and de Meillon).

Uranotaenia palmeirimi De Meillon.

Larva and breeding-places unknown.

Uranotaenia ornata Theobald. (Fig. 18.)

The very round pecten-scales are unlike those of any other known species of *Uranotaenia* in our area; the chaetotaxy of the head is also diagnostic.

Described from numerous skins and whole larvae of var. *musarum* Edwards from Nyakasura, near Fort Portal, collected by Mr. J. F. Shillito.

Length about 7 mm.; *colour* white, head and siphon rather dark brown.

Head slightly longer than broad (as 1 : 0·9), very rotund. The rotundity of the head is such that in uncrushed specimens the clypeal spines are hidden and the setae I have assumed to be B might be mistaken for them; the arrangement of the head-setae is peculiar, all being placed very far forward, and the homologies I have suggested for them may be incorrect.

Antenna less than $\frac{1}{4}$ length of head, smooth, cylindrical; tuft represented by a single seta at beyond $\frac{3}{5}$; terminal and subterminal spines small. Clypeal spine short, stout and blunt, concealed in undamaged specimens. Seta A set very far forward, much in advance of antenna, with 2 or 3 simple branches, B and C single,

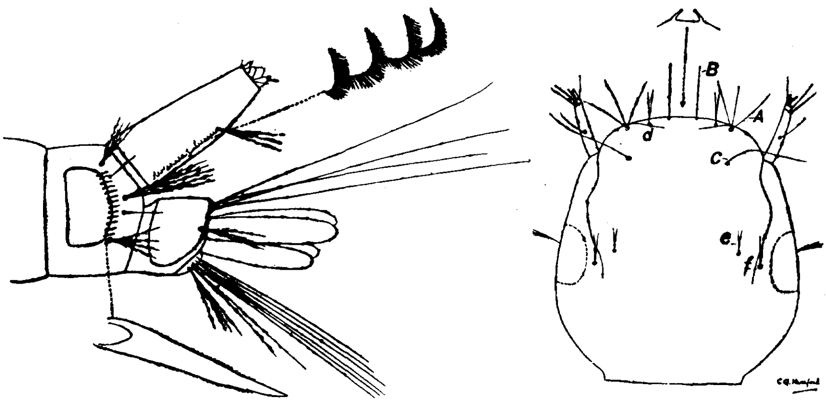


FIG. 18.—*Uranotaenia ornata* Theo. Head and terminal segments.

simple, B set on the extreme front of the head in uncrushed specimens, and simulating the clypeal spines; *d*, *e* and *f* all small, 2-branched.

Abdomen.—Comb-plate large and well-sclerotized, comb of 15–16 spines, each with a very delicate fringe. Siphon with index about $3\frac{1}{2}$; subventral tuft of 3 plumose branches at $\frac{5}{8}$; pecten of about 20 almost circular, overlapping scales, extending to tuft. Anal segment with incomplete saddle, the distal margin of which is fringed with short stout spicules; upper and lower caudal setae double; lateral seta 2- or 3-branched, plumose. Ventral brush consisting of 5 tufts, each with 2 or 3 branches; shorter tufts with plumose branches, longer with simple ones. "Gills" cylindrical, with rounded ends, dorsal pair about twice length of saddle, ventral $\frac{6}{7}$ length of dorsal.

Larvae of the typical form from Lagos (Connal, 1931) are stated to have a comb of only 12 teeth and a siphonal index of about 5; I have not been able to see this material, which in other respects seems to agree with Uganda larvae.

Breeding-places.—Bacot records larvae from the axils of *Dracaena* and *Colocasia*; Philip (1931) states that Dr. A. M. Evans found larvae in a tree-hole and in the axils of a "large dracaena-like shrub." Connal (1931) records larvae as plentiful in pineapple plants. In Uganda var. *musarum* occurs plentifully in the axils of wild banana (*Musa fecunda*), and has been found once by Mr. J. D. Gillett breeding between the fibre and the stem of a cultivated banana (*gonja* variety) in the Bwamba area of Toro district.

Dr. A. J. Haddow has twice bred var. *musarum* from tree-holes. (The same author (1948) found larvae abundantly in *Pandanus* axils and in the " Gonja " banana and two species of colocasia. Van Someren (1951) notes that these larvae (from *Pandanus*) show slight differences from Hopkins' description, having head-seta A with 2–5 branches, comb with 13–16 spines subventral tuft sometimes 4-branched, thorax and abdomen with a few stellate setae and propleural hairs as in *U. yovani*. —P. F. M.).

Uranotaenia yovani E. C. C. van Someren.

The following description is taken from van Someren (1951).

" *Head*.—Very round in uncrushed specimens, with the setae arranged as described by Hopkins (1936) for *U. ornata* var. *musarum*. A well forward with 5–7 branches, B and C single, *d* bifid, *e* and *f* with 2–5 branches. Antennae very short, cylindrical, smooth, and with a fine, single seta below a $\frac{1}{2}$. Mentum rather long and narrow with 8 strong teeth on either side of the central tooth.

" *Thorax*.—Integument covered with stellate setae composed of many, strong, short, very finely plumose branches. Propleural group of hairs with well-sclerotized boss, a 5-branched plumose seta, and one short, strong seta upturned at tip, split distally into 2–3 dendriform branches and with numerous forwardly directed short, stiff hairs on distal $\frac{1}{4}$ below.

" *Abdomen*.—Covered with stellate setae as on thorax. Comb plate large and with 15–23 long, strong, fringed spines on distal edge. Siphon pale, slightly flattened dorso-ventrally, straight-sided dorsally, sigmoid ventrally (concave about the middle and convex about the tuft), and with an index of about 5 in whole larvae; in specimens mounted with pressure the index is reduced to 3 and the shape of the siphon changes, the ventral surface appearing convex only. Pecten extending the whole length of the siphon, of 38–46 pale, finely fringed scales, mostly long and narrow, but a few short, broad ones at apex; subventral tuft about one and a half times the length of the diameter of the siphon and with 2–4 (usually 3) fine, simple branches. Anal segment with an incomplete saddle the distal edge of which is fringed with long spines; lateral seta one and a half times the length of the saddle and usually with 2 (occasionally 3) stout, finely plumose branches; lower caudal seta with 2–4 branches, upper with 3–4; brush with 5 paired, 3–6-branched tufts in the barred area and the branches of the shorter tufts plumose. 'Gills' long, narrow, and about two and a half times the length of the saddle."

Breeding-places.—Leaf axils of screw pine (*Pandanus chiliocarpus*).—P. F. M.

Uranotaenia nigripes Theobald.

Length about 5 mm.; *colour*, head dark, thorax pale in front, more or less darkened behind, abdominal segments more or less pigmented dorsally except segment IV, which appears as a pale band.

This larva appears to be identical structurally with that of *U. fusca* (p. 67), with the exception that in the present species the " gills " are not quite three times the length of the saddle as against nearly four times the length of the saddle in *fusca*. This difference is most unlikely to be constant.

Breeding-places.—Several observers have reported that this species breeds in rock-pools. Wigglesworth (1929*a*) found the larvae to be plentiful in little rock-pools along the course of a stream. Philip (1931) states that Dr. Evans reared "atypical specimens approaching *ornata* from rock-pools near Freetown"; Dr. Edwards has examined the specimens in question, and finds them to be fairly typical *nigripes* but with the thorax discoloured.

Uranotaenia pandani Theobald. (Fig. 19.)

Mrs. van Someren has kindly contributed the whole of the following account.

The only other species of *Uranotaenia* in the area with similar head chaetotaxy is *ornata*. *U. pandani* can be easily separated from *ornata* by the pecten, which is composed of spines.

Described from one larval pelt with associated adult and a few whole larvae collected by Mr. J. O. Harper (Medical Department, Kenya) at Mahé, Seychelles.

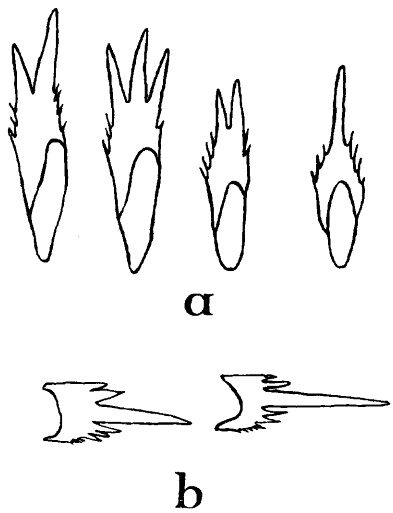


FIG. 19.—*Uranotaenia pandani* Theobald. *a*, comb spines. *b*, pecten spines.

Head longer than broad and dark brown in colour. Antenna about $\frac{1}{4}$ the length of the head; tuft a single, fine seta at about $\frac{2}{3}$. Clypeal spines short and thick. Head-setae arranged as in *ornata*; A 3-branched, B and C single, and *d* a small bifid seta.

Thorax and *abdomen*.—Main setae normal, not as in *nepenthes*. Abdominal segment VIII with a comb-plate. Comb of 6–8 small, pale-coloured spines, which may be bifid or trifid at the tip and with smaller basal denticles, or sharp pointed with numerous basal denticles. Siphon cylindrical and pale, index about $2\frac{1}{2}$; pecten reaching to before a $\frac{1}{2}$, of 3–6 widely spaced, pale-coloured spines, which are broad at the base with a long narrow central point and many fine basal denticles ventrally and 1–2 coarse basal denticles dorsally; subventral tuft at a $\frac{1}{2}$ and composed of 3 simple branches which are about the length of the diameter of the siphon at point of attachment. Saddle incomplete and with a few small spicules on the distal margin; lateral seta a stout, black, finely plumose seta, about $1\frac{1}{2}$ times the length of the saddle, and with 2–3 branches. Upper and lower caudal setae each with 2 branches. Ventral brush with 5 pairs of bifid setae. "Gills" sausage-shaped and from $1\frac{1}{2}$ to 3 times the length of the saddle.

Breeding-places.—Mr. Harper obtained the larvae from leaf-axils.*

Uranotaenia nepenthes Theobald.

The larva is not certainly known, but five larvae (preserved whole) which were found in the same pitcher as the type female probably belong to this species.† These larvae differ very greatly from those of *U. nigripes* and *ornata* and have more resemblance to *U. shillitonis*. The specimens are not well preserved and an adequate description cannot be given; they have several characters in common with the Oriental pitcher-plant breeding species of this genus.

Length about 6 mm.; *colour* of sclerotized parts quite pale.

Head longer than broad. Antenna about $\frac{1}{4}$ length of head; tuft a single minute seta at about $\frac{2}{3}$. Eye very small. Clypeal spines very short and thick, peg-like. One pair of moderately long and simple setae (c ?), placed far forwards near front margin of clypeus and far in front of antennae, a second pair of minute setae external to them, but others not distinguishable.

Thorax and *abdomen* with all the main setae represented by long, single or double, stout black bristles, which give the larva a very peculiar appearance and make it easily separable from other African species. Comb apparently of about 6 spines. Siphon cylindrical, index under 2, pecten and tuft not distinguishable (pecten probably absent). Anal segment longer than broad, saddle without spicules; caudal and lateral setae strong and single; ventral brush represented by a close-set row of 5 stout, slightly plumose bristles on each side, each set of 5 arising from a rather prominent chitinous plate. "Gills" very short, less than half as long as saddle, ovoid. The small size of the "gills" is perhaps a reaction to the digestive ferments found in pitcher-plants.

Breeding-places.—Pitcher of *Nepenthes* sp. (Theobald, 1912).

Uranotaenia pauliani Doucet.

From the description of *U. pandani* given above it would appear to differ from the present species in a number of particulars. A critical examination of Mr. Harper's material of *pandani* from Mahé suggests, however, that most, if not all, of these differences are unreliable. The antennal seta of *pandani* is very delicate and may well have been overlooked in *pauliani*. The mentum, undescribed for *pandani*, appears to be very similar in the two species. The siphon of *pandani* varies very considerably in colour but shows in all cases some degree of pigmentation and in one whole larva is almost as dark as the head. The siphonal tuft is 4-branched in several of the whole larvae and, although only very lightly plumose in the paedotype pelt, it is quite conspicuously plumose in several of them. The degree of spiculation of the distal edge of the saddle is variable. In some cases the spicules appear to be as strongly developed as those figured for *pauliani* by Doucet. The saddle itself is in most cases only lightly sclerotized and shows varying degrees of pigmentation. In one or two

* For a further discussion of this material see under *U. pauliani*.—P. F. M.

† For reasons given under *U. pauliani* I am unable to agree with this attribution.—P. F. M.

whole larvae it appears to be complete though unpigmented over a part of its area. The only differences from *pauliani* which appear to be constant concern the length of the "gills" and the presence of dorsal denticles on the pecten teeth. The absence of the latter is not specifically stated by Doucet in his description and is inferred from his figure. In *pandani* comb spines of the more deeply incised types shown in this figure are rare. The great majority have a single central tooth and delicate basal fringe. Edwards (1941) suggested that *nepenthes*, which is known to occur in Madagascar, may only be a colour variety of *pandani*. In my opinion this is probably the case and the very peculiar unassociated larvae attributed to *nepenthes* are those of a distinct species of which the adult is unknown while the true larvae of *nepenthes* are those described under the name *pauliani*. The following is a translation of the description of *pauliani* given by Doucet (1949*b*) :—

"*Length* about 9 mm. ; general colouration pale, head and siphon brown.

"*Head* longer than broad. The interpretation of the chaetotaxy is based on that given by Hopkins for *U. ornata*. Antennae short and cylindrical, a third the length of the head. Antennal seta absent. A and B the same length as the antenna : A trifid, B single, these two setae set very far forward. C a little longer than the antenna and single *d*, *e*, *f* bifid and very small. Mentum pentagonal with 9 teeth (the 8th very prominent) on each side of a prominent digitiform central tooth.

"*Abdomen*.—The chitinous plate of the 8th segment is small with 6–8 delicately fringed spines inserted on it. Siphonal index 2. The subventral tuft, composed of 4 plumose branches, arises at $\frac{2}{3}$. Anal segment with complete chitinous ring, fringed distally with strong, short spines. Upper and lower caudal setae double. Lateral seta with 3 plumose branches. Ventral brush composed of 5 tufts each with two branches. Gills subequal and cylindrical, rounded at the apex, 4–5 times the length of the anal segment.

"*Site of collection*.—The larvae were taken in abundance on the 30th May, 1948, in dried rachides of *Neodypsis* lying on the ground in a small forest of *Neodypsis* filling a valley of Mt. Ambohiby." *Neodypsis* is a genus of palms apparently peculiar to Madagascar. The adult of *pauliani* is unknown.—P. F. M.

Uranotaenia mashonaensis Theobald. (Figs. 20, 21.)

Characterized by the unique form of head-setae B and C, which are moderately stout plumose spines ; in all other known larvae of the genus these setae are either simple hairs or very stout serrated or simple spines.

Length about 5 mm. ; *colour* not recorded, head dark.

Head slightly wider than long. Antenna $\frac{1}{4}$ length of head, dark, spiculate ; tuft a single short, rather stout, subplumose seta at about $\frac{3}{4}$. Clypeal spines unusually short. Seta A a tuft of about 8 subplumose branches, B and C moderately stout spines, much more delicate than those of such species as *U. alboabdominalis*, and plumose instead of serrated, *d* small, situated rather close to and slightly anterior to C, 4–6-branched from beyond base. Mentum sub-triangular, with 10–12 small teeth on each side of the centre.

Abdomen.—Basal plate of comb large but weakly sclerotized, comb of 10–14 moderately large but weakly chitinized scales. Siphon weakly chitinized, index

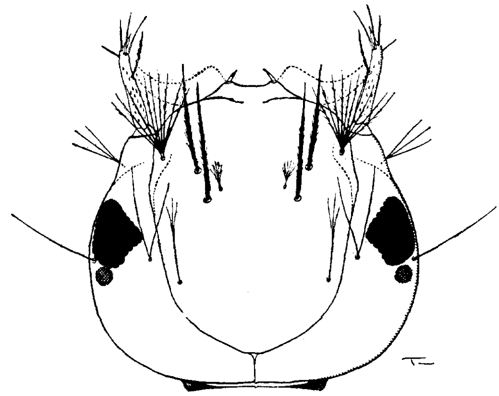


FIG. 20.—*Uranotaenia mashonaensis* Theo. Head.

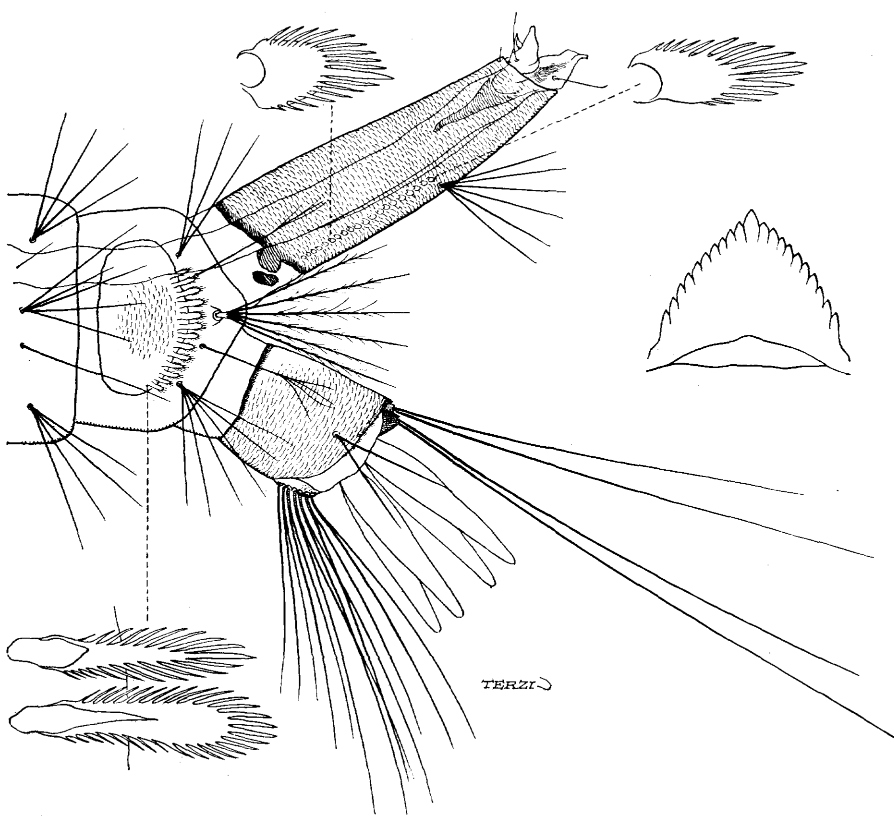


FIG. 21.—*Uranotaenia mashonaensis* Theo. Terminal segments and mentum. The specimen was probably somewhat crushed, the siphonal index being much lower than is usual.

about 5 ; tuft of 5–6 sparsely plumose branches at about $\frac{1}{2}$; pecten extending to $\frac{1}{2}$, composed of 20–30 very broad, weakly sclerotized scales. Anal segment longer than wide, posterior margin of saddle with exceedingly minute spicules ; caudal setae both 2-branched ; lateral seta stout, double, subplumose, slightly shorter than saddle. Ventral brush with about 5 pairs of single or double setae. " Gills " subequal, pointed, rather longer than saddle.

Breeding-places.—Ingram and de Meillon record the species breeding in a swamp, a rock-pool in a river bed and a shaded pool in forest . In Uganda Mr. E. G. Gibbins has bred the species from the more open parts of a papyrus swamp occupying an old crater, where larvae were found among *Lemna* sp., and also from grass at the side of a tiny stream.

Uranotaenia nigromaculata Edwards.

Larva not distinguished, perhaps inseparable from that of *mashonaensis*.

Breeding-places.—Rock pools (Schwetz, 1927) as *mashonaensis*.

Uranotaenia micromelas Edwards.

Larva unknown. The breeding-place was a " shaded stone trough fed by a small spring at 4000 ft., bottom of water with layer of dead leaves."

Uranotaenia fusca Theobald. (Fig. 22.)

Separable from all known species except *nigripes* by the combination of hair-like head-setae B and C and extremely long " gills " ; from *nigripes* the larva described above appears to differ only in the length of the " gills."

Length about 6 mm. ; *colour* not recorded, head almost black.

Head.—Length and breadth approximately equal. Antenna about $\frac{1}{4}$ length of head, dark ; tuft a single minute seta slightly beyond $\frac{1}{2}$. Seta A with about 5 branches, B and C single rather stout hairs, B placed very far forwards and considerably internal to C, *d* placed close to the base of C, moderately large, 2-branched. Mentum subtriangular, with about a dozen very small teeth on each side.

Abdomen.—Comb of about a dozen strongly fringed spines. Siphon with index 4, more tapering than usual in the genus ; pecten of about 15–27 coarsely fringed scales, starting a little above base and extending distinctly beyond tuft to about $\frac{3}{4}$; tuft of 3–6 plumose branches at $\frac{5}{8}$. Anal segment about as long as broad, with a complete saddle, distal edge of saddle with only very small spicules ; caudal setae both single ; lateral seta double or single, plumose, slightly longer than saddle. Ventral brush with a very small number of tufts, each with but two rather long branches. " Gills " very long, subequal, nearly four times length of saddle, tapering apically to blunt points.

Breeding-places.—Nearly all the records of breeding of this species are from rock-pools ; in Jinja, Uganda, the rock-pools in which it was found contained somewhat dirty water and little vegetation, but there was grass round the edges. Schwetz (1927 and 1930*b*) records the species breeding, in addition, in a street gutter, a clay-pit and the Kisanga River.

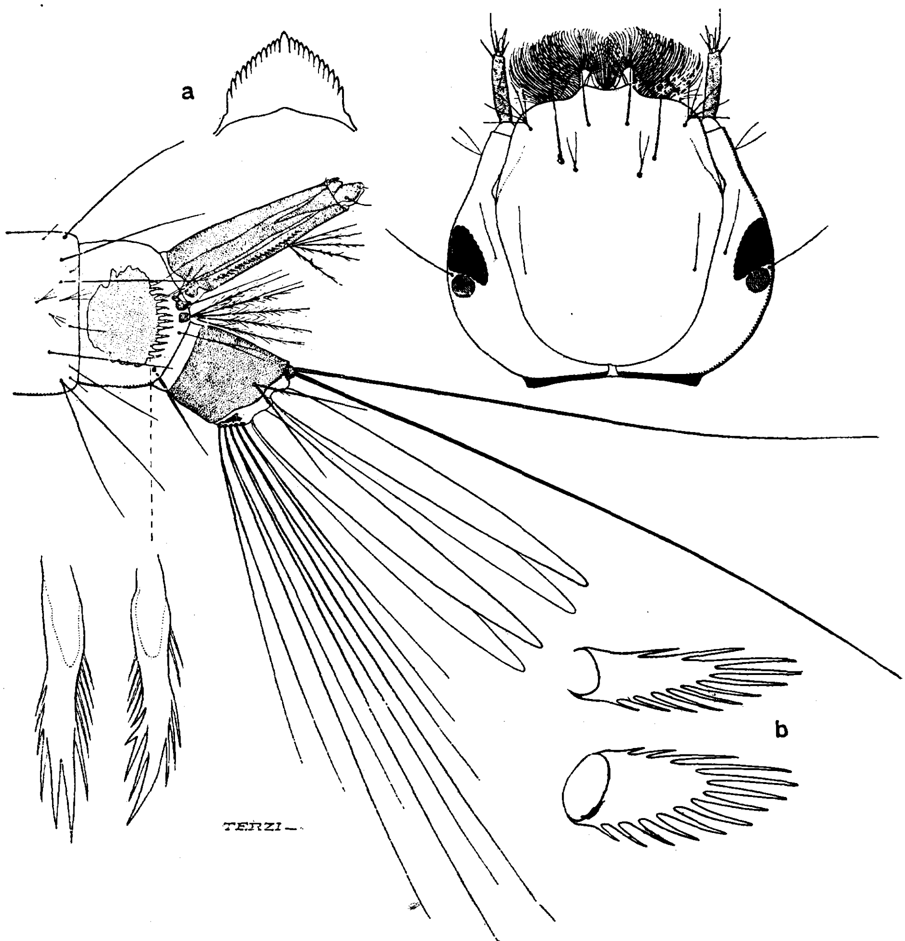


FIG. 22.—*Uranotaenia fusca* Theo. Head and terminal segments. *a*, mentum. *b*, pecten scales.

Uranotaenia shillitonis Edwards. (Figs. 23, 24.)

The general facies of this larva is that of an *Eretmapodites* and it is unlikely to be confused with anything else. The constrictions at each extremity of the siphonal trachea and the peculiar chitinized boss from which the tufts of the ventral brush arise appear to be unique features.

Described from 3 skins and 12 whole larvae from Nyakasura, near Fort Portal, Uganda.

Length about 9 mm.; *colour* nearly white, head and siphon yellow-brown.

Head about as long as broad, all sutures very obscure. Antenna about $\frac{1}{4}$ length of head, cylindrical, smooth, dark brown; tuft a single or double small simple seta at about $\frac{7}{9}$. Both the "larval" and "imaginal" eyes are unusually small and the latter very often devoid of pigment. Clypeal spines short, straight, slender and pale-coloured. normally hidden among the setae of the mouth-brushes. Head-setae all simple and, with the exception of C, very inconspicuous, A placed unusually

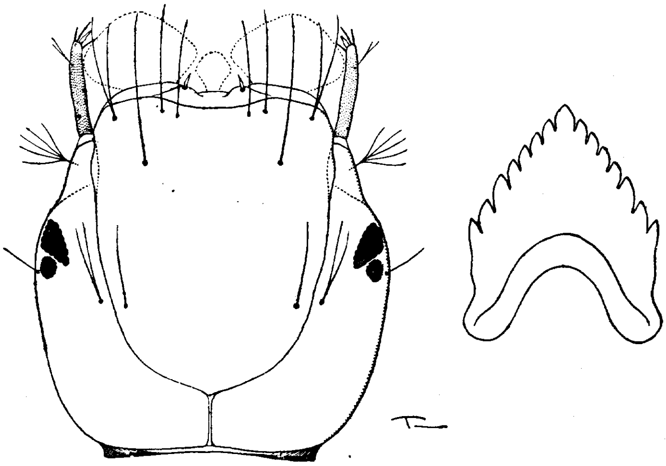


FIG. 23.—*Uranotaenia shillitonis* Edw. Head and mentum.

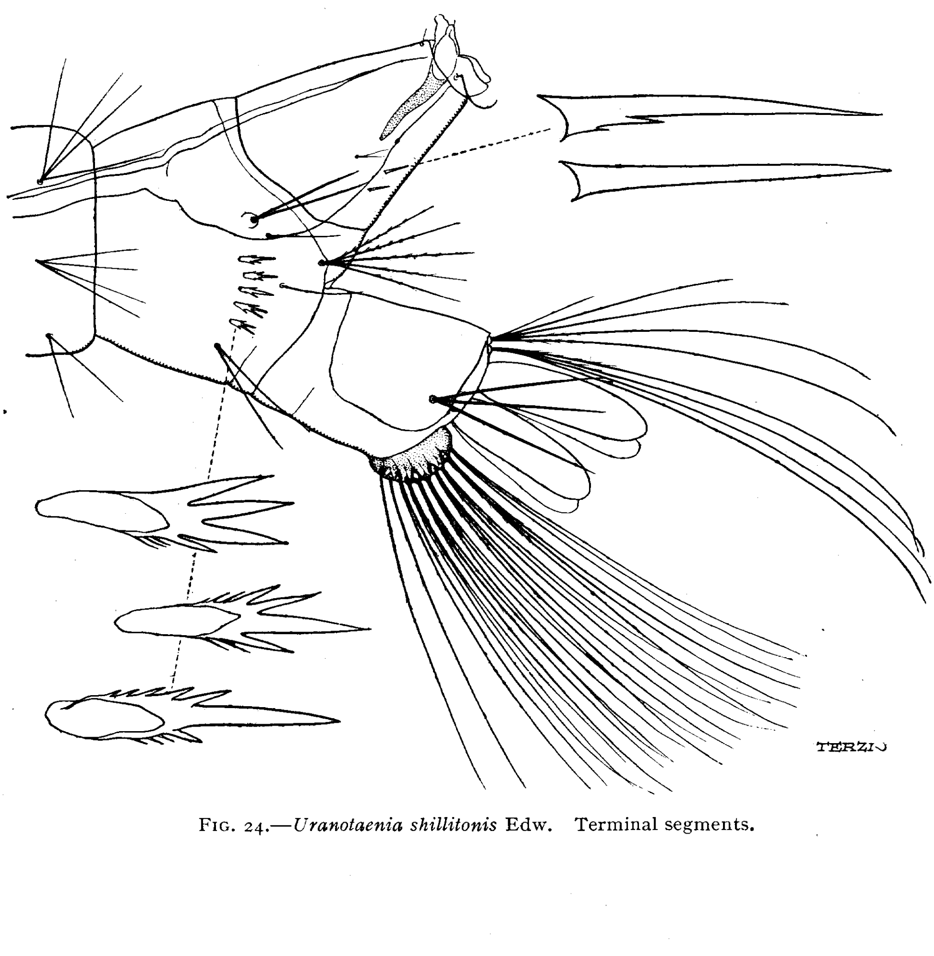


FIG. 24.—*Uranotaenia shillitonis* Edw. Terminal segments.

far forward, 2-branched, B and *d* both single, placed close together and very similar in size, C distinctly longer than antenna, stouter and much longer than any of the other head setae, *e* a moderately long single or double seta placed very far back, *f* double. Mentum a roughly equilateral triangle with slightly curved sides and about 7 rather coarse teeth on either side of the central larger tooth.

Abdomen.—Comb a row of strong spines, which are very variable both in number (3–7, the number seldom the same on the two sides of the same larva) and in shape; they have 1, 2 or 3 sharp main teeth and a varying number of smaller lateral denticles. Siphon highly conical, tapering strongly, index little more than 1; trachea of the siphon of a shape which has not been found in any other Ethiopian larva, strongly constricted where it enters the seventh abdominal segment, and somewhat less so near the apex of the siphon; pecten of 1–2 peg-like spines, which are usually quite simple; subventral tuft very minute and delicate, placed somewhat before $\frac{1}{2}$, 1–2-branched. Anal segment with saddle moderately large but poorly sclerotized, its distal edge quite smooth; upper and lower caudal setae each with 4 (occasionally 3 or 5) plumose branches; lateral seta with 3–4 exceptionally stout and dark simple branches, which are slightly longer than the saddle. Ventral brush composed of 10 tufts, each with 2–3 sparsely plumose branches, placed almost on the midventral line and not obviously arranged in pairs; the bases of these tufts are placed on a comparatively well-sclerotized large rounded prominence, and show little or no trace of the triangular prolongations which in most mosquito larvae form the "barred area." "Gills" sausage-shaped, equal, slightly longer than saddle.

Breeding-places.—Larvae were found in considerable numbers in water contained in the hollow stems of a very large reed belonging to the genus *Phragmites*. These reeds, which have a diameter often exceeding an inch, are used extensively by the natives in the building of huts, and it was in the stumps of reeds cut for this purpose that Mr. J. F. Shillito first discovered the larvae. We subsequently found them in large numbers in the stems of bamboos, some of which had been cut and others bored by the larvae of a moth, at elevations of 8000–8500 ft.; at such elevations the reeds are not found.

Uranotaenia garnhami E.C.C. van Someren. (Fig. 25.)

The following description is taken from van Someren (1948). Resembles *U. shillitonis* (Hopkins, 1935) by having the ventral brush arising from a large sclerotized boss and by having no comb plate, but is easily distinguished by the shape of the siphon and the greater number and shape of the pecten teeth, and by having the comb composed of scales. Differs from *shillitonis* as follows:

"*Head.*—Antennal hair single or divided into 3–4 branches distally. Seta A with 7–8 simple branches, *d* with 4–7 simple branches which are about $\frac{1}{2}$ the length of B, *f* with 3–4 branches; mentum with 6 teeth on either side of the large central tooth.

"*Abdomen.*—Comb a row of 5–12 long but weakly sclerotized scales. Siphon cylindrical, slightly tapered at apex, with an index of 2 in uncrushed whole larvae; pecten reaches to just over a $\frac{1}{2}$ and is composed of 11–16 pale spines which have many fine ventral denticles, which are often continued round the tip to the upper half of the dorsal side or for full length dorsally; subventral tuft at two-thirds short, and with 5–8 simple branches. Saddle weakly sclerotized, incomplete, and with a few spines on distal border ; lateral seta usually 2-branched but one specimen has the lateral seta 3-branched on one side ; upper and lower caudal seta with 2-5 branches, lower usually 2-branched.

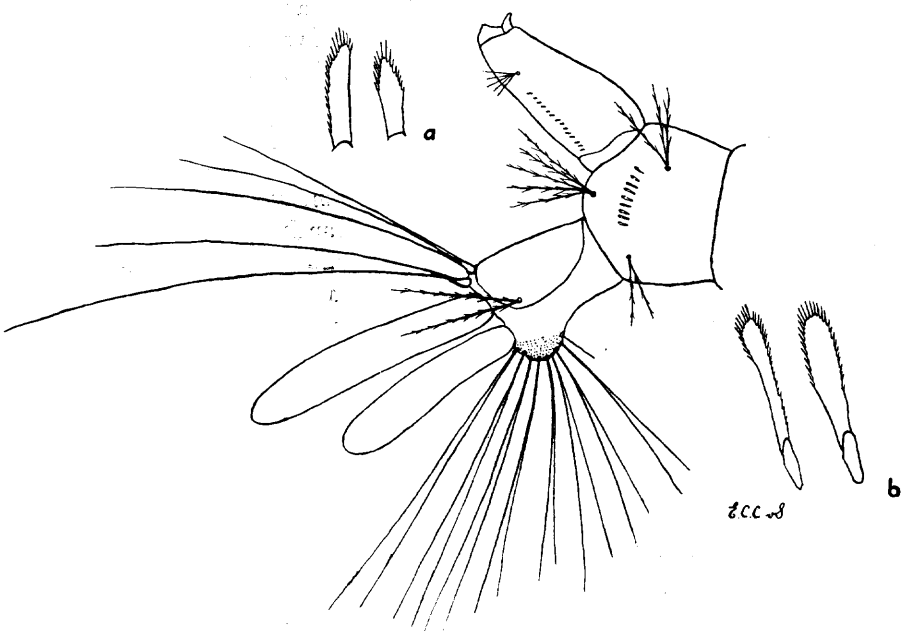


FIG. 25.—*Uranotaenia garnhami* E. C. C. van S. Terminal segments. *a*, pecten scales. *b*, comb scales. (From van Someren, 1948).

" *Field Notes*.—The larvae were collected from bored bamboos and were found together with the larvae of *U. shillitonis*." Mrs. van Someren was kind enough to allow me to refer to her MSS. for the purpose of taking this extract while her paper was still in the press."—P. F. M.

Uranotaenia henrardi Edwards.

Larva and breeding-places unknown. Probably breeds in bamboo stems.

AËDOMYIA Theobald.

The larvae are extremely characteristic, and cannot readily be mistaken for those of any other genus. The enormous flattened antenna is completely diagnostic, while the hairiness of the entire integument and the fact that the comb is set on a plate are also unusual features.

Head very large, about as broad as thorax. Antennae enormous, much flattened, spiculate ; tuft placed near middle and composed of long plumose branches ; terminal and subterminal setae placed more or less together at tip, subterminal setae and one of terminal setae very long and more or less plumose ; tip of antenna a chitinous pedestal set at an angle with the shaft, dark in colour and bearing two small spines. Clypeal spines set very wide apart, clypeus forming a semicircular projection between them. Setae A, B and C very long, multiple and coarsely plumose. Maxillae with a long black apical spine. Mentum very small, almost square, with very few teeth (two on each side of the central tooth in the two African species). A large retractile bladder-like organ of unknown function arises from near the base of the antennae. (See p. 22.)

Thorax.—All main setae immensely long, all those of prothorax, including innermost shoulder-hair, set in distinct chitinous plates ; innermost shoulder-hair composed of 2 or 3 very long plumose setae and a tuft of very numerous slender short branches ; tufts of remaining shoulder-hairs with 2, 1, 1 and 1 branches respectively. Propleural group small and inconspicuous, composed of three short setae and one minute ; mesopleural group of two very long setae and one moderately long, set in a rather large plate, which bears a short spine ; metapleural group similar, but with the third seta short and set in a large plate, which also bears a spine. Numerous stellate tufts present on dorsum.

Abdomen.—Lateral setae of first two segments very much longer and stronger than those of following segments, arising from chitinous plates, which extend from base of setae to posterior margins of segments. Numerous stellate tufts similar to those of the thorax are present on the abdomen. Comb a row of long straight spines set on the edge of a large but weakly sclerotized plate. Siphon short, somewhat curved and tapering, weakly sclerotized ; pecten absent, but whole surface of siphon more or less hairy ; a single pair of large subventral tufts at or beyond middle and a short subdorsal tuft of few branches (usually only one) near the apex ; tracheae rudimentary ; anterior valves very small, each bearing a strong curved spine ; posterior valves also small and bearing a conspicuous tuft of plumose setae. Saddle of anal segment poorly sclerotized but very large ; upper and lower caudal setae very long, single, with very coarse and long plumosity on the dorsal side only. Ventral brush composed of 6 or 7 pairs of tufts, each of which is a single seta which bears very long and coarse unilateral plumosity.

Breeding-places and habits.—Larvae are found in swamps and borrow-pits, less commonly in rivers (accompanying vegetation probably floated off from swampy backwaters by floods) ; living vegetation is a constant feature of the breeding-places. It has been suggested by Howard, Dyar and Knab that, in view of the rudimentary tracheal system, respiration is probably largely cuticular, and they also suggest that the large antennae may have a respiratory function. The first part of this hypothesis is to some extent corroborated by the extremely weak sclerotization of the entire larva and by the habits of the two African species : Ingram (1912) records the habit of larvae of *A. africana* of descending to the bottom when disturbed, and remaining below for many minutes ventral side up and balanced on the siphon and the dorsum of the thorax, and the present writer has observed this habit in both the species. Furthermore, a pool containing enormous numbers of *A. furfurea* was oiled with no apparent effect on their numbers, though the *Anopheles* and *Culex* larvae present were destroyed (this observation is, of course, equally consistent with cuticular respiration or with the obtaining of air from plants). Dr. Wigglesworth kindly informs me that larvae of *Aëdomyia africana* obtain air with equal facility from the water-surface or from the film on the underside of the leaves of *Pistia*. In the case of *A. furfurea* I have often seen the tip of the siphon closely applied to the stems of leaves of a species of *Potamogeton* which does not bear hairs, and therefore does not have a visible surface film of air ; there was apparently an attempt to thrust the tip of the siphon into the tissues of the plant, and during this operation the antennae were sometimes clasped round a portion of the plant, possibly for the purpose of obtaining air (if the suggestion as to the respiratory function of the antenna is correct), but apparently in order to obtain an anchorage ; after an anchorage was obtained the attitude of the larva was exactly like that assumed by larvae of *Taeniorhynchus.*

KEY TO THE LARVAE OF THE GENUS.

1. Branches of stellate setae of thorax and abdomen with plumosity forming a tuft near the tip . . . . *furfurea.*
   Plumosity of these branches with no tufted appearance . . . . *africana.*

Aëdomyia africana Neveu-Lemaire. (Figs. 26, 27.)

Length about $4\frac{1}{2}$ mm. ; *colour* olive brown, head pale brown.

Head similar in shape to that of *furfurea.* Antenna with tuft of 5–7 branches at slightly beyond $\frac{1}{2}$; subterminal setae plumose (the shorter only at the base). Clypeal spines long, strongly curved, dark. Setae A, B and C each with about 6 branches, *d* rather large, with 2–3 simple branches, *e* small, single.

Thorax.—Chaetotaxy similar to that of *furfurea,* but the rosette setae are either uniformly plumose, or, if the basal part is simple, do not present a tufted appearance.

Abdomen.—Rosette setae similar to those of the thorax. Comb composed of 12–15 spines, with a very delicate subterminal and terminal fringe. Siphon with

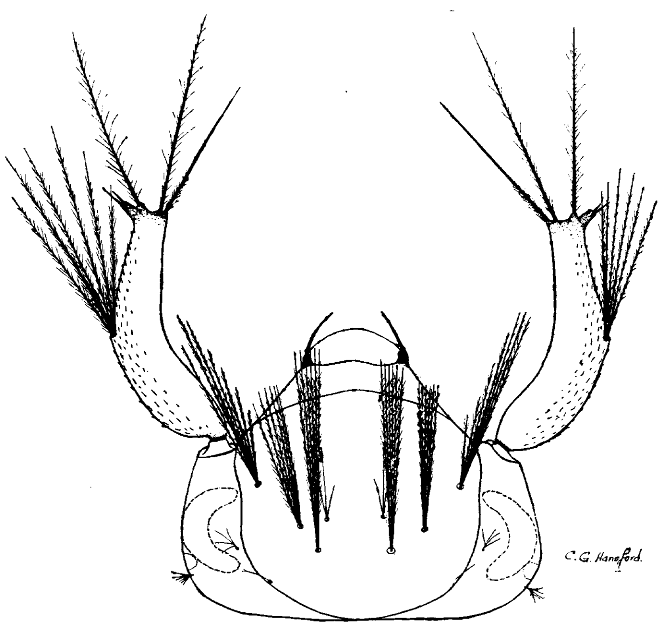


FIG. 26.—*Aëdomyia africana* N.-L. Head.

index about $3\frac{1}{2}$; whole surface covered with minute spicules which develop into moderately long soft hairs on the ventral side, particularly near the base and apex ; subventral tuft at a little beyond $\frac{1}{2}$, composed of 4 simple branches, of which 2 are more than twice the length of the others ; subdorsal tuft single or 2-branched ; tuft on posterior valve of siphon rather large, of about 5 branches. Anal segment with a complete saddle which bears dorsally several rows of rather long slender spines, whereas the remainder of the segment is sparsely spiculate ; lateral seta with

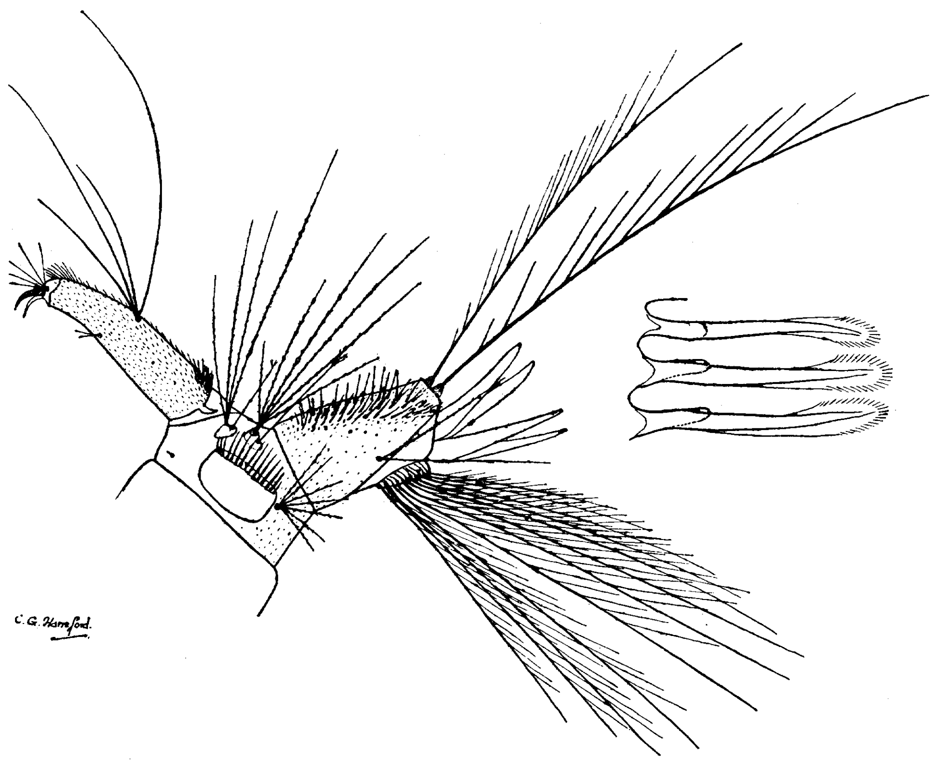


FIG. 27.—*Aëdomyia africana* N.-L. Terminal segments, with detail of comb-spines.

2-3 subplumose branches. Ventral brush of about 7 pairs of tufts. "Gills" subequal, fusiform, slightly shorter than saddle.

Surface of thorax and abdomen, except siphon and anal segment, almost without the dense covering of minute setae present in *furfurea*.

Breeding-places.—The constant feature of all breeding-places of this species is the presence of *Pistia*. Probably for this reason larvae occur (in Uganda) most commonly in more or less open areas, overgrown with this plant, at the edge of Lake Victoria ; they also occur occasionally in borrow-pits in which *Pistia* is present. Dr. Wigglesworth kindly informs me that he has found larvae of this species on isolated plants of *Pistia stratiotes* floating in mid-stream in the rivers Benue and Niger.*

* A record from ponds devoid of *Pistia* and covered with duckweed (*Lemna* sp.) is, however, given by Berner (1947).—P. F. M.

Aëdomyia furfurea Enderlein. (Figs. 28, 29.)

Immediately separated from *A. africana* by the unique character of the stellate setae.

Length about 9 mm.; *colour* green or olive-green.

Head broadly triangular in shape, length and breadth approximately equal. Antenna with spiculation taking the form of short hairs; tuft at $\frac{3}{5}$ composed of about 12 branches; subterminal setae plumose, slightly longer than the shaft. Clypeal

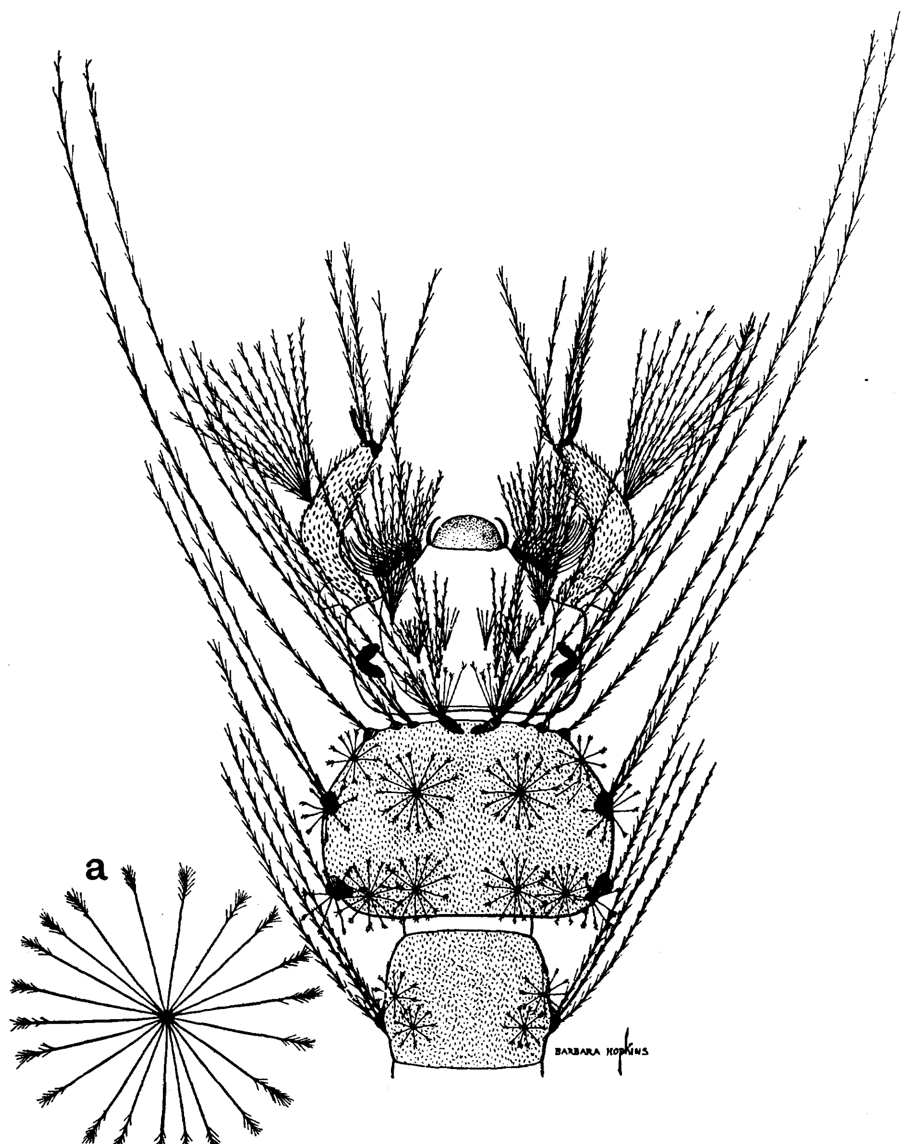


FIG. 28.—*Aëdomyia furfurea* End. Head, thorax and first abdominal segment. *a*, stellate tuft of metathorax.

spines short, stout and curved. Setae A, B and C with about 12, 9 and 3 branches respectively, *d* large, with about 5 simple branches, *e* single, simple. Mentum very small, almost square, with 2 teeth on each side of the centre.

Thorax.—The pair of chitinous plates bearing the innermost shoulder-hairs large ; the components of the tuft of short branches with a very peculiar form of plumosity, which, in the writer's experience, is unique ; the shaft of each branch is

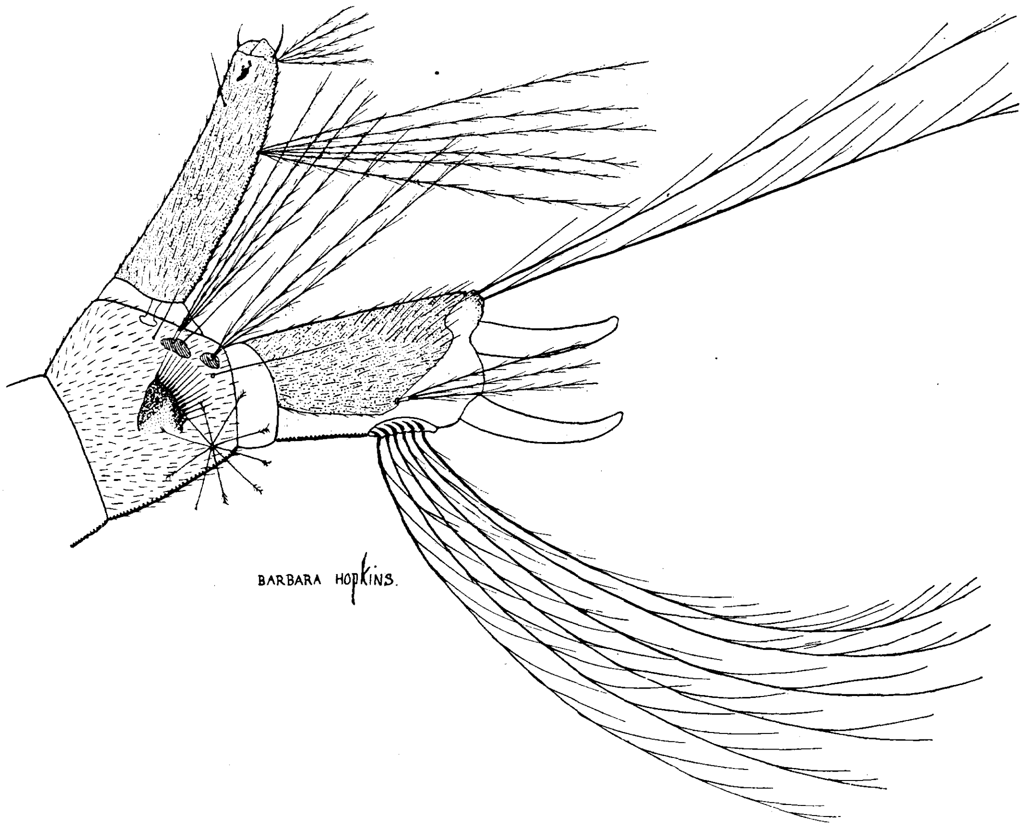


FIG. 29.—*Aëdomyia furfurea* End. Terminal segments.

but slightly pilose, whereas near the tip the secondary branches form a definite tuft. The other shoulder-hairs are immensely long, extending to as far again as the tips of the antennal bristles ; their plumosity is normal (without tuft). Meso- and metathorax each with 2 pairs of large stellate dorsal tufts ; a similar but smaller stellate tuft arises near the base of the pleural tufts of these two segments ; these stellate tufts, together with those on the abdomen, show the same peculiar plumosity as those on the prothorax, but in a more marked degree, since the shaft is entirely bare, accentuating the tufted appearance of the tip.

Abdomen.—Stellate tufts similar to those on the meso- and metathorax. Comb composed of about 15 spines. Siphon short, index about 3 ; the whole surface of the siphon is covered with short hairs, which are slightly longer and more numerous near the tip on the ventral side ; subventral tuft of about 6 plumose branches, which are more than $1\frac{1}{2}$ times as long as the siphon, at $\frac{3}{4}$; subdorsal tuft a single short, rather stout seta ; tuft on posterior valve of siphon large, 4–5-branched. Saddle of anal segment with very strong pilosity, especially on the dorsal side ; lateral seta as long as saddle, with 3 plumose branches. "Gills" slightly more than half length of saddle, bluntly pointed.

The whole surface of thorax and abdomen has a dense covering of minute setae.

Breeding-places.—Larvae were found in enormous numbers in large and long-abandoned clay-pits in Kampala. These pits were completely overgrown with submerged masses of a species of *Potamogeton* (near *schweinfurthii*) ; the water was clean. In similar pits of long standing, which had no *Potamogeton*, the larvae occurred in much smaller numbers and in all cases they were found among the vegetation.

THEOBALDIA Neveu-Lemaire.

The larvae of the different subgenera differ greatly in structure, and it seems impossible to obtain a satisfactory description which will apply to all of them. In the two subgenera which occur in our region the subventral tuft of the siphon is placed very near the base. This character is only shared by *Hodgesia* and the genus *Ficalbia s.str.* ; from both these *Theobaldia* can be separated by the quite different head-chaetotaxy, in addition to the characters given in the key.

The tufts of the setae on the anterior margin of the prothorax are well developed, as are also the mesopleural and metapleural groups, but the propleural group is not very large.

Though the genus is difficult to define on larval characters, there is not the slightest difficulty in recognizing the larvae of the two species which occur in the Ethiopian Region. Diagnoses will be found in the specific descriptions (p. 77 and p. 79).

Subgenus **ALLOTHEOBALDIA** Brolemann.

Only one species is known and it seems unnecessary to give a definition of the subgeneric characters, since these are included in the description of *T. longiareolata* (p. 77). The following additional characters may be noted : Mouth-brushes not very large ; no air-sacs in thorax ; the pecten is somewhat irregular, and is continued on to the unsclerotized skin proximal to the siphon (a unique feature).

Breeding-places.—Pools and barrels.

Subgenus **THEOMYIA** Edwards.

In this subgenus, also, but one species (*T. fraseri*) is known. The head is very large and the mouth-brushes rather small. There is a pair of large but thin-walled air-sacs in the thorax.

Breeding-places.—Tree-holes.

Theobaldia (Allotheobaldia) longiareolata Macquart. (Figs. 30, 31.)

The position of the subventral tuft at the extreme base of the siphon separates this larva from all others except *T. fraseri*, *Hodgesia* and the subgenus *Ficalbia* ; with none of these could it possibly be confused.

Apparently not previously described from Ethiopian material; described here from 2 skins and 1 whole larva from South Africa. These specimens agree in all essentials with Palaearctic ones. The figures are from Palaearctic material.

Length about 11 mm.; *colour* not recorded but evidently very dark, head and siphon almost black.

Head.—Antenna about $\frac{1}{3}$ length of head, smooth; tuft of 2–3 short simple branches at a little beyond $\frac{1}{2}$; terminal and subterminal setae all very small and placed at the tip. Clypeal spines large, broadening apically and with the apex frayed out into a fringe. Seta A with 2–4 short, slender, simple branches, B and C also slender and simple, but single, C placed almost directly behind B, *d* small, usually with 2 branches, *e* single, *f* single or double. Mentum a straight-sided triangle with about 8 teeth on each side of the centre.

Abdomen.—Comb a roughly triangular patch of about 40 spines, which are variable in shape; all have numerous lateral spinules, which in some cases (particularly on

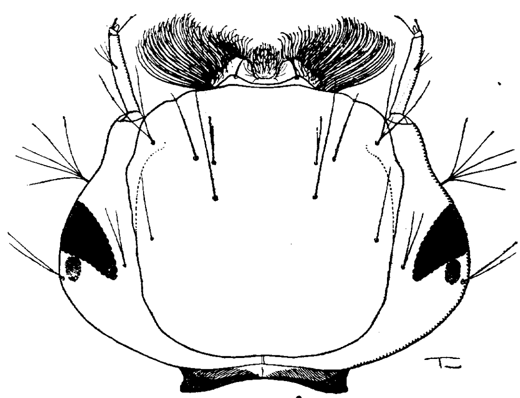


FIG. 30.—*Theobaldia longiareolata* Mcq. Head.

the more distal spines) are almost or quite as large as the central spinule, the tooth then approximating to a scale. Siphon with index about 2; subventral tuft placed at extreme base and composed of about 12 plumose branches; pecten with 3 or 4 small spines placed proximal to the siphon (a unique feature) and about 9, in a somewhat irregular row, on the siphon; most of these spines quite simple, but a few of the most proximal with several basal denticles. Anal segment with saddle very small, its posterior margin fringed with very large spicules interspersed with smaller ones; caudal setae lost in all the Ethiopian specimens I have seen; in Palearctic specimens upper caudal seta with about a dozen branches, lower bifid (sometimes trifid) from a point somewhat beyond its base; lateral seta very small, placed low down in the ventro-distal angle of the saddle, 3-branched (in Palaearctic specimens the number of branches varies from 3 to 6). Ventral brush of about 9 pairs of tufts with numerous branches, elongated bases of proximal 4 tufts very small. "Gills" short and tapered, dorsal pair about as long as saddle, ventral pair shorter.

Breeding-places.—Pools, barrels, dipping-tanks and in a tarpaulin holding rain-water (Bedford, 1928). Lewis (1943*b*) found larvae usually in old oil-drums, sometimes in ditches and pools.*

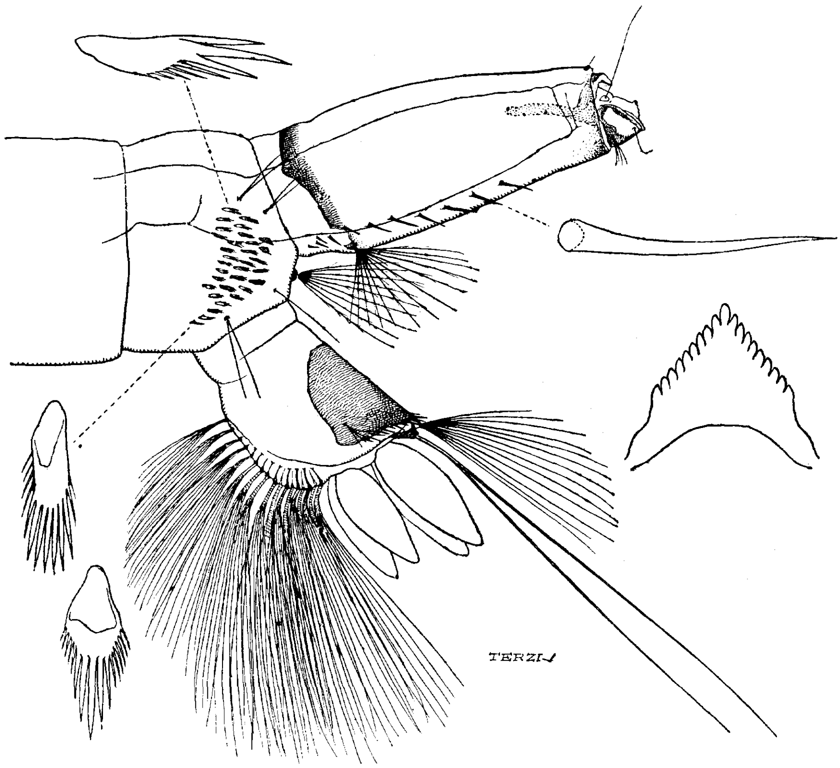


FIG. 31.—*Theobaldia longiareolata* Mcq. Terminal segments and mentum.

Theobaldia (Theomyia) fraseri Edwards. (Figs. 32, 33.)

Several characters borne by this remarkable larva are unique ; it is only necessary to mention the form of the mentum, the extreme degree of sclerotization of the saddle and siphon and the character of the pecten-teeth.

Length apparently about 12 mm. (the material consists of skins only) ; *colour* " strikingly blue " (Garnham, Harper and Highton, 1945), head dark, anal segment and siphon black.

* Abbott (1948) gives the following notes on breeding habits in the Sudan.

" Breeds in profusion in the Marra Mountains above 6000 feet. Small pools beside streams are the favourite site but rock pools and stationary rocky backwaters are frequently chosen. At Dereiba, in the crater, larvae were numerous in fresh pools beside the salt lake and some were even breeding in the water of the salt lake itself." The following is an analysis of this water in 1941 :

> " The water is a solution of sodium carbonate (1·262 gms./100 c.cs.) and sodium chloride (0·645 gms./100 c.cs.) with a smaller quantity of sodium bicarbonate (0·155 gms./100 c.cs.). Other salts are present in insignificant quantities."

" It was noticeable that the larvae from the salt lake were in general considerably paler than those breeding in fresh water close by." Mara (1945) gives records from barrels, etc., on Mt. Bizen, Eritrea, at about 7900 ft. above sea-level in association with *Aëdes aegypti* and *Culex fatigans, laticinctus, theileri and trifilatus*.—P. F. M.

Head very large and somewhat square in shape. Antenna smooth, a little more than $\frac{1}{4}$ length of head, spindle-shaped; tuft of about 10 long plumose branches at a little beyond $\frac{1}{2}$; subterminal and terminal setae all placed at apex, small, two longest less than $\frac{1}{2}$ length of antenna. Clypeal spines short and peg-like. Setae A, B and C with their bases almost in line, those of B and C close together, A with about 5 branches, B and C rather long, 2–3-branched. Mentum unusually small, narrow,

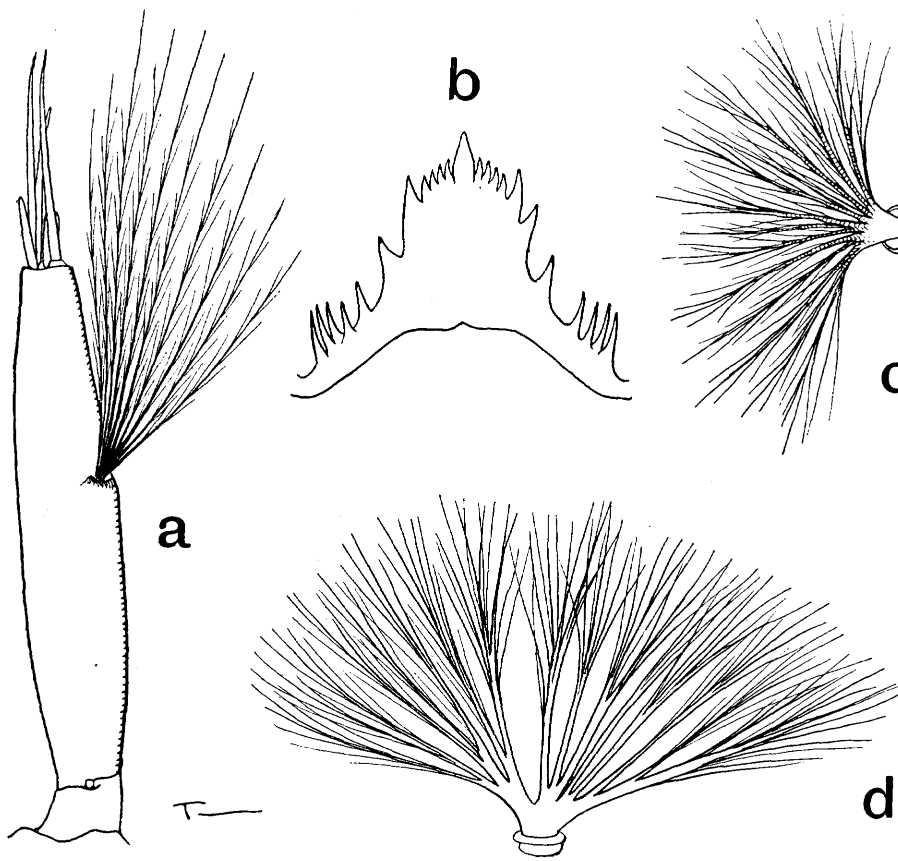


FIG. 32.—*Theobaldia fraseri* Edw. *a*, antenna. *b*, mentum. *c* and *d*, dendritic setae of thorax and abdomen.

having a large central tooth, followed on each side by about 3 very small and a series of about 7 large teeth, the latter rather irregularly placed and extending to the extreme base. Other mouth-parts unmodified, but mouth-brushes rather small.

Thorax.—Chitinous bases of setae small and inconspicuous. Prothoracic pleural group including one long single seta, two others which are also single and more than half the length of the first, and one minute and branched; meso- and metathoracic, each including one very long and one shorter single seta, a many-branched tuft and a minute seta. Between the pleural group and the dorso-lateral tuft of each segment is placed a small densely dendritic tuft of very unusual form, which is not unlike that found on the first abdominal segment of most pupae.

Abdomen.—Comb a patch of about 50 small narrow scales, of which the more proximal are much smaller than the distal. Siphon tapering very gradually to near apex, then rather more rapidly ; index about 8 ; subventral tuft a single simple seta placed very close to base ; pecten of about 25 slender short bristles which are

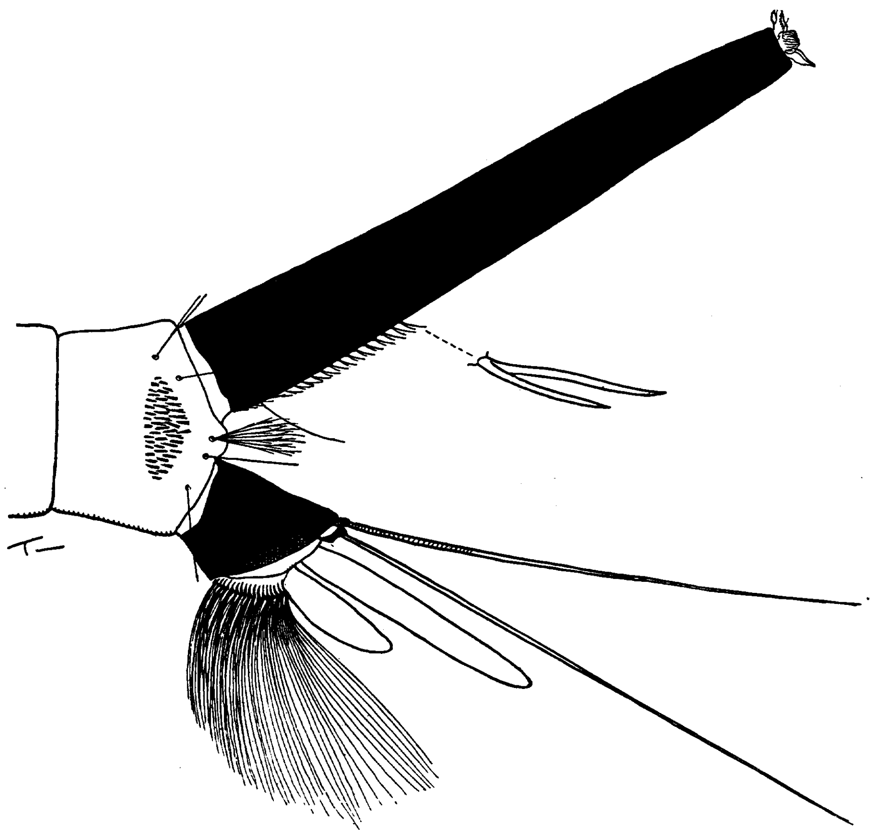


FIG. 33.—*Theobaldia fraseri* Edw. Terminal segments. The lateral seta of the anal segment is omitted in the figure.

bifid from the base. Anal segment with saddle forming a complete ring, distal edge smooth ; upper and lower caudal setae single ; lateral seta (omitted in the figure) slender, simple, about $\frac{1}{2}$ length of saddle. Ventral brush composed of 8 pairs of tufts of rather short but very numerous branches, all of which are placed in the barred area. " Gills " distorted, apparently sausage-shaped, ventral pair much shorter than dorsal.

Breeding-places.—In tree-holes (Edwards, 1930*a*) ; Kumm (MS.) ; Garnham, Harper and Highton.

ORTHOPODOMYIA Theobald.

The double row of comb spines set on the edge of a chitinous plate is sufficient to separate the genus at once from any other.

"Body with a strong pink or reddish colour, usually replaced by blue or violet before pupation.* Antenna usually somewhat swollen at base, with branched tuft before middle; sense bristles all apical. Mouth-parts unmodified, brushes long and dense. Thorax containing a pair of large tracheal dilatations. Prothoracic hairs well developed dorsally, but the propleural group remaining rather small. One sublateral hair on the prothorax, two on the mesothorax, also one in the mesopleural and metapleural groups are extremely long and single; similar very long single hairs occur laterally on each of abdominal segments 3–6. In the fourth-stage larva (except . . . in some specimens of *O. arboricollis*) dorsal chitinous plates are present on each of segments VI–VIII. Siphon without trace of pecten; one pair of hair-tufts a little before middle; valves unmodified. Comb teeth usually in two regular rows, one very slightly distal to the other and composed of much larger teeth. Anal segment (in fourth stage) with a complete chitinous ring; outer dorsal hair single, inner branched; ventral brush well developed" (Edwards, 1932).

Breeding-places.—Both the Ethiopian species breed in tree-holes.

Orthopodomyia arboricollis d'Emmerez de Charmoy.

The peculiar form of the comb at once separates this larva from any other Ethiopian species.

The following notes are extracted from the description and figures published by MacGregor and Gébert:

Colour very variable, sometimes reddish, often colourless, blue-grey or sky-blue, siphon black and glistening, head transparent.

Head.—Antenna yellow, either straight and short or longer and strongly curved; tuft of few plumose branches at about $\frac{1}{3}$. Setae A, B, C and *d* all situated almost in line and close to the anterior margin of the head, all composed of strongly plumose branches which are excessively variable in number and length; *d* considerably smaller than the others but still large. All intermediates occur between forms with the head setae much and but little developed, often in the larvae collected from a single breeding-place; the presence of long curved antennae is correlated with that of dense tuft and *vice versa*.

Thorax with very long and dense lateral tufts and prominent stellate setae on the dorsum.

Abdomen also with numerous stellate setae. Large chitinous plates are often present on the sixth to eighth abdominal segments and on the anal segment (proximal to the saddle), but vary greatly in development and may be entirely absent. Comb composed of two rows of very long spines, of which the distal row contains many fewer spines than the proximal. Siphon widest at rather before $\frac{1}{2}$, index nearly 4; pecten absent; subventral tuft at about $\frac{1}{3}$. Anal segment with complete saddle;

* Similar colouring is found in the genus *Ficalbia*, but is there a specific character, blue specimens being *F. perplexens*, whereas *F. hispida* and *F. mediolineata* are usually red, never blue.

upper caudal seta with very numerous branches; lateral seta very large and composed of plumose branches. "Gills" very short and rounded.

Breeding-places and habits.—In tree-holes only. The type of water in the holes varies much and may either be clear or stale, dark and sherry-coloured. They "swim normally with a slow action of the abdomen, but when disturbed they are capable of rapid movement, diving to the bottom and remaining submerged for long periods. The specific gravity of the larvae is very nearly the same as that of water, and the larvae may often be seen in stable equilibrium at different depths in the water."

MacGregor (1927) states that in the warm months development is fairly rapid, but during autumn and winter becomes extremely slow; MacGregor and Gébert record that the whole winter is passed in the larval state, pupation taking place towards the end of this season. MacGregor notes that the species exhibits to a striking degree the phenomenon of "suspended development" when, "in spite of a high atmospheric temperature and an ample food supply," larvae cease to develop while remaining active and healthy; he mentions an instance in which larvae remained in this phase for nearly 6 weeks before being accidentally thrown out. But the evidence which he gives for the presence of ample food is not convincing. since the debris present in the water may well have been entirely devoid of nutritive value. Edwards has recorded an instance of a larva of *O. pulchripalpis* in England living for more than a year in the third stage, and the present writer has seen an instance of suspended development in the case of larvae of *Aëdes vexans* in Samoa; in the latter case the addition of more water from the breeding-place caused the larvae to resume development at once, and the writer attributes such cases to insufficiency or absence of suitable food.

Orthopodomyia vernoni E. C. C. van Someren.

The following description of the larva is taken from van Someren (1949*a*):—

"The larva is not certainly known, but as the larva described here was taken from a tree hole in Sakaramy it probably belongs to this species. It is very like *O. arboricollis* as described by Hopkins (1935) but differs in the arrangement of the head setae and by having the subventral tuft at a half.

"*Head*.—Antennae about half the length of the head, straight and swollen on basal half; tuft at one third and with 3–5 plumose branches. Setae A, B, C and *d* are placed about the mid line of the head; all are large and with many plumose branches; *d* slightly shorter than the others. A, B and *d* with their bases almost in a straight line, C out of alignment, below, and mid way between B and *d*; *e* and *f* long and plumose, *e* single, *f* with 2–3 branches.

"*Thorax* with stellate setae.

"*Abdomen*.—Integument covered with small sclerotized plaques and with many stellate setae. Comb a double row of long sharp-pointed spines which have a few fine basal denticles; spines of proximal row more numerous than distal row and slightly shorter. Siphon slightly swollen in the middle, with an index of about 5 in mounted specimens; no pecten present; subventral tuft at a half, mounted on a small tubercle, and with 10 plumose branches which are one and a half times the diameter of the siphon. Lower caudal seta single; upper with many branches. Lateral seta long with 2 simple branches. 'Gills' very short."

"*Breeding-places*.—Tree-holes."—P. F. M.

FICALBIA Theobald.

The very characteristic shape of the antenna, coupled with the long head setae should readily distinguish larvae of this genus (except *F. plumosa*) from those of any other; *plumosa* differs from all other known mosquito larvae in lacking a sclerotized mental plate.

Head usually large and very dark. Maxilla usually with a single long and stout apical spine similar to the clypeal spines. Antenna with the portion of the shaft distal to the subterminal setae sharply distinguished from the rest, much narrower, never spiculate, and (except in *F. plumosa*) directed outwards at an angle from the basal portion of the shaft; with the same exception the antenna is long and strongly curved and in all species the basal portion is spiculate (weakly in *plumosa*, strongly in all the other species); tuft large, multiple and plumose. Setae A, B and C always multiple and plumose; in all species except *plumosa* they are as long as or longer than the head, and have a rather characteristic coarse plumosity. Mentum well developed in most species, absent in *plumosa*.

Thorax.—Dorsal setae of prothorax usually not much developed, innermost shoulder-hair not set in a distinct plate. Propleural group including one long and two short setae, not set in a distinct plate; mesopleural and metapleural groups each composed of three long setae, more or less branched, set in a large plate bearing a rather strong spine; plate of metapleural group especially large, supporting a large projecting tubercle which is very conspicuous in life. No definite air-sacs in the thorax.

Abdomen.—Lateral tufts of first two segments large. Comb almost invariably composed of spines and usually arranged in a single row, but sometimes taking the form of a very regular double row or of a proximal row and distal patch; these last two arrangements are not found outside the present genus; *Orthopodomyia* has the comb-spines in a double row, but they are quite different in character and arise from a chitinous plate. The siphon varies considerably, but there is a strong tendency to reduction of the pecten, leading to its complete absence in some forms. The anal segment has the saddle forming a complete ring which is always longer than broad; both caudal setae are branched from the base.

Of the three subgenera found in our region, *Ficalbia* is very readily separated by the basal position of the subventral tuft of the siphon, the smooth apical margin of the anal segment (spiculate in the other two subgenera), and the strongly barbed clypeal spines. There seem to be no larval characters which will distinguish *Mimomyia* from *Etorleptiomyia*.

Breeding-places and habits.—The breeding-places of all three subgenera are similar: in clear stagnant water with vegetation growing in it; *plumosa* is again an exception, being commonly found in muddy water with little or no visible vegetation. The association of this genus with aquatic plants has already been dealt with (p. 22).

KEY TO THE KNOWN LARVAE OF THE GENUS.

1. Subventral tuft of siphon placed very near the base (subgenus *Ficalbia*) *uniformis* (p. 98).
   This tuft placed at or beyond $\frac{1}{3}$ . . . . 2.
2. Siphon short and conical, modified for piercing aquatic plants . *pallida* (p. 91).
   Siphon not thus modified . . . . 3.
3. Antenna very short ; head-setae less than half length of head . *plumosa* (p. 94).
   Antenna long ; setae B and C nearly or quite as long as head . . . . 4.
4. Comb-teeth arranged in a proximal row and a distal patch which contains many teeth. . . . . *lacustris* (p. 88).
   Comb-teeth arranged in a single row or in two rows, not as above . . . . 5.
5. Comb of two rows, spines of the distal row much larger than those of the proximal . . . . 6.
   Comb a single row (or at most with two or three small spines representing the distal row) . . . . 7.
6. Siphon strongly curved and tapered ; subventral tuft of siphon a single seta ; pecten absent . . . . *perplexens* (p. 89).
   Siphon not as above ; subventral tuft with about 4 branches ; pecten present *hispida* (p. 87)
7. Siphonal index about 3 . . . . *splendens* (p. 85).
   Index at least 5 . . . . 8.
8. Siphonal index about 5 ; pecten of several spines present *mimomyiaformis* (p. 93).
   Index about 8 ; pecten completely absent . . . . *mediolineata* (p. 96).

Ficalbia (Mimomyia) splendens Theobald. (Fig. 34.)

The short siphon separates this species from any other with which confusion is possible except *uniformis*. The latter is immediately distinguished by the position of the subventral tuft of the siphon.

Length about 5 mm. ; *colour* whitish, thorax very pale green in front dorsally, head and siphon dark brown, approaching black.

Head.—Tuft of antenna at about $\frac{1}{2}$ ($\frac{2}{3}$ of basal portion), composed of about 20 plumose branches. Seta A with about 8 branches which are unusually heavily plumose, B and C with 3–4 and 4–5 branches respectively, *d* large, with 3 or 4 branches, *e* long and single, *f* usually 4-branched.

Abdomen.—Comb a single row of 5–7 large spines with but a slight fringe round the base. Siphon short, index about 3 ; pecten reduced to 2 (sometimes 1) almost simple peg-like spines ; subventral tuft at about $\frac{1}{2}$ and composed of about 6 sub-plumose branches ; the dorsal valves of the siphon bear a pair of strong hook-like spines. Distal margin of anal segment much more strongly spiculate than is shown in the figure, long spicules alternating with shorter ones ; upper caudal seta with 6–7 branches, lower usually with 5 ; lateral seta more than twice length of saddle. Ventral brush composed of 4 pairs of 2-branched setae. " Gills " fusiform, subequal, about half length of saddle.

Breeding-places and habits.—In clear water in borrow-pits, water-holes and the margins of swamps, invariably among *Pistia*, with which the association appears to be absolute.* De Meillon and Rebêlo record a single larva " in an evil-smelling swamp well supplied with rotting and floating vegetation." Ingram and Macfie

* Berner (1947), however, gives a record from ponds devoid of *Pistia* and covered with duckweed (*Lemna* sp.).—P. F. M.

(1917) give a good account of the habits as follows: "The larvae were very active in their movements, but when stationary lay practically parallel with the surface of the water. They appeared to be definitely associated with the weed *Pistia stratiotes*, as they were generally found under the leaves of this plant. The leaves

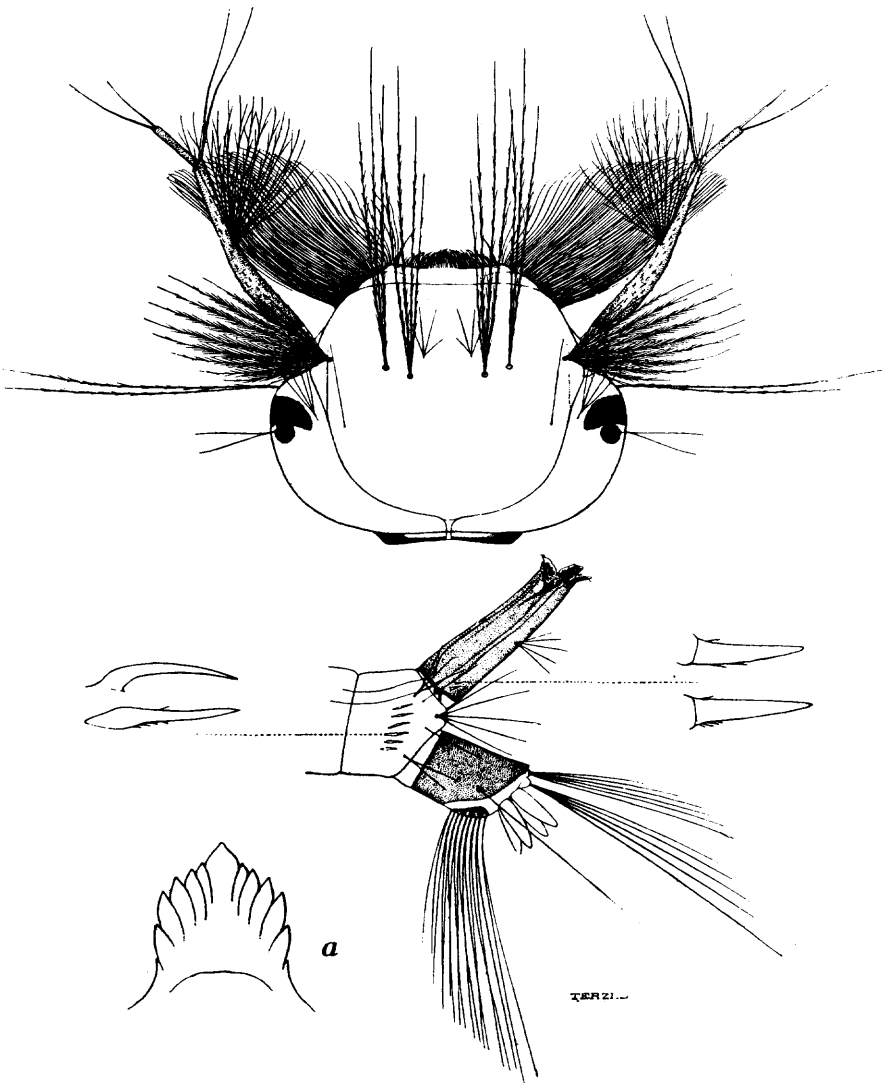


FIG. 34.—*Ficalbia* (*Mimomyia*) *splendens* Theo. Head and terminal segments. *a*, mentum.

of *P. stratiotes* have an unwettable surface and are strongly ribbed on the underside, so that as the plant expands the outer leaves come in contact with the surface of the water and carry down with them a film of air. It was to the underside of these outer leaves that the larvae of *M. splendens* attached themselves, lying horizontally with their siphons inserted into the film of air, and in maintaining this position the hooks described above were no doubt of great assistance. In this manner they were able to live a long time (in one experiment 24 hours) without direct access to the air and may moult whilst still submerged." In the laboratory it has so far been found impossible to breed out this species without introducing *Pistia* into the vessel.

Ficalbia (Mimomyia) hispida Theobald. (Figs. 35, 36.)

The only other known African larva of the genus (except *pallida*, which is unmistakable) which normally has a comb composed of 2 rows of spines is *perplexens*, which is readily distinguished by the shape of the siphon and the fact that the

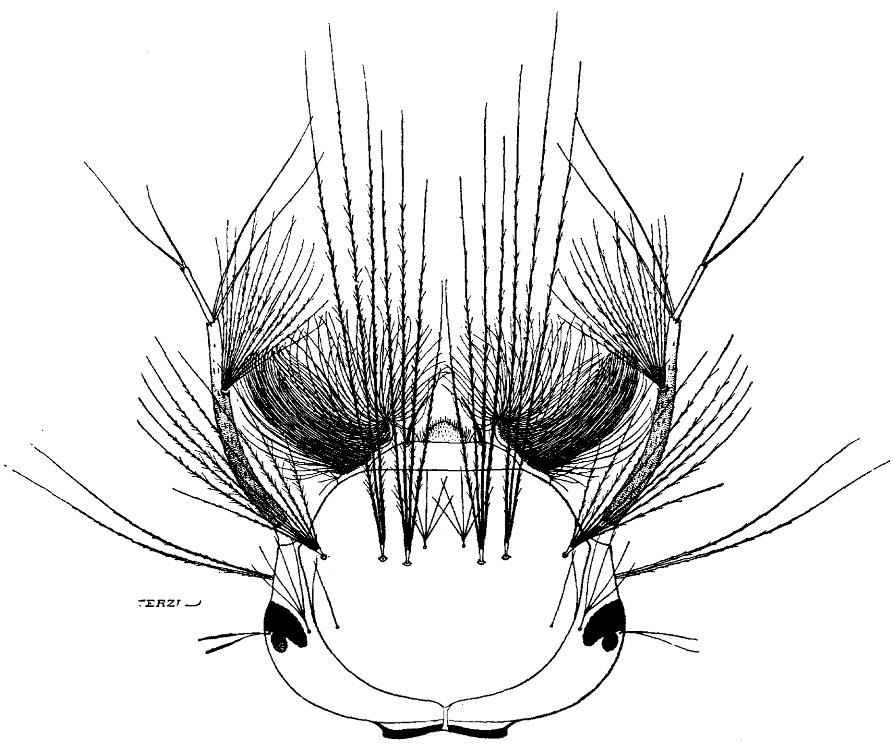


FIG. 35.—*Ficalbia* (*Mimomyia*) *hispida* Theo., var. *sunyaniensis* Edw. Head.

subventral tuft is a single seta. In *mimomyiaformis* there are occasionally 2 or 3 spines representing a distal row, but these are of the same size as those of the proximal row, whereas in the present species they are decidedly larger.

Length about 8 mm.; *colour* red-brown, head not very dark.

Head.—Tuft of antenna at about $\frac{1}{2}$, consisting of about a dozen branches. Seta A with about 8 branches, B $1\frac{1}{2}$ times length of head, 3-branched, C slightly shorter, 4-branched, *d* very large, with half a dozen simple branches, *e* single or double.

Abdomen.—Comb a proximal row of about 20 fringed spines and a distal row of 4–6 spines very similar in shape to the proximal ones, but very much larger. Siphon with index about 6; subventral tuft placed at about $\frac{2}{5}$, composed of 4–5 simple branches; pecten of 3 or 4 weak spines placed diagonally to the long axis of the siphon. Upper and lower caudal setae with about 10 and about 6 branches respectively; lateral seta three times length of saddle. Ventral brush composed of 4 pairs of tufts, each with not more than 4 or 5 branches. "Gills" subequal, about length of saddle, lanceolate, but with rounded tips.

Breeding-places.—Ditches, swamp-pools and abandoned clay-pits, always with a certain amount of vegetation among which the larvae are found.

The form (var. *sunyaniensis* Edw.) described by Macfie and Ingram (1916*a*) is stated by them to be grey in colour. They state that it is much paler than that

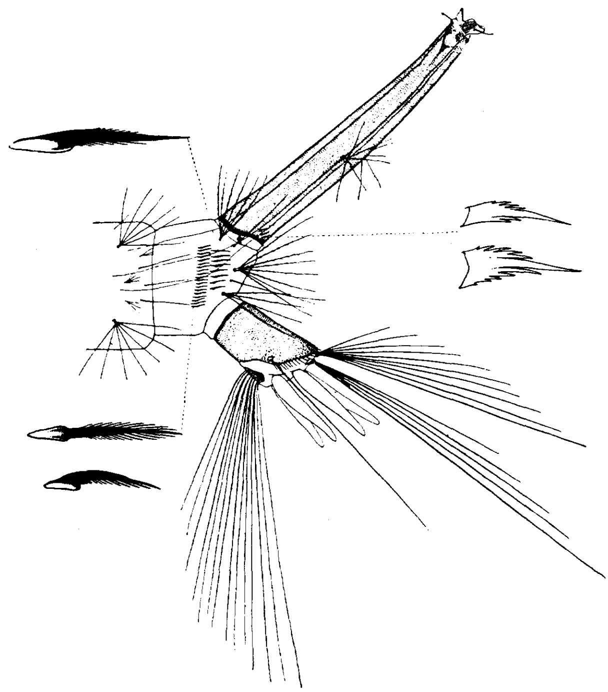


FIG. 36.—*Ficalbia* (*Mimomyia*) *hispida* Theo., var. *sunyaniensis* Edw. Terminal segments.

of *mimomyiaformis*, but this remark may apply only to the sclerotized parts, since Uganda larvae of *mimomyiaformis* are not dark-coloured. Structurally the larva of var. *sunyaniensis* Edwards seems to differ very little from that of the typical form, but the distal row of the comb comprises 5–8 spines, and the discrepancy in size between the spines of the two rows, though obvious, is markedly less than in the typical form.

The larva of var. *palustris* Theobald has not been separated. It is probably similar to that of typical *hispida*, and the breeding-places also appear to be similar.

Ficalbia (Mimomyia) lacustris Edwards. (Fig. 37.)

This is the only known larva of this genus which has a comb composed of scales. The arrangement of the comb-teeth in a proximal row and a distal patch is also unique, though other species have them arranged in two rows.

Described from one skin and many whole larvae from Uganda (Jinja, Entebbe, and Komolo swamp).

Length about 8 mm.; *colour* reddish, head black, much darker than that of *F. hispida.*

Head.—Similar to that of *F. hispida* in all respects except that seta B (as well as C) is 4-branched.

Abdomen.—Comb a proximal row of 25–30 small narrow scales and a more or less semicircular patch of 14–18 similar scales, which are little or not at all larger

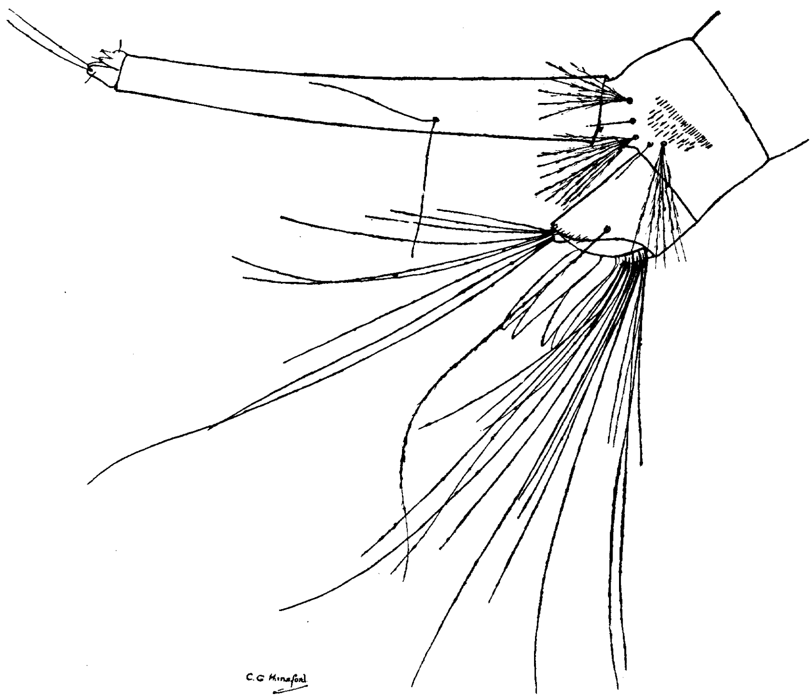


FIG. 37.—*Ficalbia (Mimomyia) lacustris* Edw. Terminal segments.

than those of the proximal row. Siphon distinctly longer than that of *hispida,* index nearly 8; subventral tuft double instead of with 4–5 branches. Anal segment somewhat shorter than that of *hispida*; upper and lower caudal setae with 7–8 and 3 branches respectively; other features of anal segment as in *hispida.* "Gills" a little shorter than the saddle. Lewis (1945) notes that in some larvae from Keilak, Sudan, the distal comb scales are arranged almost in a row.

Breeding-places.—Common among short grass or other vegetation at the inner edge of swamps bordering Lake Victoria; found also in similar situations in inland swamps.

Ficalbia (Mimomyia) perplexens Edwards. (Fig. 38.)

The shape of the siphon is unique; in life the present species is immediately distinguishable in a mixed batch of larvae by its blue colour.

Described from 2 skins and 12 whole larvae from Kampala.

Length about 7 mm.; *colour* blue, head and siphon chestnut-coloured, much paler than in *hispida* or *lacustris*.

Head.—Tuft of antenna distinctly before $\frac{1}{2}$; apical setae shorter than in *hispida*. Seta A with about 12 branches, B and C respectively with 3 and 4 branches which are slightly shorter than the head. In other respects the head is similar to that of *hispida*.

Abdomen.—Comb consisting of a distal row of 5–8 large spines and a proximal row of about 20 small spines, which are less than half the size of the distal ones.

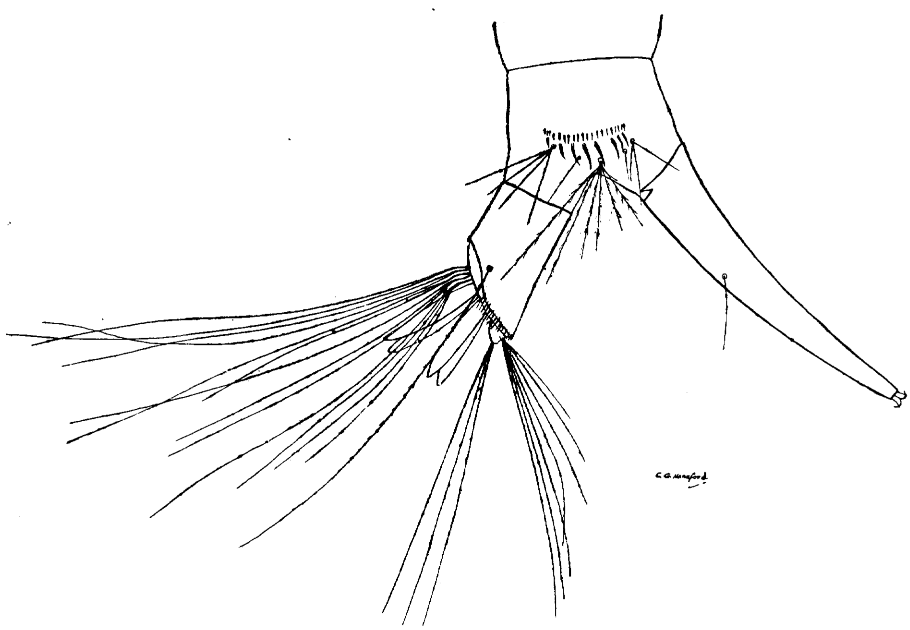


FIG. 38.—*Ficalbia* (*Mimomyia*) *perplexens* Edw. Terminal segments.

In 13 of the 14 specimens, including both skins, the comb is accompanied by a somewhat irregular chitinous plate; this plate is variable in size and appears to be an internal structure (as opposed to that in *Uranotaenia* and *Aëdomyia*, which is external); it is not visible in unmounted larvae. Siphon strongly curved and sharply tapering, index 6; subventral tuft a single simple seta at about $\frac{1}{3}$; pecten completely absent. Anal segment as in *hispida*, but upper caudal seta with about 8, lower with 3 simple branches. "Gills" subequal, about $\frac{3}{5}$ length of saddle.

Breeding-places and habits.—Among short vegetation in ditches, swamp-pools and abandoned clay-pits. The larva swims with a slow wriggling motion like that of a *Taeniorhynchus* and hides itself among aquatic vegetation, but I have not been able to observe if the siphon is (as its structure would lead one to suppose) used for attachment to plants.

Ficalbia (Mimomyia) pallida Edwards. (Figs. 39, 40.)

The form of the siphon in the present species is unique ; the shape is very similar to that of the siphon in *Taeniorhynchus*, but the structure is totally different, since in the latter genus the portion of the organ which is thrust into the tissues of plants is made up almost entirely of the valves, while in *F. pallida* the valves are very small. In structure the siphon of *pallida* resembles extremely closely that of *F. perplexens* or of the first-stage larva of *Taeniorhynchus*.

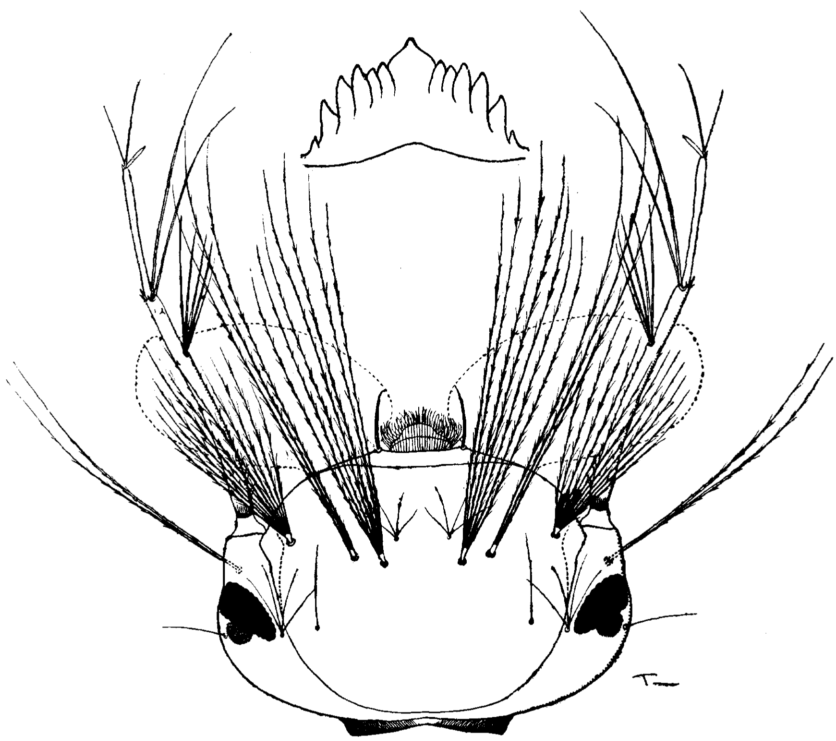


Fig. 39.—*Ficalbia* (*Mimomyia*) *pallida* Edw. Head and mentum.

Described from a number of whole larvae from Lagos (Mrs. Connal) ; Mrs. Connal bred adults from isolated larvae but the writer has not seen skins.

Length about 5 mm. ; *colour* not recorded, head and siphon not dark.

Head.—Antenna with tuft of about 6 branches at about $\frac{3}{8}$; terminal portion of antenna $\frac{3}{5}$ length of basal portion, and thus much longer than in the other species. Seta A with about 8 branches, B and C with 3 and 6–7 branches respectively, branches of B coarser and much longer than those of C, *d* large, with 4–5 branches, *e* single, *f* with 3–4 rather long branches. Mentum similar to that of *splendens*, but much broader, the lateral teeth almost in line with the median, about 5 teeth on each side of the centre.

Abdomen.—Comb a double row of 4–5 large and 6–8 small spines, the latter placed almost in the same line as the former but very slightly proximal to them, individual spines similar to those of *splendens* but longer and with sharper points. Siphon conical with slightly convex sides, tapering very strongly to a little before apex, index about 2 ; pecten absent ; subventral tuft a single simple seta, about as long as the diameter of the siphon, placed at about $\frac{1}{2}$; valves very small, median and posterior valves hook-like. Distal margin of saddle of anal segment bearing a row of very long spicules and a few small ones ; upper and lower caudal setae with

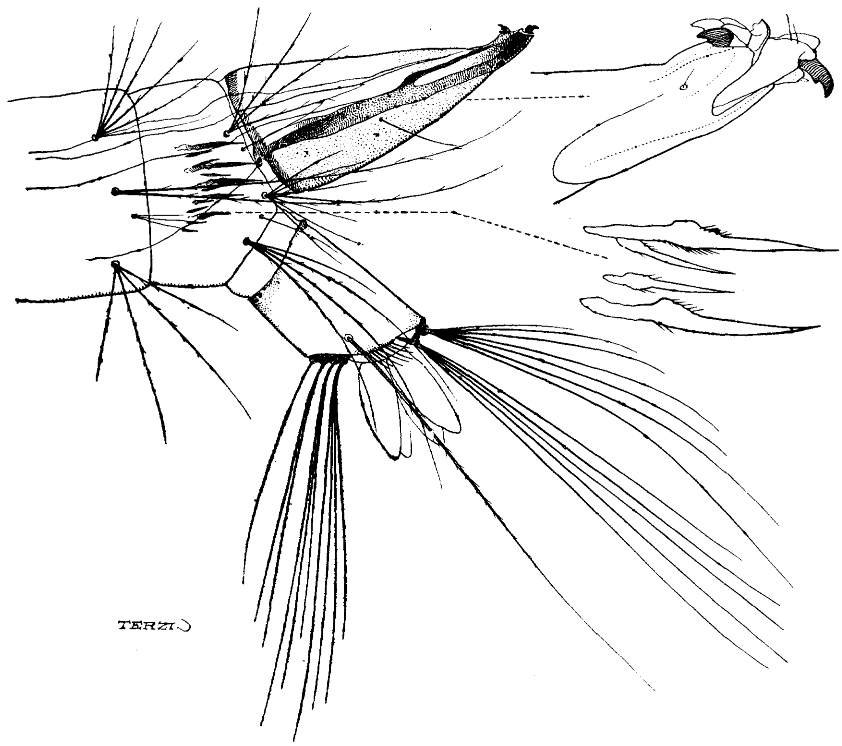


FIG. 40.—*Ficalbia* (*Mimomyia*) *pallida* Edw. Terminal segments.

about 7 and 5 branches respectively ; lateral seta thrice length of saddle. Ventral brush composed of 4 pairs of tufts. " Gills " subequal, small and wedge-shaped.

Breeding-places.—Mrs. Connal found the larvae among roots of *Pistia* in company with larvae of *Taeniorhynchus*.

Ficalbia (Mimomyia) femorata Edwards.

Larva and breeding-places unknown. The species is likely to breed in clear water among aquatic vegetation.

Ficalbia (Mimomyia) flavopicta Edwards.

Larva and breeding-places unknown. Probably breeds in swamps.

Ficalbia (Mimomyia) mimomyiaformis Theobald. (Figs. 41, 42.)

The larva of this species most resembles that of *F. hispida,* but the spines of the distal row of the comb are usually absent, and even when present never markedly larger than those of the proximal row. From *mediolineata* it is at once separated by the presence of a pecten and the more numerous branches of the subventral tuft of the siphon.

Length about 5½ mm. ; *colour* light grey, head black, siphon brown.

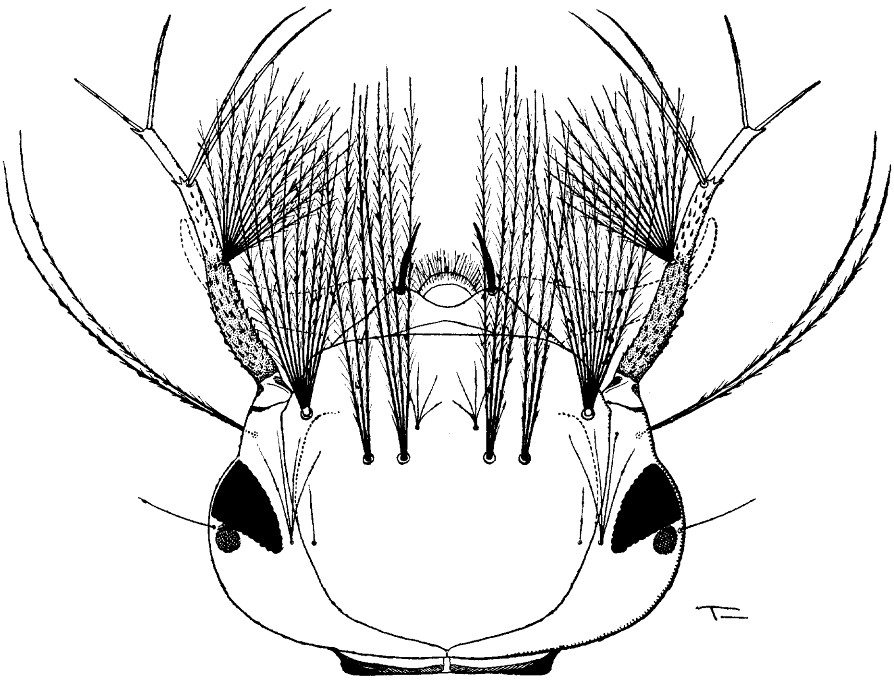


FIG. 41.—*Ficalbia* (*Mimomyia*) *mimomyiaformis* Newst. Head.

The larva differs from that of *F. hispida* as follows :

Head.—Antenna with discrepancy in length of apical setae markedly greater, tuft at a little beyond ½. Seta A with about 12 branches, B and C considerably shorter, somewhat less than length of head, *d* with about 3 branches.

Abdomen.—Comb a row of 6–7 large spines very similar in shape to those of *hispida.* Siphon shorter, index about 5 ; pecten of 2 spines placed almost vertically ; subventral tuft with the branches subplumose. Caudal setae with fewer branches, 6 and 3 respectively.

The larva described above is that described by Wesché from the West Coast as that of *Megaculex pincerna* Graham, and included in Edwards's key (1912) ; I have also seen this form from Lira, Uganda, associated with typical adults of *F. mimomyiaformis.* On the other hand larvae associated with adults of the var. *pincerna* in Kampala and near Lake George, Uganda, differ markedly in the fact that the comb is composed of a row of 12–14 much smaller spines, and may have 2 or 3 similar spines placed distal to the main row. I have seen similar specimens (including the variety with spines distal to the main row) from Sapele, Southern Nigeria ; a damaged skin from the Gold Coast (Mr. A. W. J. Pomeroy) appears to be similar, but has 3 pecten spines on one side and 5 on the other.

Breeding-places.—These do not seem to differ for the two forms, and include borrow-pits, ditches, slack water at the edges of streams, and pools at the margin of swamps, always among vegetation, and always in clear water.

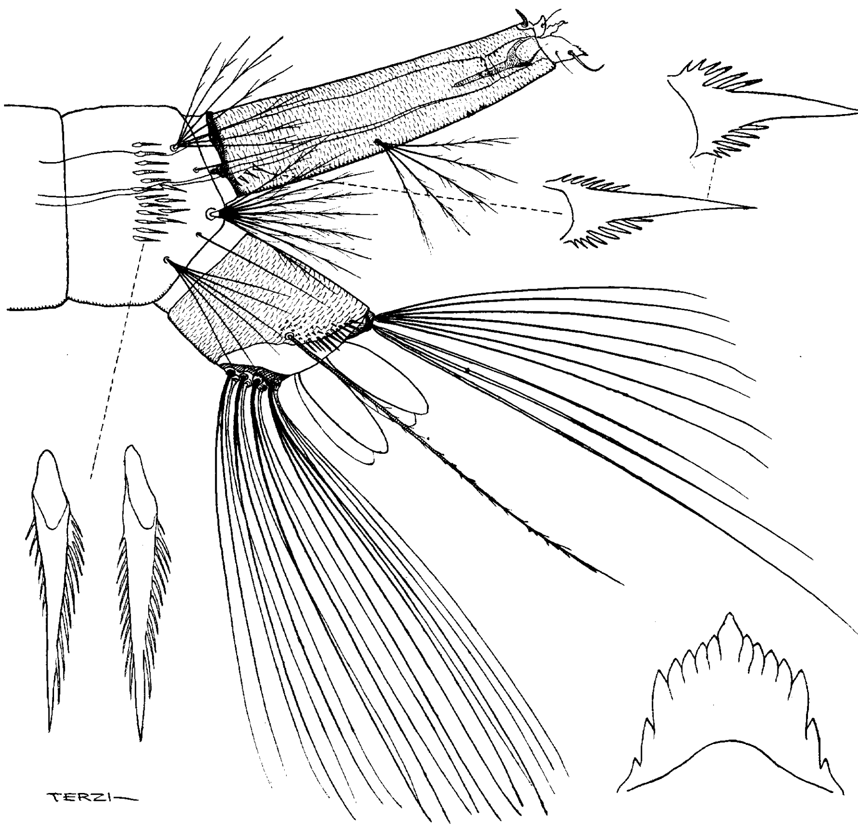


FIG. 42.—*Ficalbia (Mimomyia) mimomyiaformis* Newst. Terminal segments.

Ficalbia (Mimomyia) parenti De Meillon and Lavoipierre.

Larva and breeding-places unknown.

Ficalbia (Mimomyia) plumosa Theobald. (Fig. 43.)

Easily separated from any other known Culicine by the shape of the head, the articulated upper portion of the antenna, and the absence of a sclerotized mentum.

Length about 11 mm. ; *colour* brown or yellowish-brown, head and siphon concolorous with body.

Head.—Very small (much narrower than thorax), and in life set very close into the thorax so that the neck (often very conspicuous in preserved larvae) is quite invisible ; the shape of the head is extremely characteristic, largely on account of the conspicuous angular indentation of the lateral margin immediately in front of the eye. Mouth-brushes very poorly developed, short and somewhat sparse.

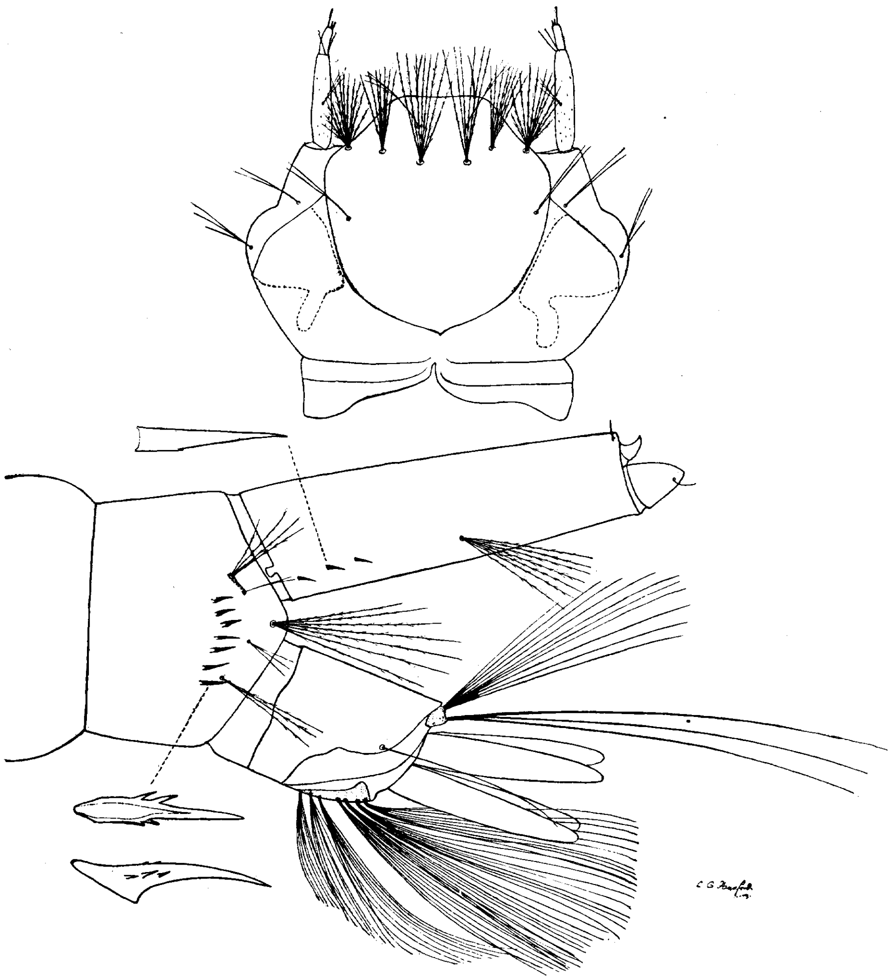


FIG. 43 —*Ficalbia* (*Mimomyia*) *plumosa* Theo. Head and terminal segments.

Antenna less than half length of head, sparsely spiculate towards base, portion of shaft beyond subapical setae not outwardly directed (as in other members of the genus), but stouter than usual and definitely articulated with basal portion of shaft so as to form a second segment ; tuft of 2–3 short simple branches at about $\frac{1}{3}$ (well before middle of basal portion of shaft) ; subapical and apical setae very small. Setae A, B and C all less than half length of head, coarsely plumose, with about 10, 8 and 6 branches respectively, *d* with 1–3 branches almost as long as C, set very far forward, *e* and *f* also long and simple, usually bifid. Mentum not sclerotized and without teeth.

Abdomen.—Comb of 6–9 thornlike spines in a single very irregular row. Siphon with very small acus; index about $3\frac{1}{2}$; tuft of about 8 plumose branches at a little beyond $\frac{1}{2}$; pecten of 2–4 strong simple or almost simple spines. Anal segment with distal margin of saddle finely spiculate; upper caudal seta with about 10. branches, lower 3-branched; lateral seta about $1\frac{1}{2}$ times length of saddle, single, simple. Ventral brush composed of 4 or 5 pairs of tufts with numerous simple branches. "Gills" subequal, lanceolate, longer than saddle.

Larvae from Uganda agree very well with those from the Gold Coast.

Breeding-places and habits.—In borrow-pits, ditches and edges of marshes, usually with a considerable amount of dead or living vegetation and with or without shade; occasional in pools in dense forest with little or no living vegetation. The larvae in life are frequently much coated with mud. Edwards, in describing the larva, suggested that it might be predaceous, while stating that the structure gave little support to this theory; I have had many larvae under observation, but have never seen any evidence of predacity, and the structure of their mouth-parts, especially the reduction of the brushes, is apparently very unsuited to this mode of life. At the same time the mouth-brushes are not suited to the netting of plankton, as in other members of the genus, and I believe that larvae of this species get their food by ingesting the soft mud, rich in organic matter, among which they usually occur; in such a mode of life large mouth-brushes would be very inconvenient. Dissection of a number of larvae revealed no evidence of predacity, but the gut contained cellular vegetable matter and much unorganized brownish debris.

Ficalbia (Etorleptiomyia) mediolineata Theobald. (Fig. 44.)

The strongly curved siphon and absence of pecten will immediately distinguish this larva from any except *F. perplexens*; from the latter it is readily separated by the character of the comb.

Length about 5 mm.; *colour* pale red-brown, siphon pale bronze-brown, head pale.

Head.—Antenna not infuscate; tuft of about 8 branches at $\frac{1}{2}$. Seta A with about 8 branches, B and C respectively with 3 and 5–6 branches which are somewhat longer than the head, *d* very small, with about 4 branches, *e* and *f* small, 3-branched.

Abdomen.—Comb a very regular row of about 12 coarsely fringed spines. Siphon rather strongly curved, index about 8; pecten absent; subventral tuft of 2 simple branches at about $\frac{1}{3}$. Dorsal portion of saddle spiculate, spicules at distal margin all long, not alternately long and short; upper caudal seta with about 4 branches, lower with about 3; lateral seta (only the base shown in the figure) about three times length of saddle. Ventral brush of a few pairs of tufts which are composed of double or single setae. "Gills" about $\frac{2}{3}$ length of saddle, subequal, broadly lanceolate.

Breeding-places.—The larvae seem never to occur in large numbers; they are found most frequently in papyrus swamps, but also occur in pools of various kinds, overgrown with vegetation, including borrow-pits and pools in marshes.

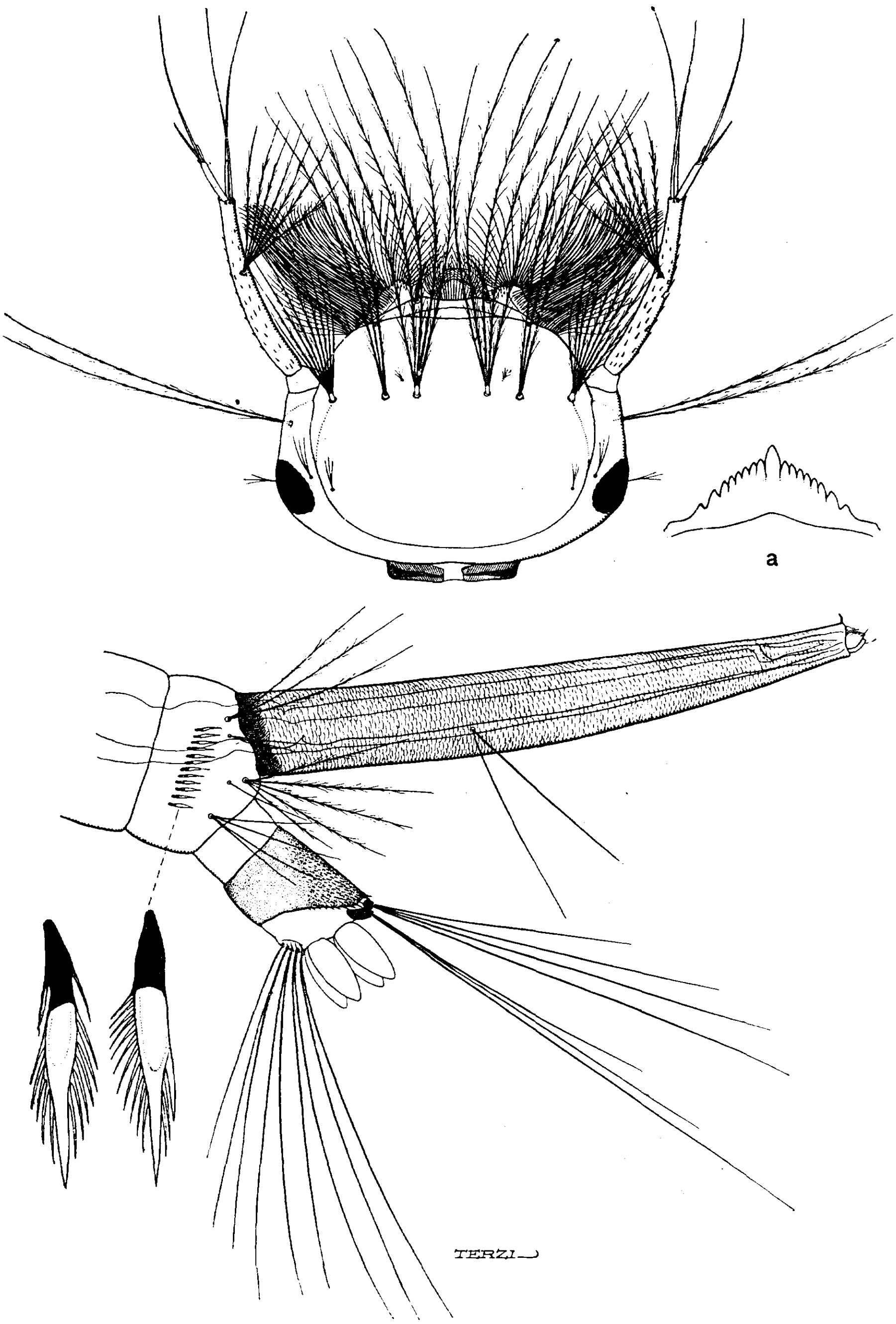


Fig. 44.—*Ficalbia* (*Etorleptiomyia*) *mediolineata* Theo. Head and terminal segments. *a*, mentum.

Ficalbia (Etorleptiomyia) xanthozona E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Ficalbia (Ficalbia) uniformis Theobald. (Fig. 45.)

Length about 4 mm.; *colour* dirty white, head black, siphon very dark brown.

Head.—Antenna spiculate proximal to subterminal setae, infuscate at base and apex only, very slender and strongly curved; tuft of about a dozen simple branches on the outer aspect at a little beyond $\frac{2}{3}$; subterminal setae equal, about $\frac{2}{3}$ length of

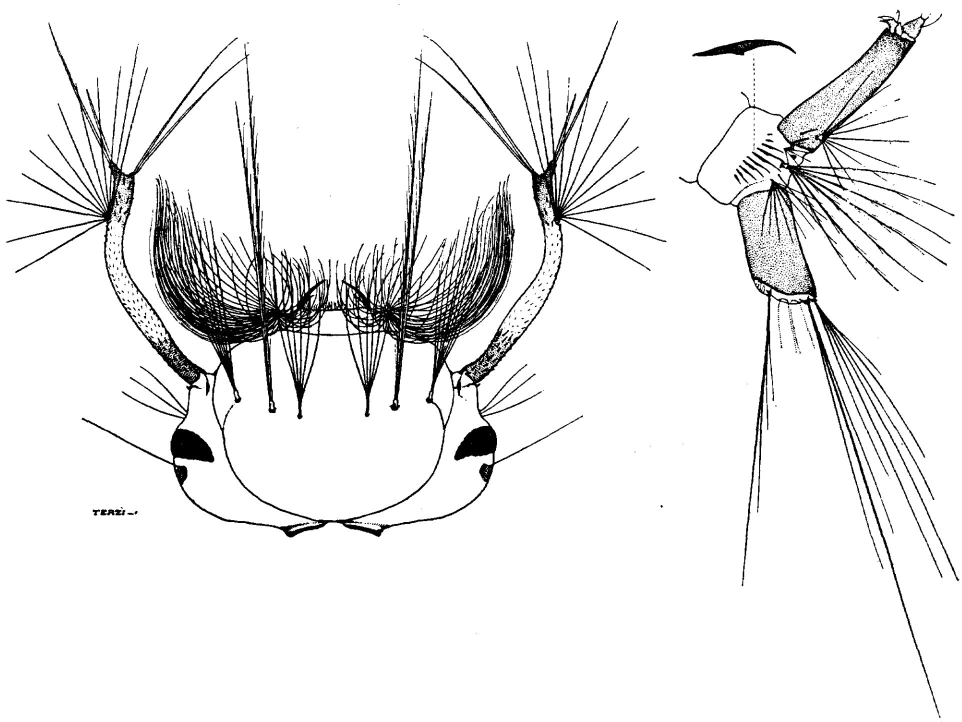


FIG. 45.—*Ficalbia (Ficalbia) uniformis* Theo., var. *malfeyti* Newst. Head and terminal segments. Head-setae A and C should be plumose, *d*, *e* and *f* are omitted. "Gills," lateral seta and most of the ventral brush are lost in the specimen figured.

antenna, terminal setae markedly unequal, outer as long as subterminals, inner about half length of outer and much stouter. Clypeal spines strongly barbed, there being a small accessory spine on the inner aspect. Seta A with about 10 branches, which are about as long as the head, B double, about twice length of A, C similar to A, with 5–6 branches, *d* small, 2-branched.

Abdomen.—Comb a row of 7–10 spines which appear to be entirely without a basal fringe, and of which those towards the ends of the row are markedly smaller than the more central. Siphon slightly curved upwards towards the tip, index a little more than 3; pecten of 2 large simple spines; subventral tuft of about 10 simple branches. Anal segment about twice as long as broad, distal margin of saddle smooth except for a few small spicules in the neighbourhood of the bases of the caudal setae; caudal setae divided from beyond the base into about 6 and 3 branches respectively; lateral seta (lost in specimen figured) with about 6 branches which are slightly more than half the length of the saddle. Ventral brush (mostly broken off in figure) of 5 pairs of single setae which bear a number of subsidiary branches. "Gills" fusiform, subequal, shorter than saddle.

The above description is of var. *malfeyti* Newstead. Larvae found in association with adults of the typical form seem to differ in no respect from those of var. *malfeyti*.

Breeding-places.—Ingram (1912) found larvae in a well-shaded water-hole containing clear water. Schwetz (1930*b*) records them among *Pistia* and once from a rock-hole. Galliard (1931) found larvae very abundantly in a temporary pool among grass. The larvae of both the typical form and var. *malfeyti* are not uncommon in Uganda in old borrow-pits and in the lake-edge swamps, in both instances always among grass. There seems to be little or no difference between the breeding-places of the two forms.

Ficalbia (Ficalbia) nigra Theobald.

Larva and breeding-places unknown, but unlikely to differ much from those of *F. uniformis*.

Ficalbia (Ficalbia) circumtestacea Theobald.

Larva and breeding-places unknown. Probably breeds in clean water of ground-pools, among vegetation.

TAENIORHYNCHUS Lynch-Arribalzaga.

(*Mansonia* Blanchard.)

Larvae of this genus are perhaps more easily recognized than those of any other; no other known larva except *Ficalbia pallida* could possibly be mistaken for a member of this genus. The siphon is highly modified for piercing plant-tissues, it is very short and without any trace of a pecten or acus; the anterior valves are small and each bears a stout curved bristle, while the posterior pair are greatly enlarged (as long as the siphon itself), and fused together to form a sheath for a complicated internal apparatus which includes a strongly sclerotized saw. The antennae are long and spiculate, the subterminal bristles placed much before the tip and at least one of them is always long; the tuft is large and placed before the middle. The head-setae are all very small.

The two subgenera differ mainly in the character of the portion of the antenna lying distal to the subterminal setae; in *Mansonioides* this portion is rigid and comparatively short, while in *Coquillettidia* it is very long and flexible.

Head small, much wider than long. Antenna long, spiculate; tuft large and plumose, at beyond $\frac{1}{2}$; subterminal setae long or very long and placed much before the tip. Mouth-parts not specially modified, but maxilla, in addition to the hair-tuft, with a single long and rather stout apical spine, similar in length and thickness to the long clypeal spines. Mentum small.

Thorax containing a pair of large tracheal dilatations. Hair-tufts, including those of prothorax, well developed; mesopleural and metapleural groups of setae set in distinct but not very large chitinous plates.

Abdomen.—Comb composed of a few spines in a single row. Siphon exceedingly short, without pecten or acus; subventral tuft almost at junction between siphon-

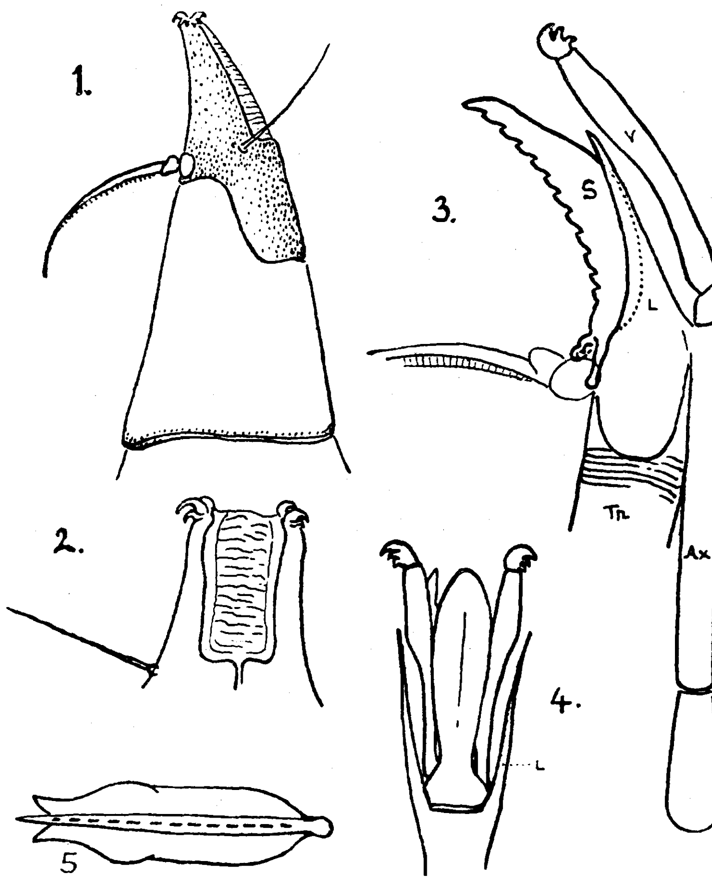


FIG. 46.—*Taeniorhynchus* (*Mansonioides*) *africanus* Theo. Structure of siphon. 1. Outer case, side view (siphonal tuft omitted). 2. Distal third of outer case, ventral view. 3. Inner elements: *Tr.*, trachea; *S.*, saw; *L.*, lateral pieces; *V.*, ventral pieces; *Ax.*, axial rod. 4. Ventral pieces flattened out and seen from ventral aspect; *L.*, lateral piece in profile. 5. Saw flattened out, dorsal view.

tube and valves; valves highly modified for piercing tissues of aquatic plants (see below) and almost or quite as long as rest of siphon. Anal segment with a complete saddle which is cylindrical and much longer than broad; upper and lower dorsal setae both multiple. Ventral brush (in all Ethiopian species) with a number of small mid-ventral tufts proximal to the barred area.

Ingram and Macfie (1917) have published a detailed description of the apical portion of the siphon (*i. e.* the valves and the structures contained in them) of *T. africanus*, which is as follows: "The apical third of the siphon tube is more highly chitinized than the basal two-thirds and appears to be movable on the latter portion. It is an incomplete tube composed of two lateral chitinous lamellae with a ventral membrane connecting them, but dorsally it is open to accommodate the saw-like element to be referred to immediately. The lateral chitinous lamellae extend to the tip of the siphon, where they come into relationship with the ends of the internal structures, and they bear at their extremities two pairs of slightly chitinized hooks. At the base of each lamella there is a single bristle, which lies therefore at about the same level as the larger dorsal bristles, but more ventrally. . . . These bristles are simple and are not furnished with a fringe or membrane. The ventral membrane is feebly chitinized and is irregularly ribbed or folded transversely, so that in profile it looks like the edge of a file. It is attached laterally and basally to the chitinous part of the siphon by a delicate membrane.

"Within the siphon tube a number of complicated structures can be seen. Running from end to end of the tube and extending for some distance into the abdomen there is an axial rod of chitin, a narrow flat structure with its edges directed towards the dorsal and ventral aspects of the siphon, and with a hinge or joint at its lower end. The two tracheal trunks pass upwards inside the siphon to the right and left of this axial rod; in the apical third they lose their spiral structure and unite with the rod so as to form the 'common hollow space' described by Raschke. This arrangement is usual in mosquito larvae, but in the case of *Mansonioides africanus* the margins of the space do not form simple valves, but are highly specialized so as to enable the larva to penetrate the roots of *Pistia stratiotes* and to attach itself firmly to the plant. Laterally the outer walls of the tracheal tubes are continued as highly chitinized plates, which rapidly taper to points. On the ventral aspect the axial rod is continued as a stout, highly chitinized structure, on which a trough-shaped body composed of a mesial and two lateral parts is jointed, each of the lateral pieces bearing at its distal end a triple hook of great strength. A delicate flexible membrane connects the bases of these hooks with the edge of the siphon. On the ventral margin of the 'common hollow space' a highly chitinized trough-shaped structure with a saw-like dorsal keel is hinged. Howard, Dyar and Knab state that in *Taeniorhynchus* the 'outer portion of the tube is . . . furnished with serrations,' but in *Mansonioides africanus* the saw appears to be attached to the margin of the 'common hollow space,' and to be separate from the tube, and for these reasons we conclude that it probably represents a modified valve. These structures may perhaps be correlated with the primitive elements in the closing mechanism above the spiracles of Anopheline larvae, corresponding respectively to the lateral flaps, the posterior plate, and the anterior fan-shaped plate.

"The saw-like structure has about 14 teeth, and appears to be attached a little above its lower end to the dorsal margin of the 'common hollow space.' Its lower end divides, a strong median process passing down into the siphon tube and two knob-like bodies projecting dorsally, so as to lie between but in close apposition to the bases of the two stout curved bristles situated at the junction of the apical third of the siphon with the basal portion. These bristles have a delicate fringe or membrane on their lower surfaces, which suggests that they may have a sensory function, and may be of service to the larva when feeling its way between the rootlets in search of a suitable point at which to attach itself.

"The siphon of the larva in the first instar bears but a slight resemblance to that of the fully-developed larva; it is a bottle-shaped structure, which is made up of a conical basal portion (8·5 units) and a more highly chitinized and slender apical portion (7·5 units). The basal ring is hardly visible, the movable junction between the apical third and the basal portion is indistinguishable, but the chitinized axial rod is well developed, and has powerful muscles attached to it in the lower half of the tube. About half-way up the lower part of the siphon and slightly on the ventral aspect, that is, in the position occupied by the tuft in the fully-developed larva, there is a single, very long, simple hair. At the shoulder of the bottle, that is, at the point where the narrow part of the siphon commences, the tracheal trunks are constricted, and from this level run up the distal end of the siphon as two chitinized tubes separated by the axial rod. At the tip of the siphon on the ventral aspect there is a pair of powerful highly chitinized double hooks, corresponding with the similar triple hooks of the fully developed larva; dorsally there are two pairs of less highly chitinized hooks, which are toothed; and a pair of relatively stout bristles mounted on large bases can be distinguished, which appear to represent the dorsal bristles of the later stages. The saw-like structure on the dorsal aspect is not developed at this stage. The relatively poor development of the terminal structures is no doubt associated with the habit of the larva in this instar of attaching itself to the rootlets instead of to the tougher tap-root.

"The larva at this stage, the first instar, differs in many other respects from the fourth-phase larva. The head is large, considerably larger than the thorax; the antennae are relatively huge, possessing the two prominent bristles which are conspicuous in the fully-grown larva, and have in place of the tuft a single stout branched hair. The mental plate is small, and has 3 slender lateral teeth on each side of the prominent mesial tooth. The eyes are prominent and rounded; the 'main' eye is not yet developed. The lateral abdominal hairs are 2 on the first, and 1 on each succeeding segment. The comb consists of 3 to 5 fringed spines, quite unlike the curious elements of the comb of the fully-developed larva. The tuft on the siphon is represented by a simple stout hair, and all the plumes of the eighth segment are in this stage simple hairs. The dorsal hairs on the anal segment are conspicuous, arranged in pairs, the ventral pair being shorter than the dorsal; there is no beard. The anal papillae are equal, and have rather less sharply pointed ends than those of the fully grown larva.

"After the first moult the siphon assumes the form described as being characteristic of the species. The dorsal saw-like structure is well developed in the second instar, but has rather fewer teeth than in the fully developed larva."

Breeding-places and habits.—The larvae are all very sluggish, and swim with a peculiar slow wriggling motion. Their habit of attaching themselves by means of the valves of the siphon to the stems or leaves of aquatic plants and obtaining their oxygen from the tissues of the plants is well known. This habit renders them safe from many of the perils which beset members of other genera, and neither oiling nor paris green have much effect on them. Although thus dependent on plants for oxygen, they are, in emergency, capable of breathing air from the surface like other mosquito larvae, but only do this when disturbed and unable at once to obtain a new siphon-hold.

The long flexible apical portion of the antenna has been observed to have a prehensible function in the case of an Oriental species of *Coquillettidia* (Edwards and Given).

Ingram and Macfie (1917) suggest that the large bristles on the siphon are sensory and assist the larva in finding a suitable point of attachment. They state: "The actual process by which the larvae penetrate the tissues of the root, appreciate the fact when they have reached the air-containing tubes, and fix themselves firmly, must be a matter of surmise, but as extremely powerful muscles are attached to the axial rod, it may be conjectured that this structure plays an important part both by approximating the terminal elements, so as to form a sharply-pointed cone for thrusting into the root, and by putting into action the saw-like structure attached to it, which, as we have stated, is poised on the dorsal margin of the 'common hollow space' as its fulcrum. The six sets of terminal hooks no doubt suffice to anchor the larvae once they have penetrated the plant tissues. In specimens killed and fixed *in situ* and subsequently cleared, the siphon is seen to be embedded in the root up to a point about half-way between the tip of the tube and the bases of the dorsal bristles, the hooklets at the end are spread out in a cluster and appear to be firmly fixed in the tissues, and the dorsal and ventral bristles of the siphon are widely extended, with their tips in contact with the surface of the root."

Both the larvae of the subgenus *Mansonioides* are well known, but about half the species of *Coquillettidia* have never been bred; these are listed below:

annetti Theobald, *nigrithorax* Theobald, *flavocinctus* Edwards, *grandidieri* Blanchard, *chrysosoma* Edwards, *aureus* Edwards, and *wahlbergi* Edwards; *auripennis* Edwards is apparently only a colour-form of *microannulatus*, and it is highly improbable that the larvae of these two differ in any way. All these species are likely to breed in swamps or marshes among aquatic or semiaquatic vegetation.

Almost the whole of the information about the subgenus *Coquillettidia* is taken from Gillett (1945*a*, *b*; 1949).

Key to Known Larvae of the Genus.

1. Portion of antenna beyond subterminal setae (flagellar segment) very long and flexible; comb of 4–10 sharp-pointed spines (*Coquillettidia*) . . . . 3.
   This portion of the antenna much shorter, rigid; comb of 2–3 blunt-ended spines (*Mansonioides*) . . . . 2.
2. Tuft B of eighth abdominal segment long, 2-branched . . *uniformis* (p. 111).
   This tuft much shorter, with 3–5 branches . . . . *africanus* (p. 110).
3. Tuft B of eighth abdominal segment double . . . . 4.
   This tuft single . . . . 6.
4. Subterminal setae of antenna of nearly equal length, and both very short, saddle almost smooth; no tufts proximal to barred area *metallicus* (p. 105).
   Subterminal setae of unequal length, the longer at least $\frac{1}{2}$ length of flagellar segment . . . . 5.
5. Antennal tuft at about $\frac{4}{5}$*; longer subterminal seta not longer than $\frac{1}{2}$ length of flagellar segment . . . . *maculipennis* (p. 107).
   Tuft at about $\frac{3}{4}$; longer subterminal seta $\frac{2}{3}$ to $\frac{3}{4}$ of length of flagellar segment *fuscopennatus* (p. 108).
6. Antennal tuft placed at from $\frac{3}{4}$ to $\frac{4}{5}$ . . . . 7.
   This tuft at from $\frac{4}{7}$ to $\frac{2}{3}$ . . . . 8.

* The flagellar segment is excluded in measuring the position of the antennal tuft.

7. Antennal tuft at about $\frac{4}{5}$; longer subterminal seta about $\frac{1}{2}$ length of flagellar segment . . . . *pseudoconopas* (p. 106).
   Tuft at about $\frac{3}{4}$; longer subterminal seta about $\frac{2}{3}$ length of flagellar segment *fraseri* (p. 110).
8. Antennal tuft at about $\frac{2}{3}$; longer subterminal seta about $\frac{2}{3}$ length of flagellar segment . . . . . *vanoyei, schoutedeni* and *versicolor* (p. 106).
   Tuft at about $\frac{4}{7}$; longer subterminal seta from $\frac{3}{4}$ to $\frac{7}{8}$ length of flagellar segment *aurites* (p. 109) and *microannulatus* (p. 110).

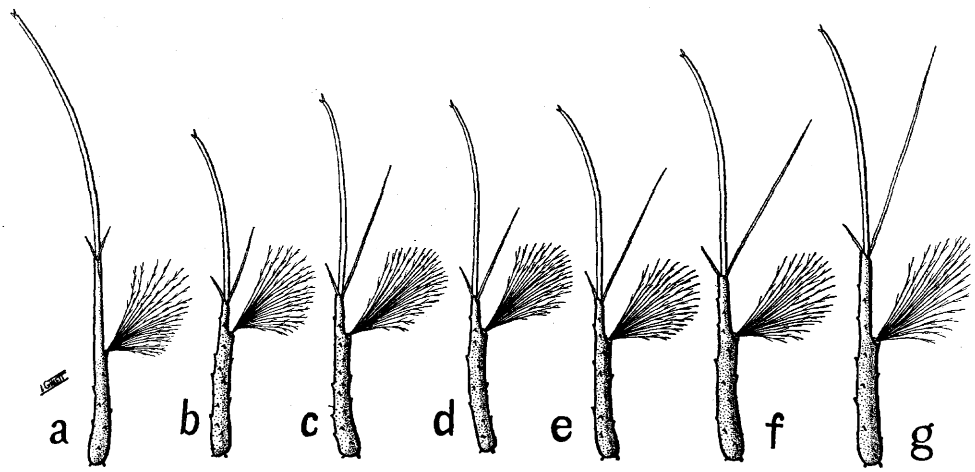


FIG. 47.—*Taeniorhynchus* (*Coquillettidia*) spp. Larval antennae. *a, metallicus* Theo. *b, maculipennis* Theo. *c, fuscopennatus* Theo. *d, pseudoconopas* Theo. *e, fraseri* Theo. *f, versicolor* Edw. *g, aurites* Theo. and *microannulatus* Theo.

Subgenus **COQUILLETTIDIA.**

A general description of larvae of this subgenus will save much repetition, and is given below :

Medium-sized larvae (5 to 9 mm. in length), pale-coloured (pale greyish-white to bright green or blue), valves and basal ring of siphon black. Easily separated from those of the subgenus *Mansonioides* by the enormously long flagellar segment of the antenna.

Head.—Broader than long. Antenna weakly spiculate from base to subterminal setae ; tuft of about 20 to 30 plumose hairs on the inner aspect between $\frac{1}{2}$ and $\frac{4}{5}$ (excluding flagellar segment) ; flagellar segment at least as long as the pedicellus (the portion proximal to the subterminal setae). Clypeal spines long and slender. Setae A and B short tufts of 8–12 plumose branches, C smaller and with 5–6 branches, *d* shorter than A or B, with 5–7 branches.

Abdomen.—Comb a row of 4–10 sharp-pointed spines which have a basal fringe (these spines simple in *metallicus*). Tuft B of eighth segment long, plumose, single or double. Subventral tuft of siphon with about 3–6 branches. Saddle of anal segment complete, covered with spicules which are most prominent dorso-distally ; lateral seta moderately large, with about 12 branches (small and 4-branched in *metallicus*) ; upper caudal seta with about 10 branches, lower with about 8 (about

15 and 10 respectively in *metallicus*). Ventral brush composed of 4 pairs of about 10 simple branches; in addition there are from 5 to 7 small unpaired tufts proximal to the barred area (no unpaired tufts in *metallicus*). The size of the "gills" varies with the salinity of the water in the breeding-place.

Taeniorhynchus (Coquillettidia) metallicus Theobald. (Figs. 47*a*, 48.)

Readily separable from other known species of the subgenus by its colour, the fact that both subterminal setae of the antenna are short, and the absence of unpaired tufts proximal to the barred area in the ventral brush of the anal segment.

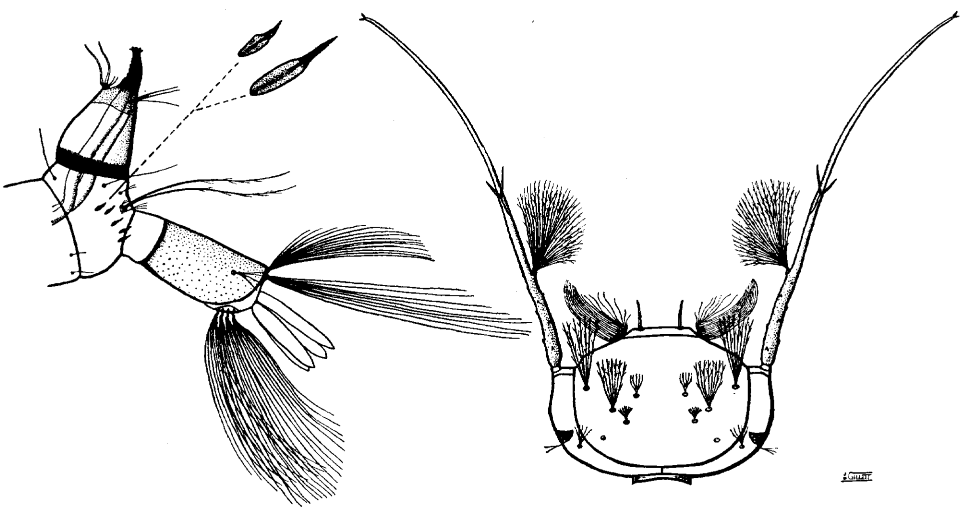


FIG. 48.—*Taeniorhynchus (Coquillettidia) metallicus* Theo. Head and terminal segments.

Length about 5 mm.; *colour* bright green or bright blue.

Head.—Tuft of antenna at about $\frac{1}{2}$ (excluding flagellar segment); flagellar segment very long and slender, nearly $1\frac{1}{2}$ times length of pedicellus, distal portion of pedicellus semi-flexible; subterminal setae both short and nearly equal in length (inner slightly the longer). Seta A moderately long, with 8–12 plumose branches, C with 9–10 branches, *d* with 3–6 branches.

Abdomen.—Comb a row of 4–6 very dark simple spines. Tuft B of eighth segment long, plumose, and double, arising from a well-developed basal tubercle. Subventral tuft of siphon 3-branched. Saddle covered with very minute spicules (but appearing smooth in balsam mounts); lateral seta small, 4-branched; upper caudal seta with about 15 branches, lower with 10; no tufts proximal to the barred area.

Breeding-places and habits.—Breeds in shallow grassy swamps and in small collections of water in which vegetation is growing. Gillett (1945*b*) notes that when pupating the larva has the extraordinary habit of breaking off its antennae and separating the head capsule from the rest of its cast pelt, leaving the pelt in four pieces (the two antennae, the head, and the remainder of the integument).

Taeniorhynchus (Coquillettidia) versicolor Edwards. (Fig. 47*f*.)

A large bluish-white larva, only likely to be confused with those of *aurites* and *microannulatus*, from which it may be separated by the position of the antennal tuft and the fact that the longer subterminal seta of the antenna is shorter than in these species.

Length 7–8 mm.; *colour* whitish to bluish white.

Head.—Antennal tuft at $\frac{2}{3}$ (excluding flagellar segment); longer subterminal seta usually $\frac{2}{3}$ length of flagellar segment (nearly $\frac{3}{4}$ in one specimen).

Abdomen.—Comb a row of 7–9 pale, sharp-pointed spines with a basal fringe. Tuft B of eighth segment long, single and very weakly plumose, with only the merest trace of a basal tubercle.

Breeding-places.—Shallow swamps containing aquatic plants.

Taeniorhynchus (Coquillettidia) schoutedeni Wolfs.

The following description is translated from Wolfs (1948*a*):

"*Head*.—The head is broader than long. Clypeal spines long and strong. The flexible part of the antennae is as long as the remainder. The antennae are spiculate even on the part beyond the antennal tuft. The antennal tuft is situated at about $\frac{2}{3}$ and has about 25 plumose branches. Seta A has about 10 branches, B about 6, C also 6, D also 6 and E has 5 branches. We were unable to distinguish seta F in our material. All the setae are very short, seta A being longer than the others.

"*Abdomen*.—The comb forms a row of 7–9 spines with a basal fringe. Seta B of the 8th segment is simple and strongly plumose. The siphon is very broad at the base. The subventral tuft has 5 branches. The saddle is complete and is covered with spicules of which the largest are to be found towards the dorsal corner. The saddle tuft comprises 8 branches with the base fanlike. There are 4 tufts in the barred region and 5 small tufts proximal to this region. The gills are all the same length, narrow and rounded at the end. The upper caudal seta has 12 branches and the lower 7. The tip of the siphon is the same as in all the other species of *Taeniorhynchus*."

"*Breeding-place*.—A papyrus swamp. . . . The swamp is parallel to the river Ruzizi but does not communicate with this nor with Lake Kivu which is nearby. The pH of the water is about 5. Altitude 1460 m."—P. F. M.

Taeniorhynchus (Coquillettidia) vanoyei Wolfs.

Wolfs (1948*b*) states that the larva of this species is indistinguishable from that of *T*. (*C*.) *schoutedeni*.—P. F. M.

Taeniorhynchus (Coquillettidia) pseudoconopas Theobald. (Figs. 47*d*, 49.)

Only likely to be confused with that of *fraseri*, from which it may be separated by the greater length of the longer subterminal seta of the antenna in *fraseri*, and by the larger and darker comb-spines in the present species.

Length 6–7 mm.; *colour* greenish blue.

Head.—Antenna with tuft (of about 20 plumose hairs) placed at about $\frac{4}{5}$ (excluding flagellar segment); longer subterminal seta about $\frac{1}{2}$ length of flagellar segment.

Abdomen.—Comb a row of 7–10 large, dark, sharp-pointed spines with a basal fringe on most, these spines larger and darker than in any other of the known species except *metallicus*. Tuft B of eighth segment long, single, plumose, and arising from a well-developed basal tubercle.

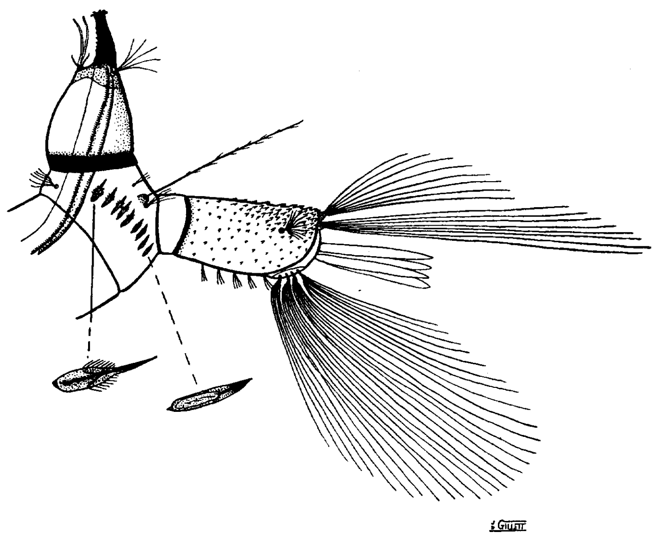


FIG. 49.—*Taeniorhynchus* (*Coquillettidia*) *pseudoconopas* Theo. Terminal segments.

Breeding-places.—The species was found on the roots of *Thaumastocostus* sp., in a depth of about an inch of water, in dense forest.

Taeniorhynchus (Coquillettidia) maculipennis Theobald. (Figs. 47*b*, 50.)

Separated from the other known larvae of the subgenus by the following combination of characters: antennal tuft (as in *pseudoconopas*) at $\frac{4}{5}$, longer subterminal seta of antenna about $\frac{1}{2}$ length of flagellar segment, but tuft B of eighth abdominal segment double.

Length 5–6 mm.; *colour* pale green.

Head.—Antennal tuft (of about 30 plumose branches) at about $\frac{4}{5}$ (excluding flagellar segment); longer subterminal seta about $\frac{1}{2}$ length of flagellar segment.

Abdomen.—Comb a row of 7–9 pale, sharp-pointed spines with a basal fringe. Tuft B of eighth segment long, plumose, and double.

Breeding-places.—In shallow dirty water containing aquatic vegetation, both in forest and in open lake-side situations.

Taeniorhynchus (Coquillettidia) cristatus Theobald.

Larva undescribed. Leeson (1931) bred specimens from a swamp, and in Uganda the writer bred one specimen from a small seepage swamp overgrown with semi-aquatic vegetation; the water was only a couple of inches deep and was clean.

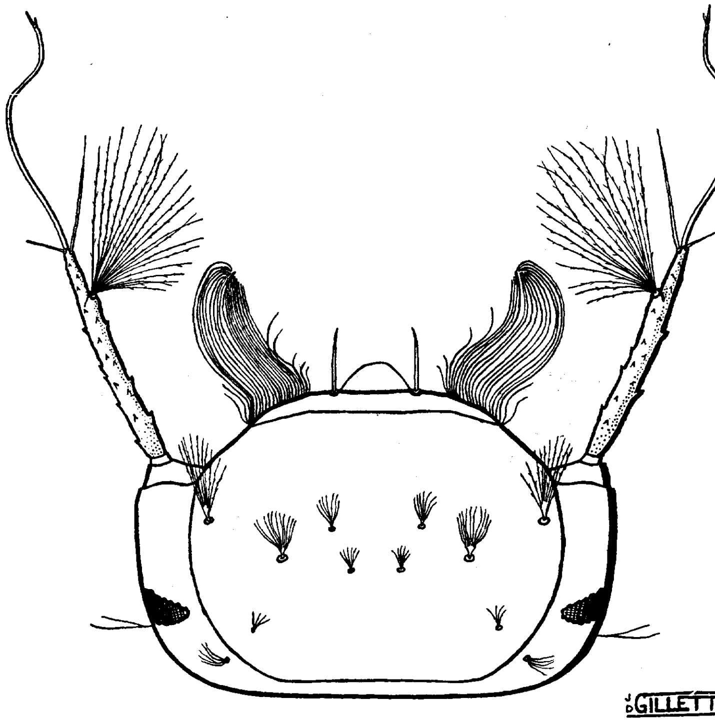


FIG. 50.—*Taeniorhynchus* (*Coquillettidia*) *maculipennis* Theo. Head.

Taeniorhynchus (Coquillettidia) fuscopennatus Theobald. (Figs. 47*c*, 51.)

Separated from other known larvae of the subgenus having tuft B of the eighth abdominal segment double by the characters of the antenna, especially the great length of the longer subterminal seta.

Length about 7 mm. ; *colour* dirty white with a distinct violet tinge.

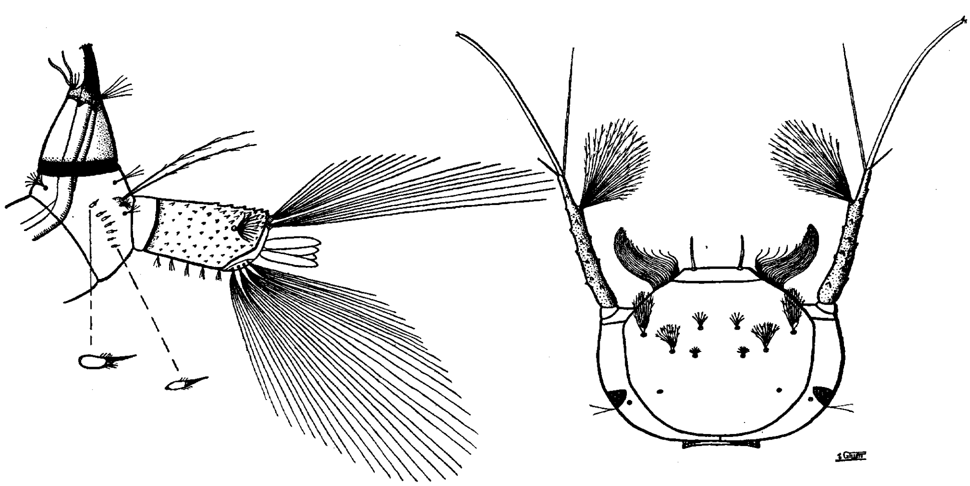


FIG. 51.—*Taeniorhynchus* (*Coquillettidia*) *fuscopennatus* Theo. Head and terminal segments.

Head.—Antennal tuft at about $\frac{3}{4}$ (excluding flagellar segment) ; longer subterminal seta from $\frac{2}{3}$ to $\frac{3}{4}$ length of flagellar segment.

Abdomen.—Comb a row of 7–9 pale, sharp-pointed spines with a basal fringe. Tuft B of eighth segment long, plumose and double.

Breeding-place.—A grassy swamp.

Taeniorhynchus (Coquillettidia) aurites Theobald. (Figs. 47*g*, 52.)

Larva inseparable from that of *microannulatus* ; separable from all the other known species by the position of the antennal tuft and the great length of the longer subterminal seta.

Length about 8 mm. ; *colour* variable, dirty bluish white, purplish white, or bright green.

Head.—The very large antenna has the tuft at about $\frac{4}{7}$ (excluding flagellar segment) ; longer subterminal seta nearly as long ($\frac{3}{4}$ to $\frac{7}{8}$) as flagellar segment.

Abdomen.—Comb a row of 7–9 pale, sharp-pointed spines with a basal fringe Tuft B of eighth segment long, highly plumose, single, and arising from a well developed basal tubercle.

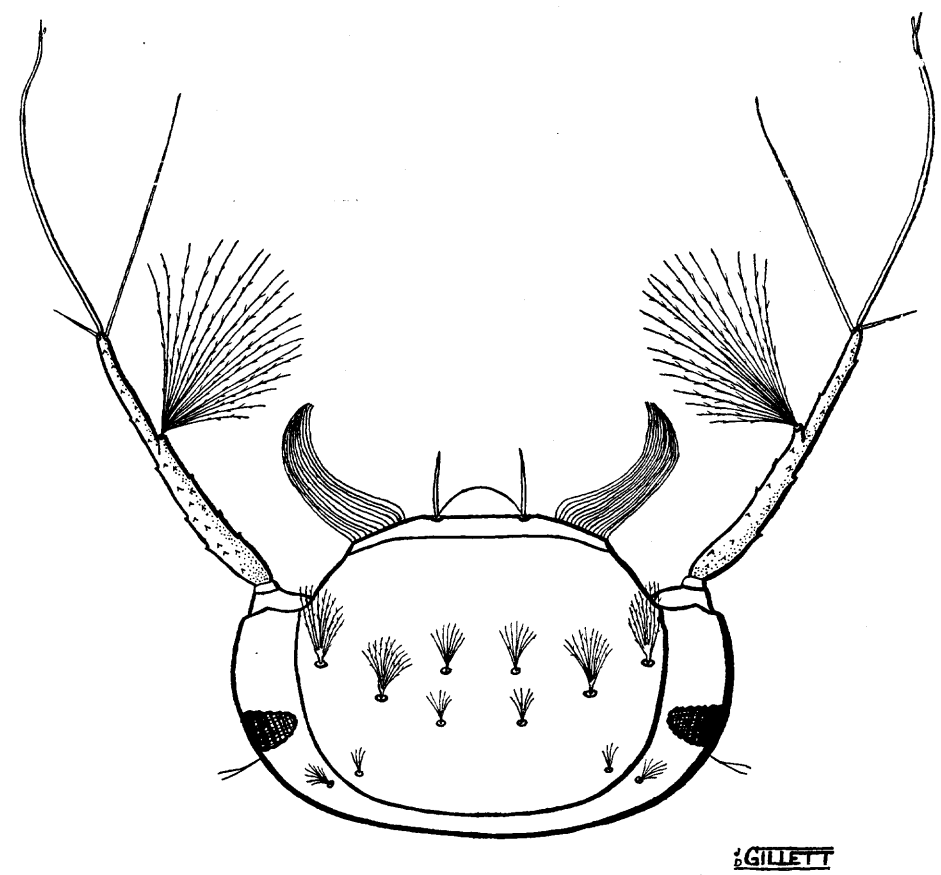


FIG. 52.—*Taeniorhynchus (Coquillettidia) aurites* Theo. Head.

Breeding-places and habits.—I obtained larvae in somewhat foul water in swamps and the ditches draining them; Gillett obtained them from shallow grassy swamps. The presence of *Pistia* is not a necessity (*cf.* Schwetz 1930*a*), since this plant was not present in any of the breeding-places mentioned, but some form of aquatic vegetation is, of course, essential. Gillett (1945*b*) records that during the process of pupation the species anchors its pupal trumpets in the root of a plant, and then lets go the hold of the larval siphon in the usual way; it then discards the larval skin by means of violent circular movements of its abdomen. This operation invariably leaves the cast pelt nearly inside out, the siphon and anal segment being drawn through the remainder of the pelt until they reach the head capsule, so that the final result much resembles a sock prepared for easy putting on; the ventral brush and caudal setae are very often left projecting into the head capsule.

Taeniorhynchus (Coquillettidia) microannulatus Theobald. (Fig. 47*g*.)

Larva indistinguishable from that of *aurites*.

Breeding-places and habits.—I found larvae in a large papyrus swamp, where the water contained much rotting vegetation, and in a ditch draining the same swamp, in which the water (overgrown with vegetation) was much cleaner than in the swamp itself; Gillett found them in shallow grassy swamps.

Taeniorhynchus (Coquillettidia) fraseri Theobald.* (Fig. 47*e*.)

The larva is only likely to be confused with that of *pseudoconopas*, from which it differs in its smaller and paler comb-spines, by the characters of the antenna (especially the greater length of the longer of the subterminal setae), and by the position of the tufts proximal to the barred area.

Length.—5–6 mm.; *colour* grey-blue to bright green.

Head.—Antennal tuft (of about 30 plumose branches) at about $\frac{3}{4}$ (excluding flagellar segment); longer subterminal seta about $\frac{2}{3}$ ($\frac{4}{7}$–$\frac{3}{4}$) length of flagellar segment.

Abdomen.—Tuft B of eighth segment long, plumose, and single, arising from a distinct basal tubercle. Tufts proximal to barred area of anal segment arranged in two rows (not in pairs, but markedly "staggered," and not forming a nearly straight line as in the other members of the subgenus).

Breeding-place.—Found in a shallow grassy swamp in dense forest.

Taeniorhynchus (Mansonioides) africanus Theobald. (Fig. 53.)

Length about 8 mm.; *colour* dirty reddish brown, valves of siphon deep black.

Head.—Length: breadth as 1 : 1·4. Antenna spiculate, portion beyond subterminal setae almost smooth; tuft at a little beyond $\frac{1}{3}$, composed of about 20 long coarse plumose branches; subterminal setae at about $\frac{2}{3}$, equal, more than $\frac{1}{2}$ length of antenna; terminal setae short, one stout and spine-like, the other longer and slenderer; papilla extended into a sharp spine; upper half of antenna colourless, lower half moderately dark. Head-setae all small and with simple branches, A with about 8 branches, B about 6, C, *d*, *e* and *f* with about 3–4. Mentum very small, central tooth much larger than the 5 at each side.

* Gillett (1949) points out that his *T. atroapicalis* (Gillett, 1946) is identical with this species which was treated by Edwards (1941) in error as synonymous with *T. aurites* Theo.—P. F. M.

Abdomen.—Comb a row of 2–3 long, narrow, blunt-ended spines ; tuft B of eighth segment with 3–5 simple branches, which are not much longer than half the diameter of the saddle. Siphon very short ; the single tuft on each side (which must be regarded as the subventral tuft, though actually lateral in position) is composed of 3–4 single branches. Saddle of anal segment about twice as long as broad, its surface minutely spiculate ; upper and lower caudal setae with about 10 and about 8 simple branches respectively ; lateral seta placed far back from distal margin, with about 6 very short branches. Ventral brush with 4 pairs of many-branched tufts in the barred area and 4 small unpaired midventral tufts proximal to it. " Gills " subequal, wedge-shaped, about $\frac{3}{4}$ length of saddle.

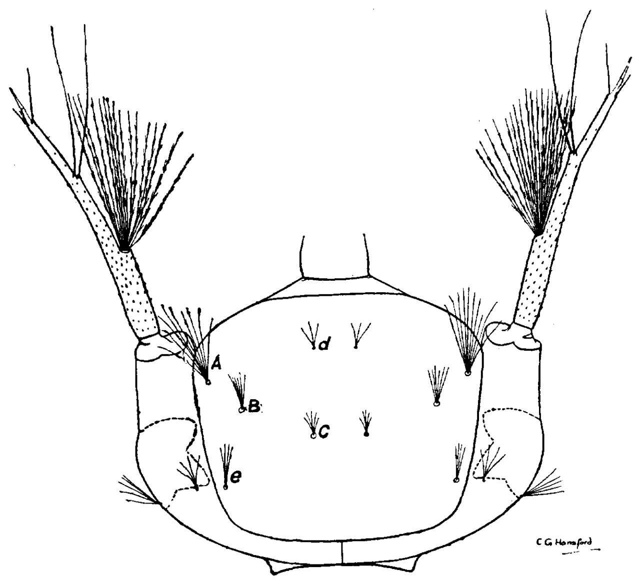


FIG. 53.—*Taeniorhynchus* (*Mansonioides*) *africanus* Theo. Head.

Breeding-places.—These are in the main the same as those of *T. uniformis* ; the present species has perhaps a slightly more marked preference for moderately clean water, and is therefore (in Uganda) somewhat more frequent in the lake-shore swamps, but the range of breeding-places is identical, and the difference is confined to relative abundance of the two species. An interesting record is that of Connal 1928–29), who found larvae and pupae attached to the lower surface of leaves of duckweed (*Lemna aequinoctialis*).

Taeniorhynchus (Mansonioides) uniformis Theobald. (Fig. 54.)

Only separable from *T. africanus* by the form of tuft B of the eighth segment, which (in a long series of specimens) is always long and 2-branched, while that of *T. africanus* is much shorter and has 3–4 branches.

Breeding-places.—Many authors have pointed out the association of the African species of *Mansonioides* with *Pistia* (water-lettuce), but this connection is by no means absolute. It may safely be assumed that wherever *Pistia* grows freely larvae of one or both of these species will be found, but they also occur freely in the absence of *Pistia* and in the presence of other amphibious plants, such as grasses and *Polygonum.* The larvae appear to prefer somewhat cleaner water than that chosen by those of

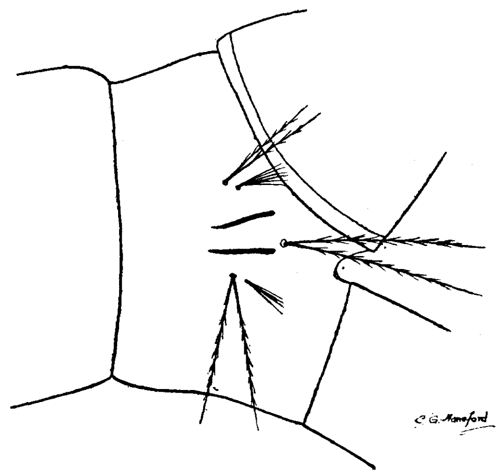


FIG. 54.—*Taeniorhynchus* (*Mansonioides*) *uniformis* Theo. Eighth abdominal segment.

the other subgenus, and the adults of this species and of *africanus* are, therefore, the most obvious (perhaps the dominant) species of mosquitoes found in the larger swamps, especially lake-shore swamps, and in swampy rivers in Uganda. Larvae are also found in old overgrown borrow-pits.

AËDES Meigen.

This very large genus has larvae which are distinguished more by the absence of peculiar characters than by their presence. For this reason it has not been possible to give a short diagnosis.

Head.—The antenna is never very large and flattened and is often short and cylindrical; the tuft is placed at or near the middle. The mouth-brushes are not modified for predacity (except in the case of the subgenus *Mucidus*), but the inner setae are usually more or less serrated.

Thorax.—Inner shoulder-setae and propleural group but little developed; usually only one long simple seta in the propleural group, the other three shorter; plates of meso- and metapleural groups usually small, commonly bearing spines.

Abdomen.—The comb may consist of spines or scales, and these are never set on a chitinous plate. The single subventral tuft of the unmodified siphon is placed at or beyond the middle, never very near the base; the pecten never consists of less than half a dozen teeth; in a number of species the more basal teeth are dark coloured and the more distal are pale; this character appears to be confined to the present genus. The siphonal index is rarely more than about 3. The saddle of the anal segment rarely forms a complete ring The ventral brush never lacks a

barred area (except occasionally in *unilineatus* P.F.M.) and is seldom markedly reduced, always having at least 4 pairs of tufts.
The lower caudal seta is almost always single, rarely double.

The *breeding-places* vary much in the different subgenera, but all the larvae, except those of the subgenus *Mucidus*, are primarily bottom-feeders and browse over the surface of mud or debris. Seasonal prevalence of larvae is very marked in several of the subgenera. Species which breed in small pools which are liable to be dried up commonly have a very short larval life ; Lamborn (1930) records pupae of *A. vittatus* and *A. fowleri* three days after rain had filled previously-dry rock-holes.

Subgenus **MUCIDUS** Theobald.

The larvae are very readily distinguishable from any others. In the field they might be mistaken for those of *Culex* (*Lutzia*) *tigripes*, but the longer siphon and less horizontal position at the surface of the water should easily separate them. Under the microscope their modified mouth-brushes (the bristles of which are stouter than usual and reduced to about 30 in number) will immediately distinguish them from all larvae except those of *Toxorhynchites* and *Lutzia* ; from the former they are divided by the absence of a large chitinous plate on the eighth abdominal segment, and from the latter by the single subventral tuft on the longer siphon. The mandibular teeth are very large and strong. The comb-scales form a large patch, and the anal segment bears an unusually large saddle and a particularly well developed ventral brush.

Breeding-places and habits.—It would appear that *Mucidus* has the same habits with regard to oviposition as are known to be possessed by some of the other subgenera of *Aëdes*, the females scattering their eggs over low-lying ground, where they mature and become ready to be washed into temporary pools and swamps by the first heavy rain. The evidence for this suggestion is that larvae are always found in such situations, young and older larvae or pupae are seldom found together, and there does not appear to be a succession of generations in one breeding-place.

The larvae of all the species are predaceous ; in view of the breeding habits the larvae on which they prey usually belong to the subgenera *Aëdimorphus* or *Banksinella*, but *Culex* is also often eaten.

Subgenus **OCHLEROTATUS** Lynch-Arribalzaga.

The larvae of all the three species of this subgenus which occur in our area are described. Neither the larva nor the breeding-places of *Ochlerotatus* seem to be separable from those of the pool-breeding sections of *Aëdimorphus*.

Subgenus **FINLAYA** Theobald.

The larvae of six of the species are known, which fall into two very distinct groups. Larvae of this subgenus do not seem to be separable from those of *Aëdimorphus*, but the pecten has no wider-separated apical spines as have most species of the latter subgenus. All the species of which the breeding habits are known occur in tree-holes and similar places.

8

Subgenus **STEGOMYIA** Theobald.

The siphon is invariably very short, having an index which is usually about 2, and never exceeds 3. The antenna bears no spicules. Head-setae A, B and C are usually simple (A rarely with 2–5 branches, B rarely double). The comb is a single row, sometimes rather irregular, of spines. The ventral brush consists of about 4 pairs of few-branched tufts, and there are no median tufts proximal to the barred area.

A. (*S.*) *vittatus* differs from all the other members of the subgenus in several important respects. The antenna is spiculate; seta A has 4–8 branches, and the ventral brush is totally different in character and includes several tufts proximal to the barred area.

Breeding-places.—With the single exception of *A. vittatus*, the larvae characteristically breed in tree-holes; many are also found in artificial receptacles, such as discarded tins or bottles, and *A. aegypti* has a considerably wider range of breeding-places which, while including the above, also comprises barrels, tanks, and rock-holes. Some species breed in plant axils and *A. vittatus* is found in rock-pools. Many species of this and other subgenera are known to have eggs resistant to desiccation, and some may readily be bred from the dry material found in tree-holes (Dunn, 1926). Many of the pool-breeding subgenera are so seasonal in their incidence that it is almost beyond doubt that they, also, possess eggs resistant to drying.

Subgenus **AËDIMORPHUS** Theobald.

The antenna is almost always spiculate (smooth in *A. minutus*, very sparsely spiculate in *A. natronius*), and usually a little more than half the length of the head. Head-setae B and C are usually rather long, multiple and plumose. Unlike the subgenera *Stegomyia* and *Dunnius* the species of *Aëdimorphus* are not confined to small breeding-places, and in correlation with this habit we find that the siphon is considerably longer than that of a *Stegomyia* or *Dunnius*, and there are almost always unpaired tufts in the ventral brush proximal to the barred area.

Breeding-places.—Edwards (1925) has divided the subgenus into a number of groups; it is interesting to note that his grouping shows complete correlation with larval habits so far as these differ. The species of *Aëdimorphus* can be divided into two sections, a smaller the members of which breed in tree-holes and similar small containers, and a larger the members of which breed in pools of various kinds, some in brackish or alkaline water. Of the 6 species now included in Edwards' Group II (Group I has been transferred to *Diceromyia*), 5 are known to breed in tree-holes and similar places; none of the remaining species of the subgenus are known to breed in small containers. The grouping is also to some extent borne out by the structure of the larvae, since the members of the tree-hole series bear a strong general resemblance to one another.

The remarks made as to the oviposition of *Mucidus* apply also to *Aëdimorphus*, *Banksinella* and *Ochlerotatus*, of which *Mucidus* appears to be a specialization. It is interesting to note that these oviposition habits are apparently largely shared by the tree-hole-breeding group of *Aëdimorphus*; they have a strongly marked seasonal incidence (being found only after heavy rain), and I have not found any succession of generations in the same hole.

Subgenus **BANKSINELLA** Theobald.

Only two larvae of this subgenus are known, but there is some indication of the habits of some others. In the known species the spiculate antenna is about half the length of the head, the comb-spines are in a single, somewhat irregular row, the siphonal index is about 3, and there are median tufts proximal to the barred area of the ventral brush. These characters will not distinguish the subgenus from *Aëdimorphus*.

Breeding-places.—So far as the evidence goes, there is every indication that the habits and breeding-places are the same as those of the pool-breeding section of *Aëdimorphus*.

Subgenus **DICEROMYIA** Theobald.

The larvae of five of the six species are known, but *flavicollis* only from a single much-damaged pelt. Assuming the characters which canot be checked in *flavicollis* to be the same as in the others, all have spiculate antennae bearing a branched tuft; head-seta B with few branches (1–3). The meso- and metapleural plates bear spines. Comb composed of a single row of not more than about 12 spines. The ventral brush is poorly developed, and there are no unpaired tufts proximal to the barred area. "Gills" with rounded apices in the species for which this character is known. Siphon short; more distal pecten-spines not wider spaced than the remainder; subventral tuft near middle.

All the characters given are shared by some members of *Aëdimorphus*, but the combination of characters will separate off larvae of *Diceromyia*.

Breeding-places.—All the species breed in tree-holes.

Subgenus **DUNNIUS.**

The larvae differ from those of all the other subgenera except *Stegomyia* and *Skusea* by the combination of smooth antennae and absence of unpaired tufts in the ventral brush. From *Stegomyia* they are separable by the fact that head-seta *d* is as large as A, and from *Skusea* by the smaller number and different shape of the comb-teeth. The larvae of three of the species are known.

Breeding-places.—Tree-holes and bamboos.

Subgenus **SKUSEA** Theobald.

The larva of the single Ethiopian species can readily be separated from that of any other member of the genus by the peculiar shape of the comb-teeth, which are deeply cleft into two divisions. It also differs from most members of the other subgenera in possessing only a very small and weakly-sclerotized saddle on the anal segment.

Breeding-places.—Crab-holes on the coast.

Key to the Known Larvae of the Genus Aëdes.*

1. All the setae of the mouth-brushes modified (for predacity) into strong curved spines (subgenus *Mucidus*) . . . . 2.
   Mouth-brushes not modified thus, or with only a median patch of modified setae . . . . 4.
2. Pecten with at least the two distal spines simple . . . *nigerrimus* (p. 122).
   Pecten with at most the terminal spine simple . . . . . . 3.
3. Subventral tuft of siphon placed at or beyond ½. . . . *grahami* (in part, p. 123).
   This tuft placed well before ½.
   scatophagoides (p. 121), *mucidus* (p. 122), *grahami* (in part, p. 123).
4. Siphon with a ventral row of appressed spines near the apex. . . . . 5.
   Siphon without such spines . . . . 6.
5. Comb of about 30 scales; subventral tuft of siphon placed at about ⅔ the distance from base to apex . . . . . . *pseudotarsalis* (p. 179).
   Comb of about 60–80 scales; subventral tuft of siphon at less than ½ the distance from base to apex . . . . *boneti* (p. 191).
6. Antenna smooth; no tufts in ventral brush proximal to barred area (except sometimes 1–2 in *amaltheus*) (Subgenera *Stegomyia*, except *vittatus*, *Dunnius* and *Skusea*) . . . . 7.
   Either with antenna spiculate (usually markedly so) or with several tufts in ventral brush proximal to barred area, usually with both these characters (*Stegomyia vittatus* and subgenera *Aëdimorphus*, *Diceromyia*, *Finlaya*, *Banksinella* and *Ochlerotatus*) . . . . 26.
7. Teeth of comb bifid almost to base (subgenus *Skusea*) . . *pembaensis* (p. 222).
   Comb-teeth never as above . . . . 8.
8. Head-seta A with 3–8 branches; *d* almost as long as A and sometimes with about 15 branches (subgenus *Dunnius*) . . . . 9.
   Seta A rarely with more than 3 branches; *d* much shorter than A and never with more than about 10 branches (subgenus *Stegomyia*) . . . . . 10.
9. Head-seta A with about 4 branches; siphonal index about 2 . *michaelikati* (p. 221).
   Head-seta A with about 8 branches; siphonal index about 3
   argenteoventralis (p. 219) and *kummi* (p. 220).
10. Comb-spines somewhat spatulate, fringed all round the apex
    luteocephalus (p. 157), *africanus* (p. 156) and *pseudoafricanus* (p. 157).
    Comb-spines sharp-pointed, never with an apical fringe . . . . . 11.
11. Ventral brush with at least the great majority of the setae single . . . . 12.
    Ventral brush with at least the great majority of setae branched . . . . 14.
12. Lateral seta of saddle and subventral seta of siphon single . *angustus* (p. 156).
    These setae each with at least 2 branches . . . . 13.
13. Comb spines with a small number of well-developed lateral denticles, at least the median ones easily visible under low powers of the microscope
    amaltheus (in part, p. 154).
    Comb spines with the lateral denticles less strongly developed, invisible or visible only with difficulty under low powers of the microscope
    unilinectus (p. 158).
14. Comb-spines with a basal fringe of fine denticles which reaches to near apex of spine . . . . *fraseri* (p. 144).
    Comb-spines appearing simple or with basal denticles not forming a fringe to near apex . . . . 15.
15. Pecten-spines appearing simple under low powers of microscope and only very fine inconspicuous denticles visible under high powers . . . . . 16.

* Species not found on the mainland of Africa are omitted from the key.

Pecten-spines with at least one distinct ventral denticle visible under low powers ; 1–3 coarse ventral (and occasionally 1 small dorsal) denticles visible under high powers . . . . 20.

16. Comb-spines with prominent basal denticles, readily visible under low powers of microscope . . . . 17.

Comb- and pecten-spines simple, or with only very fine inconspicuous basal denticles visible under high powers of microscope . . . . . . 19.

17. Lower caudal seta with 2 or more branches . . . . 18.

Lower caudal seta single
heischi (p. 148), *keniensis* (p. 151) and ? *pseudonigeria* (p. 151).

18. Typical pecten teeth short and broad, not more than 4 × as long as their breadth at base . . . . . *simpsoni* (p. 139) and *demeilloni* (p. 147).

Typical pecten teeth longer and narrower, at least 6 × as long as their breadth at base . . . . *strelitziae* (p. 140).

19. Pecten-spines regularly spaced except beyond the tuft
dendrophilus (p. 145), *deboeri* (p. 150) and *bambusae* (p. 155).

Pecten-spines irregularly spaced and placed in groups of 2–5 spines
bambusae ssp. *kenyae* (p. 155).

20. Spines at base of meso- and meta-thoracic pleural tufts large and curved (rose-thorn shape) . . . . 21.

Spines at base of meso- and meta-thoracic pleural tufts small (straight or curved) . . . . 22.

21. Thorax with large strong stellate setae ; comb-spines not appearing trifid under low powers of microscope . . . . . . *metallicus* (p. 141).

Thorax without large stellate setae ; comb-spines appearing trifid under low powers of microscope . . . . *aegypti* (p. 134).

22. Comb spines appearing simple under low powers of the microscope and with only very small fine denticles visible under high powers. . . . . 23.

Comb spines with prominent basal denticles readily visible under high powers of microscope . . . . 24.

23. Ratio of distance of antennal tuft from base of antenna to length of antenna as a whole less than 0·7
calceatus (p. 148), *soleatus* (p. 149), *langata* (p. 151), *schwetzi* (in part, p. 145).

This ratio greater than 0·7 *apicoargenteus* (p. 143), *schwetzi* (in part, p. 145)

24. Pecten-spines deeply cleft ; comb-spines narrow at base and with numerous moderately long slender basal denticles (fig. 73*a*) . *subargenteus* (p. 138).

Pecten-spines with small basal denticles ; comb-spines with 2–3 coarse basal denticles and a few finer ones . . . . 25.

25. Saddle with coarse spicules on posterior margin . . *amaltheus* (in part p. 154).

Saddle smooth . . . . *contiguus* (p. 149)

26. Pecten of 35–40 spines extending to $\frac{3}{4}$ length of siphon . *phyllolabis* (p. 177).

Pecten of many fewer spines and usually much less extensive . . . . 27.

27. Siphonal index 7–8 . . . . *ochraceus* (p. 207).

Index not or little more than 4 . . . . 28.

28. Antenna smooth . . . . *minutus* (p. 178).

Antenna spiculate, sometimes only sparsely and minutely so . . . . 29.

29. Without median unpaired tufts proximal to the barred area in the ventral brush ; comb always a single row of spines ; larvae in tree-holes (subgenus *Diceromyia*)* . . . . 30.

With such tufts ; comb often otherwise ; larvae often in pools . . . . 34.

30. Pecten-spines few (3–13) and widely spaced . . . . 31.

Pecten a close-set row of 18–25 spines . . . . 33.

* *A. flavicollis* would probably run down here, but the sole known pelt is so damaged that the species cannot be carried further in the key. It is possibly separable from the other members of the subgenus by the larger number of spines in the comb (about 12, as against 4 to about 10).

31. Spines at base of meso- and metapleural groups of setae very conspicuous under low powers of microscope, large, curved, bifid and heavily sclerotized (therefore dark brown) . . . . *fascipalpis* (p. 217).
These spines inconspicuous under low powers, small, straight, not obviously bifid, and pale-coloured . . . . 32.
32. Head-setae B and C about the same length, each with 2–3 branches; siphonal index about 4; no barred area in ventral bush . . . . *zethus* (p. 217).
Seta C single, B bifid and about ½ length of C; siphonal index about 2; a barred area present in ventral brush . . . . . . *adersi* (p. 215).
33. Siphonal index over 4 . . . . *taylori* (p. 213).
Index not over 3·6 . . . . *furcifer* (p. 213).
34. Head obviously spiculate, body either spiculate or covered with small sclerotic plaques . . . . 35.
Head not spiculate,* body not spiculate, rarely with inconspicuous plaques . 36.
35. Skin of body covered with small sclerotic plaques . . . *cumminsi* (p. 195).
Skin of body densely spiculate . . . . *fowleri* (p. 202).
36. Head-setae B and C both single or at most double, about equal in length, or C much longer than B . . . . 37.
Either at least one of these setae (usually both) with 3 or more branches *or* B much longer (and usually much stouter) than C . . . . . . 49.
37. Comb a patch of about 70 *scales* . . *longipalpis* (p. 127) and *fulgens* (p. 129).
Comb an irregular row or small patch of not more than about 25 *scales or spines* 38.
38. Comb of about 20 *scales* . . . . *tricholabis* (p. 182).
Comb composed of *spines* . . . . 39.
39. Spines of pecten strongly denticulate on both sides (none of these spines more widely spaced) . . . . *fryeri* (p. 123).
Pecten-spines at most very weakly denticulate on the dorsal side . . . . 40.
40. None of the distal pecten-spines more widely spaced . . . . . . 41.
At least one pecten-spine more widely spaced . . . . 43.
41. Comb of about 10 large spines with secondary denticles confined to the base *caballus* (p. 124).
Comb of 25–30 spines with secondary denticles reaching nearly to apex, i.e., with median denticle relatively less developed . . . . . . 42.
42. Lateral seta of saddle single; head setae B and C only about half the length of the head; anal papillae small and rounded, shorter than the saddle *caspius* (p. 125).
Lateral seta of saddle with several branches; head setae B and C longer; anal papillae narrow and pointed, at least the dorsal pair longer than the saddle . . . . *luteostriatus* (p. 134).
43. "Gills" barely longer than saddle, rounded; comb a regular, almost straight, row . . . . *durbanensis* (p. 204).
"Gills" much longer than saddle, lanceolate; comb a very irregular row . 44.
44. Antenna very sparsely spiculate; pecten composed of very closely set spines of which most have 3 or more basal denticles, and of which only the most distal is wider spaced . . . . *vittatus* (p. 160).
Antenna more strongly spiculate; pecten-spines less closely set and usually with only 1 basal denticle (or none); usually 2 or more of the distal spines more widely spaced . . . . 45.
45. Subventral tuft with 2–4 branches; or pecten spines with one basal denticle or none . . . . 46.
Subventral tuft with 7–8 branches; pecten-spines with several basal denticles *arabiensis* (p. 198).

* Minute spicules not visible under low magnifications occur in some species belonging to this section of the key.

46. Head seta B single . . . . 47.
This seta bifid . . . . *bevisi* (p. 197).
47. Pecten spines with several basal denticles . . . *dentatus* (in part, p. 194).
Pecten spines with only one basal denticle or none . . . . 48.
48. Subventral tuft of siphon placed beyond pecten; pecten-spines moderately large . . . . ? *palpalis* var. *maculicosta* (p. 212).
Subventral tuft placed before distal group of pecten-spines; pecten-spines enormously large . . . . *palpalis* (p. 211).
49. Comb composed of sharp-pointed spines which are not fringed round the apex 50.
Comb usually composed of scales; if of spines then the spines with an apical fringe . . . . 60.
50 Head-seta B single (rarely double), much longer and usually stouter than C . 51.
This seta with at least 2 branches, not or but little longer than C . . . 53.
51. Seta C with 2–3 branches . . . . 52.
This seta with 5–6 branches . . . . *hirsutus* (p. 201).
52. Tuft of antenna single or double; comb of about 25 spines; pecten without wider-spaced spines . . . . *pulchrithorax* (p. 132).
Antennal tuft of about 8 branches; comb of 10–12 spines; pecten with 2–3 wider-spaced spines distally . . . . . *dentatus* (in part, p. 194).
53. Siphon distinctly angulated at insertion of tuft; tuft twice as long as diameter of siphon . . . *argenteopunctatus* (p. 170) and *punctothoracis* (p. 171).
Siphon not angulated; tuft not or little longer than diameter of siphon . 54.
54. Antenna with very sparse spicules, appearing nearly smooth; head-setae not plumose, B and C short and rather inconspicuous; pecten-spines peculiarly long and slender; "gills" ovate, about as long as saddle . *natronius* (p. 205).
Antenna usually obviously spiculate; at least head-seta A plumose, B and C large and conspicuous; pecten-spines comparatively short and stout; "gills" usually either lanceolate or much longer than saddle . . . 55.
55. Siphonal index $4\frac{1}{2}$; 5–6 comb-spines . *domesticus* (p. 173) and *leptolabis* (p. 174).
Index not more than 3; comb-spines usually more numerous . . . 56.
56. None of distal pecten-spines wider spaced nor simple; head-seta *d* enormous *ingrami* (p. 130), *wellmani* (p. 129) and *embuensis* (p. 130).
At least one of the distal pecten-spines wider spaced and simple; seta *d* very small . . . . 57.
57. Pecten of 9–11 pale-coloured spines, of which only 1 is wider spaced *albocephalus* (p. 181).
Pecten of at least 12 (usually dark-coloured) spines, of which at least 2 are wider spaced . . . . 58.
58. "Gills" very narrowly lanceolate; pecten-spines with only 1 basal denticle *circumluteolus* (p. 208) and *lineatopennis* (p. 207).
"Gills" more broadly lanceolate; some of pecten-spines with 2–3 denticles . 59.
59. Tuft of antenna at $\frac{1}{2}$, of about 12 branches; subventral tuft of siphon with about 6 branches . . . . *quasiunivittatus* (p. 193).
Tuft of antenna at about $\frac{1}{3}$, of about 8 branches; tuft of siphon with 3–4 branches . . . . *gibbinsi* (p. 192).
60. Antenna longer than head . . . . 61.
Antenna shorter than head . . . . 63.
61. Antenna colourless; subventral tuft of siphon placed much nearer to apex of siphon than to distal pecten-spine . . . . . . *wigglesworthi* (p. 183).
Antenna infuscated for at least its distal half; subventral tuft of siphon placed more basally, nearer to most distal pecten-spine than to apex of siphon . 62.
62. Antenna with proximal half not infuscated; antennal tuft distinctly beyond middle . . . . *alboventralis* (p. 184).
Antenna with less than proximal quarter pale; antennal tuft at, or only slightly beyond, middle . . . . *abnormalis* (p. 183).

63. Antenna only slightly shorter than head . . . . 64.
Antenna much shorter than head (up to $\frac{5}{7}$ usually only about $\frac{1}{2}$) . . . 65.

64. Upper caudal seta with about 15 branches which are about as long as the saddle *leesoni* (p. 185).
Upper caudal seta with 5–7 branches of which the longest are about $1\frac{1}{2}$ the length of the saddle . . . . *dalzieli* (p. 186).

65. Head-seta B with 2 or 3 branches, much longer than C; subventral tuft of siphon single . . . . 66.
Seta B with at least 4 branches which are seldom longer than those of C; subventral tuft with at least 2 branches . . . . 67.

66. Seta B double, much longer than head; distal spine of pecten wider spaced; "gills" lanceolate, about twice length of saddle . *centropunctatus* (p. 199).
This seta 3-branched, slightly shorter than head; distal spine of pecten not wider spaced; "gills" ovoid, dorsal pair about length of saddle *nigricephalus* (p. 188).

67. "Gills" very short and rounded, less than half length of saddle; head-seta B obviously longer than C . . . . *irritans* (p. 187).
"Gills" at least as long as saddle; seta B not, or very little, longer than C . 68.

68. Subventral tuft of siphon much shorter than diameter of siphon; siphon not heavily sclerotized and therefore pale in colour . . . . . . 69.
Subventral tuft nearly as long as diameter of siphon or longer; siphon very highly sclerotized and dark brown . . . . 73.

69. Subventral tuft of siphon placed beyond most distal pecten-spine; comb of 15 scales . . . . *yangambiensis* (p. 179).
Subventral tuft proximal to most distal pecten-spine; comb of at least about 20 scales . . . . 70.

70. Subventral tuft of siphon with about 5 branches . . . *hopkinsi* (p. 171).
This tuft with at most 3 branches . . . . 71.

71. Comb with 40–50 scales . . . . *tarsalis* (p. 176).
Comb with 20–30 scales . . . . 72.

72. Pecten with 3 distal teeth simple and widely spaced . . . *filicis* (p. 174).
Pecten with 5 distal teeth simple and widely spaced . . . *mutilus* (p. 172).

73. Comb composed of at least 20 pale-coloured *scales* . . . . . . 74.
Comb composed of 9–14 dark-coloured fringed *spines* . . . . . . 79.

74. Apex of siphon pale, in strong contrast to basal half . . . *lamborni* (p. 189).
Siphon dark-coloured throughout . . . . 75.

75. Comb of about 80 scales; pecten-spines each with 2–3 lateral denticles; index about $4\frac{1}{2}$ . . . . *apicoannulatus* (p. 169).
Comb scales less, about 20–40 . . . . 76.

76. Pecten-spines with 2–3 basal denticles; about 20–30 comb-scales . . . . 77.
Pecten-spines with one lateral denticle; about 40 comb-scales . *simulans* (p. 167)

77. Subventral tuft of siphon placed well beyond pecten, an appreciable gap between its base and the tip of the last pecten spine . . *haworthi* (p. 167).
Subventral tuft placed immediately beyond pecten, about level with tip of last spine . . . . 78.

78. Mentum triangular (Fig. 83); basal $\frac{1}{2}$ of siphon not greatly swollen; index 3–3·25 . . . . *kapretwae* (p. 163).
Mentum pentagonal (Fig. 82); basal $\frac{1}{2}$ of siphon swollen; index 3·3–4·5 *capensis* (p. 163), *ngong* (p. 165).

79. Mentum with about a dozen teeth on each side; "gills" with blunt apices *marshalli* (p. 162).
Mentum with 8–9 teeth on each side; "gills" with tapered apices *stokesi* (p. 165).

Aëdes (Mucidus) scatophagoides Theobald. (Fig. 55.)

Length about 10 mm. ; *colour* yellowish-white, mouth-brushes and valves of siphon dark brown.

Extremely similar in all respects to *A. mucidus*, from which it is doubtfully separable. It appears normally to have fewer (30–40) comb scales, but Dr. De

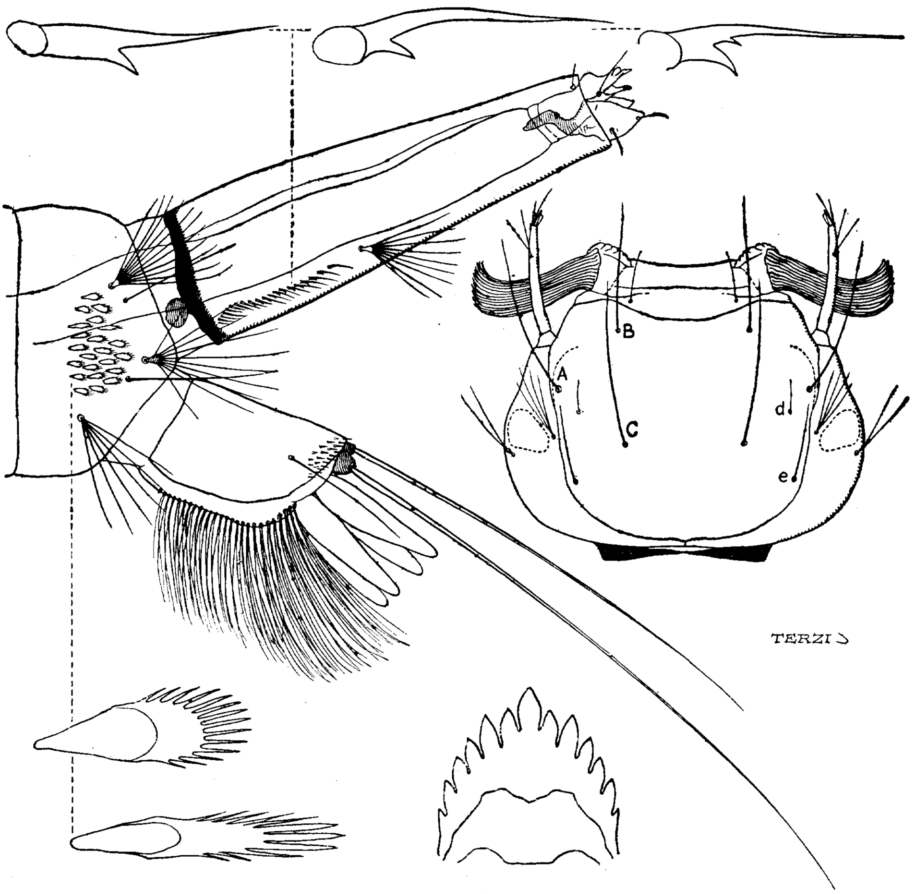


FIG. 55.—*Aëdes* (*Mucidus*) *scatophagoides* Theo. (From Indian material.) Head, terminal segments and mentum. The comb-scales are more numerous in the few Ethiopian larvae available.

Meillon informs me that one batch of pelts from which he reared the species had 35–55 scales (average about 48).

Breeding-places and biology.—" After heavy rains in mud-pools and marshy ground " (Bedford, 1928). Other authors record similar breeding-places. Nieschulz, Bedford and du Toit note that the larvae of this species occur in newly-flooded pools simultaneously with those of *Ochlerotatus* and *Banksinella*, while larvae of *Culex* (including *Lutzia*) appear later. In the writer's opinion this is strong evidence that the eggs of *Mucidus* are resistant to drying and become " mature " (*i. e.* with the larva developed and ready to hatch on wetting) before the pools are flooded, whereas the eggs of *Culex*, including *Lutzia*, are not resistant to desiccation and are laid after the pools are flooded.

Aëdes (Mucidus) mucidus Karsch.

The larva is very similar to that of *nigerrimus*, the chief differences being as follows: Siphon longer (index about 5), tapering on distal third; subventral tuft well before middle; pecten of 25–27 spines.* The larger number of comb-scales is the most obvious distinction from *scatophagoides*.

The breeding-places are usually exactly similar to those of the other species of the subgenus, but Aders (1917*a*) records having found this species once in an old cement tank containing water rich in decaying vegetation.

Larvae show no reluctance to eat smaller specimens of their own species.

Aëdes (Mucidus) tonkingi Gebert.

Larva unknown. Gebert (1948) states that the early stages were taken from a pool of stagnant rain-water in association with those of *Anopheles gambiae* and *Aëdes fowleri*.—P. F. M.

Aëdes (Mucidus) nigerrimus Theobald.

The larva of this species is that previously attributed to *africanus* (Hopkins, 1931).

Length about 10 mm.; *colour* yellowish-white, mouth-brushes and valves of siphon dark brown.

Head quadrangular in shape, somewhat broader than long (as 1·2 : 1); mouth-brushes set very wide apart, the setae modified into strong highly sclerotized spines each edged apically with a row of small teeth, as in *Culex* (*Lutzia*) *tigripes*. Antenna $\frac{1}{3}$ as long as width of head, slender, not infuscate, with very few minute spicules; tuft of 2 short simple branches at $\frac{5}{6}$; terminal and subterminal setae very small. Clypeal spines placed very far back, long and slender, almost reaching anterior margin of head. Head-setae all small, single and simple. Mentum† with about 7 small teeth on each side of the median longer tooth.

Abdomen.—Comb a patch of about 60 approximately equal scales, each with a broad apical fringe. Siphon moderately long, scarcely tapering; index 3–4 in preserved specimens, probably somewhat more in fresh ones; subventral tuft of 6–7 simple branches at just beyond $\frac{1}{2}$; pecten of about 20 (18–21) spines, extending to about $\frac{1}{3}$, more basal spines with 1–2 strong basal denticles, last 3 spines more widely spaced than the remainder and simple. Anal segment with saddle extending over the greater part of the segment, posterior margin with a small number of rather large coarse spicules dorsally; both pairs of caudal setae single, approximately equal; lateral seta single, simple, about as long as saddle. Ventral brush very strongly

* It is improbable that differences in the number of pecten-spines are of any assistance in distinguishing the species of this subgenus. In *scatophagoides* they vary in number from about 20 to over 30.

† The mental plate varies considerably in shape, but similar apparent differences exist in a short series of larval skins of *A. scatophagoides* from West Africa; they are probably due to misplacement in mounting the skins.

developed, composed of about 16 pairs of tufts, but individual tufts short and with simple branches. "Gills" subequal, about ½ length of saddle.

Breeding-places similar to those of *M. scatophagoides*.

Aëdes (Mucidus) grahami Theobald.

Larvae have been described from Belgian Congo (Wolfs 1945*a*) and Gold Coast (Shield 1945, Mattingly 1947) and a series from Uganda has been presented to the British Museum by Mr. G. R. Barnly. The material available for description is therefore comparatively varied and extensive. The variability of all the characters hitherto considered to be of taxonomic significance is considerable and separation from *A. mucidus* and *A. scatophagoides* is not always possible. The diagnostic characters given by Wolfs (1945*a*) for Belgian Congo material are not applicable over the whole range.

Length about 9 mm.; *colour* brown with darker siphon and mouth brushes (not recorded for Uganda and Belgian Congo specimens).

Head squarish, chaetotaxy as in other members of the subgenus. Antenna sparsely spiculate with minute terminal setae and tuft reduced to 2 (occasionally up to 4) simple branches.

Abdomen.—Comb a patch of about 30–60 scales each with a broad apical fringe but the shape of individual scales varies considerably. Siphon tapering slightly with index about 5 (Wolfs says 3–4 but this may refer to crushed specimens). Subventral tuft of 4–10 branches situated either slightly before, at or beyond ½. Pecten of 16–30 spines stretching to 1/3 or beyond. The terminal spine may or may not be simple and separated from the others. Typical spines with a single well developed secondary denticle. Ventral brush very well developed with about 15–20 pairs of tufts. "Gills" about ½ the length of the saddle. Saddle spiculate on the postero-dorsal edge.

Breeding-places.—Temporary pools. Larvae usually found only after heavy rain.—P. F.M .

Aëdes (Ochlerotatus) fryeri Theobald.

Although the evidence for the attribution of the larva described below to *fryeri* is not conclusive, it is very strong. The material (two fourth-stage larvae in balsam) was collected on Aldabra Island, whence came also the type of *fryeri*. As *fryeri* is purely coastal in its distribution it probably breeds in salt water; the only species of *Aëdes*, apart from the present larva, known to occur in the neighbourhood of Aldabra and to breed in salt water is *A.* (*Skusea*) *pembaensis*, of which the larva is known with certainty.

The larva is peculiar in that the pecten-spines have prominent coarse denticles *on both sides* of the main spine; this, coupled with the head-chaetotaxy, is diagnostic.

Head.—Distinctly broader than long. Antenna wholly pale, spiculate, nearly straight, not quite ½ length of head; terminal and subterminal setae all placed at apex, one much longer than remainder, but all very short; tuft of about 8 apparently very sparsely plumose branches at ½. Seta A with about 8 branches, B and C 2-branched; all these setae simple or very sparsely plumose and much less than half length of head ; bases of B and C placed close together, C placed nearly behind B, but slightly internal to it. Mentum triangular, with about a dozen teeth on each side; central tooth not much larger than lateral ones.

Abdomen.—Comb an irregular line of 10 and 11 (on the two sides of one larva ; I cannot count them on the other, which is distorted) rather small pale-coloured spines, of which the lateral denticles approach the terminal denticle in size and are few in number. Siphon with index about $2\frac{1}{2}$; pecten of 14–16 rather closely-set spines extending to about $\frac{3}{5}$; spines all moderately dark, very broad, usually with 3 ventral denticles which approach in size the terminal denticle, most of them with at least one large denticle on the dorsal side in addition; none of the spines markedly wider spaced ; subventral tuft of about 4 apparently simple branches, which are much shorter than the diameter of the siphon, placed at $\frac{7}{10}$. Saddle of anal segment incomplete, dorso-apical angle rather coarsely spiculate ; upper caudal seta with numerous (apparently about 8) branches, lower single ; lateral seta small, single. Ventral brush with 4 or 5 large tufts proximal to the barred area. "Gills" subequal, very broadly lanceolate, about length of saddle.

Breeding-places.—In salt water in company with *Anopheles gambiae.*

Aëdes (Ochlerotatus) caballus Theobald. (Fig. 56.)

The following description, by Mrs. van Someren, is from a whole larva reared by Dr. De Meillon from eggs laid by a female *caballus.*

This larva is very similar to *caspius* and *fryeri*, but the short fine basal denticles on the comb-spines will separate it from both these species.

Head.—Broader than long. The hairs of the inner $\frac{1}{2}$ of the mouth brushes are stout and modified, having on their distal margin a row of small teeth like the setae found in the mouth-brushes of *Culex tigripes.* Antenna short (about $\frac{1}{2}$ or a little less than $\frac{1}{2}$ the length of the head), very slightly curved and slightly tapered, moderately but minutely spiculate ; tuft just before a $\frac{1}{2}$, composed of 2–3 almost simple

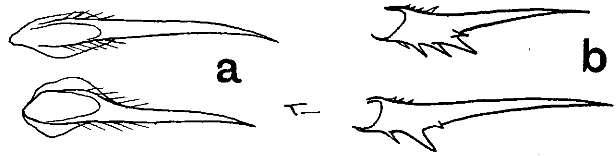


FIG. 56.—*Aëdes (Ochlerotatus) caballus* Theo. Larval details. *a*, comb spines. *b*, pecten teeth.

branches ; subterminal setae very near the apex, one short and one fairly long, terminal setae short and spine-like. Setae A, B, and C finely and sparsely plumose ; A about $\frac{1}{2}$ the length of the antenna and with 6–7 branches ; B and C single, C a little longer than the antenna and B a little shorter than C ; *d* very short, fine, single, and placed in a line with and inside B. Mentum not visible in the available specimen.

Abdomen.—Comb a small patch of 8–9 fairly large sharp-pointed spines which have a strong terminal denticle and a broad base fringed with short fine denticles. Siphon short and pale, index in mounted specimen about $2\frac{1}{2}$; pecten reaching to $\frac{1}{2}$, composed of 20–24 close set spines ; none of which are more widely spaced ; these spines narrow with a long fine terminal portion and ventrally 1–2 short and coarse basal denticles plus 2–3 fine ones; dorsally there are a few very short fine basal denticles (only visible under high powers); subventral tuft at three-fifths, composed of 4 nearly simple branches which are about $\frac{1}{2}$ as long as the diameter of the siphon. Saddle incomplete, minutely spiculate on the upper distal border; lateral seta placed well in from the distal border, single, simple, and about $\frac{1}{2}$ the length of the saddle; lower caudal seta long and single, upper with 7–9 short branches. Some of the tufts of the ventral brush are missing, but there seem to be about 6 paired tufts in the barred area, with 6–9 branches in each, and 3 unpaired tufts outside the barred area. "Gills" damaged, but apparently about $1\frac{1}{2}$ times the length of the saddle.

Breeding-places and habits.—The only records of breeding-places are in a rock-pool (Ingram and De Meillon), in a stream (Leeson, 1931), and the observations of Nieschulz, Bedford and du Toit. The latter authors found the species breeding in large numbers in water-furrows and in small or medium-sized depressions in the veldt which were filled periodically by rain or irrigation-water. The breeding-places usually contained vegetation. Permanent water is never utilized, and (in common with species of the subgenera *Aëdimorphus* and *Banksinella*) this species only produces one generation if the water in a breeding-place becomes permanent. There are indications that the eggs do not all respond to the stimulus of flooding simultaneously, since large numbers of larvae hatch at every flooding, however short the intervening dry period. "This fact is of great biological importance to the species. If all the eggs were to hatch out after the first contact with water, practically all the larvae would be destroyed after some rains insufficient to permit of the larvae emerging."

The same authors found the larval period to be 5–6 days and the pupal 1–2 days, adults sometimes appearing within a week after heavy rain.*

Aëdes (Ochlerotatus) caspius Pallas. (Figs. 57, 58.)

No Ethiopian material being available, the description is taken from specimens collected in Macedonia, Palestine and Egypt.

The larvae of the three known Ethiopian species of *Ochlerotatus* share a number of unusual characters: The spiculate antenna is very short, and head-setae B and C are either single or double, and not or little more than half the length of the head; C is placed almost directly behind B; the pecten is composed of teeth which are all similarly coloured, and of which none are markedly wider spaced; in *caspius* and *fryeri* the shape of the comb-spines is also unusual. Though each of these characters can be paralleled in other subgenera, the combination of them seems to be peculiar to these three species. *A caspius* differs most obviously from *fryeri* in its larger number of comb-spines, differently-shaped pecten-spines, and much shorter gills and from *caballus* in the shape of the comb spines.

Length about 8 mm.; *colour* apparently pale, head and siphon yellow.

Head slightly broader than long. Antenna short and nearly straight, slightly less than $\frac{1}{2}$ length of head, fairly densely but minutely spiculate; tuft of about 8 almost simple branches at, or just before, $\frac{1}{2}$; subapical setae placed very close to

* Mara, in Jannone *et al.* (1946), states that this species occurs abundantly in coastal regions of Eritrea where the larvae are found in crab-holes or in water of high salinity (4·05 % chloride) among *Avicennia* mangrove roots. He emphasises the fact that they do not occur in true sea-water but in isolated bodies of water not communicating directly with the sea itself.—P. F. M.

apex, one short, the other moderately long; apical setae short and spine-like. Seta A with 8–10 sparsely plumose branches; B and C single or (abnormally) double, very sparsely plumose; C placed almost directly behind B; C about $\frac{1}{2}$ length of head; B slightly shorter; *d* placed a little in front of C and internal to it, very small, 3- or 4-branched. Mentum triangular, with about 10 teeth on each side of the centre; central tooth not markedly larger.

Abdomen.—Comb a semicircular patch of about 25 small spines, which have a long and coarse subapical fringe, the terminal denticle not very much longer than the lateral ones. Siphon with index about $2\frac{1}{2}$ (Kirkpatrick gives it as 2·3–2·6); pecten of about 23 rather close-set moderately dark spines, of which none are markedly wider spaced, extending to slightly beyond $\frac{1}{2}$; spines moderately long, most of them

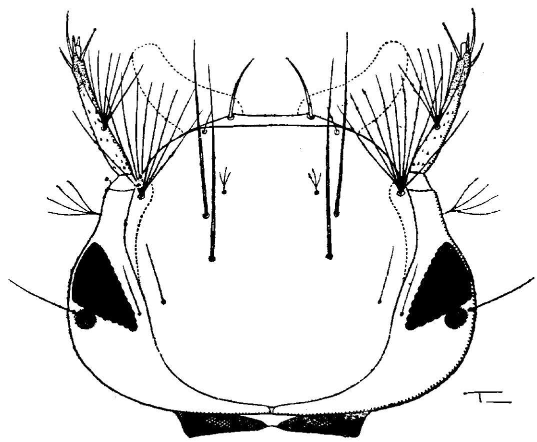


FIG. 57.—*Aëdes* (*Ochlerotatus*) *caspius* Pall. Head.

with 3 or 4 basal denticles, which are very small in comparison with the long and sharp terminal denticle; subventral tuft of 5–7 plumose branches, which are about $\frac{1}{2}$ as long as the diameter of the siphon, placed a little beyond end of pecten. Saddle of anal segment large, but incomplete, dorso-apical angle slightly spiculate; upper caudal seta with about 10 short branches, lower single; lateral seta about $\frac{2}{3}$ length of saddle, single and simple. Ventral brush unusually well developed, of 6–7 many-branched tufts in the barred area and about 4 proximal mid-ventral tufts; main tufts with about 12 or more branches. "Gills" $\frac{1}{3}$–$\frac{1}{2}$ length of saddle, rounded but considerably longer than broad, dorsal pair slightly longer than ventral.

Kirkpatrick describes a larval variety which differs chiefly in having a shorter siphon (index 1·95–2·0), the subventral tuft of the siphon with only 3–4 branches, and the gills much smaller and almost circular.

Breeding-places.—No Ethiopian records are available. Kirkpatrick states that in Egypt *caspius* usually breeds in fresh, or nearly fresh, water, but can tolerate a high degree of salinity; his maximum figure for this factor is 7·02%. He states that the species is commonest in borrow-pits and other pools, usually those in which reeds grow, and often at the reedy sides of large areas of water. It occurs very often in ditches, frequently in residual pools in irrigation channels, and occasionally at

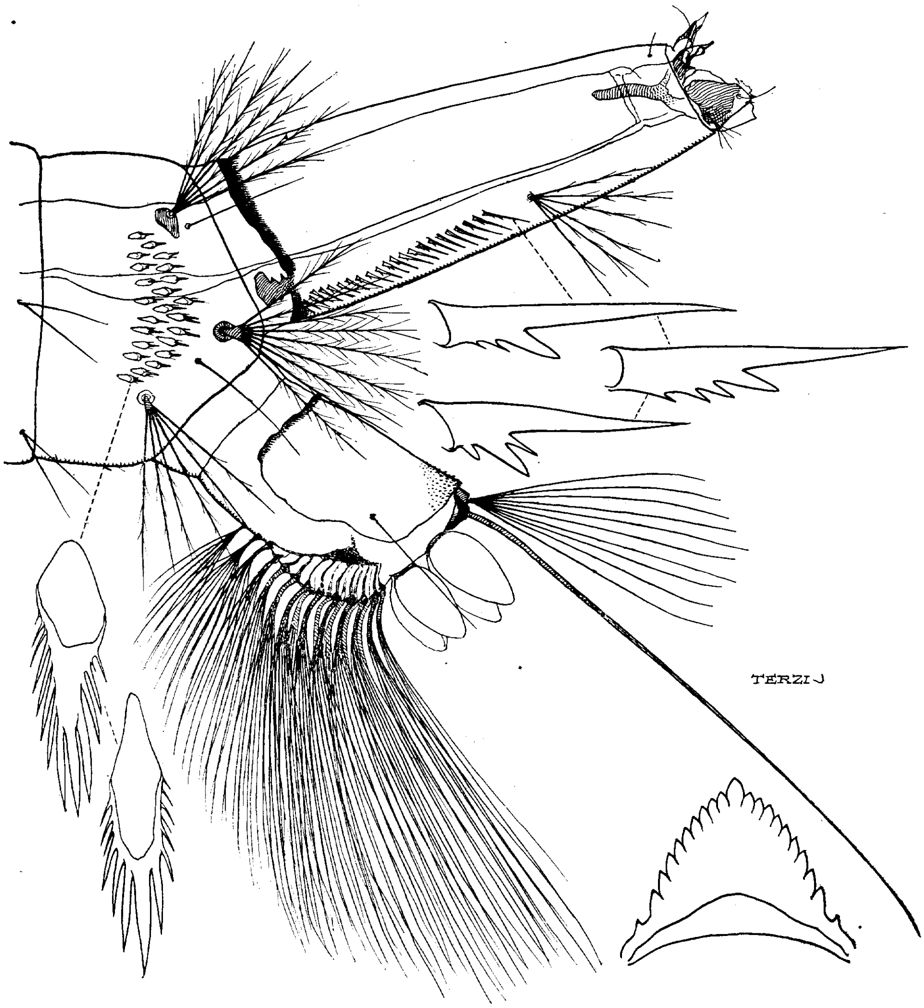


FIG. 58.—*Aëdes* (*Ochlerotatus*) *caspius* Pall. Terminal segments and mentum.

the reedy sides of fast-flowing canals. The atypical larvae occurred abundantly in small brackish pools in the oases.

Aëdes (Finlaya) longipalpis Grünberg. (Fig. 59.)

From all other known *Aëdes* larvae which have head-setae B and C single, except *fulgens*, the present species is at once distinguished by the very numerous comb-scales.

Length 5–6 mm.; *colour* apparently brown, head and siphon very dark brown.

Head much broader than long (as 1·4 : 1). Antenna sparsely spiculate, dark brown, slightly more than $\frac{1}{3}$ length of head; tuft a small single or 2-branched seta at about $\frac{2}{3}$. Seta A sometimes single and about as long as B, sometimes with 2–5 branches and shorter than antenna; B and C single and simple or very sparsely plumose, roughly twice length of antenna; C placed almost directly behind B, sometimes slightly exceeding it in length and sometimes slightly shorter and slenderer; *d* minute, with about 4 branches, placed midway between B and C and a little on the inner side of a line joining them. Mentum with central tooth very much larger

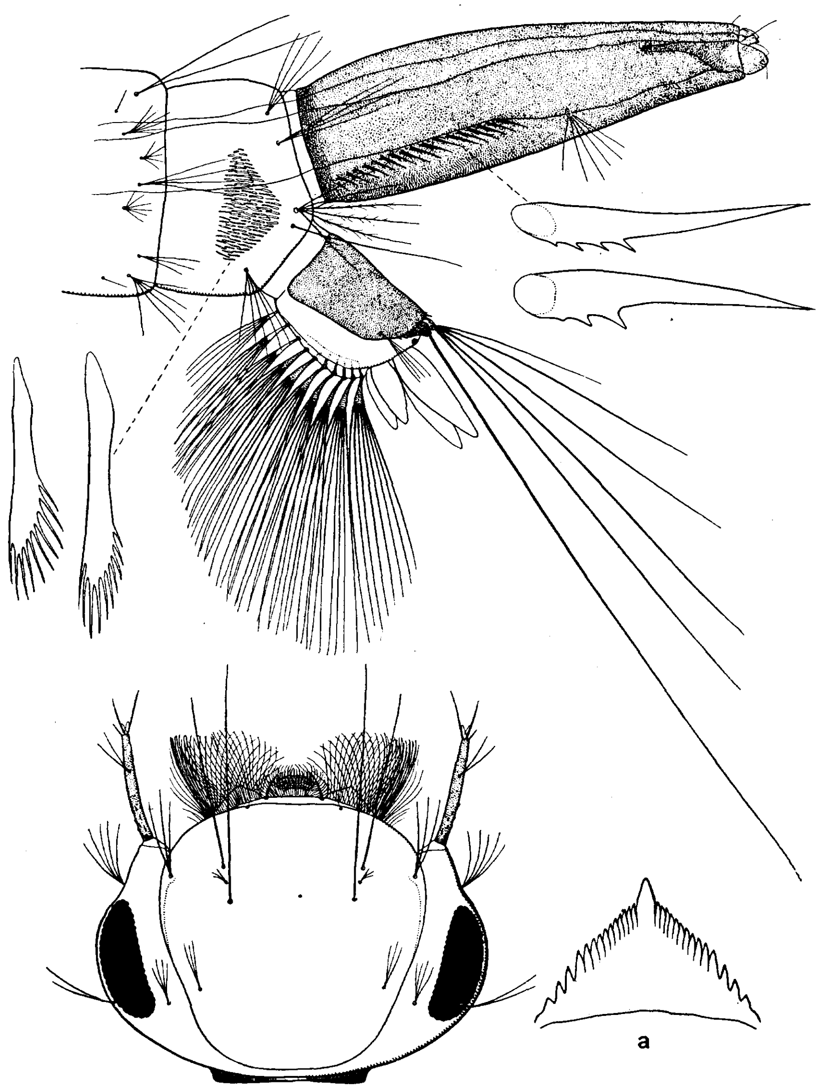


FIG. 59.—*Aëdes (Finlaya) longipalpis* Grünb. Head and terminal segments. *a*, mentum.

than remainder; about 16 small teeth, which increase towards the base in size and in width of spacing, on each side of the centre.

Abdomen.—Comb a roughly triangular patch of about 70 small narrow scales. Siphon with somewhat convex sides and tapering markedly towards apex; index apparently very variable, from 2 to nearly 4; pecten a very regular row of 15–22 very dark-coloured (pale-tipped under high magnifications) and large spines, none of which are markedly wider spaced, individual spines with 1–4 small basal denticles; subventral tuft placed just beyond end of pecten and apparently very variable in number of branches—Macfie and Ingram describe this tuft as having about 8 branches, whereas the few specimens which I have seen from Nigeria have 1–3 branches. Anal segment with a very incomplete saddle, the upper distal margin of which bears a small number of exceptionally large spicules; upper caudal seta 4–5-branched, lower single and nearly five times length of saddle; lateral seta with 1–4 branches which are much shorter than the saddle. Ventral brush composed of 5 pairs of tufts in the barred area and 2 unpaired tufts proximal to it, the larger tufts with about 8 branches and the smallest with about 5. "Gills" bluntly lanceolate; dorsal pair as long as saddle, ventral pair considerably shorter.

Breeding-places and habits.—Numerous authors have recorded this species from tree-holes; Kumm (1931) found larvae in bamboo stumps also. Wesché mentions that larvae found in August did not pupate until October; these larvae were probably partially starved, but the record is of interest as an instance of resistance to adverse conditions.

Aëdes (Finlaya) fulgens Edwards.

The larva is excessively like that of *longipalpis*, from which it is perhaps not separable; fortunately the two forms seem never to occur together. According to Aders (1917*a*) this larva has a peculiar faint rose colour.

Variation in the larva of *fulgens* seems to cover the entire range exhibited by that of *longipalpis*, the only apparently constant difference being the position of head-seta *d*. This seta is rather variable in position, but is always well within the line joining the bases of B and C on the same side, usually almost level with the line joining the bases of seta B on the two sides but occasionally much further back. Other supposed differences (Hopkins, 1942) are proved, by examination of a series of pelts belonging to Dr. B. De Meillon and collected in Transvaal and Northern Rhodesia, to be inconstant.

Breeding-places and habits.—Aders (*l.c.*), McHardy (1928), Harris (1942) and Garnham, Harper and Highton (1945) all record the larvae from tree-holes, and the larvae received from Mrs. van Someren (Hopkins, 1942) and from Dr. De Meillon were all from this type of breeding-place. Shircore (MS.) records larvae from well-shaded rock-pools with decaying leaves, Garnham, Harper and Highton (1946) record very rare breeding in such pools, and Teesdale (1941) mentions larvae from pineapple-axils. Muspratt (1945) records larvae from tins as well as from tree-holes.

Aders states that the larvae "are easily recognized by their habit of hanging suspended for considerable periods of time in the middle of their breeding water."

Aëdes (Finlaya) monetus Edwards.

Larva and breeding-places unknown. Likely to breed in tree-holes or bamboos.

Aëdes (Finlaya) wellmani Theobald.

Mr. Hopkins is of the opinion that the larva attributed to this species by Kumm (1931) was probably and that attributed to it by Ingram and Macfie (1922–23) certainly *ingrami*. Mr. G. G. Robinson kindly gave me the following details of the larva from a paper then in the press (Robinson 1948):

"The larvae were very similar to those of *ingrami*, the setae being as follows:

"A 5–10 branches averaging 8. B 4–9 branches averaging 6. C 2–8 branches averaging 5. *d* about 9–16 branches. Siphonal tuft 3–6 branches averaging 5 (20 larvae). Two or more pecten spines always showed 3rd and sometimes 4th denticles (not recorded for *ingrami* by Hopkins). Larvae were bred from tree-holes filled with water in the dry season at Balovale, N. Rhodesia."—P. F. M.

Aëdes (Finlaya) ingrami Edwards. (Figs. 60, 61.)

Comparison of the particulars given by Edwards (1930*a*) in describing this species with those given by Macfie and Ingram (1922–23) show that the larva described as that of *A.* (*F.*) *wellmani* by the latter authors was the specimen from which the type of *A. ingrami* was reared. This is the only known specimen of the larva.

The larva would most readily be mistaken for that of *A. furcifer*, but the head chaetotaxy of the two species is quite different.

Length apparently about 7 mm.; *colour* not recorded, siphon dark.

Head.—Antenna sparsely and very finely spiculate, strongly curved and tapering; tuft of about 6 long subplumose branches, which are about $\frac{1}{2}$ as long as the antenna, at about $\frac{3}{7}$. Seta A with about 10 plumose branches, which arise from a large base shaped like the handle of a fan; B and C arising from similar bases, but with 6 and 4 branches respectively; *d* a very exceptionally large tuft of 14–16 plumose branches. Mentum rounded, 10–11 teeth on each side of the larger central tooth.

Abdomen.—Comb a row of about 8 spines, which have a long central tooth finely fringed at the extreme base. Siphon with convex sides, index about 3; pecten a rather closely-set row of about 20 dark-coloured spines, each with one coarse denticle, extending to a little beyond $\frac{1}{3}$; distal spines not wider spaced nor simple; subventral tuft at about $\frac{1}{2}$, composed of 4–5 nearly simple branches, which are nearly as long as the diameter of the siphon. Saddle of anal segment very large, distal edge with a few small spicules; upper caudal seta with 3–4 branches, lower single; lateral seta 2-branched, $1\frac{1}{2}$ times as long as saddle. Ventral brush composed of 4 pairs of 2–3-branched tufts in the barred area and 3 median tufts proximal to it. "Gills" sausage-shaped, subequal, about $2\frac{1}{2}$ times length of saddle.

Breeding-places.—The type was reared from a larva found in the hollow of a cut bamboo, another specimen from a tree-hole (Edwards, 1930*a*). Mr. J. D. Gillett has bred specimens from tree-holes in forest at Entebbe, Uganda.

Aëdes (Finlaya) embuensis Edwards.

Mrs. van Someren has contributed the following account of the larva:—

Indistinguishable from that of *ingrami*. Varies as follows:

Colour pale creamy white with a dark head and a nearly black siphon.

Head.—Antennal tuft with 2–6 branches. Seta A with 6–11, B with 2–8, C with 2–10, and *d* with 10–18 branches respectively.

Abdomen.—Comb of 7–10 spines. Pecten composed of 12–20 dark, close set spines which have one coarse basal denticle and usually, but not always, one or two

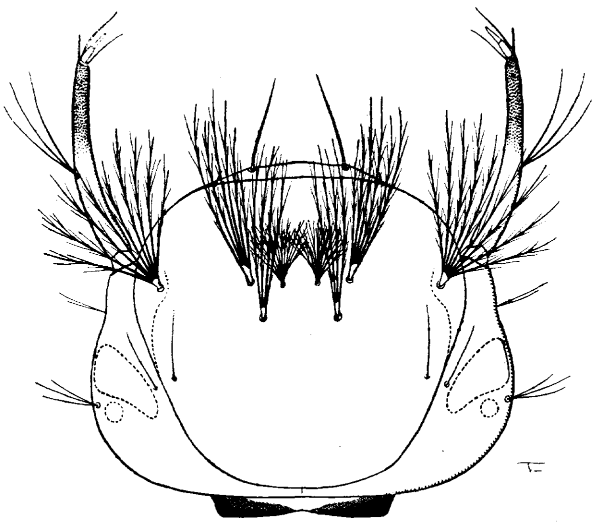


FIG. 60.—*Aëdes (Finlaya) ingrami* Edw. Head. The antenna should be finely and sparsely spiculate.

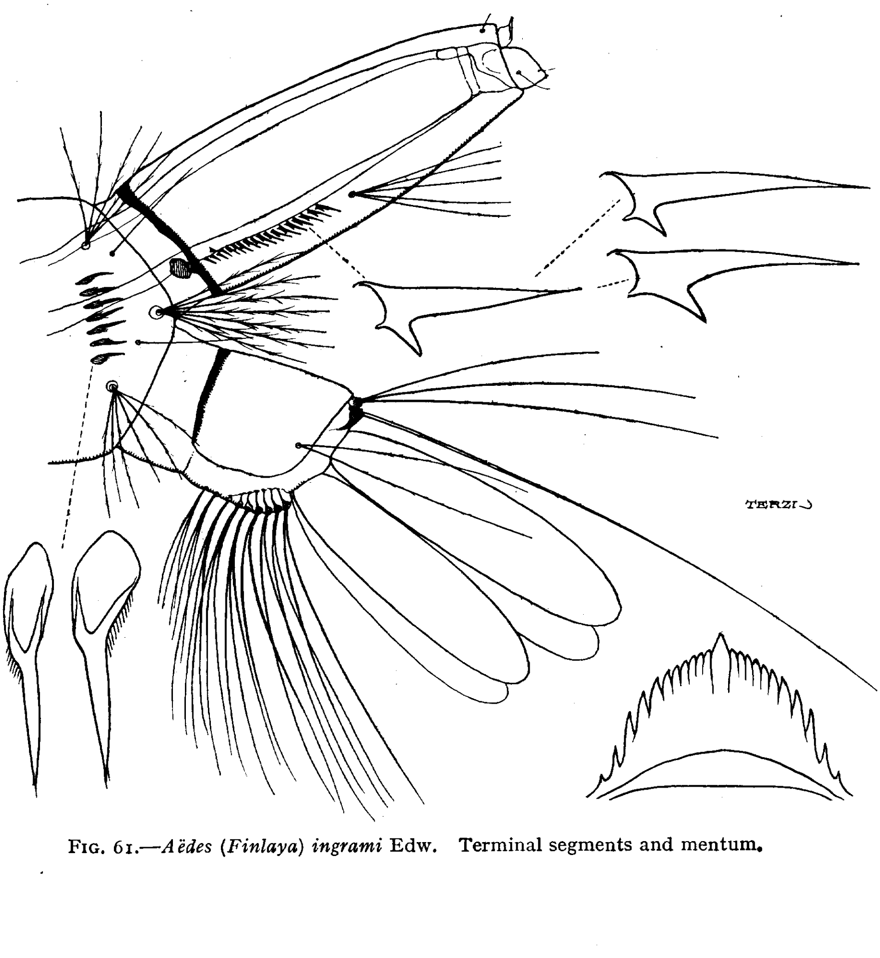


FIG. 61.—*Aëdes (Finlaya) ingrami* Edw. Terminal segments and mentum.

finer ones ventrally; occasionally one or more of the pecten spines has a small dorsal denticle as well. Subventral tuft with 3–5 branches. Upper caudal seta with 3–5 branches; lateral seta two or more times the length of the saddle. "Gills" of variable length, about $1\frac{1}{2}$–$3\frac{1}{2}$ times the length of the saddle.

Breeding-places.—Tree-holes.

Aëdes (Finlaya) nyasae Edwards.

Larva unknown. The type-series was bred from eggs which were abundant in dry material from tree-holes (Edwards, 1930*a*; Lamborn, 1930).

Aëdes (Finlaya) phillipi E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Aëdes (Finlaya) barnardi Edwards.

Larva and breeding-places unknown. The species is likely to occur in tree-holes.

Aëdes (Finlaya) madagascarensis E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Aëdes (Finlaya) pulchrithorax Edwards. (Figs. 62, 63.)

Edwards (1941, p. 430) describes the larva of this species as follows:

" The larva is very readily distinguished from others of the genus *Aëdes* by the following combination of characters: Antenna slender and very scantily spiculate;

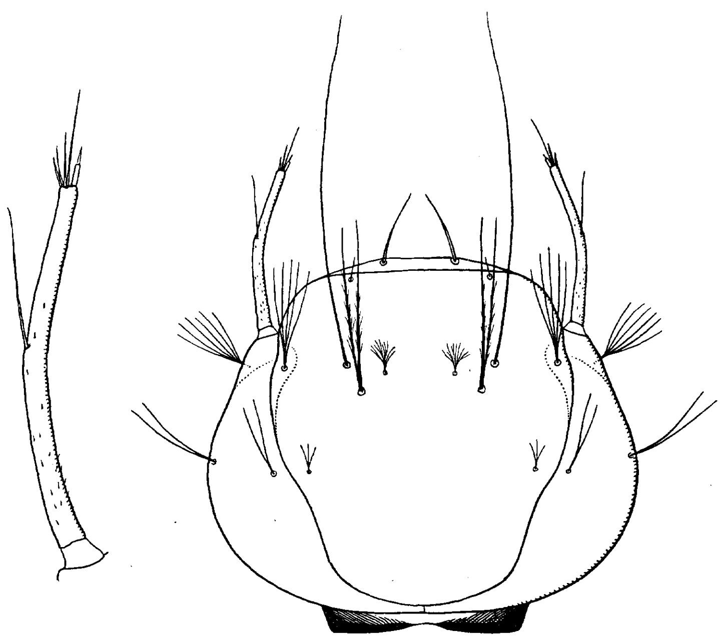


FIG. 62.—*Aëdes (Finlaya) pulchrithorax* Edw. Head.

head-seta B very long and single, C double ; pecten without detached teeth and comb with about 25 spines in a patch.

" *Length* 5–6 mm. Head and siphon dark brown.

" *Head.*—Broader than long. Antenna long and unusually slender, uniformly dark ; spicules very few, chiefly towards base ; tuft usually represented by a single seta, sometimes double, position varying from just beyond middle to about $\frac{2}{3}$. Seta A shorter than antenna, with 4–6 branches ; B very long (longer than whole head

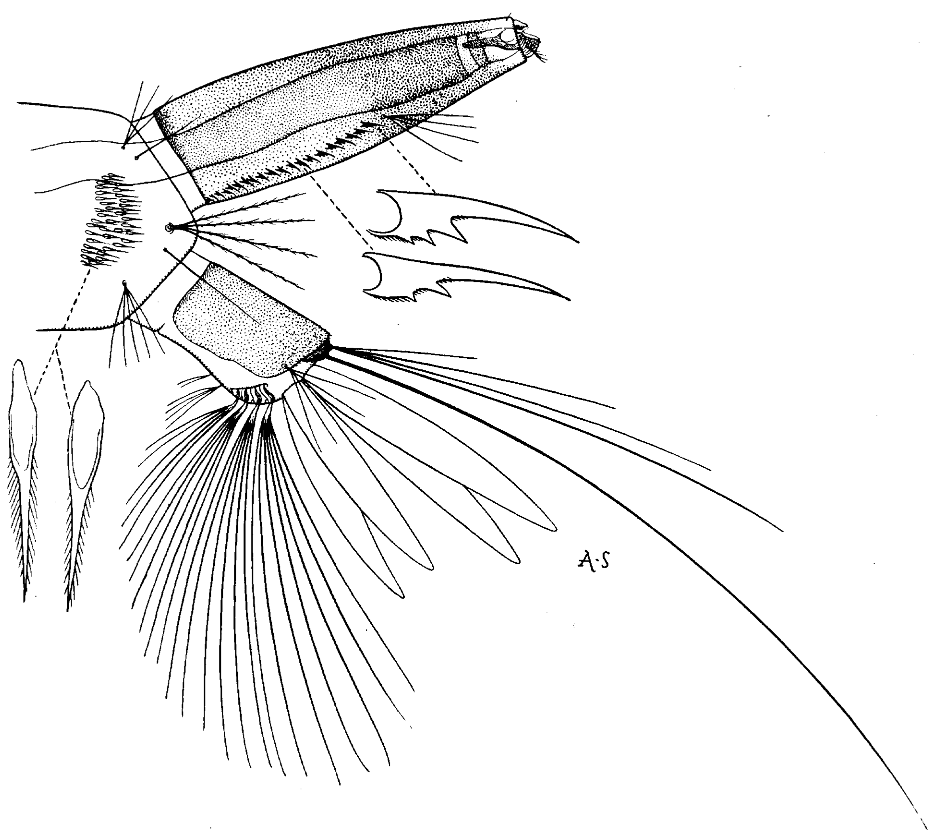


FIG. 63.—*Aëdes (Finlaya) pulchrithorax* Edw. Head and terminal segments.

and about twice as long as antenna), single and slender ; C usually double and rather shorter than antenna, sometimes single and then longer, placed a little inside and not far behind B ; *d* very small, with several branches, well inside and behind B, the three bases forming a slightly scalene triangle (the plumosity of setae A, B and C noted in the original description is not visible in the balsam mounts). Mentum with about 13 teeth on each side, the outer 3–4 very much more widely spaced.

"*Abdomen.*—Comb a small patch of about 25 long, sharp-pointed teeth. Siphonal index about 2·5–3. Pecten composed of 20–25 close-set and regularly-spaced spines, reaching somewhat beyond middle of siphon ; spines of moderate length, tips not pale ; usually two strong basal denticles on each spine with sometimes a third smaller denticle.* Subventral tuft just beyond end of pecten, of 4–5 branches. Saddle large, but widely interrupted ventrally as usual, with only a few minute denticles on its posterior margin ; lateral seta of 4–6 branches, much shorter than saddle. Caudal setae as in related species. Gills moderately stout but rather sharply pointed ; upper pair almost twice as long as saddle, lower pair $\frac{2}{3}$ as long as upper."

Breeding-places.—Tree-holes (MacDonald, 1939).

Aëdes (Finlaya) luteostriatus Robinson.

The following description is taken from Robinson (1950).

"The larva is like that of *pulchrithorax*, from which it differs in the shorter seta B, the longer siphon, and the tuft which has more numerous branches.

"*Length* :—about 6 mm. *Head* :—antenna tapering, somewhat under half length of the head, sparsely spiculate with a 1–3-branched tuft at about two-thirds. Setae A with 4–6 branches, B single, C single or double, *d* small and 6-branched, placed medial to C. A plumose, B and C sparsely so. Mentum with 16 teeth on either side of the larger central tooth.

"*Abdomen* :—comb with somewhat under 30 spines fringed to the base of the apical tooth and with broad bases. Siphonal index 4. Pecten reaching nearly to mid-point of siphon, composed of about 20 spines, each with 3 secondary denticles, of which the first is larger than the rest. Tuft of 7–8 simple branches about half the diameter of the siphon in length, and placed just distal to the pecten. Anal segment with incomplete saddle which is spiculate, those spicules on the posterior margin being much enlarged. Lateral seta with 4–6 branches much shorter than saddle. Upper caudal seta with 4 branches, lower single and over five times as long as the sadlde. Ventral tuft with five pairs of tufts on the barred area, two small unpaired tufts. Gills lanceolate, dorsal pair somewhat longer than saddle."

Breeding-places.—Tree-holes.—P. F. M.

Aëdes (Stegomyia) aegypti Linnaeus. (Figs. 64, 65, 66, 67, 68.)

The larva of this species is distinguishable from any other in our area by the possession of very large metapleural spines, coupled with the shape of its comb-spines and pecten-spines.

Length about 8 mm. ; *colour* varying from dark grey to nearly white ; specimens from tree-holes are usually dark, those from water with less organic content (tanks, etc.) usually paler, head rather light brown, siphon dark brown.

Head about as broad as long. Antenna about $\frac{1}{3}$ length of head, cylindrical ; tuft a single minute seta at about $\frac{2}{3}$. Setae A, B and C single, simple, B placed almost directly in front of C ; *d* small, usually 3-branched ; *e* and *f* rather long, single. Mentum triangular, with about a dozen teeth on each side of the centre.

Thorax.—The pleural tufts of meso- and metathorax have at their bases strong curved and sharply-pointed spines which have very much the shape of a rose-thorn.

Abdomen.—Comb a single curved row of 7–12 spines which have a large main

* A curious feature of these pecten spines, not mentioned in the original description, is that, in addition to the more conspicuous secondary denticles, most of them have a basal fringe of minute spines (Fig. 62). —P. F. M.

terminal denticle and a number of basal denticles, of which one on each side of the terminal denticle is usually considerably larger than the rest, thus giving the whole spine a distinctly trifid appearance when examined under a low power. Siphon somewhat barrel-shaped, index rather more than 2; subventral tuft of 2–5 simple

FIG. 64.—*Aëdes* (*Stegomyia*) *aegypti* L. Head of larva in each of the four stages (I–IV).

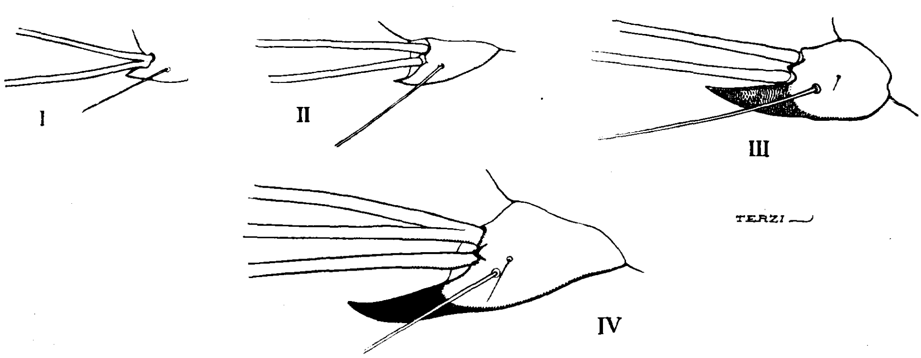


FIG. 65.—*Aëdes* (*Stegomyia*) *aegypti* L. Metapleural spine of larva in each of the four stages (I–IV).

branches at just beyond $\frac{1}{2}$; pecten extending to tuft and composed of 14–20 spines, each with 2–4 basal denticles. Anal segment with saddle well developed; upper caudal seta with from 3–5 branches, lower single or more usually double; lateral seta double. Ventral brush of about 4 pairs of tufts each with 2 or 3 simple branches. "Gills" sausage-shaped, subequal, rather more than twice length of saddle.

Breeding-places and habits.—It is probable that the original breeding-places of this species were in tree-holes, and it is found very commonly in such places (including water lodged in the hollows of buttress-roots of trees) in Africa. It is still more common in artificial breeding-places of many kinds, including barrels, discarded tins, bottles, machinery (especially discarded motor-car parts and tyres), cement gully-traps, cement water-tanks (even when covered over and dark), sagging gutters (particularly when shaded by a tree and therefore moderately cool), and canoes, boats and iron lighters. Dalziel records it commonly from crab-holes. It also occurs in the pans of water-closets which are not in use, and Harris (1942) records it from soakage-pits. Dalziel records the species commonly from wells in Lagos, and Wiseman, Symes, McMahon and Teesdale (1939) found it occasionally in wells in Mombasa ; the wells in Lagos were presumably of masonry, as those in Mombasa

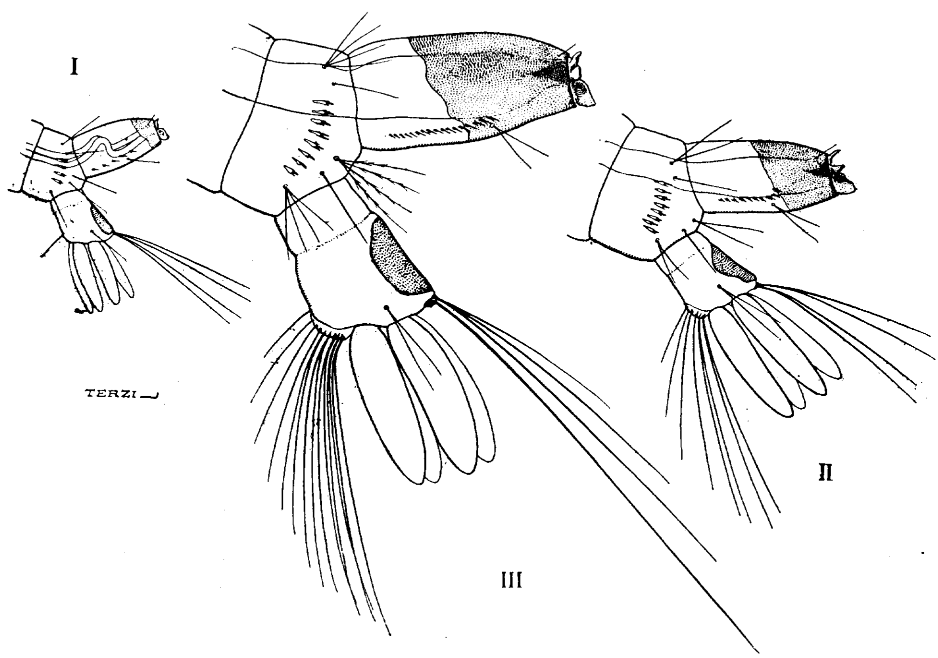


FIG. 66.—*Aëdes* (*Stegomyia*) *aegypti* L. Terminal segments of larva in stages I–III.

certainly were. The same authors record it from banana and pineapple plants. Garnham, Harper and Highton (1946) found the species on numerous occasions in "rock pools in rivers which are drying up in drought periods" ; these pools were "a long way inside the forest." It is not uncommon in small rock-holes (often in company with *A. vittatus*), and very occasional in plant-axils ; a most unusual record is that (Ingram and de Meillon) of breeding in a snail-shell.

Dr. Haddow has kindly given me figures for the occurrence of *aegypti* in plant axils : in searches of nearly 35,000 axils he encountered *aegypti* only 10 times, the number of larvae obtained in all being 29 out of 26,002 larvae of all species from plant axils. (See Haddow, 1948.—P. F. M.).

Carter (1924) has laid down a formula as regards the breeding of this species as follows : " In the Americas we have not found this mosquito, *Aëdes* (*Stegomyia*)

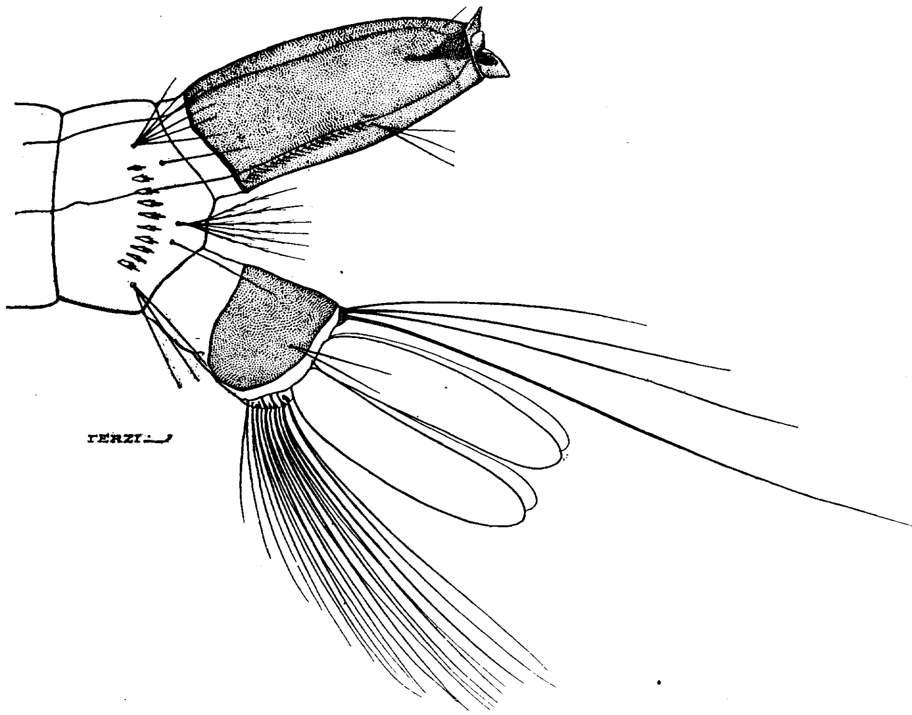


FIG. 67.—*Aëdes* (*Stegomyia*) *aegypti* L. Terminal segments of fourth-stage larva.

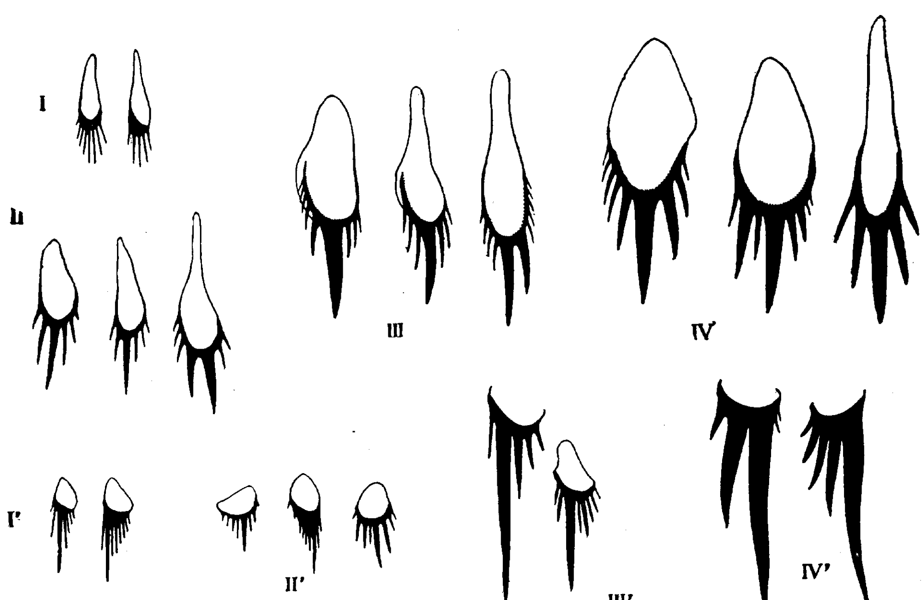


FIG. 68.—*Aëdes* (*Stegomyia*) *aegypti* L. Comb-spines (I–IV) and pecten-spines (I'–IV') in each of the four stages.

aegypti, breeding, in nature, completely, from oviposition to imago, in any collection of water all the sides of which at the water's edge were of mud." This dictum appears to hold absolutely true for Ethiopia with the possible exception of Dalziel's record (confirmed by Dunn, 1927–28, and Riqueau) from crab-holes.

The species shows a definite preference for clean water, though it will breed in tree-holes where the water has a fairly high organic content. According to Macfie (1914 and 1921) it is unable to survive in water containing 2% of salt, but according to authors quoted by Balfour (1921) it is able to breed in brackish water.

Shannon has shown that larvae of this species are able to survive in pools in the ground if they are protected from predators, but it is improbable that predators have much to do with the absence, in practice, of larvae of *aegypti* from such pools. Buxton and Hopkins have indicated some of the factors which govern females of this species when seeking a place for oviposition, and the conditions in most ground-pools violate several of the preferences of the insect.

MacGregor (1915) states that young larvae are readily eaten by larger ones of the same species.*

Aëdes (Stegomyia) subargenteus Edwards. (Fig. 73*a*.)

The comb-spines are unlike those of any other member of the subgenus. In all the four or five other species which have somewhat similar comb-spines the base of the spine is much broader than in *subargenteus*. The shape of the pecten-spines is unique.

The only known larva of this species was bred from an egg laid by the type. It was compared by Edwards (1925) with that of *aegypti*, but does not very closely resemble that species. The specimen is not in very good condition, having shrunk in preservation, but enough is visible to show that the larva is unlike that of any other known species. The pale colour of all sclerotized parts, equally with the shrinking, are possibly due to the larva having been preserved soon after a moult.

Head.—Seta *d* 2-branched.

Thorax with very small straight spines at bases of meso- and metathoracic pleural tufts. Setae on anterior margin of prothorax all small and inconspicuous. Setae on median area of thorax apparently absent.

Abdomen.—Comb a row of sharp-pointed spines (10 on one side, 8 on the other), with moderately long slender denticles at the base; one spine on each side is bifid, but there is no approach to the trifid condition of the comb-spines in *aegypti* and *simpsoni*. Lateral seta of anal segment single, moderately long. Siphon distorted, index not measurable (Edwards gives it as about 2·2); pecten of 8–10 spines, which are very deeply incised; subventral tuft a long single seta, apparently quite as long as original breadth of siphon, situated just beyond the distal pecten-spine. "Gills" subequal, sausage-shaped.

Breeding-places.—This species has been bred from material found in tree-holes.

* Mara (1945) gives an interesting record of larvae of *A. aegypti* from barrels and basins (" vasche scoperte ") on Mt. Bizen, Eritrea, at a height of about 7,900 ft. above sea-level in association with *Culex fatigans*, *laticinctus*, *theileri* and *trifilatus* and *Theobaldia longiareolata*. These larvae were found during September and it is suggested that some degree of acclimatization may be indicated since the temperature at this time of year would be likely to be below that normally regarded as minimal for the propagation of this species.—P. F. M.

Aëdes (Stegomyia) woodi Edwards.

Larva and breeding-places unknown. Likely to breed in tree-holes.

Aëdes (Stegomyia) simpsoni Theobald. (Fig. 69.)

This larva rather closely resembles that of *aegypti*, from which it is readily distinguished by numerous characters, particularly the shorter siphon and the presence of both dorsal and ventral denticles on the pecten-spines. It also closely resembles *keniensis*, but is separated by its branched lower caudal seta and pale-coloured siphon.

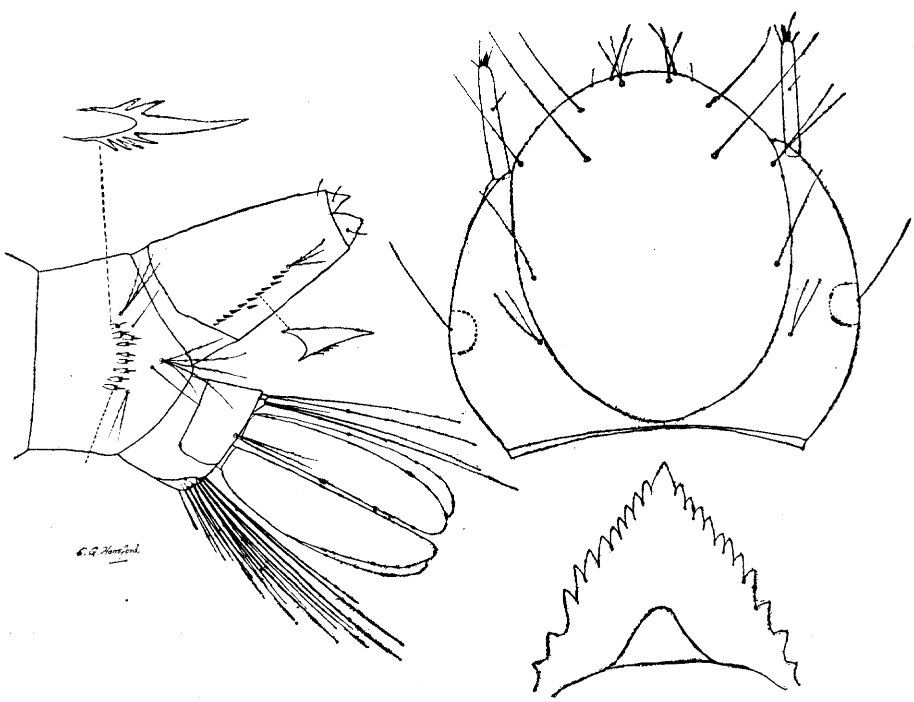


FIG. 69.—*Aëdes* (*Stegomyia*) *simpsoni* Theo. Head, terminal segments and mentum.

Length about $8\frac{1}{2}$ mm.; *colour* whitish, head and siphon light yellow-brown.

Head.—Much narrower than is usual in the subgenus, length and breadth about equal. Antenna less than $\frac{1}{3}$ length of head; tuft reduced to a single minute seta a little beyond $\frac{1}{2}$; terminal and subterminal setae all apical and very small. Clypeal spines long and slender. Setae A, B and C all simple, A single or bifid, B and C single; *d* large, set very far forward, 2- or 3-branched; *e* long and single, *f* double. Mentum triangular, much narrower proportionately than that of *aegypti*, with about 11 teeth on each side. Eye very small and mouth-brushes poorly developed.

Thorax.—The spines at the bases of the meso- and metathoracic pleural tufts are less well developed than in *aegypti*; they tend to be much less curved, and therefore lack the " rose-thorn " shape of those of the latter species.

Abdomen.—Comb a rather irregular single row of 6–10 (usually 7) spines, which are very similar to those of *aegypti*, but not so strongly sclerotized and slightly less barbed. Siphon with index $1\frac{1}{2}$, much shorter and more conical than that of *aegypti*; pecten of 5–12 rather short broad spines, which are fringed both dorsally and ventrally with small denticles, the pecten is somewhat irregular in arrangement, and there is commonly a detached spine beyond the tuft; subventral tuft of 2–3 subplumose branches at about $\frac{2}{3}$. Anal segment with a small saddle; upper and lower caudal setae each with 2 or 3 branches; lateral seta long and plumose, normally single, sometimes bifid. Ventral brush composed of 4 pairs of few-branched tufts; barred area very poorly developed. "Gills" subequal, sausage-shaped, about four times length of saddle.

Larvae from Uganda do not differ from those from West Africa.

Breeding-places.—Abundant in plant-axils (*Dracaena*, *Colocasia*, certain types of banana or plantain, *Bilbergia*, *Sansevieria* and pineapple tops). Gibbins (1942) dealt in detail with the breeding of this species in plant-axils, and showed that the essential requirements are an axil suitably shaped to retain water for a sufficient period and the absence of turbidity due to latex in the water; J. D. Gillett (unpublished work) and Gibbins (*l.c.*) have both shown that the variety of banana is of extreme importance in this connection, the *gonja* variety providing an enormously greater proportion of breeding-places than other common varieties in Uganda. Many authors have found it commonly in tree-holes, but in Uganda it is very scarce in tree-holes; probably it does not breed freely in these latter unless plant-axils are not available in sufficient quantity. Very occasional in artificial containers, including discarded tins, bottles or coconut shells. Pomeroy (MS.) has a number of records from tubs, and Harris (1942) records one collection of this species from an iron tank.*

Aëdes (Stegomyia) strelitziae Muspratt.

The following description is taken from Muspratt (1950). Mr. Muspratt kindly allowed me to use his manuscript for this purpose while his paper was in the press.

"*Head*:—pale, antennae smooth and usually rather darker than head. Antennae differ from *simpsoni* in the much longer antennal hair which is about one-third of the length of the antenna (excluding the apical setae and papilla). The hair is situated at about half, whereas that of *simpsoni* is more distal . . . Setae A, B and C: simple and single; *d*: 2–3-branched and somewhat shorter than that of *simpsoni*; *e*: single; *f*: single or 2-branched. Mentum: with 11–13 teeth on each side, those at the base of the triangle being finer and closer together than in *simpsoni*.

"*Thorax*:—spines short and straight with large bases which are usually darker than *simpsoni*.

"*Abdomen*:—comb an irregular row of 7–12 (usually 8) spines which are longer than those of *simpsoni* and with smaller basal denticles. Siphon: paler than *simpsoni* and with rows of minute spicules; *simpsoni* has a few scattered and very

* Haddow (1948), in a detailed study of the breeding of this species in plant axils in Uganda, lists colocasias (*Xanthosoma sagittifolium*), the "Gonja" variety of cultivated banana and pineapples (*Ananas comosus*) as the most important foci. Medium-sized axils with a capacity of 4–8 c.c. appeared to be favoured. The wild banana, screw pine (*Pandanus*) and *Colocasia esculentum* yielded no *simpsoni* larvae but it is suggested that this may have been merely a reflection of the fact that they grew in environments unsuited to the species. The same author confirms the observation made by Dunn (1926), based on tree-hole material, that this species has a drought-resistant egg.—P. F. M.

minute spicules but not in rows; the index of ten unmounted larvae varies between 2·1 and 2·6, averaging 2·3; it is almost cylindrical on the proximal two-thirds. The siphon of *simpsoni* is rather shorter, but in larvae from this locality (Margate, Natal.—P. F. M.) it is less conical than figured by Hopkins (1936, p. 114) especially when viewed in a truly lateral position and particularly on the ventral side; the index is about 2. Subventral tuft of *strelitziae:* 3–4 simple branches, placed at about two-thirds and about two-thirds width of siphon in length. Pecten: varying from 9–17 spines most of which have very fine denticles on each side; these denticles are placed nearer the base of the spine than *simpsoni*, but they may be absent from the proximal two or three spines. The most distal spine is separated from the others and usually placed beyond the tuft. The pair of dorsal setae near the apex of the siphon are longer and stouter than those of *simpsoni*. Anal segment: saddle not quite complete; upper and lower caudal setae: 4-branched; lateral seta: 2–4-branched (*simpsoni* usually single) and very minutely plumose under high power magnification. Ventral brush: four pairs of 3–4-branched tufts. Anal papillae: upper pair about length of saddle, lower slightly shorter; on the living larvae they are more pointed than *simpsoni*."

Breeding-places.—Plant axils, especially those of *Strelitzia nicolai* Regel and Koch, rarely in *Dracaena* (Muspratt in litt.).—P. F. M.

Aëdes (Stegomyia) metallicus Edwards. (Fig. 70.)

The spines at the bases of the pleural setae of the thorax are much more developed than in any other known species; the presence of denticles on both sides of the pecten-spines is also an unusual feature, but not peculiar to the present species.

Length about 8 mm.; *colour* dark (Macfie and Ingram, 1916*a*).

Head.—Chaetotaxy indistinguishable from that of *A. aegypti*, except that *d* is usually rather shorter and with more branches; head-seta A may be double. Mentum with about 10 teeth on each side of the centre.

Thorax.—Spines at bases of meso- and metathoracic pleural groups very large, rose-thorn shaped. Stellate setae large.

Abdomen.—Comb a row of 3–10 (usually 6) stout spines, which appear almost simple under a low magnification, but have their bases heavily fringed with delicate secondary denticles. Siphon with sides only slightly convex, index slightly more than 2; pecten of 11–14 broad spines with rather coarse small denticles irregularly placed on both the dorsal and ventral sides; an extra spine sometimes occurs beyond the tuft; subventral tuft at a little beyond ½, composed of 2–4 long, sparsely plumose setae which are somewhat longer than the diameter of the siphon. Saddle of anal segment small, distal margin smooth; upper caudal seta 3–4-branched, lower single; lateral seta with 4–5 sparsely plumose branches, which are nearly twice as long as the saddle. Ventral brush composed of 4–5 pairs of bifid setae. "Gills" sausage-shaped, markedly unequal, dorsal pair a little more than twice length of saddle, ventral about ⅗ length of dorsal.

Breeding-places.—There are numerous records from tree-holes. Ingram (1919) found larvae in a watering-pot under a tree, and McHardy (1928) records obtaining them in coco-nut shells. Harris (1942) found larvae in two water-pots, an icemachine, an iron tank and a coco-nut shell, as well as in 23 of the 69 collections of larvae from tree-holes which he examined; Teesdale (1941) gives two records from banana-axils. Muspratt (1945) records the species breeding in tins.*

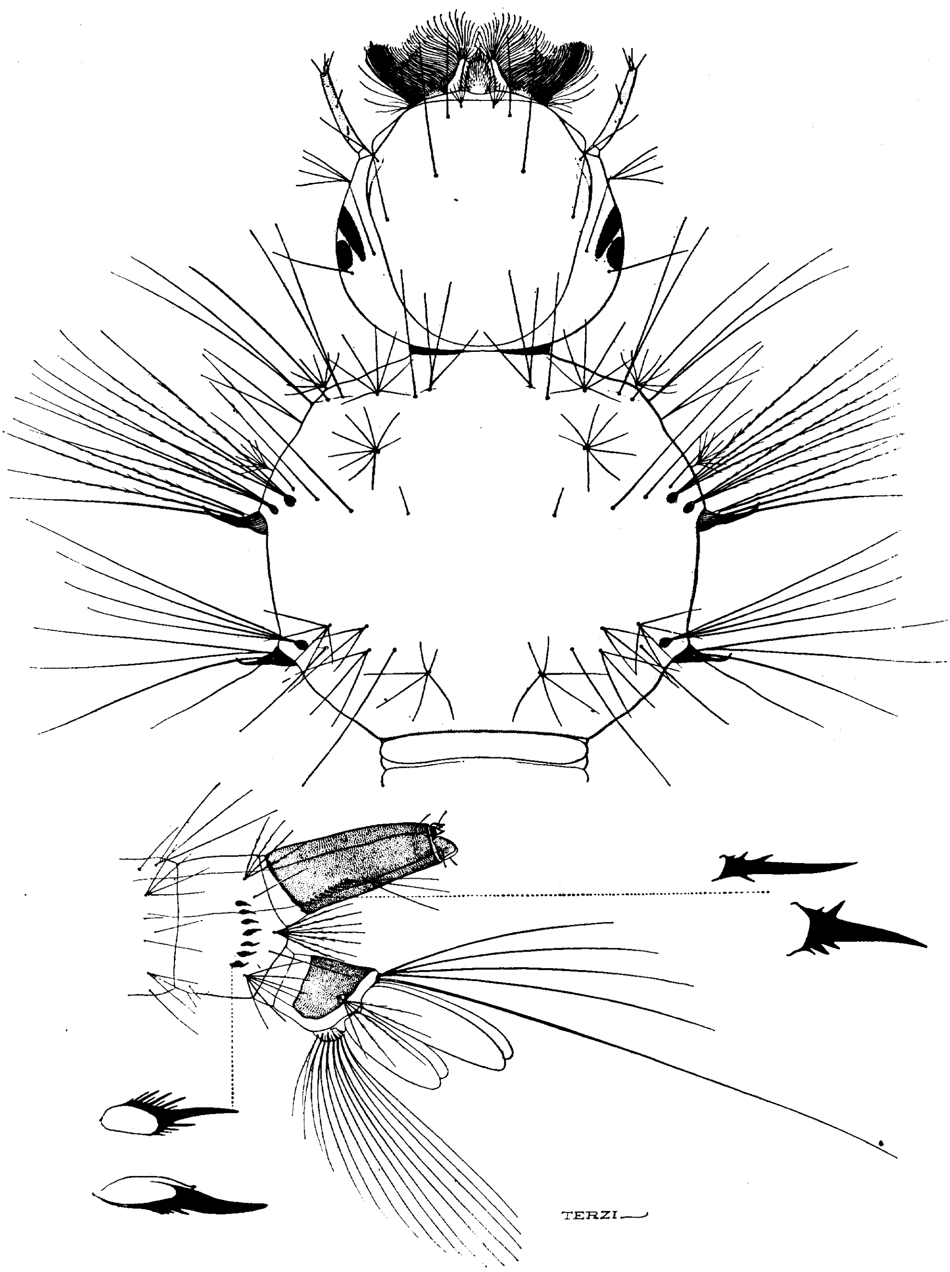


FIG. 70.—*Aëdes* (*Stegomyia*) *metallicus* Edw. Head and terminal segments.

* Abbott (1948) found larvae in tree-holes and a concrete basin.—P. F. M.

Aëdes (Stegomyia) chaussieri Edwards.

Larva and breeding-places unknown. Probably breeds in tree-holes.

Aëdes (Stegomyia) apicoargenteus Theobald. (Fig. 71.)

Larvae of this species are very liable to be mistaken for those of *fraseri* and vice versa. In general the comb spines of the latter appear to have coarser secondary denticles but I have been unable to check this character in West African specimens since none are at present available to me. I consider it unlikely that any diagnostic character will prove to be applicable over the whole of their joint range. *apicoar-*

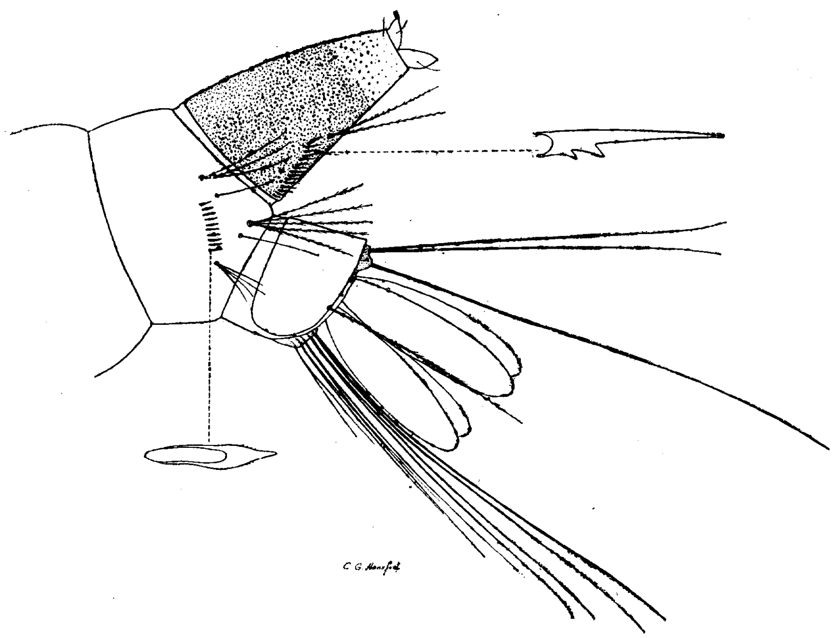


FIG. 71.—*Aëdes (Stegomyia) apicoargenteus* Theo. Terminal segments.

genteus is readily separable from *dendrophilus* and *bambusae* on the character of the pecten spines. All larvae available to me are separable from those of the *calceatus* group on the character given in the key. Larvae of *schwetzi* do not appear to be separable with certainty. The pale tip to the siphon provides a further distinction from *dendrophilus* and *bambusae* but is not shown clearly by var. *denderensis* (Wolfs—1949)., P. F. M.

Length about 8 mm. ; *colour* grey, head and siphon blackish.

Head.—Length and breadth approximately equal. Antenna cylindrical, about $\frac{1}{4}$ length of head ; tuft a single minute seta at about $\frac{6}{7}$; terminal and subterminal setae minute and apical. Clypeal spines long and slender. Head-setae arranged very much as in *aegypti*, A double, B and C single, *d* small but with about 10 branches, *e* and *f* single. Mentum triangular, with about 9 teeth on each side of the larger central tooth.

Thorax.—Straight thorn-like spines are present at the bases of the meso- and metathoracic pleural tufts. Stellate setae are not present on the thorax, though there are numerous single or double setae.

Abdomen.—Comb a row of 7–16 sharp-pointed spines, which are delicately serrated. Siphon conical, index slightly more than $1\frac{1}{2}$, apical fourth much paler than remainder ; pecten of 9–16 very closely-set spines, which are rather coarsely denticulate ventrally, extending to beyond $\frac{1}{2}$; subventral tuft just beyond pecten, composed of 2 long plumose branches, which are more than half length of siphon. Anal segment with a large and heavily sclerotized, but not complete, saddle ; upper caudal seta double, lower single ; lateral seta single, plumose, about thrice length of saddle. Ventral brush composed of 4 or 5 pairs of 2-branched tufts. " Gills " subequal, sausage-shaped, more than twice length of saddle.

Specimens from West Africa and from Uganda agree in all respects.

Breeding-places.—Abundant in tree-holes ; also found in a bamboo stump (Kumm). Harris (1942) records larvae from rock-pools by the lake shores, water-pots and discarded tins, as well as from tree-holes.

Aëdes (Stegomyia) fraseri Edwards. (Fig. 72.)

The larva is described (E. C. C. van Someren, 1946*a*) as follows : " This larva is very similar to *A*. (*S*.) *apicoargenteus* Theo., but may be distinguished by the presence of stellate setae on the thorax and the comb spines, which have a coarse basal fringe of denticles which reaches to near the apex of the spine.*

"*Colour* grey with a dark brown head and siphon, the apical $\frac{1}{4}$ of the siphon pale. Length about 8 mm.

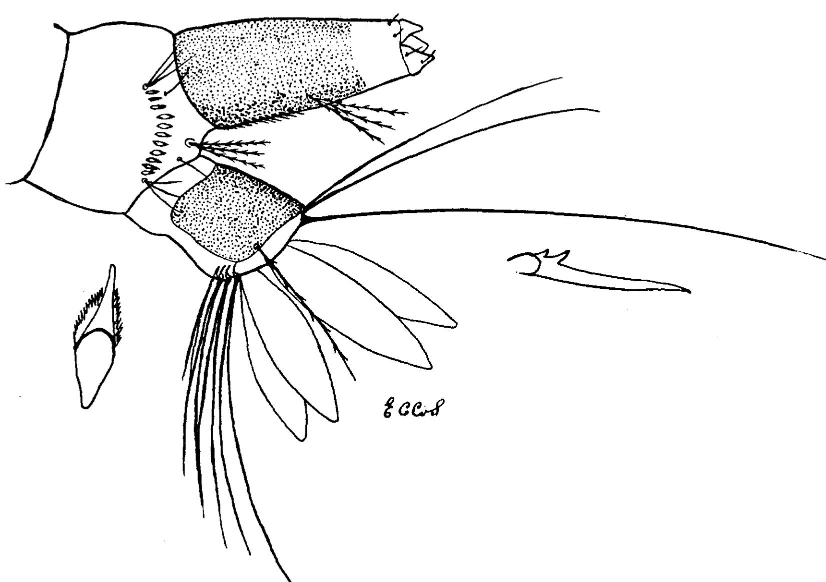


FIG. 72.—*Aëdes* (*Stegomyia*) *fraseri* Edw. Terminal segments.

* See, however, my note on *Aëdes apicoargenteus*.—P. F. M.

"*Head* about as long as broad. Antenna short, about one-third the length of the head, cylindrical, and smooth; tuft a minute seta at $\frac{3}{4}$. Setae A, B and C single, A sometimes bifid; *d* with 6–8 branches, small, and set well forward and inside C; *e* and *f* single. Mentum triangular with 8–10 teeth on either side of the central tooth, the basal 1–2 wider spaced and smaller.

"*Thorax* with medium sized curved spines at the base of the meso- and meta-thoracic pleural tufts. Stellate setae present but inconspicuous.

"*Abdomen.*—Comb a rather neat row of 10–14, usually 12, sharp-pointed spines, each with a wide basal fringe of fine denticles which reaches to near the apex. Siphon heavily chitinized on the basal $\frac{3}{4}$, apical $\frac{1}{4}$ light. Index $1\frac{3}{4}$–2. Pecten reaches to two-fifths and is an even row of 10–20 close set, fairly long, narrow, sharp pointed spines each with 2–3 small basal denticles. Subventral tuft placed at a $\frac{1}{2}$, with 2–4 branches which are finely plumose under the high powers of the microscope and about the length of the diameter of the siphon at point of attachment. Saddle chitinized but incomplete. Lower caudal seta single, upper with 2 branches. Lateral seta single, finely plumose under the high powers of the microscope and about twice the length of the saddle. Gills rather variable, lanceolate, but sometimes sausage-shaped, subequal, with the upper pair 2–3 times the length of the saddle, most often twice the length of the saddle. Ventral brush composed of 4 pairs of bifid setae."

Breeding-places.—Garnham, Harper and Highton found larvae commonly in tree-holes and holes in shaded granite boulders in dense forest, rarely in exposed rock-pools in the forest. The type series of *blacklocki* (a synonym of *fraseri*) was bred from tree-holes. (M. Holstein has sent me a single adult bred from a larva found in a rot-hole in mangrove at Dubreka, Ivory Coast.—P. F. M.)

Aëdes (Stegomyia) schwetzi Edwards.

I am indebted to Mr. G. G. Robinson for the following note on the larva of this species:

"There seems to be no striking difference in the larva from that of *apicoargenteus*. Trivial points of difference comparing with Hopkins' account of the latter species are: antennal tuft at $\frac{5}{8}$–$\frac{6}{8}$; pecten of 14–18 spines; comb spines broader and serrations larger than in *apicoargenteus*. The larvae of this species far outnumber any other species of *Aëdes* breeding in tree-holes at Ndola, N. Rhodesia."

The position of the antennal tuft, which Mr. Robinson has since given me more exactly as 0·62 to 0·77 × the length from the base, may prove in some cases to be a useful character for separating this species from *apicoargenteus* although the figure of $\frac{6}{7}$ given by Hopkins for the latter in the present work appears in general to be rather high and in some pelts it is as low as 0·72.

Breeding-places.—Tree-holes (Robinson *in litt.*), tin can, water-pot and hole in cement (Schwetz—1927)., P. F. M.

Aëdes (Stegomyia) dendrophilus Edwards. (Fig. 73*b*.)

The following description, based on Nigerian material, is due to Mr. Hopkins:

"*Length* about 7 mm.; *colour* whitish, head and siphon dark.

"*Head.*—About as long as broad. Clypeal spines long and slender. Antenna smooth and cylindrical, about $\frac{1}{3}$ length of head; tuft a small single seta at $\frac{2}{3}$. Seta

A usually 2-branched; B and C usually single (C sometimes bifid from beyond middle); *d* with 5–8 branches. Mentum with 10–11 teeth, the basal three of which are more widely spaced, on each side of the central tooth.

"*Thorax*.—Stellate setae usually present and sometimes large and conspicuous, but very often much reduced or even unrecognizable. Spines at bases of pleural groups of setae short and straight.

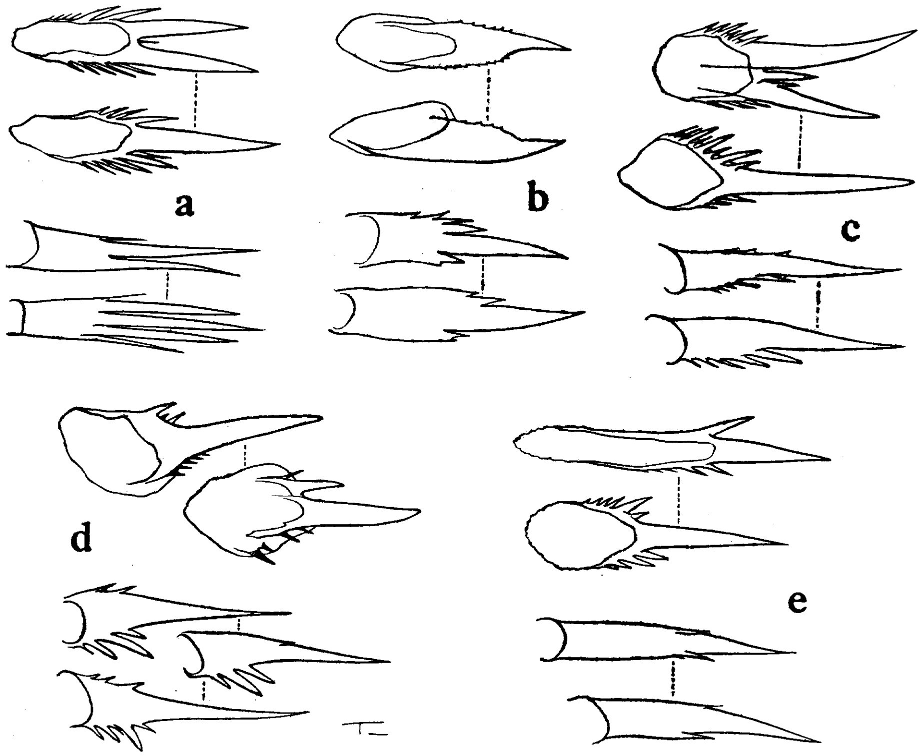


FIG. 73.—Comb-spines (upper figures of each species) and pecten-spines (lower figures) of different species of *Aëdes* (*Stegomyia*). *a, subargenteus* Edw. *b, dendrophilus* Edw. *c, angustus* Edw. *d, contiguus* Edw. *e*, ? *pseudonigeria* Theo.

"*Abdomen*.—Comb a row of 8–14 sharp-pointed spines which appear simple under low magnification and even under higher powers show only minute basal denticles. Siphon dark throughout, index about $2\frac{1}{2}$ ($1\frac{1}{2}$ in crushed pelts); pecten an uneven row of 9–15 spines extending to about $\frac{1}{2}$ or sometimes to near the apex, often with 1–3 of the most distal spines more widely spaced and placed beyond the tuft, the individual spines about the same colour as the siphon, rather long and pointed appearing simple under low powers of the microscope, but under higher powers with few or many minute ventral denticles and sometimes a few dorsal ones, the apical 2–3 denticles sometimes coarser than the rest; subventral tuft placed at $\frac{2}{3}$, usually 2-branched but rarely single, slightly shorter to slightly longer than diameter of siphon. Saddle of anal segment well developed and sclerotized but incomplete and with smooth distal margin ; upper caudal seta with 2–3 branches, lower single ; lateral seta usually with 2 sparsely plumose branches but occasionally single, about thrice length of saddle. Ventral brush composed of 4–5 pairs of bifid setae. " Gills " subequal, sausage-shaped, from twice to five times as long as the saddle (in pelts)."

Larvae from Bwamba County, Uganda and Kaimosi Forest, Kenya have been described by van Someren (1946*a*) under the name *deboeri* ssp. *demeilloni*. They differ from the Nigerian form only in minor details. These differences are as follows: Head seta *d* sometimes 4-branched. Comb with 6–12 spines. Subventral tuft of siphon usually single, occasionally double. Lateral seta of saddle sometimes trifid, Through the kindness of Dr. De Meillon and Mr. Muspratt of the South African Institute for Medical Research I have been able to examine liaison pelts of the South African form from Natal and Zululand. These appear to differ from Mr. Hopkins' description only in having the subventral tuft of the siphon at or only very slightly beyond half way. The only two Nigerian pelts available to me have the subventral tuft slightly before $\frac{1}{2}$ and Bwamba and Kaimosi specimens have it at or slightly before. It seems, therefore, that Mr. Hopkins' figure of $\frac{2}{3}$ may be an error.

Breeding-places.—Records from Gold Coast and Nigeria include tree-holes (commonly), a banana axil, a banana stump and cut bamboos. In Uganda the larvae have been found only in tree-holes and in Kenya they have been found commonly in tree-holes and occasionally in rock-holes (Garnham, Harper and Highton, 1946). South African records are from tree-holes only, an interesting distinction from *demeilloni*.—P. F. M.

Aëdes (Stegomyia) demeilloni Edwards.

The identity of the larvae from Magoebaskloof, Transvaal, attributed by Ingram and De Meillon (1929) to *pseudonigeria* and subsequently renamed by Edwards (1936) *deboeri demeilloni* remains obscure. I have investigated this question very carefully and have been unable to trace any associated adults from Magoebaskloof or to obtain definite evidence that either *demeilloni* or *pseudonigeria* occurs in the Transvaal. I have preferred therefore to describe Ingram and De Meillon's larvae under *pseudonigeria*. The description of *demeilloni* which follows is based on a series of pelts from Eshowe, Zululand, kindly supplied to me by Dr. De Meillon, one of which is associated with an adult of the species in question.

Length.—Apparently about 7 mm. Head apparently pale, siphon dark.

Head.—About as long as broad. Clypeal spines long and slender. Antenna short, smooth, cylindrical, tuft a small single seta at $\frac{3}{5}$ to $\frac{2}{3}$. Seta A bifid, B bifid, single in one case, C single, *d* mostly with 3, occasionally with 4 branches. Mentum with 10–12 teeth on either side of the main central tooth, the last 3 widely spaced.

Thorax with moderately developed stellate setae. Spines at bases of pleural setae short and straight.

Abdomen.—Comb a row of 8–12 spines with conspicuous basal denticles much as shown for the Magoebaskloof larvae (Fig. 72*e*). Siphonal index about $2\frac{1}{2}$ ($1\frac{1}{2}$ in crushed pelts). Pecten a row of 11–17 spines, similar to those of *dendrophilus*, of which 1–2 are widely spaced and inserted beyond the subventral tuft, the latter trifid and inserted at slightly beyond $\frac{1}{2}$, about equal to the breadth of the siphon at point of attachment or slightly shorter, its branches very lightly and delicately plumose.

Saddle well developed, incomplete ventrally, its distal edge devoid of spicules. Upper caudal seta with 3–4 branches, lower bifid or trifid. Lateral seta with 2–3 sparsely plumose branches about twice the length of the saddle. Ventral brush of 4 pairs of bifidor trifid setae. Gills subequal, sausage-shaped, between 2 and 3 × the length of the saddle.

Breeding-places.—Known only from the axils of " Fern Trees."—P. F. M.

Aëdes (Stegomyia) heischi E. C. C. van Someren.

Distinguishable from *keniensis* by the large spines at the bases of the pleural tufts.

The following description is taken from van Someren (1951).

" *Head.*—Antennae short and cylindrical and with a short single seta just beyond a half. Seta A with 2 branches, B single, C single or bifid beyond a half, *d* with 2–4 branches, *e* and *f* single. Mentum with 11 teeth on either side of the central tooth, the basal 3 wider spaced and larger, except for the lowest tooth, which is very small. Thorax with large, curved rose-thorn spines at the bases of the meso- and metapleural groups of hairs. Thorax and abdomen often covered with numerous stellate setae, but sometimes these setae very much reduced.

" *Abdomen.*—Comb a curved row of 8–12 spines, which have a large, strong, basal denticle on either side, giving it a trifid appearance, and with a few finer basal denticles. Siphon dark or pale brown, with an index of about 2 ; pecten of 6–13 spines, usually 1 and occasionally 2 placed beyond the subventral tuft ; these spines triangular, with fine denticles on either side ; subventral tuft of 2–4 branches, usually 2. Anal segment with well-developed saddle, but not complete ; lower caudal seta single, upper with 2–3 branches lateral seta with 3–4 branches, usually 3, and about one and a half times the length of the saddle ; brush with 4 paired setae of 2 or sometimes 3 branches. ' Gills ' round-tipped, subequal and upper pair one and a half to four times the length of the saddle."

Breeding-places.—Tree-holes.—P. F. M.

Aëdes (Stegomyia) trinidad Gil Collado.

Larva and breeding-places unknown. Likely to breed in tree-holes.*

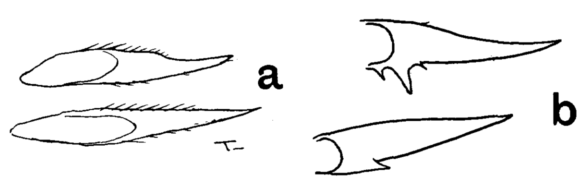


FIG. 74.—*Aëdes* (*Stegomyia*) *calceatus* Edw. Larval details. *a*, comb spines. *b*, pecten teeth.

Aëdes (Stegomyia) calceatus Edwards. (Fig. 74).

According to De Meillon and Lavoipierre, the only differences between this larva and that of *dendrophilus* are that head-seta *d* has 5–8 branches, the comb-spines

* Through the kindness of the Director of the Instituto Espanol de Entomologia I have been able to examine the types of this form. It appears to be at most subspecifically distinct from *dendrophilus*. —P. F. M.

usually have more prominent denticles, the subventral tuft of the siphon is 3-branched (with 1–2 branches in *dendrophilus*), and typical pecten-spines have two ventral and two small dorsal denticles.

Breeding-places.—Larvae common in tree-holes and also found in tins (Muspratt, 1945).

Aëdes (Stegomyia) soleatus Edwards.

The account of this larva is by Mrs. van Someren.

Very like *apicoargenteus* and *langata*, no reliable difference being noted.*

Head as in *apicoargenteus*. Setae A, B and C single ; *d* with 8–11 branches.

Thorax with small straight spines at the base of the meso- and metathoracic groups of pleural setae. There are small stellate setae on the one reasonably complete pelt.

Abdomen as in *langata*. The siphon seems to be shorter, index about $1\frac{1}{4}$ in crushed specimens and with a wider pale band at the apex, about the apical third being pale. Pecten of 14–18 close-set spines as in *langata*.

Breeding-places.—In "bamboo pots." Harris (1942) records the species from tree-holes and bamboo stumps.

Aedës (Stegomyia) contiguus Edwards. (Fig. 73*d*.)

The spines of the comb and pecten of this species are highly characteristic ; they show most resemblance to those of *metallicus*, but the latter species is readily distinguished from *contiguus* by the large size of its thoracic spines and the presence of stellate setae on the thorax ; *unilineatus* and *demeilloni* have rather similar comb-spines, but the pecten-spines are quite different and the former possesses stellate setae on the thorax. The large number of branches in head-seta *d* is very uncommon in the subgenus *Stegomyia*, and the only species which both possesses this character and has comb-spines similar to those of *contiguus* is *angustus* (see p. 156).

Length apparently about 8 mm. (the material consists of skins only) ; *colour* not recorded, head dark, siphon almost black.

Head.—Differs from that of *aegypti* mainly as follows : Seta A with 2–3 simple or very delicately plumose branches ; B and C shorter and more delicate than in *aegypti*, B sometimes 2-branched, C delicately plumose ; *d* with about 10 branches.

Thorax.—Stellate setae absent. Spines at bases of pleural groups short and straight.

Abdomen.—Comb a row of 8–10 spines, which have the central denticle very heavily sclerotized and bearing a number of small but rather conspicuous secondary denticles at its extreme base ; basal portion of spine unusually wide. Siphon with strongly convex sides ; index less than $1\frac{1}{2}$ in the skins, probably little more in uncrushed material ; pecten of 8–17 very strongly sclerotized spines, which are of uniform size and set moderately close together ; individual spines with conspicuous coarse denticles on the ventral side and others (often absent and usually smaller) dorsally, most distal spine occasionally (in one specimen out of 14 examined) separated from the remainder and placed beyond the tuft ; subventral tuft composed of 3–5

* Those larvae which I have examined appear to be separable from *apicoargenteus* on the character given in the key ; *calceatus* is separable by its all dark siphon.—P. F. M.

simple branches, which are about $\frac{2}{3}$ as long as the diameter of the siphon. Saddle of anal segment smooth distally ; upper caudal seta with 2–3 branches, lower single ; lateral seta slightly plumose, 2-branched from a little beyond base. Ventral brush of 4 pairs of bifid setae. " Gills " much shrunken in the material, apparently sausage-shaped.

Breeding-places.—Ingram and de Meillon bred the species (which they recorded as *poweri*) from tree-holes, a rot-hole in a paw-paw tree (*Carica papaya*), axils of *Pandanus* and a snail-shell.

Aëdes (Stegomyia) poweri Theobald.

Larva and breeding-places unknown, the records by Ingram and De Meillon under this name proving to refer to *contiguus*. Likely to breed in tree-holes or plant-axils.

Aëdes (Stegomyia) masseyi Edwards.

Larva and breeding-places unknown ; latter probably tree-holes.

Aëdes (Stegomyia) deboeri Edwards.

In Mr. Hopkins' MS. this species was treated as synonymous with *dendrophilus* but Mrs. van Someren who has had considerable experience of it in the field informs me that she considers it a distinct species. On the evidence of distribution and differences in adult colour markings I fully agree with her. Her description of the larva (van Someren 1946*a*) follows. Ssp. *demeilloni* which was attributed by Edwards to this species is also considered to be a distinct species and is treated as such in the present work.

"*Head.*—Length and breadth about the same. Clypeal spines long and slender. Antenna smooth, cylindrical, and about one-third the length of the head ; tuft a small single seta at two-thirds. Seta A usually with 2 branches, B and C usually single, but C sometimes bifid beyond a half, *d* with 5–8 branches. Mentum with 10–11 teeth on either side of the central tooth ; the basal 3 more widely spaced.

"*Thorax.*—Stellate setae present, sometimes large and conspicuous, but very often much reduced, and sometimes unrecognizable. Short straight spines at the base of the meso- and meta-thoracic plaural hairs.

"*Abdomen.*—Comb a row of 8–14 sharp-pointed spines which have minute basal denticles. Siphon dark to the tip with an index of $1\frac{1}{2}$ in larval pelts, but probably 2 in uncrushed specimens. Pecten an uneven row of 9–15 rather long, pointed spines, which are about the same colour as the siphon ; 1–3 of the more distal spines widely spaced and placed beyond the subventral tuft, the most distal spine may reach to near the apex of the siphon. The spines may be simple, or have few or many fine ventral, and sometimes a few dorsal denticles ; sometimes the apical 2–3 denticles may be coarser than the rest. The denticles on both comb and pecten are very inconspicuous under low powers of the microscope, appearing almost simple. Subventral tuft placed at two-thirds, bifid, but occasionally a single seta, not quite as long as the diameter of the siphon at point of attachment, and finely plumose. Saddle chitinised, well developed but incomplete. Upper caudal seta with 2 branches, lower single. Lateral seta with 2 sparsely plumose branches which are about 3 times the length of the saddle. Ventral brush with 4–5 pairs bifid setae. Gills sausage-shaped and in larval pelts they vary in length from2–5 times the length of the saddle."

Breeding-places.—Tree-holes (Harris, 1942, van Someren, 1946*a*).—P. F. M.

Aëdes (Stegomyia) pseudonigeria Theobald. (Fig. 73*e*).

The larva and breeding-places of this species are not known with certainty. Those attributed to it by Ingram and De Meillon (1929) were reidentified by Edwards (1936) as *demeilloni*. For reasons given in the account of that species I prefer to describe them under *pseudonigeria* while stressing the fact that this attribution is a doubtful one. Differences from *demeilloni* shown by Ingram and De Meillon's material are as follows: Antennal tuft at only just beyond half way, pecten with 8–14 teeth, subventral tuft of siphon bifid, upper caudal seta with 2–3 branches, lower single.

Breeding-place.—Axils of *Dracaena*.—P. F. M.

Aëdes (Stegomyia) langata E. C. C. van Someren. (Fig. 75.)

The description of this larva is by Mrs. van Someren.

Very similar to *apicoargenteus*. Varies as follows:

Head.—Antenna about $\frac{1}{3}$ length of head; tuft at $\frac{3}{5}$. Seta A usually single, occasionally bifid; *d* small and with 3–6 branches. Mentum with 9–10 teeth on each side of the central tooth.

Thorax.—Small straight spines present at base of meso- and metathoracic pleural groups of setae. With or without sellate setae.

Abdomen.—Comb a row of 8–10 sharp-pointed spines appearing simple under low powers of the microscope, but with fine and sometimes conspicuous basal denticles visible under high powers. Siphon dark with a narrow apical pale ring, the sides slightly convex and tapering slightly at the apex; index 2·3–2·7; pecten a close-set row of 13–17 dark spines extending to about $\frac{1}{2}$, spines with at least 1 (usually 2) coarse basal ventral denticle and sometimes also one or two finer ones; there may also be one coarse dorsal basal denticle; none of the pecten-spines wider spaced nor placed beyond the subventral tuft; subventral tuft placed just beyond $\frac{1}{2}$, composed of 2–3 simple branches which are shorter than the diameter of the siphon. Lateral seta of anal segment subplumose, single or double and about $1\frac{1}{2}$ times as long as the saddle. Ventral brush composed of 4 pairs of bifid setae. "Gills" of variable length, about 1 to 3 times as long as the saddle.

Breeding-places.—Tree-holes.

Aëdes (Stegomyia) keniensis E. C. C. van Someren. (Fig. 76.)

This larva closely resembles that of *simpsoni*, but is easily separated by the fact that the lower caudal seta is single, and by the dark colour of its siphon.* It is described (E. C. C. van Someren, 1946*a*) as follows:

"*Head.*—Antenna short, smooth, and cylindrical, with a single simple seta at a $\frac{1}{2}$. Seta A with 2–3 branches, B bifid at a $\frac{1}{2}$; C usually double, but in one specimen

* It has an even greater resemblance to *heischi*, from which, however, it can be recognised by its smaller pleural spines.—P. F. M.

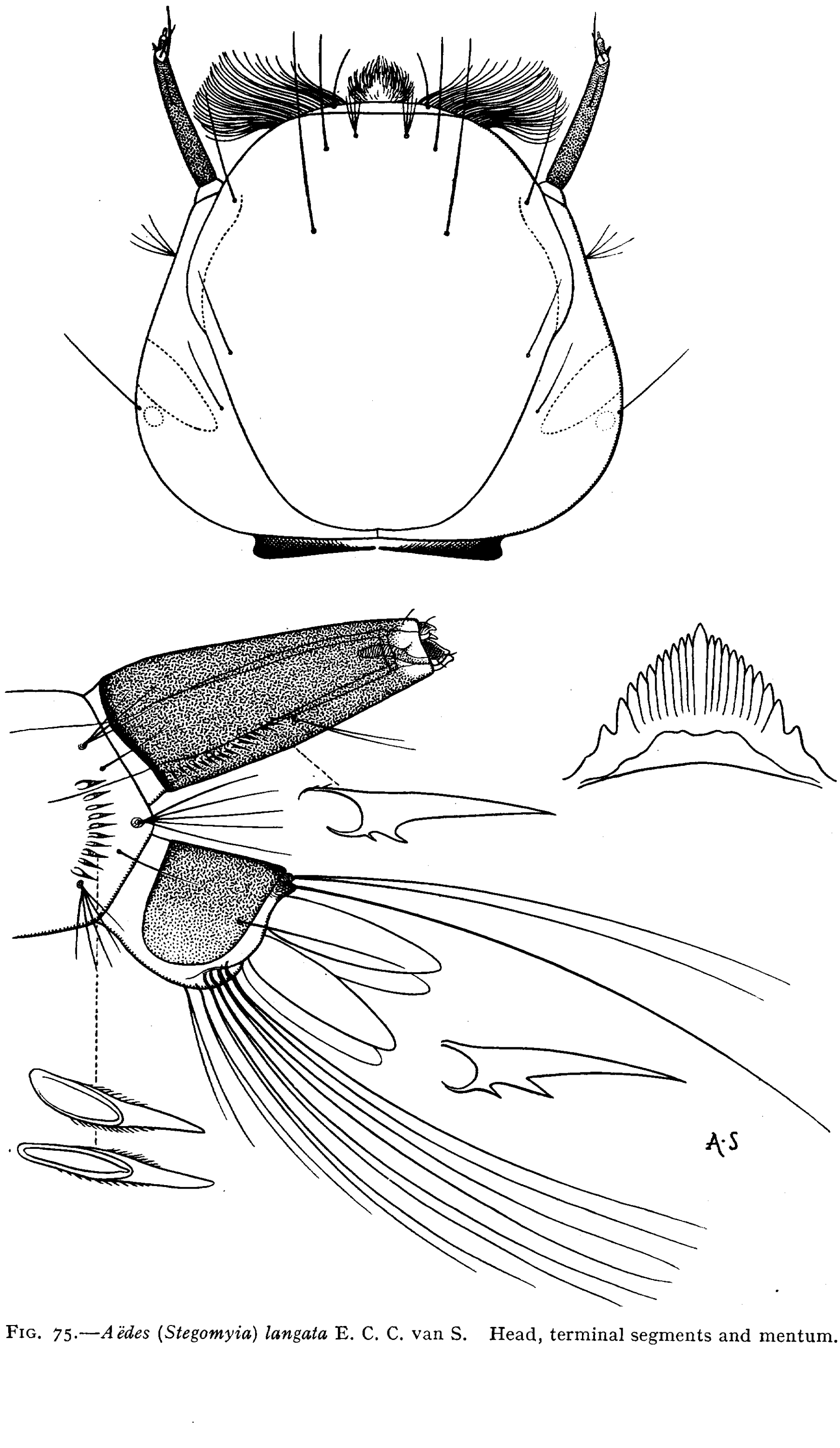


FIG. 75.—*Aëdes* (*Stegomyia*) *langata* E. C. C. van S. Head, terminal segments and mentum.

single on one side and with 3 branches on the other; *d* with 3 branches. Mentum with 10–11 teeth on either side of the central tooth, the lower 3 more widely spaced.

"*Thorax* with stellate setae, but sometimes these setae much reduced or absent.

"*Abdomen.*—Comb a row of 8–11 spines which have small secondary denticles at the base, 2 of them being longer and stouter than the rest, giving the spines a

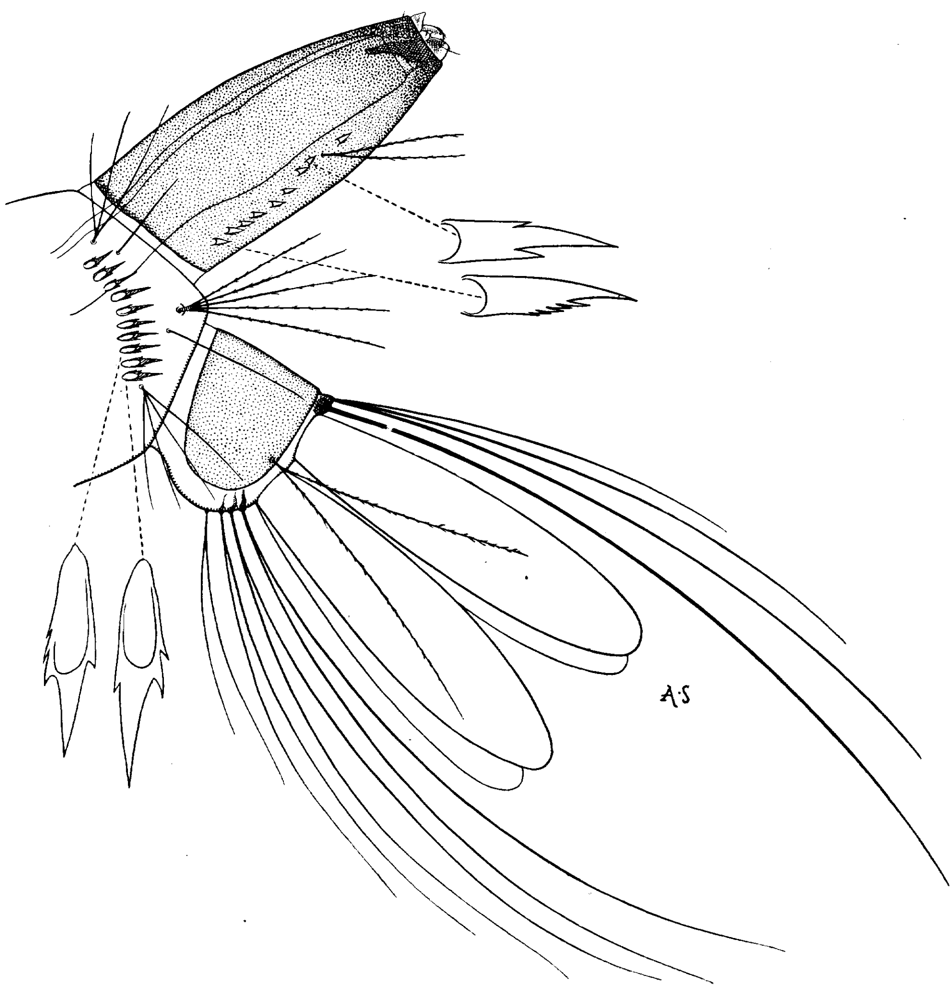


FIG. 76.—*Aëdes* (*Stegomyia*) *keniensis* E. C. C. van S. Terminal segments.

trifid appearance under the low powers of the microscope. Siphon dark to tip and with an index of $1\frac{1}{2}$ in crushed specimens. Pecten composed of 8–11 triangular spines which have fine ventral denticles and sometimes a few dorsally; one spine is usually placed just beyond the subventral tuft, which has 2–3 branches, finely plumose under high powers of microscope, about the length of the diameter of the siphon at point of attachment, and placed at a $\frac{1}{2}$. Saddle chitinized but not complete; lower caudal seta single, upper with 2–3 branches; lateral seta with

2–3 branches, finely plumose under high power, and about twice the length of the saddle. Ventral brush with 4 pairs of bifid setae. Gills sausage shaped, sub-equal, with the upper pair 3–5 times the length of the saddle."

Breeding-places.—Tree-holes (E. C. C. van Someren, 1946*a*).

Aëdes (Stegomyia) amaltheus De Meillon and Lavoipierre. (Fig. 77.)

The following description is a rearrangement of that published by De Meillon and Lavoipierre :

The larva very closely resembles that of *unilineatus*, differing principally in the larger basal denticles of the comb-spines, the smaller pecten-spines, and the branched antennal tuft.

Head pale brown. Antenna smooth, the shaft (without terminal process) about twice as long as distance between preclypeal spines ; tuft at about $\frac{5}{8}$, double (with 2–4 branches, De Meillon, *in litt.*), simple. Seta A with 3–5 branches, minutely barbed ; B bifid, simple, and shorter than the antenna ; C longer than the antenna, single, simple ; *d* with 7–10 delicate branches of which the longest is shorter than B.

Thorax with numerous stellate setae. Spines accompanying pleural setae small and straight.

Abdomen with many stellate setae. Comb of 7–8 large black spines, each with a long, pointed apical portion and bearing basally a number of prominent denticles which vary in number from 1 to 4, and in length from nearly half that of the terminal spine to much shorter. Siphonal tuft of 8th segment with 10 pectinate branches, the longest branch about $\frac{1}{2}$ length of siphon ; subsiphonal tuft of 7 pectinate branches which are about as long as those of the siphonal tuft ; anal tuft of 9 much

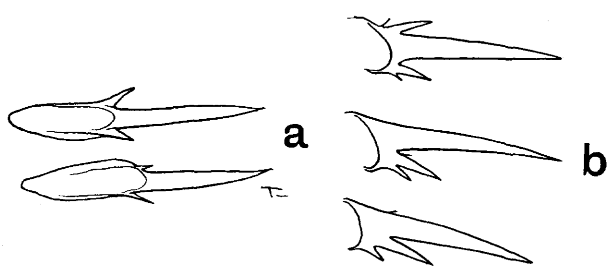


FIG. 77.—*Aëdes* (*Stegomyia*) *amaltheus* De M. and Lavoipierre. Larval details. *a*, comb spines. *b*, pecten teeth.

shorter branches. Siphon minutely spiculate ventrally, index 3·4 in the only uncrushed pelt ; pecten of 5–7 large dark spines extending to about $\frac{1}{2}$, spines always with one large ventral basal denticle and one or two smaller ones, sometimes with a minute dorsal denticle ; subventral tuft just beyond end of pecten, with 3–4 branches. Anal segment with complete saddle bearing rather coarse spicules along its distal margin ; a large " window " at the insertion of the lateral seta, which has 5–6 branches ; upper caudal seta 2-branched, lower single. Ventral brush of 4 or 5 pairs of setae, some of which (at least) are bifid or simple.

Breeding-place.—A tree-hole.

Aëdes (Stegomyia) bambusae Edwards.

Easily separable from most other species by the simple or almost simple spines of both comb and pecten. Now that the presence or absence of stellate setae on the thorax is known to be inconstant, the larva of the typical form is not separable from those of *dendrophilus* and *de-boeri*. The larva of ssp. *kenyae* is distinguished from those of all other species by the peculiar grouping of the pecten-spines.

Length about 8 mm. ; *colour* whitish, head and siphon dark brown.

Head.—Seta A double, B and C single, *d* with about 4 branches. Mentum with 9 teeth on each side of the centre, the most basal tooth more widely separated than the remainder.

Thorax without stellate setae. Meso- and metathoracic pleural groups of setae with minute spines at the base.

Abdomen.—Comb a row of 9–12 entirely simple* spines, of which one or two may (rarely) be out of alignment. Siphon with almost straight sides in uncrushed specimens, index about 2 ; subventral tuft of 2 (rarely 1) simple setae, about as long as the diameter of the siphon, at about $\frac{3}{5}$; pecten of 7–11 simple spines, of which one is placed beyond the tuft, and in some specimens another is placed still more distally and quite near the apex of the siphon. Saddle of anal segment well developed ; upper caudal seta with 2–4 branches, lower single or double ; lateral seta with 2–4 branches, which are about twice as long as the saddle. Ventral brush of about 4 pairs of 2-branched tufts. " Gills " sausage-shaped, subequal, of variable length, but at least twice length of saddle.

Breeding-places.—Larvae were found commonly in bored bamboos.

The following description of ssp. *kenyae* is by Mrs. van Someren.

Described from two rather damaged pelts. Essentially the same as *bambusae*, but readily distinguished by the grouping of the pecten-spines.

Head.—Antenna smooth, cylindrical, about $\frac{1}{2}$ the length of the head, and with a small, single simple seta at about two-thirds. Seta A double, B and C single, *d* with 5 branches. Mentum with 11 teeth on either side of the central tooth.

Thorax.—Spines at the base of the meso- and metapleural groups short and straight. Stellate setae present.

Abdomen.—Comb a row of 10–13 sharp-pointed spines appearing simple under low powers of the microscope and with very short, fine, inconspicuous basal denticles visible under high powers. Siphon crushed, dark throughout, and index probably about 2 ; subventral tuft (only one seen) a single finely plumose seta, placed at a $\frac{1}{2}$, and about the length of the diameter of the siphon. Pecten a row of 9–11 spines, which appear simple, but may have a few ventral denticles visible under high powers of the microscope ; the spines are irregularly spaced and placed in groups of 1–5, the spines in each group set very close together and almost overlapping ; there is one spine placed just beyond the tuft, and there may be another spine placed well beyond the tuft and near the apex of the siphon. Saddle smooth and incomplete ; lower caudal seta single, upper with 2 branches ; lateral seta bifid, finely plumose, about twice the length of the saddle. Ventral brush composed of 4 pairs of bifid setae. " Gills " sausage-shaped and about $1\frac{1}{2}$ times the length of the saddle.

* In occasional specimens one or two spines have one small secondary denticle.

Breeding-places.—Tree-holes (including holes in buttresses), deeply shaded holes in granite boulders, containers at different heights up to sixty feet, and "bamboo pots" placed on the ground in the forest (Garnham, Harper and Highton, 1946).

Aëdes (Stegomyia) angustus Edwards. (Fig. 73*c*).

Described from the skin of the larva from which the type-female was reared.

This larva greatly resembles that of *contiguus*, from which it differs chiefly in that the pecten-spines are fewer (about 6), much less strongly sclerotized (therefore pale-coloured), and somewhat differently shaped. The comb contains 6 spines on one side and 8 on the other; their denticulation is rather coarser and more profuse than in *contiguus*. (Further material now available shows it to be distinguishable from all others, except those of *unilineatus*, by having the setae of the ventral brush single.—P. F. M.)

Breeding-places.—The larvae occurred in bamboo-stems bored by caterpillars; altitude about 8000 ft.

Aëdes (Stegomyia) africanus Theobald. (Fig. 78.)

Easily separated from any other known Ethiopian species of the subgenus, except *luteocephalus*, by the form of the comb-spines.

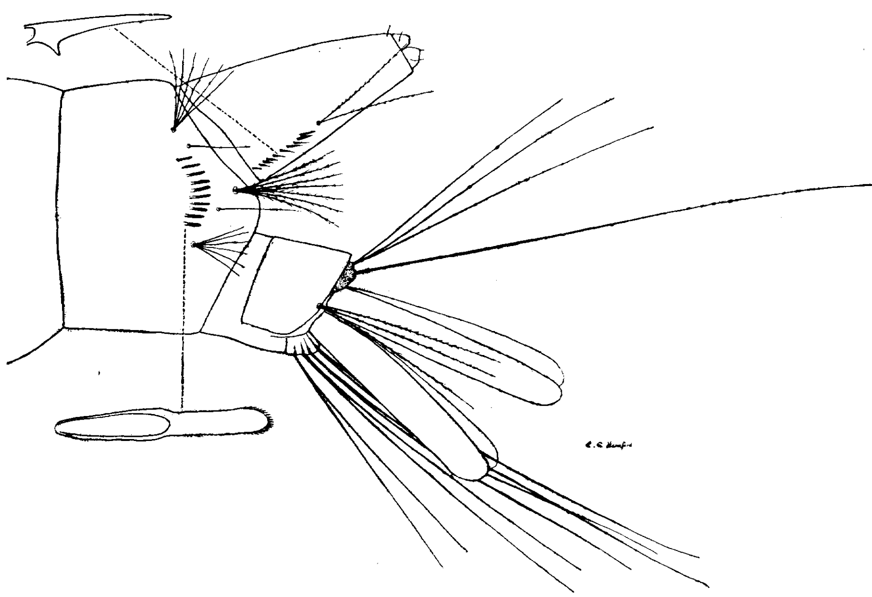


FIG. 78.—*Aëdes (Stegomyia) africanus* Theo. Terminal segments.

Length about $8\frac{1}{2}$ mm.; *colour* grey, head and siphon black.

Head nearly as long as broad. Antenna little more than $\frac{1}{4}$ length of head, tuft a single very minute seta at about $\frac{5}{8}$; terminal and subterminal setae all very small and placed at apex. Setae A and B 2-branched; B placed very far forward; C single, situated almost in a line with the bases of the antennae; *d* a rather large tuft of about

8 branches slightly anterior to and on the inner side of B; *e* and *f* rather long, single. Mentum triangular, with about 10 teeth on each side of the centre, the central tooth much larger than the rest.

Thorax.—Well-developed straight spines present at base of pleural tufts of meso- and metathorax. Both thorax and abdomen bear numerous stellate tufts of setae, which vary greatly in size.

Abdomen.—Comb a single row of 8–11 very strongly sclerotized spatulate spines, which have a short fringe round the whole distal part of the spine. Siphon very highly sclerotized, conical, with very straight sides; apical fourth much paler than remainder, index about $1\frac{3}{4}$; pecten of 10–20 rather long, closely-set spines, each with 1 basal denticle, extending to about $\frac{1}{2}$; subventral tuft of 2 (sometimes 1) subplumose branches, half as long as siphon, placed just beyond pecten. Anal segment with saddle incomplete but large and strongly sclerotized; upper and lower caudal setae 3-branched and single respectively; lateral seta with 2 (sometimes 3) stout plumose branches, which are more than twice as long as the saddle. Ventral brush composed of 4 pairs of 2-branched tufts. "Gills" subequal, sausage-shaped, about twice length of saddle.

Larvae from Uganda and from West Africa agree in all respects.

Breeding-places.—Common in tree-holes and bamboo-stumps; occasional in discarded tins, motor-tyres, etc. Mr. Gillett has twice obtained larvae from native water-pots in the Bwamba area of Toro district, Uganda, and Garnham, Harper and Highton (1945) also mention "domestic containers." These authors note that pools in the buttresses of trees are favoured breeding-places, and that shaded holes in granite are fairly often utilized by this species.

Aëdes (Stegomyia) pseudoafricanus Chwatt.

The larva is apparently inseparable from that of *africanus*.

Breeding-places.—Rot-holes in *Avicennia nitida* (white mangrove) growing in salt-water swamps (Chwatt, 1949).—P. F. M.

Aëdes (Stegomyia) ruwenzori E. C. C. van Someren and Haddow.

Larva and breeding-places unknown.—P. F. M.

Aëdes (Stegomyia) luteocephalus Newstead. (Fig. 79.)

Extremely similar to *A. africanus*, from which it differs as follows*: Comb-spines slightly less spatulate. Siphon somewhat longer (index nearly $2\frac{1}{2}$), not conical but with decidedly convex sides; subventral tuft usually single, occasionally double; at least some of pecten-spines with more than one ventral basal denticle and with small dorsal denticles. "Gills" apparently shorter (in balsam mounts).

Breeding-places.—Many authors have recorded larvae from tree-holes and bamboo stumps, and less commonly from sagging roof-gutters and domestic utensils. Dalziel records finding the species once in a crab-hole and once in a pool, and Bacot states that it occurs occasionally in rock-pools.†

* It does not appear that any of these differences are absolutely constant.—P. F. M.

† Abbott (1948) records it from tree-holes and rock-pools in the Sudan.—P. F. M.

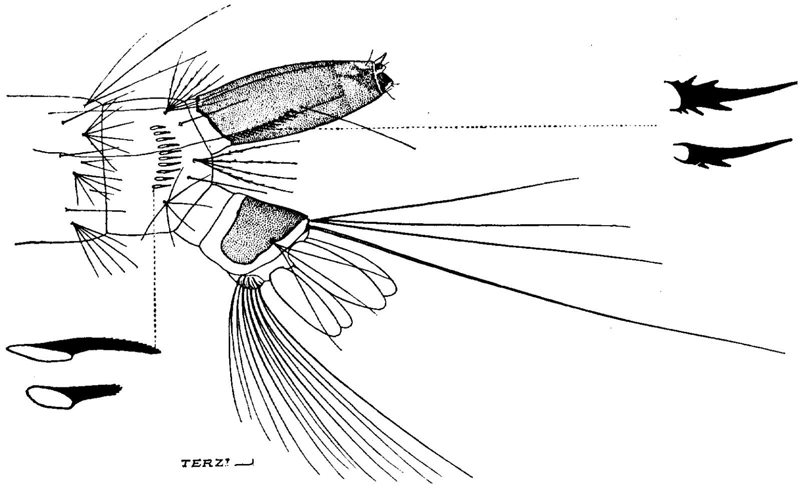


FIG. 79.—*Aëdes (Stegomyia) luteocephalus* Newst. Terminal segments.

Aëdes (Stegomyia) unilineatus Theobald.

Separable from all other known species (except *angustus*, *amaltheus* and *albopictus*.—P. F. M.) by the fact that the setae of the ventral brush are unbranched. The shape of the comb-spines is apparently unreliable, since both De Meillon and Lavoipierre (1944, p. 56, fig. 3*g*) and Lewis (1945) have bred *unilineatus* from larvae in which the comb-spines have very small and inconspicuous basal denticles and appear simple under low magnifications.*

Length about 7 mm.; *colour* not recorded.

Head.—Differs from that of *aegypti* as follows: Seta A with about 3 branches, B sometimes double; *d* rather large, with about 5 branches.

Thorax.—Numerous prominent stellate setae are present on both thorax and abdomen. Spines at base of pleural tufts of meso- and metathorax small and straight.

Abdomen.—Comb of 4–8 large strong spines, which have a fringe of rather small denticles at the base. Siphon with index about 2; pecten of 6–12 spines, each with 2 or 3 ventral and 1 or 2 dorsal denticles, extending to nearly $\frac{1}{2}$; subventral tuft placed slightly beyond $\frac{1}{2}$ and composed of 2–5 simple branches. Anal segment with complete saddle; upper and lower caudal setae triple and single respectively; lateral seta of 3–5 simple branches slightly longer than saddle. Ventral brush composed of about 4 pairs of unbranched setae. "Gills" subequal, sausage-shaped, about 3 times length of anal segment.

Breeding-places.—Many authors have recorded this species breeding in tree-holes.

* The confusion has arisen entirely from errors in the labelling of Fig. 61 in the first edition of the present work. An examination of the original drawings for this figure and of the material from which they were taken shows that the figure of *A. angustus* was labelled "*deboeri* var. *demeilloni*" while that of "*deboeri* var. *demeilloni*" (here described as "? *pseudonigeria*") was labelled *unilineatus*. In the present edition these errors have been corrected. The range of Indian and Ethiopian pelts of *unilineatus* in the British Museum collection shows very little variation in the comb spines. They are perhaps slightly coarser in the single pelt available from West Africa than in the others but the difference is too slight to be significant. There can be no doubt that the condition described by De Meillon and Lewis is the normal one.—P. F. M.

Ingram and de Meillon found larvae in a hole in a pawpaw tree (*Carica papaya*) ; the succulent rather than woody nature of this tree makes this latter habitat somewhat different from an ordinary tree-hole.

Aëdes (Stegomyia) albopictus Skuse.

According to MacGregor (1927) the larva of this species can easily be separated from those of the other species of the subgenus which occur in Mauritius " by the fact that the comb-teeth, under moderate magnification, appear simple, *i.e.* not denticulate, and that they collectively project at a distinct angle from the sides of the abdominal segment on which they are set, whereas in the other two species the comb-teeth are denticulate and lie more or less appressed to the sides of the abdominal segment."

Breeding-places.—" Its chief breeding-place is in tree-holes and rock-holes in the vicinity of human dwellings. . . . Occasionally it is found breeding in artificial situations, such as water-butts, drains, old tins, old bottles, etc." " Most water-containing tree-holes in Mauritius may be relied upon to contain a supply of *Aëdes albopictus* larvae " (MacGregor, *l. c.*).

Aëdes (Stegomyia) mascarensis MacGregor.

According to MacGregor (1927) this larva is separable only with difficulty from that of *A. aegypti*, but differs in having more numerous comb-spines (an average of 10 as against 8) and fewer pecten-spines (averaging 8–12 as against 15–20) ; also the subventral tuft of the siphon is usually at the same level as the most distal spine, and not, as in *aegypti*, often placed distal to it.

Breeding-places.—In tree-holes only (MacGregor, *l. c.*) ; he notes that he has never found them in the same tree-hole as *A. aegypti*.

Aëdes (Stegomyia) granti Theobald.

The following description is taken from Leeson and Theodor (1948). Major Leeson kindly allowed me the use of the MS. while their paper was still in the press. The larva of *granti* resembles that of *unilineatus* very closely and, since the degree of development of the stellate setae may be expected to vary considerably in both, it is unlikely that they can be separated with certainty.

Head.—Length of antennal shaft hair about one fifth the length of the shaft, arising beyond midway. Outer frontal hairs (A) bifid ; inner frontal hairs (C) arising on a level with bases of antennae, long, reaching to end of antennae, simple ; middle frontal hairs. (B) arising near anterior margin of clypeus, simple or bifid, reaching as far as apex of antennae ; anterior frontals (d) situated between bases of inner frontals, very short, with seven or eight branches ; inner sutural hairs (e) arising level with front of eyes, short, simple ; outer or trans-sutural (f) arising near eye, simple. Mentum, 1 median tooth and eleven teeth each side, closely arranged.

Thorax.—Propleural hairs with no basal spine. The pleural tufts of meso- and meta-thorax have at their bases strong, bluntly pointed spines.

Abdomen.—Comb consisting of nine to twelve spines, each with one main terminal denticle and a number of small basal ones. Siphon barrel shaped, index about 2 ;

subventral tuft with 4 or 5 branches arising at or more than two-thirds along siphon; pecten with eleven to twenty-two spines, each having a large main tooth and several small basal ones, no spines beyond tuft. Saddle, incomplete; saddle hair, 3–4 branches delicately barbed. Caudal setae simple, or one or two may be bifid. Papillae (gills); two long, two short, with parallel sides and rounded ends."

Breeding-places.—" Wells at Mouri."—P. F. M.

Aëdes (Stegomyia) vittatus Bigot. (Figs. 80, 81.)

The combination of sparsely spiculate antennae, single head-setae B and C, and the character of the comb and pecten, will separate this species from all others known in our area.

Length about 9 mm.; *colour* grey, head blackish.

Head somewhat quadrate, little broader than long. Antenna about $\frac{2}{5}$ length of head, shaft with a very few minute spicules, hardly tapered, and of a uniform brown colour; tuft of 1–3 almost simple branches at $\frac{1}{2}$; terminal and subterminal setae

FIG. 80.—*Aëdes (Stegomyia) vittatus* Big. Head.

all situated at the apex and very small. Seta A with 4–8 slightly plumose branches, B and C single, simple, *d* placed very close to the base of B, with 2–4 minute branches, *e* and *f* single. Mentum subtriangular, with about 12 subequal teeth on each side of the centre.

Thorax.—No spines at bases of meso- and metathoracic pleural tufts.

Abdomen.—Comb an irregular row of 8–10 spines, which are fringed at the base. Siphon with index $1\frac{1}{2}$, conical; subventral tuft of about 6 subplumose branches at a little beyond $\frac{1}{2}$; pecten of 20–28 very long and closely-set spines, of which the most distal is placed much beyond the remainder and considerably distal to the tuft, most of the spines with 3 or more short and blunt basal denticles, but those of the distal spines smaller, more acute, and usually present on both sides of the spine. Saddle covering only a small part of anal segment; upper and lower caudal setae 5-branched and single respectively; lateral seta very small, single, placed at the ventro-distal angle of the saddle. Ventral brush composed of 4 pairs of numerous simple branches and 3 unpaired proximal tufts. "Gills" fusiform, dorsal pair more than thrice length of saddle.

Breeding-places.—The larvae are found in very large numbers in rock-pools, and there is no question that these are the preferred type of breeding-place. Larvae are also recorded from domestic utensils (various authors), boats (Kennan) and cattle hoof-prints (Leeson, 1931). Patton (1905) states that at Aden "it breeds in the wells, and wherever water is stored in barrels, buckets, etc."; Kerr (1933) states "among larvae taken from tree-holes in Ibadan . . . we identified a few *A. vittatus*"; Harris (1942) also records larvae from tree-holes, and includes among other exceptional breeding-places a pool in a road and discarded tins. Harris notes that records from "domestic water jars are usually from localities where rock pools are a source of drinking water." Larval incidence is not seasonal except in so far as it is governed by the drying up of the rock-pools.*

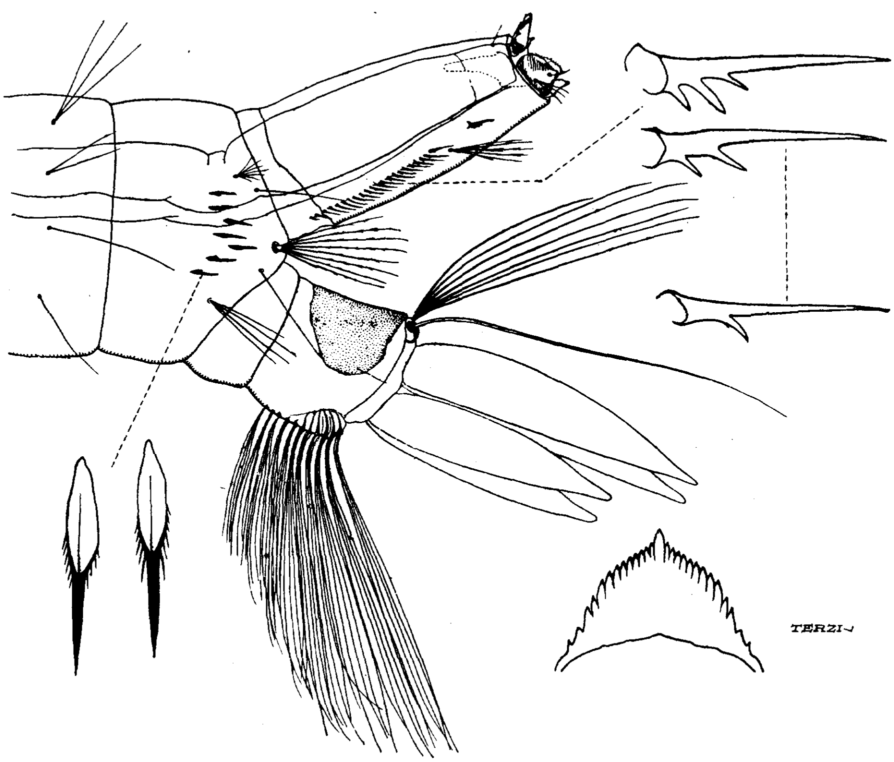


FIG. 81.—*Aëdes (Stegomyia) vittatus* Big. Terminal segments and mentum.

The larva is by no means a typical *Stegomyia*; the spiculate antenna and presence in the ventral brush of unpaired tufts proximal to the barred area are very unusual

* Abbott (1948) gives a record from concrete basins and Mara, in Jannone *et al.* (1946), gives one from a turbid rain pool without vegetation but with broken shade and a chloride content of 0·04 %.—P. F. M.

features. The habits are also atypical, since it is the only member of the subgenus which does not breed primarily in tree-holes and domestic utensils.

Aëdes (Aëdimorphus) marshalli Theobald.

The *apicoannulatus* group of *Aëdimorphus*, to which the present species belongs, has a characteristic general facies which is unlikely to allow confusion with any other members of the genus. The sclerotization of head and siphon is so marked as to give a superficial resemblance to the subgenus *Stegomyia*, but from this subgenus (except *vittatus*) they differ in the possession of spiculate antennae, multiple head-setae and median unpaired tufts proximal to the barred area of the ventral brush. No other members of the subgenus (except *A. lamborni**), or of the other subgenera which possess these characters, have their head and siphon sclerotized to anything approaching the same degree. In all members of the group the head-setae are multiple, the comb-teeth, if spines, are not sharp-pointed, the siphon has convex sides, the subventral tuft consists of branches which are nearly or quite as long as the diameter of the siphon, and the pecten is composed of dark-coloured spines, none of which are markedly wider spaced than the others.

The present species shows strong resemblances to *A. stokesi*, but has more numerous teeth in the mentum, and the " gills " (tapered in *stokesi*) are cylindrical in the present species. These two species differ from all other known larvae of the genus except *A.* (*Stegomyia*) *africanus* and *luteocephalus* in the fact that the comb consists of spines which have a fringe extending all round the apex.

A larva stated to be that of *A. marshalli* was described by Wesché, but the attribution is incorrect.

Described from a number of skins and 3 whole larvae from Lira, Uganda.

Length about 8 mm. ; *colour* not noted, head and siphon dark.

Head rounded, little broader than long. Antenna spiculate, dark-coloured throughout, about $\frac{1}{2}$ length of head ; tuft of 4 or 5 plumose branches, which are nearly $\frac{1}{2}$ as long as the shaft, at about $\frac{4}{7}$. Setae A, B and C with about 10, 4 and 7–9 rather coarsely plumose branches respectively ; *d* larger than usual, with about 10 branches, placed but little anterior to the line joining the bases of C on each side. Mentum with central tooth much larger than those adjoining it ; the dozen teeth on each side increase markedly in size towards the base.

Abdomen.—Comb an irregular row of 10–14 well-sclerotized spines, which have, however, a fringe extending all round the apex. Siphon with sides convex, tapering somewhat strongly, index about $2\frac{3}{4}$; pecten extending to slightly before $\frac{1}{2}$, composed of 20–25 dark-coloured spines, of which the majority have one large basal denticle, and a few have an additional very small denticle ; subventral tuft at $\frac{1}{2}$, composed of about 5 plumose branches which are as long as the diameter of the siphon. Anal segment with saddle covering about half the lateral area, distal edge smooth ; upper caudal seta with 3 long branches, lower single ; lateral seta conspicuous, with 1–3 (usually 2) very sparsely plumose branches, which are about $\frac{2}{3}$ length of saddle. Ventral brush composed of about 4 pairs of tufts, each with about 8 branches, in the barred area, and 2–3 small tufts proximal to it. " Gills " sausage-shaped, very long, dorsal pair slightly longer than ventral.

* And *A. boneti*.—P. F. M.

Breeding-places.—In tree-holes, only after heavy rain ; Wesché also records the species from a bamboo-stump.

Aëdes (Aëdimorphus) capensis Edwards. (Fig. 82.)

The present larva and that of *kapretwae* are both very similar to that of *haworthi*, but both can be separated from *haworthi* by the shorter lateral seta of the anal segment and by having the comb-scales fairly broad. (Van Someren, 1950*a*, notes that *Aë. ngong* is intermediate between *haworthi* and *capensis* with respect to the comb scales but *haworthi* can be separated from the other three species on the position of the subventral tuft, as indicated in the key.—P. F. M.)

Edwards (1941, p. 162) divided the East African forms of this species into a number of categories which he called A, B, C and D, pending a decision as to whether they are sufficiently stable to be regarded as sub-species. The larva described below (E. C. C. van Someren, 1946*a*) is that of type A.

"Very similar to that of *kapretwae*, from which it may be distinguished by the shape of the mentum and the siphon.

"*Head* as in *kapretwae*. Antennal tuft usually with 6 branches. Setae A, B and C with 10–11, 5–7 and 6–7 branches respectively. Mentum (Fig. 82) smaller than *kapretwae*, elongated and more pentagonal in shape, with 10–11 teeth on either side of the central tooth, the basal 2 small, widely spaced, more so than in *kapretwae*.

"*Abdomen* as *kapretwae*. Siphon usually heavily chitinized, and therefore dark brown or blackish in colour, the basal ½ swollen, apical ½ narrower and tapering to apex. Index 3·3–4·5."

Breeding-places.—Type A is recorded by several authors from tree-holes, and Garnham, Harper and Highton (1946) found it very commonly in shaded rock-holes in deep forest, twice in the axils of wild bananas, and in "natural and artificial (bamboo) containers up to sixty feet." Type B has been bred from bored and cut bamboos (Edwards, 1941).

Aëdes (Aëdimorphus) kapretwae Edwards. (Fig. 83.)

The larva is very similar to those of *haworthi* and *capensis* ; the differences from both are given above under *capensis*. Mrs. van Someren's description is as follows :

Head about as broad as long. Antenna about ½ the length of the head, spiculate and slightly infuscate ; tuft at a ½ and composed of 3–5 finely plumose setae. Setae A, B and C plumose and with 8–13, 5–8 and 7–12 branches respectively ; *d* small, with 7–10 fine branches. Mentum (Fig. 83) triangular with 11–12 teeth on either side of the central tooth, the basal 2 smaller and more widely spaced.

Abdomen.—Comb a patch of 20–28 small pale scales, which are fairly broad and with a long apical fringe. Siphon usually pale brown and with nearly straight sides, only slightly swollen basally and tapering gradually from base to apex. Index 3–3·25. Pecten reaches to just before the tuft, and is composed of 16–18 dark spines each with 2–3 small basal denticles. Subventral tuft at a ½ and composed of 4–5 finely plumose branches which are a little longer than the diameter of the siphon at point of attachment. Anal segment with saddle chitinized but incomplete. Lower caudal seta single, upper with 4–5 branches. Lateral seta simple, as long as (or a little

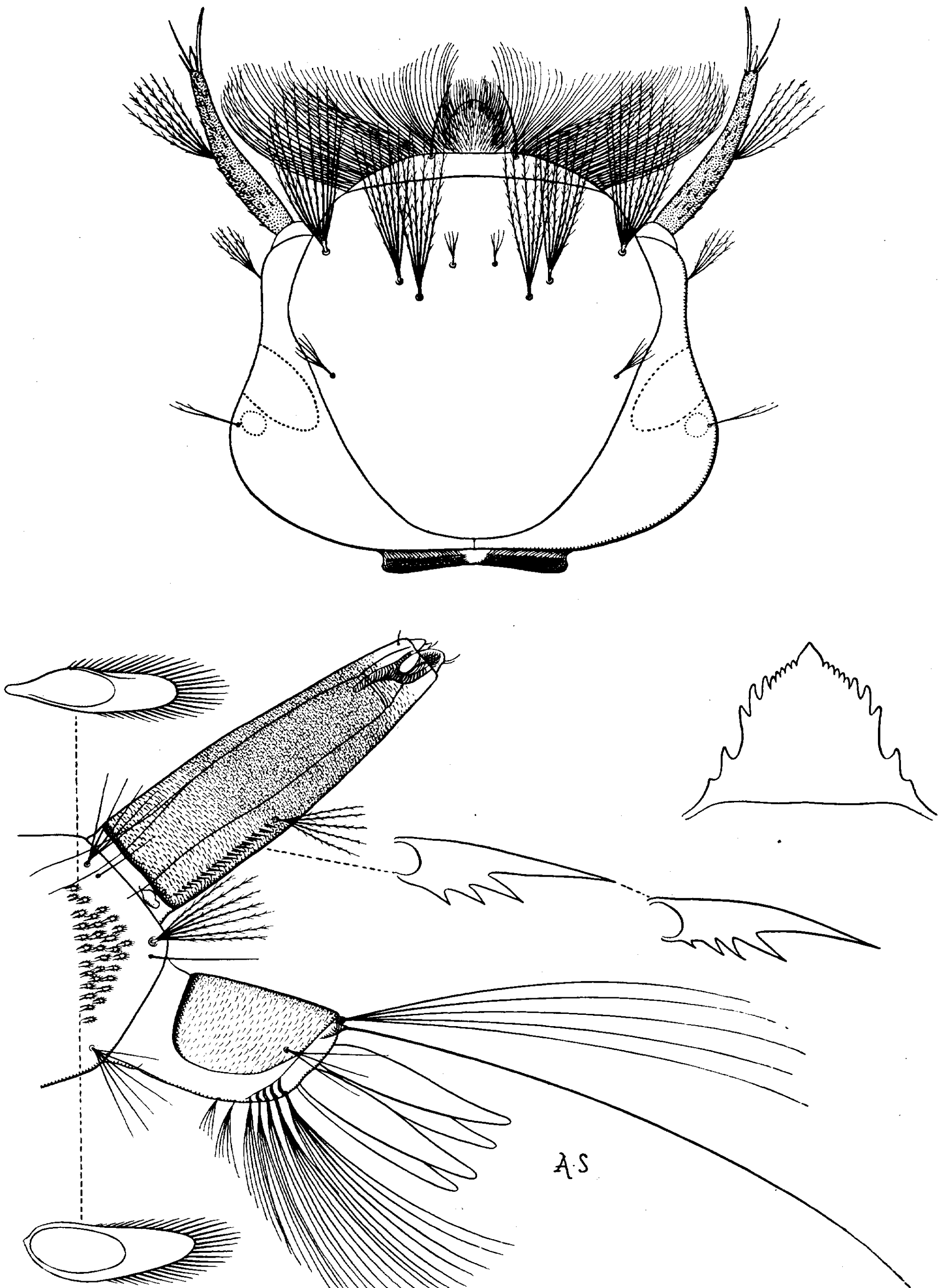


FIG. 82.—*Aëdes* (*Aëdimorphus*) *capensis* Edw. Head, terminal segments and mentum.

shorter) than saddle with 2–6 branches. Gills variable and 1–3 times the length of the saddle. Ventral brush of 3–4 paired tufts of 5-branched setae in the barred area and 2 unpaired setae outside the barred area.

Breeding-places.—Tree-holes at altitudes over 7500 feet (E. C. C. van Someren, 1946*a*).

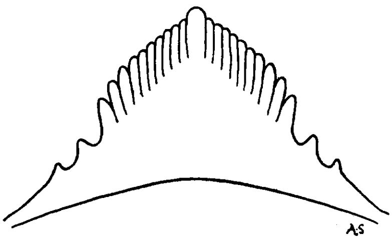


FIG. 83.—*Aëdes (Aëdimorphus) kapretwae* Edw. Mentum.

Aëdes (Aëdimorphus) ngong E. C. C. van Someran.

The following account is taken from van Someren (1950*a*): "The larva differs from *stokesi* by having the comb composed of scales, not fringed spines. It is very similar to that of *A.* (*A.*) *capensis* Edwards and like *capensis* it differs from the very similar larva of *A.* (*A.*) *kapretwae* Edwards by the shape of the mentum (van Someren, 1946). It has not been found possible to separate it from *capensis*.

Head about as long as broad. Antenna about half the length of the head, infuscate for full length, sparsely spiculate, curved and very slightly tapered from base to apex; tuft at about a half and composed of 3–5 finely plumose branches. Setae A, B and C with 7–11, 5–8 and 5–10 plumose branches respectively; *d* small and with 8–9 branches. Mentum small, pentagonal, and with 10–11 teeth on either side of the central tooth, the basal 2 small and widely spaced.

Abdomen.—Comb a patch of 24–32, usually 28 pale scales which are usually rather narrow but some are broad and all with a short fringe. Siphon dark brown; index 3–4 in uncrushed specimens. Pecten reaches to about a half and composed of 22–23 close set dark spines, each with one coarse denticle and 2–3 smaller ones ventrally, and sometimes a few fine dorsal denticles. Subventral tuft placed immediately beyond the pecten, about level with the tip of the last spine, and with 4–6 finely plumose branches which are a little longer than the diameter of the siphon. Anal segment with well developed saddle; lateral seta a little shorter than the saddle and with 2–3 branches; lower caudal seta single, upper with 3–6 branches. Brush with four 6-branched paired setae in the barred area and 2 unpaired tufts outside the barred area. "Gills" pointed, upper 1–2 times the length of the saddle, lower shorter."

Breeding-places.—Tree-holes.—P. F. M.

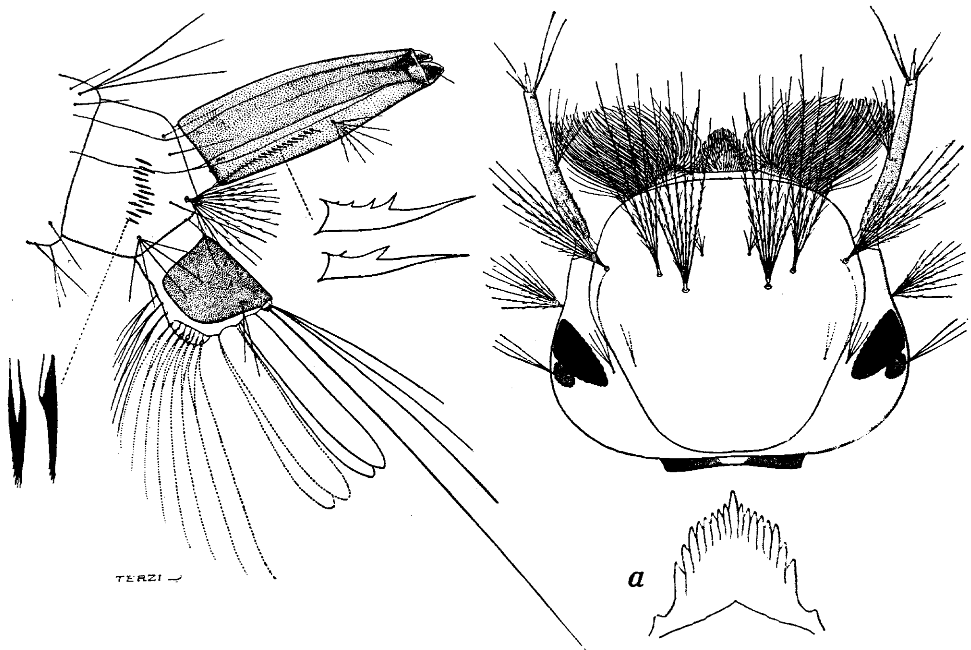
Aëdes (Aëdimorphus) stokesi Evans. (Fig. 84.)

With the exception of *africanus* and *luteocephalus*, which have smooth antennae and a totally different head-chaetotaxy, the present species and *marshalli* are the only known members of *Aëdes* in our area to possess a comb composed of apically-fringed *spines*. The present species is very similar to *marshalli*, but the mentum possesses fewer teeth and the " gills " are somewhat differently shaped.

The larva of this species is, as has been pointed out by Evans, 1929*b*, that described as *apicoannulatus* by Ingram and Macfie.

Length about 8 mm. ; *colour* dark brown.

Head slightly broader than long (as 1·2 : 1) ; antenna dark brown, slender, rather less than half length of head ; tuft of 5 or 6 plumose branches at a little beyond $\frac{1}{2}$. Setae A, B and C tufts of about 10, about 6 and about 7 plumose branches



84.—*Aëdes* (*Aëdimorphus*) *stokesi* Evans. Head and terminal segments. *a*, mentum.

respectively ; *d* small, 4-branched. Mentum with 8 or 9 teeth on each side of the centre.

Abdomen.—Comb an irregular row of 9–14 highly-sclerotized narrow fringed spines. Siphon with index about 3 ; pecten of 14–22 barbed spines, none of which are markedly wider spaced, extending to about $\frac{1}{2}$; tuft of about 6 (5–8) subplumose branches at about $\frac{3}{5}$. Anal segment with a well-developed saddle ; upper and lower caudal setae triple and single respectively ; lateral seta with 2–3 simple branches about as long as saddle. Ventral brush composed of 3 or 4 pairs of tufts each with few simple branches ; proximal to the barred area are 3 short unpaired tufts. " Gills " more than twice length of saddle, cylindrical, with tapered but not sharply-pointed ends, dorsal pair slightly longer than ventral.

Larvae from Uganda agree very well with those from West Africa.

Breeding-places.—The usual breeding-places are in tree-holes, but I have once found larvae in a discarded tin. They are only found after heavy rain. (M. Holstein has sent me larvae from Dubreka, Ivory Coast, which were collected from a rot-hole in a mangrove.—P. F. M.).

Aëdes (**Aëdimorphus**) **haworthi** Edwards.

The larva of *haworthi* is a typical member of the *apicoannulatus* group (see p. 162), and is easily separated from the other members of the group by the fact that its comb contains about 20 scales.

Described from 2 pelts collected by Dr. B. de Meillon.

Length apparently about 7 mm. ; *colour* not noted, siphon very dark.

Head.—Antenna curved, rather sparsely spiculate, strongly tapering ; tuft of 3–4 plumose branches, which are about $\frac{3}{8}$ as long as the antenna, at $\frac{1}{2}$. Setae A, B and C coarsely plumose, with about 10, 4 and 6–7 branches respectively, arranged as in *stokesi* ; branches of B thicker, but not longer than those of C. Mentum shaped like that of *stokesi*, but with 10–11 teeth on each side of the centre.

Abdomen.—Comb a patch of 20–22 pale-coloured scales. Siphon and anal segment as in *stokesi*, but lateral seta of anal segment $1\frac{1}{2}$ times as long as saddle. " Gills " missing.

Breeding-places.—Ingram and de Meillon record this species (as *A. apicoannulatus*) breeding in tree-holes, including a hole in a paw-paw tree. Harris (1942) records it from tree-holes and once from a borrow-pit ; he also found it fairly numerous in sections of bamboo which he used as traps, so bamboo-stumps are almost certainly among its natural breeding-places. McHardy (1928) mentions one record of the species breeding in a cement tank. Muspratt (1945) found larvae commonly in tree-holes.

Aëdes (**Aëdimorphus**) **simulans** Newstead and Carter. (Figs. 85, 86.)

The species of the tree-hole breeding group of *Aëdimorphus* to which *simulans* belongs have a general facies which makes them unlikely to be confused with any others (see p. 162). From all the other members of the group the present species is separable by most of its pecten-spines possessing only one obvious secondary denticle.

Length apparently about 6 mm. (the material consists of skins only) ; *colour* " relatively dark " (Kumm, 1931).

Head.—Antenna slender, not very strongly spiculate, infuscate throughout, but somewhat lighter in colour basally ; tuft of 3–5 plumose branches, rather more than $\frac{1}{2}$ length of shaft, at about $\frac{4}{7}$. Setae A, B and C large tufts of plumose branches ; A with about 10 branches, B about 5 and C about 8 ; bases of B and C rather close together ; *d* minute but rather conspicuous, with about 6 branches, situated on the inner side of the base of C and very little in advance of it (a large part of the chaetotaxy figured by Kumm is ventral). Mentum with the sides just above the base decidedly more vertical than is usual ; central tooth large in proportion ; about 10 teeth on either side.

Abdomen.—Comb a patch of about 40 small pale scales (Kumm gives the number as 40–65, but appears to have counted some of the scales of both sides in reaching the higher figure). Siphon crushed, but apparently with an index of about 4 (3 in the crushed skins); pecten of 15–22 dark spines arranged in a continuous row and extending to about $\frac{2}{5}$, the majority of the spines with one strong lateral denticle; subventral tuft of 3–4 plumose branches, which are longer than the diameter of the siphon. Anal segment with saddle large but incomplete, posterior margin smooth; upper caudal seta with about 3 branches, lower single; lateral seta with 1–3 simple branches, which are nearly as long as the saddle. Ventral brush with about 4 pairs

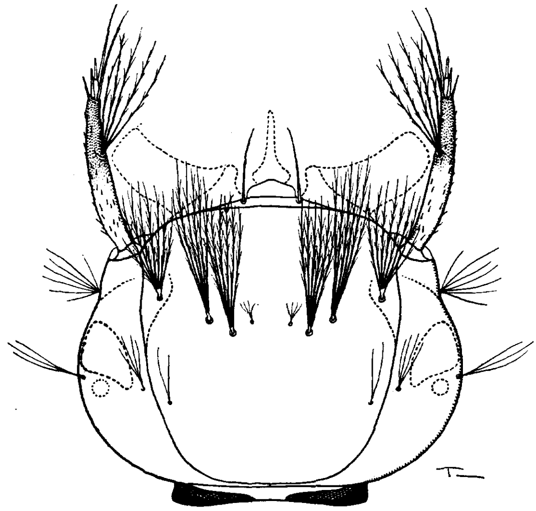


FIG. 85.—*Aëdes* (*Aëdimorphus*) *simulans* N. and C. Head.

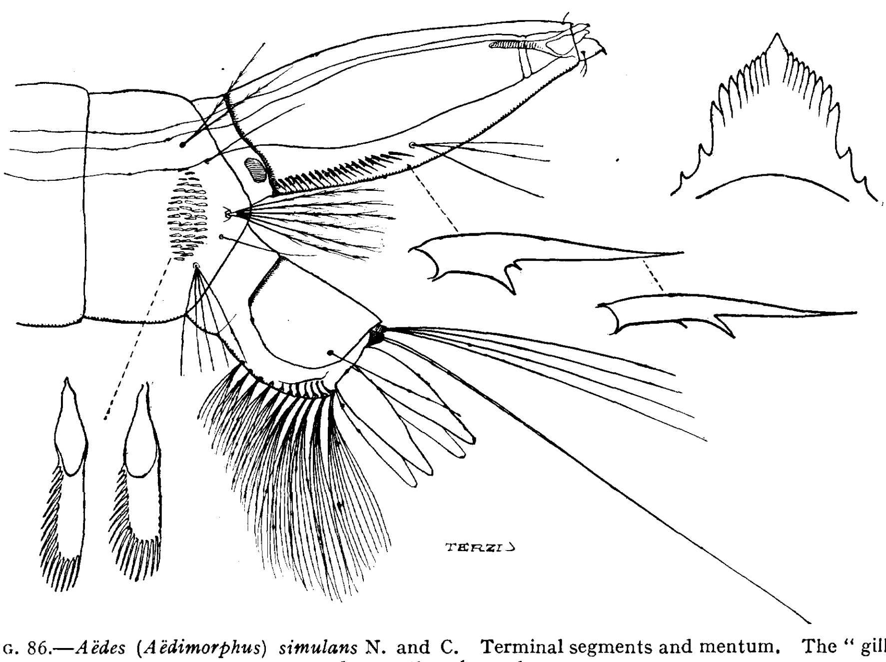


FIG. 86.—*Aëdes* (*Aëdimorphus*) *simulans* N. and C. Terminal segments and mentum. The "gills" are longer than here shown.

of multiple tufts in the barred area and about 5 mid-ventral tufts proximal to it. "Gills" lanceolate, subequal, nearly twice length of saddle.

Breeding-places.—There are numerous records of this species breeding in tree-holes; Kumm (1931) found it commonly in bamboo stumps.

Aëdes (Aëdimorphus) apicoannulatus Edwards. (Fig. 87.)

The large number of comb-scales, coupled with the multiple head-setae and normal "gills," will prevent confusion with any other species of *Aëdimorphus* except *lamborni*, from which *apicoannulatus* may be distinguished by the smaller number of comb and pecten teeth and the unicolorous siphon. The species bears a considerable resemblance to *simulans*, but differs in possessing much more numerous comb-scales, more numerous branches in the upper dorsal seta and in other respects.

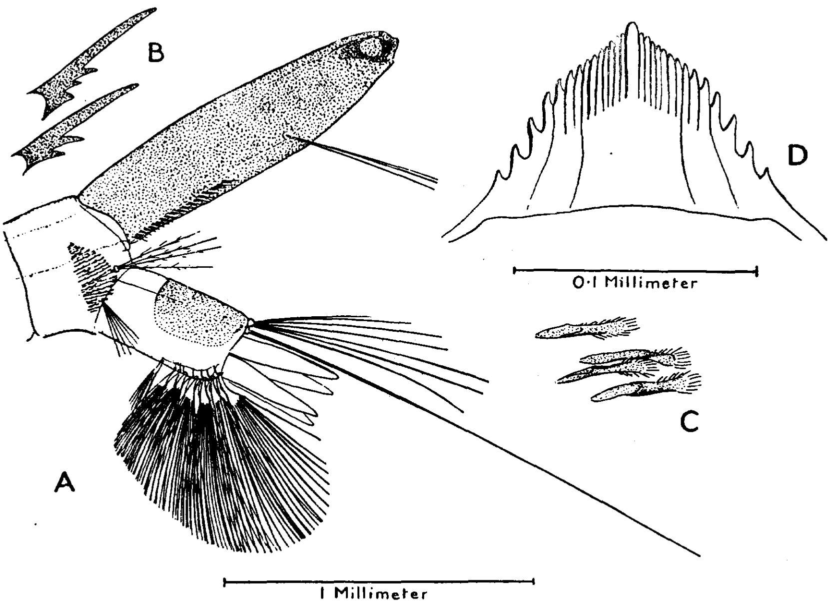


FIG. 87.—*Aëdes* (*Aëdimorphus*) *apicoannulatus* Edw. A, terminal segments. B, pecten spines C, comb-scales. D, mentum.

Length about 6 mm.; *colour* not recorded, apparently pale.

Head.—Antenna a little more than half length of head, curved and slender, infuscated beyond basal third, sparsely spiculate; tuft of 5 branches at a little beyond $\frac{1}{2}$. Setae A, B and C with about 10, 6 and 8 plumose branches respectively; bases of B and C close together, and that of B only slightly anterior to that of C; *d* minute, with about 3 branches, placed a little on the inner side of and on the same level as C. Mentum with 14 teeth on each side of the centre, the median 7 or 8 on each side very small and close together.

Abdomen.—Comb a more or less semi-circular patch of about 80 small narrow scales. Siphon with distinctly convex sides, index about $4\frac{1}{2}$; subventral tuft of 2–3 long simple setae (about twice diameter of siphon) at about $\frac{3}{5}$; pecten of about

20 (18–21) dark-coloured spines, each with 2–3 basal denticles on the ventral side, spines all approximately equidistant and rather close-set. Anal segment with saddle poorly sclerotized and small, distal margin spiculate; upper caudal seta with about 7 branches, lower single and more than five times length of saddle; lateral seta slender, single, simple, shorter than saddle. Ventral brush composed of 5 pairs of many-branched tufts in the barred area and 2 unpaired proximal tufts. "Gills" subequal, lanceolate, slightly longer than saddle.

Breeding-places.—Records of this species appear all to be from tree-holes. Many of the earlier records have had to be omitted as possibly referring to *A. stokesi*, from which the present species was formerly not distinguished.

Aëdes (Aëdimorphus) argenteopunctatus Theobald. (Fig. 88.)

The doubt as to the identity of the larva described below has been almost completely resolved, the explanation apparently being that the larvae of *argenteopunctatus* and *punctothoracis* are almost or quite indistinguishable. Wesché (1910) and Galliard (1931) ascribed the larva to *punctothoracis*, and Mr. P. F. Mattingly

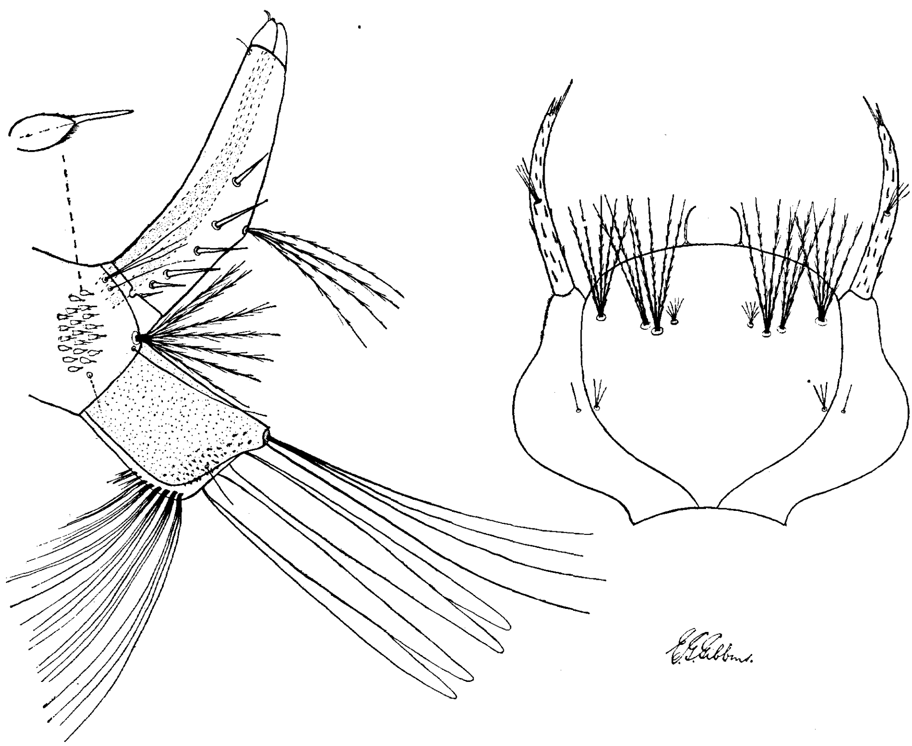


FIG. 88.—*Aëdes* (*Aëdimorphus*) *argenteopunctatus* Theo. (?). Head and terminal segments.

and Dr. J. D. Robertson permit me to state that they have both bred this species from similar larvae at Takoradi (Gold Coast) and Kumasi (Ashanti). On the other hand, Bedford (1918) described the larva as that of *argenteopunctatus*, and Dr. Robertson bred *argenteopunctatus* from larvae of this type at Bo, Sierra Leone.

Furthermore, larvae similar to that described have been found in Uganda, where *punctothoracis* probably does not occur but *argenteopunctatus* is definitely found.

The larva is quite unmistakable, the form of the siphon being unique and the very long subventral tuft of the siphon decidedly unusual.

Length about 6 mm.; *colour* not recorded.

Head.—Antenna strongly spiculate, about $\frac{1}{2}$ length of head; tuft of 4 simple branches at about $\frac{1}{2}$. Seta A with 4–5, B with 3–4 and C with 4 plumose branches. Mentum triangular, with about 15 teeth on each side of the centre.

Abdomen.—Comb a patch of 14–20 spines, which are finely fringed at the base. Siphon distinctly concave dorsally and convex ventrally, angulated at insertion of tuft, index about 3; pecten of 7–8 very large spines, of which the most distal is widely separated from that next to it, and which are simple or with very minute denticles; subventral tuft situated at about $\frac{1}{2}$, and composed of 4–5 plumose branches, which are twice as long as the diameter of the siphon. Anal segment with very large saddle, distal edge almost smooth; upper caudal seta with 2 or 3 branches, lower single; lateral seta single. Ventral brush composed of about 4 pairs of few-branched tufts in the barred area and 3 proximal unpaired tufts. "Gills" subequal, lanceolate, about 3 times length of saddle.

Breeding-places.—Bedford found his larvae in pools along the banks of a river, and Galliard collected them from temporary pools among grass. The breeding-places of *argenteopunctatus* and *punctothoracis* are unlikely to differ materially.

Aëdes (Aëdimorphus) punctothoracis Theobald.

This species has been discussed above in connection with *A. argenteopunctatus*.

Aëdes (Aëdimorphus) hopkinsi Edwards. (Fig. 89.)

The rather long siphon will separate this from most other species with which it might be confused; the position and small size of the subventral tuft of the siphon and the small number of scales forming the comb will distinguish it from most of the remainder. It differs from *yangambiensis* by the possession of an isolated pecten-spine placed beyond the subventral tuft of the siphon.

Described from 5 skins from Lira, Uganda, and 2 whole larvae from Nambadzidza, near Kampala.

Length about 7 mm.; *colour* not noted.

Head.—Antenna much shorter than head, strongly curved and tapered, not infuscate, coarsely spiculate; tuft of about 10 plumose branches (about half as long as the antenna) at $\frac{1}{2}$. Setae A, B and C large (B and C about half length of head), with about 10, 7 and 8 plumose branches respectively; *d* minute but with numerous branches, placed on a level with the base of C; *e* and *f* with 2–3 and 3–4 small branches respectively. Mentum with about 20 small teeth on each side of the centre.

Abdomen.—Comb a patch of about 20 pale-coloured scales. Siphon with slightly convex sides, index nearly 4; pecten composed of 12–17 spines, of which the more basal are closely-set and the distal 3 or 4 widely spaced; the more basal spines are not, or very slightly, darker in colour than the distal and have each 1 or 2 blunt basal denticles, whereas the much larger distal spines are simple or have 1 very small denticle (the most distal of these spines is, in many specimens, but not in the one figured, placed very near the apex of the siphon) ; tuft placed a little beyond ½ and between the two most distal spines of the pecten, composed of about 5 simple branches, which are much shorter than the diameter of the siphon. Anal segment with complete but poorly sclerotized saddle ; upper caudal seta with about 10 branches, lower single ; lateral seta single, about as long as saddle. Ventral brush composed of 4 pairs of multiple tufts in the barred area and 4 median unpaired tufts. " Gills " narrowly lanceolate, dorsal pair 2½ times length of saddle, ventral slightly shorter.

Breeding-places.—Most commonly found in muddy pools of rain-water, also in rock-pools.

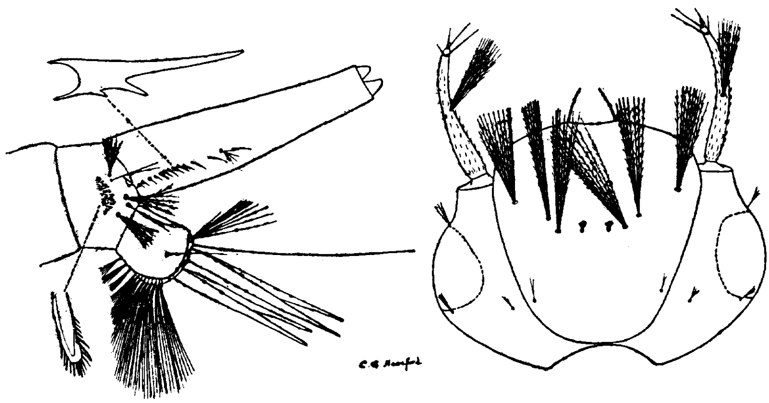


FIG. 89.—*Aëdes* (*Aëdimorphus*) *hopkinsi* Edw. Head and terminal segments.

Aëdes (Aëdimorphus) mixtus Edwards.

Larva and breeding-places unknown. Likely to breed in temporary ground-pools, including swamps.

Aëdes (Aëdimorphus) microstictus Edwards.

Larva and breeding-places unknown. Latter probably ground-pools and swamps.

Aëdes (Aëdimorphus) mutilus Edwards.

The following description is taken from van Someren (1950*c*).

" The larva is very like that of *A.* (*A.*) *filicis* I. and De M., but differs by having the last 5, instead of 3, pecten teeth large, simple and widely spaced.

" *Head.*—Antenna slender, spiculate, curved and pale throughout ; tuft just below a half and with about 8 plumose branches. Setae A, B and C with about 9–11, 5 and 7 plumose branches respectively ; *d* small and with about 10 branches. Mentum with 20 small teeth on either side of the central tooth.

" *Abdomen.*—Comb a patch of about 26 broad, pale coloured, coarsely fringed scales. Siphon pale ; index 4·9* in crushed specimens ; pecten of 15 dark spines, the basal few set close together and each with one coarse and sometimes another very small ventral denticle, the apical 5 spines widely spaced, larger, and simple ;

* This appears to be an error. The paedotype pelt has an index of about 2·9 (crushed).—P. F. M.

subventral tuft with 3 simple branches which are about half the length of the diameter of the siphon, placed well beyond middle and between the last 2 pecten spines. Anal segment with a large, pale, smooth saddle ; lateral seta single and about the length of the saddle ; upper caudal seta with 10 short branches, lower single and long. Ventral brush with 4 pairs of many-branched setae in the barred area and 4 unpaired, branched setae outside. ' Gills ' long and pointed, upper pair a little over 3 times the length of the saddle, lower slightly shorter."

Breeding-places.—Ground pools.—P. F. M.

Aëdes (Aëdimorphus) bedfordi Edwards.

Larva and breeding-places unknown. Likely to breed in ground-pools and swamps.

Aëdes (Aëdimorphus) insolens Edwards.

Larva and breeding-places unknown. Probably breeds in temporary ground-pools and swamps.

Aëdes (Aëdimorphus) domesticus Theobald. (Fig. 90.)

The small number of comb-spines (5–6) and long siphon will immediately separate this larva from that of any described Ethiopian species of *Aëdes* which has spiculate antennae.

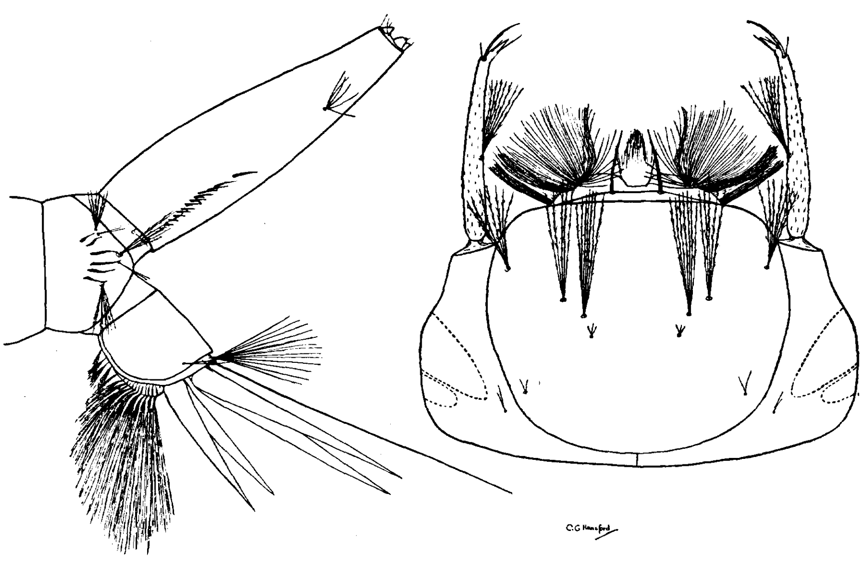


FIG. 90.—*Aëdes* (*Aëdimorphus*) *domesticus* Theo. Head and terminal segments.

Length about 9 mm. ; *colour* not noted.

Head.—Antenna nearly straight, infuscate except basally, strongly spiculate ; tuft of about 8 almost simple branches at about $\frac{3}{7}$. Setae A, B and C with about

10, 6 and 8 almost simple branches respectively; *d* set very far back (almost directly behind C), minute, 3-branched; *e* small, 2-branched. Mentum triangular with, on each side of the central tooth, about 20–30 small teeth not markedly smaller than the former.

Abdomen.—Comb a curved row of 5–6 long, simple, sharp-pointed spines, each with a very narrow basal fringe. Siphon with moderately curved sides, index $4\frac{1}{2}$; pecten of 14–16 spines extending to nearly $\frac{1}{2}$; most distal spine simple and markedly wider spaced than remainder, rest, except the small basal ones, with 1 (occasionally 2) basal denticles; a small subventral tuft of about 6 (4–9) simple branches at $\frac{5}{8}$. Anal segment with large saddle; upper caudal seta with about 20 simple and equal branches, lower single; lateral seta nearly as long as saddle, single or double, simple. Ventral brush of 6 pairs of tufts in the barred area and 4 or 5 unpaired small tufts proximal to it. "Gills" very long and lanceolate, dorsal nearly thrice length of saddle, ventral $\frac{2}{3}$ length of dorsal.

Larvae from Nigeria and from Uganda agree in all respects.

Breeding-places.—The only record in the literature is from borrow-pits (Wesché); in Uganda we have obtained larvae in small pools in a grassy swamp. The record (Hopkins, 1936) from pools in forest refers to *A. leptolabis*.

Aëdes (Aëdimorphus) leptolabis Edwards.

In Uganda this species was bred from larvae and pupae obtained from temporary rain-pools in dense forest. The larva is not known with certainty, but those from the forest pools are not separable from *A. domesticus*.

Aëdes (Aëdimorphus) longiseta Edwards.

Larva and breeding-places unknown. Probably breeds in temporary pools and swamps.

Aëdes (Aëdimorphus) filicis Ingram and de Meillon. (Figs. 91, 92.)

The present species very closely resembles *A. tarsalis*, but differs in possessing fewer scales in the comb, rather more branches in head-seta A, and in that the subventral tuft of the siphon is placed considerably beyond $\frac{1}{2}$; these differences are probably inconstant, since Garnham, Harper and Highton found larvae of *tarsalis* which agree almost perfectly with the description of *filicis*. An amost identical larva has been ascribed by Ingram and de Meillon to *alboventralis*.

Length apparently about 7 mm.; *colour* not recorded, head and siphon not dark.

Head.—Antenna slender, spiculate, strongly curved tuft of about 6 almost simple branches at, or a little before, $\frac{1}{2}$; subapical setae placed a little before apex, one short and the other very short. Setae A, B and C with their bases almost in a straight line; A with about a dozen, B with 5–6, C with 7–8 plumose branches; *d* small, with several branches, placed almost on the transverse line joining the bases of C on the two sides; *e* and *f* rather large, *e* 2-branched, *f* with about 4 branches. Mentum with central tooth no larger than remainder, 18–20 teeth on each side of the centre.

Abdomen.—Comb a patch of 20–30 pale-coloured scales, which are more coarsely-

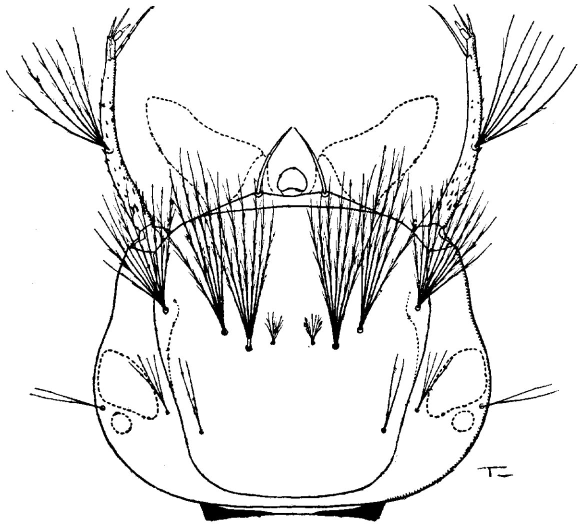


FIG. 91.—*Aëdes* (*Aëdimorphus*) *filicis* Ingr. and De M. Head.

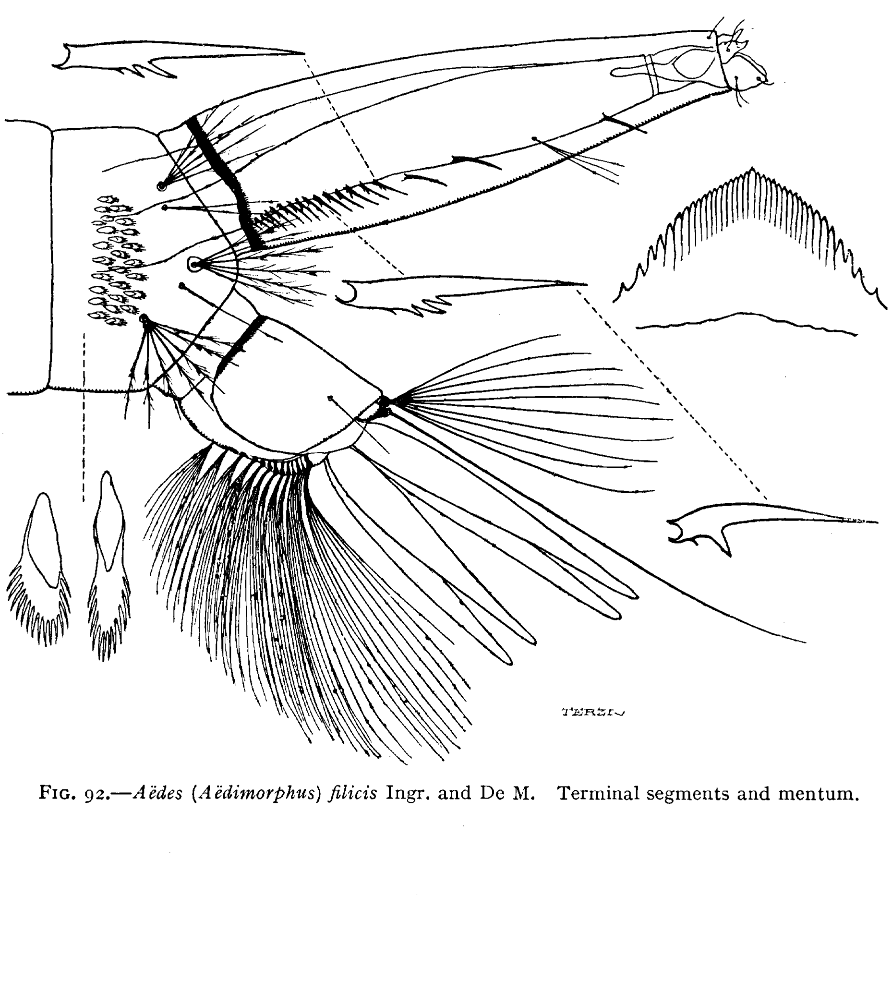


FIG. 92.—*Aëdes* (*Aëdimorphus*) *filicis* Ingr. and De M. Terminal segments and mentum.

fringed than usual. Siphon with slightly convex sides, tapering rapidly beyond about $\frac{1}{3}$, index nearly 4; pecten composed of 17 dark-coloured spines, of which the more proximal are closely set and furnished with prominent denticles and the distal 3 simple and widely spaced, the most distal of all is placed close to the apex of the siphon; subventral tuft placed between the two most distal spines of the pecten and composed of 3 slender branches, which are much shorter than the diameter of the siphon. Saddle of anal segment very large but incomplete, distal edge smooth; upper caudal seta 10-branched, lower single; lateral seta single, small. Ventral brush with about 5 pairs of tufts, each with about 7 branches, in the barred area and 2 small median tufts. "Gills" long and lanceolate, dorsal pair rather longer than ventral.

Breeding-places.—Ingram and de Meillon bred the type-series of this species from a small pool, overshadowed by ferns, in forest.

Aëdes (Aëdimorphus) tarsalis Newstead.

From other species having head-setae B and C with more than 6 branches, lanceolate "gills" and a siphonal index not less than 3 or more than 5, *A. tarsalis* is separated by having a siphonal index of about 4 and a comb of 40–60 (as against 20–30) scales, but certain larvae collected by Garnham, Harper and Highton (1946) seem inseparable from those of *filicis.*

Length about 7 mm.; *colour* brown, head and siphon not markedly darker.

Head.—Considerably broader than long. Antenna slender, curved, spicules rather sparse; tuft of about 6 slightly plumose setae at a little before $\frac{1}{2}$; subterminal setae placed slightly before apex; one very small, the other rather stout and about $\frac{1}{3}$ length of antenna; terminal setae very small. Setae A, B and C tufts of 7–9, 7–9 and 9–10 plumose branches respectively; *d* minute, variable, but usually with about 12 very fine branches, placed slightly behind a line joining the bases of C on the two sides of the head; *e* rather long, 2-branched. Mentum subtriangular, with about 20 small teeth (increasing in size basally) on each side of the centre.

Abdomen.—Comb consisting of 40–50 scales. Siphon rather longer than usual in this subgenus, index nearly 4; tuft of 2–3 small branches a little beyond $\frac{1}{2}$; pecten composed of about 8 spines, of which the more basal are set close together, and have 2–3 small blunt basal denticles, whereas the distal 2 or 3 are simple and much more widely-spaced. Anal segment much longer than broad; saddle nearly complete; upper caudal seta with about 10 simple branches, lower single; lateral seta short and single. Ventral brush with about 4 pairs of many-branched tufts in the barred area and 4 median unpaired tufts proximal to it. "Gills" lanceolate, subequal, $2\frac{1}{2}$ times length of saddle.

The larvae obtained by Garnham, Harper and Highton (1946) differed by head-seta A having 11–12 branches, B 6–7, C 8, the comb-scales 28–35 in number, and the subventral tuft of the siphon at $\frac{3}{5}$.

Breeding-places.—Small rock-pools along a stream (Wigglesworth, 1929*a*), and at the edge of a swamp among grass. The larvae collected by Garnham, Harper and Highton (1946) were, "common in rock pools in the forest, including both sunlit and deeply shaded ones, and were even more common in pools beside rocky streams."

(Larvae sent me by M. Holstein from Forecariah, French Guinea, where the species is common, were collected from Banana axils.—P. F. M.).

Aëdes (Aëdimorphus) yvonneae Edwards.

Larva and breeding-places unknown. Likely to breed in ground pools.

Aëdes (Aëdimorphus) smithburni E. C. C. van Someren.

Larva and breeding places undescribed.—P. F. M.

Aëdes (Aëdimorphus) phyllolabis Edwards. (Fig. 93.)

The larva doubtfully ascribed to this species (Hopkins, 1936) proves to be that of some other form ; it is perhaps only a variety of *albocephalus*.

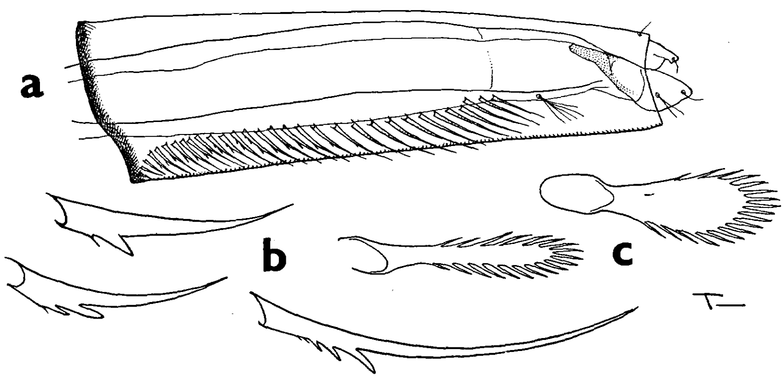


FIG. 93.—*Aëdes* (*Aëdimorphus*) *phyllolabis* Edw. Larval details. *a*, siphon. *b*, pecten teeth. *c*, comb scales.

The true larva of *A. phyllolabis* is separable from those of all other Ethiopian species by the extreme development of its pecten ; the larva of *A.* (*Banksinella*) *palpis*, Newstead, also has a greatly developed pecten, but in the latter species the comb is composed of spines and the chaetotaxy of the head is completely different.

Edwards (1941) describes the larva as follows :

"*Head* about as broad as long, mostly pale except towards neck. Antenna shorter than head, moderately stout and tapering, entirely pale and coarsely spiculate ; tuft of about 5 branches placed at or just before middle of shaft ; one of the subapical bristles long and rather stout, the other scarcely one-third as long ; apical bristle as long. Setae A, B, C and *d* in a slightly curved line, the last three about equidistant ; A with 8–12, B and C each with 5–7 plumose branches, all of much the same length and shorter than antenna ; *d* very small as usual, with several irregular branches. Mentum with about 15 teeth on each side of the larger median tooth, mostly close-set.

"*Abdomen.*—Comb a patch of about 50–60 scales which are longer than broad, and evenly fringed all round. Siphon pale except for the narrow basal ring, evenly tapering ; index 4 ; tracheae filling siphon. Pecten composed of unusually large spines and extending about $\frac{3}{4}$ length of siphon or even more ; all spines pale, rather evenly spaced, and 35–40 in number; basal spines small as usual, but the rest long and sharp-pointed; about the first 25 teeth have a rather long denticle near middle and one or two smaller ones towards base; remaining spines mostly or all simple, curved, except last one, which is straight. Subventral tuft just beyond, but internal to the last pecten-spine; 5–6 branched, about half as long as diameter of siphon. Saddle large, distal margin not obviously spiculate. Upper caudal seta with about 6 branches, half as long as the single lower caudal seta. Lateral seta small and single. Ventral brush composed of about 6 pairs of tufts, with sometimes one unpaired tuft outside the barred area. Gills long, slender, sharp-pointed, about three times as long as saddle."

Breeding-place.—Rock pool in dense forest shade.

Aëdes (Aëdimorphus) minutus Theobald. (Fig. 94.)

The complete absence of spicules on the antenna will at once separate this larva (which is unfortunately only known from much-damaged pelts) from any other member of the subgenera *Aëdimorphus, Banksinella, Diceromyia* and *Finlaya.* The shape of the pecten spines is also highly characteristic, but is not unlike that found in *natronius, palpalis* and *phyllolabis.*

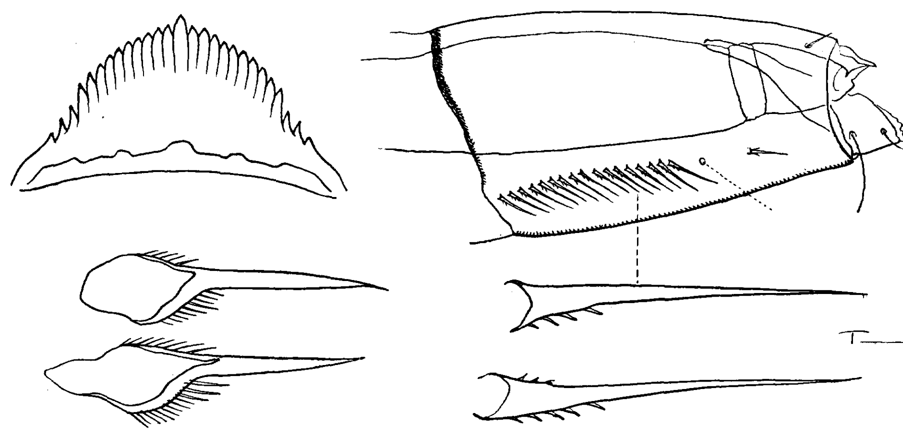


FIG. 94.—*Aëdes (Aëdimorphus) minutus* Theo. Mentum, siphon, comb-spines and pecten-spines.

Length probably about 6 mm.; *colour* not recorded; head dark, siphon pale.

Head.—Antenna short and cylindrical, entirely without spicules; tuft of 4 simple branches at a little before $\frac{1}{2}$. I am unable to make out the head-chaetotaxy with certainty, but B and C appear to be single. Mentum with about 15 teeth on each side of the centre.

Abdomen.—Comb an irregular row of 5–8 spines which have a strong terminal denticle and a broad fringed base. Siphon crushed; index in skins about $1\frac{1}{2}$, probably at least 2 in uncrushed larvae; pecten of 18 spines, of which the most distal is very widely spaced; spines very unusually long, straight or concave dorsally, each with 3–4 basal denticles on the ventral side (the distal spine has denticles on both the ventral and dorsal sides); scar of subventral tuft placed between the last

2 pecten-spines, at about $\frac{3}{5}$. Anal segment too damaged to be described; "gills" missing.

Breeding-places.—The larvae are stated by Ingram and de Meillon to have been found in pools in a river-bed; the label of the slide is "from rock pools."*

Aëdes (Aëdimorphus) pseudotarsalis E. C. C. van Someren. (Fig. 95.)

The larva is at once distinguished from that of any other known Ethiopian species of the genus† by the presence of a row of appressed long black spines near the apex of the siphon. The following description is taken from E. C. C. van Someren (1946*a*):

"*Head.*—Antenna pale, spiculate, and with a tuft of 10 finely plumose setae just below a $\frac{1}{2}$. Seta A with 10–15, B with 6–8, and C with 7–9 plumose branches; *d* small and with about 11 branches. Mentum with 17–20 teeth on either side of the central tooth."

"*Abdomen.*—Comb a patch of 29–33 scales. Siphon pale with a ventral semi, circle of long black spines near the apex; index $3\frac{1}{2}$–4. Pecten of 16–21 fairly long-dark spines, the last 2–3 more widely spaced, and in one specimen one of the more widely spaced spines is placed beyond the subventral tuft. The most distal spine is always simple, and sometimes all the more widely spaced spines are simple; the rest have from 1–3 denticles. Subventral tuft usually placed just beyond the pecten at two-thirds, with 2–3 simple branches which are not quite as long as the diameter of the siphon at point of attachment. Saddle complete; lateral seta single, simple, and about the length of the saddle. Ventral brush with 5 paired setae each with 8 branches and 2 unpaired tufts outside the barred area. Gills long, narrow, and lanceolate, about twice the length of the saddle."

Breeding-places.—A borrow-pit and rock-holes (E. C. C. van Someren (1946*a*)).

Aëdes (Aëdimorphus) yangambiensis De Meillon and Lavoipierre.

The larva is very close to those of *hopkinsi*, *tarsalis* and *filicis*, but differs from all these by there being no isolated pecten-spine placed beyond the subventral tuft of the siphon, also by the smaller number of spines in the comb, but this latter character is not likely to prove constant. The description below is that of de Meillon, Parent and Black (1945).

"*Head.*—Antenna spiculate, about half length of head. Tuft situated at about $\frac{1}{2}$ consisting of 14 sparsely plumose branches. Head seta A with 10 plumose branches;

* From an examination of some larvae sent me by M. Holstein from Dubreka and Forecariah in French Guinea I am able to add the following details:

"Antennal tuft with 2–4 branches. Seta A with about 5–7 branches, B and C single. B slightly anterior to A, C further back, almost directly behind B. *d* small and slender, split distally, inserted close to B but nearer the mid-line. Comb with up to 9 spines, an atypical bifid one occasionally present. Siphonal tuft with 5–8 branches. Pecten with 19–32 teeth. Two specimens have 2 teeth beyond the siphonal tuft, the more distal one being almost at the tip of the siphon. Saddle apparently incomplete below, its distal edge devoid of spicules. Lateral seta short, slender, single. Upper caudal seta with about 5–6 branches, lower single. Ventral brush with 6 pairs of tufts. No unpaired tufts outside the barred area although the four proximal ones are more widely spaced than the remainder and more or less on the mid-line. "Gills" narrow, pointed, between 2 and 3 × as long as the anal segment. The larvae were obtained from banana axils and from a water-bottle in a banana grove."—P. F. M.

† The larva of *A. boneti* also has conspicuous appressed spines at the apex of the siphon. Those specimens of *pseudotarsalis* available to me appear to have the saddle incomplete in the mid-ventral line.—P. F. M.

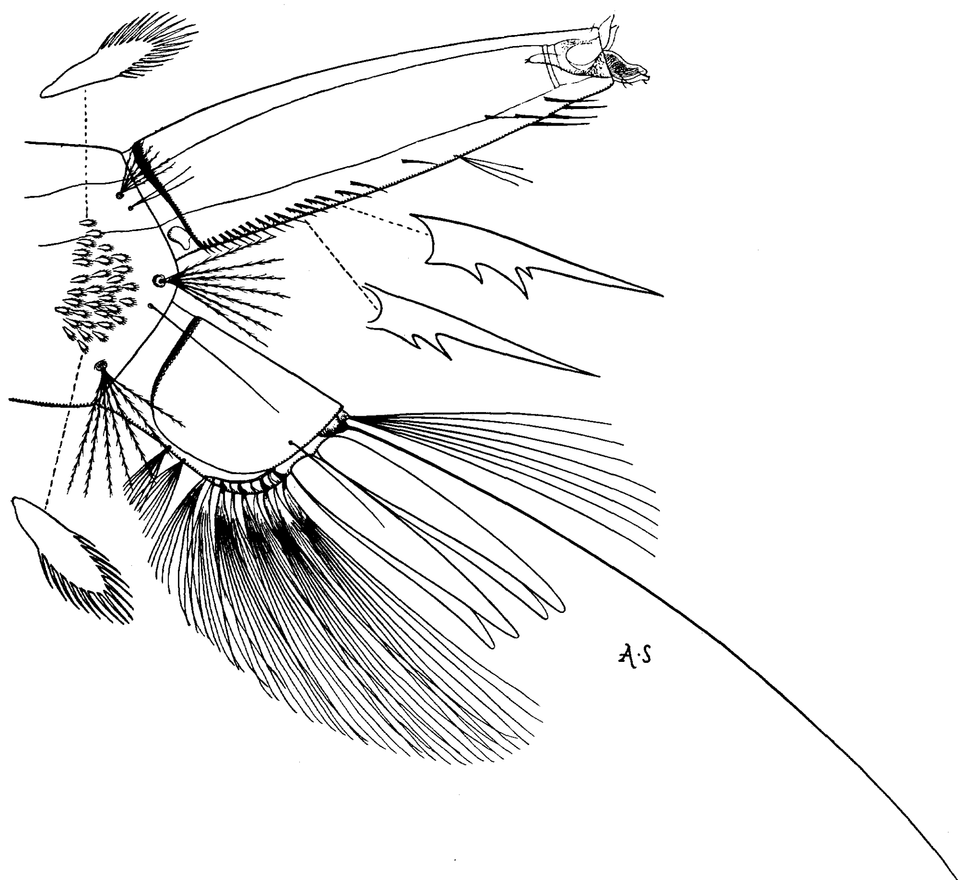


FIG. 95.—*Aëdes (Aëdimorphus) pseudotarsalis* E. C. C. van S. Terminal segments.

B with 4 sparsely plumose branches ; C appears to be 5-branched and *d* is missing. Mentum with 15 small teeth on each side of the central tooth.

"*Abdomen.*—Comb a patch of 15 pale, short, broad scales. The specimen examined was slightly flattened but the siphon appeared to have convex sides. Siphonal index 2·8. Pecten of 16 spines, heavily pigmented and with 1 or 2 basal denticles, the proximal spines having one large basal denticle and sometimes a second smaller one, and the 2 distal spines which are longer than the rest with 1 or 2 basal denticles. The 2 distal pecten-spines are more widely spaced than the rest. The subventral tuft is minute and composed of 4 simple branches which are shorter than the diameter of the siphon, and the tuft is placed distally to the end of the pecten. Anal segment rather badly damaged. Upper caudal seta missing. Lower caudal seta single. Ventral brush with 4 pairs of tufts in barred area and with several small unpaired tufts proximal to the barred area. Lateral seta and gills missing."

Breeding-places not recorded. Probably breeds in ground pools.

Aëdes (Aëdimorphus) albocephalus Theobald. (Fig. 96.)

This species is distinguished from most others by the combination of spiculate antennae, multiple head-setae B and C, a comb composed of ten or a dozen spines, and a short siphon bearing a pecten of about 10 (7–11) pale-coloured spines. From *lineatopennis*, which it rather closely resembles, it is easily distinguished by the longer subventral tuft of the siphon and smaller number of pecten-spines.

Length about 6½ mm.; *colour* greyish, head and siphon rather pale brown.

Head wider than long, slightly more than half width of thorax. Antenna slender, curved, a little more than half length of head; tuft of half a dozen plumose branches

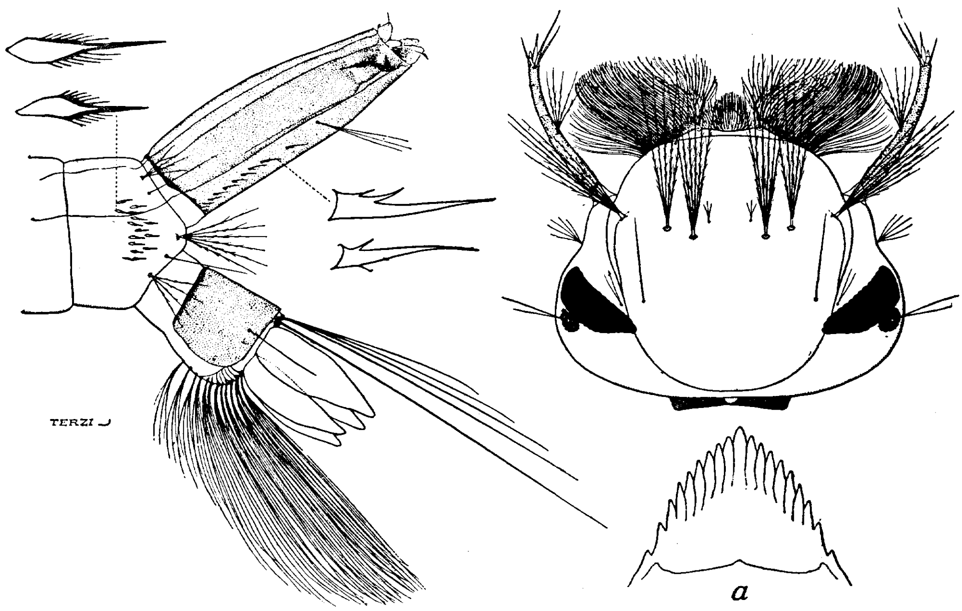


FIG. 96.—*Aëdes* (*Aëdimorphus*) *albocephalus* Theo. Head and terminal segments. *a*, mentum.

at about ½. Setae A, B and C plumose, with about 8, 5 and 6 branches respectively; bases of B and C close together; *d* minute, with 3–6 branches; *e* rather long, single. Mentum subtriangular, with 9 teeth on each side of the centre.

Abdomen.—Comb of 12–15 pale-coloured spines arranged in an irregular patch, spines with a moderately long basal fringe. Siphonal index about 3; subventral tuft at a little beyond ½, composed of 3 simple branches; pecten not extending to ½, of 9–11 spines which have few basal denticles and are more widely spaced distally. Anal segment with an incomplete saddle, posterior margin smooth; upper caudal seta with 4 branches, lower single; lateral seta single, simple, about as long as saddle. Ventral brush composed of about 5 pairs of multiple tufts and 3 median tufts outside the barred area. "Gills" subequal, nearly 1½ times length of saddle, broadly lanceolate.

Specimens from Uganda agree in most respects with those from the Gold Coast described above, but have fewer (8–10) comb-spines and only 7–9 pecten-spines.

The " gills " are slightly narrower than in specimens from the Gold Coast, but a series captured at the same time and place is variable in this respect. It seems possible that the larva described by Ingram and Macfie (1917) as that of *minutus*, and later doubtfully ascribed (Hopkins, 1936) to *phyllolabis*, may be only a variety of *albocephalus*. The principal differences from typical larvae of this latter species are that the " gills " are considerably shorter, the subventral tuft of the siphon has more numerous and shorter branches, head-seta *e* is 2-branched and shorter and the mentum is rather differently shaped. With the possible exception of the last-mentioned, all these characters fall within the normal range of variation in this subgenus.

Breeding-places.—Typical sites for larvae of this species are grassy swamps, including the edge of Lake Victoria, where they are seasonally common. They are also to be found in pools of various kinds, small streams and drains, and even in crab-holes (Ingram and Macfie, 1917). Harris (1942) found the species breeding ' in marshy pools in creeks and drains," the mention of creeks suggesting that it can tolerate some degree of salinity. The larvae ascribed by Ingram and Macfie to *minutus* were found " at the margin of a lagoon in crab-holes that had been enlarged by children digging for crabs. The water in which they were living was dirty, thick with deposit, and quite salt."

Aëdes (Aëdimorphus) congolensis Edwards.

Larva and breeding-places unknown. Likely to occur in ground-pools after heavy rain.

Aëdes (Aëdimorphus) tricholabis Edwards.

The larva of the type form is unknown. The following description of ssp. *bwamba* is taken from van Someren (1950*d*).

" Very similar to *A*. (*A*.) *filicis* I. and De M., from which it can be differentiated by having the head setae B and C only 2-branched. Dr. Haddow (personal communication) states that the larvae are very pale and transparent in life, with the eye spots very large and black. Usually the swimming is done with the mouth brushes but when they are disturbed, body swimming movements occur. They are markedly restless, often looping the loop under water and have a habit of browsing. The larval skins are very fragile, with all the setae pale and transparent and easily detached.

" *Head.*—Antennae pale throughout, not much shorter than the head, curved and spiculate ; tuft at a half has been detached in all specimens ; terminal setae just below the apex. Seta A short and with about 6 very fine branches ; B and C longer, stouter, plumose and 2-branched ; *d* small, very fine and inconspicuous, and with about 4 branches. Mentum with 16 teeth on either side of the central tooth.

" *Abdomen.*—Comb a patch of 17–21 broad, pale coarsely fringed scales. Siphon pale, index about 4 ; pecten not quite reaching to a half, of 17–19 slightly darker spines, each with one course," [coarse] " and sometimes with an extra one or two smaller, ventral denticles, the last 2 spines wide spaced and larger ; subventral tuft beyond a half and with 5–7 very fine branches which are less than the diameter of the siphon at point of attachment. Anal segment with a large pale saddle, the distal edge of which has a patch of large pale spicules; lateral seta single or 2-branched and about the length of the saddle. Upper caudal seta with 11–14 short branches, lower single. Brush with 4 paired setae in the barred area and 4 many-branched, unpaired setae outside. 'Gills' about twice the length of the saddle and pointed."

Breeding-places.—Ground pools.—P. F. M.

Aëdes (Aëdimorphus) abnormalis Theobald.

Five paratype pelts of the subspecies *kabwachensis* are very similar to those of *A. wigglesworthi* and *alboventralis*, but differ in the points noted below. As in *wigglesworthi* and *alboventralis*, both the subterminal setae of the antenna are long and equal in length to the terminal seta—a point which will distinguish these three larvae from many or most others of the genus. All three are exceptional in that the antenna is longer than the head.

Antenna not much longer than head, therefore resembling *alboventralis* more than *wigglesworthi*, but still more infuscated, with less than the proximal fourth pale; tuft at or only slightly beyond middle. Setae B and C longer than in *wigglesworthi*, reaching a little beyond front edge of clypeus. Mentum with 12–14 teeth on each side of the median tooth. Siphon with tip rather narrower; last two (simple) pecten spines more widely spaced; subventral tuft (when traceable at all) nearer to last pecten spine than to tip of siphon.

Breeding-place.—Rock pool in dense shade, in company with *phyllolabis* and *tarsalis*.

Aëdes (Aëdimorphus) semlikiensis E. C. C. van Someren.

Larva and breeding-places undescribed.—P. F. M.

Aëdes (Aëdimorphus) wigglesworthi Edwards. (Fig. 97).

The great length of the antenna will immediately separate the larva from any other member of the genus except *alboventralis* (p. 184). The absence of unpaired median tufts from the ventral brush is a most unusual character in this subgenus.

Length about 8 mm.; *colour* pale.

Head somewhat triangular, decidedly broader than long (as 1·4 : 1). Antenna extremely long and slender (slightly longer than head), sparsely spiculate, colourless throughout; tuft of 5 or 6 short, slightly plumose branches at $\frac{2}{3}$; subterminal and terminal setae placed together at apex, $\frac{1}{6}$ length of shaft; papilla on a cylinder of chitin as long as diameter of shaft. Setae A, B and C all small and plumose, their bases and that of *d* almost in a straight line; A with 5 or 6 branches; B and C 3-branched and placed close together; *d* minute; *e* very small, with 2 subplumose branches. Mentum triangular, with about 12 teeth, which become larger and wider spaced basally, on each side of the centre.

Abdomen.—Comb a patch of about 30 broad strongly-fringed scales. Siphon pale except for a very narrow dark basal ring, index 3; pecten of about two dozen spines extending nearly to $\frac{1}{2}$; spines darkened apically and with 3 or 4 blunt basal denticles, the 2 or 3 most distal spines more widely spaced, pale and simple. Subventral tuft very small, 5-branched, placed almost at apex of siphon. Anal segment about as broad as long; saddle covering almost entire segment; distal margin spiculate, especially dorsally; upper caudal seta with numerous short branches,

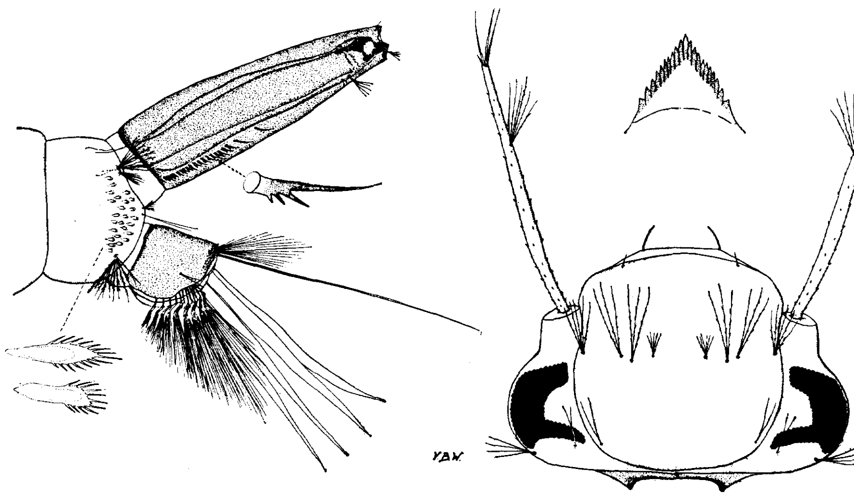


FIG. 97.—*Aëdes (Aëdimorphus) wigglesworthi* Edw. Head, terminal segments and mentum.

lower single; lateral seta with 2–4 short delicate branches. Ventral brush of about 6 pairs of multiple tufts, none of which are outside the barred area. "Gills" lanceolate, equal, four times length of saddle.

Breeding-place.—The larva was collected from "a shady roadside puddle in a rubber plantation."

Aëdes (Aëdimorphus) eritreae Lewis.

Larva unknown. Lewis (1943*b*) records breeding in a large rock-pool.

Aëdes (Aëdimorphus) alboventralis Theobald.

The larva very closely resembles that of *wigglesworthi*, but differs in the following respects:

Antenna somewhat stouter in proportion, the distal half infuscated. Subventral tuft of siphon placed more proximally, about midway between the most distal pecten-spine and the apex of the siphon.

Breeding-places.—The larvae were not uncommon in open pools in swampy ground.

The larva attributed to *alboventralis* by Ingram and de Meillon is entirely different, and resembles that of *filicis* very closely indeed. The unique skin was kindly lent to me by Dr. de Meillon. I am unable to find any tangible difference from *filicis*, with the exception that the siphon (which is badly crushed) has now an index of only 2. This represents an index of at least about 3 before crushing, and it seems possible that the larva is really that of *filicis*.

Ingram and de Meillon record *alboventralis* as breeding in a small stream, pools in a stream, a marsh and water-holes. These records might quite possibly refer to *filicis*, but the only record of the latter species is from a pool in forest.

Aëdes (Aëdimorphus) leesoni Edwards. (Fig. 98.)

The larva of the typical form is unknown; the description by Lewis (1944) of that of *A. l. verna* is given below. The larva is separable from those of all other species with a similar head-chaetotaxy and with a comb composed of scales by the

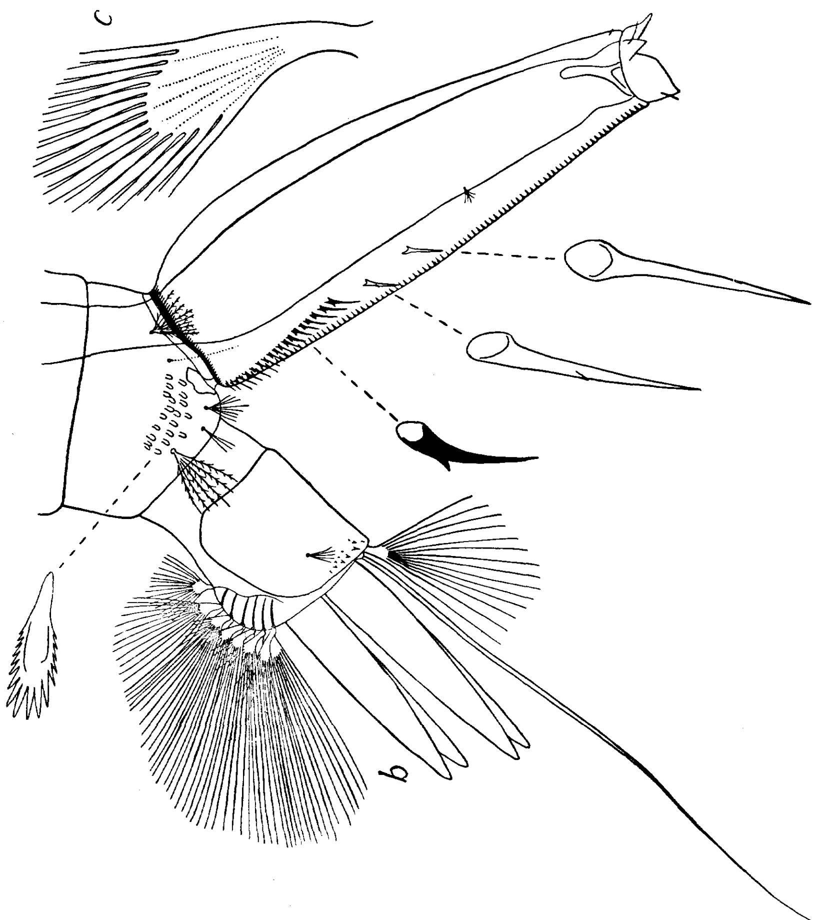


FIG. 98.—*Aëdes* (*Aëdimorphus*) *leesoni* ssp. *verna* Lewis. Terminal segments and base of tuft from ventral brush.

fact that there is only one unpaired tuft in the ventral brush proximal to the barred area.

"*Head* distinctly broader than long. Antennae almost as long as head, spiculate, infuscated on distal half; tuft of about 9 branches at $\frac{2}{5}$; terminal and sub-terminal setae placed together at apex, the latter seta $\frac{1}{6}$ length of shaft; papilla on a cylinder of chitin shorter than diameter of shaft. A, B and C plumose, their bases and that of *d* almost in a straight line ; A with about 6 branches, B 3-branched and C 4-branched, *d* minute, *e* and *f* with 4 branches.

"*Abdomen* : comb of about 20 scales. Siphon pale except for basal ring, index 4·3 ; anteriorly near base it narrows steeply to basal ring ; pecten extending to about $\frac{1}{2}$ and consisting of about 21 spines of which the most distal 1 or 2 are wider spaced ; most spines dark with one basal denticle ; last 1 or 2 pale, last one simple ; sub-ventral tuft very small, with about 5 branches, placed at about $\frac{2}{3}$. Anal segment with an incomplete saddle, a few spicules near posterior margin ; upper caudal seta with about 15 branches, as long as saddle, lower single ; lateral seta small, branched. Ventral brush with six pairs of many-branched tufts in the barred area and one unpaired tuft proximal to it ; tufts with unusually wide bases. Gills lanceolate, longer than saddle, subequal."

Breeding-places.—De Meillon and Rebêlo (1941) reared adults of the typical form from larvae collected in open rain-pools. Lewis (1944) found larvae of subspecies *verna* in pools and also in domestic water jars " to which they may have been transported."

Aëdes (Aëdimorphus) dalzieli Theobald.

Mr. G. G. Robinson kindly supplied me with the following notes on the larva of this species *in litt*:

" This larva is rather like Hopkins's description of *alboventralis* but would appear to differ in the shorter antenna. Larvae in the batch examined were pale and inclined to be sluggish.

"*Length* about 9 mm.

"*Head* broader than long (1·6 : 1). Antennae strongly spiculate, a little shorter than the head. Tuft at $\frac{1}{2}$, of ten branches. Distal half infuscated. Setae A, B and C smallish and plumose, A with 8 branches, B and C with 3 (occasionally 4), *d* very small with 4 branches. Mentum with 14 teeth a side.

"*Abdomen.*—Comb a patch of 20 strongly fringed scales. Siphon pale with dark basal articulation ; index about 4. Pecten of 22 spines the last two of which are more widely spaced. 1–3 secondary denticles. Subventral tuft very small with 5 branches and placed half way between distal pecten spine and the apex. Saddle incomplete ; upper caudal seta 5–7 branches, lower single about twice as long as saddle. Ventral brush—5 pairs of tufts on the barred area, 2 median tufts. Gills very long and lanceolate.

"*Breeding-places.*— ' A roadside puddle ' (Robinson *in litt.*) and a stream (Leeson 1931). A specimen from the collection of the Wellcome Tropical Research Laboratory is labelled as reared from ' stagnant water in dung pits, sanitary well ' (Hopkins MS.). —P. F. M.

Aëdes (Aëdimorphus) irritans Theobald. (Fig. 99.)

The small size of the " gills " and their rounded shape distinguish this species from any other known *Aëdes* larva in our area which has a similar head chaetotaxy.

Length about 7 mm. ; *colour* pale, including head and siphon.

Head.—Antenna with spiculations very delicate and somewhat sparse; tuft of about 4 simple branches slightly beyond $\frac{1}{2}$. Setae A, B and C with about 10, 5 and 6 plumose branches respectively, B much longer than the others, and about $\frac{2}{3}$ length of head; *d* very small, with 2–3 branches, *e* single, *f* double. Mentum with sides convex apically, concave towards the base; central tooth small, but slightly larger than its neighbours; there are about 9 small teeth on the convex portion of each side and below these 5 larger ones, which diminish in size towards the base, so that the largest are just beyond the beginning of the concave portion.

Abdomen.—Comb a roughly triangular patch of about 50 small scales. Siphon with index about $3\frac{1}{2}$; pecten of 15–20 rather small pale-coloured spines extending

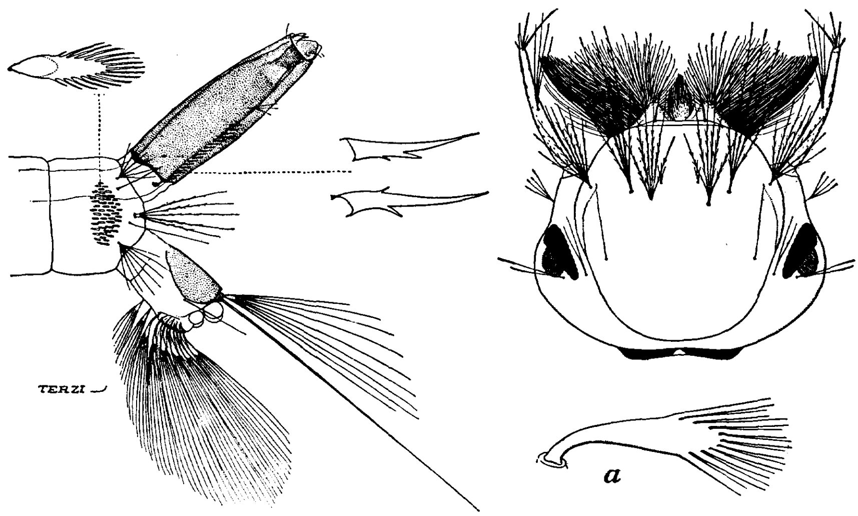


FIG. 99.—*Aëdes (Aëdimorphus) irritans* Theo. Head and terminal segments. *a*, base of one of the tufts of the ventral brush.

nearly to $\frac{1}{2}$; these spines long and narrow, and usually with only one small basal denticle; subventral tuft at about $\frac{2}{3}$, composed of 2–4 simple branches, which are much shorter than the diameter of the siphon. Anal segment with saddle covering less than half its lateral area; posterior margin of saddle smooth; upper caudal seta with about 10 branches, lower single; lateral seta single. Ventral brush composed of about 5 pairs of many-branched tufts in the barred area and 2 unpaired tufts proximal to it. "Gills" very short and rounded; dorsal pair larger than ventral, but less than $\frac{1}{3}$ length of saddle; the width proportionally to the length is not quite so great as is shown in the figure, and the apices in particular are narrower.

Breeding-places.—Many authors have found larvae of this species in crab-holes and brackish surface pools, and these are evidently its main breeding-grounds; Dalziel records finding them also frequently in wells, once in a boat and twice in roof-gutters. Macfie and Ingram (1916*a*) note that "in one sample in which *O. irritans* was flourishing an analysis showed that the chlorine amounted to 1400 parts per 100,000 (2·2% salt)."

Aëdes (Aëdimorphus) nigricephalus Theobald. (Figs. 100, 101.)

From all other species with ovoid "gills" *nigricephalus* is easily distinguished by the chaetotaxy of the head. Among the species with lanceolate "gills" *centropunctatus* shows greatest resemblance to the present species, but has head-seta B

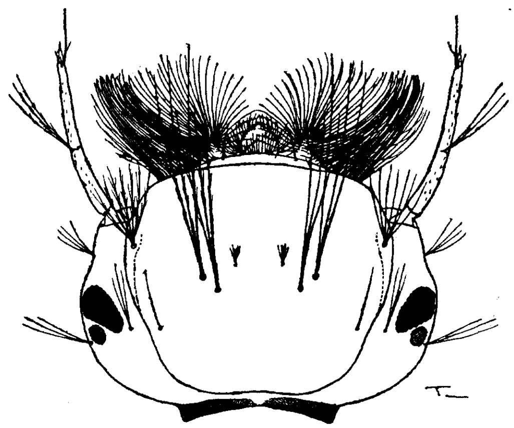


FIG. 100.—*Aëdes* (*Aëdimorphus*) *nigricephalus* Theo. Head.

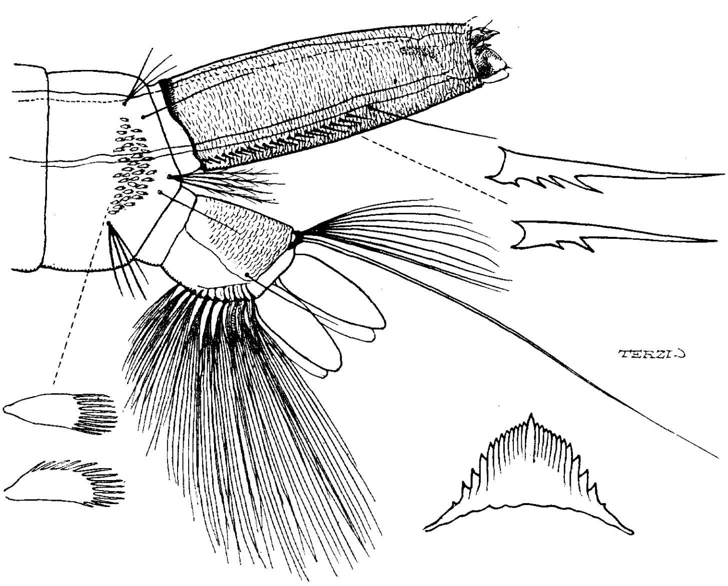


FIG. 101.—*Aëdes* (*Aëdimorphus*) *nigricephalus* Theo. Terminal segments and mentum.

much longer and with only 2 branches, and the distal pecten spines markedly wider spaced.

Length about 6 mm.; *colour* not recorded.

Head.—Antenna very slender, sparsely spiculate, rather more than half length of head; tuft of about 4 sparsely plumose branches at $\frac{1}{2}$. Seta A with about 8 plumose branches, which are less than half as long as those of C; B and C each with 3 plumose branches; branches of B nearly as long as head, those of C two-thirds length of those of B. Mentum with about 12 teeth each side of the centre.

Abdomen.—Comb a patch of about 50 small scales. Siphon with slightly convex sides, broadest about middle, index about 3; pecten of 12–19 spines, which have few (usually 1 large and 1 or 2 small) basal denticles, and of which none are markedly wider spaced nor different in colour from the others; subventral tuft a single rather stout simple seta at a little before $\frac{2}{3}$. Anal segment with a rather small saddle, distal edge smooth; upper caudal seta with about 12 branches, lower single; lateral seta single. Ventral brush of 4 pairs of many-branched tufts and 3 unpaired tufts proximal to the barred area. "Gills" short (dorsal pair about as long as saddle, ventral slightly shorter) and ovoid.

Breeding-places.—Many authors have recorded the species as common in crab-holes; Dalziel also found larvae commonly in surface pools and once in a canoe.

Aëdes (Aëdimorphus) lamborni Edwards. (Figs. 102, 103.)

Two larvae of a batch from which *lamborni* was bred, and which have been described by Edwards (1926), probably belong to this species. The larvae are in balsam, and some of the details are difficult to make out.

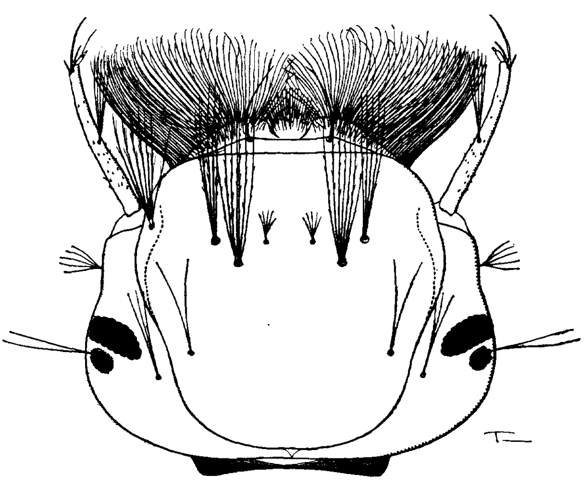


FIG. 102.—*Aëdes* (*Aëdimorphus*) *lamborni* Edw. Head. Seta A is omitted on one side and both this and *d* should have more numerous branches.

The very large number of comb-scales distinguishes this larva from any of its known congeners, except *longipalpis* and *apicoannulatus*; the former has head-setae B and C single, whereas the latter has a much longer siphon bearing a subventral tuft with much longer branches; the pecten of the present species and the colour of the siphon are also rather characteristic.

Length about 8 mm.; *colour* not recorded, but evidently dark. Head not much darker than body; siphon rather dark at base and darkening gradually to a point near the apex ; at this point the dark colour ceases abruptly and the tip of the siphon is yellow.

Head.—Antenna about ½ length of head, slender, rather sparsely spiculate, curved, tapering very slightly and uniformly ; tuft of 4–5 apparently simple branches, which are rather less than ½ length of antenna, at just before ½. Setae A, B and C almost in line ; A with about 12 plumose branches, B 6-branched, C with 8–9 branches which are rather shorter than those of B ; *d* placed almost directly in front of C, small, but

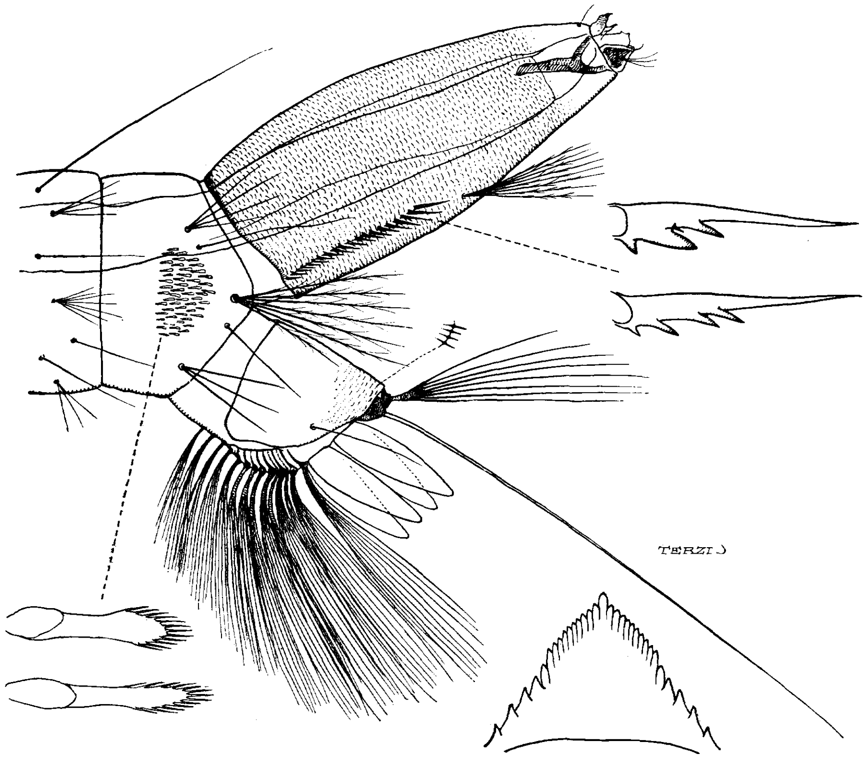


FIG. 103.—*Aëdes* (*Aëdimorphus*) *lamborni* Edw. Terminal segments and mentum. The comb-scales are more numerous than shown.

with about 10 branches ; *e* and *f* both 2-branched. Mentum triangular, central tooth not much larger than its neighbours ; about 14 rather coarse teeth on each side, of which the first 7 are smaller and more closely set than the remainder.

Abdomen.—Comb a patch of about 100 small scales. Siphon crushed, but apparently with convex sides and evidently short (index 2½ in the mounted material, probably about 3 in uncrushed specimens) ; pecten extending to about ⅓, composed of 25–30 very closely set dark-coloured spines, each with 2–4 conspicuous basal denticles ; most distal spine larger than remainder and simple or nearly so, but not wider spaced ; subventral tuft placed at about ½ and thus well beyond end of pecten, composed of 9–11 stout plumose branches, which are (in the crushed specimens) about ⅗ as long as the diameter of the siphon, and in uncrushed material would probably be about as long as the diameter. Anal segment with saddle large, distal edge smooth, but bearing a few spicules near the bases of the caudal setae ; upper caudal seta with about 10 branches, lower single ; lateral seta short, single. Ventral brush with about 6 pairs of many-branched tufts in the barred area and 2 or 3 proximal to it. Dorsal pair of "gills" missing; ventral broadly lanceolate, about length of saddle.

Breeding-places.—The type was reared from a larva found in a pool of foul water in the top of a well-shaded rock (Edwards, 1922–23), and the larvae described above were found in a "pig-hole" (Dr. Van Someren, who collected them, kindly informs me that this was a muddy pool used as a pig-wallow). The only other published record is one (McHardy, 1929) from streams or drains, but Dr. R. E. Lloyd has reared the species from rock-pools in Rhodesia, and Harris (1942, p. 184) seems to imply that McHardy's record also applies to rock-pools.

Aëdes (Aëdimorphus) boneti Gil Collado. (Fig. 104.)

The following description of the larva of ssp. *kumbae* is taken from Chwatt (1948). Dr. Chwatt kindly allowed me the use of his MS. while his paper was still in the press:

"*Length* 6 to 8 mm: *colour* dark brown to blackish.

"*Head* somewhat broader than long, uniformly pigmented. Antennae slender, slightly more than two fifths the length of the head, spiculate, uniformly coloured, except for a narrow dark ring at the base. One long subterminal seta about twice the length of the terminal seta, and one short subterminal seta about half the length of the latter. Antennal tuft at two fifths the length of the shaft, with 3 to 4 simple branches, the longest of which is about half the length of the antenna. Clypeal spines slender, about one quarter the length of the head. Seta A with 6 to 9 delicate plumose branches, seta B slightly longer than either A or C, with 4 to 6 delicately plumose branches ; C with 7 to 9 almost simple branches ; *d* very small, situated on the inner side of the base of B with 3 to 5 simple branches. Mentum in the form of an obtuse-angled triangle, with 13–16 teeth on either side of the large central tooth, the four basal teeth larger than the subterminal teeth and widely separated.

"*Thorax* with the spines at the bases of the metathoracic pleural tufts small and blunt, those at the bases of the mesothoracic tufts larger.

"*Abdomen* with the comb forming a triangular patch of about 60 to 80 delicately fringed scales. Siphonal seta with 3 simple branches, subsiphonal seta with 5 plumose branches, anal seta with 3 stiff simple branches. Siphon dark, with a scale-like arrangement of chitin up to about $\frac{1}{8}$ of the distance from the base to the apex, where the surface becomes gradually smooth and slightly paler. Siphonal index about 3. Subventral tuft at about $\frac{2}{5}$ the distance from the base to the apex of the siphon, with 6–10 plumose branches, approximately equal in length to the diameter of the siphon. A double, not very regular, and rather asymmetrical row of long, strong, dark, simple (occasionally bifid) spines, 6–8 on either side, extending from below the subventral tuft almost to the apex, where they form an irregular bunch of 8–10 spines. The terminal spines are stronger, darker, and almost twice the size of subterminal spines. Pecten composed of 17–22 spines, reaching nearly to the siphonal tuft. Basal pecten spines minute, occasionally widely separated from the remainder, with both dorsal and ventral denticles. Typical middle spines with 3 ventral denticles.

One or more of the distal spines have one minute denticle or are simple. The distribution and the number of pecten spines on each side of the pecten is often unequal. Anal segment with the saddle well developed, its chitin scale-like, as in the siphon. Distal edge more heavily chitinized and almost simple. Lateral seta simple. Upper caudal seta with 12–14 branches, lower caudal seta long and simple. Ventral brush with 5–6 paired tufts in the barred area and 2–4 unpaired tufts. Anal papillae

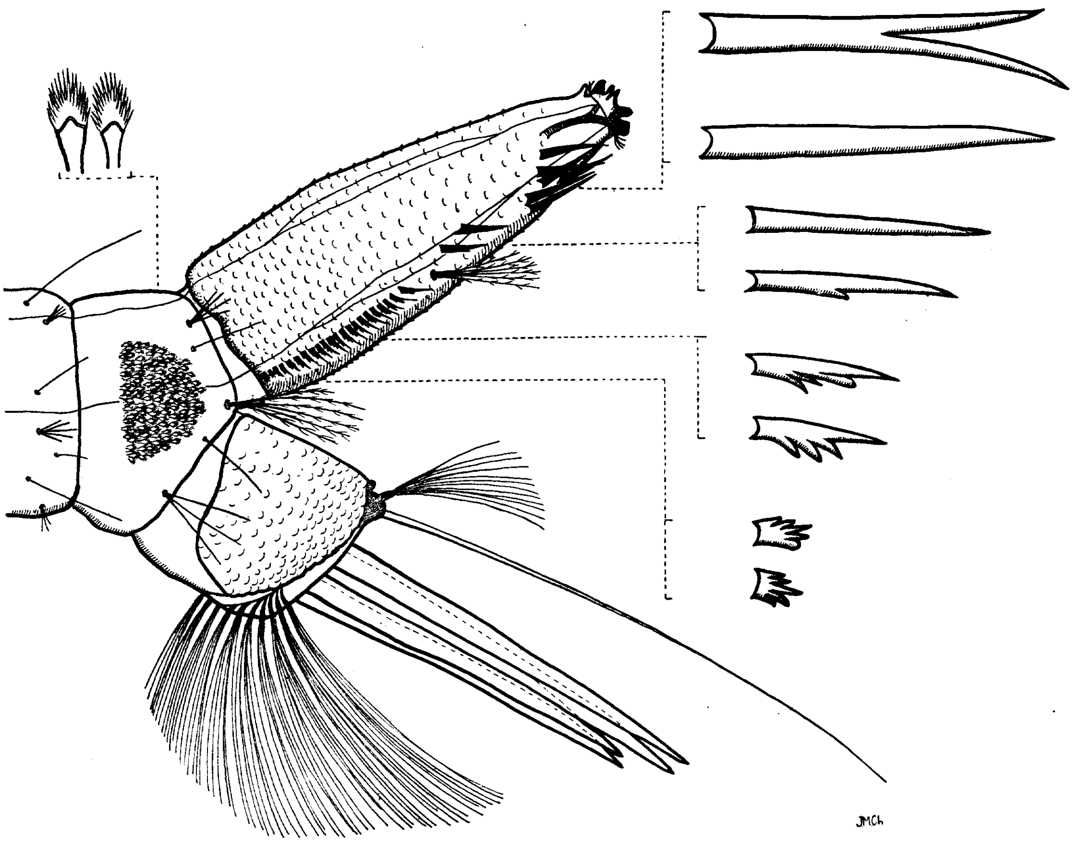


FIG. 104.—*Aëdes (Aëdimorphus) boneti* ssp. *kumbae* Chwatt. Terminal segments.

lanceolate, the dorsal pair about three times the length of the saddle, the ventral pair slightly shorter."

Breeding-place.—The larvae of the type form are unknown. Those of ssp. *kumbae* were found in a rock-pool in the bed of a densely shaded stream near Kumba, British Cameroons.—P. F. M.

Aëdes (Aëdimorphus) gibbinsi Edwards.

This larva is excessively like a small specimen of *quasiunivittatus* ; I am unable to find any appreciable differences except those mentioned in the key (p. 119) and the smaller number of pecten-spines.

Described from 4 skins and 1 whole larva from Ruwenzori.

Length about 7 mm.; *colour* not recorded, head and siphon moderately dark.

Head.—Antenna spiculate, slender, markedly curved, unicolorous, nearly half length of head; tuft of about 8 plumose branches at about $\frac{1}{3}$. Setae A, B and C with 8–10, 3–4 and 5–7 strongly plumose branches respectively, C placed (as in *quasiunivittatus*) external and a little anterior to B. Mentum similar to that of *quasiunivittatus*.

Abdomen.—Comb a patch or irregular double row of 11–12 spines, which have a long sharp central tooth and are finely fringed basally. Siphonal index about 3; pecten of 12–15 dark-coloured spines extending to somewhat beyond $\frac{1}{2}$; more proximal spines closely spaced, with 1–3 basal denticles; distal 2 much larger and much wider spaced, with at most 1 basal denticle; tuft of 3–4 simple branches, which are about $\frac{2}{3}$ as long as diameter of siphon, at about $\frac{2}{3}$. Anal segment with nearly complete saddle; upper caudal seta with 5–8 branches, lower single; lateral seta single, simple, more than $\frac{1}{2}$ length of saddle. Ventral brush and "gills" as in *quasiunivittatus*.

Breeding-places.—The larvae were found in small pools of turbid water, lightly shaded by tall trees and clumps of bamboo, in a temporary marsh.

Aëdes (Aëdimorphus) leucarthrius Speiser.

Larva and breeding-places unknown. Edwards (1941) suggests that this may be the same as *gibbinsi*, and it doubtless breeds in similar places.

Aëdes (Aëdimorphus) quasiunivittatus Theobald. (Fig. 105.)

The present species is separable by its combination of spiculate antennae, multiple head-setae B and C, comb of about 12 spines, and short siphon with a subventral tuft about as long as its diameter and a pecten of about 20 spines, of which the 2 most distal are markedly wider spaced. It very closely resembles *gibbinsi*, but is larger and has more numerous pecten spines, besides differing in the points mentioned in the key.

Described from 4 skins and 2 whole larvae from the Fort Portal district, Uganda.

Length about $8\frac{1}{2}$ mm.; *colour* not noted.

Head distinctly quadrate, broader than long (as 1·3 : 1). Antenna strongly curved, about half length of head; tuft composed of a dozen plumose branches at $\frac{1}{2}$. Setae A, B and C with about 10, 3–5 and 6–9 plumose branches respectively; *d* a small tuft of about 4 branches; *e* rather long, 2–3 branched. Mentum triangular, with about 16 rather uniform teeth on each side of the centre.

Abdomen.—Comb an irregular patch of about 12 spines, which are long and slender and have a slight basal fringe. Siphonal index about 3; subventral tuft of about 6 simple branches at $\frac{2}{3}$; pecten extending to about $\frac{1}{2}$, composed of about 20 spines, of which the more proximal are very regularly and closely placed and with several basal denticles, whereas the two distal ones are much wider spaced and simple. Anal segment with well-developed saddle; upper caudal seta with 6 branches, lower single; lateral seta very small, single, simple. Ventral brush composed of 6 pairs of tufts, each with numerous branches, in the barred area and 3 or 4 short unpaired

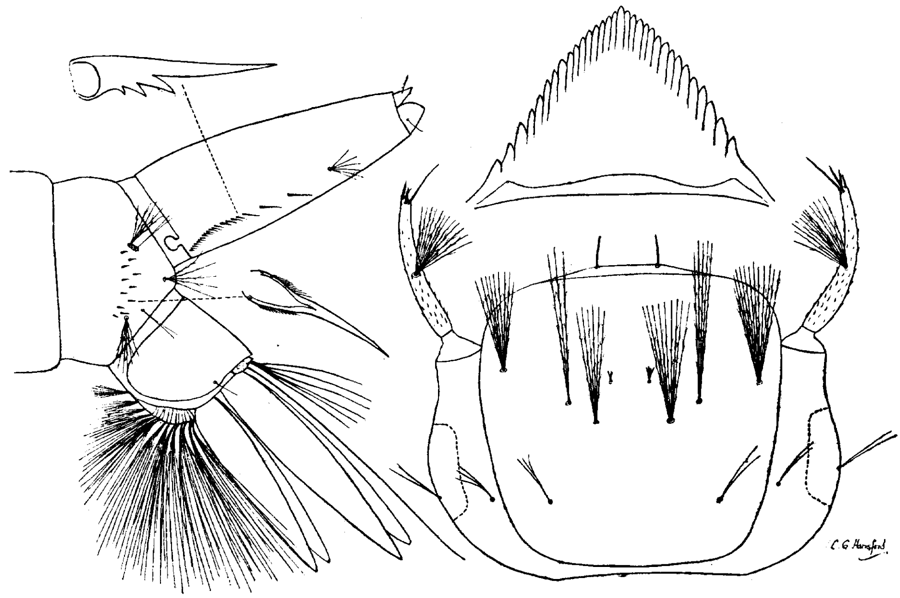


FIG. 105.—*Aëdes* (*Aëdimorphus*) *quasiunivittatus* Theo. Head, terminal segments and mentum. The gills are not so broad as shown.

proximal tufts. "Gills" lanceolate, dorsal pair about 3 times length of saddle, ventral slightly shorter; the gills are not quite as broad as shown in the figure.

Breeding-places.—The larvae were found in temporary muddy rain-pools devoid of vegetation. Ingram and de Meillon record breeding the species from pools in a river-bed. (Abbott (1948) records it from rock-pools.—P. F. M.).

Aëdes (Aëdimorphus) dentatus Theobald.

This is the only known Ethiopian *Aëdes* larva with head-seta B single and C 2–3-branched; *A. hirsutus* has B single and C with 5–6 branches. These two larvae very closely resemble each other but, in addition to the larger number of branches in seta C, *A. hirsutus* differs in the shape of the comb-spines, which have very definite secondary barbs instead of the delicate fringe found in *dentatus*; on the saddle of the former species the spiculation is coarse and confined to the distal margin, whereas in *dentatus* it is finer and distributed over the whole surface of the saddle. The sclerotized parts are much lighter coloured in all the specimens of *hirsutus* examined than in the present species. The pecten-spines are very similar in the two species.

Described from 2 skins and 3 whole larvae from Kigezi and Ruwenzori (Uganda).

Length about 8 mm.; *colour* not recorded; head and siphon moderately dark.

Head.—Antenna spiculate, nearly straight, unicolorous, nearly half length of head; tuft of about 8 simple or almost simple branches, which are nearly $\frac{1}{2}$ length of antenna, at just before $\frac{1}{2}$. Setae A, B and C all simple or almost so; A with 5–6 branches; B single, distinctly stouter than the other setae and nearly $\frac{1}{2}$ length of head; C placed almost directly behind A, single or with 2 or 3 branches (in one specimen it has 2 branches on one side and 3 on the other). Mentum triangular, with apparently about 18 small teeth on each side of the centre.

Abdomen.—Comb a patch (in some specimens an irregular double line) of 10–12 long and sharply-pointed spines, which are delicately fringed on the basal portion. Siphon finely denticulate, with index about 3; pecten extending nearly to tuft, composed of 2 very distinct sections, of which the more basal contains 12–15 closely-spaced spines having a sharp main denticle and several coarse but very short basal denticles on one or both sides of the spine, and the more apical consists of 2–3 much larger and very widely-spaced spines, which are simple or nearly so, the spines of both sections very dark in colour; tuft of 2–4 simple branches, which are a little less than $\frac{1}{2}$ length of diameter of siphon, at about $\frac{2}{3}$. Anal segment with saddle nearly complete, finely spiculate similarly to the siphon, the spicules on both arranged in rows and giving the appearance of scales; upper caudal seta with 4–5 simple branches, lower single; lateral seta small, single, simple. Ventral brush composed of about 7 pairs of 3–5 branched tufts in the barred area and about 4 unpaired tufts proximal to it. "Gills" lanceolate; upper pair about $2\frac{1}{2}$ times length of saddle, lower pair slightly shorter.

Breeding-places.—The larvae described were found in the unshaded swampy edges of a lake in the course of a stream. The water was shallow and clear, but contained much floating debris, about which the larvae occurred.

The species is often common after heavy rain in all kinds of surface pools, particularly the edges of swamps. These pools very commonly contain much grass, but Nieschulz, Bedford and du Toit only found the species in pools which, though well shaded, were devoid of vegetation.

Aëdes (Aëdimorphus) pachyurus Edwards.

Larva and breeding-places unknown.

Aëdes (Aëdimorphus) caliginosus Graham.

A larva stated to be that of this species was described by Wesché and included in Edwards's key (1912). There is great doubt as to whether the larva really belonged to this species, and the larva of *caliginosus* must be considered unknown.

Breeding-places.—Wesché's specimens came from borrow-pits; Ingram (1919) records the species from pools in the course of a stream.

Aëdes (Aëdimorphus) subdentatus Edwards.

Larva unknown. The type-series was reared from rock-edged ground pools.

Aëdes (Aëdimorphus) cumminsi Theobald. (Figs. 106, 107.)

The spiculate head-capsule and chitinous plaques on the skin of thorax and abdomen at once distinguish this larva from any other known species. *A. domesticus* bears similar (but smaller) plaques on the body, but head-setae B and C have several branches; *A. fowleri* has the whole body densely spiculate.

Described from 3 skins and 7 whole larvae from Lira, Uganda.

Length about 11 mm.; *colour* pale, head and thorax brown.

Head somewhat quadrate, slightly broader than long (as 1 : 1·3). Antenna about $\frac{1}{3}$ length of head; tuft just before $\frac{1}{2}$. Seta A with about 8 simple branches; B and C very stout, single, simple (one of the specimens has C double on one side), C placed almost directly behind B; *d* very minute, placed slightly in front of and on the inner side of B, with 2–3 branches; *e* single, simple. Mentum an almost equilateral triangle,

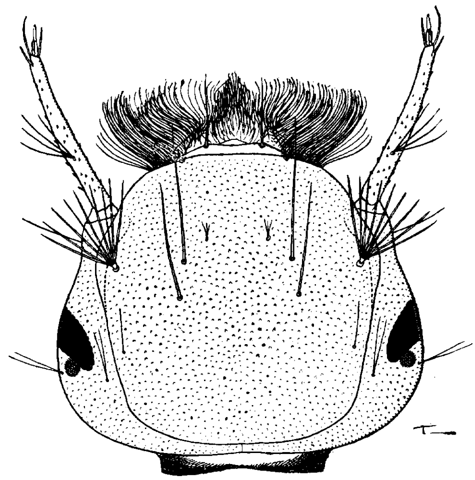


FIG. 106.—*Aëdes* (*Aëdimorphus*) *cumminsi* Theo. Head.

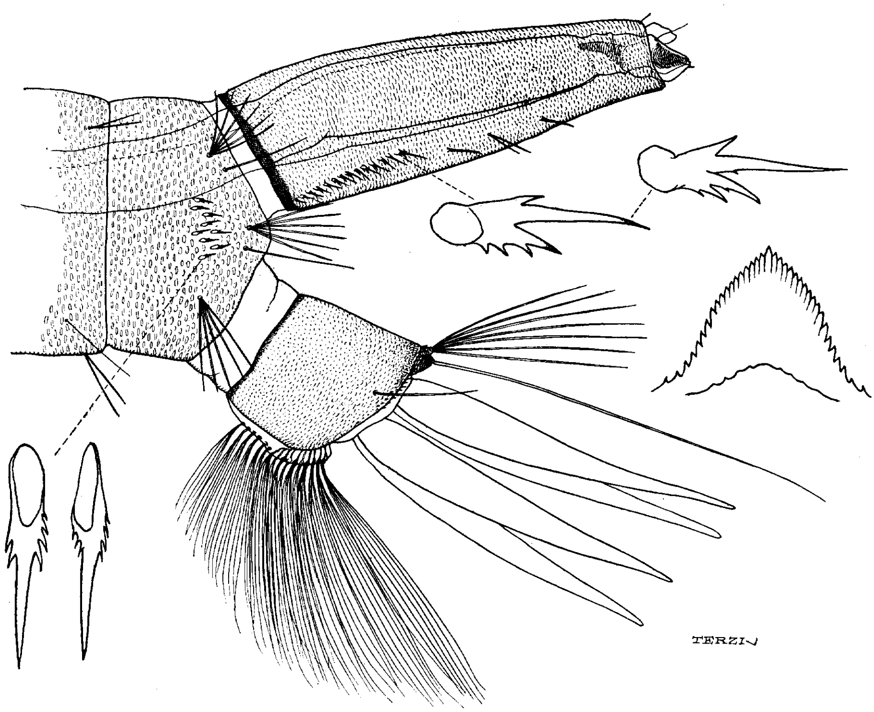


FIG. 107.—*Aëdes* (*Aëdimorphus*) *cumminsi* Theo. Terminal segments and mentum.

with about 20 teeth on each side of the centre. Whole surface of head-capsule covered with small triangular spicules.

Abdomen.—Comb an irregular row or patch of 8–12 spines, which have small denticles round the base. Siphon with index about $2\frac{1}{2}$, sides slightly convex ; pecten composed of 14–17 spines, of which the most distal few (2–4) are much larger, wider spaced, and frequently lighter coloured than the remainder, the more basal spines with at least 1–2 ventral basal denticles, and the larger and more distal often with 1 or 2 dorsal denticles in addition, the wider-separated distal spines usually either simple or with only one ventral basal denticle ; subventral tuft situated at about $\frac{2}{5}$, with 2–4 branches. Anal segment with nearly complete saddle, which bears a number of rather small denticles on the dorso-apical margin. Upper caudal seta with about 6 branches, lower single ; lateral seta single. Ventral brush with 10 pairs of many-branched tufts in the barred area and 6 unpaired proximal tufts. " Gills " long and lanceolate ; dorsal pair about $2\frac{1}{2}$ times length of saddle, ventral pair slightly shorter.

All the less chitinized areas of thorax and abdomen are studded with small chitinous plaques.

Breeding-places.—Turbid water in temporary pools at the edge of a marsh.

Aëdes (Aëdimorphus) pubescens Edwards.

Larva and breeding-places unknown.

Aëdes (Aëdimorphus) bevisi Edwards.

The following description is taken from Muspratt (1950). Mr. Muspratt kindly allowed me the use of his manuscript for this purpose while his paper was in the press.

" Very similar to *A. dentatus* Theobald as described by Hopkins (1936, p. 149). Differs in head setae B, which are 2-branched, and C, which are single or 2-branched ; also in details of the pecten spines, length of the anal papillae and tufts of the anal segment.

"*Head* :—fairly pale with a reticulum of fine denticles. Otherwise similar to *dentatus,* except setae B and C. Antennae spiculate with tuft of about 6 nearly simple branches one-third to half length of antenna ; the tuft is placed at about half. Seta A : very finely plumose with 6–8 branches ; B : 2-branched (simple) ; C single or 2-branched (simple) ; *d :* very finely 3-branched ; *e :* 2-branched ; *f :* single or 2-branched. The placing of the head setae is like that of *A. cumminsi* Theobald (Hopkins, 1936, fig. p. 151), except that *d* is a little further back (almost between B).

' *Thorax.*—meso and meta pleural spines with 1–3 straight spines and several smaller spines, or denticles, around the bases of each tuft.

" *Abdomen* :—comb a patch of 8 or 9 spines with a basal fringe of fine denticles apparently similar to *dentatus ;* the spines tend to be in rows. Siphon as *dentatus* —finely denticulate with an index of 3·2 and 3·3 measured on two larvae. Subventral tuft with 3 or 4 simple branches, less than half diamter of siphon and placed just beyond two-thirds. Pecten of 10–16 spines on basal half or less, placed close together and 1–3 larger and wider-spaced spines between these and the tuft. Most of the close-spaced spines have one large basal denticle and one or two smaller denticles, but differ from *dentatus* in that the latter are on one side of the spine only. The larger wide-spaced spines may be almost straight, or curved, and simple or with one or two large or small denticles. Anal segment: similar to *dentatus* in having a nearly complete saddle with spicules in rows, single or 2-branched simple lateral seta (not very long), and a single lower caudal seta; but upper caudal seta with 6–7 simple branches. Ventral brush with about 7 paired, 5–9-branched, tufts on the barred area and 3 or 4 tufts proximal to it. Anal papillae; lanceolate and one and a half times length of saddle, sub-equal."

Breeding-places.—". . . unknown, but probably a pool breeder as *dentatus* and *subdentatus*."—P. F. M.

Aëdes (Aëdimorphus) arabiensis Patton. (Fig. 108.)

The only other *Aëdes* larvae with the comb composed of a small number of spines, the antenna spiculate, unpaired tufts present proximal to the barred area of the ventral brush, head-setae B and C single and the last 2–3 pecten spines wider-spaced are *cumminsi*, *fowleri* and *durbanensis*. From the first two of these the larva of *arabiensis* is easily separated by the absence of dense spicules or plaques on its integument, from *durbanensis* by its incomplete saddle and the fact that the distal edge of the saddle is smooth, and by the shape of the "gills."

The larva is described by Lewis (1945) as follows:

"*Head.*—Antenna about 0·5 length of head; shaft with small spicules; tuft of 7–11 branches inserted at about 0·3. Median hairs of mouth brush with comb at tip. Setae A, B and C plumose, A with 7–8 branches, B single, C single or double, almost directly behind B; *d* very small with about 5 branches. Mentum roughly triangular with about 15 teeth on each side of the centre.

"*Abdomen.*—Comb a patch or irregular row of 8–12 sharp-pointed spines with small basal denticles. Siphon with index about 2·5, pale, tuft with 7 or 8 branches at about 0·7; pecten reaching slightly beyond middle, of about 20 teeth varying in shape, a few at base often simple; central teeth with 1–4 basal denticles of varying size; of the last 1–3 teeth usually 2 larger and widely spaced, one or all simple or with 1–3 basal denticles. Anal segment nearly ringed by saddle; upper caudal seta with 4–7 branches, lower single; lateral seta single or (occasionally) double; ventral brush of 5 pairs of multiple tufts in barred area and 3 or 4 unpaired tufts proximal to it. Gills subequal, lanceolate, much longer than saddle."

Breeding-places.—Patton records that the species was breeding in company with *A. vittatus* in the rain-water that had collected in a "tank" on the plain near Ulab Camp and also in the crater at Aden. Mr. Lewis kindly informs me that his larvae were found in temporary rain-water pools.*

* Abbott (1948) gives the following notes on this species in the Sudan: "Larvae were found in great numbers breeding in temporary rain pools in the early rains. On one occasion six days after the first rain had fallen at El Fasher, pools in a wadi were teeming with pupae of this species. No other developmental stages were seen and the assumption is that its eggs had been laid the season before and had remained dormant and alive through the intensely hot, dry months, to be hatched simultaneously after the first downpour." Mara in Jannone *et al.* (1946) records larvae from stagnant, muddy water in sunlit or partly shaded pools in irrigation channels, etc., with chloride content 0·06 %–0·65 %.—P. F. M.

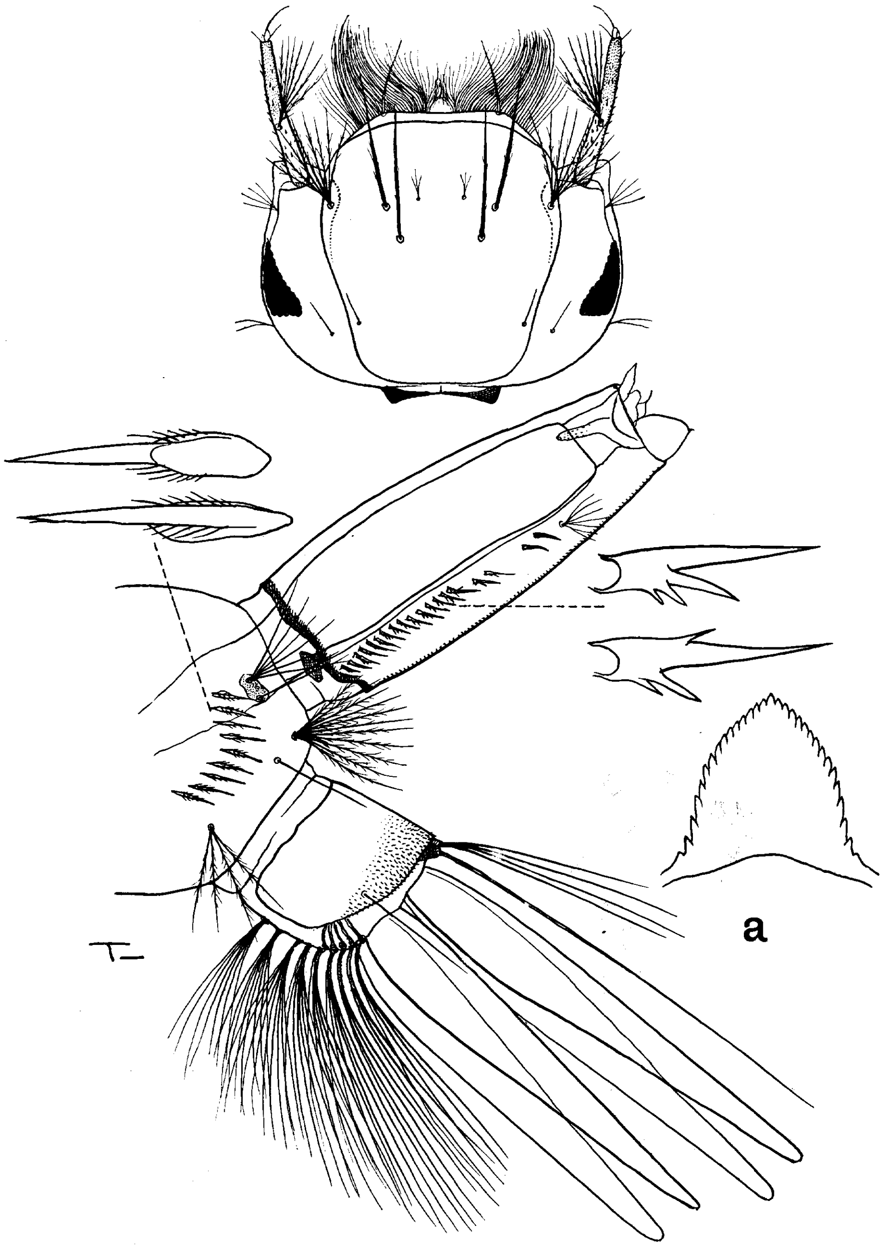


FIG. 108.—*Aëdes (Aëdimorphus) arabiensis* Patton. Head and terminal segments. *a*, mentum.

Aëdes (Aëdimorphus) centropunctatus Theobald. (Fig. 109.)

Easily distinguished from any other species by the head-chaetotaxy, particularly the large size of seta B, coupled with a comb of numerous scales.

Length about 8 mm. ; *colour* grey with dark siphon and pale head (Macfie and Ingram, 1916*a*).

Head.—Antenna spiculate, slender, about $\frac{5}{7}$ length of head; tuft of 3 long simple branches at about $\frac{2}{5}$. Setae A, B and C plumose, A with about 8 short branches, B with 2 coarse branches which are about $1\frac{1}{2}$ times as long as the head, C with 3–4 branches about as long as the head, *d* very small, with about 4 branches, *e* single, *f* 3-branched. Mentum with central tooth much larger than remainder, about 12 teeth on each side.

Abdomen.—Comb a patch of 60–70 small scales. Siphon narrowing rather sharply beyond $\frac{1}{2}$, index a little more than 3; pecten composed of about 15 spines,

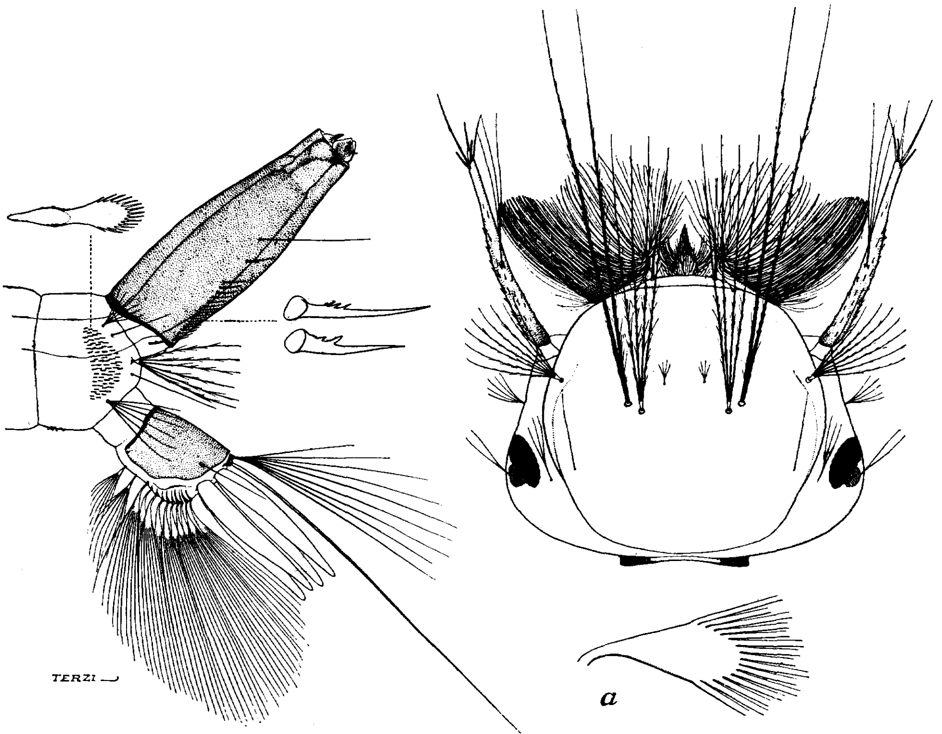


FIG. 109.—*Aëdes* (*Aëdimorphus*) *centropunctatus* Theo. Head and terminal segments. *a*, base of one of the tufts of the ventral brush.

of which the most distal one or two are wide spaced and the more proximal fairly close-set, individual spines long and narrow with several very small denticles; sub-ventral tuft a single simple seta, slightly longer than the diameter of the siphon, placed at about $\frac{3}{5}$. Saddle large but incomplete, distal edge smooth; upper caudal seta with about 10 branches, lower single; lateral seta single, simple, slightly shorter than saddle. Ventral brush composed of 4 or 5 pairs of many-branched tufts in the barred area and 2 proximal to it; bases of tufts unusually wide. "Gills" subequal, lanceolate, but with rounded tips, about twice length of saddle.

Breeding-places.—In small holes made by natives in search of crabs (Macfie and Ingram, 1916*a*), and crab-holes (Kumm, 1931).

Aëdes (Aëdimorphus) hirsutus Theobald. (Figs. 110, 111.)

No other known larva of *Aëdes*, except *A. dentatus*, has head-seta B single and C multiple; for the differences between these two species see *dentatus* (p. 194). The writer has seen specimens which have seta B double, either on both sides or on one side only; such specimens appear to be very rare.

Length about 7 mm.; *colour* light grey, head and siphon brown.

Head.—Antenna about half length of head; tuft of numerous branches at $\frac{2}{5}$. Setae A, B and C all plumose, A with 6–8 branches, B single, much longer and stouter than A or C, C with 5 or 6 branches, *d* minute, branched at tip. Mentum triangular, with about a dozen teeth on each side of the centre.

Abdomen.—Comb an irregular row of 7–11 strongly-barbed spines. Siphon not strongly chitinized, index about 3; subventral tuft placed slightly before $\frac{2}{3}$, with

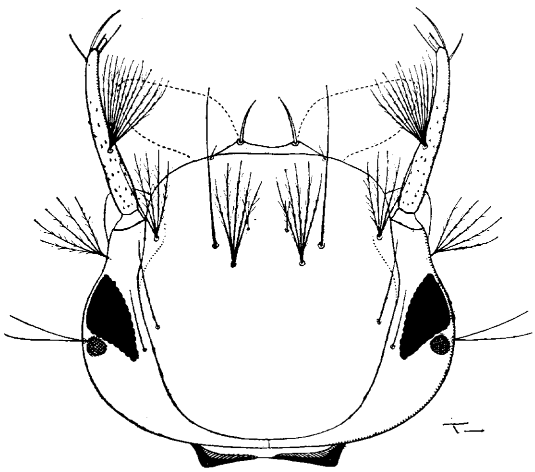


FIG. 110.—*Aëdes* (*Aëdimorphus*) *hirsutus* Theo. Head.

4–8 branches; pecten of 14–22 spines, of which the more proximal have several coarse basal denticles, whereas the distal 2 are either simple or with but 1 conspicuous denticle and are much wider spaced. Anal segment with saddle almost complete, upper distal margin strongly spiculate; upper caudal seta with about 7 simple branches, lower single; lateral seta small, slender and simple. Ventral brush of 4 pairs of multiple tufts in the barred area and 3 unpaired tufts proximal to it. "Gills" subequal, lanceolate, about $2\frac{1}{2}$ times length of saddle.

The above description applies equally to larvae from South Africa, Nigeria and Uganda.

Breeding-places and biology.—The normal breeding-places are in muddy pools formed by recent rain and usually devoid of vegetation; larvae also occur commonly in marshy ground and hoof-marks (Bedford, 1928), and they are sometimes found in pools in the beds of streams (Ingram and de Meillon). A very unusual record is that (Ingram and Macfie, 1919) of 2 pupae in a disused kerosene tin among vegetation.*

* Abbott (1948) gives the following notes from Darfur Province, Sudan: "This species, with *A. arabiensis*, was noticeably the most common mosquito breeding in rain pools during the early part of the rains. It was observed that larvae were in the habit of lying parallel with the surface of the water apparently feeding from the underside of the surface film."—P. F. M.

The phenomenon of production of numerous larvae from dormant eggs on the filling of a pool (common to several of the subgenera of *Aëdes*) is very clearly shown for this species by Nieschulz, Bedford and du Toit. These authors note that larvae appeared four days after filling of the pools, and that pupae occurred in large numbers five days later, the first adults appearing eight to ten days after the filling of the pools. This latter fact illustrates very well the short larval life of these breeders in temporary pools.

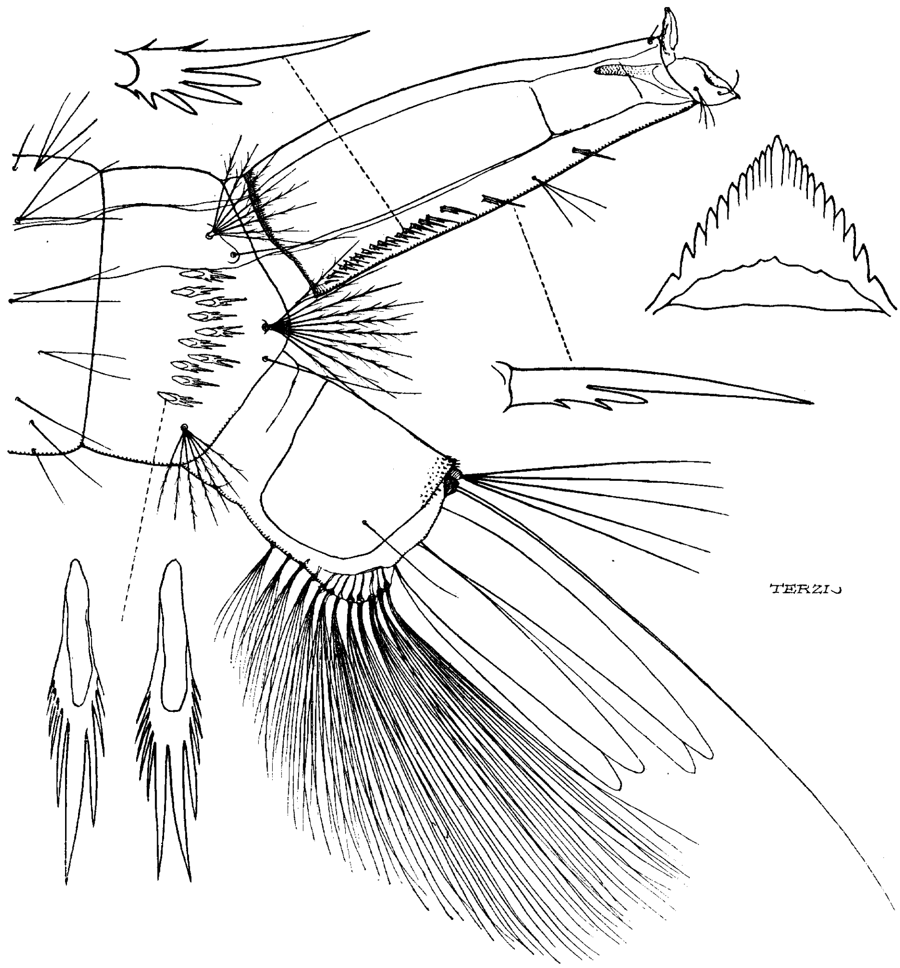


FIG. 111.—*Aëdes* (*Aëdimorphus*) *hirsutus* Theo. Terminal segments and mentum.

Aëdes (**Aëdimorphus**) **fowleri** d'Emmerez de Charmoy (*nigeriensis* Theo.). (Fig. 112.)

The densely spiculate body at once separates this from any other described larva. *A. cumminsi* somewhat resembles it in this respect, but in the latter species the spicules (except on the head) are replaced by flat plaques of chitin.

The larva has not been described, though it was figured by Edwards (1912) as *nigeriensis* ; it is now described from 7 specimens from Mauritius and the Gold Coast and 4 specimens from Uganda, which the writer had previously determined with some doubt as this species, and which agree perfectly with those from Mauritus and the Gold Coast.

Length about 8 mm. ; *colour* not recorded. Whole body, including head, siphon and saddle of anal segment covered with minute spicules.

Head.—Antenna moderately spiculate, about ½ length of head ; tuft of about 5 simple branches at ½. Seta A with about 7 branches ; B and C single, simple (C double on one side of one specimen). Mentum with about 16 teeth on each side of the centre.

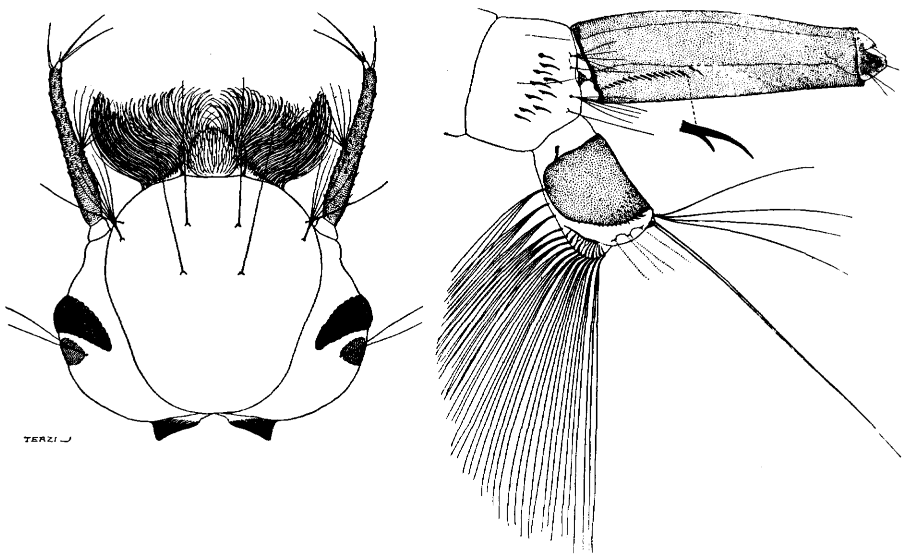


FIG. 112.—*Aëdes* (*Aëdimorphus*) *fowleri* d'Emm. de Charm. Head and terminal segments. The subventral tuft of the siphon is omitted in the figure ; its position is between the two most distal pecten spines.

Abdomen.—Comb an irregular single or double row of 6–11 strong spines with fringed bases. Siphon pale, sides somewhat convex, index about 3 ; pecten extending nearly to apex of siphon, composed of about 20 dark-coloured spines, of which the more basal are close-set and have small blunt basal denticles, whereas the distal 3 or 4 are widely-spaced and tend to be simple ; tuft of about 4 short simple branches midway between the 2 distal spines. Anal segment with saddle large but incomplete ; upper caudal seta with about 6 branches, lower single ; lateral seta single, simple. Ventral brush composed of about 5 pairs of 3-branched tufts in the barred area and about 5 tufts, with more numerous branches, proximal to it. "Gills" lanceolate, subequal, about twice length of saddle.

Breeding-places and habits.—Ingram (1912) notes "only found for two days in November in a muddy pool formed by a shower of rain," and several other authors have recorded the species from rain-pools, very often in rock. MacGregor (1927) found them in rock-pools only, and states that larvae and pupae occasionally occurred singly in cracks between rocks and in drill-holes. His statement that the species is obtainable at all times of the year probably refers to adults. Nieschulz, Bedford and du Toit found larvae in shallow grassy depressions in the veldt. The record (Harris, 1942, p. 183) of specimens being reared from bamboo pots exposed for experimental purposes is very exceptional.

MacGregor (*l. c.*) mentions that larval development is rapid, and that all the larvae in a given breeding-place pupate simultaneously; he suggests that this is because all are from one batch of eggs, but the present writer considers that it is due to the eggs all having been caused to hatch by the same shower of rain, as is known to be true of other species of the subgenus.

Aëdes (Aëdimorphus) durbanensis Theobald. (Fig. 113.)

Rebêlo and Pereira (1943) bred specimens of this species from larvae which differ very markedly in head-chaetotaxy and (especially) in the shape of the pecten-spines

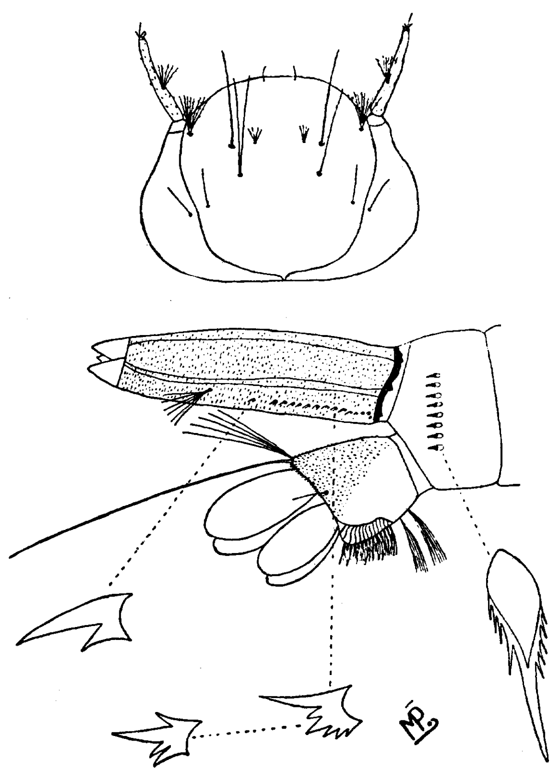


FIG. 113.—*Aëdes* (*Aëdimorphus*) *durbanensis* Theo. Head and terminal segments. (From Rebêlo and Pereira, 1943).

from those which I doubtfully ascribed to the species (Hopkins, 1936). Their description is translated below. The larva is very like that of *arabiensis*, but is separated by having a complete saddle with spines on the distal margin, and by the shape of the " gills."

Head.—Antenna about $\frac{3}{7}$ length of head, sparsely spiculate, pale in the basal third and infuscate in the apical two-thirds; antennal tuft with about 6 sparsely plumose branches. Seta A with about 8 plumose branches; setae B and C with 1 and 1–2 simple or finely plumose branches respectively, of equal size and about half the length of the head; seta *d* small, with about 4 branches; setae *e* and *f* long and simple. Mentum with 12–13 teeth on each side, not including the median tooth.

Abdomen.—Comb of about 8 spines arranged in a row. Siphon cylindrical, pale, with a dark ring at the base, wholly covered with small spiculate ridges; siphonal index about 3; pecten of about 15 spines arranged in a slightly irregular row, not reaching to half length of siphon, the last or the two last spines widely spaced; subventral tuft at $\frac{2}{3}$, 6-branched. Anal segment with complete saddle and with the distal margin covered with small spicules; upper caudal seta 5-branched, lower simple; lateral seta short and almost always simple. Ventral brush with 7 pairs of multiple setae and two others on the ventral part of the anal segment (*i.e.* beyond the barred area). "Gills" ovoid, dorsal pair slightly longer than saddle or than ventral pair.

Breeding-places.—Aders (1917*a*) records larvae from a rain-water pool; Nieschulz, Bedford and du Toit found them in shallow grassy depressions in the veldt; Wanson (MS.) reared adults of both sexes in 1934 from crab-holes; Rebêlo and Pereira found larvae in pools and ditches with shallow water and with vegetation, rushes and *Lemna*. None of these authors mention whether the water was saline, and in some of the instances this seems unlikely, but the form of the "gills" is precisely as in *natronius*, which is known to breed in saline water.

Aëdes (Aëdimorphus) natronius Edwards. (Figs. 114, 115.)

This very distinctive larva is chiefly characterized by the head-chaetotaxy, the very peculiar pecten-spines, and the shape of the "gills."

Described from 3 skins (including that of the type) and many whole larvae from several localities in the neighbourhood of the north end of Lake Edward and the south end of Lake George, Uganda, collected by Mr. L. Beadle.

Length about 10 mm.; *colour* oily brown, sometimes with a greenish tinge; head and siphon little darker than body.

Head.—Antenna short (about $\frac{3}{7}$ length of head), cylindrical, pale-coloured, with extremely sparse spicules; tuft of about 5 simple or very sparsely plumose branches at about $\frac{2}{5}$. Setae A, B and C all rather small and inconspicuous, simple or sparsely plumose; A with about 8 branches, B and C with 2–3 and 3–5 branches respectively; *d* minute, with several branches. Mentum a regular triangle with about 10 teeth on each side of the slightly larger central tooth.

Abdomen.—Comb a patch of about 20 small pale-coloured spines. Siphon somewhat cylindrical, pale-coloured, but with a dark ring at the extreme base; index about 3; pecten extending to a little beyond $\frac{1}{2}$, composed of about 40 very long and unusually narrow closely-set pale-coloured spines, which are mostly simple, or nearly so, and of which a number are usually out of alignment with the remainder (a very unusual feature); subventral tuft of usually 4–5, but sometimes more numerous, branches at about $\frac{2}{3}$. Anal segment with a large but incomplete saddle, the posterior margin of which is smooth; upper caudal seta with about 6 branches, lower single; lateral seta small, single. Ventral brush composed of about 7 pairs of many-branched tufts in the barred area and 2 median tufts proximal to it. "Gills" ovoid, dorsal pair slightly longer than saddle, ventral about $\frac{3}{4}$ length of dorsal.

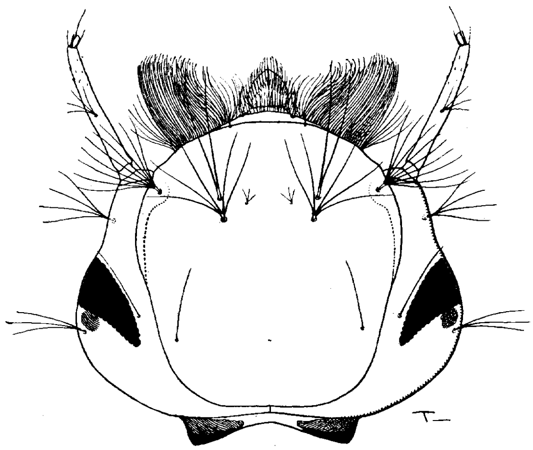


FIG. 114.—*Aëdes* (*Aëdimorphus*) *natronius* Edw. Head.

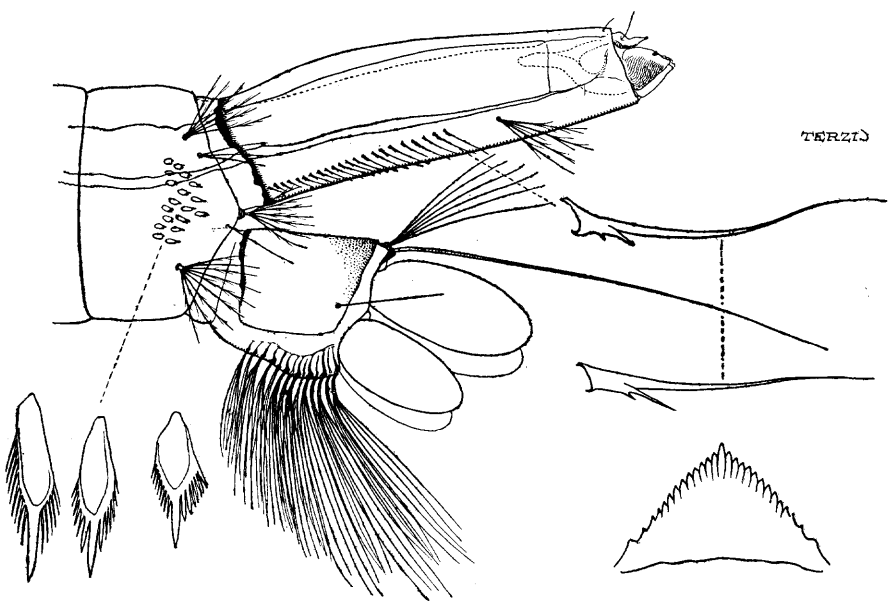


FIG. 115.—*Aëdes* (*Aëdimorphus*) *natronius* Edw. Terminal segments and mentum.

Two pelts from Nakuru (C. B. Symes) produced female adults which were identified as being probably either *durbanensis* or *natronius*. This discovery by Rebêlo and Pereira of the larva of *durbanensis* shows that the Nakuru larvae do not (as I formerly suggested) belong to that species, and it now seems likely that they may represent a larval variety of *natronius*. The differences from known larvae of *natronius* which can be made out in these much-damaged pelts are that the head-setae are rather longer, the comb is of only about 10 spines, and the pecten of rather more than 20 spines. The form of the pecten-spines is precisely as in typical larvae of *natronius*.

Breeding-places.—Larvae were found in very large numbers in hippo hoof-prints on mud-flats surrounding Lake Edward; the hoof-prints were full of extremely foul muddy brown water. Larvae also occurred at the edge of a small fresh-water lake, in foot-prints near the edge of a crater-lake (the water containing much sulphide), and in "prodigious numbers" at the edge of Lake Maseche, a crater-lake having an alkalinity 0·71 N (Mr. Beadle notes that this is the highest degree of alkalinity he has ever found).

Aëdes (Aëdimorphus) ochraceus Theobald. (Fig. 116.)

Confusion of this larva with that of any other member of the genus is impossible; it might readily be mistaken for some species of *Culex*, but the single subventral tuft of the siphon and the Aëdine character of the pecten should at once betray it.

The larva is that described as *Culex univittatus* by Ingram and Macfie (1919). Redescribed from 3 skins and numerous whole larvae from Lira and Soroti, Uganda.

Length about 9 mm.; *colour* pale, head and siphon slightly darker.

Head.—Slightly broader than long. Antenna pale at base, infuscate beyond tuft; tuft of about 8 simple or very slightly plumose branches at just before $\frac{1}{2}$. Setae A, B and C each with about 8 plumose branches; *d* single, simple; *e* small, with several branches. Mentum an equilateral triangle with about 10 teeth on each side of the centre.

Abdomen.—Comb an irregular patch of 8–11 rather small basally-fringed pale spines. Siphon abnormally long for this genus (index 6–8); pecten of 13–18 spines, of which the more basal are closely set, dark in colour and denticulate, and the distal 2–4 are normally much larger, very widely separated, pale and usually without denticles; subventral tuft very small, at about $\frac{2}{3}$, with half a dozen simple branches. Anal segment with dorsal portion of apical margin of saddle finely spiculate; upper caudal seta with about 8 branches, lower single; lateral seta small, with 2–3 branches. Ventral brush composed of multiple tufts, 3 pairs in the barred area and 6 unpaired proximal tufts. "Gills" lanceolate but with rounded tips; dorsal pair about three times length of saddle, ventral pair very little shorter.

Breeding-places.—The larvae described by Ingram and Macfie were found in a grassy pool of clean water at the edge of a swamp; Bequaert (1930) bred specimens from an open ditch in a large forest-clearing; in Uganda the species is locally abundant at certain seasons in turbid water in temporary rain-pools.*

Aëdes (Banksinella) lineatopennis Ludlow.

Practically the whole of the account given previously of this species (Hopkins, 1936) actually refers to *A.* (*B.*) *circumluteolus*. This is the less serious because the larvae and breeding-places of the two forms appear to be absolutely indistinguishable.

* Abbott (1948) and Kartman *et al.* (1947) also record it from rain pools in the Sudan and the Daker area respectively.—P. F. M.

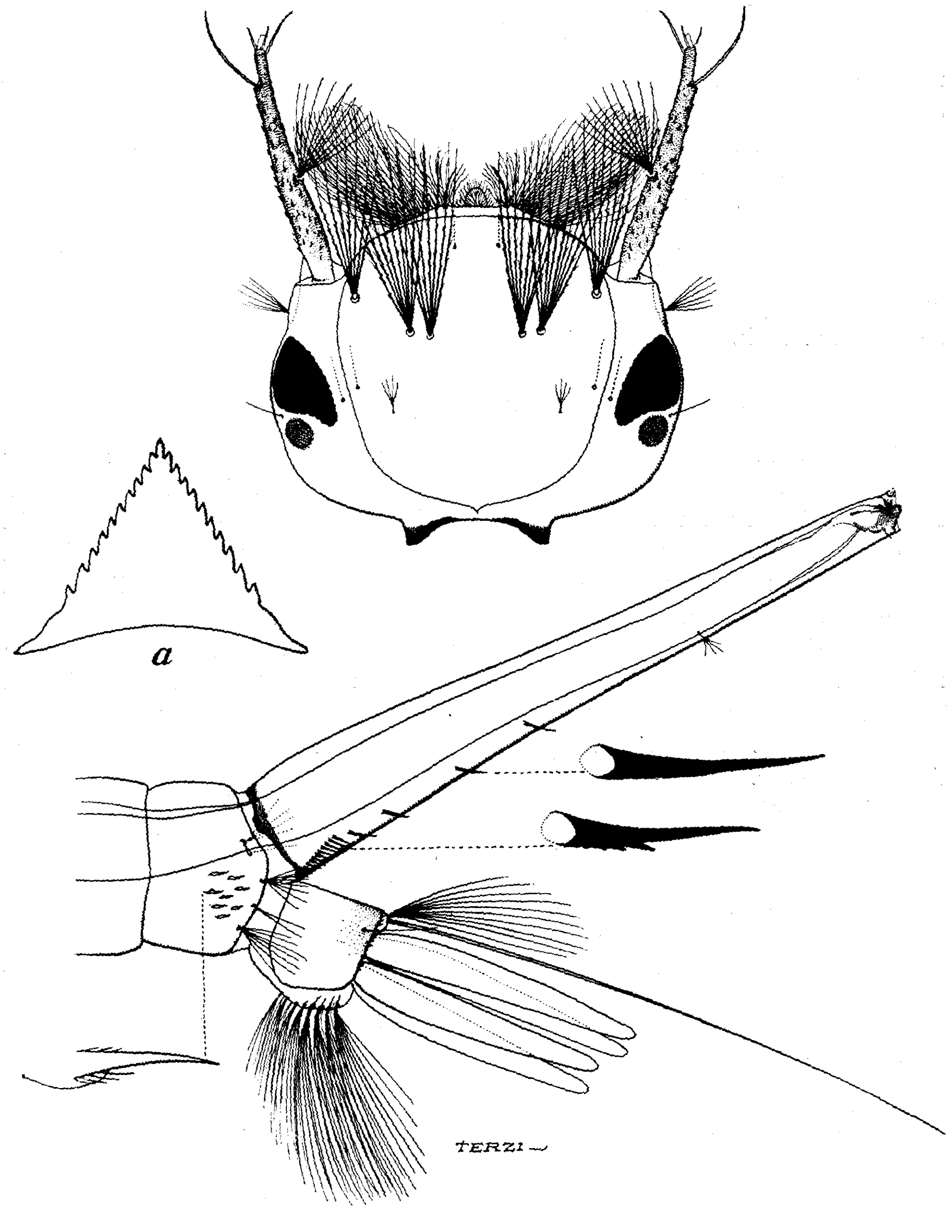


FIG. 116.—*Aëdes* (*Aëdimorphus*) *ochraceus* Theo. Head and terminal segments. *a*, mentum.

Aëdes (Banksinella) circumluteolus Theobald. (Figs. 117, 118.)

This larva might readily be mistaken for that of *A. albocephalus*, but differs from it in a number of characters, including the more numerous teeth in the mentum, the greater number of branches in the upper dorsal seta of the anal segment and the much smaller subventral tuft of the siphon ; this latter character will at once separate *circumluteolus* from most of the other known larvae with which it might otherwise be confused. It seems to be quite indistinguishable from that of *lineatopennis*.

Length about 7 mm.; *colour* drab.

Head.—Antenna rather more than $\frac{1}{3}$ length of head, spiculate; tuft of 6–8 simple branches at about $\frac{1}{2}$. Setae A, B and C with about 10, 5–8 and 7–9 very sparsely

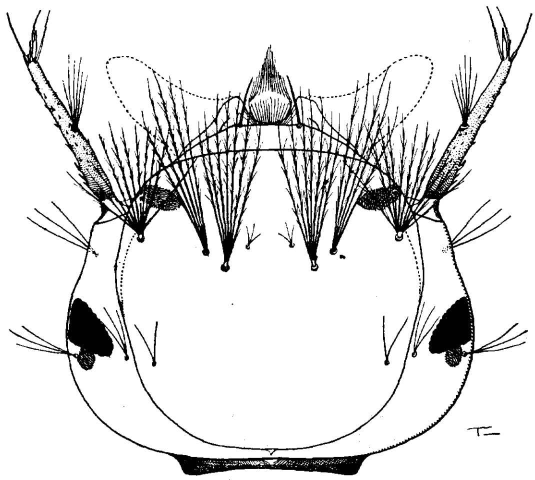


FIG. 117.—*Aëdes* (*Banksinella*) *circumluteolus* Theo. Head.

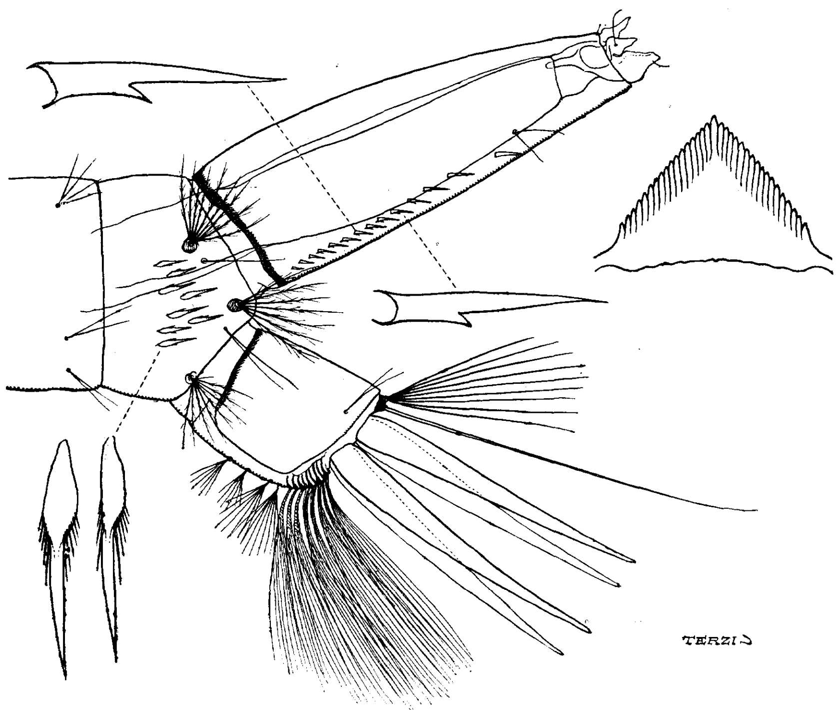


FIG. 118.—*Aëdes* (*Banksinella*) *circumluteolus* Theo. Terminal segments and mentum. The subventral tuft of the siphon usually has more numerous branches.

plumose branches respectively; *d* very minute, placed a little anterior to the base of c and slightly nearer the middle line. Mentum triangular, with about 20 small teeth on each side of the centre; central tooth little larger than those each side of it.

Abdomen.—Comb an irregular row of 8–9 spines with fringed bases. Siphon with index about 3; pecten of 13–19 spines extending to nearly $\frac{2}{3}$; proximal spines each with 1 basal denticle, the two most distal spines wider spaced than remainder and usually simple; subventral tuft placed just beyond most distal spine of pecten and composed of 4–5 very small simple branches. Anal segment with a very large saddle, which sometimes appears complete in whole larvae but is not joined ventrally, distal edge smooth; upper caudal seta with about 10 branches, lower single; lateral seta single or double, about $\frac{1}{2}$ length of saddle. Ventral brush composed of about 5 pairs of multiple tufts in the barred area and 3 or 4 unpaired tufts proximal to it. "Gills" long and lanceolate, subequal.

Breeding-places and biology.—Commonest in pools in marshy ground or at the edges of swamps, also common in hoof-prints in soft ground; only found after heavy rain. The breeding-places nearly always contain much grass or other vegetation.

Nieschulz, Bedford and du Toit found the larval period of *circumluteolus* in South Africa to occupy 5–6 days and the pupal period 1–2 days, adults appearing within a week of the flooding of the breeding-place. They point out (as the writer is able to confirm from observations in Uganda) that there is a strong probability that some of the eggs do not hatch at the first contact with water, since there is a continual supply of larvae in a breeding-place, always provided that dry periods intervene between each pair of generations.

Aëdes (Banksinella) luteolateralis Theobald.

Larva unknown. The only records of breeding-places are those of Leeson (1931) from a tub (probably transported) and from a river.

Aëdes (Banksinella) albothorax Theobald.

Larva and breeding-places unknown.

Aëdes (Banksinella) albicosta Edwards.

Larva undescribed. Harris (1942) records one larva from a pool.

Aëdes (Banksinella) punctocostalis Theobald.

Larva unknown; breeding-places likely to be ground pools in forest. The larva attributed to this species by Wigglesworth was most probably that of a variety of *A. palpalis*.

Aëdes (Banksinella) taeniarostris Theo.;
A. (B.) flavimargo Edw.;
A. (B.) monotrichus Edw.;
A. (B.) pogonurus Edw.;
A. (B.) crassiforceps Edw.;

A. (B.) **ellinorae** Edw.;
A. (B.) **bolensis** Edw. and
A. (B.) **fuscinervis** Edw.

Larvae unknown; breeding-places likely to be rain-water pools, flooded lake-margins and swamps.

Aëdes (Banksinella) bequaerti Wolfs.

Larva and breeding-places unknown.—P. F. M.

Aëdes (Banksinella) palpalis Newstead. (Figs. 119, 120.)

The exceptionally large spines of the pecten will readily distinguish this larva from that of any other known species of the genus. The siphon is strongly reminiscent of that of *Culex trifilatus*, but lacks, of course, the numerous subventral tufts of a *Culex*.

Described from numerous skins and 2 whole larvae from Nabadzidza, near Kampala, Uganda.

Length about 6 mm.; *colour* drab, head and siphon dark brown.

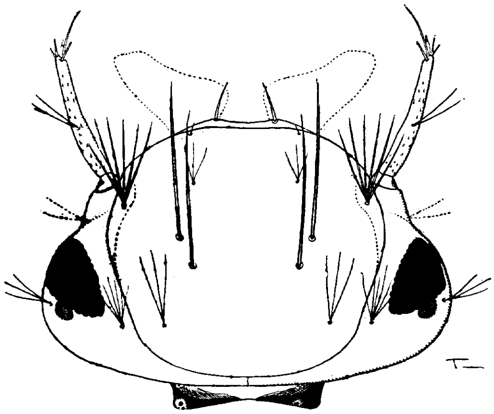


FIG. 119.—*Aëdes (Banksinella) palpalis* Newst. Head.

Head about 1½ times as broad as long. Antenna short and slender (about ½ length of head), spiculate, pale-coloured; tuft of about 4 simple branches at about ½. Setae A, B and C simple, unusually stout; A with 4–6 branches; B and C single; *d* very small and inconspicuous, with about 3 branches, placed almost directly in front of C but not near to it; *e* and *f* with about 3 and about 6 branches respectively. Mentum triangular, with about 18 small teeth on each side of the centre.

Abdomen.—Comb an irregular row of about 8 spines with a delicate basal fringe. Siphon with index about 3½; pecten extending to well beyond ⅔, composed of 16–19 spines, of which the more proximal are very large, regularly spaced and each with 1 basal denticle, whereas the 2 most distal are exceptionally large, simple, and separated by a wide space from the remainder; some of the more distal members of the proximal group often resemble the distal 2 spines in size and in lacking a basal denticle; subventral tuft composed of several minute simple branches, placed in the gap between the proximal and distal groups of pecten-spines. Anal segment with saddle similar to that of *lineatopennis*, distal edge smooth; upper caudal seta with about 12 simple branches, lower single; lateral seta single, $\frac{2}{3}$ length of saddle. Ventral brush composed of about 5 pairs of tufts in the barred area and 1 or 2 unpaired tufts proximal to it. "Gills" lanceolate, very long and slender, dorsal pair longer than ventral.

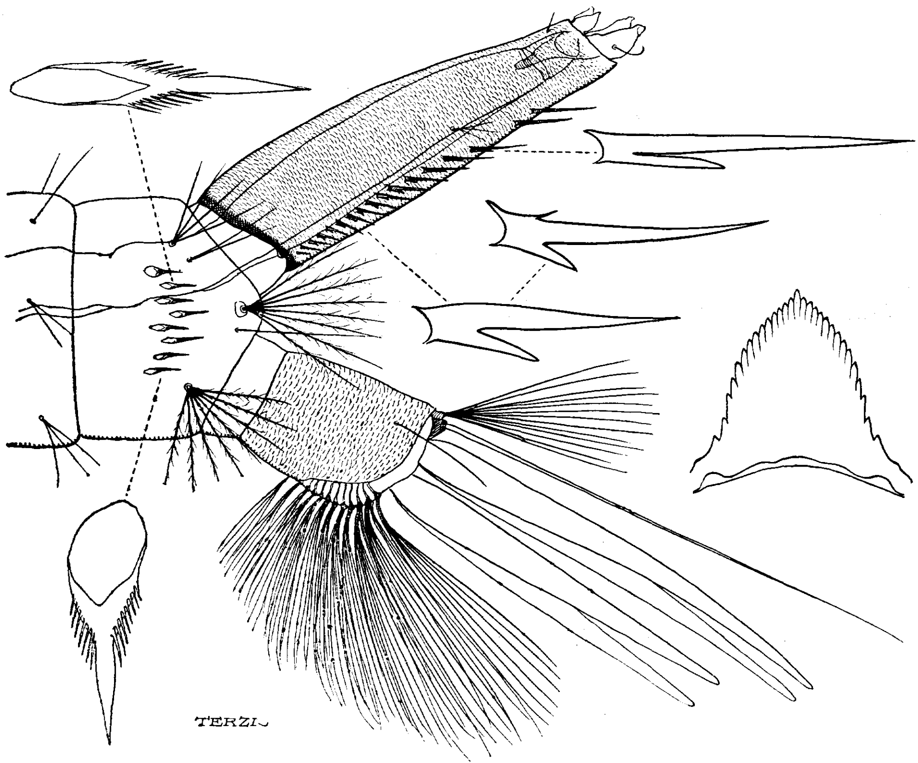


FIG. 120.—*Aëdes (Banksinella) palpalis* Newst. Terminal segments and mentum.

Breeding-places.—In rain-pools in forest, under heavy shade; only found for a short period after heavy rain, but in large numbers at that time.

The larva described by Wigglesworth (1929*a*) as that of *punctocostalis* is of uncertain identity, but may belong to *palpalis* var. *maculicosta* Edwards. It differs from *palpalis* chiefly in its characteristic colour-pattern in life ("head black, abdominal segments i, ii, iii, v and vi black, iv, vii and viii orange"), smaller size and number of pecten-spines (14–15), the fact that the subventral tuft is placed beyond the pecten, and in the more numerous branches (2–4) of the lateral seta of the anal segment.

The variety was bred from a shady residual pool of an extensive swamp (Wigglesworth, 1929*a*). Pupae found in an adjacent pool produced *palpalis* ssp. *carteri* Edwards (Edwards 1936). No isolations were made.

Aëdes (Diceromyia) furcifer Edwards.

No other known Ethiopian *Aëdes* larva except *natronius*, *taylori* and *zethus* has a combination of spiculate antennae, 3-branched head-setae B and C, and a comb composed of a small number of spines. The larva of *natronius* (which does not resemble *furcifer* at all closely) has the antennae very sparsely spiculate ; the main differences between the larvae of *furcifer* and *taylori* are given in the key (p. 118). That of *zethus* differs by having fewer pecten-spines (8–13 as against 18–25 in *furcifer*).

I have not seen this larva ; the particulars given are adapted from Ingram and de Meillon's description, with a few additions kindly contributed by Dr. de Meillon.

Head.—Antenna spiculate ; tuft of 2–3 plumose branches near ½. Setae A, B and C with about 7, 3 and 3 plumose branches respectively, B situated in front of and somewhat internal to C. Mentum triangular, with 8–9 teeth on each side of the centre.

Abdomen.—Comb composed of 8–10 spines in a single row, each with a very fine basal fringe. Siphon short (index nearly 2) ; pecten extending to just beyond ½ and composed of 18–25 stout spines with basal denticles ; subventral tuft situated just beyond pecten, 3-branched. Anal segment with posterior edge of saddle spiculate ; upper caudal seta 6-branched, lower single ; lateral seta 4-branched, pectinate. " Gills " subequal ; rounded distally.

Lewis (1942) finds that Sudan larvae differ from South African specimens (described by Ingram and de Meillon) by having a much longer siphon. His larvae differed from specimens of *A. taylori* in head-chaetotaxy by having seta A 9-branched, B with 2–3 branches, C with 5–6 and *d* with about 13 branches. The siphonal index was 3·3–3·6 ; the pecten was composed of 20–29 teeth extending slightly more than half the length of the siphon, and the subventral tuft of the siphon had 4 branches. The mentum had 11 or 12 teeth (the outer four on each side widely spaced) on each side of the central tooth.

Breeding-places.—Macfie and Ingram (1922–23) and Harris (1942) found the species breeding in rot-holes in trees in the Gold Coast and Tanganyika Territory respectively ; Ingram and de Meillon found larvae in South Africa in similar places, including a hole in a paw-paw tree.

Aëdes (Diceromyia) taylori Edwards. (Fig. 121.)

The larva is perhaps inseparable from that of *furcifer*. It is described by Lewis (1942*b*) as follows :

Head.—Antenna spiculate, with single or double seta near ½. Setae A, B and C with 6, 2 and 3 subplumose branches respectively (seta C with 4 and 5 branches on the two sides of another individual described by Lewis, 1945), B in front of C, *d* with 6–10 branches. Mentum with outer teeth widely spaced.

Thorax.—Straight spines on meso- and metapleural plates. Well-developed stellate tufts of setae on dorsum.

Abdomen.—Numerous stellate tufts. Comb composed of about 10 simple spines in a straight row. Siphon dark brown, long, index 4·3 or 4·4 (little more than 3 in larva described by Lewis (1945)) ; pecten extending to about ½, composed of 20–22

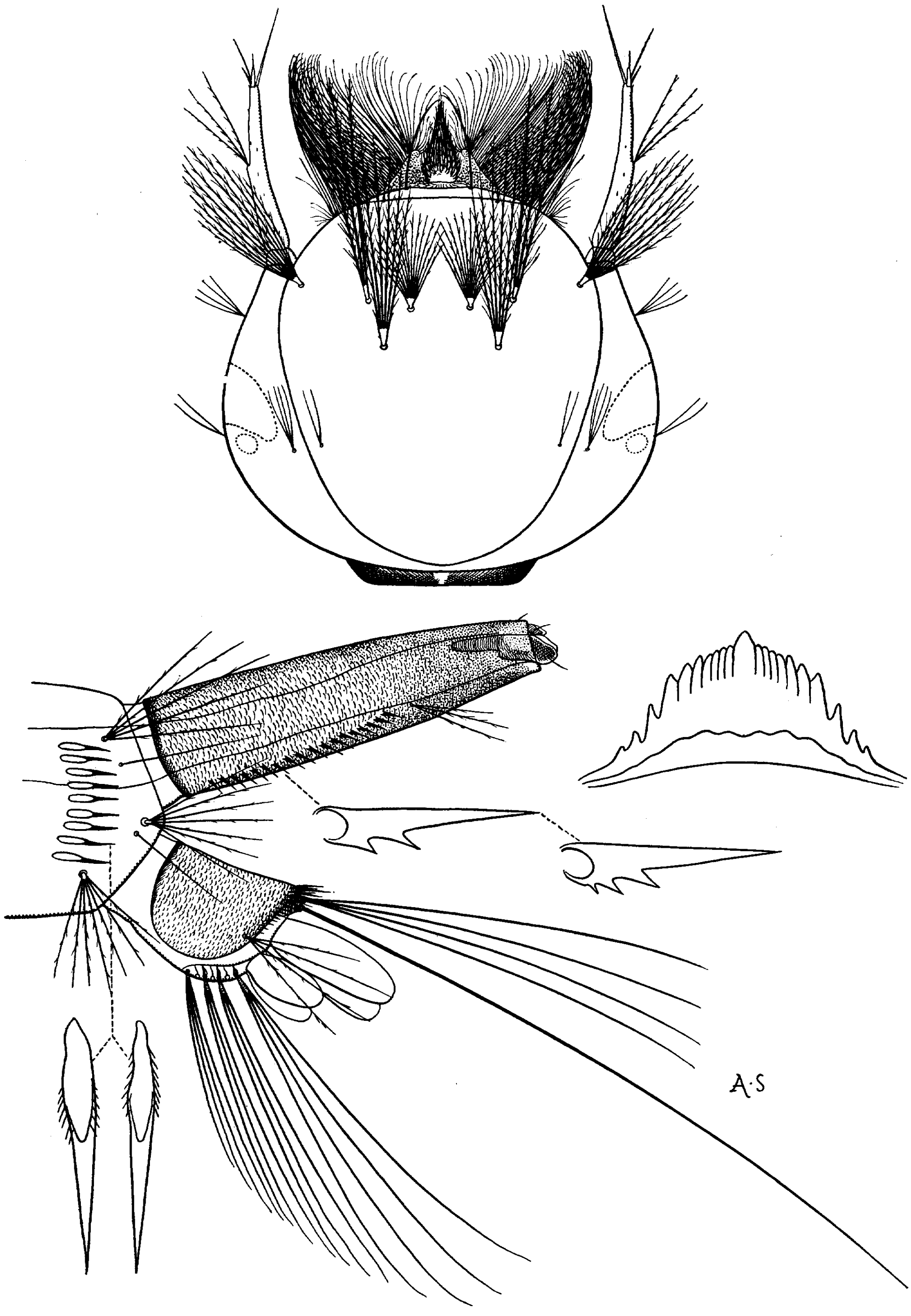


FIG. 121.—*Aëdes* (*Diceromyia*) *taylori* Edw. Head, terminal segments and mentum

evenly spaced stout teeth, each with 3 or 4 secondary denticles;* subventral tuft just beyond pecten, 2–3 branched. Anal segment with posterior edge of saddle spiculate, upper caudal seta 6-branched, lower single; lateral seta 3- or 4-branched. Ventral brush composed of 4 pairs of 4- or 5-branched tufts all within barred area, anterior tufts much shorter than posterior. "Gills" rounded, upper pair about as long as segment and longer than lower.

Breeding-places.—Tree-holes (Lewis, 1942*b*; Harris, 1942; Muspratt, 1945).

Dr. de Meillon kindly informs me that larvae of a form he doubtfully ascribes to *taylori* (de Meillon, 1943, p. 92) differ from the larva described by Lewis in a number of respects. They run down to *taylori* in the key (p. 118), but differ from the Sudan larvae as follows:

Head.—Antennal tuft with 2–7 (usually 3–5) branches. Setae A, B and C with 7–14, 2–3 and 6–11 branches respectively, *d* with 12–22 branches; seta B is rather stouter than A or C.

Abdomen.—Comb a straight row of 8–10 spines, each with a very fine basal fringe as in *furcifer*. Siphon with index 5·4 in an uncrushed whole larva; pecten of 14–29 (usually 18–25) spines which have 1–3 (usually 2) secondary denticles; subventral tuft with 2–5 branches.

Aëdes (Diceromyia) adersi Edwards. (Fig. 122.)

The larva differs from all other known members of the subgenus except *fascipalpis* by having head-seta C much longer than B and by the small number of pecten-spines (4–6); it is separable from *fascipalpis* by the fact that head-seta C is single (sometimes forked at the tip), and by having small straight spines (instead of large curved ones) at the base of the meso- and metapleural groups of setae.

Mrs. van Someren has contributed the description of this larva.

Head.—Antenna sparsely spiculate, with shaft-hair of 2–3 simple branches at about $\frac{1}{2}$. Seta A with from 8–14 sparsely plumose branches which are about a half to two-thirds the length of C; B with two simple branches about half the length of C and placed a little outside C and well up the head; C a simple seta about half the length of the head and in a line with A (in some specimens C is forked at the apex); *d* with 14–18 simple branches about half the length of B. Mentum with one large tooth in the middle and 8 smaller teeth on each side, the last two being more widely spaced.

Thorax.—Thoracic pleural spines small, pale and straight, bifid in some specimens but not in others.

Abdomen.—Setae on abdomen and thorax short and heavy, giving the larva a "prickly" appearance. Comb composed of 8–10 (usually 8) strong, sharp-pointed spines with a fringe of fine basal denticles. Siphonal index about 2; pecten spines from 4–6 in number (usually 6), broad and deeply indentated on the ventral side and sometimes also dorsally; subventral tuft usually of 3 (sometimes 2) simple setae,

* Larval pelts of this species sent to the British Museum from the Sudan by Mr. D. J. Lewis have the comb spines delicately fringed at the base as in South African specimens and occasional pecten spines appear to have less than 3 secondary denticles. The small dorsal denticles are not, however, always very easy to see. Sudan larvae sent to me by Mr. Lewis have up to 8 branches in head seta A and 3 in B. A South African pelt sent by Dr. de Meillon has even more numerous branches in the head setae (Fig. 121) and larvae from both regions may have the antennal seta trifid. One Sudan larva has only 4 branches in u. c. s.—P. F. M.

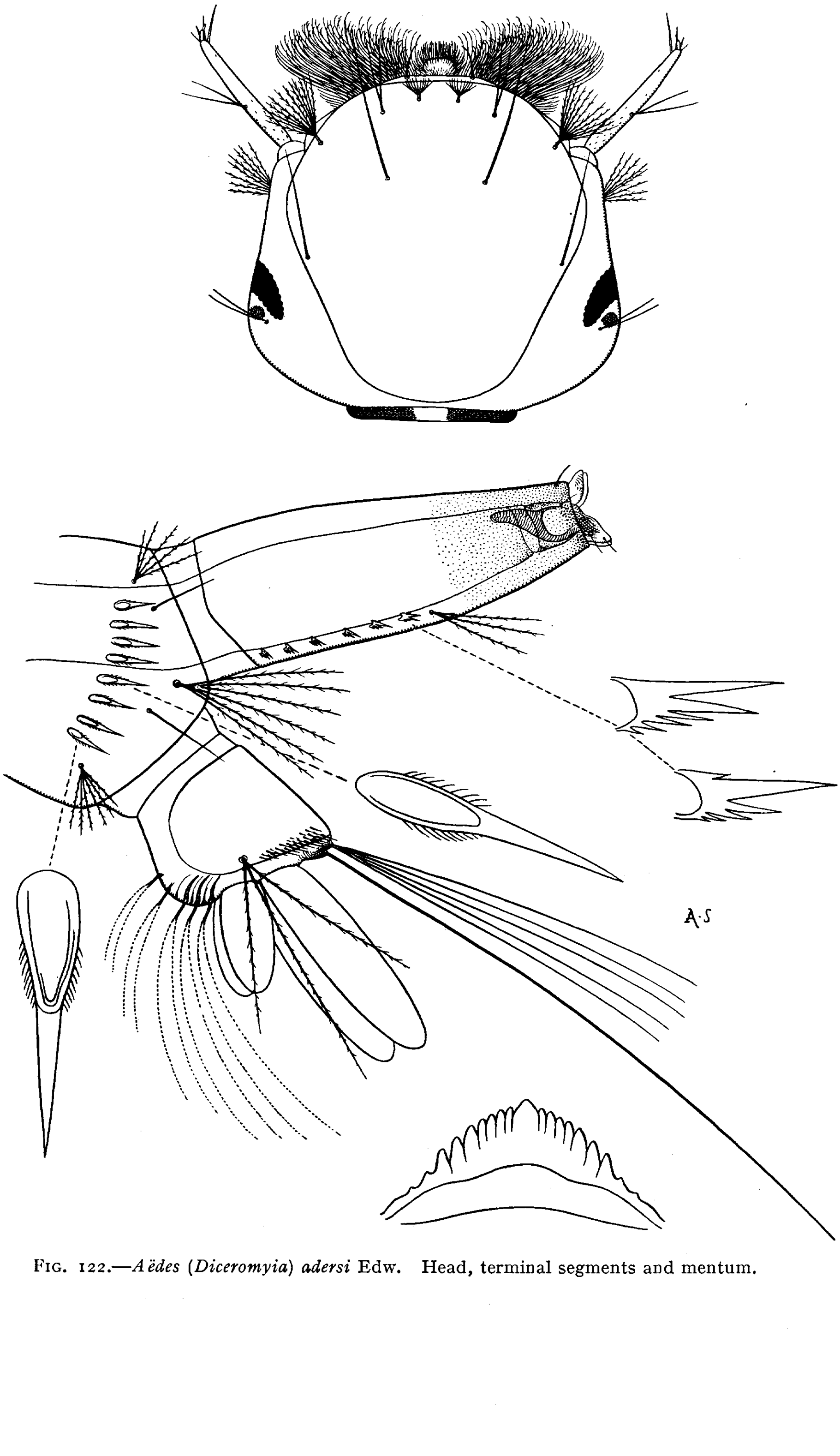


FIG. 122.—*Aëdes* (*Diceromyia*) *adersi* Edw. Head, terminal segments and mentum.

situated just beyond the pecten at a little beyond ½. Anal segment with an incomplete saddle which is heavily spiculate on the upper distal margin ; lower caudal seta single, upper with 5 branches ; lateral seta with 2–4 simple branches about 1½ times the length of the saddle. Ventral brush damaged in most specimens, but apparently with 4 pairs of tufts each with about 5 simple branches. "Gills" sausage-shaped, upper pair about twice length of saddle, lower pair about a third the length of the upper.*

Breeding-places.—Tree-holes and axil of banana leaf (van Someren, 1942) ; tree-holes, a water pot and an iron tank (Harris, 1942).

Aëdes (Diceromyia) fascipalpis Edwards. (Fig. 123.)

Separable from all other known larvae of the subgenus (except *adersi* and *zethus*) by the smaller number of pecten spines and the fact that these are not closely or evenly set, from *adersi* by the fact that head-seta C is bifid, and from both *adersi* and *zethus* by the large bifid spines of the meso- and metapleurae.

Head.—Antenna spiculate, tuft placed at ⅗, bifid, more than half length of antenna. Seta A with 11–14 branches which are nearly as long as the antenna ; B and C both bifid and minutely pectinate (B about five-sixths as long as C, which is considerably longer than the antenna) ; *d* with 13–18 branches, of which the longest is more than half as long as B.

Thorax.—Basal spines associated with meso- and metapleural groups of setae large, curved and bifid, each with a long terminal portion and a much shorter secondary spine arising from the swollen basal portion of the main spine.

Abdomen.—Comb of 4–8 lightly-pigmented spines, each with a delicate basal fringe. Siphonal tuft of 8th segment composed of 4 delicately pectinate branches, subsiphonal of 7–8 similar branches, anal of 5 somewhat stiff delicately pectinate branches of which the most ventral is slightly thicker than the rest. Siphon dark, straight-sided, slightly tapering, index 2·4–3·1 ; subventral tuft slightly beyond ½, of 3 delicate branches about as long as width of siphon (de Meillon and Lavoipierre's figure shows only 2 branches) ; pecten usually reaching to just beyond ½, composed of 3–8 spines which usually have 1–2 (sometimes 3) large or small ventral basal denticles and sometimes also a dorsal basal denticle. Saddle coarsely spiculate dorso-apically ; upper caudal seta with 4–6 long branches, lower single ; lateral seta of 2 moderately long simple branches, placed almost on distal margin of saddle. Tufts of ventral brush with 4–5 branches.

Breeding-places.—Tree-holes (Ingram and de Meillon ; Harris ; Muspratt).

Aëdes (Diceromyia) zethus de Meillon. (Fig. 124.)

The larva resembles those of *adersi* and *fascipalpis* in the small number of its pecten-spines, but differs from these two species by having head-seta A with 2–3 branches and subequal to B in length.

Head.—Antenna sparsely spiculate ; tuft of 3–5 simple or very sparsely plumose branches just before ½. Seta A of 12 finely plumose branches ; B situated well forward

* One larva sent me for drawing has 9 teeth on either side of the central tooth of the mentum and another has l.c.s. double.—P. F. M.

about in line with *d*, of 2–3 moderately long simple or minutely pectinate branches, C 2–3 branched, simple, about as long as B; *d* about half length of B, of about 12–15 delicate simple branches. Mentum with a large pointed tooth in the centre; on each

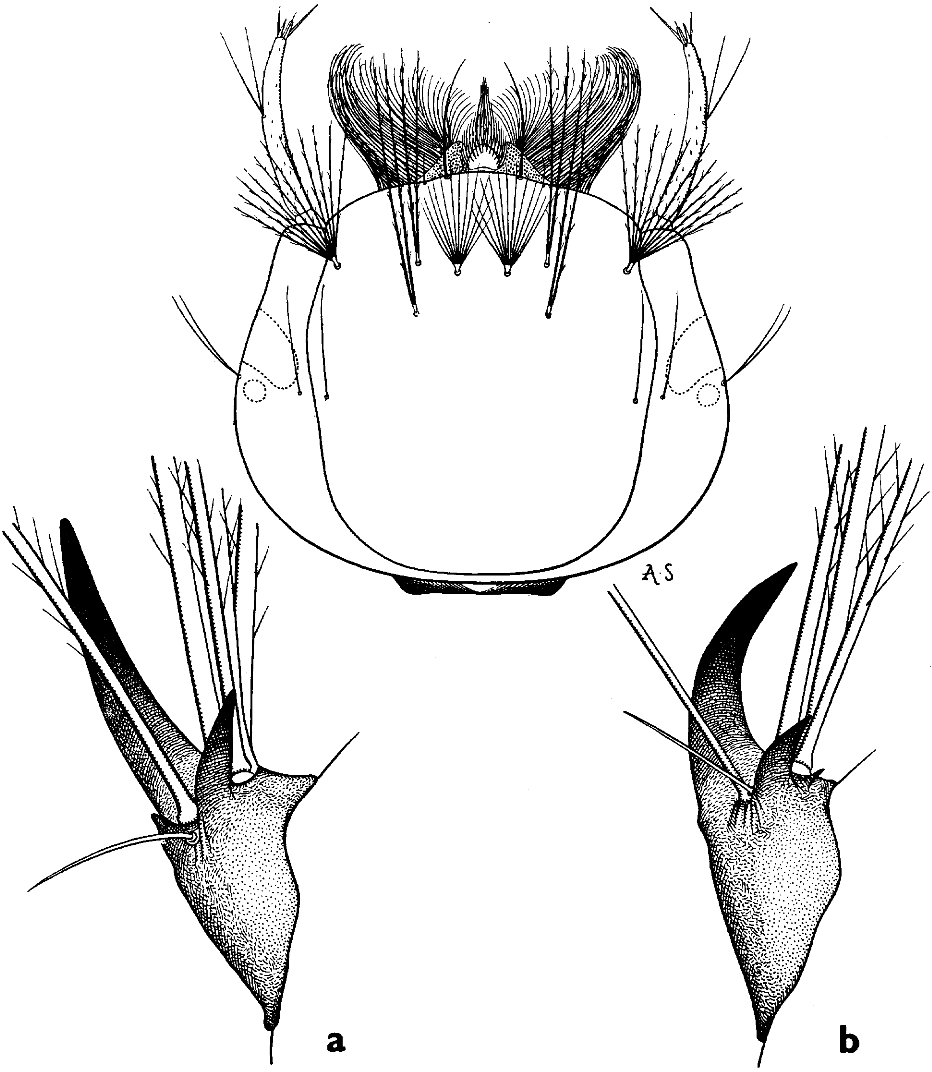


FIG. 123.—*Aëdes (Diceromyia) fascipalpis* Edw. Head and pleural spines. *a*, mesothoracic spine. *b*, metathoracic spine.

side of this five smaller teeth followed by three somewhat larger ones, of which the last is somewhat wider spaced.

Abdomen.—Comb of ten heavy spines, each with a fringe of small basal denticles. Siphonal tuft of 5 delicately barbed branches, subsiphonal of about 10 similar branches; anal of about 10 apparently similar branches. Siphon dark brown index 4 in one pelt ; tuft at about $\frac{1}{2}$ of five branches, the longest of which exceeds the diameter of the siphon. Pecten reaching nearly to $\frac{1}{2}$, composed of 8–13 spines, of which the more proximal are simple or with a minute subbasal denticle, while in the more distal ones this denticle is enlarged until it almost attains the length of the main spine ; the terminal spine may have two additional basal denticles. Upper caudal seta with 4 very long simple branches ; lower caudal seta single and simple ; lateral seta with 3 minutely barbed branches. Saddle complete, its upper distal margin with small spicules (not coarse ones as in *fascipalpis* and *adersi*). Ventral brush consisting of 3–4 pairs of tufts, each of 3–5 relatively short branches ; there is no barred area.

Breeding-places.—Tree-holes (de Meillon, 1943 ; Muspratt, 1945).

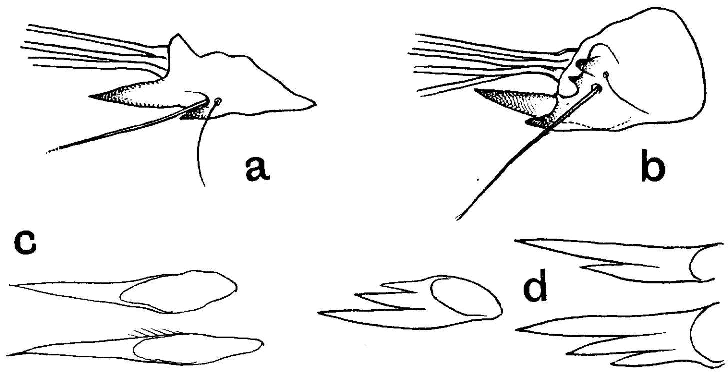


FIG. 124.—*Aëdes* (*Diceromyia*) *zethus* de M. Larval details. *a*, mesothoracic spine. *b*, metathoracic spine. *c*, comb spines. *d*, pecten teeth.

Aëdes (Diceromyia) flavicollis Edwards.

Only one much-damaged skin is known. Edwards (1927–28) has described the specimen as follows :

" Head slightly broader than long ; scars of hairs B almost immediately in front of those of C. Antennae spicular, somewhat tapering, fully half as long as the head, terminal bristles over a third as long as the shaft. Siphon strongly sclerotized, somewhat tapering, index about 2·5 ; pecten of about 16 nearly simple and evenly spaced teeth extending to middle ; scar of siphonal tuft just beyond pecten ; acus very broad. Comb of about 12 strong sharp-pointed teeth in a single row."

Breeding-places.—The type-series was bred from larvae found in a tree-hole (Edwards, *l.c.*).

Aëdes (Dunnius) argenteoventralis Theobald var. **dunni** Evans. (Figs. 125, 126.)

This larva and that of *A.* (*D.*) *kummi* could hardly be confused with any other known Ethiopian larvae of *Aëdes* except the members of the subgenus *Stegomyia*. In *Dunnius* head-seta A has about 8 branches, and *d* is as long as A, with about 15 branches. In *Stegomyia* A rarely has more than 3 branches, and *d* (though sometimes with about 10 branches) is very much shorter than A. The pecten-spines are unlike those of any other known *Aëdes* larva in our area.

Head roughly quadrangular, length and breadth equal. Antenna about $\frac{1}{3}$ length of head, smooth; tuft of 1 or 2 very small branches at $\frac{2}{3}$. Seta A with about 8 short branches; *d* almost as long and exceptionally large, with 14–17 branches; B and C single, simple, C nearly twice length of B; *e* and *f* rather long, *e* single, *f* single or double. Mentum triangular, much broader than long, about 12 teeth on each side, central tooth much larger.

Abdomen.—Comb of 7–16 spines arranged in a single or irregular double row, individual spines with a very delicate basal fringe. Siphonal index about 3; pecten of 8–16 spines, delicately fringed ventrally, extending to about $\frac{1}{2}$; subventral tuft of 1–3 long simple setae placed a little beyond pecten. Anal segment with a small

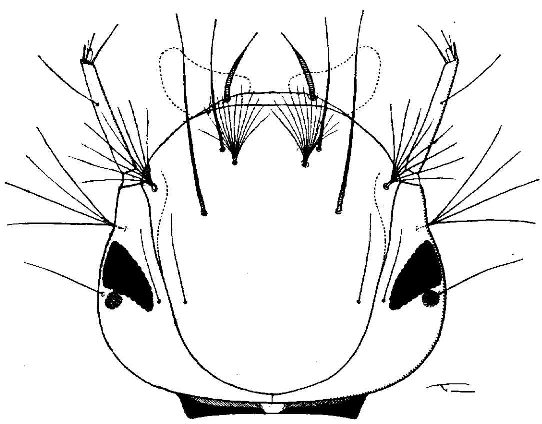


FIG. 125.—*Aëdes (Dunnius) argenteoventralis* Theo. var. *dunni* Evans. Head.

saddle; upper caudal seta triple, lower single or double; lateral seta long and stout, double, more than twice length of saddle. Ventral brush composed of 4 or 5 pairs of tufts, of which the most distal is very long and single, the most proximal short and 3–4-branched, and the remainder intermediate. "Gills" sausage-shaped, subequal, about thrice length of saddle.

Breeding-places.—The larvae of this form have been recorded by several authors, in all cases from bamboos or tree-holes; the typical form is unlikely to differ.

Aëdes (Dunnius) kummi Edwards.

Length apparently about 7 mm. (from skins); *colour* "light . . . often actually white when taken from bamboo stumps" (Kumm, 1931).

I can find no difference between the larva of this species and that of *argenteoventralis* var. *dunni*; the head-chaetotaxy figured by Kumm is almost entirely ventral, the dorsal chaetotaxy being exactly similar in the two species.

Breeding-places.—The type-series was bred from larvae found in tree-holes, others from the water contained in cut or bored bamboos (Kumm, 1931).

Aëdes (Dunnius) albomarginatus Newstead.

Larva and breeding-places unknown. Probably breeds in tree-holes and bamboos.

Aëdes (Dunnius) natalensis Edwards.

Larva undescribed. Breeds in tree-holes (Harris, 1942).

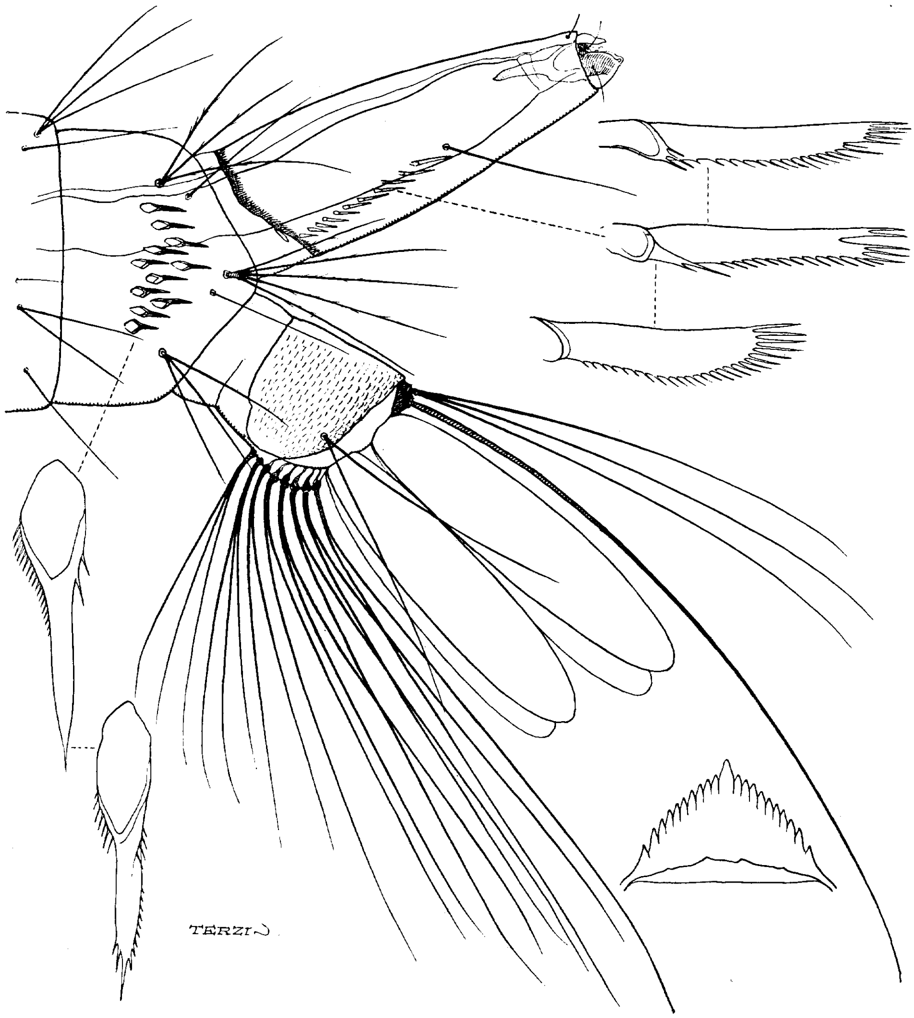


FIG. 126.—*Aëdes* (*Dunnius*) *argenteoventralis* Theo. var. *dunni* Evans. Terminal segments and mentum.

Aëdes (Dunnius) michaelikati E. C. C. van Someren. (Fig. 127.)

The following account of the larva is contributed by Mrs. van Someren.

Very like *argenteoventralis* var. *dunni*, but differs by having head-seta A with fewer branches (4–5) and by having the siphonal index about 2.

Colour pale creamy white with the head and siphon only a little darker than the rest of the body.

Head.—Clypeal spines about half the length of seta B, curved and sharp-pointed. Seta A with 4–5 finely plumose branches; B a fine single seta half the length of c and (under high powers of the microscope) broad and flattened just beyond the base and thence tapering to a very fine point; *d* with 6–8 branches. Mentum with 8–9 teeth on each side of the central tooth.

Abdomen.—Comb composed of 8–10 and pecten of 5–9 spines as in *argenteoventralis*. Siphon pale, index 1·8–2; pecten reaching to about a ½; subventral tuft just beyond a ½, single or with 2 branches, finely plumose, and about the length of the diameter of the siphon. Lateral seta of anal segment single or with 2 branches, stout, plumose, and about 2½ times the length of the saddle; upper caudal seta 4-branched, lower 2-branched. Ventral brush with 4 pairs of bifid setae. "Gills" missing.

Breeding-places.—"Bamboo pots."

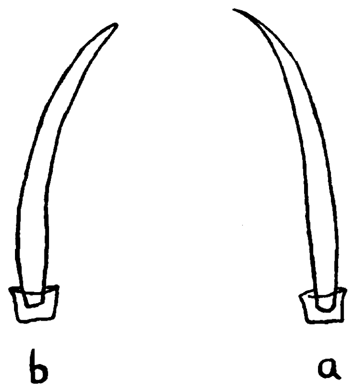


FIG. 127.—*Aëdes (Dunnius) michaelikati* van Someren. Clypeal spines. *a*, type form. *b*, Ssp. *gurneri*.

Mrs. van Someren informs me that the larva of ssp. *gurneri* is indistinguishable except perhaps by the shape of the clypeal spines. Additional characters noted by her from specimens of this form are as follows:

Head.—Clypeal spines as in *m. michaelikati* but blunt-tipped. Seta A with 3–4 branches; *d* with 6–11 branches. Mentum with 8–10 teeth on either side of the central tooth.

Abdomen.—Comb and pecten with 6–11 spines. Siphonal index 1·6–2; subventral tuft single or bifid. Lateral seta of anal segment 2-3-branched; upper caudal seta 4-branched, lower with 2–3 branches. Ventral brush with 4–5 pairs of bifid setae, the most proximal one being short and sometimes with more branches (about 4). "Gills" 3½–5 times the length of the saddle.

Breeding-places.—Tree-holes.

Aëdes (Skusea) pembaensis Theobald. (Figs. 128, 129.)

Immediately distinguishable from any other known Ethiopian *Aëdes* larva by the shape of the comb-teeth. The shape of the siphon is also very characteristic.

Length about 6½ mm.; *colour* not recorded, head and siphon pale.

Head slightly broader than long. Antenna half length of head, smooth; tuft of 3–6 small simple branches placed before $\frac{1}{3}$. Seta A very small, with about 6 simple branches, C double, B slightly shorter than C, single, *d* minute, with about 4 branches. Mentum almost square-ended, with 8 teeth (in addition to 3 more widely-separated teeth) on each side of the centre.

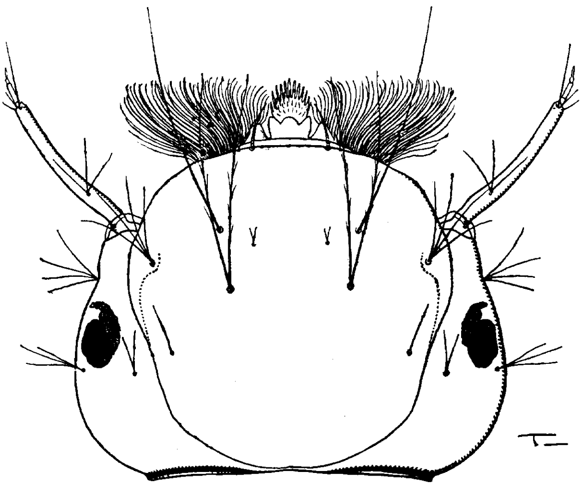


FIG. 128.—*Aëdes* (*Skusea*) *pembaensis* Theo. Head.

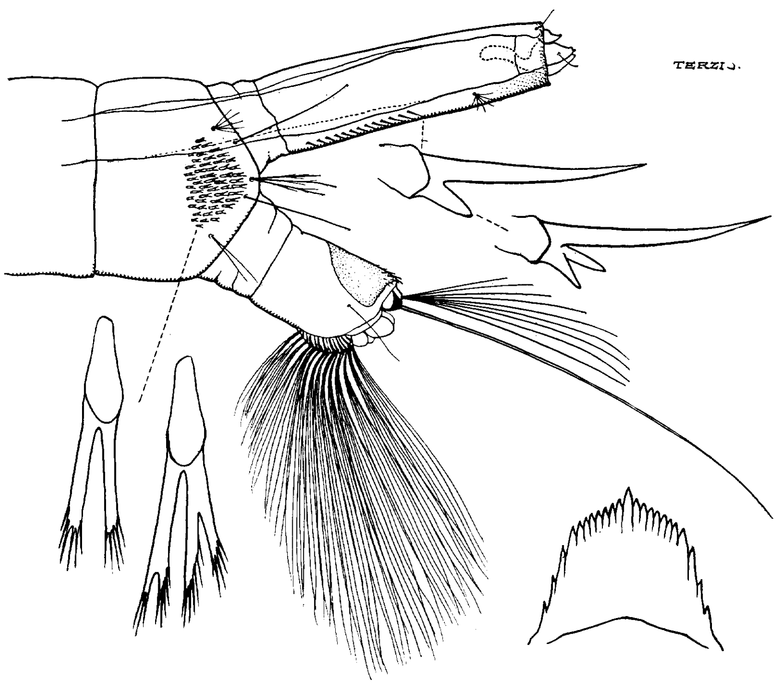


FIG. 129.—*Aëdes* (*Skusea*) *pembaensis* Theo. Terminal segments and mentum.

Abdomen.—Comb a patch of about 50 teeth, of which the more proximal are considerably smaller and less regularly-shaped; individaul teeth of a very characteristic shape, bifid to base, with tip of each prong irregularly frayed. Siphon almost cylindrical, index about $3\frac{1}{2}$; acus absent; pecten extending to a little beyond $\frac{1}{2}$, composed of 12–16 small spines which are simple or with either one or two basal denticles; tuft very small, 5-branched, placed at about $\frac{3}{4}$. Anal segment with a very small, weakly sclerotized saddle, of which the dorso-apical angle is spiculate; upper caudal seta with about 8 branches, lower single; lateral seta minute, single, placed below saddle. Ventral brush with about 6 pairs of tufts, none of which are outside the barred area, each tuft with about 10 branches. "Gills" extremely short, broader than long.

Breeding-places.—Aders (1917*a*) summarizes these as follows: "Larvae abound in crab-holes and depressions close to high-water-mark, and are able to withstand a high degree of salinity; I have never found them actually in sea-water. Experimentally they thrive in water to which 80% of sea-water has been added. . . . The larvae are long-lived and grow slowly, the average length of life under normal conditions being 12 to 14 days." Other records confirm that the normal breeding-places are crab-holes, and the structure of the "gills" is that ordinarily found in larvae which frequent salt water; but Teesdale (1941) records larvae from pine-apple-axils.

ERETMAPODITES Theobald.

Larvae of this genus are in many respects similar to those of the subgenus *Stegomyia* of *Aëdes*, and are not likely to be confused with those of any other genus, though they have a strong general resemblance to *Uranotaenia shillitonis*. From those of *Stegomyia* they may be distinguished by the reduction of the pecten to at most 4 spines and by the nature of the ventral brush; the tufts of the latter are single or double plumose setae, all of which usually arise from one small plate on each side, whereas in *Stegomyia* the tufts arise separately from elongated bases, which together make up the "barred area." A character peculiar to the present genus is that the lateral setae of abdominal segments I–VI may arise from conspicuous conical chitinous projections; unfortunately this character is well marked in only a proportion of the species.

In this genus the antenna is short, smooth and cylindrical; the tuft is usually reduced to a single short seta. Head-setae A, B and C are always short, single and simple; a supernumerary seta proximal to *d* is usual. The comb is not (as in most members of the subgenus *Stegomyia*) a single row, but always a patch of a varying number of teeth, which may be scales or spines.

Breeding-places and habits.—The larvae and breeding-places of almost all the species are known to some extent. The breeding-places are more or less similar; they include small collections of water in fallen leaves, old tins and bottles, snail-shells, etc., plant-axils, cut bamboos, and (rarely) tree-holes. Some species seem to breed exclusively in plant-axils; the majority are most frequently found in large fallen leaves in forest.

The habits are very like those of *Aëdes*, but larvae of this genus are inclined to be even more bottom-dwelling than those of *Aëdes*. When the water is poured out of the leaf containing them it will usually be found that the majority remain closely applied to the surface of the leaf, and it is necessary to wash them off with fresh water. Larvae of the species found in Uganda may often be observed crawling over the surface of the container; this habit is also noted on a slide of *E. quinquevittatus* collected by Bacot in Sierra Leone.

Haddow (1946) has studied the habits of the larvae intensively and his observations are quoted below:

"All the larvae studied in Bwamba have been found to be predatory on other mosquito larvae, on the aquatic larvae of other small Diptera, and on small aquatic oligochaetes and nematodes. Bauer noted predatory habits among his *E. chrysogaster* larvae, and J. O. Harper (private communication) observed similar behaviour in a Bwamba species closely allied to *E. dracaenae* Edw. In general, however, the predatory nature of *Eretmapodites* larvae has received little attention, and published descriptions omit reference to an interesting modification of the mouth-brushes, connected with predatory activity. The larvae of 6 species examined in Bwamba have all been found to possess a group of thickened, comb-like hairs on the medio-ventral aspect of the mouth-brushes (Fig. 130). The hairs resemble those found in the mouth-brushes of *Culex* (*Lutzia*) *tigripes* Grp. & C., whose well-known predatory habits have been discussed by MacGregor (1927) and the writer (1942). An *Eretmapodites* larva, after seizing a victim, holds it between the half-flexed head and the ventral surface of the thorax. The prey is consumed rapidly—a large larva may be devoured in about 10 minutes—and larvae are attacked even in the presence of abundant other food material. Predacity will be discussed further below, under the separate species."

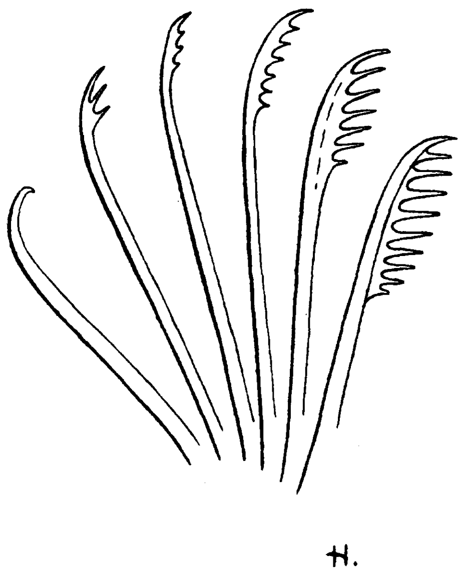


FIG. 130.—*Eretmapodites* spp. Modified hairs from the mouth-brushes.

The new key given below is taken from Haddow (1946), Dr. Haddow's work having shown that larval variation is such that the former key is not reliable.

KEY TO THE KNOWN LARVAE OF ERETMAPODITES.

1. Lateral setae of abdominal segments I–VI arising from large conical sclerotized tubercles or bosses, the surface of which is denticulate . *chrysogaster, pauliani, intermedius, subsimplicipes, semisimplicipes* and *grahami*.
   Lateral setae not arising from bosses, or arising from bosses the surface of which is perfectly smooth . . . . 2.
2. Elements of comb strongly-sclerotized spines . . . . 3.
   Elements of comb weakly-sclerotized scales . . . . 5.
3. Abdominal segments I or I and II (like III–VI) with only one strongly-developed lateral seta, forked at base on each side (always ?) . . *silvestris* (p. 232)
   Segments I–II with at least two separate strong lateral setae, either or both of which may be forked or single . . . . 4.
4. Lateral setae of abdominal segments I–VI arising from large smooth bosses; comb of 2–8 (usually 6) spines . . *oedipodius* (p. 242) and *leucopus* (p. 243).
   Bosses from which lateral setae arise either absent or very minute and rudimentary; comb of 7–20 (usually 8–10) spines *dracaenae* (p. 239), *ferox* (p. 239) and *hightoni* (p. 241).
5. Tuft B of abdominal segment VIII a very strong and conspicuous multifid seta *quinquevittatus* (p. 237).
   Tuft B of abdominal segment VIII weak and inconspicuous . . . . 6.
6. Short seta of the mesothoracic pleural group divided into 12–24 branches *inornatus* (p. 233).
   Short seta of the mesothoracic pleural group divided into 3–9 branches . 7.
7. Comb of 8–20 (usually about 15) scales; pecten absent . *penicillatus* (p. 235).
   Comb of about 25 scales (? always); pecten sometimes present *argyrurus* (p. 237).

Eretmapodites chrysogaster Graham. (Figs. 131, 132 and 133.)

This larva belongs to a group which is distinguishable by the fact that the lateral setae of abdominal segments I–VI arise from prominent and rugose sclerotized bosses. The members of this group (which includes *intermedius, subsimplicipes, semisimplicipes* and *grahami*) appear to be indistinguishable from each other.

Length 9–12 mm.; *colour* brownish, head brown, siphon almost black.

Head slightly broader than long. Antennal tuft a single very small seta at about $\frac{4}{5}$. Setae A, B, C and *d* all simple (B sometimes double); C longer than the remainder and placed almost directly behind B; supernumerary seta usually 2-branched; *e* and *f* small and delicate, double. Mentum with 6 to 8 small teeth on each side of the centre.

Thorax.—The three setae of the mesothoracic pleural group equal in length, stout, single and slightly plumose.

Abdomen.—Lateral setae of segments I–VI arising from conspicuous conical rugose bosses. Comb an irregular patch of 19 to 40 rather small spines, which are somewhat variable in shape, and frequently have a much stronger median spinule than is shown in the figure, this spinule then becoming the most conspicuous part of the tooth. Tuft B of eighth segment long and plumose, with 3–7 branches. Siphon with index about 2; pecten composed of 1–4 rather large spines, with few spicules on both dorsal and ventral sides; subventral tuft situated a little before $\frac{1}{2}$, composed of 2–3 slightly plumose setae, which are about as long as the diameter of the siphon. Anal segment with a very small saddle ; caudal setae plumose, upper usually double, lower single or double ; lateral seta minute, with about 4 branches. Setae of ventral brush single and plumose. " Gills " subequal, sausage-shaped but slightly tapered at the apex, about $3\frac{1}{2}$ times length of saddle.

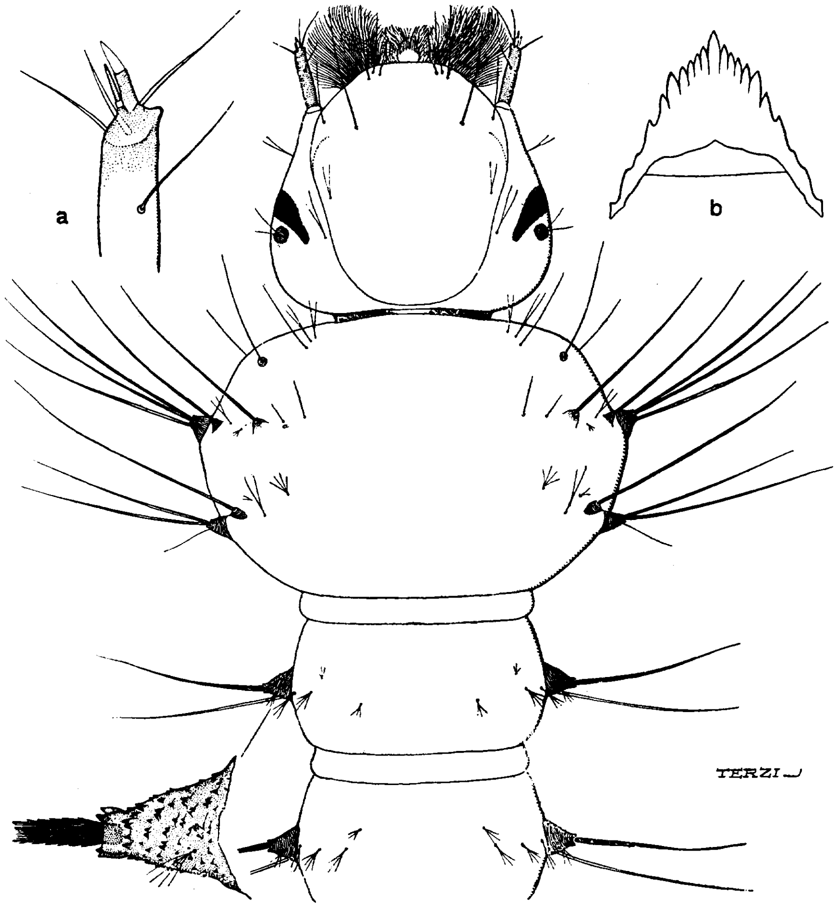


FIG. 131.—*Eretmapodites chrysogaster* Graham. Head, thorax and first two segments of abdomen. *a*, tip of antenna. *b*, mentum.

Haddow (1946) has the following remarks about variation in this species ; in this and other cases I have altered his figure-references so as to bring them into conformity with the present volume :

" The denticulate bosses or tubercles of the thorax and abdomen show great variation. At the one extreme are found very well-developed tubercles, heavily sclerotized, and with numerous well-marked denticles studding the surface. In the main, tubercles of this type resemble Fig. 131, but sometimes they are even longer and more nipple-like, the ratio of basal width to height being 1 : 1 or 1 : $1\frac{1}{2}$.

" At the other extreme are found poorly-developed, lightly-sclerotised, rather flattened tubercles, with only a few poorly-developed denticles, and with the ratio of width to height about $1\frac{1}{2} : 1$ or even almost $2 : 1$. Obviously some environmental influence is here at work, as larvae with strong tubercles are commonest in forest leaf-pools, while plant-axil specimens usually have tubercles of the weak, flattened type. Larvae of *E. grahami* have been described as having characteristic comb-spines, ' thorn-like with only very minute basal denticles ' (Hopkins). Unfortunately it has been found that spines of this kind frequently occur in *E. chrysogaster*, and as in some cases all the spines of a larva may be of this type (Fig. 133, 1–6), the form of the spines is not a reliable diagnostic character. From this extreme the spines vary

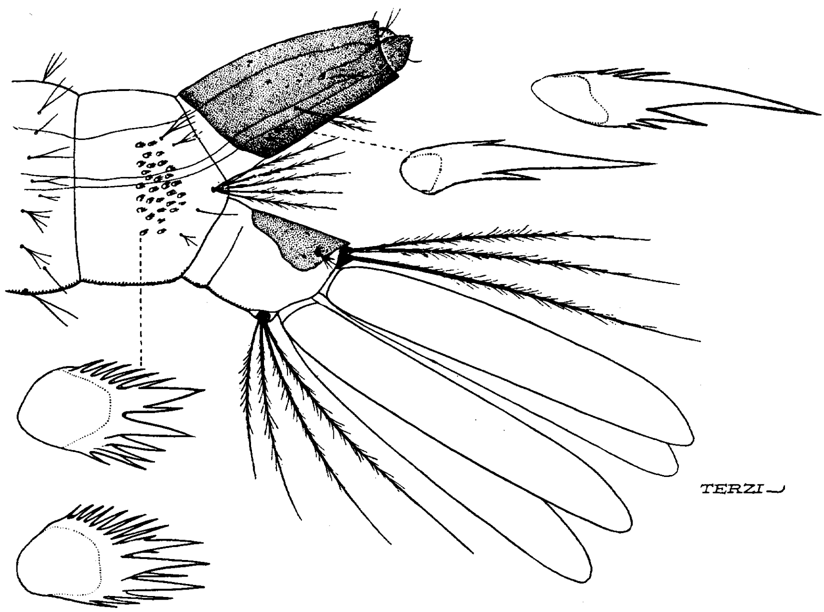


FIG. 132.—*Eretmapodites chrysogaster* Graham. Terminal segments.

through forms with a large central tooth and a few well-developed basal denticles (Fig. 133, 7–12), to types with the central tooth only a little larger than the others which are numerous and strongly-developed (Fig. 133, 13–18). So far no larvae have, been found with teeth of the extreme type shown in Fig. 132—the central tooth is always easily recognizable, though it may sometimes be bifid (Fig. 133, 9 and 17). Once again it is obvious that environment has influence on structure for, while it is unusual to find a larva with teeth all of a single type, the simple thorn-like forms are almost confined to larvae living in forest leaf-pools, while teeth with numerous secondary denticles predominate in plant-axil larvae."

Breeding-places and habits.—Records of this species are peculiarly liable to error because of confusion with the other members of the group, but the account given here is believed to be confined to true *chrysogaster*.

The larvae are perhaps most abundant in large fallen leaves (including the very large bracts of *Musanga Smithi*), and apparently occur more frequently than other members of the genus in artificial containers, such as discarded tins, and pots, but only when these are in shade and contain water strongly tinged by decaying vegetable matter. Mr. P. F. Mattingly kindly informs me that in West Africa the most important breeding-places are the split cocoa pods left on the ground after harvesting,

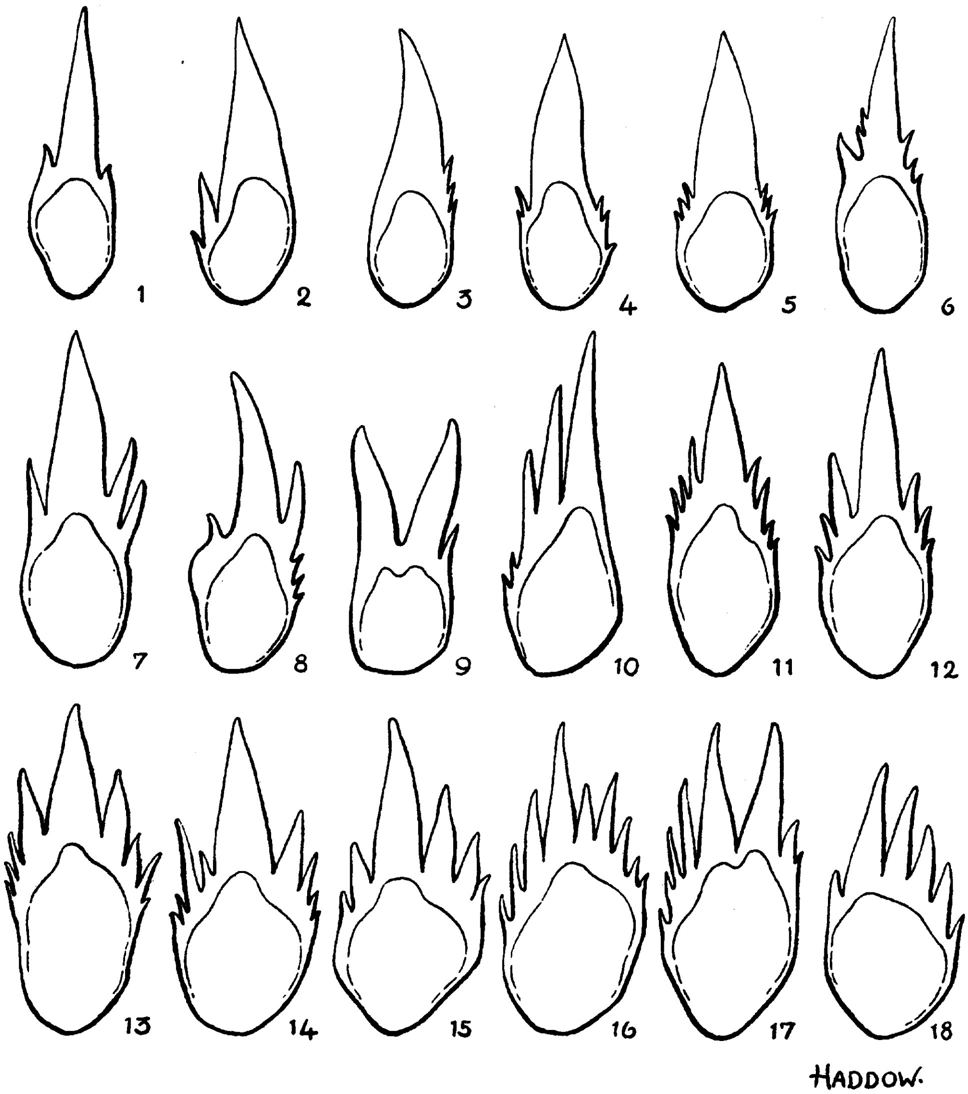


FIG. 133.—*Eretmapodites chrysogaster* Graham. Comb spines.

" which literally swarm with larvae " ; he points out that this may significantly affect the seasonal distribution of the mosquito. He mentions that cut banana leaves lying on the ground are also greatly favoured breeding-places of this species in West Africa. Teesdale (1941) and Haddow (1946) found larvae in plant-axils, and Haddow found them once in a ground pool containing dead leaves. Bequaert

(1930) and Edwards and Gibbins record the species breeding in the stumps of cut bamboos, and it occurs occasionally in tree-holes (Graham, 1909; Haddow, 1946). Pomeroy (M.S.) has a number of records from tubs.

Haddow (1946) notes that, in addition to a pronounced browsing habit, the larvae are active predators. They form a partial control of certain other larvae (*Aëdes simpsoni, Harpagomyia taeniarostris, Uranotaenia ornata musarum* and *Culex nebulosus*) which are common in plant-axils, but young larvae of the *Eretmapodites* are relatively immune to attack because their tough integument usually enables them to escape without serious injury. (M. Rageau has sent me larvae of a member of the groups which he found in flower calyces.—P. F. M.)

Eretemapodites haddowi E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Eretmapodites pauliani Grjebine.

The male terminalia of this species, as described and figured in the type description, show a close resemblance to those of *haddowi* and it seems possible that the two are conspecific. The following description of the larva is translated from Grjebine (1950).

"*Length:* 10–11 cm. *Colour:* yellowish; head brown. Siphon entirely blackish brown; *head* a little broader than long. Antenna very short, measuring 1/5th the length of the head. Tuft reduced to a simple antennal seta, the same length as the antenna and placed halfway along it. Antennal papilla short and thick. Subapical and apical setae measuring 1/3rd the length of the antenna. Setae A, B and C simple. Mentum: 10 lateral teeth on either side, the median tooth larger than the others. *Thorax:* 3 mesothoracic setae of equal length arise from a pyramidal chitinous tubercle; the 2 metathoracic setae are of equal length. All these setae are simple, stiff and conspicuously plumose. *Abdomen:* lateral setae of abdominal segments inserted on very elongated and rugose conical tubercles whose length is $4/3 \times$ their breadth at the base. Each tubercle carries only two setae, one on the apical part, the other on the basal. The lateral abdominal setae are plumose. Comb of VIIIth segment: 20–26 spines, each formed essentially of a very large, thick median denticle and 3–4 small, fine lateral denticles. Tuft B of the VIIIth segment has a double bifurcation giving, in all, 4 long, plumose branches. Siphon: index 1–1·4; pecten: 3 teeth in the form of elongated, simple spines, the third with two minute secondary dentices. Siphonal tuft situated at half the length of the siphon and composed of two plumose branches which branch off at about half way along the length of the tuft, the total length of the tuft is about equal to the diameter of the siphon. Saddle: small, surface sculptured with small spicules towards the distal edge. Caudal seta: plumose, the upper numbering 6–8, the lower double. The ventral brush has 8–10 setae; anal papillae equal, very long."

Breeding-places.—Fallen leaves in forest, in one case in association with *E. oedipodius*, in another, in a small clearing, with *E. chrysogaster*.

Diagnosis from other members of the chysogaster group.

Grjebine gives the following differences from *chrysogaster* which may or may not prove constant when sufficient authenticated pelts of the latter are available for comparison.

Mentum with 10 lateral teeth, central tooth much larger than the others. Pecten of long simple spines. Upper caudal setae with 6 branches. Ventral brush with 8–10 setae.—P. F. M.

Eretmapodites harperi E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Eretmapodites mahaffyi E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Eretmapodites intermedius Edwards.

Larva not distinguished from that of *chrysogaster*.

Breeding-places.—The only records which can definitely be referred to this species are from fallen leaves of *Musanga* (probably really the bracts) and banana (Edwards, 1941, p. 229).

Eretmapodites subsimplicipes Edwards.

Edwards (1914) separated the larva from that of *chrysogaster* by the facts that the comb is composed of 10–22 spines, as against 20–40 (average 30) in *chrysogaster*, and the pecten is usually of 3 spines as against 2 in *chrysogaster*. Too few pelts of larvae from which adults have been reared are available to allow of a decision as to whether the differences hold good.

Breeding-places.—There are specimens in the British Museum labelled by Dr. Aders " Bred swampy ground " (the writer would suggest that these were probably in fallen leaves). Ingram and de Meillon's record of *chrysogaster* breeding in bamboo stumps probably refers to the present species. Harris (1942) records this species breeding in tree-holes and discarded coconut shells.

Eretmapodites semisimplicipes Edwards.

" The larvae cannot be distinguished with certainty from those of *E. chrysogaster* but some guidance is given by the fact that the integument is usually white instead of brownish. The comb has usually fewer spines than that of *E. chrysogaster* (about 12–20) but a good deal of overlap occurs" (Haddow, 1946).

Breeding-places and habits.—Schwetz (1930*b*) records breeding this form from tree-holes, and Macfie and Ingram's record (1922–23) of breeding *chrysogaster* on several occasions from paw-paw stumps may refer to *semisimplicipes*, as there are specimens of this species in the British Museum from the locality mentioned. Haddow (1946) found larvae quite commonly in " forest leaf-pools " and in plant-axils, and notes that they have similar predaceous habits to those of *chrysogaster*. There is also a record from fallen bamboo-stems. Garnham, Harper and Highton state of this species: " The commonest breeding-places of this mosquito are the fern-hung holes in granite boulders deep in the forest and in bamboo sections placed on the ground. In such sites the larvae are always very numerous. It is less common in tree-holes, and when present is usually confined to holes near the ground. It was never found above twenty feet. Another common breeding-place is the fluid in the top of tree-stumps. This fluid comprises largely the sap, which has a most pungent odour and an alkaline reaction. In such sites it is usually accompanied by a heavy culture of *Culex nebulosus*. Larvae are found infrequently in the dry season in rock pools by the side of streams in the forest. The classical breeding-place (viz. large fallen leaves) of this group is practically absent at Kaimosi and only on one occasion were (five) larvae found in a leaf pool."

Eretmapodites grahami Edwards.

It was formerly thought possible to distinguish the larva from that of *E. chrysogaster* by the shape of the comb-spines, the much more lanceolate " gills," and the distinctly shorter siphon (index little more than 1). Haddow's work on *chrysogaster* has shown that the shape of the comb-spines is too variable to be of value and the low siphonal index is probably due to distortion. The only remaining character is the shape of the " gills," which may or may not be reasonably constant.

Breeding-places.—Usually in large fallen leaves in forest ; we once obtained larvae in the very small quantities of water contained in the concave tops of a toad-stool (*Polystichus xanthopus* Fr., Polyporaceae).

Eretmapodites gilletti E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Eretmapodites silvestris Ingram and de Meillon. (Fig. 134.)

Apparently distinguished from all other species of the genus by the fact that there is only one strongly developed lateral seta (forked at the base) on abdominal segments I–II as on III–IV ; in all the other known species these segments each bear two strongly developed setae, both of which may be either forked or single. The pelt of the type is still the only known specimen, and it is not known whether this and other characters are constant.

The larva differs from that of *E. oedipodius* as follows : Antennal tuft a single seta which is about $\frac{3}{4}$ the length of the antenna. Mentum a very regular equilateral triangle with 10 teeth on each side of the centre. Abdominal segments I–II each with only one strong lateral seta, which is forked from the base. Comb consisting of 14 spines in an irregular patch, individual spines very like those of *oedipodius* but markedly smaller. Siphon crushed, but perhaps shorter than that of *oedipodius* (index 1, perhaps about $1\frac{1}{2}$ before crushing) ; pecten-spines somewhat different in shape. Both caudal setae 2-branched. " Gills " distinctly broader, ventral pair decidedly shorter than the dorsal.

Breeding-places.—The type was reared from a larva found in the axil of a *Dracaena* (Ingram and de Meillon). The subspecies *conchobius* Edwards, of which the larva is undescribed, breeds in snail-shells in forest, " a notably different habitat from that of the type form " (Edwards, 1941).*

* A pelt of ssp. *conchobius* from Taveta, Kenya, has been sent me by Mrs. E. C. C. van Someren, and Knight and Hoogstraal have a description of further larvae of this sub-species, from Torit, Sudan, in the press (*Amer. J. Trop. Med.*). I am indebted to Lt.-Cdr. Knight for permission to quote from their MS. The Kenya pelt differs from the only available pelt of the type form in the shape of the comb spines which resemble Haddow's type 16 of *chrysogaster* (Fig. 133). The figure of *silvestris* (Fig. 134) is misleading in this respect since it shows the basal denticles more strongly developed than

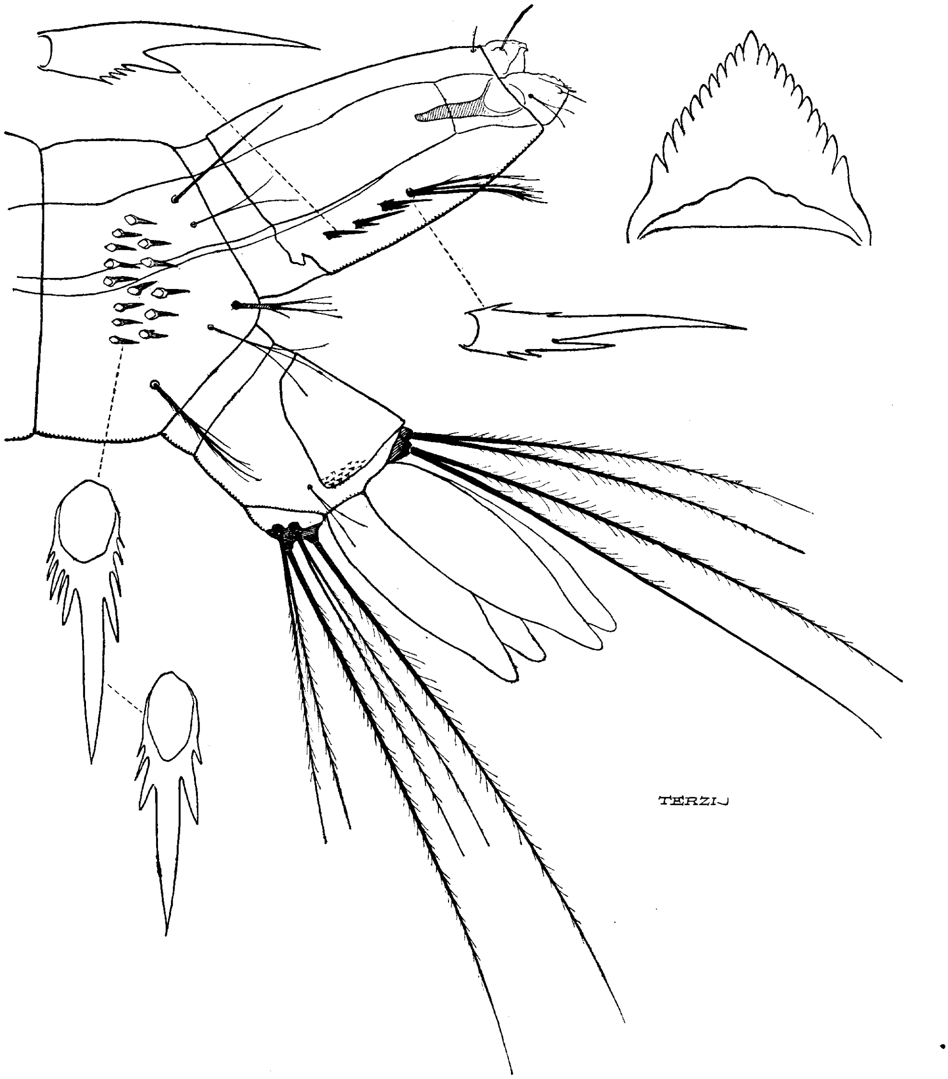


FIG. 134.—*Eretmapodites silvestris* Ingr. and de M. Terminal segments and mentum.

Eretmapodites inornatus Newstead. (Fig. 135.)

The following account of the larva is from Haddow (1946) :

" *Length* 9–12 mm. ; *colour* whitish, head horn-colour, siphon dark brown.

" *Head* about as long as broad. Antennal tuft a single slender hair at about $\frac{2}{3}$.

in fact they are. The Kenya pelt also differs from that of the type form in having more strongly developed secondary denticles on the pecten spines and in having the subventral tuft of the siphon trifid instead of bifid. The comb spines of the Sudan form appear to resemble those of the Kenya form fairly closely though with a higher proportion having the median denticle relatively exaggerated. It is not thought that this difference is significant. The pecten spines, as figured, are much simpler than in the Kenya pelt in which they have very numerous secondary denticles both dorsally and ventrally. The subventral seta of the siphon is shown as trifid.—P. F. M.

All head setae small and inconspicuous. Mentum broader than long, with about 5 teeth on either side of a rather small central tooth. Outermost teeth scarcely larger than the others.

" *Thorax* with the mesothoracic pleural group consisting of 2 long subplumose setae (1 single and 1 double, or both double) and a much shorter seta with 12–24

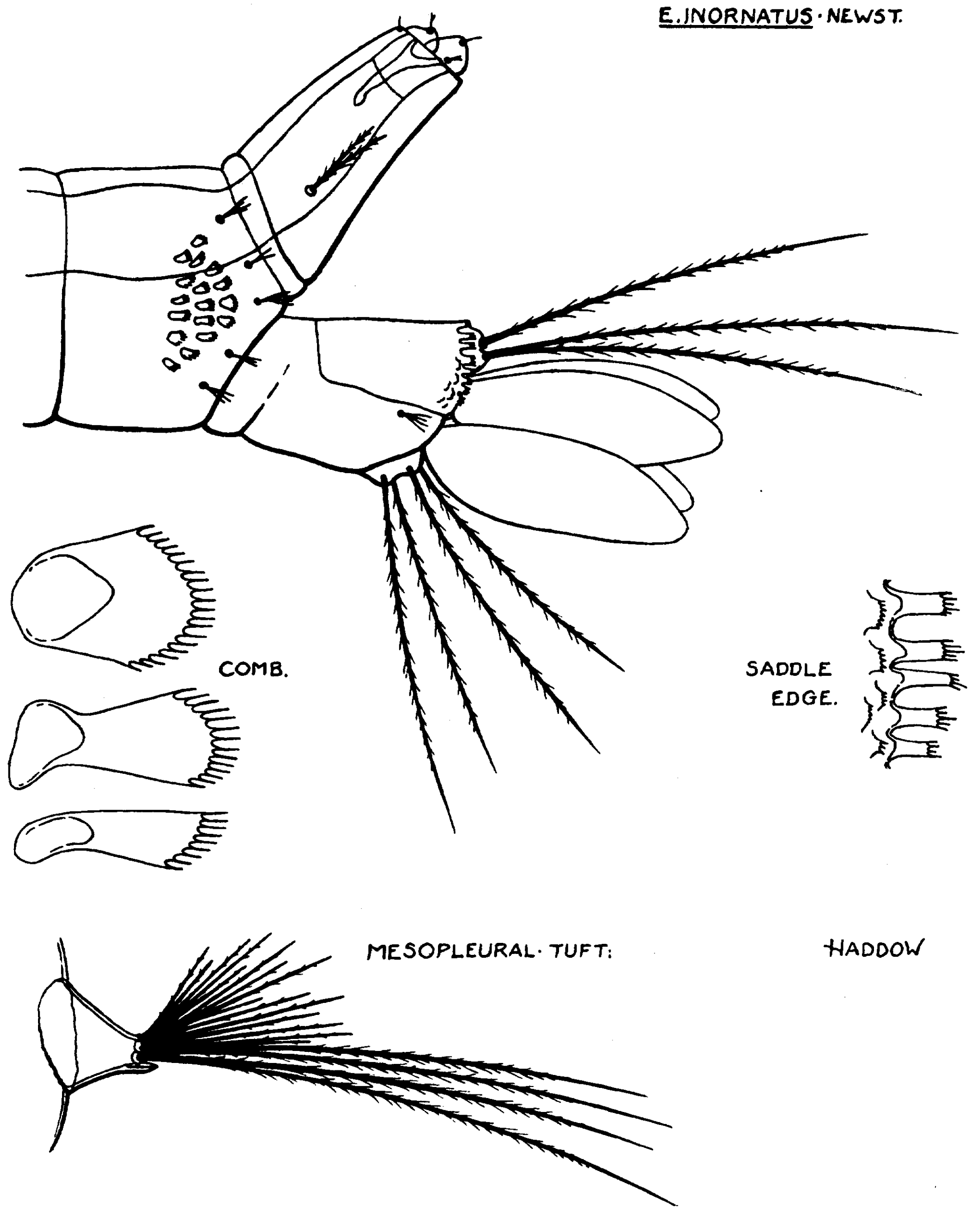


FIG. 135.—*Eretmapodites inornatus* Newst. Terminal segments, comb scales, edge of saddle and mesopleural tuft.

stiff, needle-like branches, of which the longest are about $\frac{1}{2}$ the length of the long setae. Mesothoracic lateral hairs usually double, but sometimes single or 3-branched.

"*Abdomen* with the lateral setae of segments I–III borne on large smooth bosses, those of succeeding segments on smaller but quite distinct bosses. On segment I usually 2 single setae arise from the boss, but one or both may be bifid. On segment II there are usually 3 single setae arising from the boss, but one of these may be bifid or even trifid. Perhaps the third is the main ventral seta, whose boss has become fused to that of the lateral setae proper. On succeeding segments there is a single lateral seta. Comb consisting of 5–20 (usually about 12) weakly-sclerotised scales with pronounced terminal fringes, arranged in a patch or irregular double row. Tuft B of segment VIII weak and inconspicuous, with 5–6 branches. Siphon with index $1\frac{1}{2}$–2 in life, about 1 in specimens mounted with pressure. Conical in such specimens, but in life almost cylindrical and slightly curved. Pecten absent. Subventral tuft a rather stout subplumose seta at about $\frac{1}{3}$, usually double but sometimes single or triple, about as long as the diameter of the siphon at the point of attachment. Saddle small, incomplete and lightly-sclerotised, the posterior edge markedly crenellate and the crenellae bearing terminal fringes. Lateral seta small and weak, with 3–4 branches, arising below the edge of the saddle. Upper and lower caudal setae single or double, subplumose. Ventral brush consisting of 4 pairs of unbranched plumose setae (occasionally one may be bifid). Gills subequal, sausage-shaped, about 2–3 times the length of the saddle."

Breeding-places and notes.—"Larvae have been found in snail-shells (*Achatina* and *Limicolaria* spp.), in forest leaf-pools and in *Colocasia* axils. They have a pronounced browsing habit. In life the peculiar multifid seta of the mesothoracic pleural group projects downward, outward and forward, making contact with the surface on which the larva is feeding. Development is slow. This species is less actively predatory than the members of the *E. chrysogaster* group" (Haddow, 1946).

Eretmapodites melanopus Graham.

Larva and breeding-places unknown.

Eretmapodites forcipulatus Edwards.

Larvae undescribed ; probably similar to *argyrurus*.

Breeding-places.—Bred from empty shells of a large land-snail (*Achatina*) containing very little water (Bequaert), and from a hole in concrete, containing water which was dark brown from decaying leaves (Macfie and Ingram, 1916*a*).

Eretmapodites penicillatus Edwards. (Fig. 136.)

The following account is from Haddow (1946) :

"*Length* 10–12 mm. ; *colour* white, head horn-colour, siphon dark brown.

"*Head* a little broader than long. Antennal tuft a single delicate seta just beyond $\frac{1}{2}$. Head setae all delicate and inconspicuous. Mentum broader than long, with about 7 teeth on either side of a rather small central tooth, the outermost teeth being larger than the remainder.

"*Thorax* with the mesothoracic pleural group consisting of 2 long, single, sub-plumose setae and a much shorter seta which is divided into 3–8 stiff, needle-like branches. Mesothoracic lateral hairs single.

"*Abdomen* with the lateral setae of segments I–III borne on large smooth bosses, those of segments IV and V on small bosses. On succeeding segments bosses are extremely small or absent. On segment I, 2 single lateral setae arise from the boss, on segment II, 3 single lateral setae (v.s., under *E. inornatus*). On succeeding

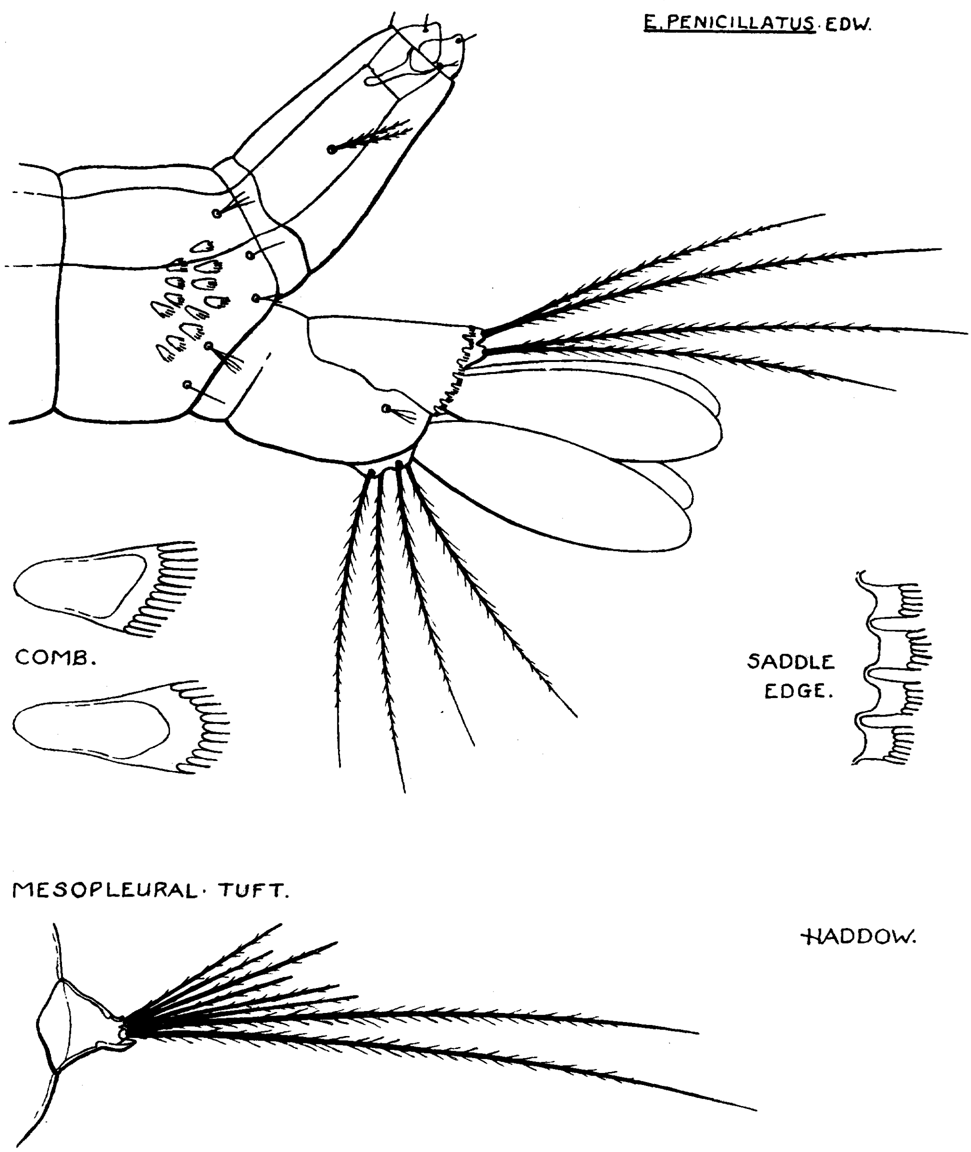


FIG. 136.—*Eretmapodites penicillatus* Edw. Terminal segments, comb scales, edge of saddle and mesopleural tuft.

segments there is a single lateral seta. Comb consisting of 8–15 weakly-sclerotised scales, with pronounced terminal fringes, arranged in a patch or irregular single or double row. Rarely as many as 20 scales may be present. Tuft B of segment VIII very minute and delicate, 2–4 branched. Siphon with index about $1\frac{1}{2}$–2 in life, about 1 in specimens mounted with pressure. Rather conical in such specimens, but in life almost cylindrical and slightly curved. Pecten absent. Subventral tuft a rather stout subplumose seta at about $\frac{1}{2}$ with 1–3 (usually 2) branches, about as long as the diameter of the siphon at the point of attachment. Saddle small, incomplete and lightly sclerotised, the posterior edge crenellate and the crenellae fringed as in the case of the comb scales. Lateral seta minute, 3–4 branched, arising below the edge of the saddle. Upper caudal seta single or double, lower double. Caudal setae subplumose. Ventral brush consisting of 4 pairs of unbranched plumose setae. Gills subequal, sausage-shaped, about 2–3 times as long as the saddle."

Breeding-places and habits.—" So far all larvae have been found in dark-brown water in snail-shells (*Achatina* and *Limicolaria* spp.) in the forest. They have the usual browsing habit, and in life the multifid seta of the mesothoracic pleural group assumes the same position as in *E. inornatus*. In nature larvae sometimes support a very heavy growth of stalked ciliates, of the *Vorticella* and *Carchesium* types, and in such cases the pupa almost always dies just after the last larval moult. Development is slow, even when food is abundant. Though many may be found together in one shell, larvae of other genera are never found in their company, on account of the marked predatory habit " (Haddow, 1946).

Eretmapodites argyrurus Edwards.

Resembles *E. quinquevittatus* very closely ; the main differences are as follows : Mentum with outermost tooth distinctly larger than the remainder. Lateral setae of meso- and metathorax single ; shorter seta of the mesothoracic pleural group split into 6–9 branches, of which the longest is not quite half the length of the 2 longer setae. Tuft B of eighth segment very small and inconspicuous. Pecten-spines (0–2 in number) very small and sharply pointed. Subventral tuft of siphon often 2-branched. Setae of ventral brush single. " Gills " somewhat narrower.

Breeding-places.—Not recorded.

Eretmapodites tonsus Edwards.

Larva and breeding-places unknown.

Eretmapodites quinquevittatus Theobald. (Fig. 137.)

From other species without large chitinous bosses at the bases of the lateral setae of abdominal segments I–VI *quinquevittatus* is immediately distinguished by the unique character of tuft B of the eighth segment.

Length about 10 mm. ; *colour* not recorded, apparently whitish with yellow head and brown siphon.

Head about as broad as long. Antenna cylindrical, smooth, about $\frac{1}{3}$ length of head ; tuft a single minute seta at about $\frac{3}{4}$. Clypeal spines minute. Setae all very inconspicuous and single, placed as in *E. chrysogaster*. Mentum triangular, with about 6 teeth on each side of the centre.

Thorax.—" Lateral hairs of the meso- and metathorax (those immediately above the pleural hairs) each split into 4–6 branches " (Edwards, 1929) ; mesothoracic pleural group with 2 long 2–3-branched setae and a much shorter seta having 12–15 branches.

Abdomen.—Lateral setae not borne on distinct tubercles. Comb an irregular patch of about 25 small weakly sclerotized scales which are decidedly variable in character, but are mostly very broad and with a fine terminal fringe. Tuft B of eighth segment arising from a conspicuous sclerotized tubercle and consisting of a

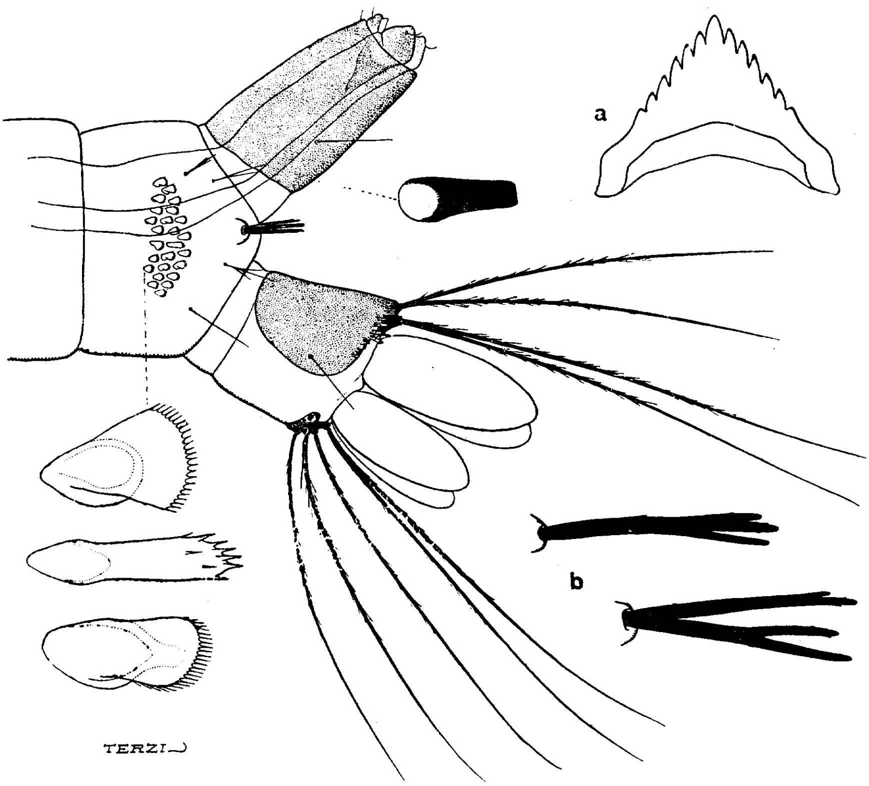


FIG. 137.—*Eretmapodites quinquevittatus* Theo. Terminal segments. *a*, mentum. *b*, tuft B of eighth abdominal segment.

single very stout short highly sclerotized seta, which is split into usually 3 stout branches. Siphon with index about $1\frac{1}{2}$; pecten reduced to a single blunt-ended spine which is apparently sometimes absent ; subventral tuft a single simple seta at about $\frac{1}{3}$. Anal segment with saddle rather small and weakly sclerotized, dorsal portion of posterior margin rather strongly spiculate ; upper and lower caudal setae both double and plumose ; lateral seta single, slender and inconspicuous, a little more than half length of saddle. Anterior 2 setae of ventral brush single, third either single or double and posterior double. " Gills " very broad ovoid, dorsal pair slightly longer than saddle, ventral pair slightly shorter than dorsal.

Breeding-places.—Aders (1917) sums these up as follows : " Common in small dirty collections of water, especially in empty molluscan shells; those of the land snail, *Achatina panthera*, nearly always harbour a number of these larvae." They are also recorded by a number of authors from old tins and bottles, and several authors confirm Aders' mention of snail-shells. Teesdale (1941) records the species from axils of banana and pineapple.

Eretmapodites dracaenae Edwards.

A single whole larva of a batch from which this species was bred (Takoradi, Gold Coast, A. W. J. Pomeroy) differs from any of the known larvae of the genus; it seems fairly safe to assume that it belongs to *E. dracaenae*; more especially as the larvae of most of the other known species have been described. It is probably indistinguishable from that of *ferox*.

The larva is badly damaged, but appears to resemble *E. oedipodius* more closely than other species. The following differences will serve to separate it: Lateral setae of abdominal segments I–VI not arising from tubercles (in *oedipodius* they arise from small and inconspicuous smooth-surfaced tubercles). Comb perhaps with more numerous spines (there are 9 on each side in the specimen examined); the majority of the spines appear decidedly trifid under a low power. Siphon broken, but apparently much shorter than that of *oedipodius*; pecten spines 3 in number and very similar to those of *oedipodius*.

This larva might also be confused with that of *E. silvestris*, but is at once distinguished by the fact that, as in all the other species except *silvestris*, abdominal segments I–II each bear 2 strongly-developed lateral setae on each side, of which the upper is forked from the base.

Breeding-places.—Pupae were found by Bacot in leaf axils of *Dracaena*, less frequently in axils of *Colocasia*, banana and *Sarsaparella* (Edwards, 1916). The writer has once bred the species, in Uganda, from the axil of a *Dracaena*.

Eretmapodites ferox Haddow. (Fig. 138.)

The larva is probably not distinguishable from that of *dracaenae*. It is described by Haddow (1946) as follows:

"*Length* about 10–12 mm.; *colour* whitish, head brown, siphon almost black.

"*Head* about as long as broad. Antennal tuft a single slender seta at about $\frac{2}{3}$. All head setae small and inconspicuous. Mentum broader than long, with about 7–9 teeth on either side of a slightly larger central tooth. Outer teeth larger than the others.

"*Thorax* with the mesothoracic pleural group consisting of 2 long double or single subplumose setae and a shorter seta which may be single or double. Lateral hairs single or double.

"*Abdomen* with the lateral setae of segments I–III sometimes arising from tiny smooth bosses, but these are usually absent. Lateral setae of other segments without bosses. On segments I and II the lateral setae are 2 in number, 1 single and 1 double, as usual. On segment III there is 1 lateral seta, which is usually double. Comb consisting of 7–20 (usually 8–10) strong spines, arranged in an irregular single or double row. The spines have a strong central tooth and numerous small secondary denticles on either side. They are very varied in shape, but often present the tridentate appearance described by Hopkins in the case of *E. dracaenae*. Tuft B of segment VIII rather prominent, black, subplumose, with 3–5 branches, some of which may be subdivided, as in Fig. 138. Siphon with index about 2–2½ in life and about 1½ in specimens mounted with pressure. Rather conical in such specimens, but in life slightly biconvex. Pecten composed of 4–6 (usually 4) strong,

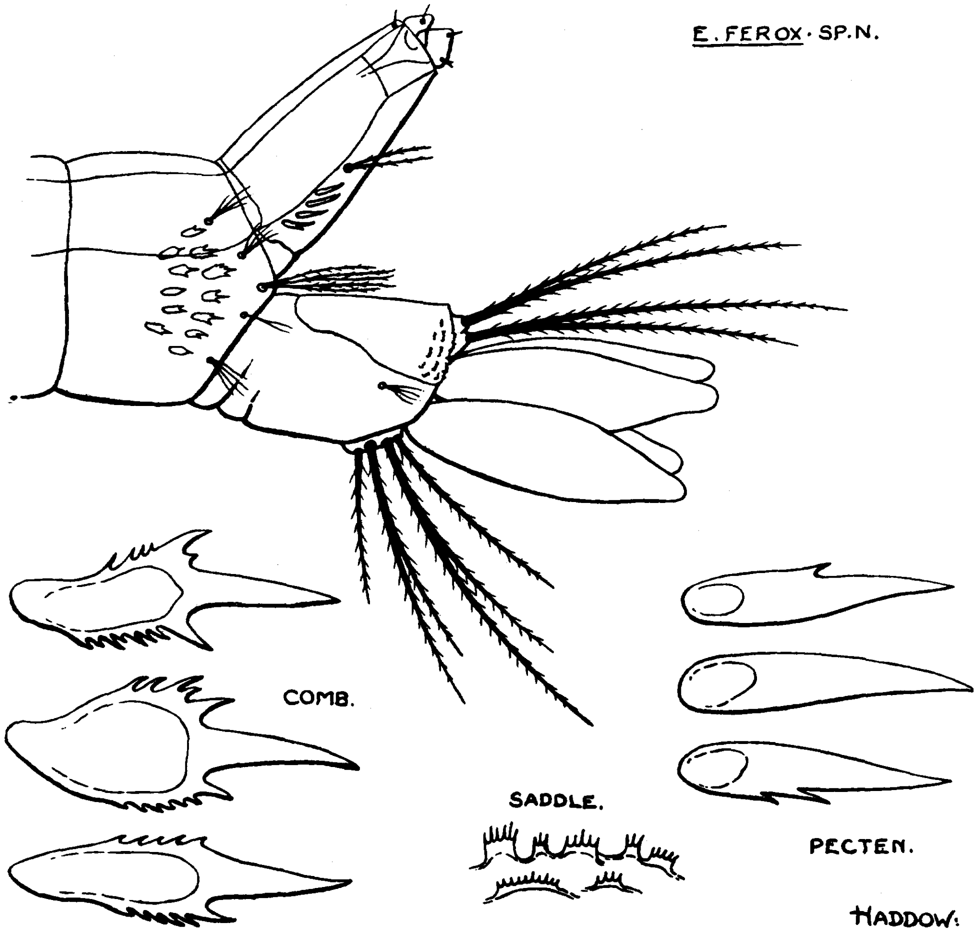


FIG. 138.—*Eretmapodites ferox* Haddow. Terminal segments, comb and pecten spines and edge of saddle.

prominent spines. These are often completely simple, but may bear 1 or 2 secondary denticles. Subventral tuft a fairly stout black subplumose hair at about ½, usually double, shorter than the diameter of the siphon at the point of attachment. Saddle small, incomplete and lightly sclerotised, with crenellate postero-ventral margin. The crenellae are fairly well marked and bear apical fringes. Lateral seta small and inconspicuous, with about 4 branches, arising below the edge of the saddle. Upper and lower caudal setae usually double, subplumose. Ventral brush composed of 4 pairs of plumose setae, of which 1 or 2 are often double. Gills 2–3 times the length of the saddle, somewhat leaf-shaped and bluntly pointed as in *E. leucopus* ssp. *productus* Edw."

Breeding-places and habits.—" The larva occurs most frequently in plant-axils, particularly those of *Colocasia* and *Dracaena ugandensis*, but it has also been found in leaf-pools in forest and banana plantations. It is perhaps the most actively predatory mosquito larva known to the writer, and the only one which sometimes goes in pursuit of its prey. If an *A. simpsoni* larva is placed in a small dish with a large *E. ferox* larva, the latter will in many cases cross the dish straight to its prey swimming by means of its mouthbrushes (a peculiar, rapid gliding motion) and, seizing it immediately, will begin to shake and worry it much as a dog shakes a rat. The savage nature of this larva is shown by the fact that it almost always occurs alone in an axil. Where 2 occur together they are always of the same size and field observation shows that they constantly attack each other. Under the microscope members of such a pair will be found to have all the main body setae cropped off short and the gills of both will show considerable damage " (Haddow, 1946).

Eretmapodites hightoni E. C. C. van Someren.

The description of this larva is by Mrs. van Someren.

This species is distinguished from all other species of this genus except *dracaenae* and *ferox* by having no, or very small, sclerotised conical bosses at the base of the lateral setae on abdominal segments I and II. There is no reliable character which will separate this species from *dracaenae* and *ferox,* but *hightoni* usually has only one strong lateral seta on abdominal segment II, and when there are two such setae, as occasionally happens (4 out of 36 larvae having 2 lateral setae), one seta is shorter and finer than the other. This character may be used with caution to distinguish *hightoni* from *dracaenae* and *ferox,* which have two strong lateral setae on abdominal segment II (? always).

Very similar to *ferox.* Varies as follows :

Head.—Mentum about as broad as long and with 9–10 teeth on either side of the slightly longer central tooth.

Thorax.—The short seta of the mesothoracic pleural group is usually trifid but may sometimes have 4 branches.

Abdomen.—Segment II usually with only one single or bifid lateral seta but very occasionally there are two such setae, in which case one is finer and shorter than the other and either or both may be single or bifid. The comb consists of 6–20 (usually 6–9) strong spines as in *ferox.* Tuft B of segment VIII with 2–3 branches and sometimes rather fine. Siphon, uncrushed specimens with an index of about 2 or a little less, crushed specimens with an index 1·2–1·3. Pecten of 2–4 strong black spines and sometimes a group of 1–3 very fine short spines at the base. The large spines may be simple or have 1–2 ventral denticles, and sometimes one dorsal denticle which may be small or large. The saddle has a small patch of fringed crenellae on the ventral posterior border and prominent apically fringed triangular spines on the distal border dorsally ; lateral seta with 2–3 branches. Ventral brush with 4 pairs of setae, one long and with 2–3 branches and three very much shorter ones which

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are usually single but one of which may be bifid. The length and shape of the " gills " is very variable.

Breeding-places.—In the Kaimosi Forest, Kenya, Garnham, Harper, and Highton (1946), referring to this species as *Eretmapodites* sp. indet., found it breeding in *Dracaena* axils and the breeding was restricted to *Dracaena* growing in the forest, none being found in *Dracaena* axils outside. It was only once found in any other type of breeding-place, and that was a small tree-hole, six feet from the ground, and with shoots covered with leaves growing out of the hole.

Eretmapodites oedipodius Graham. (Fig. 139.)

The larva is only known in the subspecies *parvipluma* Edwards. The absence of rugose conical bosses at the bases of the lateral setae of abdominal segments I–VI, and the small number of comb-spines, should distinguish this larva from all others except the apparently indistinguishable *E. leucopus* and possibly *E. silvestris*. The

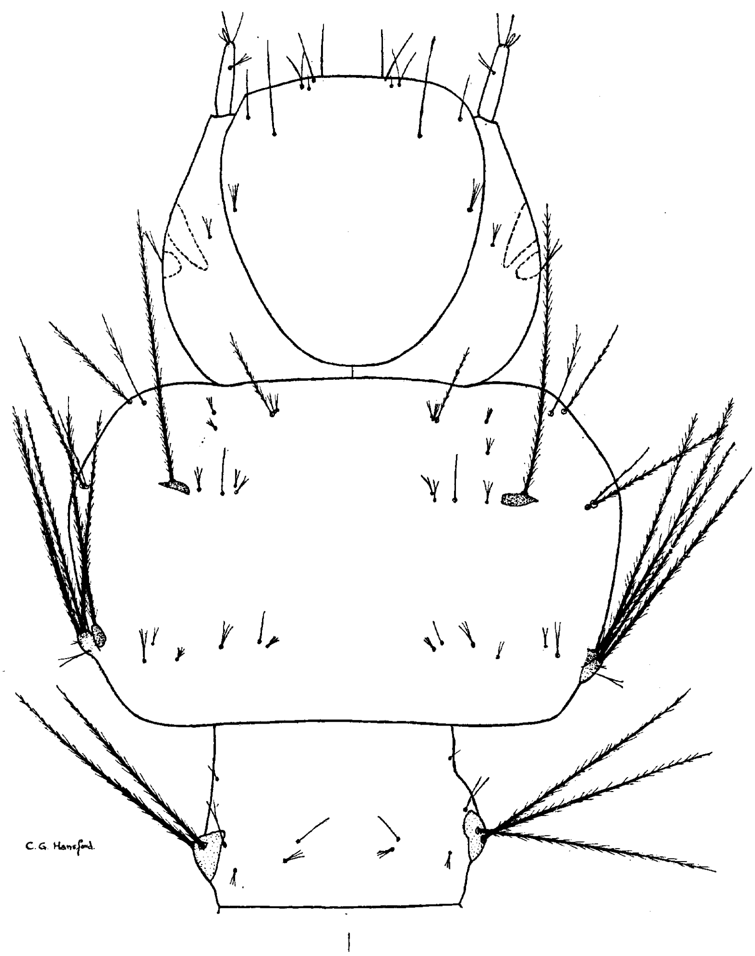

FIG. 139.—*Eretmapodites oedipodius* Graham. Head, thorax and first abdominal segment.

latter species is at once separated by the presence of only one strongly developed lateral seta on abdominal segment I–II; its comb-spines are much smaller than in the present species, and the siphon is shorter.

Resembles *E. chrysogaster,* differing mainly as follows: Third mesothoracic pleural seta only about two-thirds as long as the others, and with 2–4 branches (in *chrysogaster* this seta is single and as long as the others). Tubercles from which arise the lateral setae of abdominal segments I–VI rounded, weakly sclerotized and inconspicuous, their surface quite smooth; lateral setae less stout than in *chrysogaster,* the upper one on segments I–II usually forked close to base. Comb with spines normally about 6 in number (Edwards, 1929, records a specimen with 2 spines, and I have seen an immature larva with 8); spines very variable in shape, but always with a main central spinule and fringed with denticles at the base. Both caudal setae usually single. "Gills" decidedly shorter, broadly lanceolate.

Breeding-places.—The records (Hopkins, 1936; Haddow, 1946) of breeding in large fallen leaves in forest refer to ssp. *parvipluma,* and Edwards (1941) doubtfully ascribes adults reared from larvae found in the axils of banana leaves to the same form. Subspecies *wansoni* Edwards, has been reared (Edwards, 1941) from larvae found "in banana leaves"; there is no indication whether this means fallen leaves or leaf-axils.

Eretmapodites leucopus Graham. (Fig. 140.)

The larva, which is probably indistinguishable from that of *oedipodius,* is described by Haddow (1946) as follows:

"Bwamba larvae comply closely with Hopkins' description of that of *E. oedipodius* ssp. *parvipluma* but a few minor points and individual variations may be worth noting: The chitinous plaques or bosses on the abdominal segments, though perfectly smooth and weakly sclerotised, are quite large and easily seen. The double hair of the lateral group in the first 2 abdominal segments may have an extra branch—even 4–6 in exceptional specimens. The comb has 5–9 (usually 6) strong spines arranged in an irregular row. Tuft B of segment VIII may have as many as 5 branches, though 3 is the usual number. The siphon in life is biconvex, extremely dark, and with an index of $2\frac{1}{2}$–3. In specimens mounted with pressure it is rather conical, with an index of about 2. The pecten consists of 3–7 (usually 5) strong spines with a powerful central tooth and several small secondary denticles on one or both sides. In local specimens the lateral hair arises below the edge of the saddle. Some of the setae of the ventral brush may be double. The gills are subequal, about 3 times as long as the saddle, somewhat leaf-shaped and bluntly pointed."

Breeding-places and notes.—Dr. Evans bred an adult of the typical form from a larva found in a tree-hole; the record (Schwetz, 1930*b*) of the species breeding in fallen leaves and in bracts of *Musanga smithi* in forest probably refers to ssp. *productus.* Dr. Haddow's account of the latter subspecies (Haddow, 1946) is as follows: "Larvae are quite abundant in plant axils and in forest leaf-pools. They have occasionally been taken in tree-holes containing dark water with dead leaves. They are more prevalent in the axils of low plants such as pineapple and *Colocasia* than in the higher types such as bananas. The larvae have a characteristic dead-white appearance and this, combined with the rather long and very dark siphon, enables them to be picked out quickly in the field. The food in the gut is always of a very dark greenish-black colour, while other species occurring in the same foci usually have light brown gut contents. The larva has a very characteristic habit which might be described as ' sounding '—when leaving the surface it swims straight down to the bottom using the mouth-brushes only. It is an active browser, progressing rapidly along the bottom in a sinuous line, browsing with a slight sweeping move-

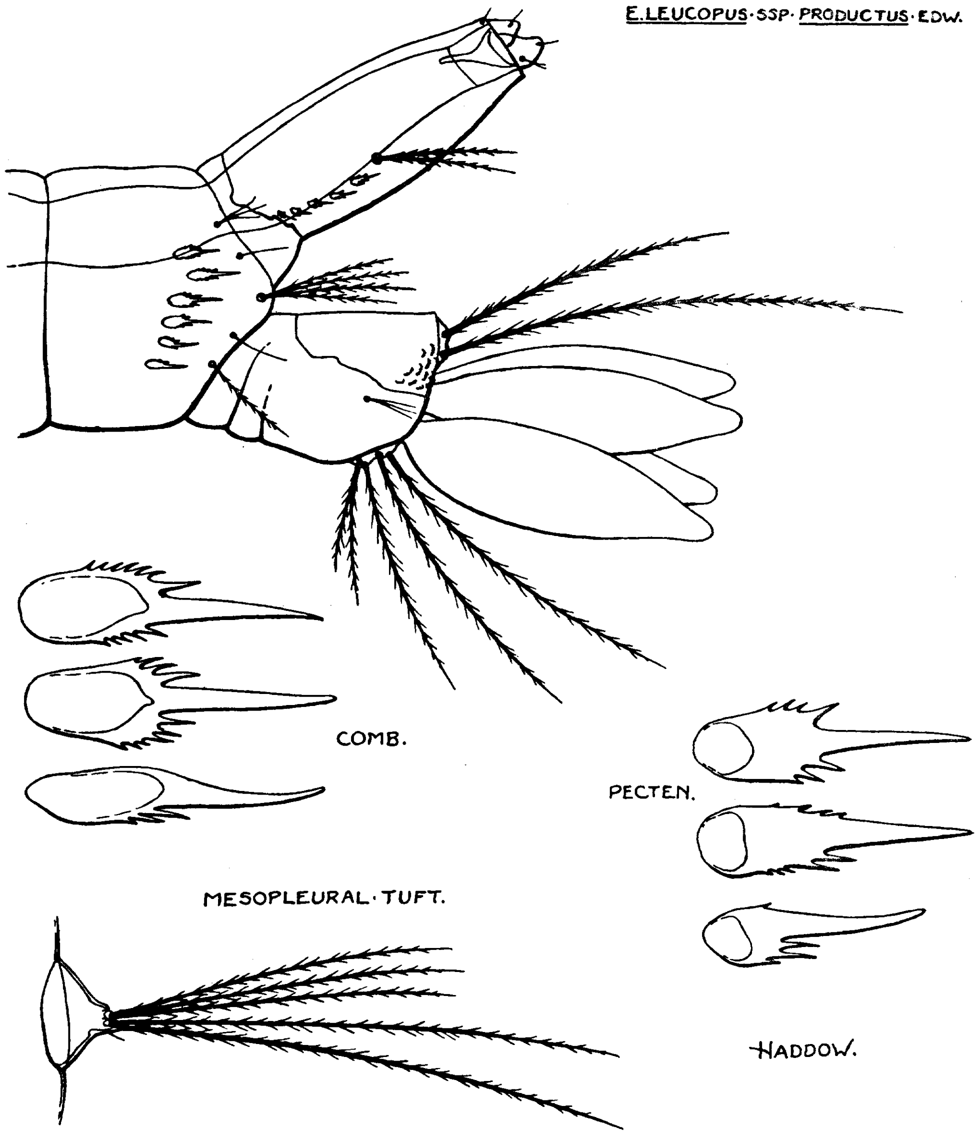

FIG. 140.—*Eretmapodites leucopus* ssp. *productus* Edw. Terminal segments, comb and pecten spines and mesopleural tuft.

ment of the head to either side. The larvae are only mildly predatory." Garnham, Harper and Highton (1946) found larvae in *Dracaena* axils, bamboo sections placed on the ground in forest, shaded rock-holes and tree-holes.

Eretmapodites plioleucus Edwards.

Larva and breeding-places unknown.

CULEX, Linnaeus.

The genus is easily distinguished in the larval state by the invariable presence of more than 1 pair of subventral tufts on the siphon; *Harpagomyia* also possesses a number of tufts, but these are mid-ventral, and in this genus there is a single pair of subventral tufts, which are much larger than the ventral ones. In a number of cases the subventral tufts of a *Culex* larva are very small and difficult to see, but this should not cause confusion, as (with the exception of *C. moucheti*, which differs from all other mosquito larvae in possessing no trace of a ventral brush) this condition only occurs in species with a long siphon, and it so happens that in all long-siphoned larvae belonging to other genera, except *Aëdes ochraceus*, the single subventral tuft is readily visible.

Most of the sub-genera do not seem to be distinguishable on larval characters, but *Lutzia* is readily separable by its strongly modified mouth-brushes and *Mocthogenes* has a characteristic head chaetotaxy. In *Neoculex* there is a very strong tendency for head-setae B and C to be single or bifid, but this character is not quite universal in the sub-genus and is shared by a few members of other sub-genera.

Head.—Mouth brushes composed of simple setae, usually very dense. Antenna usually long, almost always spiculate; tuft usually beyond $\frac{1}{2}$; subapical setae usually well removed from tip except when antenna short. Setae B and C rarely single, almost always conspicuous, branches almost always plumose.

Thorax.—Setae usually long and branched; inner shoulder-hairs well developed and usually set in distinct sclerotized plates. Propleural group usually with one long simple seta, the other three shorter; plates of large meso- and meta-pleural groups moderately large. No air-sacs present.

Abdomen.—Tuft B of eighth segment nearly always large, better developed than tuft A. Siphon in some cases very short, but usually long, and longer in some species than in any other genus; pecten always present (except in *C. moucheti*) and usually well developed; always more than 1 pair of subventral tufts, and these tufts usually numerous; lateral and subdorsal tufts are also often present. Ventral brush absent in *C. moucheti*, composed of multiple tufts in all other species, and with a well-developed barred area except in *C. hancocki*.

Breeding-places and habits.—The great majority of the species breed in the "ground-pool" type of habitat; a few breed in small containers. None are specially modified for obtaining air from plants, but in *poicilipes* the valves are unusually large, and this species is able to utilize the bubbles of air on the surfaces of plants under water. All the species, except the predaceous subgenus *Lutzia*, are netters of plankton rather than browsers, and in most instances they spend most of their time at the surface of the water; the species nearly related to *annulioris* frequently lie hidden in masses of filamentous green algae.

KEY TO THE KNOWN LARVAE OF THE GENUS *Culex*.*

1. Mouth-brushes modified (for predacity) into strong curved spines . *tigripes* (p. 249).
   Mouth-brushes unmodified . . . . 2.
2. Integument of thorax and abdomen covered with minute spicules and bearing numerous stout, dark, very conspicuous stellate setae . *stellatus* (p. 266).
   Without such combination of characters . . . . 3.
3. Anal segment with no trace of ventral brush . . . . *moucheti* (p. 338).
   Ventral brush developed . . . . 4.
4. Siphon with subdorsal setae on distal two-thirds . . . *arbieeni* (p. 251).
   Siphon not thus . . . . 5.
5. Siphon with prominent appressed spines near apex . . . . . 6.
   No such spines present . . . . 9.
6. Siphon with a marked bend towards the dorsal side near apex . *toroensis* (p. 314).
   Siphon straight . . . . 7.
7. These spines in a ventral group only; siphonal index 8–14 . *ingrami* (p. 332).
   Spines normally both dorsal and ventral; index about 6 . . . . 8.
8. Subventral tufts inconspicuous, shorter than diameter of siphon *chorleyi* (p. 316).
   These tufts large, longer than diameter of siphon . . *vansomereni* (p. 312).
9. Siphon swollen and strongly bilaterally convex towards middle . . . . 10.
   Siphon not strongly swollen, at most unilaterally convex . . . . . 12.
10. Subventral tufts of siphon represented by long, single setae *duttoni* (p. 287) and *watti* (p. 288).
    These tufts strongly branched . . . . 11.
11. Siphon strongly spiculate, at least on ventral surface in neighbourhood of pecten; pecten of about 20 spines . . . . . . *pruina* (p. 335).
    Siphon not spiculate; pecten of 9–13 spines . . . *philipi* (p. 337).
12. Pecten extending to $\frac{3}{5}$ or beyond . . . . 13.
    Pecten not extending beyond $\frac{1}{2}$, seldom beyond $\frac{1}{3}$ . . . . . . 14.
13. Siphonal index about $3\frac{1}{2}$ . . . . *trifilatus* (p. 308).
    Index about 6 . . . . *weschei* (p. 330).
14. Mentum an equilateral straight-edged triangle edged with very numerous small teeth which are not visible under low magnifications (comb composed of a very small number of spines; subventral tufts shorter than diameter of siphon) . . . . 15.
    Mentum not as above, obviously toothed . . . . 16.
15. Head-seta *e* with 2–3 moderately long branches *bitaeniorhynchus* (p. 282) and *ethiopicus* (p. 282).
    Seta *e* with about 6 much shorter branches *annulioris* (p. 283) and *aurantapex* (p. 282).
16. Head-setae B and C both much shorter than head; siphon with index about 5 or 6 and subventral tufts longer than its diameter (subgenus *Mochthogenes*) 17.
    Not with this combination of characters . . . . 20.
17. Spines of pecten exceptionally long and narrow, most distal nearly as long as diameter of siphon; upper caudal seta single . . *fimbriforceps* (p. 278).
    Pecten-spines much shorter and broader in proportion; upper caudal seta 2-branched . . . . 18.
18. Longest subventral tufts only slightly longer than diameter of siphon *castor* (p. 278).
    These tufts at least $1\frac{1}{2}$ times diameter of siphon . . . . 19.
19. Subventral tufts sparsely plumose, longest tufts more than twice diameter of siphon; head-seta B bifid . . . . . . *inconspicuosus* (p. 276).
    Subventral tufts simple, the longest about $1\frac{1}{2}$ times diameter of siphon; seta B 4-branched . . . . *simpliciforceps* (p. 280).

* *coursi* and *milloti*, which are known only from Madagascar, are not included.—P. F. M.

20. Comb composed wholly or partly of *spines* . . . . 21.
Comb composed entirely of *scales* . . . . 32.
21. Siphon very short, index less than 2 . . . . *hancocki* (p. 317).
Siphon longer, index at least about $3\frac{1}{2}$ . . . . 22.
22. Siphonal index about $3\frac{1}{2}$; comb of 7–8 spines; siphon distinctly bent upwards near apex . . . . *poicilipes* (p. 280).
Index more than $3\frac{1}{2}$, at least about 6 except in species with numerous comb-teeth; siphon not bent upwards near apex . . . . 23.
23. Spine on dorsal valve of siphon exceptionally long, conspicuously denticulate towards base . . . . *argenteopunctatus* (p. 288).
This spine short and inconspicuous, not denticulate . . . . . 24.
24. Head-setae B and C with about 5 and about 7 branches respectively; comb composed of about 50 teeth . *hopkinsi* (p. 312) and *ninagongoensis* (p. 308).
These setae usually single or double, at most with 3 and 3–5 branches respectively; comb with at most about 30 teeth . . . . 25.
25. Siphon very long, index at least 10; comb composed of spines with no admixture of scales . . . . 26.
Siphonal index usually not over 8, but if index about 9 then comb largely composed of scales . . . . 27.
26. Subventral tufts of siphon single and longer than its diameter; more distal pecten-spines very widely spaced; spines of comb of two distinct sizes *striatipes* (p. 296).
Subventral tufts much shorter than diameter of siphon, some of them 2-branched; pecten-spines more evenly spaced; spines of comb fairly equal in size . . . . *grahami* (p. 334).
27. Comb of at most 9 teeth, all of which are spines . . . *guiarti* (p. 329).
Comb of at least 14 teeth, some of which may be scales . . . . 28.
28. Comb composed of spines only; head setae B and C with 3 and 3–4 branches respectively . . . . *theileri* (p. 289).
Comb often partly composed of scales; head seta B usually and C always with at most 2 branches . . . . 29.
29. Pecten teeth with at most 1–2 minute secondary denticles . *simpsoni* (p. 293).
Pecten teeth with numerous secondary denticles . . . . . . 30.
30. Siphonal index about 9; pecten extending to about $\frac{1}{8}$. *kingianus* (p. 255).
Siphonal index at most about $6\frac{1}{2}$; pecten extending to at least $\frac{1}{3}$ . . 31.
31. Head seta C single; siphonal index about $6\frac{1}{2}$ . . . . *sinaiticus* (p. 295).
This seta double; siphonal index about $4\frac{1}{2}$ . . . . *seldeslachtsi* (p. 298).
32. Head setae B and C single . . . . 33.
These setae with at least 2 branches . . . . 38.
33. Subventral tufts of siphon large and 2-branched or moderately large and 5-branched . . . . 34.
Subventral tufts very small with 2–4 branches . . . . 35.
34. Subventral tufts of siphon 2-branched . . . . . *avianus* (p. 253).
These tufts 5-branched . . . . *salisburiensis* (p. 254).
35. Pecten spines normally with only one secondary denticle (an occasional spine may have two) near the base; dorsal pair of "gills" only about $\frac{1}{2}$ the length of the saddle . . . . *adersianus* (p. 264).
Pecten spines normally with at least two basal denticles (except in *wansoni*); dorsal pair of "gills" at least twice the length of the saddle . . . . 36.
36. Pecten spines with numerous delicate secondary denticles extending along the whole of the ventral edge . . . . . . *horridus* (in part, p. 265).
Pecten spines with one or two stouter denticles near the base and a small number of more slender ones distally . . . . 37.
37. Upper caudal seta single; head seta A with about 6 branches *albiventris* (p. 263).
Upper caudal seta double; head seta A with 4–5 branches . *wansoni* (p. 264).

38. Siphonal index about 5 or less . . . . 39.
Index about 6 or more . . . . 52.
39. Siphon with slight sigmoidal curvature . . . *pipiens* (in part ; p. 300).
Siphon without such curvature . . . . 40.
40. Head and siphon blackish ; antenna less than half length of head ; siphonal index 3 or under ; " gills " about thrice length of saddle . . . 41.
Head and siphon at most dark brown ; antenna at least half length of head ; siphonal index usually more than 3 ; " gills " usually shorter . . . 42.
41. Antenna spiculate ; comb of about 30 scales . . . *nebulosus* (p. 268).
Antenna without spicules ; comb of not more than 18 scales . *cinereus* (p. 271).
42. Siphonal index under $3\frac{1}{2}$; dorsal pair of " gills " 3–4 times length of saddle . 43.
Siphonal index usually at least 4 ; " gills " shorter . . . . . . 44.
43. Pecten spines with only one basal denticle ; subventral tufts about three times as long as diameter of siphon ; head setae B and C each with about 15 branches . . . . *musarum* (p. 319).
Pecten spines with 2–3 basal denticles ; subventral tufts less than diameter of siphon ; head setae B and C each with 4–6 branches . *bukavuensis* (p. 303).
44. Dorsal pair of " gills " at most as long as saddle ; upper caudal seta with at least 3 branches, usually with 4 or more ; subventral tufts of siphon placed very close to mid-ventral line 45
Dorsal pair of " gills " longer than saddle ; upper caudal seta usually 2-branched, rarely with 3 branches ; subventral tufts much more lateral in position . . . . 49.
45. Siphonal index not more than $2\frac{1}{2}$ . . . . . *sitiens* (in part ; p. 284).
Index about 5 . . . . 46.
46. Proximal subventral tufts of siphon placed well proximal to distal end of pecten ; comb of about 35 scales . . . . *laticinctus* (p. 298).
All subventral tufts placed distal to distal end of pecten ; comb of at least about 50 scales . . . . 47.
47. Pecten of 9–10 spines ; dorsal pair of " gills " about $\frac{3}{4}$ length of saddle ; lateral seta of anal segment minute . . . . . . *mirificus* (p. 306).
Pecten of 12–16 spines ; dorsal " gills " less than $\frac{1}{2}$ length of saddle ; lateral seta nearly twice length of saddle . . . . 48.
48. Comb of about 65 scales . . . . . . *thalassius* (p. 284).
Comb of about 35 scales . . . . . *sitiens*, Red Sea form (p. 284).
49. Head-setae B and C 3-branched ; comb of about 30 scales *Culex* sp. (*? perfidiosus*) (p. 327).
These setae with at least 4 and 5 branches respectively ; comb of at least about 50 scales . . . . 50.
50. Head usually very dark brown ; distal pecten-spines more widely spaced than remainder ; a sclerotic "tooth" on dorsal side of siphon near apex . *andersoni* (p. 310).
Head pale brown or yellowish ; distal pecten-spines not markedly wider spaced; no " tooth " near apex of siphon . . . . 51.
51. Head-seta *f* usually less than $\frac{1}{2}$ length of *e* and with an average of 3·5 branches ; siphon usually with markedly convex sides . . . . *fatigans* (p. 304).
Seta *f* usually more than $\frac{1}{2}$ length of *e* and with about 6 branches ; siphon usually with less convex sides *pipiens* in part (p. 300), ssp. *molestus*, and *tamsi* (p. 309).
52. Siphon very dark brown . . . . 53.
Siphon pale brown to nearly colourless . . . . 54.
53. Subventral tufts about as long as diameter of siphon . . *macfiei* (p. 275).
Tufts much shorter than diameter of siphon . . *horridus* (in part, p. 265).
54. Pecten spines bifid at tip, with one large and sometimes one small basal denticle . . . . *cinerellus* (p. 273).
Pecten spines not bifid at tip, often with more than two denticles . . 55.

55. Subventral tufts a little longer than, or $1\frac{1}{2}$ times, the diameter of siphon at point of attachment . . . . 56.
These tufts minute, shorter than diameter of siphon . . . . . 58.
56. Ventral brush with no unpaired tufts outside the barred area; subventral tufts $1\frac{1}{2}$ times the diameter of the siphon at point of attachment *tritaeniorhynchus* (p. 286).
Ventral brush with unpaired tufts outside the barred area . . . . 57.
57. Head-setae B and C bifid; subventral tufts 2-branched and about $1\frac{1}{2}$ times the diameter of the siphon at point of attachment . . *wigglesworthi* (p. 261).
Head-setae with more than 2 branches; subventral tufts single and only a little longer than the diameter of the siphon at point of attachment *subaequalis* (p. 274).
58. Head-setae B and C only about half length of head, sparsely plumose . . 59.
These setae about as long as head; obviously plumose . . . . . 60.
59. Siphon with sides convergent from base to apex; pecten of 11–12 spines *rubinotus* (p. 257).
Siphon with sides convergent to about $\frac{2}{3}$, then slightly divergent; pecten of about 8–9 spines . . . . *subrima* (p. 258).
60. Denticles of more distal pecten spines numerous (at least 6), very regular and extending along whole ventral side of spine . . . *sunyaniensis* (p. 259).
Denticles of more distal spines not so numerous (at most 5), irregular in size and position and not extending along whole ventral side of spine . 61.
61. None of pecten-spines with more than 3 secondary denticles . . . 62.
At least some of the pecten-spines with 4 or more secondary denticles . . 63
62. Antenna tapering abruptly just beyond tuft, infuscated at base as well as beyond tuft . . . . *telesilla* (p. 326).
Antenna tapering much more gradually, infuscated only beyond tuft . *perfuscus* (p. 324).
63. Siphonal index 8–11; ventral pair of "gills" much shorter than dorsal pair *decens* (p. 320) and *invidiosus* (p. 323).
Index 6–7·5; "gills" subequal . . . . 64.
64. Index about 6; head-seta C nearly always 2-branched, seldom triple; more distal pecten spines with 2 denticles . . . . . *antennatus* (p. 320).
Index about 7; seta C with at least 3 (sometimes 4) branches; more distal pecten spines with about 4 denticles . . . . 65.
65. Saddle smooth . . . . *univittatus* (p. 291).
Saddle covered with spicules . . . . *zombaensis* (p. 306).

Culex (Lutzia) tigripes Grandpré. (Fig. 141.)

The larva is quite unmistakable. Apart from the modified mouth-brushes, the shape of the siphon and anal segment are unique features.

Length about 11 mm.; *colour* whitish, head and siphon brown.

Head.—Mouth-brushes converted into stout bristles, the apical portion of which is edged on one side (that which meets the corresponding setae of the opposite side when the brushes are drawn inwards) with sharp teeth which assist in holding prey; the portion of the head anterior to the clypeal spines projecting strongly forwards, and thus greatly increasing the area available as attachment for the brushes. Clypeal spines very short and slender. Antenna extremely short (less than $\frac{1}{4}$ length of head), smooth; tuft reduced to one very minute seta near the base. Setae A, B and C set very far back, long, single, and simple; *d* also set very far back, with 2 small simple branches; *e* and *f* small, 2-branched.

Abdomen.—Comb a patch of about 40 rather narrow scales. Siphon very short (index about 2) ; subventral tufts about a dozen in number, arranged in a zigzag row instead of being obviously paired, each tuft with 2 plumose branches ; a small lateral tuft with 2–3 simple branches is also present ; pecten composed of about 10 rather large spines, extending to the apex of the siphon, the proximal spines with a single basal denticle, the remainder simple. Saddle of anal segment much longer than wide, the whole surface of both saddle and siphon covered with small spicules ; upper and lower caudal setae single ; lateral seta short, single, simple, ventral brush of about 7 pairs of tufts. " Gills " subequal, less than $\frac{1}{4}$ length of saddle.

Breeding-places and habits.—The breeding-places seem to be limited more by the presence or absence of other larvae on which to prey than by any other factor, and we accordingly find that this species has a more diverse list of breeding-places than almost any other. It is, however, much more commonly found in swamps,

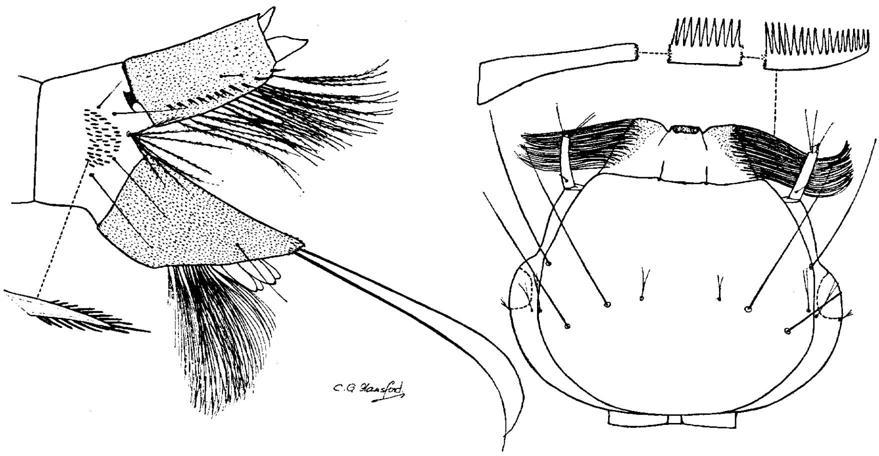

FIG 141.—*Culex* (*Lutzia*) *tigripes* Grp. Head and terminal segments.

pools of all kinds, and ditches than in any other type of water, and there appear to be no records from other than stagnant water unless it be that of Bedford (1928), who mentions it from streams, but without any indication as to whether there was any appreciable current, but the record of *tigripes* breeding in snail-shells (Harris, 1942) shows that its choice is even wider than was formerly supposed.* The species is very uncommon in tree-holes, and in tins ; it occurs occasionally in barrels and domestic water-vessels, and there is a single record (Kennan) from leaf-axils. A very unusual record is that of Hancock, from an old banana leaf on the ground. It breeds with equal facility in open or shaded conditions and even in dense forest, and G. R. C. van Someren (1943) found larvae in " very saline water."

It would appear that the common breeding-places in Mauritius are somewhat different, since MacGregor (1927) states that the species breeds mainly in rock-holes, tree-holes and holes in the ground.

The larvae are predaceous on those of other species of mosquitoes, and will eat

* Abbott (1948) found larvae in a variety of situations in Darfur Province, Sudan, in most of which the water was stagnant, but records that ". . . . on Jebel Marra they were found in numbers in back-waters and at the edges of streams where the current was very sluggish."—P. F. M.

each other, even in the presence of larvae of other species. When a *tigripes* larva is seized by a comrade of about its own size it usually manages to break away without damage, but a small larva seized by a larger member of its own species is devoured (Haddow, 1942). MacGregor (1927) notes that they will eat Chironomid larvae, small Nematode worms, live insects that have fallen into the water, and sometimes even young minnows ; Lamborn (1920–21) records larvae which, from his description, must have belonged to this species, attacking and destroying the much larger larvae of a Syrphid (*Phytomia curta*, Lw.). MacGregor states that he has seen a larva captured by that of *Lutzia* remain alive for over twenty minutes while being slowly devoured. Other larvae do not seem to be seized unless they come within very close range of the *tigripes* larva, when the mouth-brushes immediately grip them and they are crushed and devoured. Haddow (1942) noted that larvae of *tigripes* are able to seize a larva approaching from almost directly behind, and also demonstrated the degree to which they may control breeding of *Anopheles gambiae*. He found that attacks on pupae by these larvae were rather rarely successful owing to the highly sclerotized integument of the pupae.

On account of the shortness of the siphon, larvae of this species lie nearly parallel with the surface of the water, where they spend most of their time waiting for their prey to approach.

Culex (Neoculex) arbieeni Salem. (Fig. 142.)

The following description is from larvae obtained by Dr. P. H. Abbott in Darfur, and has been drawn up by Mr. D. J. Lewis. The Sudanese larvae agree in all important respects with those from Sinai (Salen, 1938, 1940) with the possible exception of the thoracic and abdominal spicules. The larva is immediately separable from any other known Ethiopian member of the genus by the great development of the subdorsal setae of the siphon, which give it a superficial resemblance to that of *Harpagomyia*.

Length about 8–10 mm ; *colour* not recorded.

Head.—Antenna sparsely spiculate, very pale proximal to insertion of subterminal setae but much darker distally ; tuft of about 16 slightly plumose branches at or just before $\frac{2}{3}$; subterminal setae a pair of long bristles (nearly $\frac{5}{8}$ of length of shaft), situated ventrally at $\frac{5}{6}$; terminal setae two in number, the longer of which is slightly shorter than the subterminals. Seta A with 4 or 5 shortly-plumose branches, B and C each with 2 very long slightly plumose branches, *d* single. Mentum with 7 teeth on each side of the central tooth.

Thorax much wider than long, with very long, shortly-plumose setae. Numerous spicules present on dorsal, ventral and lateral surfaces, dense on dorsal surface.

Abdomen.—Spicules similar to those of the thorax present on the dorsal, ventral and lateral surfaces of the first to eighth segments and the posterior margin of the ninth. Comb a patch of about 50 narrow scales. Siphon with index about 4·4 ; pecten not extending beyond $\frac{1}{5}$, composed of 10 straight spines (3–7 in Salem's larvae), of which some of the more distal are slightly more widely-spaced and with about 7 small basal denticles, whereas the proximal ones have only 3 denticles. Subdorsal and subventral tufts of siphon starting just beyond pecten ; subdorsals about 20 long setae which tend to be arranged in two irregular rows, the setae slightly longer than the width of the base of the siphon ; subventral tufts composed of 2-branched setae (some of the more distal single) about $1\frac{1}{2}$ times as long as the subdorsals ; sublateral setae single, as long as subventrals, one situated just above

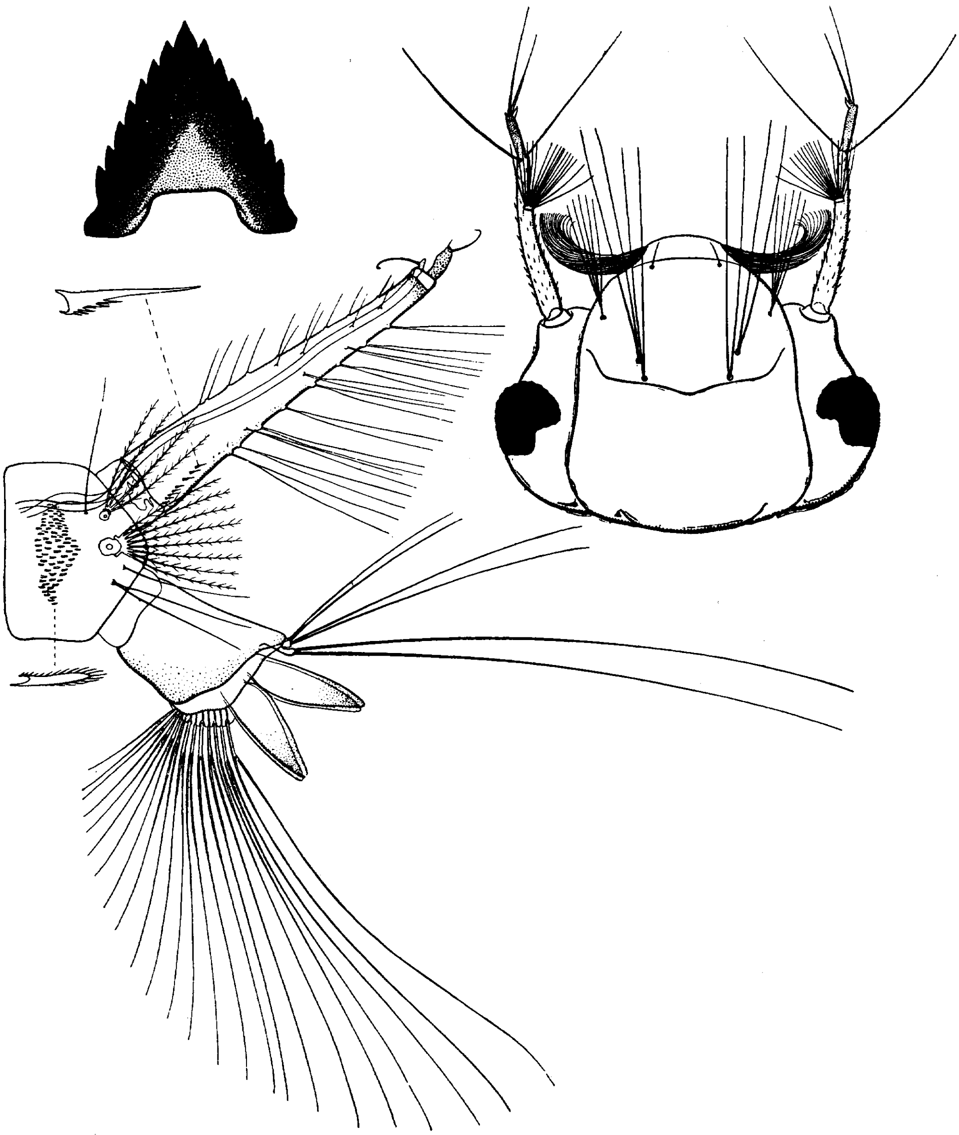

FIG. 142.—*Culex* (*Neoculex*) *arbieeni* Salem Head, terminal segments and mentum. The plumosity of the head setae is omitted.

the subventrals about the middle of the siphon and the other more distally ; bristles on valves of siphon especially long and strong, curved. Siphonal tuft of 8th segment composed of about 4 branches, subsiphonal of about 8 and anal of 2 long branches.

Upper caudal seta 2-branched, lower single ; lateral seta small, 3-branched. Ventral brush composed of 5 pairs of long tufts. " Gills " subequal, $\frac{2}{3}$ length of saddle.

Breeding-places.—Salem's larvae were found in a " water reservoir in the Wadi El Arbieen " ; the Sudan larvae, all obtained among the Marra Mountains by Dr. Abbott, were found in a rock-pool beside a stream at over 6,000 ft. (Lewis, 1944*b*), in a puddle in a sandy stream bed, and at the edge of a stream at 5,000 ft.

Culex (**Neoculex**) **pulchrithorax** Edwards.

Larva and breeding-places unknown ; latter probably ground-pools.

Culex (**Neoculex**) **avianus** De Meillon.

Of the very small number of known Ethiopian *Culex* larvae with head-setae B and C single, the present species most resembles *salisburiensis*, from which it is easily separated by the larger number of basal denticles on the pecten spines, and the smaller number of branches of the subventral tufts of the siphon. The following description is a slight rearrangement of that published by de Meillon (1943).

Colour.—Brownish with a darker head.

Head.—Antenna spiculate, infuscated to beyond tuft. Seta A with 4–5 branches, B and C each single, very long and minutely barbed, *d* short and single or bifid.

Abdomen.—Comb of more than 50 delicately-fringed scales. Siphonal tuft of eighth segment with 3 pectinate branches, subsiphonal with 4 long pectinate branches. Siphon with index about 7 ; pecten of 15 sharply pointed straight spines each with 4–5 basal denticles, extending to about $\frac{1}{3}$; the 4–6 subventral tufts are double and very much longer than the diameter of the siphon. Tuft of saddle composed of two simple branches ; upper caudal seta 3-branched. Ventral brush well developed and with a few tufts proximal to the barred area. " Gills " slender, pointed, subequal, and longer than the saddle.

Breeding-places.—The type series was bred from " larvae collected in a rock-pool of brownish water in deep shade in the bed of a small stream " (de Meillon, 1943).

Culex (**Neoculex**) **péringueyi** Edwards.

Larva and breeding-places unknown.

Culex (**Neoculex**) **seyrigi** Edwards.

Larva and breeding-places unknown. (But see under *Culex coursi*.—P. F. M.)

Culex (**? Neoculex**) **coursi** Doucet.

This larva, recently described from Madagascar, has a shorter siphon than any other so far known with head setae B and C single. The adult is unknown and the species cannot therefore be placed with certainty in *Neoculex*. The combination of single head setae with comb composed of scales, shown also by *adersianus*, *wansoni*, *avianus*, *salisburiensis*, *albiventris* and, occasionally, *horridus* has, however, not yet been found in any other subgenus. It should be noted that *C.* (*Neoculex*) *seyrigi* Edwards, of which the early stages are unknown, was also found in Eastern Madagascar. The following description is translated from Doucet (1949*a*) :

" This larva closely resembles that of *Culex salisburiensis* in the fact that head setae B and C are simple, but it differs notably in the shortness of the subventral tufts of the siphon, siphonal index of 5 instead of 7, number of branches in the upper caudal seta (two instead of four) and number of branches in the lateral seta of the anal segment (one instead of two) and, finally, in the structure of the mentum.

"*Head.*—Antenna spiculate, antennal tufts composed of numerous plumose branches at $\frac{2}{3}$. A with about 4 plumose branches, B, C and *d* simple (B sometimes double), *e* and *f* with one and two branches respectively. Mentum with 6 teeth (the fifth particularly well developed) situated on each side of a prominent central tooth.

"*Abdomen.*—Comb of eighth segment composed of about 35 dark scales. Siphonal index about 5; pecten reaching almost to one-third, composed of about 10 spines with two basal denticles; the three pairs of subventral tufts each composed of two to four simple branches, distinctly shorter than the diameter of the siphon; single lateral tuft with three branches; single subdorsal tuft with two branches. Anal segment about one and a half times as long as broad; upper caudal seta with two branches; lateral seta small, single. Ventral brush composed of six pairs of multiple setae (4 branches), the last pair being represented by a pair of single setae. Gills fusiform, subequal and almost as long as the anal segment.

"*Place of capture.*—Vegetation at edge of rice field on the road from Bejofo to Amparafaravola. pH = 7. T = 28."—P. F. M.

Culex (Neoculex) salisburiensis Theobald. (Figs. 143, 144.)

The larva is sharply differentiated from almost all those with which it might be confused by the fact that setae B and C are single; this character is shared by *albiventris*, which has the upper caudal seta single, by *sinaiticus*, which has a comb composed of spines, and by *avianus*, which differs in having more numerous basal denticles on the pecten-spines, fewer branches in the subventral tufts of the siphon, and several tufts beyond the barred area in the ventral brush.*

Colour pale, "with a large dark spot on the posterior margin of the abdomen" (Bedford, 1918).

Head.—Antenna spiculate, infuscate at base and beyond tuft; tuft of numerous plumose branches at $\frac{2}{3}$. Seta A with about 6 plumose branches; B, C and *d* single, simple (C about $\frac{1}{2}$ length of B in specimens from Nairobi); *e* and *f* each with about 4 branches. Mentum with 3 large and 1 minute (basal) tooth on each side of the centre (4 large teeth in larvae collected by Garnham, Harper and Highton at Kaimosi).

Abdomen.—Comb a patch of about 40–50 narrow, dark-coloured scales (about 70 in the Kaimosi larvae). Siphon with index about 7; pecten extending to about $\frac{1}{3}$, composed of about 14 nearly straight spines each with 2 basal denticles (sometimes with 1 or 2 additional very small and fine basal denticles); the 4–6 pairs of subventral tufts are each composed of 5 to 8 simple branches, which are distinctly longer than the diameter of the siphon; about 6 very minute lateral and subdorsal tufts are composed of single or double setae. Anal segment more than $1\frac{1}{2}$ times as long as broad; upper caudal seta with 4 branches; lateral seta small, 2- or 3-branched. Ventral brush composed of 7 pairs of multiple tufts. "Gills" more or

* Other species having setae B and C single include *adersianus*, *wansoni* and, occasionally, *horridus*. All these species differ from *salisburiensis* in having smaller subventral tufts on the siphon. Other distinguishing characters are given in the sections dealing with them.—P. F. M.

less fusiform, ventral pair somewhat shorter than saddle, dorsal pair distinctly shorter than ventral.

Breeding-places.—Bedford (1928) records the species from pools and stagnant or slowly-flowing streams ; Ingram and de Meillon from water lying in a disused quarry, a small water-hole in forest and backwaters in streams. (Abbott (1948) records it from the edge of streams.—P. F. M.).

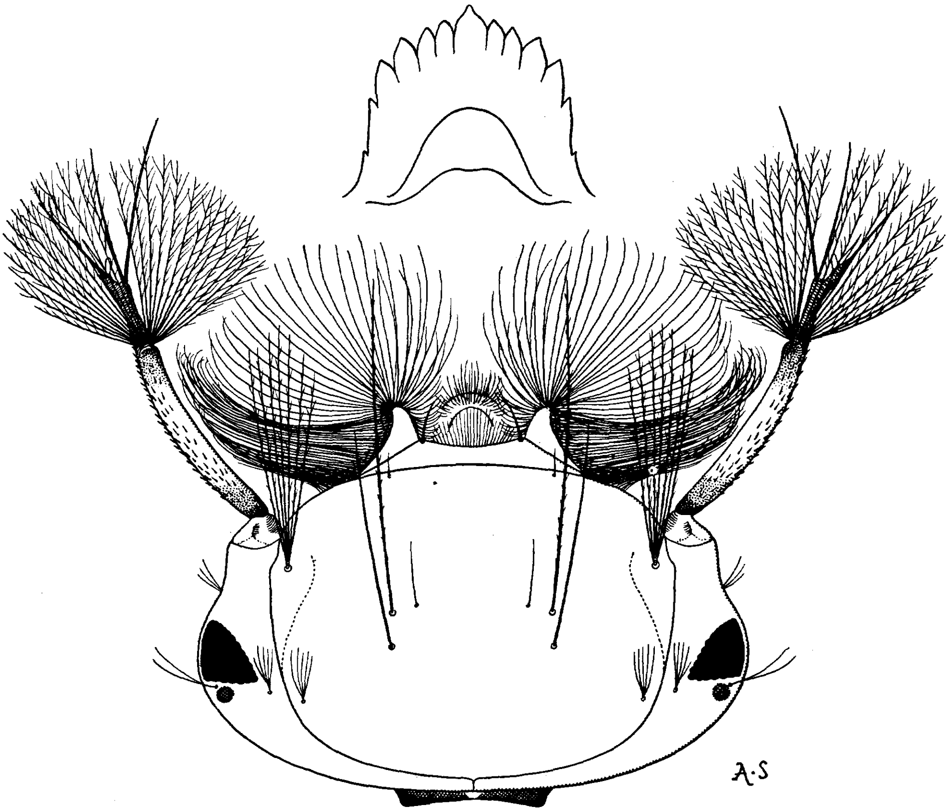

FIG. 143.—*Culex (Neoculex) salisburiensis* Theo. Head and mentum.

Culex (**Neoculex**) **andreanus** Edwards.

Larva unknown. The species has been bred from larvae and pupae obtained in pools among tall papyrus and " makindu " palms (*Phoenix reclinata*) near Kampala, Uganda.

Culex (**Neoculex**) **kingianus** Edwards.

The identity of the larva described below (from material obtained at and near Kampala, Uganda) is not fully established ; the writer on several occasions bred *kingianus* from batches which apparently contained no other larvae, but on the only occasion when adults were reared from isolated larvae the specimens were accidentally destroyed.

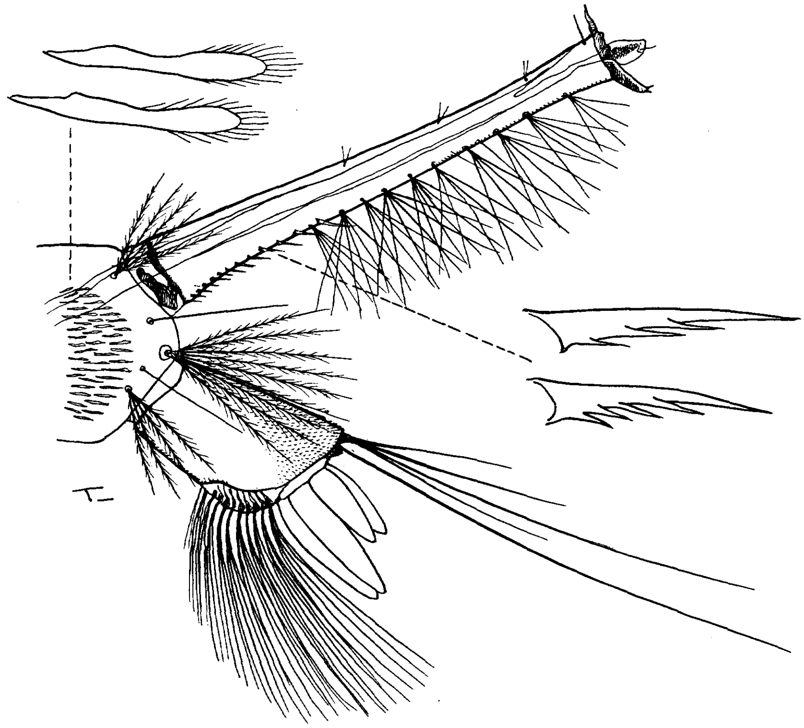

FIG. 144.—*Culex (Neoculex) salisburiensis* Theo. Terminal segments.

The larva is separable from all other known species by the small size of head-setae B and C, coupled with the fact that the comb is composed of both scales and spines. Both these characters are very unusual, but the former is shared to some extent by *rubinotus* and the latter is now known to occur in one or two other species.

Length about 7 mm. *Colour* : head and siphon pale brown, abdominal segments I–III and VI–VIII dark brown, remainder pale drab.

Head unusually broad, length : breadth as 1·4 : 1·0. Antenna spiculate, infuscate at base and beyond tuft ; tuft of about 30 plumose branches at $\frac{3}{4}$. Seta A with about a dozen plumose branches, B and C very small, single or bifid, simple, *d* minute, single. Mentum with about 9 teeth on each side of the large median tooth.

Abdomen.—Comb a patch of about 30 teeth, of which the more proximal are small scales, while the most distal are much larger and are spines. Siphon tapering regularly, index about 9 ; pecten extending to about $\frac{1}{6}$, composed of 9–11 widely-spaced spines with numerous delicate denticles on the ventral side ; subventral tufts very minute. Anal segment with complete saddle, distal edge smooth ; upper caudal seta 2-branched, lower single ; lateral seta with about 5 very short branches. Ventral brush of about 6 pairs of many-branched tufts. " Gills " subequal, lanceolate, with rounded tips.

Breeding-places.—We have only found this species in pools under dense shade, either from forest trees or from bushes and tall papyrus ; Schwetz (1930*b*) records it from the River Kisanga, but gives no further details.

Culex (Neoculex) kilara. E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Culex (Neoculex) rubinotus Theobald. (Figs. 145, 146.)

This larva is very like those of *decens* and *sunyaniensis*, but differs markedly from both by the small size of head-setae B and C. It still more closely resembles *subrima*, but setae B and C in the present species are 2-branched, and the siphon is of a different shape and apparently much longer than in *subrima*. The larvae of *kingianus* and *wigglesworthi* are also very similar to that of *rubinotus*, but in *kingianus* the comb-teeth of the distal row are spines and in *wigglesworthi* the subventral tufts of the siphon are much longer.

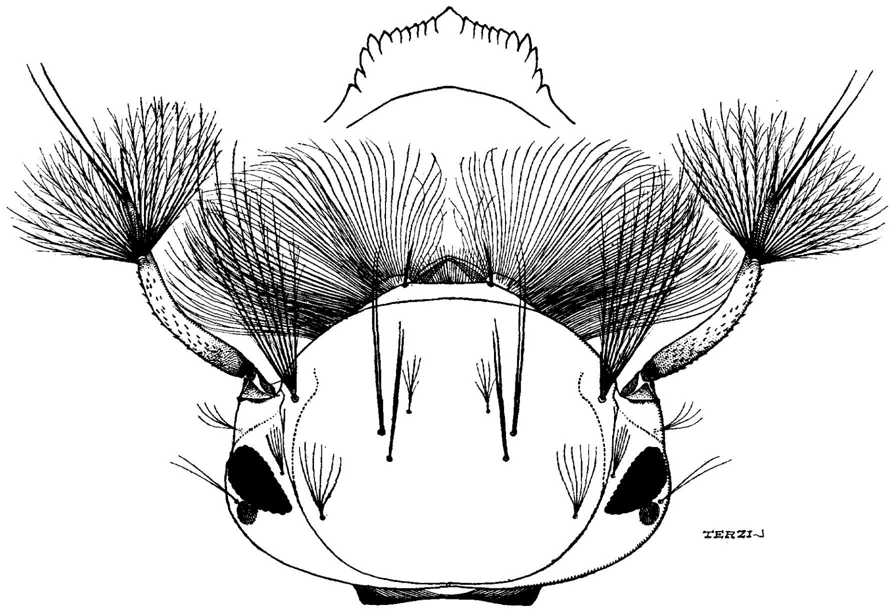

FIG. 145.—*Culex* (*Neoculex*) *rubinotus* Theo. Head and mentum. Setae B and C are sparsely plumose.

Described from 4 skins from Toro, Uganda, and 1 whole larva from Kampala.

Length about 7 mm.; *colour* not noted; head and siphon not dark.

Head.—Antenna spiculate; tuft placed at about $\frac{3}{4}$, composed of about 30 long, coarsely plumose branches. Seta A with about 10 coarsely plumose branches; B and C both 2-branched, coarsely but sparsely plumose, about $\frac{1}{2}$ length of head; *d* 4–5-branched, *e* with about 5 branches. Mentum with about 10 teeth on each side of the much larger central tooth.

Abdomen.—Comb a patch of about 50 long narrow scales, of which the more distal are very much larger than the more proximal. Siphon very long, index about 11, tapering strongly to about $\frac{1}{4}$ then very slightly; pecten extending to nearly $\frac{1}{4}$, composed of 11–12 straight spines, which are rather widely spaced (especially distally), and which are fringed along their whole ventral side with a row of numerous very fine denticles; 2 or 3 pairs of excessively small subventral tufts, invisible under low magnification. Anal segment with a complete saddle, distal edge smooth ; upper caudal seta with 1 long and 2 short branches, lower single ; lateral seta with about 6 very short branches. Ventral brush composed of 6 pairs of many-branched tufts. " Gills " subequal, lanceolate but with rounded tips, about as long as saddle.

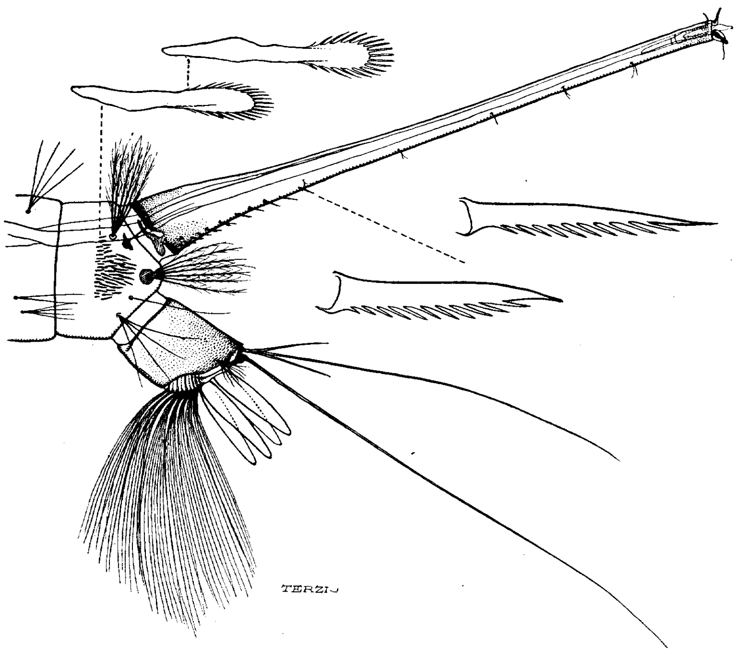

FIG. 146.—*Culex (Neoculex) rubinotus* Theo. Terminal segments.

Breeding-places.—Most frequent in swamps, particularly papyrus swamps, the water of which is rich in decayed vegetable matter and consequently brown. Also found in weedy or *Pistia*-covered borrow-pits.

Culex (Neoculex) rima Theobald.

Larva undescribed, perhaps inseparable from that of *sunyaniensis*.

Breeding-places.—The discovery that the *rima*-group includes eight species has made a number of the breeding-records valueless because of the impossibility of ascertaining to which species they refer. This is especially unfortunate because the group includes both breeders in ground pools and breeders in small containers, so that it is impossible to suggest the probable sources of those species whose habits in this respect are not definitely known. The record (Dalziel, 1920–21) of three instances of *rima* breeding in crab-holes probably refers to the true *C. rima*.

Culex (Neoculex) subrima Edwards.

Mr. J. Muspratt has kindly sent me a single pelt together with the terminalia of the male adult bred from it and notes on both. He points out that the terminalia are typical for *subrima* except that the leaf on the outer aspect of the lobe of the coxite, which Edwards (1941, p. 263) describes as unstriated, is striated in this specimen and there is on the lobe a hair, with its base adjacent to that of the leaf, which is not mentioned or figured by Edwards. The specimen was collected by Dr. M. Parent at Yangambi (Stanleyville), Belgian Congo.

The larva greatly resembles those of *rubinotus* and *sunyaniensis*, but differs from both in the shape of the siphon and in setae B and C being usually trifid.

Head.—Setae B and C about half length of head, 3-branched (usually so, according to Mr. Muspratt), coarsely but sparsely plumose; *d* long and single. Mentum very similar to that of *rubinotus*.

Abdomen.—Comb-scales long and narrow, the distal scales very much larger than the proximal ones. Siphon with sides converging fairly rapidly to about $\frac{2}{3}$ and then diverging slightly (but obviously) to the apex, index (in the single pelt) about 6; pecten extending to a little beyond $\frac{1}{3}$, with 8 spines on one side and 9 on the other, spines very like those of *sunyaniensis*, set closer together than in *rubinotus* and the more distal spines not more widely-spaced, as they commonly are in *rubinotus*; subventral tufts very minute. Anal segment as in *rubinotus* but lateral seta apparently 4-branched; no tuft proximal to barred area.

Breeding-places.—The record (Schwetz, 1930*b*) of *C. rima* breeding at the edge of a marsh probably refers to the present species.

Culex (**Neoculex**) **insignis** Carter.

The larva is partly described by MacGregor (1927, p. 175), fig. 42, under the name *rima*, but the characters he gives will not distinguish it from *sunyaniensis*, from which it is perhaps inseparable.

Breeding-places.—MacGregor records this species (under the name *rima*) breeding "only in shady situations, in holes in the ground under trees near rivers, in shaded river pools, in rock-holes close to the main course of rivers and occasionally in shaded ponds"; he notes that "the larvae seem to prefer water that is quite foul with decomposed vegetation." The records of Dalziel, from crab-holes, surface pools and (once) from a well, and those of Dunn (1927–28) from crab-holes, also appear to refer to true *insignis*.

Culex (**Neoculex**) **sunyaniensis** Edwards. (Fig. 147.)

According to Edwards (1941, p. 432) the figure published by Macfie and Ingram (1916*a*) as *insignis* and by myself (1936) as *rima* var. *insignis* is of the segregate to which he gave the name *sunyaniensis*, "but the description, if made from Uganda specimens, most probably refers to the true *C. insignis*." The description I published was that of Macfie and Ingram, checked by the material I saw, and with the one addition of a description of the mentum (now deleted); I have no material of the larva.

The larva of *sunyaniensis* is perhaps inseparable from those of other members of the *rima*-group; from all other known *Culex* larvae whose siphon bears small subventral tufts (except *perfuscus*, *decens* and *cinerellus*) it is separable by the siphonal index coupled with the pale colour of the siphon; none of these three species has a tuft proximal to the barred area nor pecten-spines shaped like those of *sunyaniensis*. Both *decens* and *cinerellus* have less numerous pecten-spines, and head-seta C in both is triple. The larva greatly resembles that of *subrima*, but in the present species head setae B and C are much longer than in *subrima*.

Length about 6 mm. ; *colour* " grey with very dark hairs on the anal segment " (Macfie and Ingram, 1916*a*) ; siphon pale brown.

Head.—Antenna spiculate, decidedly narrow, more or less infuscate throughout ; tuft of about 25 plumose branches at $\frac{3}{4}$. Setae A, B and C plumose, A with about 7 branches, B and C each double and slightly longer than head, *d* single.

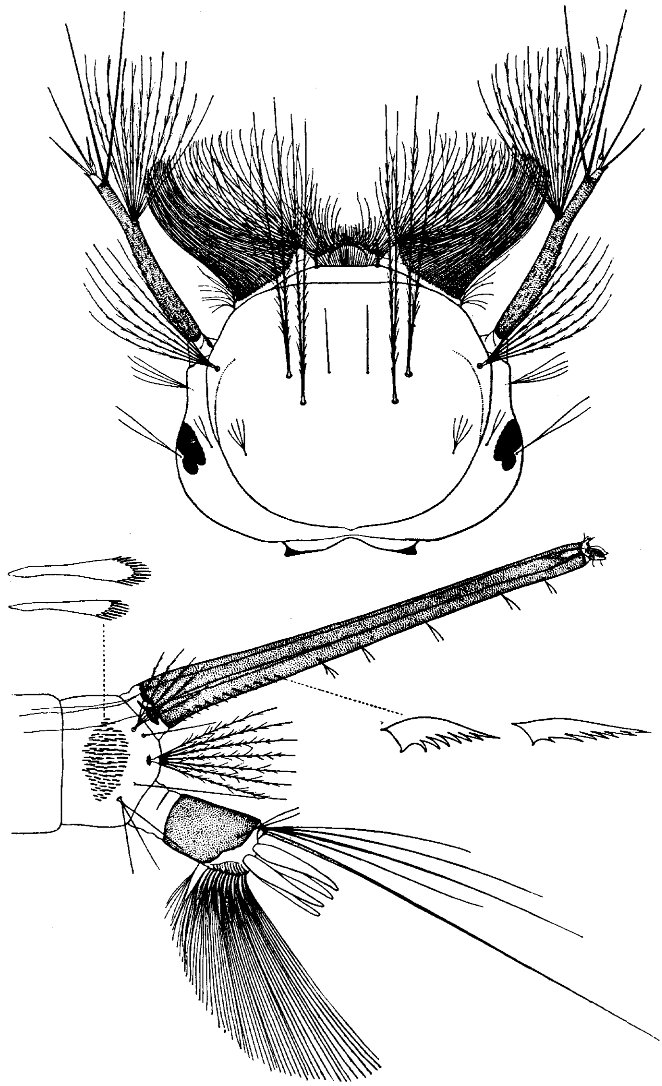

FIG. 147.—*Culex* (*Neoculex*) *sunyaniensis* Edw. Head and terminal segments.

Abdomen.—Comb a patch of about 70 rather narrow scales. Siphon with index 8–9 ; pecten of 12–15 spines, each with numerous denticles, extending to $\frac{1}{4}$; 2–3 pairs of very inconspicuous subventral tufts are placed beyond the pecten, and are each composed of 2–3 simple branches, which are much shorter than the diameter of the siphon. Anal segment with complete saddle, the distal margin of which is almost smooth ; upper caudal seta with 4 branches, lower single ; lateral seta 2-branched, nearly as long as saddle. Ventral brush with about 7 pairs of many-branched tufts in the barred area and one small mid-ventral tuft proximal to it (a most unusual feature in *Culex*). " Gills " subequal, lanceolate, about as long as saddle.

Breeding-places.—Macfie and Ingram (1916*a*) found their larvae " in holes excavated by the native children in search of crabs ; the water contained in the holes held much matter in suspension."

Culex (Neoculex) wigglesworthi Edwards. (Figs. 148, 149.)

I have not seen this larva, and the account of it is a combination of those published by E. C. C. van Someren (1945) and de Meillon, Parent and Black (1945). The larva greatly resembles that of *sunyaniensis*, especially in the possession (rare in

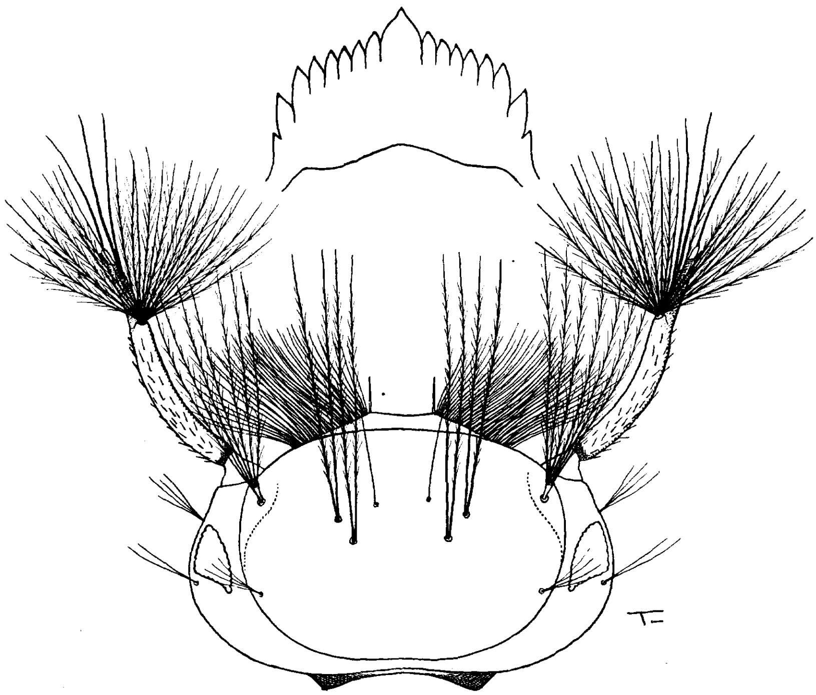

FIG. 148.—*Culex (Neoculex) wigglesworthi* Edw. Head and mentum.

Culex) of unpaired tufts proximal to the barred area in the ventral brush. It can be separated from *sunyaniensis* by the pale colour of its siphon, the fact that the subventral tufts of the siphon are longer than its diameter, and by the spiculate margin of its anal segment. It also greatly resembles *subaequalis* ; the differences are given in the key.

Head.—Antenna slightly curved, spiculate and infuscate for its full length ; tuft of 23–29 coarsely plumose setae at $\frac{3}{4}$. Setae A, B, and C plumose, A with 6–7 branches, shorter than B and C, which are bifid and about the length of the head; *d* long, single and simple; *e* and *f* each with about 9 short branches. Mentum with 7 teeth on either side of the broad central tooth.

Abdomen.—Comb a large patch of about 69 scales (about 45 in de Meillon's larva), the more proximal scales smaller than the distal ones, which are rather long and narrow. Siphon pale, index 9 in larval pelts. (6·9 in de Meillon's pelt, which is perhaps crushed). Pecten of 10–12 spines, which have many small denticles

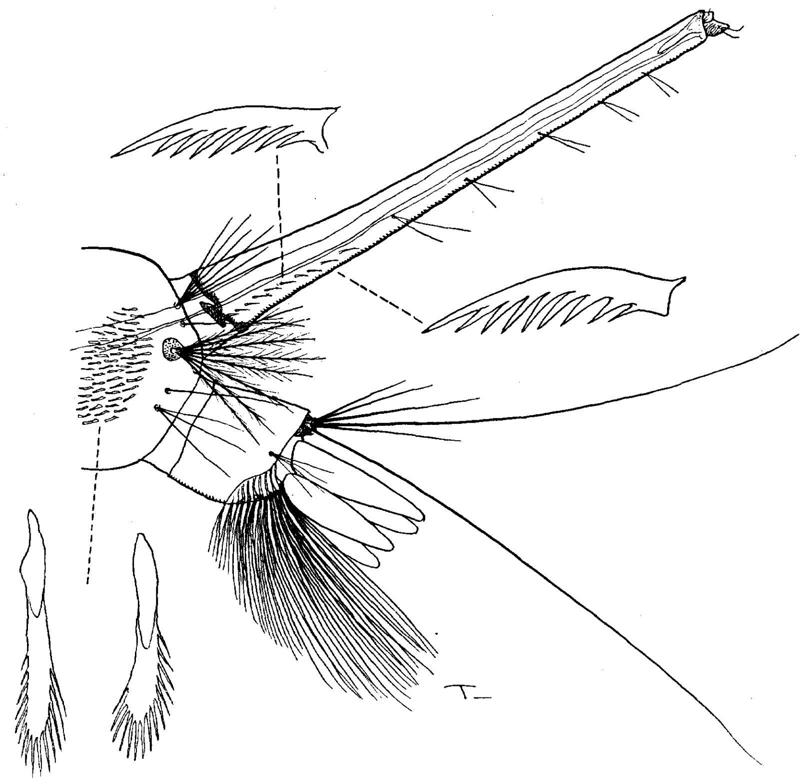

FIG. 149.—*Culex (Neoculex) wigglesworthi* Edw. Terminal segments.

(4–6) extending along the whole ventral side.* Five subventral tufts, all placed beyond the pecten, and each with 2 simple branches about 1½ times the diameter of the siphon. Saddle of anal segment complete, its apical edge spiculate. Lateral seta with 4 simple branches and about ½ the length of the saddle. Lower caudal seta single, upper with one long branch and 2–3 very much shorter ones. Ventral brush with 5 or 6 paired tufts, each with 7–9 branches, in the barred area and 3 small unpaired tufts outside the barred area. "Gills" lanceolate and about the length of the saddle.

Breeding-places.—Mrs. van Someren's larvae were found in clear, slowly-flowing water in a backwater of a forest stream, under moderate shade.

* Some specimens from Kenya now in the British Museum, including the one used for Fig. 150, have up to 8 secondary denticles on the pecten spines.—P. F. M.

Culex (**Neoculex**) **albertianus** Edwards.

Larva and breeding-places unknown.

Culex (**Neoculex**) **calabarensis** Edwards.

Larva and breeding-places unknown.

Culex (**Neoculex**) **galliardi** Edwards.

Larva and breeding-places unknown.

Culex (**Neoculex**) **albiventris** Edwards. (Fig. 150.)

The additions I made (Hopkins, 1936) to Macfie and Ingram's description probably refer in part to other species, and have been deleted.

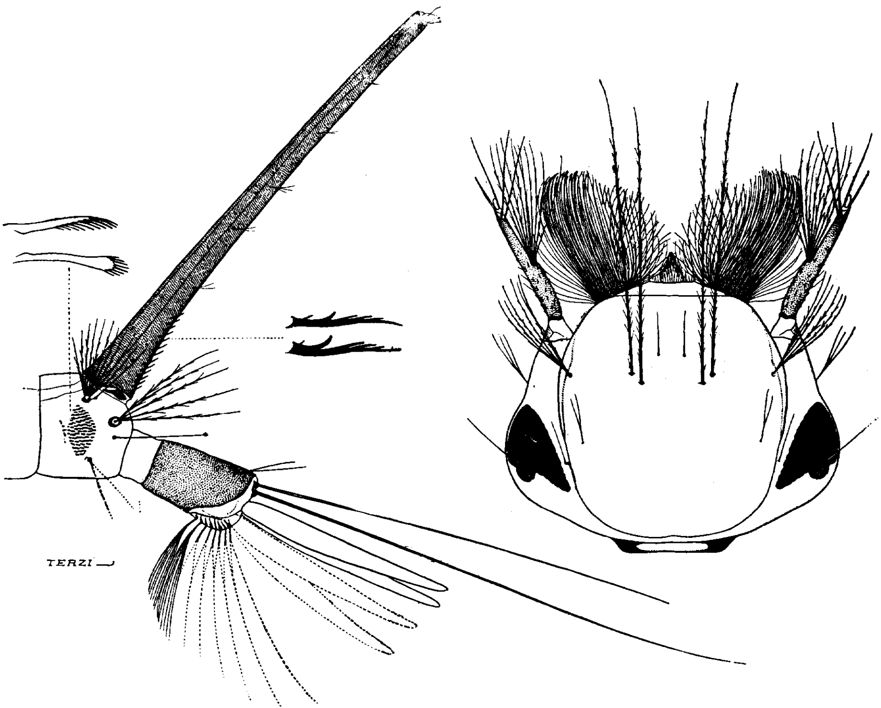

FIG. 150.—*Culex* (*Neoculex*) *albiventris* Edw. Head and terminal segments.

This larva could hardly be confused with that of any other Ethiopian species of *Culex* except *salisburiensis*, which shares with it the very unusual unbranched character of head-seta B and C; from *salisburiensis* it differs in numerous points, of which the most readily noted is that in the latter species the upper caudal seta is not single; *sinaiticus* also has setae B and C single, but has a comb composed of spines.*

* Other species having head setae B and C single include *avianus*, from which the present species can readily be distinguished by the much smaller siphonal tufts, *adersianus* which has the dorsal "gills" much shorter, and *wansoni* which resembles it closely but is believed to be distinguishable on the characters given in the key. I am informed by Mr. G. G. Robinson that setae B and C are occasionally single in larvae of *Culex horridus* in Northern Rhodesia. This species can, however, be very easily distinguished by the character of the pecten spines.—P. F. M.

Length about 7 mm. ; *colour* " very dark " (Macfie and Ingram).

Head.—Antenna spiculate ; tuft of about 10 plumose branches at about $\frac{1}{2}$. Seta A with about 6 plumose branches ; B and C long, stout, single and plumose ; *d* single, *e* 2-branched, *f* single.

Abdomen.—Comb a patch of about 50 small unusually narrow scales. Siphon dark brown, index about 10 ; pecten extending to about $\frac{1}{5}$, composed of about a dozen spines, the rather peculiar basal denticles of which are shown in Fig. 150 ; subventral tufts shorter than diameter of siphon, with 2–3 simple branches. Anal segment with complete saddle which is longer than broad ; caudal setae both single ; lateral seta about $\frac{2}{3}$ length of saddle, 2-branched. Ventral brush composed of multiple tufts, apparently 4 pairs (lost in the available material). Dorsal pair of " gills " long and narrow, ventral pair lost in the available material.

Breeding-places.—Macfie and Ingram (1916) found larvae and pupae in " clear water in the burnt-out hollow of a fallen tree in a clearing in the forest," and the record of Philip (1933), who found the species breeding in bamboo sections put out as traps, probably refers to true *albiventris*. Garnham, Harper and Highton (1949) found two larvae " in the basin in a low fork of a tree."

Culex (Neoculex) kanyamwerima E. C. C. Van Someren.

Larva and breeding-places unknown.—P. F. M.

Culex (Neoculex) adersianus Edwards.

Mrs. van Someren (in Hopkins, 1942) notes that the larva resembles that of *albiventris* in all characters except that head-seta A has 3–4 plumose branches, the pecten-spines have only one basal denticle, and the " gills " are broadly lanceolate and much shorter than in *albiventris*, the upper pair about half the length of the saddle and the lower pair about $\frac{1}{3}$ as long as the upper.

Breeding-places.—Mrs. van Someren's larvae were obtained from tree-holes, and it is almost certain that Aders' record (1917) of *albiventris* breeding in holes in *Terminalia* trees refers to the present species. Garnham, Harper and Highton (1946) state that large tree-holes near the ground are selected.

Culex (Neoculex) acrostichalis Edwards.

Larva unknown. Hancock's record of *albiventris* breeding in a ditch definitely refers to the present species.

Culex (Neoculex) wansoni Wolffs.

The following description of the larva of this species is translated from Wolfs (1945*b*). Other species having head setae B and C single include *salisburiensis*, *avianus* and, occasionally, *horridus*, from all of which it can be distinguished on the shape of the pecten spines, and *adersianus* and *albiventris* which are believed to be separable from it on the characters given in the key. *sinaiticus* also has setae B and C simple but in this species the comb is composed of spines :

" *Antennae.*—Half the length of the head—tuft situated at $\frac{4}{5}$ comprises 20 to 25 plumose bristles. Antenna spiculate.

" *Head.*—Seta A with 4 to 5 short, plumose branches. Seta B simple, a little longer than the head and plumose. Seta C simple, a little longer than the head and plumose. Seta *d* single, simple, not very long. Seta *e* bifid, simple. Seta *f* single, simple.

"*Eighth segment.*—Seta A with 5 plumose branches. Seta B with 7 to 10 plumose branches, one of them sometimes bifid. Seta C single, strongly plumose. Comb of about 50 scales which are fringed on the side and at the apex.

"*Anal segment.*—Saddle complete—saddle hair small with 3 or 4 branches. Caudal setae very long and double. There are 10 tufts in the barred region. Dorsal gills $2\frac{1}{2} \times$ the length of the saddle; ventral gills $1\frac{1}{2} \times$ the length of the saddle.

"*Siphon.*—Strongly chitinized—index 9–10, pecten of 13 spines of an unusual kind; they have a secondary denticle near the base and 3 or 4 denticles at the apex. On the siphon we counted 3 subventral tufts and 3 lateral tufts."

Breeding-place.—A roadside drain with little vegetation.—P. F. M.

Culex (Neoculex) horridus Edwards. (Fig. 151.)

The long, dark-coloured and very straight-sided siphon is characteristic, and should distinguish this larva from most other species of the genus; it very closely resembles *C. macfiei*, but the latter has subventral tufts which are longer than the diameter of the siphon.

Length about 6–7 mm.; *colour* light to dark grey, head moderately dark, siphon very dark brown.

Head.—Antenna spiculate, tuft of about 20 unusually strongly plumose branches at about $\frac{3}{4}$. Setae A, B and C all plumose, A with about 6 branches, B and C with 2–4 (usually each with the same number); *d*, *e* and *f* all single. Mentum markedly triangular and with central tooth much larger than lateral teeth; the lateral teeth are 8–9 on each side, of which the apical 4 are somewhate square-ended and the basal ones pointed.

Abdomen.—Comb a patch of about 35 exceptionally narrow scales with moderately long fringe. Siphon with sides (except at the extreme base) nearly parallel, index about 12 (in mounted specimens usually 9–10); pecten extending to about $\frac{1}{4}$, composed of 12–15 slender spines, which have numerous very delicate denticles extending the whole length of the ventral edge; about 5 pairs of subventral tufts are very minute and inconspicuous, 2–3-branched; subdorsal and lateral tufts absent. Anal segment with complete saddle, almost the whole surface of which is covered with small spicules which are little longer along the distal margin than elsewhere; upper and lower caudal setae single; lateral seta 4-branched, much shorter than saddle. Ventral brush of 4 pairs of 6-branched tufts. "Gills" cylindrical, tapering rapidly near the apex to fairly sharp points; dorsal pair about twice as long as saddle, ventral much shorter.*

Breeding-places.—Common in tree-holes, barrels and closed cement tanks; Schwetz (1930*b*) records it from paw-paw stumps, and Dr. Wigglesworth informs me that he has obtained it in similar situations and also in cut bamboos. Harris (1942) records it from a deep stone-lined well and also from the cut bamboos he used as traps. Teesdale (1941) mentions it breeding in pineapple axils.

* Mr. G. G. Robinson has kindly informed me that Northern Rhodesian larvae differ from the above description in the following particulars.:

"Antennal tuft with 8–11 branches; head setae B and C with 1–4 branches; head setae *d* and *e* single or double."—P. F. M.

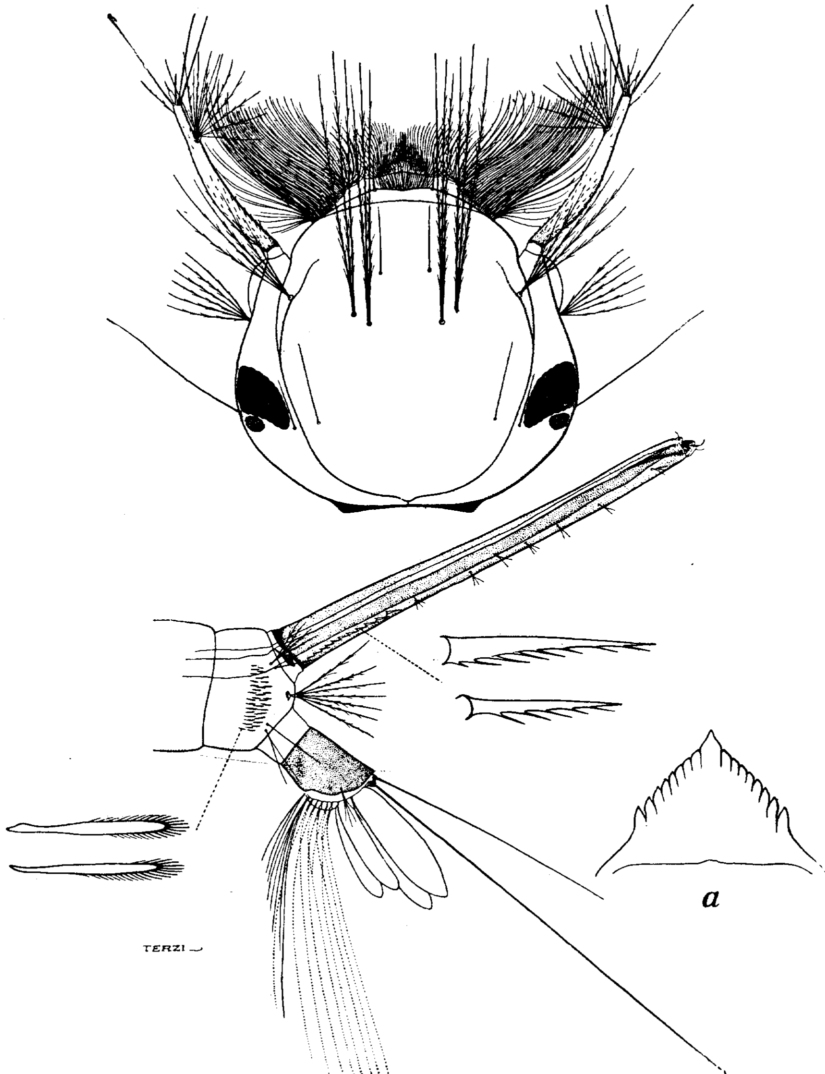

FIG. 151.—*Culex* (*Neoculex*) *horridus* Edw. Head and terminal segments. *a*, mentum.

Culex (Neoculex) stellatus E. C. C. van Someren. (Figs. 152, 153.)

The spiculate integument and dense covering of plumose, stellate setae on the thorax and abdomen will at once distinguish this species from any other member of the genus in the Ethiopian region. The following account is taken from van Someren (1947).

"*Head*.—Without spicules and about as long as broad. Antennae curved, sparsely spiculate, and about one-third the length of the head. The antennal tuft, just below a ½, consists of about 12 plumose branches. Clypeal spines long. Setae A, B and C about one third the length of the head and *d* not much shorter; B is placed a little below A, C is above B and almost in line with A and *d* is a little below B. A, B and *d* plumose and with about 20 branches each but the number of branches is variable, B having as few as 6 in one specimen ; C single. Mentum small and with 9 close set teeth on either side of the central tooth. Ventral surface of the head with two pairs of large stellate setae on either side about the middle.

"*Abdomen.*—Comb consists of a single, or double, semi-circular row of 15–23 long, slender, sharp-pointed spines which have a lateral fringe of many fine denticles on

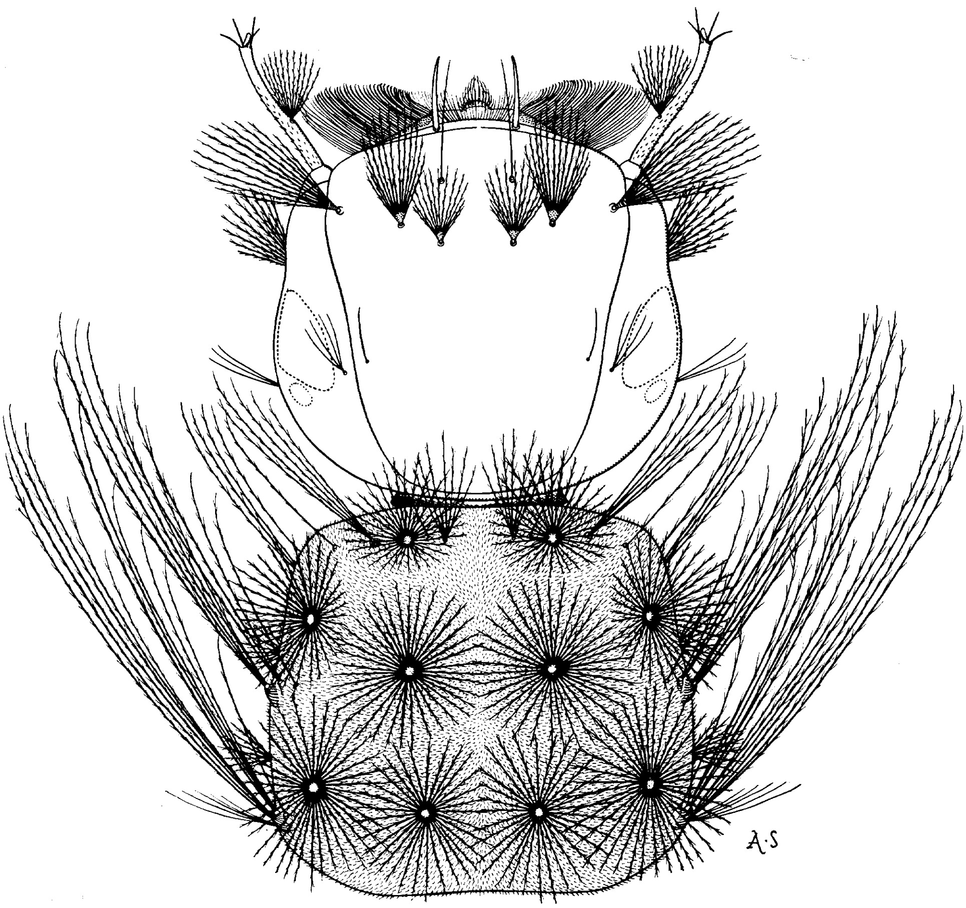

FIG. 152.—*Culex* (*Neoculex*) *stellatus* E. C. C. van S. Head and thorax.

the basal $\frac{1}{2}$. Siphon covered with small spicules, unmounted specimens have a siphonal index of $4\frac{1}{2}$ which may be reduced to 3 in crushed specimens. Pecten consists of 5–9 small spines which may be either simple or have 1–2 ventral denticles or they may only have 1 or 2 dorsal denticles; very often the basal spines are simple or with ventral denticles and the distal spines with dorsal denticles only. There are 3 or 4 sparsely plumose, 3-branched subventral tufts which are 3 times the length of the diameter of the siphon, and there are 2 dorsal setae about the middle of the siphon which are sparsely plumose, about twice the length of the diameter of the siphon, and with 2–3 branches. Saddle of anal segment complete and covered with spines which are long and fine on the distal border; the lateral seta which is placed on the distal border is strong and conspicuous and consists of 10 plumose branches which are about twice the length of the saddle. Upper caudal setae with 7–8 and

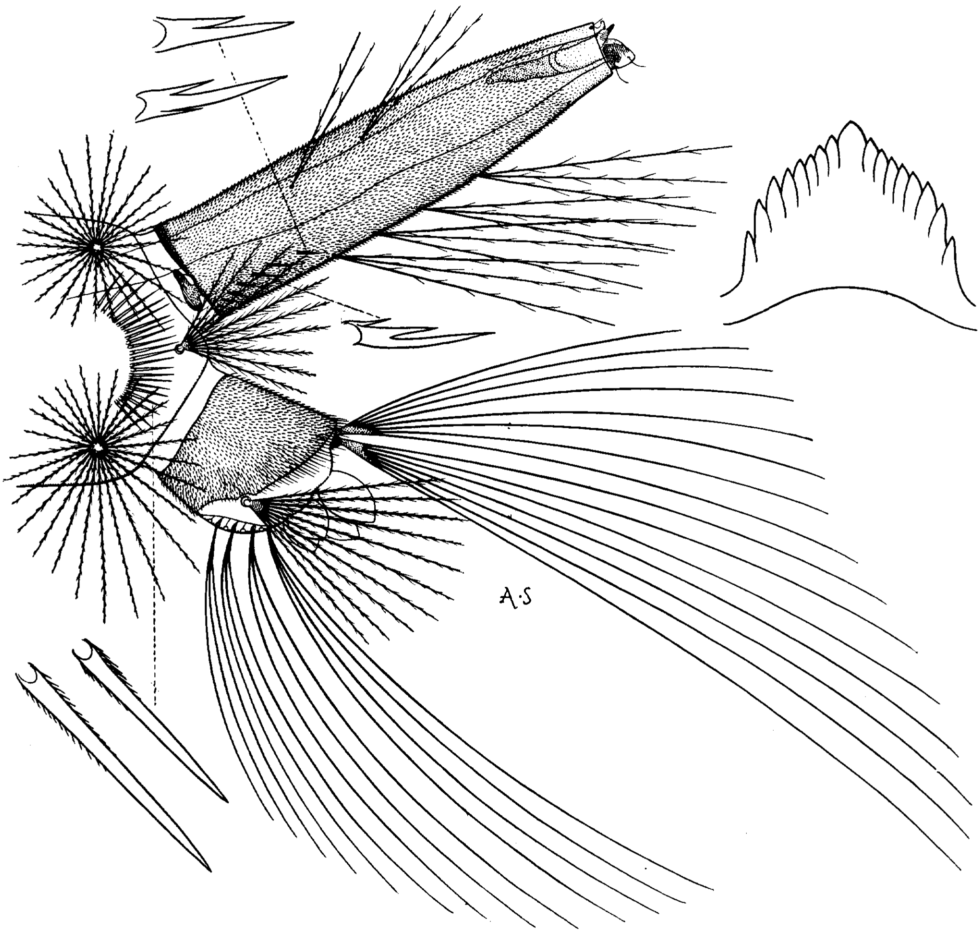

FIG. 153.—*Culex* (*Neoculex*) *stellatus* E. C. C. van S. Terminal segments and mentum.

lower with 8–10 branches. Brush with 4 pairs of 2–4 branched setae. "Gills" short, about ½ the length of the saddle, and round."

"*Breeding-place.*—Steps cut in coconut palms on Mahé Island, Seychelles (J. O. Harper)."—P. F. M.

Culex (Culiciomyia) nebulosus Theobald. (Figs. 154, 155.)

The siphonal index of about 3 and the very short antenna immediately distinguish this species from any other known Ethiopian *Culex* larvae, except *musarum* and *cinereus* ; from the latter it is readily separated by the greater number of comb scales, the spiculate antenna, and the different arrangement of the main head-setae, from the former by the blackish head and siphon.*

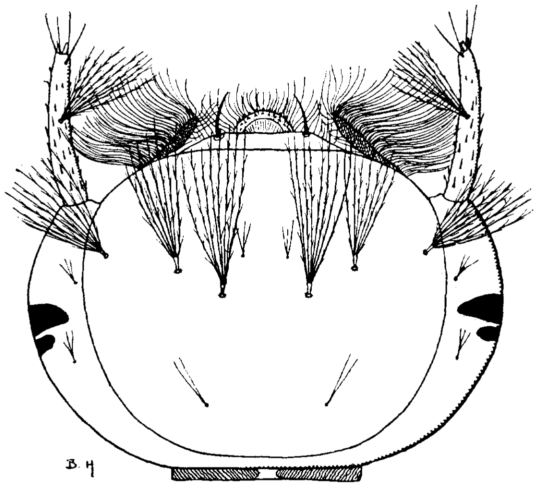

FIG. 154.—*Culex* (*Culiciomyia*) *nebulosus* Theo. Head.

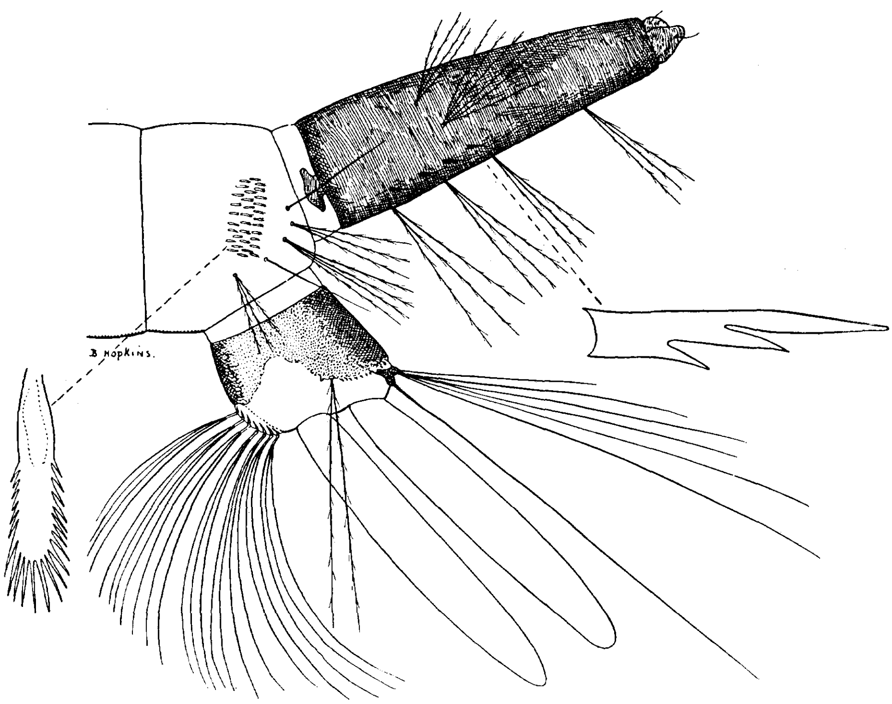

FIG. 155.—*Culex* (*Culiciomyia*) *nebulosus* Theo. Terminal segments.

* Compare also *milloti*.—P. F. M.

Length about 5 mm. ; *colour* grey, head, siphon and saddle of anal segment blackish.

Head.—Antenna less than ½ length of head, not infuscate, densely spiculate; tuft of about 10 short plumose branches at about ⅗ ; the tips of these branches reach the apex of the antenna. Setae A, B and C with about 12, 8 and 8 plumose branches respectively, their bases almost in a straight line, which forms an angle of about 60° with the long axis of the head; *d* small with 3 simple branches, *e* 2-branched. Mentum triangular, with on each side of the large central tooth about 12 teeth, of which the most distal are the smallest.

Abdomen.—Comb of about 30 approximately equal scales in a roughly semicircular patch, each scale with a long distal fringe. Siphon with index about 3 ; pecten of 4 or 5 strongly denticulate spines, extending nearly to ½ ; 4 pairs of large subventral tufts, each with about 4 subplumose branches ; single pairs of shorter lateral and subdorsal tufts, each with 4–5 simple branches. Anal segment with distal margin of saddle rather strongly spiculate ; upper caudal seta with about 6 simple branches, which are graduated in size from above down, the lowest branch being the longest, lower caudal seta single, simple, about five times length of saddle ; lateral seta double, nearly three times length of saddle. Ventral brush poorly developed, composed of 4 or 5 pairs of tufts. " Gills " sausage-shaped, equal, more than three times length of saddle.

Breeding-places.—Abundant in tree-holes and very common in barrels, closed tanks and domestic utensils. Common in discarded tins, motor-tyres, roof-gutters, and boats and canoes containing rain-water. Frequent in banana or paw-paw stumps and in large fallen leaves. The writer once bred it in numbers from bored bamboos. Bacot records it as occasional in plant-axils (*Dracaena* and *Colocasia*), and Dalziel in crab-holes and wells. Bedford (1928) mentions finding larvae breeding in large numbers in a latrine, and McHardy found them once in a snail-shell. Several authors have recorded the species from ground pools of various kinds, including swamps (Aders, 1917), "pools in bush" (Ingram, 1919), and "rain-water collections in various places, including pools, shaded and not shaded."

In view of the former confusion of several species of *Culiciomyia* under this name it is difficult to assess the value of the records given by authors, but it seems very possible that the records from ground pools are due to misidentification, and almost certain that those from crab-holes refer to *cinerellus*, which is known to breed freely in such sites. McHardy's record, and probably that of Aders, refer to var. *pseudocinereus* ; Harris (1942) gives the breeding-places of this form as " small collections of rain-water in pools, tree-holes, water barrels, discarded tins, etc." (Haddow (1948) gives records, presumably of the type form, from axils of wild banana, *Pandanus*, colocasia and pineapple and states that " In Bwamba this species seems almost ubiquitous and its larvae have been taken in almost every type of breeding water."—P. F. M.)

Culex (? Culiciomyia) milloti Doucet.

This species, recently described from Madagascar, is known only from the larva. It appears to differ from *nebulosus* in the smaller number of branches in head setae A, B, C and *d* and the larger number of comb-spines. On the basis of the material available to me these appear to be good characters. The shorter siphon is also cited by the author as diagnostic from *nebulosus* but, in fact, the siphon is somewhat variable in this species and the index may be as little as 2. It is possible that certain adults from Madagascar provisionally attributed by Edwards (1941) to *nebulosus* may belong to the present species. The description which follows is translated from Doucet (1949*b*). :

"*Length.*—About 5 mm. Colour brown with the head and siphon dark.

"*Head.*—Antenna shorter than the head, lightly spiculate ; a delicate tuft of twelve plumose setae present at $\frac{3}{5}$, the ends of these branches extending beyond the tip of the antenna. Setae A, B and C have 4–3–3 plumose branches respectively ; *d* small and single ; *e* small and with 2 simple branches ; mentum triangular with about twelve equal teeth on either side of the central tooth.

"*Abdomen.*—Comb of 8th segment with about 50 scales, each scale with a distal fringe ; siphonal index about 2, pecten of about nine teeth occupying the proximal one-third : each pecten spine has one to two secondary denticles ; four pairs of subventral setae each with 2–3 non-plumose branches longer than the breadth of the siphon at point of origin ; lateral and subdorsal setae and lateral seta of anal segment missing from the specimens collected ; upper caudal seta with two simple branches of which the upper is half as long as the lower ; lower caudal seta simple and about three times as long as the anal segment ; ventral brush poorly developed with four to five pairs of setae ; gills lanceolate, all equal in length and the same length as the anal segment.

"*Habitat.*—A stretch of water in a badly drained snake ditch, muddy and covered with vegetation and containing, at least temporarily, decomposing straw and excrement."—P. F. M.

Culex (Culiciomyia) cinereus Theobald. (Figs. 156, 157.)

The larva is unlikely to be mistaken for any other except *nebulosus* ; it differs markedly from the latter (and from all other known Ethiopian species of *Culex* except *moucheti*) in the fact that the antenna is wholly without spicules. Other highly unusual features are the possession of a comb composed of a small number of *scales* (when the comb-teeth are few they are almost invariably *spines*), and the great development of the lateral seta of the anal segment.

Length about 5 mm. ; *colour* grey ; head, siphon and saddle of anal segment blackish.

Head.—Antenna exceptionally short, not infuscate, without spicules ; tuft of 2–4 short subplumose branches at about $\frac{3}{5}$. Setae A, B and C coarsely plumose, A with about 8 branches, B and C with 5 or 6, their bases nearly in a straight line, which forms almost a right angle with the long axis of the head ; *d* with 2–3 short branches ; *e* rather long, simple. Mentum similar to that of *nebulosus*.

Abdomen.—Comb of 8–16 rather large scales arranged in an irregular patch. Siphon with index 2–2$\frac{1}{2}$; the pecten consists of 3 strongly denticulate teeth and extends to about $\frac{1}{3}$; 5 large pairs of subventral tufts, each with about 4 plumose branches ; single pairs of lateral and subdorsal setae each with 2–3 slightly plumose branches. Anal segment with distal edge of saddle spiculate ; upper caudal seta with about 7 branches, lower single ; lateral seta with 3 or 4 slightly plumose branches, more than twice as long as saddle. Ventral brush much reduced, composed of 4 pairs of tufts, each with a very small number of short branches. "Gills" about thrice length of saddle, sausage-shaped, dorsal pair slightly shorter than ventral.

Breeding-places.—Larvae are much commoner in tree-holes than in any other situation, but I have found them in very large numbers (on a few occasions only) in discarded motor tyres.

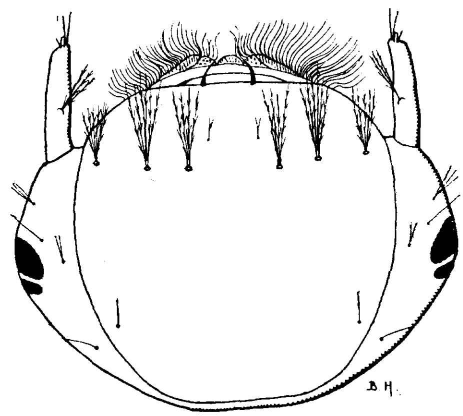

FIG. 156.—*Culex (Culiciomyia) cinereus* Theo. Head

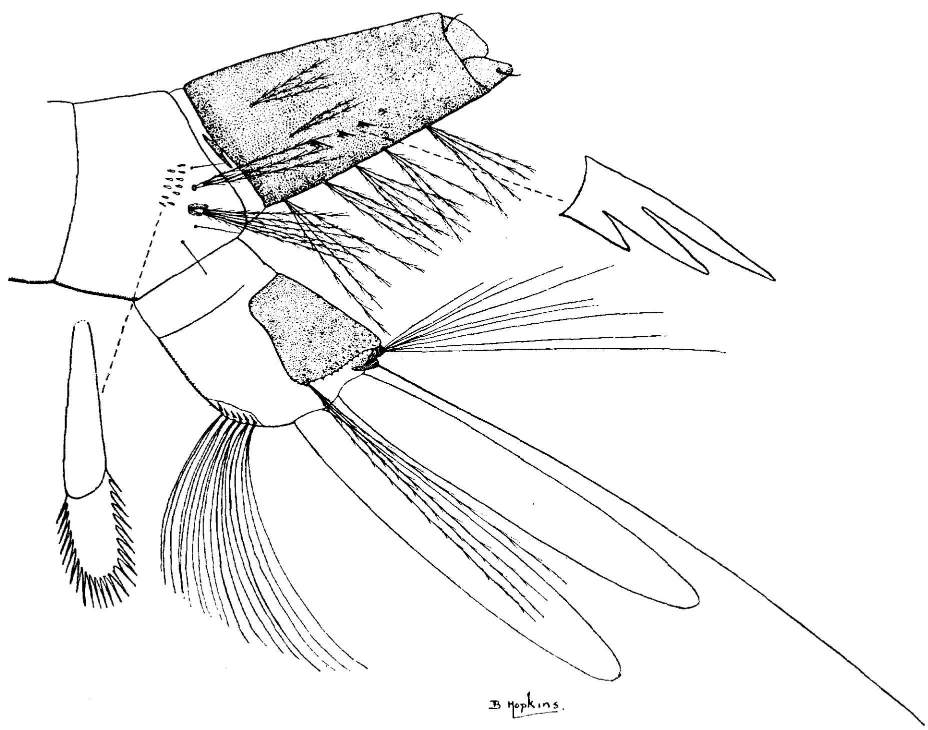

FIG. 157.—*Culex (Culiciomyia) cinereus* Theo. Terminal segments.

Culex (Culiciomyia) cinerellus Edwards. (Fig. 158.)

The peculiar form of pecten-spines exhibited by this larva seems to be unique in the genus.

Length apparently about 7 mm.; *colour* not recorded, head and siphon pale.

Head.—Chaetotaxy and antenna as in *C. macfiei* (p. 275). Mentum also very similar to that of *macfiei*, but with one or two more teeth on each side.

Abdomen.—Comb consisting of about 40 delicate scales, of which the more distal are decidedly larger than the more proximal. Siphon weakly sclerotized, index about 8; the 3 pairs of subventral tufts are composed of simple branches, which are about as long as the diameter of the siphon, the two proximal tufts 2-branched and the distal tuft single; pecten extending to nearly $\frac{1}{3}$, composed of pale-coloured spines having bifid tips, one large basal denticle, and often a second smaller basal denticle. Anal segment with a complete but lightly sclerotized saddle bearing on its posterior margin a row of rather large spicules; upper and lower caudal setae single or double; lateral seta single, about length of saddle. Ventral brush with 5 or 6 pairs of short multiple tufts. "Gills" distorted, apparently subequal and about three times length of saddle.

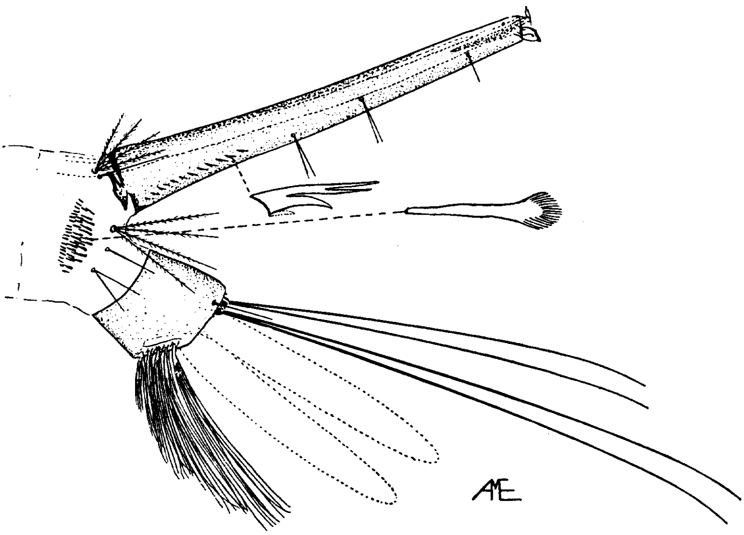

FIG. 158.—*Culex (Culiciomyia) cinerellus* Edw. Terminal segments.

Breeding-places.—Abundant in crab-holes (Dunn, 1927–28); a few specimens have been bred in Kampala (Uganda) from a discarded tin.

Culex (Culiciomyia) semibrunneus Edwards.

Larva unknown. The species has been bred from larvae or pupae obtained in pools among tall papyrus and "makindu" palms (*Phoenix reclinata*) near Kampala, Uganda.

Culex (Culiciomyia) subaequalis Edwards. (Fig. 159.)

The larva much resembles that of *cinerellus*, but differs in a number of characters, of which the form of the pecten-spines is probably the most important. It also comes close to that of *wigglesworthi*, but is easily separated by the greater number of branches in head-setae B and C. It is described (E. C. C. van Someren, 1945) as follows :

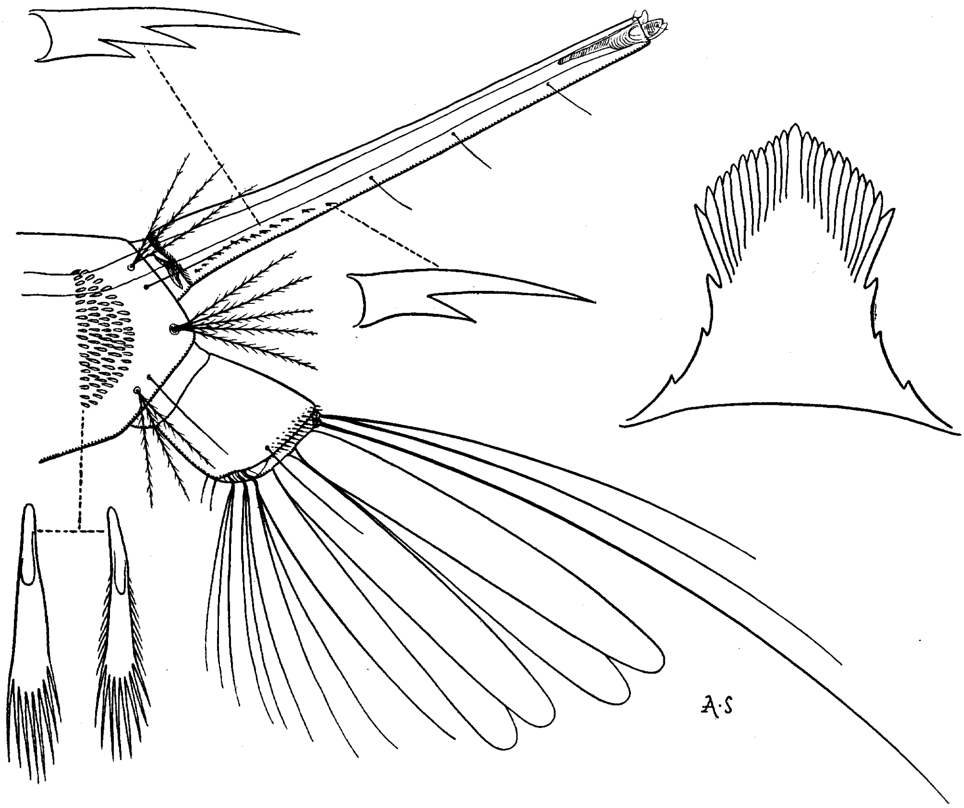

FIG. 159.—*Culex* (*Culiciomyia*) *subaequalis* Edw. Terminal segments and mentum.

"*Head*.—Slightly broader than long. Antenna about ½ the length of the head with the lower ½ spiculate and slightly swollen ; narrower, sparsely spiculate and lightly infuscate beyond the tuft, which is just before a ½ and composed of 11–13 fine plumose setae. Clypeal spines well developed. Setae A, B and C fine and plumose, A with 5–7, B with 3–4 and C with 5–7 branches ; *d* sometimes single and sometimes split into 3 branches beyond a ½ ; *e* single and *f* with 2–3 branches. Mentum long and narrow with 12 closely packed teeth on either side of the central tooth, the basal 2 small and widely spaced.*

"*Abdomen*.—Comb a patch of 60–70 narrow scales. Siphon pale and with

* Some specimens in the British Museum collection have up to 15 teeth on either side of the central tooth with 2–3 of the basal ones more widely spaced.—P. F. M.

straight sides tapering gradually from base to apex. Siphonal index 8–9. Pecten extending to about $\frac{1}{3}$, composed of 11–16 spines each with 1–2 basal denticles; usually one coarse basal denticle. One to 4 of the more distal spines are wider spaced. Three subventral tufts each a single seta and slightly longer than the diameter of the siphon at the point of attachment. Anal segment with complete saddle which bears on its distal edge a double row of prominent spines and many smaller ones. The spines in the more proximal row are slightly smaller, and alternate with the longer spines of the distal row. Lateral seta single, simple and a little longer than the saddle. Lower caudal seta single, upper with 2 branches. Ventral brush with 3 pairs of 3-branched setae in the barred area and 2 very small unpaired setae outside the barred area. Gills sausage-shaped, lower pair shorter than the upper pair, which are 3–4 times the length of the saddle."

Breeding-places.—"Spring pools beside river, in forest, clean, shaded water and bamboo pots placed on the ground in thick heavy forest and near a river" (E. C. C. van Someren, 1945). The type was bred "from stony places in rivers" (Schwetz, in Edwards, 1941).

Culex (Culciomyia) mongiro E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Culex (Culiciomyia) macfiei Edwards. (Fig. 160.)

The very dark-coloured siphon and long subventral tufts will distinguish this species from any others having a similar siphonal index; it has a strong resemblance to *C. horridus*, but is easily distinguished by the long subventral tufts of the siphon and the quite different form of the pecten spines.

Length about 6 mm.; *colour* as in *C. horridus*.

Head.—Antenna spiculate; tuft of about 20 plumose branches at $\frac{3}{4}$. Setae A, B and C plumose, A with about 8 branches, B and C with 2 and 3 branches respectively; *d* rather long, single, *e* single; *f* with 3–4 short branches. Mentum with central tooth much larger than the lateral teeth, of which there are about 9 on each side.

Abdomen.—Comb of about 40 narrow scales, of which the more distal are distinctly larger than the more proximal. Siphon tapering slightly but uniformly, index about 8 (in the figure the siphon appears too broad in proportion); pecten extending to about $\frac{1}{3}$, composed of 12–16 spines with large basal denticles; the 4 (rarely 3) pairs of subventral tufts are each composed of 2–4 almost simple branches, which are about twice as long as the diameter of the siphon. Anal segment with complete saddle, which has over its entire surface a scale-like development of the chitin, each "scale" bearing a row of minute spicules on its distal edge; spicules on distal margin of saddle much larger; upper and lower caudal setae single and double respectively; lateral seta with 1–3 branches, which are about half the length of the saddle. Ventral brush composed of 5 pairs of many-branched tufts. "Gills" variable in length, fusiform, ventral pair much shorter than dorsal; in most of my specimens the "gills" are much longer than in the specimen figured and the discrepancy between the two pairs is greater.

Breeding-places.—The larva has not as yet been found except in tree-holes.

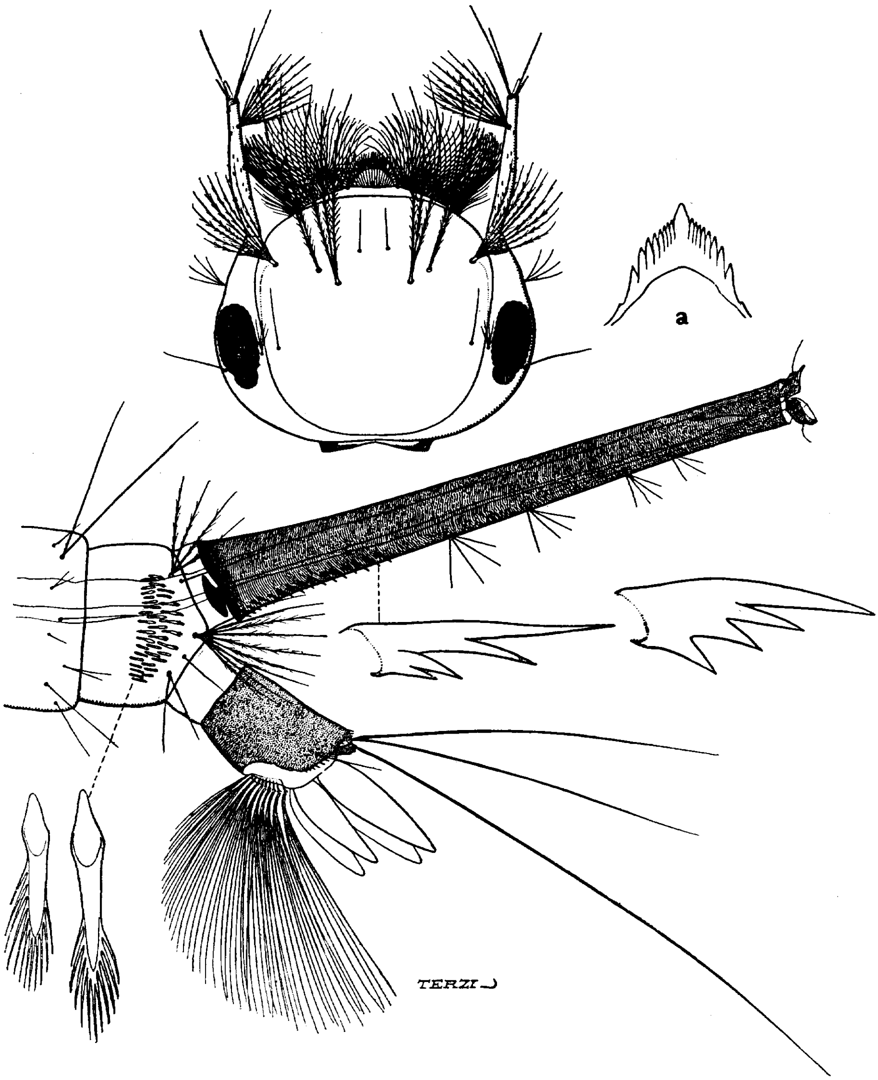

FIG. 160.—*Culex* (*Culiciomyia*) *macfiei* Edw. Head and terminal segments. *a*, mentum.

Culex (Mochthogenes) inconspicuosus Theobald. (Fig. 161.)

The larvae of this subgenus have a characteristic facies, though each of their peculiarities is shared by some other species, especially members of the subgenus *Neoculex*. Head-setae B and C are both much shorter than the head. The siphon is moderately long (index probably 5 or 6, but some of the species are only known from pelts) and the subventral tufts are long or very long; the pecten-spines are fringed with small delicate denticles all along the ventral edge. The comb is a patch of numerous teeth which may be scales, transitional from scales to spines or a mixture of both.

The present species is separable from the others by the great length of the subventral tufts of its siphon and the fact that setae B and C are both bifid from a point well beyond the base.

Length about $5\frac{1}{2}$ mm.; *colour* grey-brown.

Head unusually broad, breadth : length as 1·7 : 1. Antenna spciulate, strongly infuscate towards the base and distal to the tuft; tuft at about $\frac{2}{3}$, composed of about 35 plumose branches. Seta A with 6–9 plumose branches, which are more than $\frac{2}{3}$ as long as the head; B small (usually $\frac{1}{3}$ length of head or less), with 2 very sparsely plumose branches from much beyond base; C placed immediately behind B, variable in size, but much smaller (usually less than half length) than B, single or bifid; *d* very minute, single. Mentum much broader than long, somewhat quadrangular, central tooth much larger than those (4–5 in number) on each side.

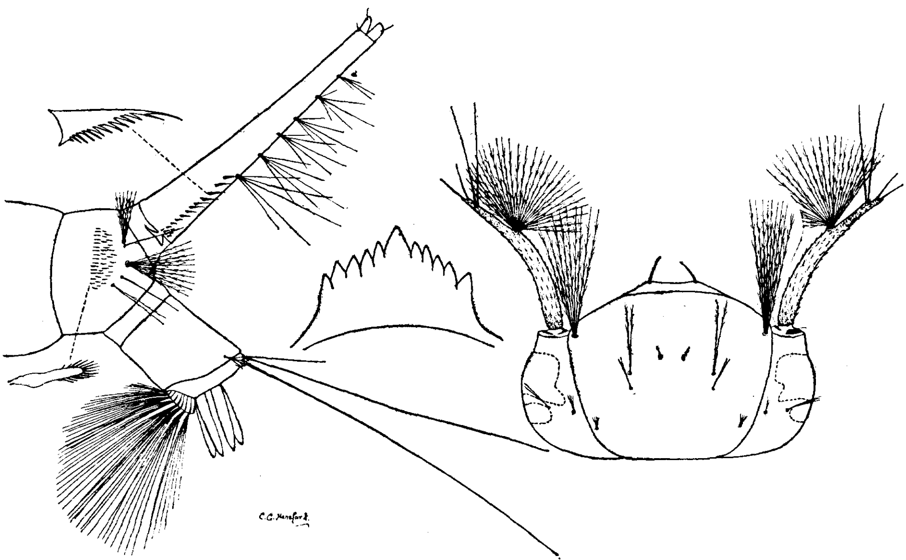

FIG. 161.—*Culex* (*Mochthogenes*) *inconspicuosus* Theo. Head, terminal segments and mentum.

Abdomen.—Comb a patch of about 40 rather narrow spine-like scales. Siphon tapering almost uniformly from base to apex, index about 6; pecten extending to about $\frac{1}{3}$, usually composed of about 14 spines, which are fringed with delicate denticles along their whole ventral edge, and of which the most basal are sometimes arranged irregularly as shown in the figure; the 6 pairs of subventral tufts have each 4–5 sparsely plumose branches, of which some are much more than twice the diameter of the siphon. Anal segment with a complete saddle, the distal margin of which is smooth; upper caudal seta 2-branched, upper branch about $\frac{1}{4}$ length of lower, lower caudal seta single; lateral seta placed towards upper margin of saddle, with 4–6 very short and slender branches. Ventral brush composed of 7 pairs of many-branched tufts. "Gills" subequal, lanceolate, shorter than saddle.

Larvae from Uganda agree excellently with those from South Africa.

Breeding-places.—These appear to be very varied; the larva is most commonly found in nearly stagnant pools in streams. Ingram and de Meillon record it, in addition, from a swamp alongside a stream, a ditch and a rock-pool; Macfie and Ingram (1922–23) obtained it from pools in swampy ground, McHardy (1927) from a seepage and from native water-holes, and Dalziel gives one record from a crab-hole.

Culex (Mochthogenes) castor de Meillon and Lavoipierre.

The larva, which is known only from a single pelt, is separable from *inconspicuosus* by having head-seta B 3-branched and the subventral tufts of the siphon much shorter, from *simpliciforceps* by the longer subventral tufts of the latter, and from *fimbriforceps* by the different shape of the pecten-spines. It is described by de Meillon, Parent and Black (1945) as follows:

"*Head*.—Antenna spiculate and slightly infuscated at base and beyond tuft. Tuft at about $\frac{4}{5}$ consisting of about 22 plumose branches. Head seta A with 10 plumose branches; seta B with 3 simple branches, reaching the anterior margin of the head, which, however, is greatly flattened in the specimen examined. Setae C and *d* missing. Mentum with a large central tooth and 5 smaller teeth on each side of the central one.

"*Abdomen*.—Comb a patch of about 40 narrow scales of 2 sizes, and fringed apically only. The distal scales are longer and broader apically than the proximal ones. Siphon somewhat infuscated apically; index 4·3. Pecten of 13–14 large closely set spines with denticles along the entire ventral edge. The pecten spines do not reach to the middle of the siphon. There are 5 pairs of subventral tufts, each tuft consisting of three simple branches. The subventral tufts are slightly longer than the diameter of the siphon at the point of attachment. Anal segment with complete saddle. Upper caudal seta 2-branched, the upper branch being approximately half the length of the lower branch. Lower caudal seta single. Ventral brush missing, but the scars of 5 pairs of tufts can be seen. Lateral seta small, 4-branched. Gills missing."

Breeding-places not recorded. Probably breeds in ground pools.

Culex (Mochthogenes) fimbriforceps Edwards. (Fig. 162.)

At once separable from all the other species of the subgenus by the great length of the pecten-spines and the fact that the upper caudal seta is single. The species is known only from pelts, the description of which (de Meillon, Parent and Black, 1945) is as follows:

"*Head*.—Antenna spiculate, dark throughout, but sometimes paler medianly; generally darker than in the other species of this subgenus. Tuft at about $\frac{3}{4}$, consisting of about 29 plumose branches. Seta A with about 8 plumose branches; seta B short, not reaching the anterior border of the head, with about 5 branches; seta C with 2–4 branches, smaller than B and placed immediately behind B; seta *d* small and delicate. Mentum with 1 central tooth and 6 teeth on each side; broader than long.

"*Abdomen*.—Comb a patch of about 40 narrow scales, the proximal row being smaller in size than those in the distal row. Siphon pale, but with a darkened median band in one specimen examined. Siphonal index varies in the specimens examined from 4·6–6·0. Pecten of 8 narrow spines with small denticles along the

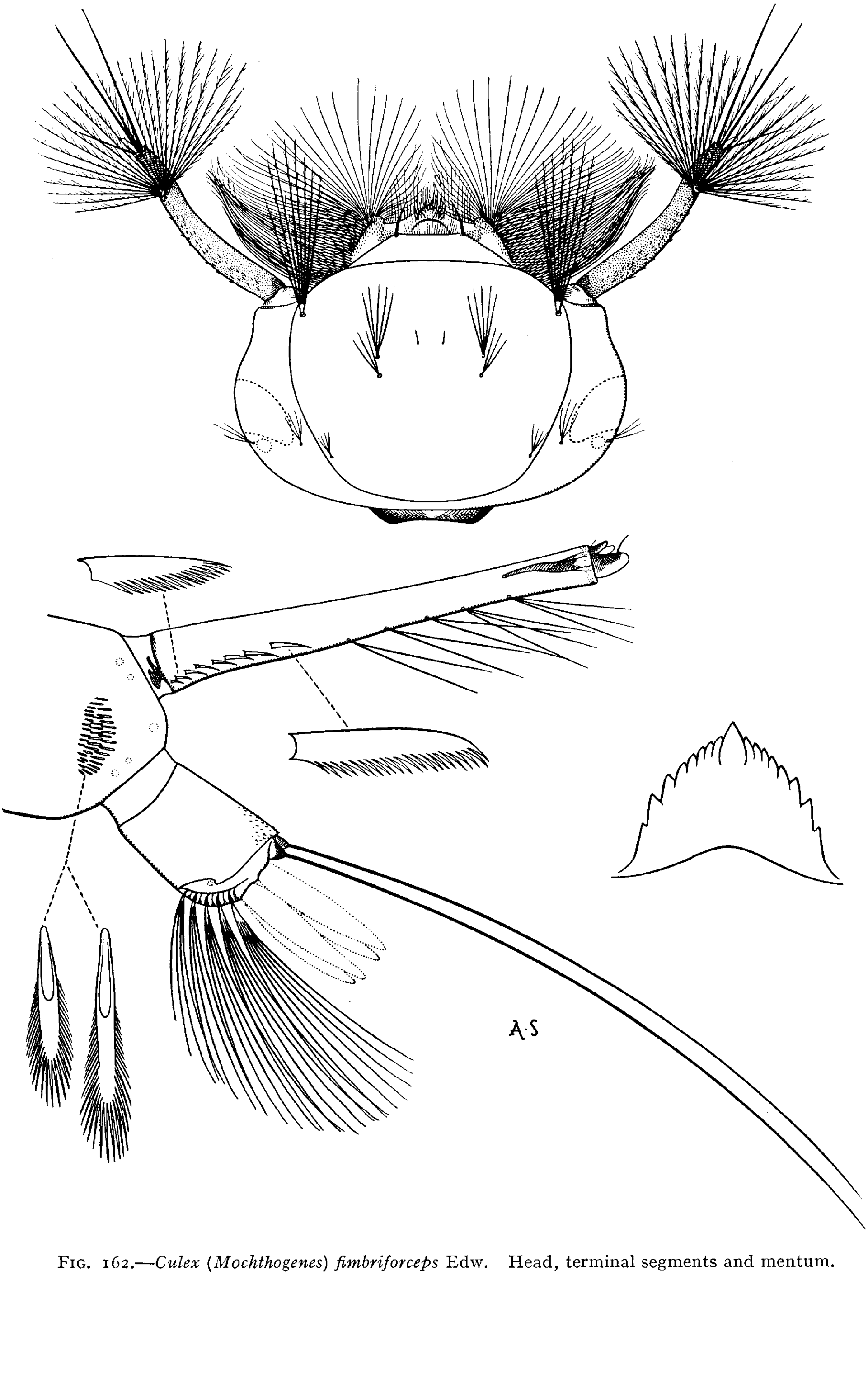

FIG. 162.—*Culex* (*Mochthogenes*) *fimbriforceps* Edw. Head, terminal segments and mentum.

whole of the ventral edge. The pecten spines are widely set, especially the apical ones, but they do not reach to the middle of the siphon. There are 5 pairs of subventral tufts each with 3 simple branches. All the subventral tufts are at least twice the diameter of the siphon at the point of attachment, and none of them are situated proximal to the pecten. Anal segment with complete saddle which bears small spines distally. Upper and lower caudal setae both single. Lateral seta 4-branched, much shorter than the saddle. Ventral brush composed of 4 pairs of 6-branched tufts. Gills missing."*

Breeding-places not recorded; doubtless in ground pools.

Culex (Mochthogenes) simpliciforceps Edwards.

The larva apparently comes nearest to that of *inconspicuosus*, from which it is most readily separable by its having head-seta B 4-branched. It has been described by Lewis (1945) from Sudan material consisting of whole larvae, and by de Meillon, Parent and Black (1945) from 5 pelts from the Belgian Congo. The description given below is that of the latter authors, with points from Lewis's description added in parentheses.

"*Head.*—Antenna spiculate. Tuft at about $\frac{7}{9}$ (well over $\frac{2}{3}$) consisting of 26 sparsely plumose branches. Head seta A with about 8 plumose branches; seta B with 4 branches which do not reach the anterior border of the head; seta C simple, with 1–2 branches about as long as B; seta *d* small, delicate, single. Mentum with 5 teeth on each side of the central tooth, which is not much longer than the lateral teeth.

Abdomen.—Comb of about 24 narrow scales which are fringed apically (30–35 teeth which anteriorly are scales and posteriorly are larger spines—Lewis). Siphon sometimes with a well-marked median dark band, and with index 4·1. Pecten of 10 closely set spines with delicate denticles along the whole ventral side. The pecten spines do not reach the middle of the siphon. There are five pairs of subventral tufts each with 3 simple branches, some of which are $1\frac{1}{2}$ times the diameter of the siphon, and others just a little more than the diameter of the siphon at the point of attachment. Anal segment with complete saddle, the distal portion of which is slightly spiculate. Upper caudal seta 2-branched, the upper branch being about $\frac{1}{2}$ the length of the lower branch. Lower caudal seta single. Lateral seta very near the distal margin and with 4 branches which are very short and slender. Ventral brush with about 6 pairs of tufts, one of which appears to be proximal to the barred area (2 small single or double setae proximal to the barred area–Lewis).

Breeding-places.—" Swampy edge of the Jebel Auliya Reservoir (White Nile) " (Lewis, *in litt.*). The breeding-place of the material from the Belgian Congo is not recorded.

Culex (Culex) poicilipes Theobald. (Fig. 163.)

The shape of the siphon, coupled with the possession of a comb of less than 10 spines, is completely diagnostic.

* The only specimen available to me has 8 teeth on either side of the central tooth of the mentum, proximal subventral tufts of siphon bifid and, apparently, 5 pairs of tufts in the ventral brush.—P. F. M.

Length about $8\frac{1}{2}$ mm. ; *colour* usually olive-green with indistinct brown bands, head and siphon pale brown ; much darker (brown) forms also occur.

Head unusually broad (breadth : length as 1·4 : 1). Antenna with tuft at about $\frac{2}{3}$, composed of about 30 strongly plumose branches. Seta A coarsely plumose, with about 10 branches ; B and C finely plumose, each with 3–5 branches, but those of C much longer than those of B ; *d* minute, usually 2-branched ; *e* and *f* minute and multiple. Mentum very small, with 6–7 teeth on each side of the centre.

Abdomen.—Comb a single row (sometimes very irregular) of 7–8 strong spines with fringed bases. Siphon of a very characteristic shape, distinctly bent upwards near the apex, index $3\frac{1}{2}$–4 ; valves unusually large ; the four pairs of subventral

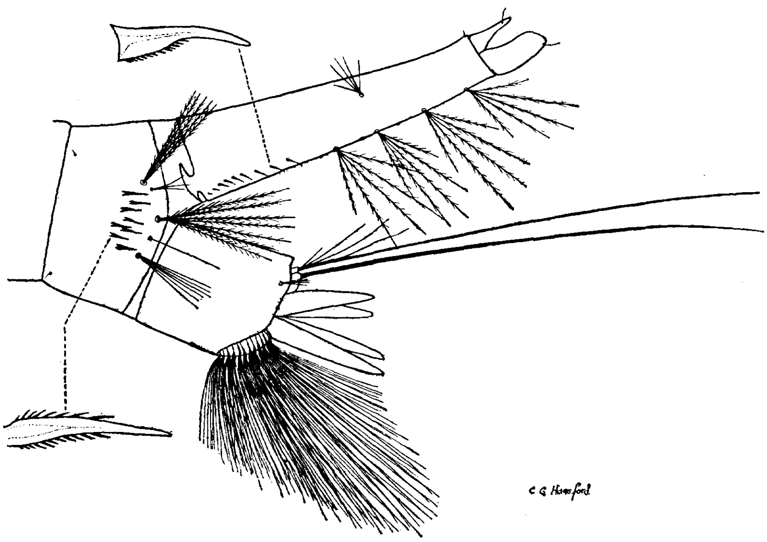

FIG. 163.—*Culex* (*Culex*) *poicilipes* Theo. Terminal segments. The shorter branches of the upper caudal seta arise from the base, not as shown.

tufts each consist of 5–7 plumose branches, which are considerably longer than the diameter of the siphon ; subdorsal tuft conspicuous, with 4–5 simple branches ; pecten extending to about $\frac{1}{3}$, composed of 8–10 spines with numerous small basal denticles. Anal segment with a complete saddle ; upper caudal seta with 5–6 branches, of which the most dorsal are very short, whereas the most ventral is almost as long as the single lower caudal seta ; lateral seta very small, but with about 5 branches. Ventral brush of 6 pairs of multiple tufts. " Gills " fusiform, ventral pair nearly length of saddle, dorsal pair distinctly shorter.

Breeding-places and habits.—Borrow-pits, ditches, pools in swamps, stagnant or semi-stagnant pools in river beds. Water generally clean, and almost always with vegetation growing in it. MacGregor (1927) makes the very interesting observation that where the water is exposed to direct sunlight and contains much submerged living vegetation the larvae may adopt subaquatic respiration, applying the tip of the siphon to the bubbles of oxygen formed by the vigorous transpiration of the plants and remaining thus for some hours without coming to the surface.

Culex (Culex) bitaeniorhynchus Giles.

The larva which I formerly attributed to the present species is definitely that of *ethiopicus,* but according to Edwards (1920) the larvae of the two species appear to be indistinguishable.

Breeding-places.—Apparently not different from those of *annulioris,* the larvae being usually found lurking in masses of green algae. (Briscoe, 1950, gives records from hollow tree-trunks.—P. F. M.)

Culex (Culex) ethiopicus Edwards. (Fig. 164.)

The larvae of *bitaeniorhynchus, ethiopicus, aurantapex* and *annulioris* are extremely similar to one another, but may very readily be distinguished from any other known *Culex* larvae by the very regular shape of the mentum, and the fact that no teeth are discernible on its margin except by the use of high magnification. That of the

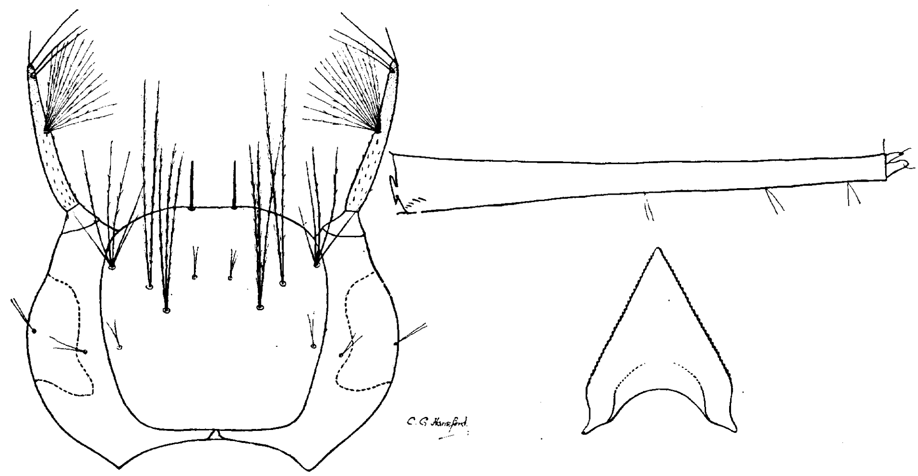

FIG. 164.—*Culex (Culex) ethiopicus* Edw. Head, siphon and mentum.

present species is perhaps separable from those of *aurantapex* and *annulioris* by the head-chaetotaxy; head-seta *e* is nearly always 2-branched (rarely 3-branched) and head-seta *f* usually has fewer branches than in *annulioris* (2–5, average about 3). The subventral tufts of the siphon have been found (Lewis, 1945) to be too variable to be of value in distinguishing the larva; they are normally double or triple but may be single or 4-branched (in the latter case with two of the branches minute).

Breeding-places.—In Kampala the breeding-places are apparently similar to those of *annulioris* and *bitaeniorhynchus.* Lewis (1943*b*) mentions finding larvae "in a pool in a hill stream and in a swamp."*

Culex (Culex) aurantapex Edwards.

The writer has seen only two skins of this species, one of the typical form from Nairobi, Kenya, and the other of the melanic variety from Jinja, Uganda. He is

* Abbott (1948) gives records from a rock-pool fed by a spring and from the edges of streams.—P. F. M.

unable to find any difference between these skins and the larva of *annulioris*. The siphonal index of the Jinja specimen is 7.

Breeding-places.—Records are few, but appear to differ little if at all from those of *annulioris*. Ingram and de Meillon bred specimens from a large swamp in South Africa, and the writer has bred them from swampy pools of clear water with a somewhat high organic content in Kenya, and from swamps bordering Lake Victoria in Uganda ; in this latter case, also, the organic content was moderately high.

Culex (Culex) annulioris Theobald. (Fig. 165.)

This larva is possibly distinguishable from those of *bitaeniorhynchus* and *ethiopicus* by the characters mentioned under the latter species. It seems to be inseparable from that of *aurantapex*.

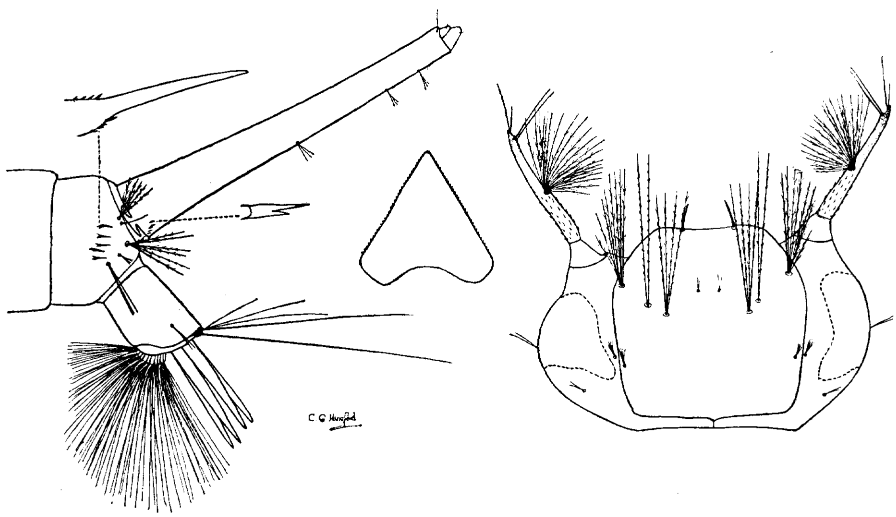

FIG. 165.—*Culex* (*Culex*) *annulioris* Theo. Head, terminal segments and mentum.

Length about 9 mm. ; *colour* bright green to olive.

Head.—Antenna with tuft at or slightly before $\frac{1}{2}$, composed of about 25 sparsely plumose branches. Setae A, B and C sparsely plumose, A with 5–7 branches, B double, C 3–4-branched; *d* minute, double; *e* and *f* minute, each with about 6 branches. Mentum an equilateral triangle with very numerous minute teeth; these teeth are not visible at low magnifications ($\frac{2}{3}$ in. objective), and the mentum then appears smooth.

Abdomen.—Comb an irregular row of 4–6 large spines, delicately fringed at the base. Siphon moderately long, index variable; most specimens I have seen have an index of about 6–7, but Macfie and Ingram (1916*a*) record an index of 10, and I have seen specimens approaching this figure ; pecten an oblique row of 5–7 spines with large basal denticles ; 3 pairs of alternating subventral tufts, each with 3–4 simple branches, which are shorter than the diameter of the siphon ; the subdorsal tuft is represented by a rather stout single seta near the apex. Anal segment with a complete saddle ; upper caudal seta with 3–4 branches, lower single ; lateral seta single or double, about $\frac{1}{3}$ length of saddle. Ventral brush with about 6 pairs of tufts composed of numerous simple branches. "Gills" subequal, slightly longer than saddle. The variety *consimilis* Newst. appears not to differ.

Breeding-places.—Always in clean water containing masses of filamentous algae, among which the larvae lurk. Given these conditions the breeding-places vary considerably, and include ditches, water-holes, pools (including rock-pools), slow-running streams, and grassy swamps. Dalziel records larvae twice from wells.

Culex (Culex) giganteus Ventrillon.

Larva and breeding-places unknown. Probably breeds in ground pools among filamentous green algae.

Culex (Culex) sitiens Wiedemann.

I have seen no definitely-identified Ethiopian material of this species, but comparison of two whole larvae (labelled *C. thalassius*) from Dar-es-Salaam with a skin of *sitiens* from India leaves no doubt that the Dar-es-Salaam larvae are those of *sitiens*.

The larva closely resembles that of *thalassius*, differing in having a comb consisting of only about 35 scales and a siphonal index of from 2 to $2\frac{1}{2}$, but a variety collected on the coast of the Red Sea has a much longer siphon, with the index 4·5–5·9 ; in this variety head-setae B and C have 4–7 and 6–9 branches respectively. The adults from these long-siphoned larvae were of the variety described, but not named, by Edwards (1941, p. 298).

Breeding-places.—The species is recorded to occur occasionally in boats and canoes (Dalziel), in cesspits (McHardy, 1927) and in sea-water at Port Sudan (Balfour, 1921). G. R. C. van Someren (1943) found larvae in almost pure sea-water in a slit-trench on the foreshore at Berbera, and in the brackish water of brick-pits. The records of MacGregor (1927) of *thalassius* from Mauritius must refer to the present species ; he found larvae to be confined to the coastal marshes, and to prefer those in which the water was somewhat foul from the decomposition of vegetable matter.

Outside our region the species is known to breed for the most part in brackish water, but is also at least sometimes found in water without any trace of salt.*

Culex (Culex) thalassius Theobald. (Fig. 166.)

This larva is very similar to that of *C. sitiens*, but differs in having a longer siphon, and about 65 as against about 35 comb-scales ; in the form of *sitiens* found on the Red Sea coast only this latter character holds good. It might also be confused with that of *C. mirificus*, but the latter has the dorso-apical angle of the saddle smooth and only 9–10 pecten-spines. It is easily separated from *laticinctus* by the fact that all the subventral tufts of the siphon are placed distal to the pecten.

Length about 8 mm. ; *colour* not recorded.

Head.—Antenna spiculate, rather short and straight ; tuft of about 20 plumose branches at about $\frac{3}{5}$. Setae A, B and C all plumose, A with about 8 branches, B and C

* Lever (1944) found larvae in undiluted sea-water in concrete tanks in Fiji. Mara in Jannone *et. al* (1946) gives records from waters with chloride contents of 0·13–4·09 %.—P. F. M.

with 3–4 and 4–5 branches respectively; *d* long and single; *e* and *f* each with about 3 branches. Mentum with about 7 stout teeth on each side of the centre.

Abdomen.—Comb a patch of 60–70 narrow scales (not, in any of the specimens I have seen, so narrow as shown in the figure and with a more extensive fringe

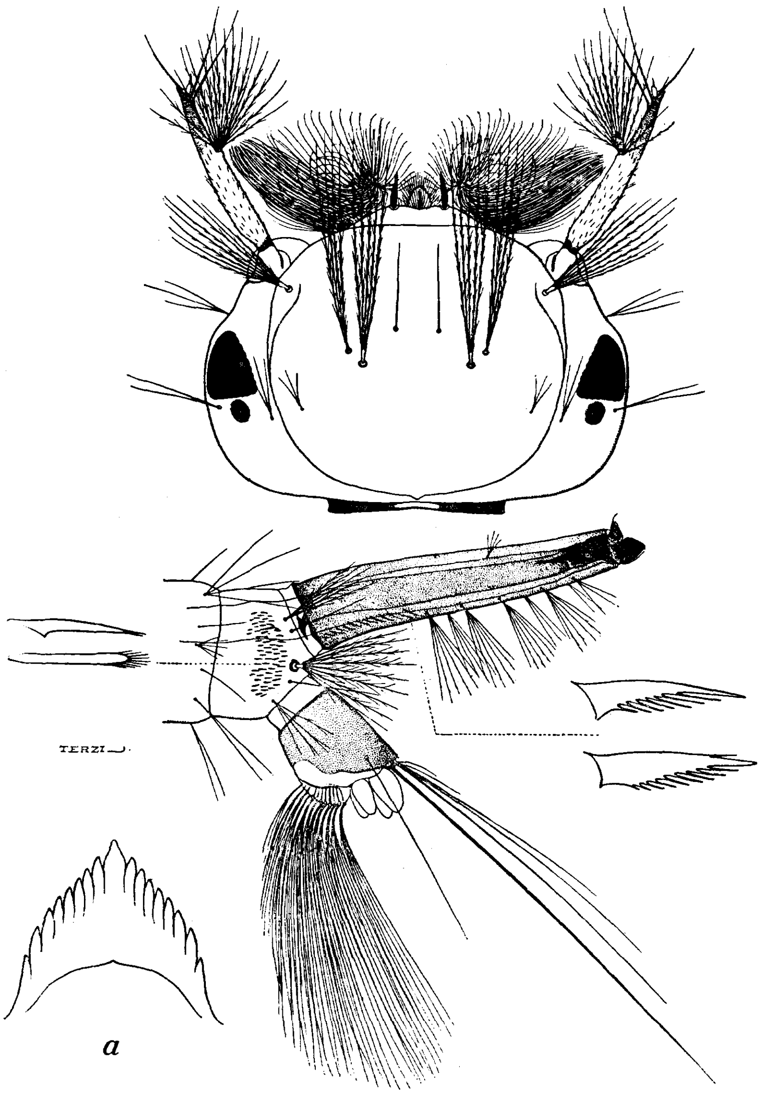

FIG. 166.—*Culex* (*Culex*) *thalassius* Theo. Head and terminal segments. *a*, mentum.

than those depicted). Siphon with index about 5; pecten extending to about $\frac{1}{3}$ and composed of 12–16 spines, each with numerous small basal denticles; 4–5 pairs of subventral tufts, each with about 8 very slightly plumose branches, which are decidedly longer than the diameter of the siphon, are all placed beyond the pecten;

a small subdorsal tuft of about 3 simple branches is placed at about $\frac{3}{5}$. Anal segment with a complete saddle, the dorso-apical angle of which is spiculate; upper caudal seta with about 4 branches, lower single; lateral seta long and single, nearly twice length of saddle. Ventral brush composed of 6 or 7 pairs of multiple tufts. "Gills" very short, rounded, dorsal pair little more than $\frac{1}{3}$ length of saddle, ventral slightly smaller.

Breeding-places and habits.—Theobald states that the type-series was bred for the most part from a drain of tidal water, others from a pool in a mangrove swamp, a canoe on the foreshore and a pool of tidal water in a drain. Ingram and Macfie (1917) summarize the breeding-places and habits as follows: "The larvae appear to be unusually adaptable. They have been found flourishing in a variety of situations such as a brackish lagoon, crab-holes, foul-smelling water-holes, earth drains, pools of various sorts, an iron pot, and a spring." They were found in "a lagoon, the water of which contained 680 parts of chlorine per 100,000. The larvae were distributed along the edge in the shallow water, but did not frequent the deeper parts. They occurred singly, drifting with the wind-swept water, and were very readily alarmed, when they sank at once to the bottom. The water in which they flourished was exposed to the full glare of the sun and was quite hot." Dalziel found larvae occasional in crab-holes and in canoes and boats.

Culex (Culex) tritaeniorhynchus Giles.

This larva somewhat resembles a number of others having a comb of numerous scales and a siphonal index of about 8, but may readily be separated from all of them except *macfiei* by the obviously greater length of the branches of the subventral tufts of the siphon. *C. macfiei* differs in its very dark siphon and differently shaped pecten-spines.

Length about 7 mm.; *colour* drab, often with transverse dark bands.

Head.—Antenna spiculate, spicules not confined to portion of antenna proximal to tuft; tuft of about 30 coarsely plumose branches at or slightly before $\frac{2}{3}$. Setae A, B and C plumose, with 6–8, 2 and 3 branches respectively, A originating from a distinct flattened base like the handle of a fan; *d* single, *e* and *f* with 3–4 branches. Mentum with 6–8 teeth on each side of the centre.

Abdomen.—Lateral setae of segments III–VI 2-branched. Comb a patch of 35–40 rather dark-coloured scales. Siphon tapering regularly from base to apex, index about 8; pecten of 9–13 spines extending to nearly $\frac{1}{3}$; individual spines long and narrow, with numerous (5–9) small denticles which extend nearly to the apex of the spine; the 4–5 pairs of subventral tufts are each composed of 3–4 simple branches about $1\frac{1}{2}$ times as long as the diameter of the siphon; the subdorsal tuft consists of 2–3 branches, which are shorter than those of the subventral tufts. Anal segment with a complete saddle, which is little longer than broad and is rather finely spiculate at the dorso-apical angle; upper caudal seta with 3 long branches and 1–2 very short ones; lateral seta with 2–4 short fine branches. Ventral brush of 6 pairs of tufts, each with about 8 branches. "Gills" subequal.

Breeding-places and habits.—Though the species appears to be confined to coastal regions, the larvae do not seem to be particularly halophilous; Ingram (1919) records them from stagnant pools in a stream bed; Ingram and Macfie (1917) found them in large numbers in a temporary swamp, particularly where water had submerged a narrow path through the grass, and also mention obtaining them in a large water-hole, the water of which contained 18 parts of chlorine per 100,000. MacGregor (1927) records them in Mauritius from marshes along the coast, and mentions a habit which they share with *C. univittatus* (see p. 293).

Culex (Culex) ventrilloni Edwards.

Larva and breeding-places unknown. Likely to breed in ground pools.

Culex (Culex) duttoni Theobald. (Fig. 167.)

The strongly biconvex shape of the siphon is only paralleled in *pruina* and *philipi*, in both of which the subventral tufts of the siphon have numerous branches. The larva of *watti* is apparently not distinguishable from that of the present species.

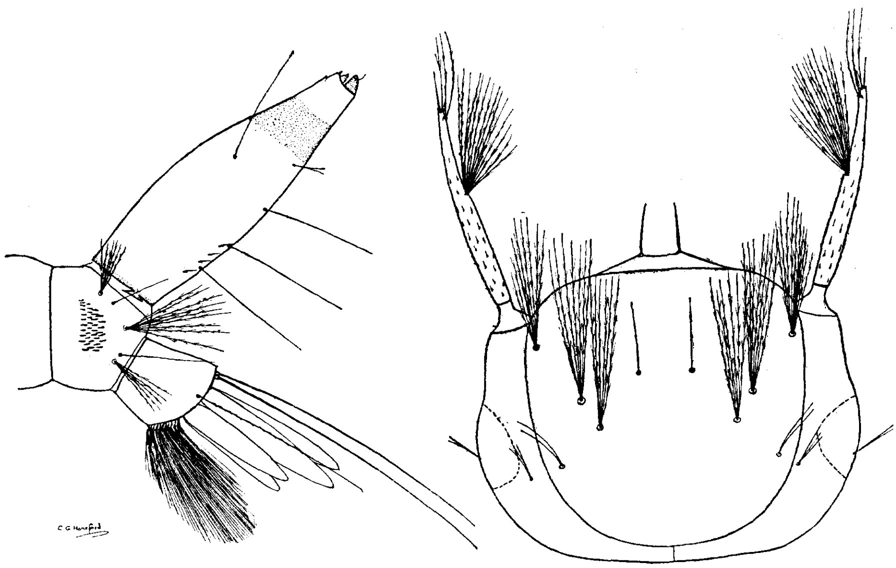

FIG. 167.—*Culex* (*Culex*) *duttoni* Theo. Terminal segments.

Length about 9 mm.; *colour* pale grey brown, siphon pale, but with a characteristic conspicuous broad, dark band (sometimes faint) near the apex; apex and valves usually dark.

Head.—Antenna spiculate, curved, a little more than half length of head; tuft of about 20 plumose branches at $\frac{2}{3}$. Setae A, B and C plumose, A with about 8, B and C each with about 6 branches; *d* small, single; *e* double, both simple. Mentum with about 16 small teeth on either side of the centre.

Abdomen.—Comb of about 40 scales, arranged in fairly definite rows. Siphon with markedly convex sides, widest at about $\frac{1}{3}$, index about $4\frac{1}{2}$; pecten very feebly (and variably) developed, consisting of 3–6 rather small denticulate spines. Subventral tufts represented by 3 pairs of alternating long single setae, and one much smaller 2- or 3-branched tuft placed just before the dark pre-apical band; the subdorsal tuft is a long single seta; just before the apex on the dorsal side is a rather prominent chitinous tooth. Anal segment with complete saddle; caudal setae both single; lateral seta subplumose, single, twice length of saddle. Dorsal "gills" twice length of saddle, ventral $\frac{4}{5}$ length of dorsal.

Breeding-places.—Borrow-pits, ditches, holes in swamps and rock-pools; the water more commonly muddy than clear and often foul from organic matter; vegetation may be present in the water but is more usually absent. There are many records of larvae in barrels, native pots, etc., but breeding in such places seems to be very uncommon in Uganda. The explanation is perhaps furnished by Harris (1942), who notes that occurrence in "cement and iron water-tanks . . . and in rock-pools green with rotting vegetation" took place in the dry season, which suggests the possibility that *duttoni* normally only uses small containers when ground pools are scarce.

Culex (Culex) watti Edwards.

Larva and breeding-places apparently indistinguishable from those of *duttoni*.

Culex (Culex) argenteopunctatus Ventrillon. (Fig. 168.)

All the available information refers to ssp. *kingi* Theobald.

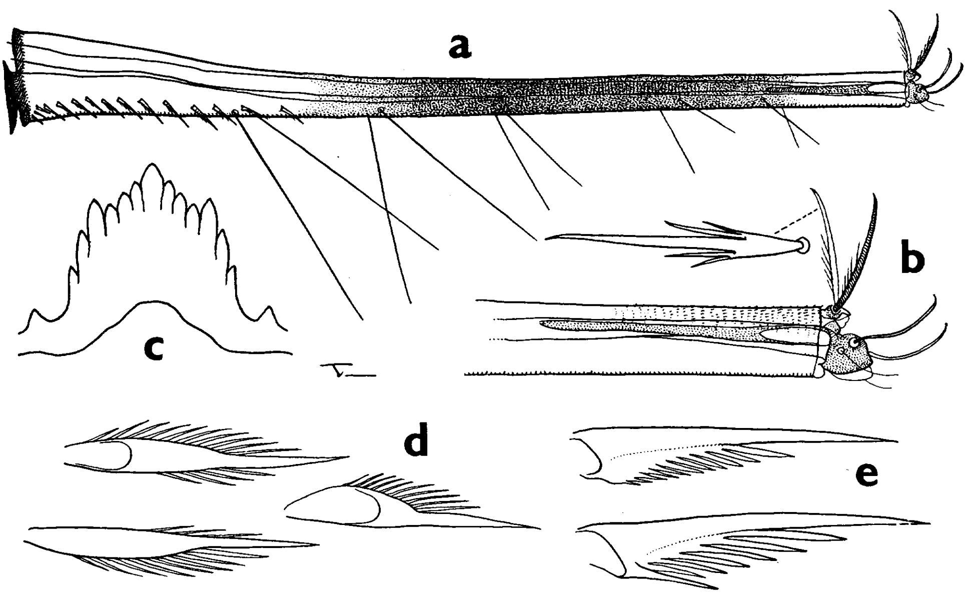

FIG. 168.—*Culex (Culex) argenteopunctatus* Ventr. Larval details. *a*, siphon. *b*, tip of siphon enlarged. *c*, mentum. *d*, comb spines. *e*, pecten teeth.

The larva is immediately separable from that of any other known species by the extraordinary form of the spine on the dorsal valve of the siphon. The description given by Edwards (1941, p. 433) has been slightly supplemented with the aid of a few whole larvae from Entebbe, Uganda.

Head not very dark. Antenna blackened from just before the tuft of about 20 coarsely plumose branches at about $\frac{5}{8}$; subterminal bristles of antenna close to tip, equal in length to the longer of the two terminal bristles, and about $\frac{2}{3}$ as long as the whole antenna. Setae A, B and C plumose, A 7-branched, B and C usually 2-branched but occasionally single. Mentum with the sublateral teeth unusually prominent.

Abdomen.—Long lateral setae mostly double. Comb a patch of about 15 spines with delicate fringe on basal half. Siphon pale at base and tip but remainder very dark, index 8–12, fairly stout on the basal fourth but with the distal $\frac{2}{3}$ or more very slender and almost parallel-sided; pecten hardly reaching beyond $\frac{1}{3}$ of siphon, composed of 10–15 pale-coloured spines of which the most distal is usually wider spaced, and which each have about 6–8 small fine denticles extending most of their length; spine on dorsal valves unusually long and stout, with several short branches towards base; ventral valves with the hook rather long and strong; subventral setae all single, the first two pairs very long, other two or three pairs short. Anal segment short, saddle normal; upper caudal seta double, lower single; lateral seta short, single or double. About 6 tufts in the ventral brush. Dorsal pair of "gills" very long, lanceolate; ventral pair missing in all the available material.

Breeding-places.—Ground pools.

Culex (Culex) theileri Theobald. (Figs. 169, 170.)

C. theileri can be distinguished from the few other species of *Culex* with a comb consisting of *spines* by the siphonal index and the size of the subventral tufts of the siphon. The curved shape of the pecten-spines is very characteristic.

The description given below is drawn up mainly from skins and whole larvae

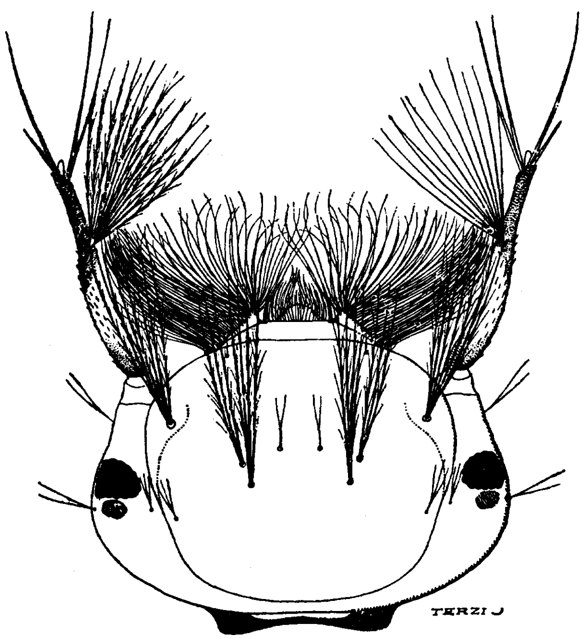

FIG. 169.—*Culex (Culex) theileri* Theo. Head.

from various parts of the Oriental and Palaearctic regions. Four skins from Kenya (Nairobi) differ in a few respects which are noted below.

Length about $8\frac{1}{2}$ mm. ; *colour* " light " (Bedford, *l. c.*).

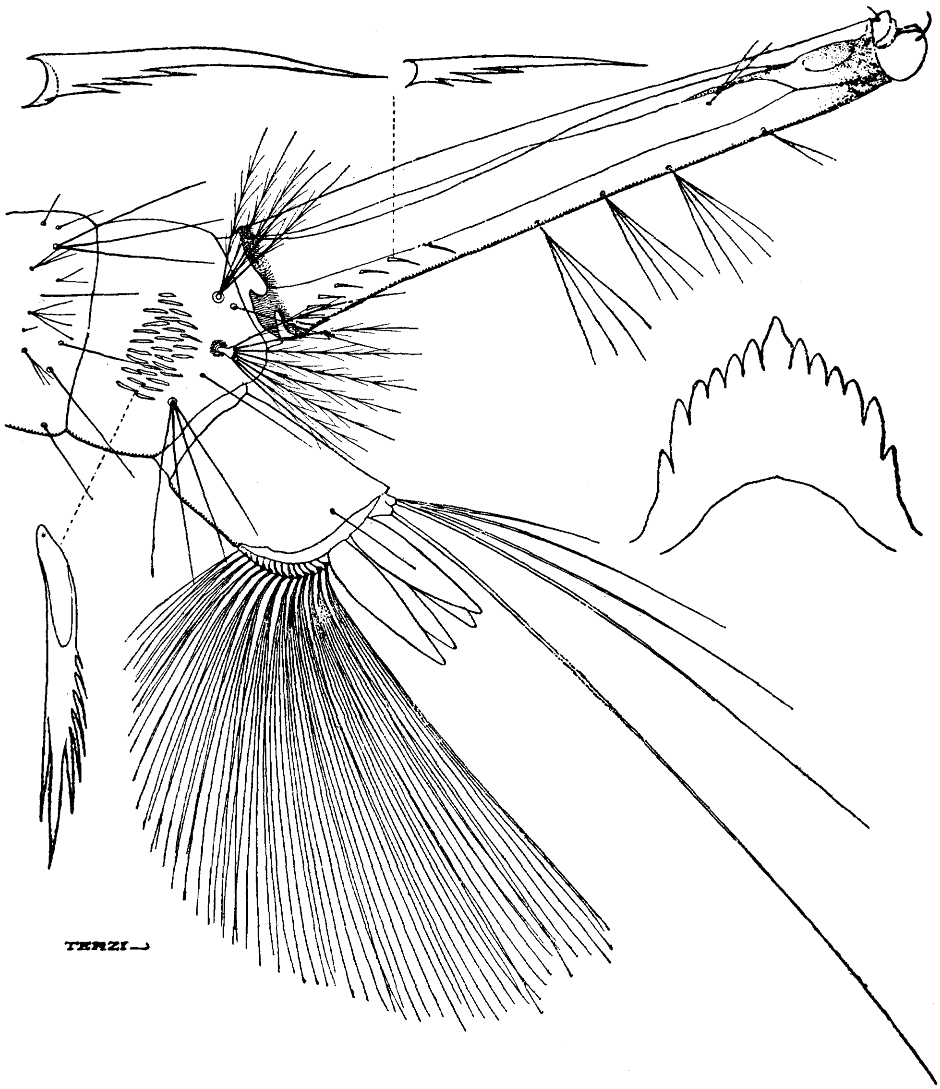

FIG. 170.—*Culex* (*Culex*) *theileri* Theo. Terminal segments and mentum.

Head.—Usually more or less extensively dark towards the base. Antenna spiculate, infuscate at base and beyond tuft ; tuft of about 20 plumose branches at about $\frac{3}{5}$. Setae A, B and C plumose, with about 8, 3 and 3–4 branches respectively (B and C with 2 and 2–3 branches respectively in the Nairobi larvae) ; *d* small, bifid from beyond base. Mentum with about 6 coarse teeth on each side of the centre.

Abdomen.—Comb a patch of about 30 spines, in most cases with the disparity in size between the terminal denticle and the lateral and basal denticles more marked than in the specimen figured. Siphon with index about $5\frac{1}{2}$–6 ; pecten of 6–9 spines extending to a little beyond $\frac{1}{3}$: more distal spines long, curved (often much more so than in the specimen figured), and with only 1 or 2 small basal denticles ; the 4–5 pairs of subventral tufts are conspicuous, and each, except the most distal, consists of about 4 simple branches, which are slightly longer than the diameter of the siphon (these tufts with up to 12 branches in the Nairobi larvae) ; a small subdorsal tuft is placed at about $\frac{7}{10}$. Anal segment with a complete saddle ; upper caudal seta with about 4 branches, lower single ; lateral seta single (with 2–3 branches in the Nairobi larvae) ; ventral brush with about 7 pairs of multiple tufts. "Gills" subequal, lanceolate, slightly shorter than saddle.

Breeding-places.—Bedford (1928) records larvae from pools, dipping-tanks, and stagnant or slowly-flowing streams ; Ingram and de Meillon found them in similar places, and add ditches, drains and backwaters of rivers, while Nieschulz, Bedford and du Toit record them abundantly in the edges of backwaters of a river and in a large variety of pools, both permanent and temporary ; Lewis (1943*b*) found the species breeding in "weedy streams."*

Culex (Culex) univittatus (Theobald). (Figs. 171, 172.)

The larva greatly resembles those of *decens*, *tritaeniorhynchus* and *antennatus*. From *decens* it may be separated by its shorter siphon and the possession of 2-branched lateral setae on abdominal segments III to VII, from *tritaeniorhynchus* by the much

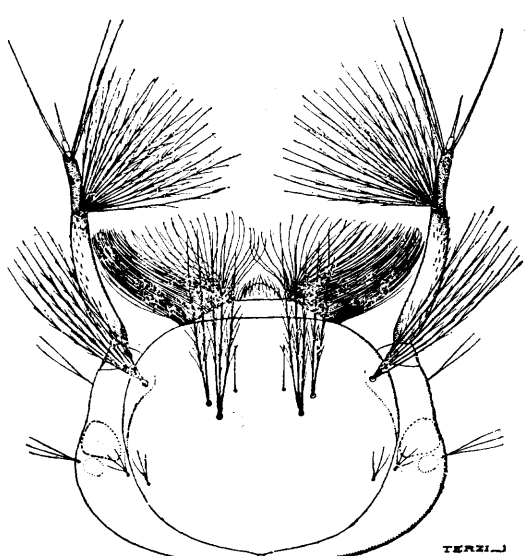

FIG. 171.—*Culex* (*Culex*) *univittatus* Theo. Head.

* Senevet (1947) gives details of variations in larval characters in different parts of its extensive range. He notes Kirkpatrick's statement that this species prefers fresh water but states that in North Africa it can adapt itself to strongly saline waters (up to 10 gm. per litre). Mara (1945) gives records from barrels and basins ("vasche scoperte") at about 7900 ft. on Mt. Bizen, Eritrea, in association with *Aëdes aegypti*, *Culex fatigans*, *laticinctus* and *trifilatus* and *Theobaldia longiareolata*.—P. F. M.

shorter siphon and the fact that the antennal tuft is placed beyond $\frac{2}{3}$, and from *antennatus* by the facts that in the latter species head-seta c is nearly always 2-branched and the pecten-spines have the basal denticles larger and fewer (2–3 against 3–5).

The larva described as that of the present species by Ingram and Macfie (1919)

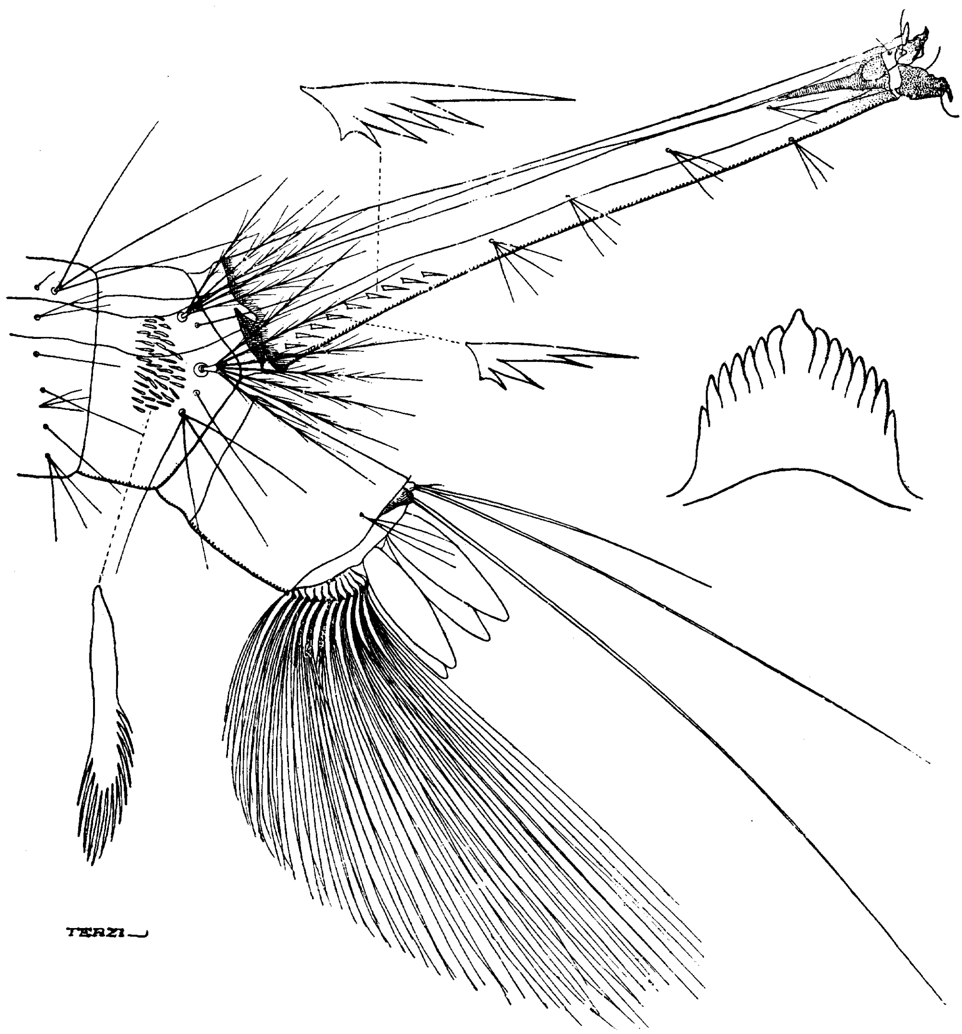

FIG. 172.—*Culex* (*Culex*) *univittatus* Theo. Terminal segments and mentum.

has now been re-discovered and proves to belong to *Aëdes ochraceus* ; the true larva of *univittatus* is that described from Palestinian material by Edwards (1921–22), from Egyptian material by Kirkpatrick under the name *perexiguus*, and from South African material by de Meillon (1928).

Length about 6 mm. ; *colour* drab, often with transverse dark brown or blackish bands.

Head.—Antenna infuscate at base and beyond tuft, spiculate proximal to tuft, spicules almost absent from inner aspect of antenna; tuft of about 25 plumose setae at about $\frac{3}{4}$. Setae A, B and C plumose, with 7–9, 2 and 3–4 branches respectively (the number of branches varies to some extent, but the arrangement described is much the most common); *d* single, *e* and *f* small tufts of several branches. Mentum with 7 teeth on each side of the centre.

Abdomen.—Lateral setae of segments III–VII 2-branched. Comb a patch of about 40 scales. Siphon with index usually about 7 (varying from 5·9 to 7·6 according to Kirkpatrick); pecten of 10–14 spines, each with 3–5 denticles, extending to a little beyond $\frac{1}{4}$, the most distal spine usually somewhat wider separated than the remainder; 3–4 pairs of subventral tufts, each with 3–4 simple branches which are variable in length, but commonly decidedly shorter than the diameter of the siphon; single pairs of similar lateral and subdorsal tufts are present. Saddle complete, slightly longer than wide, distal edge smooth; upper caudal seta with 2–3 branches, lower single; lateral seta with 2–3 branches, about $\frac{2}{3}$ length of saddle. Ventral brush composed of 6 pairs of 6-branched tufts. "Gills" variable in length, nearly equal, dorsal pair slightly longer than ventral.

Breeding-places and habits.—The breeding-places are varied, but are usually stagnant pools of various kinds. The larvae are most common in pools in marshy land and at the edges of swamps, but occur also in stagnant or semi-stagnant streams and ditches, borrow-pits, etc. Vegetation is usually present, but there is seldom dense shade.* MacGregor (1927) states of the larvae of this species and of *C. tritaeniorhynchus* that "when alarmed the larvae dive in the usual way, but, in a quite extraordinary way, after diving to various depths, they very often at once proceed to scurry in a horizontal direction through the water so that when the effort of their flight has ended, they are sometimes ten or more feet on one side or the other of their former point of suspension at the surface."

Culex (Culex) simpsoni Theobald. (Fig. 173.)

There appear to be at least two forms of the larva of this species, but the possession of a comb composed of 14 to 35 teeth most of which are *spines* will distinguish it from any other known species except *grahami* and *striatipes*, both of which have much longer siphons (index about 10–15).†

Of this species I have examined 5 whole larvae of the batch from which the synonym *richteri* Ingram and de Meillon was bred (from the Bagamuzi River, Zululand), 2 skins, and 3 whole larvae from Krokodilpoort (all somewhat badly damaged), and a number of whole larvae from Aldabra Island. These three batches differ in several particulars, but it seems probable that all are conspecific. Edwards (1941) suggests the possibility that some of them may be *terzii*, but there is no evidence that this is so. The following description is mainly from the Bagamuzi larvae.

Length not recorded; *colour* often greenish in life (MacGregor, 1927).

* Abbott (1948) records larvae from a concrete basin but does not say whether this contained vegetation or not. It is presumed that it did not. Senevet (1947) summarizes larval variations in the non-Ethiopian part of its range and states that, while this is mainly a fresh water species, larvae are occasionally found in saline waters in North Africa. Mara in Jannone *et al.* (1946) gives records from waters with chloride contents of 0·14%–0·65%.—P. F. M.

† Compare also *kingianus* (p. 255), *theileri* (p. 289), *seldeslachtsi* (p. 298) and *sinaiticus* (p. 295).—P. F. M.

Head.—Antenna spiculate, very dark at base and beyond tuft; tuft of about 25 plumose branches at $\frac{2}{3}$; terminal and subterminal setae all placed close together at apex, 3 of them equal and about $\frac{1}{3}$ length of antenna. Setae A, B and C plumose,

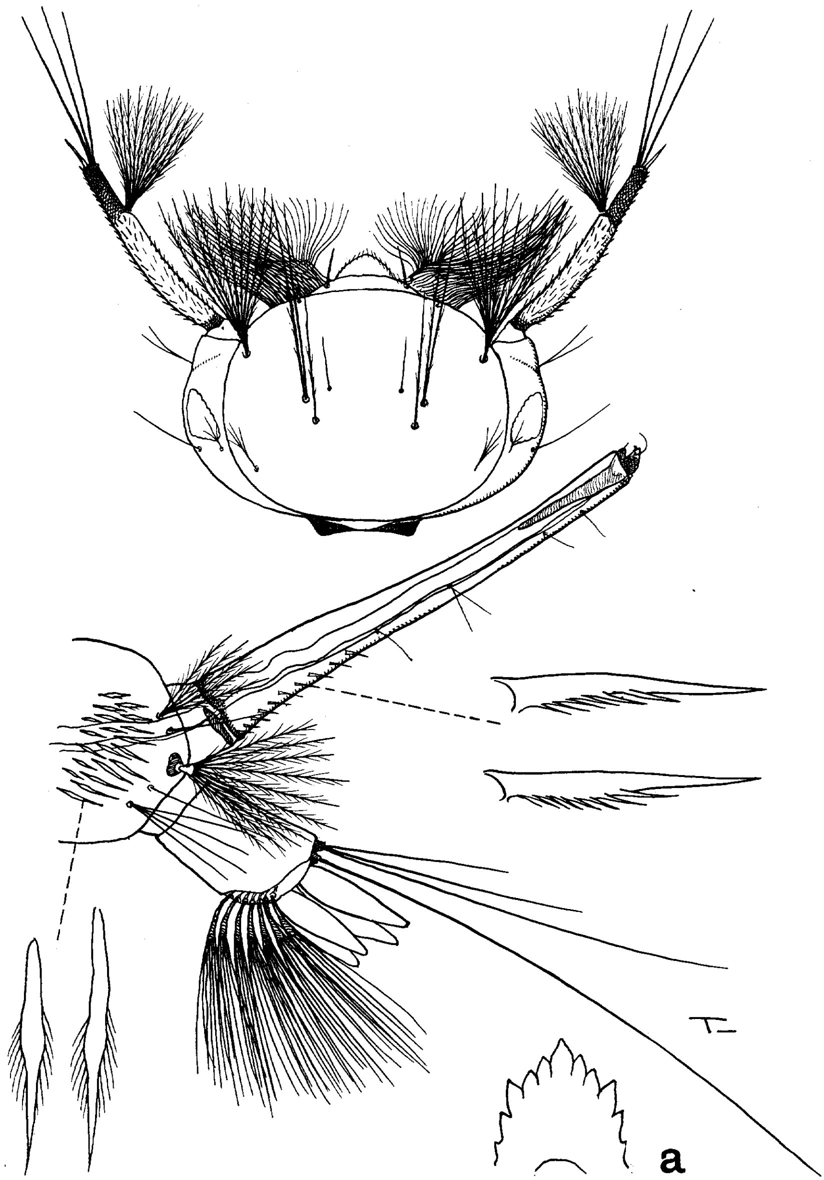

FIG. 173.—*Culex (Culex) simpsoni* Theo. Head and terminal segments. *a*, mentum.

A with about 8 branches, B and C 2-branched (in specimens from Kenya C is very often single and about $\frac{3}{5}$ the length of B); *d* very small, single. Mentum with 4 large teeth and 1 minute tooth on each side of the centre.

Abdomen.—Comb a patch of 14–25 rather small teeth which are mostly spines but of which some may be scales (30–35 teeth according to MacGregor, 1927). Siphon with index about 7; pecten not extending to $\frac{1}{3}$, composed of 8–11 (11–13, MacGregor, 1927) very long and delicate spines which are either simple or with 1 or 2 minute basal denticles; 5 pairs of subventral tufts, of which the most distal is single and the remainder with 3–4 simple branches which are twice as long as the diameter of the siphon (subventral tufts mostly lost in larvae from Krokodilpoort, but survivors distinctly shorter than diameter of siphon and with fewer branches; also short in MacGregor's figure and description). Anal segment with complete saddle; upper caudal seta 3-branched, lower single; lateral seta very delicate, double. Ventral brush composed of 6 or 7 pairs of many-branched tufts. "Gills" subequal, lanceolate, about as long as saddle (dorsal pair longer than ventral in MacGregor's description and figure).

Breeding-places.—Ingram and de Meillon record *simpsoni* from pools at the edges of rivers and in river-beds, a backwater of a small stream, the edges of a lake and of marshes, water-holes, rock-pools, a refuse pit, a dipping-tank for cattle, and collections of water on a tarpaulin; Bedford (1928) records it from rock-pools and from a tub containing rain-water, and McHardy (1929) mentions it from a small stream. MacGregor (1927) found larvae "in astonishingly large numbers" in ponds, roadside puddles and rivulets.

Culex (Culex) sinaiticus Kirkpatrick.

The larva of *sinaiticus* is distinguished from nearly all the other known species with which it might be confused by the combination of a rather long siphon, single head-setae B and C (seta B in *sinaiticus* is often double), and a comb composed partly of spines. These characters are more or less shared by *simpsoni* and *striatipes*, but in the former the pecten is much less extensive, and the latter has a much longer siphon.

Length about 8 mm.; *colour* yellowish brown, head yellow.

Head.—Antenna strongly spiculate, infuscate only at base and beyond tuft: tuft of about 30 plumose branches at or slightly before $\frac{2}{3}$. Seta A with 6–7 plumose branches; B and C slender and almost simple, B usually double, sometimes single, and rarely 3-branched, C single and about $\frac{2}{3}$ length of B; *d* 2-branched from beyond base; *e* and *f* small tufts of several branches. Mentum with 5 teeth on each side of the much larger central tooth.

Abdomen.—Comb a patch of more than 30 teeth of which the more distal are long, slender, basally-fringed spines and are much larger than the more proximal, which are mostly scales. Siphon with index about $6\frac{1}{2}$, basal half tapering rather sharply, apical half with almost parallel sides; pecten of 14–15 spines extending to about $\frac{2}{5}$, each spine with 8–10 small basal denticles; 3 pairs of subvehtral tufts, each with 2–3 branches (sometimes about 5 branches) which are a little longer than the diameter of the siphon; a small subdorsal seta near the tip. Anal segment with complete saddle; upper caudal seta with 1 long and 2 short branches, lower single; lateral seta 2-branched, about $\frac{2}{3}$ length of saddle. Ventral brush with about 9 pairs of multiple tufts. "Gills" lanceolate, dorsal pair about $\frac{3}{4}$ length of saddle, ventral pair somewhat shorter.

Breeding-places.—" In stagnant pools, both with and without water-weeds, and also in fast-flowing drains, even directly under miniature water-falls six or eight inches in height " (Kirkpatrick). Lewis (1943*b*) found the species breeding in streams and a well; G. R. C. van Someren (1943) in streams, wells and seepages in sand-rivers, with or without algae or higher vegetation.*

Culex (Culex) striatipes Edwards. (Fig. 174, 175.)

The very long siphon and the comb composed of spines give the present species a strong resemblance to *grahami* and immediately separate it from all other species except *kingi*; the latter differs in the unique structure of the spine of the dorsal

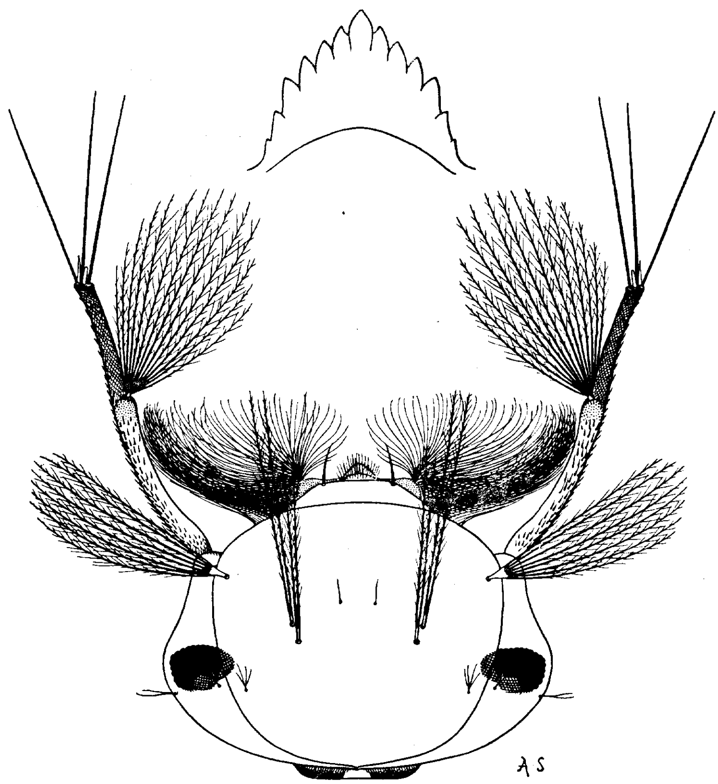

FIG. 174.—*Culex (Culex) striatipes* Edw. Head and mentum.

valves of the siphon. The most reliable differences between *striatipes* and *grahami* are given in the key (p. 247).

The larva is only known from two pelts, which are described (de Meillon, Parent and Black, 1945) as follows :

" *Head.*—Antenna strongly spiculate, very dark brown beyond tuft; tuft at about $\frac{2}{3}$ consisting of 28 plumose branches; head-seta A with eight strong, plumose

* Abbott (1948) found larvae at the edges of backwaters and swampy areas beside swift-running streams and, on one occasion, in a borrow-pit.—P. F. M.

branches ; seta B single or double, long, strong and plumose ; seta C 2-branched, plumose, as well developed as B ; seta *d* single, simple ; setae *e* and *f* small, branched. Mentum with one central tooth and 5 teeth on each side of the central one.

"*Abdomen*.—Comb of 10–14 spines of 2 distinct sizes, the ones in the proximal row being much smaller than those in the distal row. All the spines are heavily

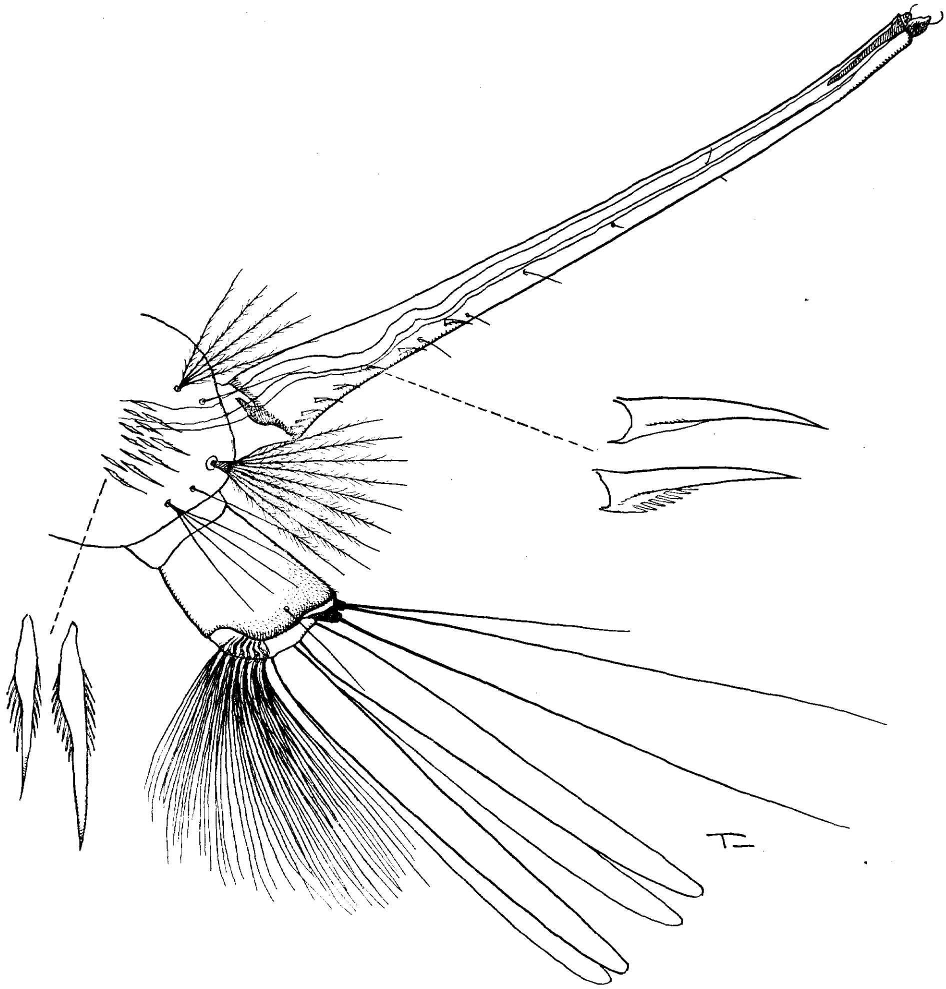

FIG. 175.—*Culex* (*Culex*) *striatipes* Edw. Terminal segments.

fringed basally. Siphon more or less straight-sided; apical half infuscated. Siphonal index 10·6. Pecten of 8 spines which are simple or with 1 small basal denticle. The spines are slightly curved and placed at increasing distances from one another. There are five subventral tufts which are small and single, the most proximal tuft being placed proximal to the last pecten-spine. Anal segment with complete saddle. Upper caudal seta double, one branch shorter than the other.

Lower caudal seta single. Lateral seta missing. Ventral brush composed of 6 pairs of tufts each with 9 branches which are simple. Gills missing."

Breeding-places not recorded.

Culex (Culex) seldeslachtsi Wolfs.

The following description is translated from Wolfs (1947*c*): "At first sight the larva is reminiscent of *C.* (*N.*) *kingianus* since the comb contains both scales and spines.

"*Head.*—The head is broader than long. Seta A has 10 plumose branches and its base is fan-shaped. Setae B and C are a little longer than A. They each have 2 plumose branches. C lies almost immediately behind B. Seta *d* is small and simple. Seta *e* is small and has 5 branches. *f* is a little smaller than *e* and also has 5 branches. The antennae are spiculate. The antennal tuft lies at $\frac{2}{3}$ and has about 30 plumose branches. The distal third and the base of the antennae are infuscated. The mentum has 4 teeth on each side of a central tooth.

"*8th segment.*—Seta A has 6 plumose branches. B has about 9–10 plumose branches C has 4 plumose branches. The comb is made up of about 10 scales and 18 spines. The spines are fringed at the base.

"*Anal segment.*—The upper caudal seta has 3 branches of which two are only half the length of the third. The lower caudal seta is simple and as long as the longest of the upper caudal setae. The gills are lanceolate, ending in a point. The dorsal gills are about the same length as the saddle and the ventral gills are nearly half this length. The saddle is complete. 7 tufts were counted in the barred area. There are some small spicules in the angle towards the dorsal edge of the saddle" (i.e. the postero-dorsal corner of the saddle as seen in side view, in the neighbourhood of the bases of the caudal setae.—P. F. M.). "The seta lies towards this edge and has 3 branches. It is small.

"*Siphon.*—Siphonal index about $4\frac{1}{2}$. The pecten has 14 spines with numerous secondary denticles. The distal spine in our specimen is a little wider spaced than the others. The subventral tufts are 2 in number and shorter than the diameter of the siphon. There are also 2 lateral tufts. These tufts have 2 branches."

Breeding-place.—"The larvae were found in a ditch with stagnant water at Costermansville, Belgian Congo."—P. F. M.

Culex (Culex) terzii Edwards.

Larva unknown unless the suggestion of Edwards (1941, p. 311) that the apparent great variability of the larva of *simpsoni* is possibly accounted for by confusion of these two species is well founded.

Breeding-places.—Bred from larvae found in a tub (Edwards, 1941).

Culex (Culex) laticinctus Edwards. (Fig. 176.)

This larva belongs to the rather difficult group which includes *pipiens*, *fatigans*, *andersoni*, and the larva formerly ascribed to *perfuscus* and now doubtfully referred to *perfidiosus*; it closely resembles the last-named in structure, but on account of its dark brown head and siphon could fairly easily be mistaken for *andersoni*. It differs from all the other members of the group in that the upper caudal seta has 4–6 branches, whereas in the others this seta is double or at most with 3 branches, and in the nearly mid-ventral position of the subventral tufts of the siphon (a

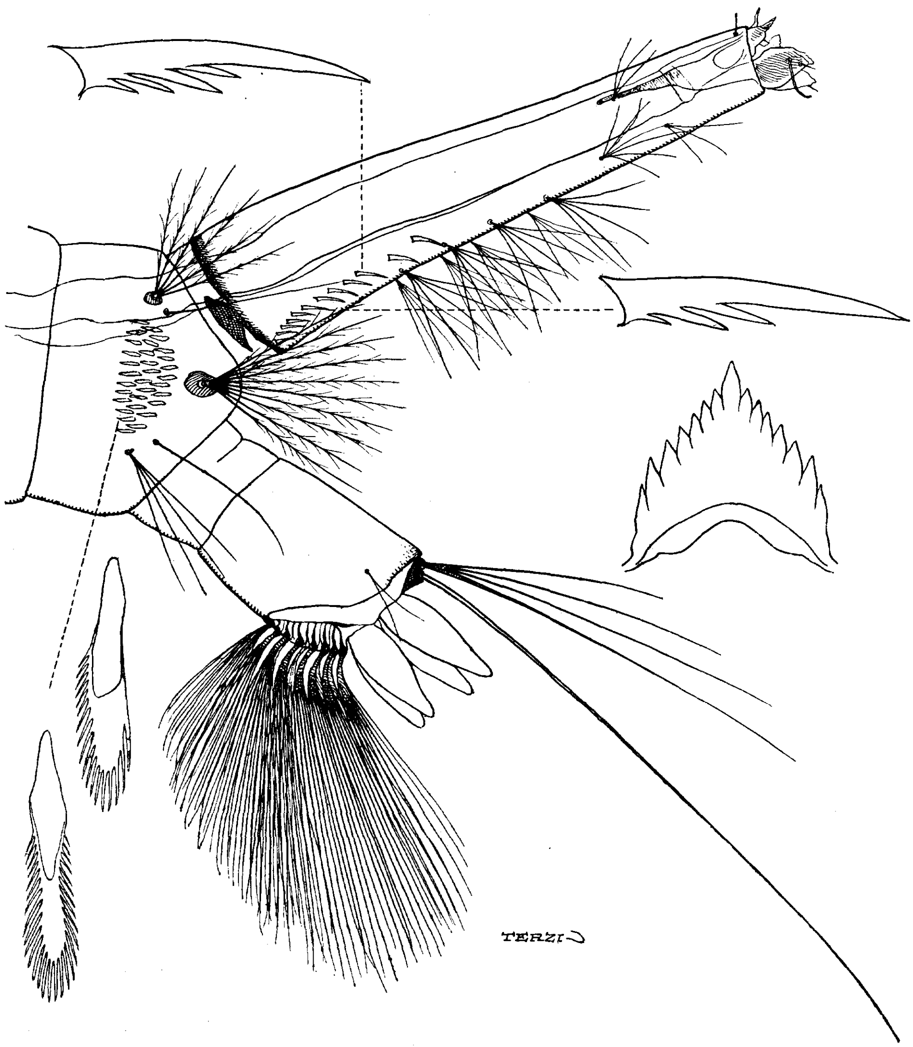

FIG. 176.—*Culex* (*Culex*) *laticinctus* Edw. Terminal segments and mentum.

character shared by *sitiens* and *thalassius*). The larva also has a close resemblance to that of *theileri*, but the comb of the latter is composed of spines.

Length about 8 mm.; *colour* pale, head and siphon dark brown, " gills " (according to Kirkpatrick) bright yellow.

Head.—Antenna strongly spiculate, basal part rather dark brown, portion beyond tuft darker; tuft of 35–40 plumose branches at $\frac{2}{3}$. Setae A, B and C plumose, A with about 10 branches, B 4-branched, C usually 4-branched, but sometimes with only 3 branches or with 5, placed almost directly behind B, but slightly internal to it; *d* single. Mentum with about 8 teeth on each side of the much larger central tooth.

Abdomen.—Comb a patch of about 35 coarsely-fringed scales. Siphon slightly concave dorsally and convex ventrally, index slightly over 4, pecten extending to slightly beyond ⅓, composed of 11–16 (usually 13) spines which are distinctly more curved than is usual and have usually 2–3 basal denticles, the most distal 2 or 3 often distinctly wider-spaced; 4 or 5 pairs of subventral tufts; the tufts of each side placed close together and very near to the midventral line are each composed of 7–8 simple branches about as long as the diameter of the siphon (the first 2 tufts well proximal to the distal pecten-spines); a small lateral tuft of 4 or more simple branches is placed in an almost subventral position near the apex, and a small subdorsal tuft is placed laterally at a point somewhat before it. Anal segment with nearly complete saddle, which is considerably longer than broad; distal edge of saddle almost smooth; upper caudal seta with 4 branches in the material available (Kirkpatrick records specimens with 5–6 branches), lower caudal seta single; lateral seta very small, with 2 or 3 branches. Ventral brush composed of about 7 pairs of many-branched tufts. "Gills" subequal, broadly lanceolate, usually about ½ length of saddle, sometimes rather longer.

Breeding-places.—Kirkpatrick states that the breeding-places are mainly in artificial pools, tanks and barrels in gardens; he records one instance of breeding at a point 70 miles from the nearest permanent dwellings, but suggests that the occurrence may have been due to transport of the larvae in a water-skin. Lewis (1943*b*) states that the species "breeds in drums, wells, tanks and pools in streams"; G. R. C. van Someren (1943) records larvae from a warm and somewhat saline spring, and from a deep well.*

Culex (Culex) pipiens Linnaeus. (Figs. 177, 178.)

This species is unlikely to be mistaken for any other except *andersoni*, *fatigans* and *tamsi*. From the former it is distinguished by the pale head and siphon and the absence of the "tooth" on the dorsal side of the siphon near the apex which characterizes *andersoni*. The differences from *fatigans* and *tamsi* are small, and are given in the descriptions of these species.

Length about 8 mm.; *colour* yellowish-brown, head and siphon not much darker.

Head.—Tuft of antenna composed of about 30 plumose branches placed at about ¾. Setae A, B and C plumose, with 8–10, 4–5 and 5–6 branches respectively; *d* rather long, single, *e* double, *f* with about 6 branches. Mentum with about 11 teeth on each side of the centre.

Abdomen.—Comb a semicircular patch of about 50 small scales. Siphon variable

* Abbott (1948) found larvae in concrete basins and in rock-pools fed by a spring. Senevet (1947) notes that in the non-Ethiopian part of its range the siphonal index is said to vary from about 3·5–4·5. Referring to North African larvae of *laticinctus* he observes that, like other desert species, it appears to be able to adapt itself to whatever sort of water is available so that it is found sometimes in very saline water (Callot) and at other times appears to prefer fresh (Kirkpatrick). Mara (1945) gives a record from a basin ("vasca scoperta") at about 7900 ft. on Mt. Bizen, Eritrea, in association with *Aëdes aegypti*, *Culex fatigans*, *theileri* and *trifilatus* and *Theobaldia longiareolata*.—P. F. M.

in length, index 4–6, usually $4\frac{1}{2}$; pecten composed of a very variable number of spines (9–18, but usually 12–14), none of the spines markedly wider spaced; usually 4 pairs of subventral tufts, the branches of which are nearly $1\frac{1}{2}$ times the diameter

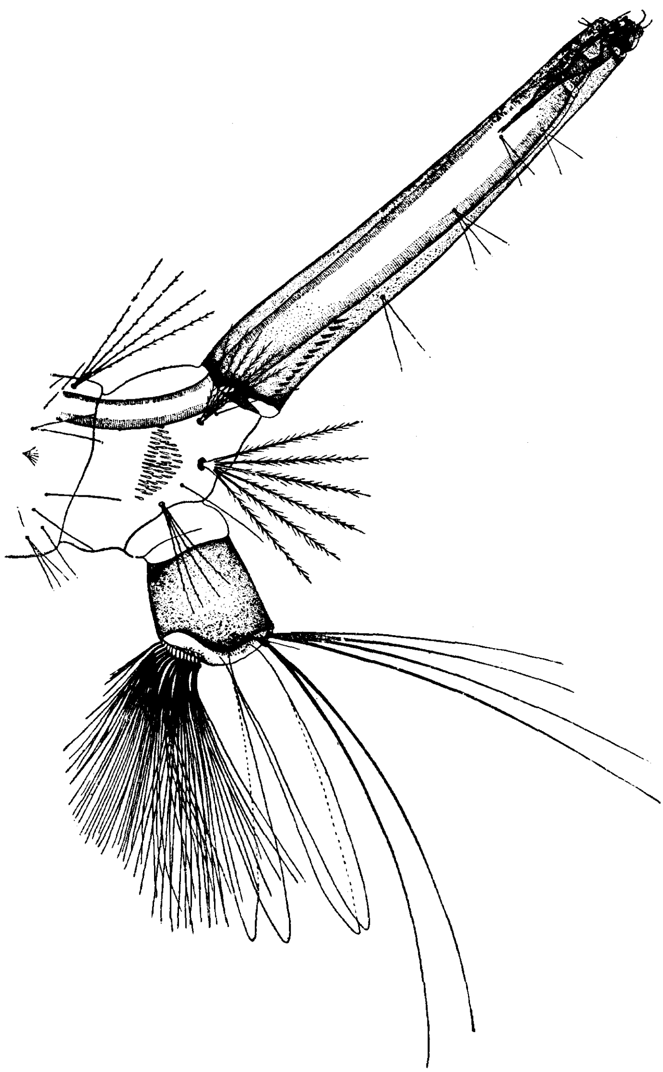

FIG. 177.—*Culex* (*Culex*) *pipiens pipiens* L. Terminal segments.

of the siphon. Anal segment with a complete saddle, surface rather sparsely and very minutely spiculate; upper caudal seta double or triple, lower single; lateral seta double or single. Ventral brush of about 12 pairs of many-branched tufts. "Gills" bluntly lanceolate, dorsal pair usually about $1\frac{1}{3}$ length of saddle, ventral slightly shorter.

Breeding-places.—This species has an immense range of breeding-places; it greatly prefers natural pools of all sorts, including borrow-pits, pools at the edge of swamps, ditches, temporary rain-pools, etc. The water may be clean or dirty, shaded or unshaded, but is perhaps more commonly dirty and unshaded, and almost invariably stagnant. The larvae have no objection to a high organic content in the water. They are found much less frequently in barrels, tanks, etc.; Hancock records the species from an old banana leaf lying on the ground, and Ingram and de Meillon from a tree-hole.

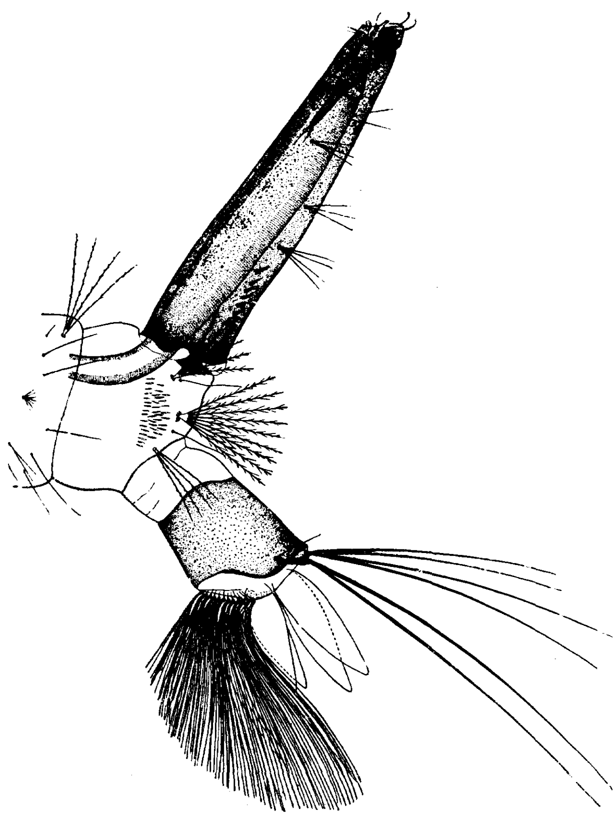

FIG. 178.—*Culex (Culex) pipiens molestus* Forsk. Terminal segments.

It is not at all clear to what extent variation in larval structure and in breeding-places is to be attributed to the presence of two forms of *pipiens* in some parts of Africa. Edwards (1941, p. 315) considered all African specimens that he had seen to be referable to true *pipiens* (the form which does not bite man) and not to *molestus* (the man-biting or autogenous form), which he treats as a species. Lewis (1945), on the other hand, identified certain mosquitoes occurring in the northern part of the Anglo-Egyptian Sudan as *C. pipiens molestus*, though noting that they differ somewhat from European specimens of this form. The position is still further complicated by the fact that crosses between the two forms (in Europe) are known to be fertile.

According to Jobling (1938), the fourth-stage larvae of *C. p. pipiens* (Fig. 177) and *C. p. molestus* (Fig. 178) differ in several characters, of which the most valuable are the shape of the siphon and of the "gills." In *p. pipiens* the number of teeth in the mentum is somewhat less than in *p. molestus* but with a considerable overlap. The siphon in *p. pipiens* is slender, gradually narrowing distally and with a slight sigmoid curvature which is much more marked near the base (where the ventral surface is concave and the dorsal surface convex); the index varies from 4·5 to 6·4, whereas in *p. molestus* the siphon is shorter and broader (index 3·5–4·8) and does not show the sigmoid curvature, its ventral side being similar to that of *pipiens* but the dorsal side almost straight. In *C. p. pipiens* the ventral valves of the siphon are roughly rectangular in lateral view and with a blunt apex, whereas in *C. p. molestus* they are more or less triangular with a rounded apex. The lever of the valves of the siphon narrows more or less uniformly towards the curved distal end in *p. pipiens*, but in *p. molestus* it narrows abruptly in two places and its narrow distal part is straight. The "gills" of *p. pipiens* are more than twice as long as those of *p. molestus* when both are bred in the same infusion, but the size of the "gills" in Culicine larvae varies so much with the type of water (see p. 21) that this would be of little value in natural conditions. Jobling's larvae of *C. p. pipiens* were from various English localities and his material of *C. p. molestus* from Britain, Palestine, Greece and Germany. He notes that, in Europe, true *pipiens* breeds in polluted water including cesspools, whereas *p. molestus* breeds in clean surface water.

The larvae collected by Lewis (1945) and attributed by him to *C. p. molestus* had siphonal indices varying from 3·6 to 5·3. Some of his larvae showed a slight sigmoidal curvature of the siphon, and in some (perhaps hybrids ?) the lever of the valves of the siphon was of the form found in *C. p. pipiens*. He found them in "the bilge-water of barges, in pit latrines and in pools" (including saline pools).*

Culex (Culex) bukavuensis Wolfs.

The following description is translated from Wolfs (1947*b*): "*Antennae.*—Shorter than the head and spiculate. They are infuscated at the base and on the distal third. The tuft, comprising about twenty-five plumose branches, is situated at $\frac{2}{3}$.

"*Head.*—Setae A, B and C have fan-shaped bases. A has 8–12 plumose branches. B with 4–5 plumose branches is a little longer than A. C has 4–6 plumose branches and is the same length as B. *d* is simple and short. *e* is minute and has 4 branches. *f* is double and longer than *e*.

"*8th segment.*—The comb has about 30 scales fringed on the sides and at the apex.

* Marshall (1938 and 1944) treats *molestus* as a distinct species. Roubaud (1945), in a detailed discussion of the problem, deprecates the use of the name *molestus*, preferring his own name of *autogenicus* which is accepted by some continental writers. For genetical work on the two forms see Tate and Vincent (1936) and Callot (1947). The latter author also gives "statistical" characters for separating larvae of the two forms. Senevet (1947), describing North African larvae of *C. pipiens*, gives the range of variation of the siphonal index as 3·3–4·8 which may indicate an admixture of *molestus*. The latter appears to be widespread in countries bordering on the northern shore of the Mediterranean and has been recorded from Italy, Malta and Greece as well as from central and northern Europe as far North as Stockholm. In Egypt the existence of a man-biting form of *pipiens* is well established and this is the topotypical *molestus*.—P. F. M.

Seta A has two lightly plumose branches. B has 5–6 plumose branches. C has 5 plumose branches.

"*Anal segment.*—The saddle is complete. The saddle hair is simple. The upper caudal seta is double, splitting just beyond the base. One branch is about $\frac{2}{3}$ the length of the other. The lower caudal seta is simple and as long as the longer of the upper caudal setae. 11 tufts were counted in the barred area. The dorsal gills are three times the length of the saddle and the ventral gills $2\frac{1}{2}$ times.

"*Siphon.*—The siphonal index is 3. The pecten has about 9 spines of which the most distal is a little wider spaced. The spines have 2–3 secondary denticles. The subventral tufts are 3 in number, shorter than the diameter of the siphon and with 8, 9 and 6 plumose branches respectively.

"*Mentum.*—Has 11 teeth on either side of a central tooth. The last of the 11 teeth is larger than those in front of it.

"*Breeding-place.*—A pool of more or less clear water on the banks of the River Kawa."—P. F. M.

Culex (Culex) fatigans Wiedemann. (Figs. 179, 180.)

Further work by Lewis (1943*b*, 1945) has shown that the larva of this species is even more difficult to separate from that of *pipiens* (*s. l.*) than was formerly supposed. Head-seta *f* may have from 1 to 6 branches and its length relative to that of *e* is variable, though it is usually more than half as long as *e* in *fatigans* and less

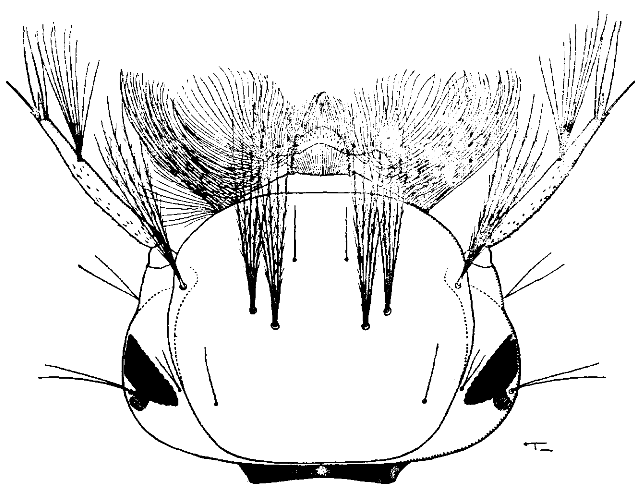

FIG. 179.—*Culex* (*Culex*) *fatigans* W. Head.

than half as long in *pipiens molestus*. The pecten-spines are usually less numerous in *fatigans*, but there may be as many as 13, so that there is complete overlap between *fatigans* and *pipiens*. Possibly the most reliable character is the shape of the siphon, which is usually (but not invariably) widest at about $\frac{1}{3}$; the siphonal index is normally less in *fatigans* (3·7–4·7 in Sudan specimens; lower indices have been recorded in Uganda), but completely overlaps the range given by Lewis for *C. pipiens molestus*.

Breeding-places.—*C. fatigans* is very much more domestic in its breeding-places than is *C. pipiens* (*s. l.*). It is tolerant of extremely foul water and breeds abundantly in cesspits; the water in which larvae are found is commonly rich in decaying organic matter, but the species is abundant in barrels, tins, tanks (including closed rain-water tanks), discarded machinery and motor-tyres and in domestic utensils of all sorts; it occurs often in water collected in boats and canoes, and Dalziel records it as occasional in wells. Macfie and Ingram (1916*b*) mention that it is able

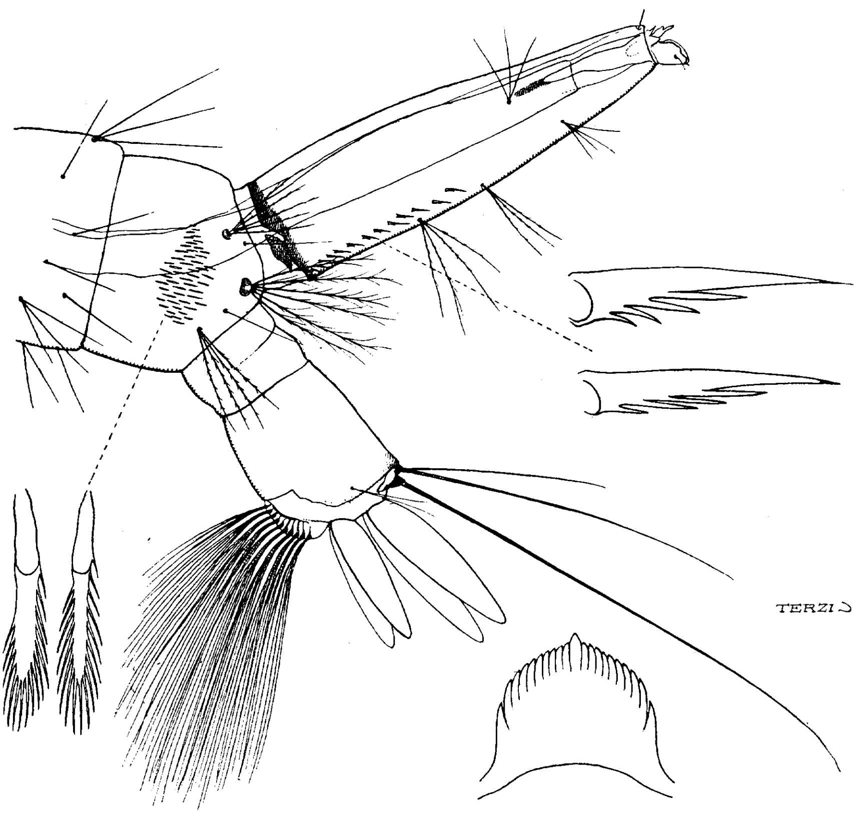

FIG. 180.—*Culex* (*Culex*) *fatigans* W. Terminal segments and mentum.

to breed in brackish water, and Dunn (1927–28) and others record it from the salt water of crab-holes. On the other hand it also utilizes (though much less commonly) breeding-places suitable for *C. pipiens*, and I have records from rain-pools, native water-holes, rock-holes, ditches, pools in the edge of swamps, and borrow-pits of all sorts; in many of these places the water was clean. Teesdale (1941) records larvae from pineapple-axils.*

* Kartman *et al.* (1947) record it (as *quinquefasciatus* Say) from Baobab tree-holes. Mara (1945) gives records from barrels and basins (" vasche scoperte ") at about 7900 ft. on Mt. Bizen, Eritrea, in association with *Aëdes aegypti*, *Culex laticinctus*, *theileri* and *trifilatus* and *Theobaldia longiareolata* and the same author, in Jannone *et al.* (1946), gives a record from a swamp with clear water and vertical vegetation, chloride content 0·25 %.—P. F. M.

Culex (Culex) zombaensis Theobald.

The following description is translated from Wolfs (1948*c*). Monsieur Wolfs kindly provided me with a copy of his MS. while his paper was still in the press:

"*Head.*—The head is broader than long. The antennae are strongly spiculate. The antennal tuft has about 30 plumose branches. There is one long and one short terminal spine and two long subterminal spines. Seta A has 7–10 plumose branches, seta B 2 plumose branches, and seta C 3–4 plumose branches. Seta *d* is short and double, seta *e* and seta *f* each have about 6 branches and are minute. Mentum—see figure.*

"*8th segment.*—The comb comprises about 30 strongly chitinized scales. Seta A has 4–5 branches, seta B 7–8 plumose branches, and seta C 6–8 plumose branches.

"*Anal segment.*—The saddle is complete. The saddle hair has 4 short branches. The saddle is covered with spicules. The ventral brush has about 14 tufts. The gills are almost twice the length of the saddle; they are narrow and rounded at the ends. The upper caudal seta has 4 branches, one very long, the others successively decreasing in length. The lower caudal seta is simple and as long as the longest of the branches of the upper caudal seta.

"*Siphon.*—The siphonal index is 7–7½. There are 3 subventral tufts and 3 lateral tufts. All these tufts are shorter than the diameter of the siphon and have 4–5 branches. In the pecten there are 8–9 spines of which the most distal are recurved. These spines are more and more widely spaced the further they are from the base of the siphon. The spines have 2–4 secondary denticles.

"*Breeding-place.*—A pool beside the River Mahuza."—P. F. M.

Culex (Culex) mirificus Edwards. (Figs. 181, 182.)

The larva differs from most of the *pipiens* group in possessing an upper caudal seta with 3–4 branches and in the shape of the pecten-spines. It closely resembles *thalassius* and *laticinctus*, differing from the former chiefly by the much shorter lateral seta of the anal segment and shorter subventral tufts of the siphon, from the latter by its differently-shaped pecten-spines, and by the fact that all the subventral tufts are placed distal to the distal end of the pecten.

Described from 1 skin and numerous whole larvae from Lake Nakuru, Kenya (C. B. Symes).

Length about 9 mm.; *colour* dirty pale yellow, often with a greenish tinge, head and siphon pale chestnut.

Head.—Antenna a little more than ½ length of head, slender, spiculate, infuscate only at extreme base and beyond tuft; tuft of numerous plumose branches at ¾. Setae A, B and C with about 8, 3 (occasionally 2) and 4 plumose branches respectively; bases of B and C set very close together; *d* single or 2-branched; *e* with about 5 branches. Mentum subtriangular, with 6 or 7 teeth on each side of the centre.

Abdomen.—Comb a semicircular patch of about 50 rather narrow scales. Siphon with index a little more than 5; pecten not extending to ⅓, composed of 9–10 rather long spines, most of which bear 5–6 secondary denticles; 4 or 5 pairs of subventral

* From the drawing sent me by Monsieur Wolfs the mentum appears to be much as in *striatipes* (Fig. 174) but without the small basal denticles. He informs me that under low magnification the comb scales might easily be mistaken for spines.—P. F. M.

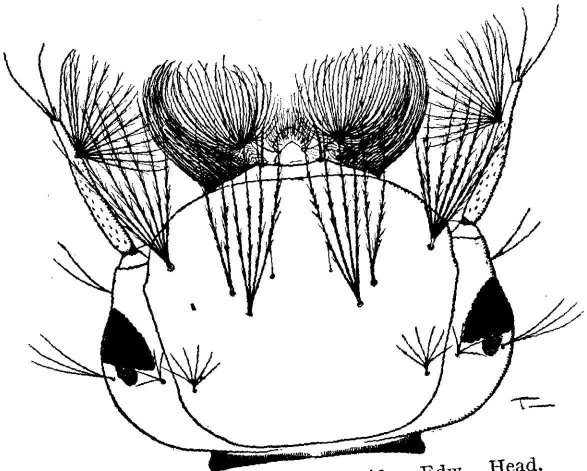

FIG. 181.—*Culex* (*Culex*) *mirificus* Edw. Head.

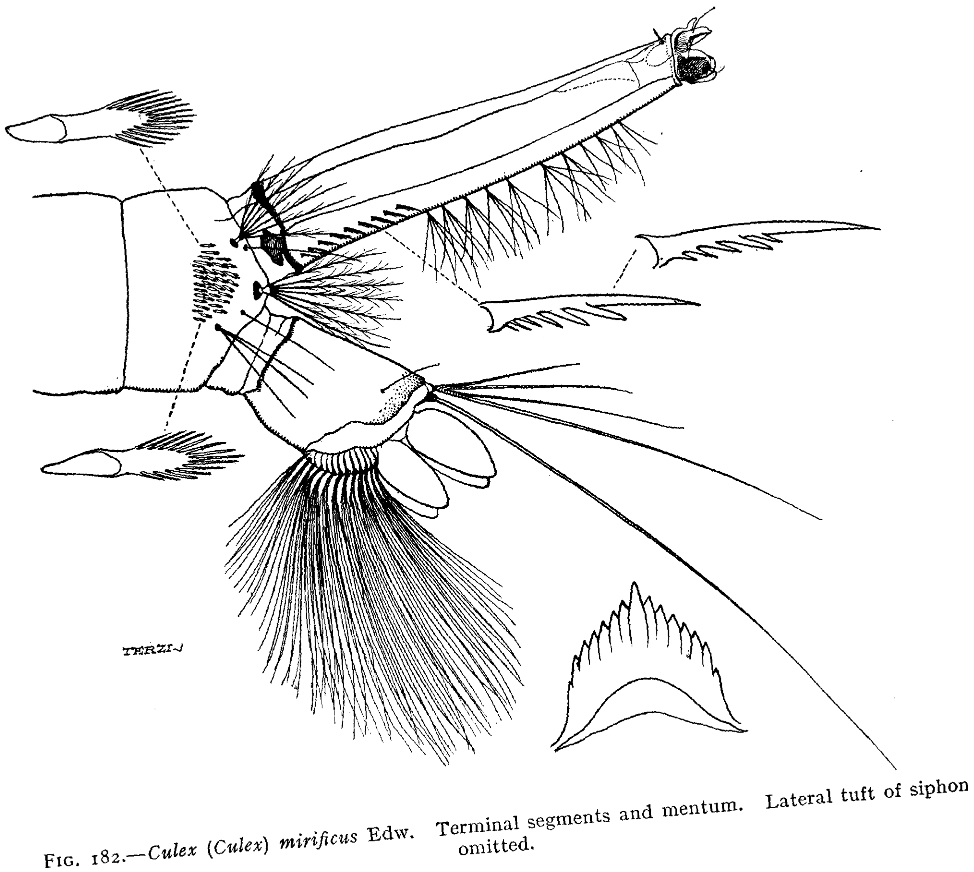

FIG. 182.—*Culex* (*Culex*) *mirificus* Edw. Terminal segments and mentum. Lateral tuft of siphon omitted.

tufts, each with half-a-dozen branches, which are slightly longer than the diameter of the siphon; lateral tuft similar. Anal segment with a complete saddle; upper caudal seta 3–4-branched, lower single; lateral seta minute. Ventral brush composed of 7 pairs of multiple tufts. "Gills" very broad and short, dorsal pair about $\frac{3}{4}$ length of saddle, ventral slightly shorter.

Breeding-places.—Mr. Symes found larvae breeding "literally in millions" in a belt ten yards wide round the shallow edges of Lake Nakuru, always among rushes; the water of this lake has a pH of 10 and contains about 13·6 grm. per litre of dissolved salts, of which approximately 75% is sodium carbonate. The water in which the larvae were found is only a few inches deep and full of decaying vegetable matter.

Culex (Culex) nakuruensis Mattingly.

Larva and breeding-places unknown. The latter may resemble those of *mirificus* —P. F. M.

Culex (Culex) ninagongoensis Edwards.

Described from 5 larvae, belonging to the batch from which the types were bred (kindly sent to the writer by Dr. Bequaert), and others, including one isolation, collected in Kigezi and on Ruwenzori by the British Museum Expedition.

The larva resembles *C. hopkinsi* (p. 312) extremely closely, but differs in a few small points; the branches of the subventral tufts of the siphon are not plumose; the lateral seta of the anal segment is 2–4-branched, and the "gills" are shorter, the dorsal pair being nearly twice, and the ventral pair $1\frac{1}{2}$ times, the length of the saddle.

Breeding-places.—The type-series was bred from larvae in a "small hole filled with spring-water amidst lava rocks at the altitude of 10,200 ft." (Bequaert). The larvae from Kigezi and Ruwenzori were found in swamps at an altitude of about 8000 ft.

Culex (Culex) calurus Edwards.

Larva and breeding-places unknown.

Culex (Culex) umbripes Edwards.

Larva and breeding-places unknown.

Culex (Culex) trifilatus Edwards. (Fig. 183.)

The fact that the pecten extends to $\frac{3}{5}$ and has the more distal spines exceptionally long coupled with the short siphon is completely diagnostic.

Described from many skins and whole larvae of ssp. *aenescens* Edwards, from the Toro District, Uganda.

Length about 8 mm.; *colour* brown; head and siphon dark.

Head.—Considerably broader than long (as 1·4 : 1·0). Antenna nearly straight, slender, spiculate; tuft of about 25 plumose branches at $\frac{3}{4}$. Setae A, B and C plumose, with about 10, 4 and 3 branches respectively; *d* rather long, simple, *e* 2-branched.

Abdomen.—Comb of about 50 rather small scales in a semicircular patch. Siphon with index about $3\frac{1}{2}$, markedly tapering; pecten of about 15 spines extending to $\frac{3}{5}$; spines increasing in size from the base (where they have small basal denticles) distally, the more distal exceptionally long, straight and simple ; 3 pairs of alternating subventral tufts of long plumose branches, each tuft with 2–5 branches (the number is variable in corresponding tufts on different larvae), which are longer than the diameter of the siphon ; a small lateral tuft of 2–4 simple branches at $\frac{5}{7}$ and a similar subdorsal tuft slightly proximal to it. Anal segment with a complete saddle ; lateral seta single or double ; upper caudal seta double, lower single. " Gills " with rounded apices, dorsal pair about $1\frac{1}{2}$ times length of ventral and about twice as long as saddle.

Breeding-places.—The records of McHardy (1929), from small pools and drains, and of Harris (1942), " larvae in rock-pool in river ; numerous larvae in bamboo pots at 3000 ft. on mountain side," presumably refer to the typical form, as do

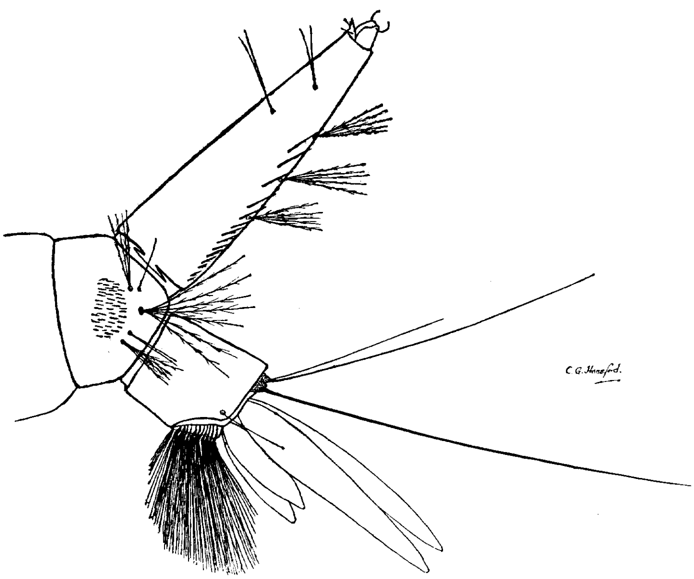

FIG. 183.—*Culex* (*Culex*) *trifilatus* Edw. Terminal segments.

some Uganda records from rock-pools in mountain streams, and probably those of Garnham, Harper and Highton (1946), who obtained the species on 43 occasions from tree-holes and 30 times from shaded rock-pools in forest. We have bred ssp. *aenescens* Edwards, in Uganda, from rock-pools in mountain streams, ditches in cultivated swamps, temporary rain-pools and a discarded tin.*

Culex (Culex) tamsi Edwards.

Described from 1 skin and 5 whole larvae from Sao Thome Island.

Resembles *C. pipiens* extremely closely, only differing as follows : tuft of antenna with fewer branches (about 20) ; seta *d* usually double ; lateral seta of anal segment with 3–4 branches ; " gills " longer and slenderer, subequal, more than twice as long as saddle.

* Mara (1945) gives a record from a basin (" vasca scoperta ") at about 7900 ft. on Mt. Bizen, Eritrea, in association with *Aëdes aegypti*, *Culex fatigans*, *laticinctus* and *theileri* and *Theobaldia longiareolata*.—P. F. M.

Breeding-place.—" Shaded stone trough fed by a small spring at 4,000 ft., bottom of water with layer of dead leaves."

Culex (Culex) andersoni Edwards. (Figs. 184, 185.)

This larva very closely resembles that of *pipiens*, but may usually be distinguished by the dark colour of the head and siphon ; the more distal pecten-spines are not more widely spaced than the others in *pipiens*, but this character is inconstant in *andersoni*. In general appearance the larva of *andersoni* still more closely resembles those of *hopkinsi* and *ninagongoensis*, but in both these latter species the comb is composed of spines. The best character for distinguishing the larva of *andersoni*, however, is the presence of a sclerotic tooth near the apex of the siphon on the dorsal

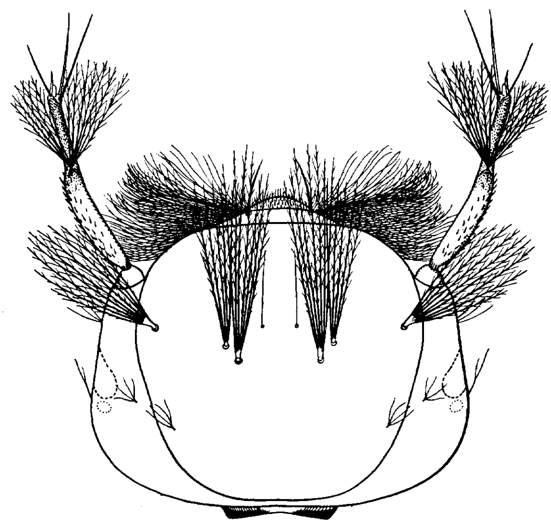

FIG. 184.—*Culex* (*Culex*) *andersoni* ssp. *bwambanus* Edw. Head.

side ; this character was overlooked in my description of the larva of *a. andersoni* (Hopkinsi, 1936) and in the description of *andersoni bwambanus* (de Meillon, 1943, p. 99), but was pointed out by Lewis (1943*b*) in the case of *andersoni abyssinicus* ; it is present in the larvae of all three subspecies.

Length about 8 mm. ; *colour* yellow brown, head and siphon usually very dark brown or blackish.

Head.—Antenna infuscate throughout, strongly spiculate ; a large tuft of about 20 plumose branches at $\frac{3}{5}$. Setae A, B and C plumose, with about 7, 5 and 7 branches respectively, bases of B and C very close together ; *d* and *e* minute, *d* simple, *e* with 1–3 branches. Mentum triangular, with about 12 teeth, increasing in size towards the base, on each side of the centre.

Abdomen.—Comb of about 60 approximately equal scales, which have a rather long apical fringe. Siphon with index 4–5 ; pecten of 12–15 spines, each with 2 or 3 very large basal denticles, last 3 spines often wider spaced than remainder ; 3 pairs of alternating subventral tufts, slightly longer than diameter of siphon, each with

3–5 simple branches ; lateral tuft of 2 or 3 branches at about $\frac{4}{5}$; a sclerotic tooth not unlike that found in *duttoni* is present on the dorsal side of the siphon near the apex. Saddle of anal segment covering almost entire segment ; upper caudal seta 2-branched, dorsal branch half length of ventral, lower caudal single ; lateral seta

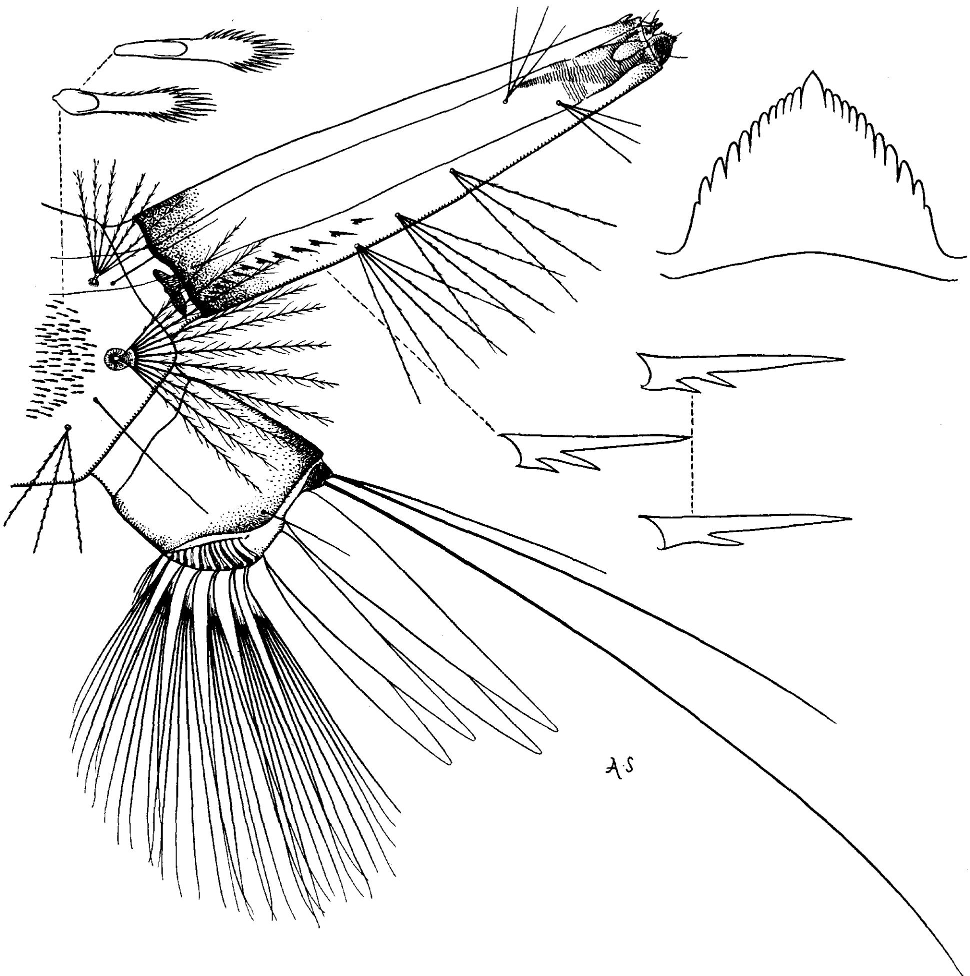

FIG. 185.—*Culex (Culex) andersoni* ssp. *bwambanus* Edw. Terminal segments and mentum.

less than half length of saddle, 2–3-branched. " Gills " lanceolate, dorsal pair longer than ventral, about twice length of saddle.

The above account refers to *a. andersoni* ; Lewis (1943*b*) does not describe the larva of *andersoni abyssinicus*, but informs me that it is inseparable from that of the nominotypical form. The larva of *a. bwambanus* is described by de Meillon (1943) and appears to differ as follows : Mentum with 9 subequal teeth on each side of the larger central tooth ; pecten of 9–15 spines ; median subventral tufts of siphon with 3–6 branches, lateral seta of anal segment with 2–4 branches. With the exception of the number of teeth in the mentum, it is most improbable that any of these differences will be found to be constant.*

Breeding-places.—The type-series was bred (Edwards, 1914) from larvae found in a bucket of rain-water. Hancock and Soundy found larvae of the nominotypical form in rock-pools (deeply shaded by foliage and an overhanging rock) on Mount Elgon, and the British Museum Expedition took them in fallen split bamboos, in ground-pools and in a " small tree-hole with clear water near ground-level " (Edwards and Gibbins). Lewis (1943*b*) found his larvae of *andersoni abyssinicus* in drums, cement tanks and pools in streams, and de Meillon obtained larvae of *a. bwambanus* from " exposed rock-pools in a stream bed."

Culex (**Culex**) **hopkinsi** Edwards. (Fig. 186.)

No other known Ethiopian larva of the genus except *ninagongoensis* has a comb composed of *spines*, which are about 50 in number. The few differences between these species are given on p. 308.

Described from 6 skins and 3 whole larvae from Kameranjoka, Toro, Uganda.

Resembles *C. andersoni*, but differs as follows: Comb composed of about 50 small blackish *spines*, which are very finely fringed basally. Pecten-spines very variable in number (9–16), with basal denticles somewhat smaller and fewer than in *andersoni*. Siphon with 4 pairs of subventral tufts, the branches of which are slightly plumose. Lateral seta of anal segment single. " Gills " more than three times length of saddle.

Breeding-places.—The larvae were found in rock-pools in company with *C. andersoni*.

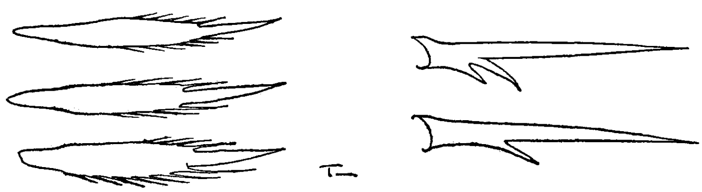

FIG. 186.—*Culex* (*Culex*) *hopkinsi* Edw. Spines of comb and pecten.

Culex (**Culex**) **vansomereni** Edwards. (Fig. 187.)

The peculiar " coronet " of spines near the apex of the siphon distinguishes *vansomereni* from all other known *Culex* larvae in our area except *chorleyi*; the latter has much shorter subventral tufts.

Length about 10 mm.; *colour* brown, head and siphon usually darker, but the degree of sclerotization (and therefore the colour) varies considerably.

* Larvae and pelts of the type form from Ruwenzori and Mt. Elgon and a single pelt of ssp. *bwambanus* from South Africa in the British Museum collection all show the comb scales fringed all round (Fig. 185). Dr. de Meillon kindly informs me that S. African specimens show considerable variation and that some scales are fringed apically and others all round. I am, however, inclined to believe that the scales are normally fringed all round and that the appearance of apical fringing is, in many cases at least, an artefact due to the angle from which they are viewed. The South African larval skin used for Fig. 185 differs from the description in having the antenna infuscate on the distal ½ only, mentum with 11 teeth (including 1 very small basal one) on either side of the central tooth and lateral seta of anal segment single.—P. F. M.

Head.—Antenna rather short, strongly spiculate, apical third infuscated; tuft of about 20–30 plumose branches at $\frac{2}{3}$. Setae A, B and C with 6–8, 3 and 4 plumose branches respectively; *d* rather small, single or with a bifid tip; *e* minute, with 2–5 branches. Mentum with about 6 teeth on each side of the centre.

Abdomen.—Comb a semicircular patch of from about 30 to about 60 rather small scales. Siphon with index 4–6; pecten of 12–16 spines, which are unusually

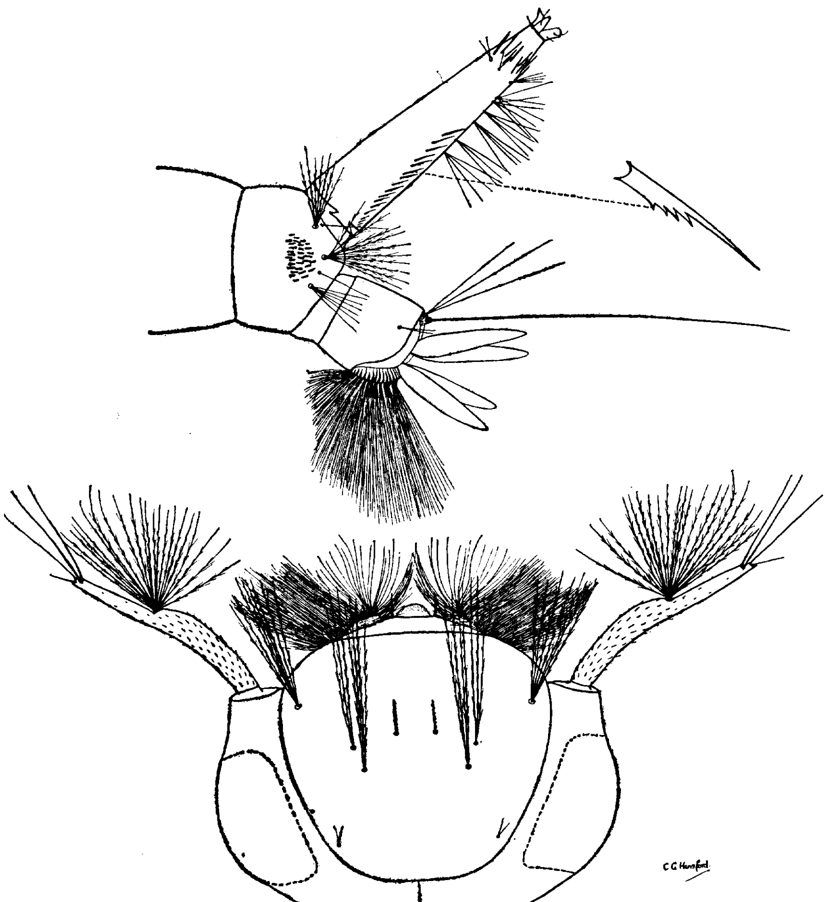

FIG. 187.—*Culex* (*Culex*) *vansomereni* Edw. Head and terminal segments.

long, and of which the more distal are simple, whereas the more proximal have small basal denticles; about 6 pairs of alternating subventral tufts, which may be single or with several simple branches, and are slightly longer than the diameter of the siphon; small lateral and subdorsal tufts are also present; an apical "coronet" of appressed spines is present, as in *C. chorleyi*, and is sometimes divided into definite ventral and dorsal groups. Saddle of anal segment a complete ring; upper caudal seta with 2–4 branches, lower single; lateral seta small, 2–3-branched. Ventral brush composed of about 7 pairs of tufts, each with numerous branches. "Gills" equal, about $1\frac{1}{2}$ times length of saddle, more or less lanceolate.

The larvae of this species vary very considerably, particularly in the degree of sclerotization of the head and siphon, the siphonal index, and the number of comb-scales. Examination of a long series of specimens from Nairobi (the type-locality of the species), South Africa (ssp. *draconis* Ingram and de Meillon), and various localities in Uganda (ssp. *vansomereni*) has shown that, though the majority of the specimens from South Africa and of those from high elevations in Uganda (6000–7000 ft.) are of the form with strongly-sclerotized and long siphon, and of those from Nairobi and from low elevations (5000 ft. and below) in Uganda of the form with a short, weakly-sclerotized siphon, the differences are not constant; in at least one of the Uganda localities specimens of both forms and also intermediates have been found breeding in the same pool. According to Edwards (1941), larvae of *vansomereni draconis* are separable by their longer siphon (index about 6), the fact that the "coronet" of subapical spines on the siphon is divided into dorsal and ventral groups, and by the subventral tufts of the siphon being double and scarcely longer than the diameter of the siphon.

Breeding-places.—The larva is recorded by Ingram and de Meillon from pools and backwaters in streams and from a ditch, and by Leeson from a tub. In Uganda it occurs in rock-pools and temporary rain-pools. The water may be clean or muddy, and is usually stagnant and devoid of vegetation.

Culex (Culex) toroensis Edwards. (Figs. 188, 189.)

Easily distinguished in typical specimens by the shape of the siphon and the arrangement of the pecten and the spines at the apex, but the larva is now known to be excessively variable. Atypical specimens are perhaps best characterized by the shape of the pecten-spines.

Length about 10 mm.; *colour* not noted, head and siphon dark.

Head.—Antenna coarsely spiculate, strongly infuscate beyond tuft; tuft of about 30 coarsely plumose branches at $\frac{3}{4}$. Setae A, B and C with about 8, 3–4 and 4–5 coarsely plumose branches respectively; *d* rather large, single or double. Mentum subtriangular, with about 7 coarse teeth on each side of the centre.

Abdomen.—Comb a patch of about 80 very narrow scales. Siphon usually bent towards the dorsal side near apex (often much more so than in the specimen figured) but sometimes straight, index about 7; pecten extending nearly to $\frac{1}{2}$ and composed of 17–19 very long spines, of which the more proximal bear small denticles, whereas the more distal are simple and tend to appear median and unpaired; near the apex on the ventral side is a group of up to 3 simple spines, and on the dorsal side 18 similar spines which tend to be paired, but both these groups of spines may be absent; 2 pairs of small but conspicuous subventral tufts are single or double and composed of simple branches; lateral and subdorsal tufts similar. Anal segment with complete saddle, distal edge smooth; upper caudal seta 3-branched, lower single; lateral seta about $\frac{1}{2}$ length of saddle, double. Ventral brush composed of 6 pairs of many-branched tufts. "Gills" subequal, lanceolate, from nearly twice to three times as long as saddle.

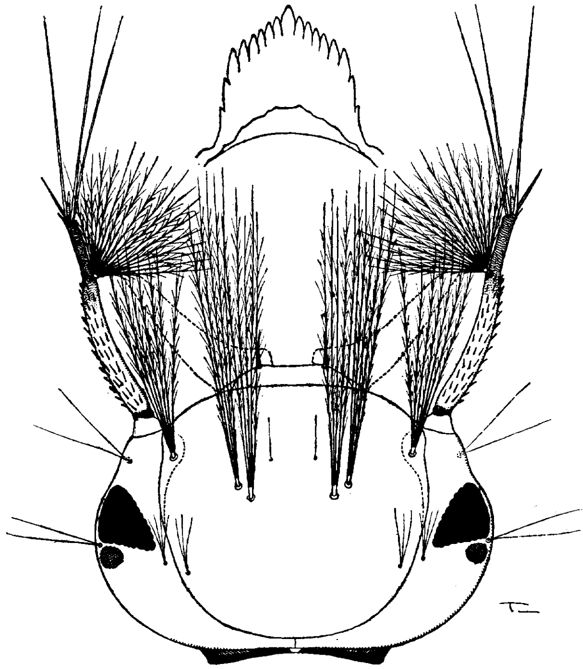

FIG. 188.—*Culex* (*Culex*) *toroensis* Edw. Head and mentum.

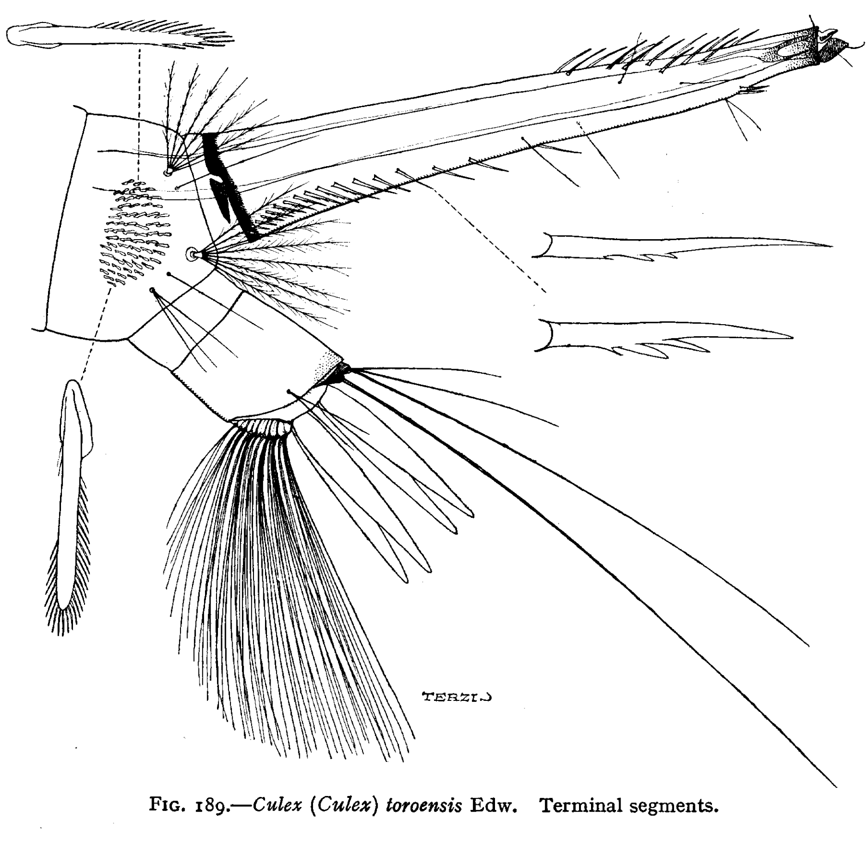

FIG. 189.—*Culex* (*Culex*) *toroensis* Edw. Terminal segments.

Breeding-places.—A small well-shaded rock-hole, bare of living vegetation but containing much debris, a pool overgrown with grass in marshy ground near the Mubuku River, and ditches and native water-holes.

The above account refers to *C. t. toroensis*; the larva of *C. toroensis macrophyllus* Edwards and Gibbins has not been identified with certainty, but is suspected to be very similar to that of *andersoni*; the form was breeding in a swamp (Edwards and Gibbins).

Culex (Culex) chorleyi Edwards. (Fig. 190.)

The larva can immediately be separated from any other known Ethiopian *Culex* larva except *vansomereni* by the "coronet" of spines near the apex of the siphon. From that of *vansomereni* it is readily distinguished by the small size of the subventral tufts of the siphon.

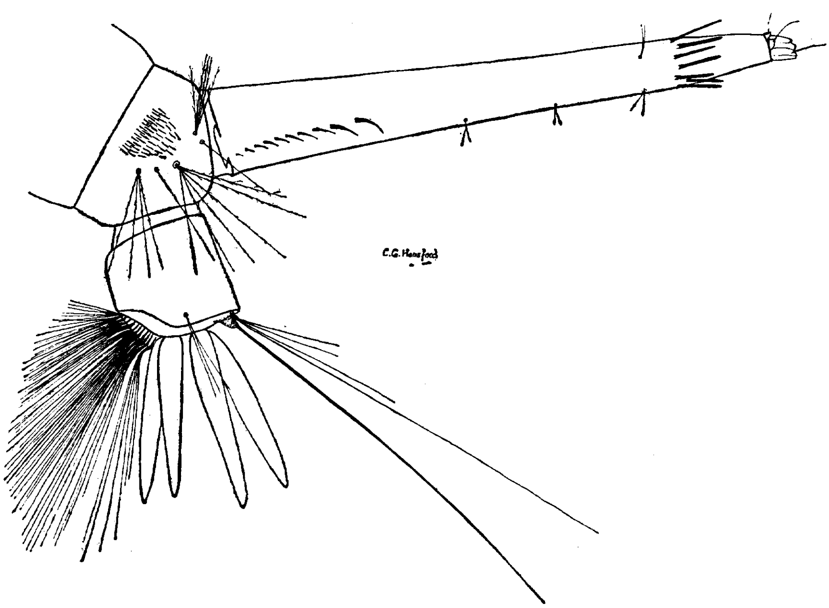

FIG. 190.—*Culex (Culex) chorleyi* Edw. Terminal segments.

The writer has seen very occasional specimens which lacked the ventral part of the "coronet."

Described from 5 skins and many whole larvae from Kampala, Uganda.

Length about 8 mm.; *colour* pale brown.

Head.—Antenna curved, infuscated slightly at the base and strongly distal to the tuft; shaft with numerous scattered spicules; a large tuft of about 30 subplumose branches at $\frac{5}{7}$. Setae A, B and C composed of slightly plumose branches, A with about 8 branches, B with 3 or 4 and C with about 6; *d* apparently simple, *e* with about 6 branches. Mentum with 3 large teeth and a small basal tooth at either side of the centre.

Abdomen.—Comb a semicircular patch of about 50 rather narrow, very broadly-fringed scales. Siphon pale, basal ring and acus dark, index 6; pecten of about 8 strong curved spines, simple or with a few minute basal denticles, extending to $\frac{1}{3}$; there are 3 pairs of very small subventral tufts and 1 pair of small subdorsal setae; just before the tip there is a complete ring of strong, bluntly-pointed spines similar to those found in the larva of *Culex vansomereni*. Anal segment weakly sclerotized; upper caudal seta with 3–4 branches, lower single; lateral seta slender, 2–3-branched. Ventral brush composed of about 6 pairs of tufts. "Gills" equal, bluntly-pointed, length about $1\frac{1}{2}$ times that of saddle.

Breeding-places.—Borrow-pits, ditches and open pools in swamp, usually without shade, water commonly muddy and often with red flocculence (probably due to one of the hydroxides of iron).

Culex (Culex) astridianus de Meillon.

Larva and breeding-places unknown. (This is believed to be a form of *chorleyi*. See Mattingly, 1949.—P. F. M.)

Culex (Culex) hancocki Edwards. (Figs. 191, 192.)

This larva may be distinguished from any other described African species of *Culex* except *moucheti* and *cinereus* by the low siphonal index; it is easily separated from that of *moucheti* by the presence of a ventral brush on the anal segment, and

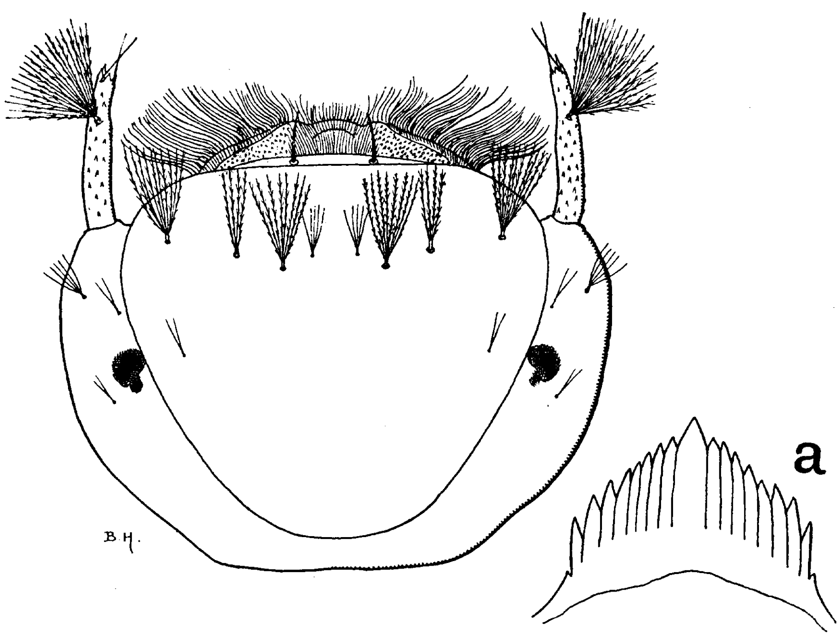

FIG. 191.—*Culex* (*Culex*) *hancocki* Edw. Head. *a*, mentum.

from *cinereus* by the facts that the comb is composed of spines, and the pecten-spines are simple. The absence of a barred area is also a most unusual feature.

Length about 7 mm.; *colour* white, head, siphon and saddle yellow.

Head.—Antenna infuscate only at extreme base, short, curved, slightly tapering, shaft covered with small spicules ; tuft at $\frac{3}{5}$, of about 20 very delicately plumose branches which appear simple at low magnification. Setae A, B and C all very short, composed of about 10, 4 and 8 finely plumose branches respectively ; *d* with about 5 rather long branches, *e* 2-branched, slender. Mentum with a large central tooth, on either side of which are about 10 teeth increasing in size towards the base. Eye very small, perhaps obsolescent.

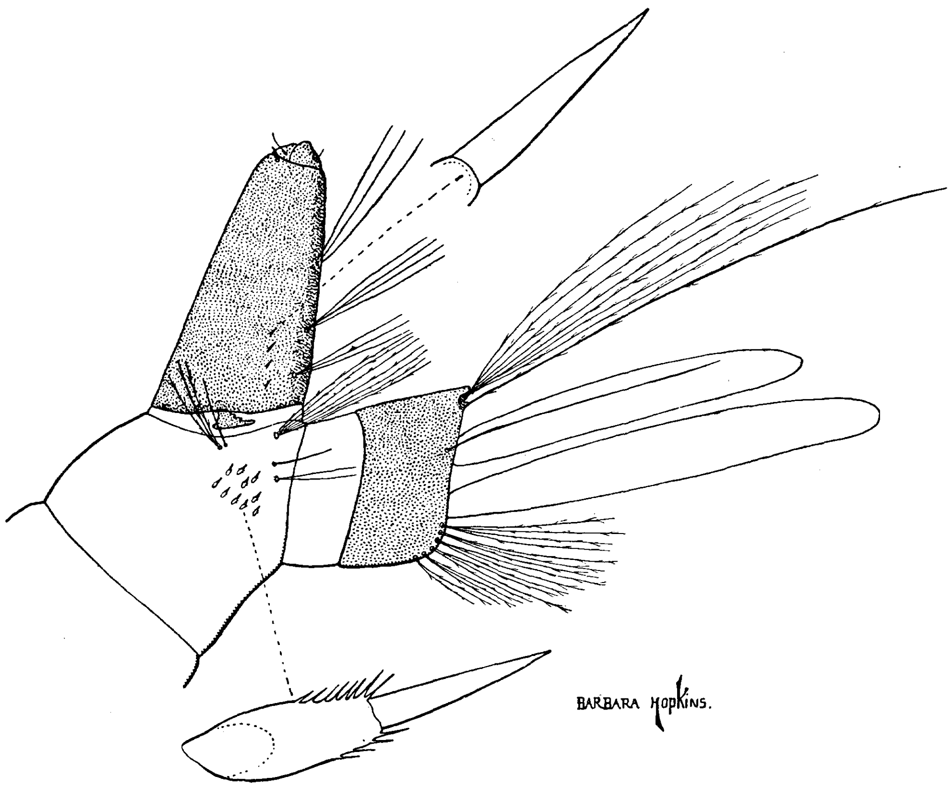

FIG. 192.—*Culex* (*Culex*) *hancocki* Edw. Terminal segments.

Abdomen.—Comb of 10–12 small spines with a delicate basal fringe, arranged in an irregular patch. Siphon with index $1\frac{1}{2}$, conical, weakly sclerotized ; pecten extending rather beyond $\frac{1}{3}$, of 4–6 simple spines ; 3 pairs of subventral tufts, each composed of 3–4 delicately plumose branches rather longer than the diameter of the siphon. Saddle of anal segment weakly sclerotized ; caudal setae very finely plumose, upper with about 7 branches, lower single ; lateral seta single, long, simple, its origin close to the distal margin of the segment. Ventral brush very feebly developed, composed of about 6 pairs of tufts, each with 3 or 4 short weak branches ; barred area obsolete. "Gills" sausage-shaped, dorsal pair slightly shorter than ventral and four times length of saddle.

Breeding-places.—Hancock and Soundy discovered the larvae breeding in large numbers in the rain-water in cut bamboos (but not in those in which the water had been fouled as a result of the activities of weevils), and in the sap in bamboos which had been bored by larvae of a Noctuid moth (*Conicofrontia* sp.) ; the sap in these latter was somewhat viscous, white, and rather sweet-smelling, but rapidly became foul on removal, thus causing the death of the larvae. The liquid in the open bamboos had a temperature of 14° C. as against 10° C. for that in the bored bamboos. Larvae from the two types of habitat showed no perceptible differences.

Culex (Culex) musarum Edwards. (Fig. 193.)

From all the other known short-siphoned *Culex* larvae the present species is at once distinguished by the very characteristic shape of the pecten-spines.

Described from 3 skins and many whole larvae from near Fort Portal, and many whole larvae from other parts of Uganda.

Length about 8 mm. ; *colour* : head, siphon and saddle of anal segment chestnut, abdomen very pale opaque grey.

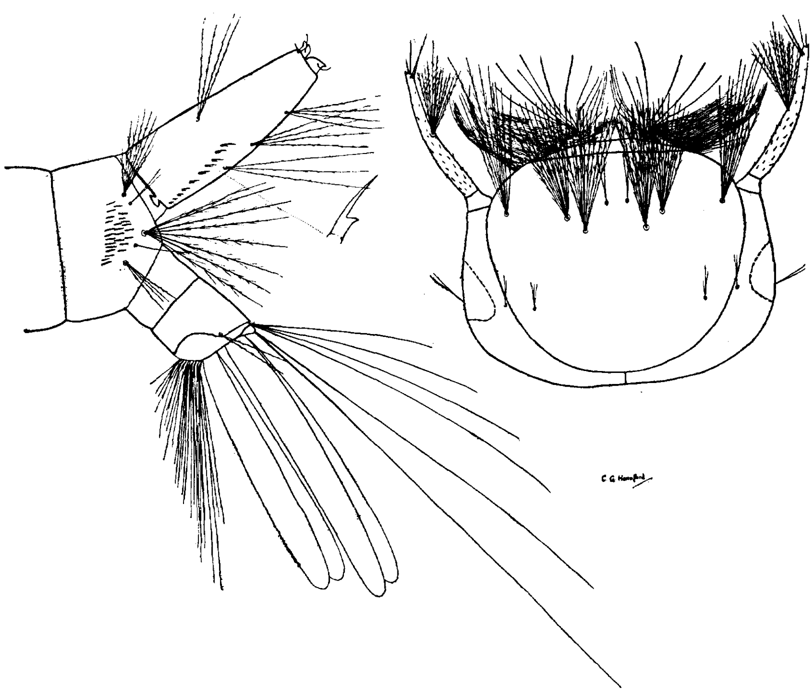

FIG. 193.—*Culex* (*Culex*) *musarum* Edw. Head and terminal segments.

Head.—Antenna very short, strongly spiculate ; tuft of about a dozen short branches at about $\frac{1}{2}$; terminal and subterminal setae very small. Setae A, B and C with about 12, 15 and 15 plumose branches respectively, B and C placed very far forward ; *d* rather large, 2–3-branched ; *e* minute, single. Mentum with an unusually prominent central tooth, on each side of which are 9 teeth increasing in size towards the base.

Abdomen.—Comb a patch of about 25 large narrow scales. Siphon with index $3\frac{1}{3}$, well sclerotized ; acus small but prominent ; 3 pairs of long subventral tufts, each composed of 3–4 subplumose branches about 3 times as long as diameter of siphon ; subdorsal tuft similar ; pecten composed of about 9 spines, each with one blunt basal denticle. Anal segment with complete saddle, the surface of which is covered with very fine pilosity ; lateral seta about length of saddle, subplumose, double ; upper caudal seta with 4, lower with 2 branches. Ventral brush composed of 4 or 5 pairs of tufts, each with 2–5 simple branches. " Gills " narrowly sausage-shaped with slightly tapering ends, dorsal pair about 4 times length of saddle, ventral $\frac{6}{7}$ length of dorsal.

Breeding-places.—Common in the axils of wild banana (*Musa fecunda*) ; not found in the axils of other plants. (Haddow (1948), however, found it in abundance in axils of *Colocasia esculentum.*—P. F. M.)

Culex (Culex) scotti Theobald.

Larva and breeding-places unknown. Likely to breed in leaf-axils or bamboos, as the adult appears most similar to *musarum* and *hancocki*.

Culex (Culex) antennatus Becker.

Length about 7 mm. ; *colour :* usually straw-coloured, sometimes greenish, head and siphon pale.

This larva is extremely similar to that of *univittatus*, but differs as follows: Head-setae B and C, especially the former, nearly always 2-branched, rarely 3-branched, and never with more than 3 branches (in *univittatus* seta C almost invariably has 3 or 4 branches). Siphon slightly shorter (index variable but usually about 6) ; pecten of 10–12 spines, which have larger and fewer (2–4) denticles than those of *univittatus* ; subventral tufts shorter, less than $\frac{1}{2}$ as long as the diameter of the siphon.

Breeding-places.—Larvae are abundant in swamps, borrow-pits and other pools, and in ditches ; Ingram and de Meillon also found them in pools in a river-bed and among algae in a stream. The water in which they occur is nearly always stagnant.*

Culex (Culex) quasiguiarti Theobald.

Larva and breeding-places unknown. Probably breeds in ground pools.

Culex (Culex) decens Theobald. (Figs. 194, 195, 196.)

The larva of *decens* closely resembles a number of others, from most of which it may readily be distinguished by the shape of the pecten-spines ; it comes nearest to *antennatus* and *univittatus*, from both of which it differs in having a longer siphon and unequal " gills." It is inseparable from that of *invidiosus*.

Length about 6–7 mm. ; *colour* usually green, sometimes very pale whitish brown, without markings, head and siphon generally little darker than body.

Head.—Antenna strongly spiculate, pale, base and portion beyond tuft only very slightly darker ; tuft of about 30 plumose branches at about $\frac{3}{4}$. Seta A with about 6 plumose branches ; B and C usually 2-branched, sometimes 3-branched,

* Kartman *et al.* (1947) add to this list native concrete wells and a wooden tank containing clear water. They state that " Observations at Dakar are not fully in accord with the statement that larvae of this species usually occur in stagnant water (Hopkins, 1936)."—P. F. M.

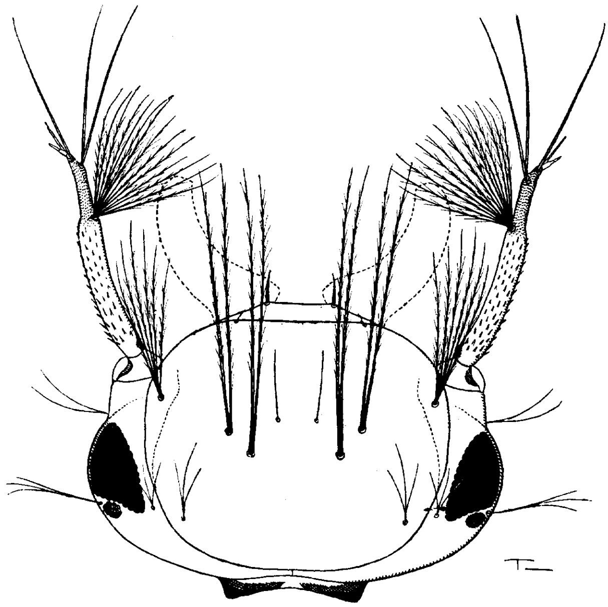

FIG. 194.—*Culex* (*Culex*) *decens* Theo. Head.

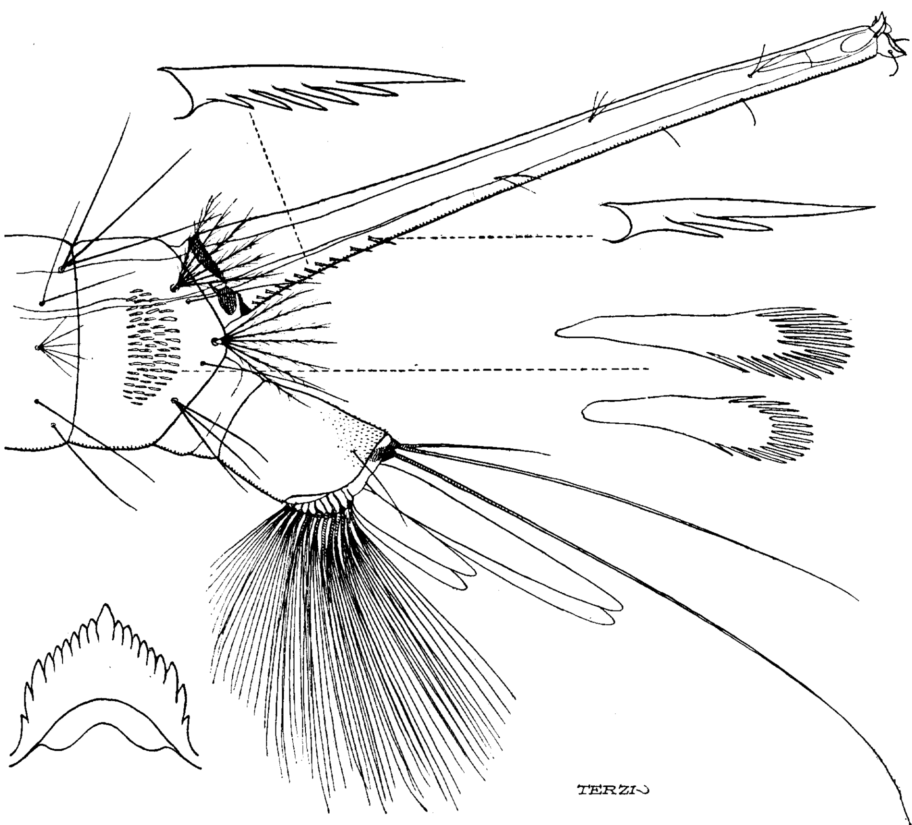

FIG. 195.—*Culex* (*Culex*) *decens* Theo. Terminal segments and mentum.

plumose, nearly as long as head ; *d* single, *e* and *f* with about 3 and about 5 branches respectively. Mentum with 6–7 teeth, increasing in size towards the base, on each side of the large median tooth.

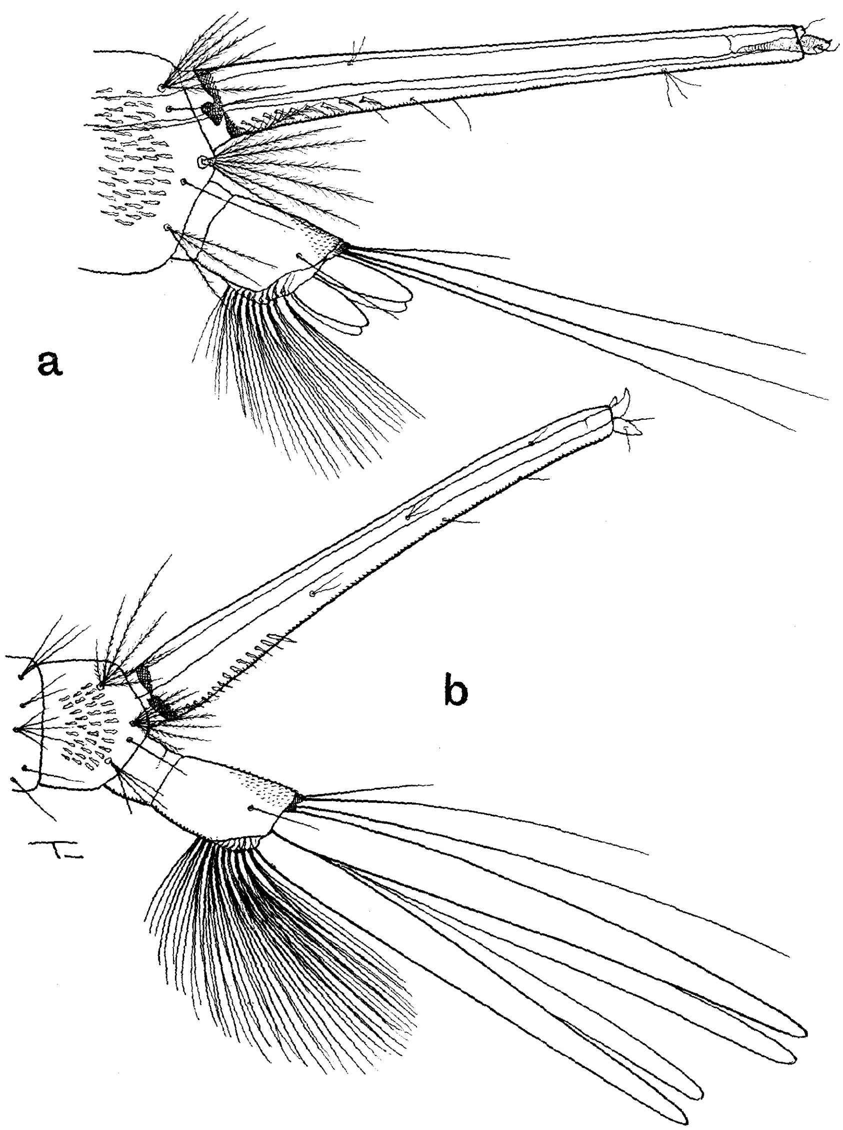

FIG. 196.—*Culex* (*Culex*) *decens* Theo. Atypical larvae. *a*, " short-gilled " form from Lake Bagusa (Beadle). *b*, " long-gilled " form from Bwamba (after Haddow).

Abdomen.—Lateral setae of segments III–VI single. Comb a semicircular patch of about 50 narrow scales, of which the more distal are much larger than the more proximal. Siphon with index 8–11, tapering very gradually from just beyond base to apex ; pecten extending to little beyond $\frac{1}{5}$, composed of 11–15 spines, each with

2 or 3 basal denticles in the case of the more distal spines and more numerous denticles nearer the proximal end of the pecten; subventral tufts (3 pairs) minute, much shorter than diameter of siphon, 2-branched or single; a similar subdorsal tuft is usually single. Anal segment with complete but poorly sclerotized saddle, the whole surface of which is spiculate; upper caudal seta double, upper branch less than $\frac{1}{2}$ length of lower, lower caudal seta single; lateral seta single or double, about $\frac{2}{5}$ length of saddle. Ventral brush composed of about 5 pairs of tufts, each with about 6 branches. "Gills" lanceolate, but with blunt tips; dorsal pair usually about $1\frac{1}{2}$ times length of saddle, ventral variable, but always shorter than dorsal and sometimes little more than half as long.

A series of skins and whole larvae from the neighbourhood of Lake Edward, Uganda, collected by Mr. L. Beadle, differ somewhat from the above description, but the adults appear to be inseparable from typical *decens*. In these larvae head-setae B and C are in many cases 3-branched, the lateral setae of abdominal segments III–VI are 2-branched in most of the specimens; the comb consists of fewer (about 30) and darker scales, and the "gills" are very short (the dorsal pair slightly shorter than the saddle and the ventral pair much shorter). This last point is the only difference from ordinary *decens* larvae which is constant throughout the series, and is probably an adaptation to the alkaline water in which these larvae were found. On the other hand, a series of larvae collected by Dr. A. J. Haddow in a leaf-pool in Bwamba county, Toro, Uganda, had the "gills" remarkably developed, the dorsal pair being more than 4 times as long as the saddle and the ventral pair not very much shorter; this is presumably a response to the low chloride content of such water.

Breeding-places.—The breeding-places are much more varied than in most species. Larvae are common in the edges of swamps and in ditches, borrow-pits and pools of all kinds (including rock-holes); Dalziel found them commonly in crab-holes and abundant in wells. Numerous authors have recorded them as occasional in tree-holes, tins, tubs, etc., and the writer has on rare occasions found larvae of *decens* in all these types of breeding-place. Dr. Wigglesworth informs the writer that, in addition to more normal breeding-places, he has obtained the species from cut bamboos and a rot-hole in a paw-paw tree. Teesdale (1941) records larvae from banana-axils, and Dr. Haddow's larvae from a leaf-pool have been mentioned above. Larvae may be found in water which is clean or dirty, running or stagnant. Perhaps the most remarkable record is that of Bedford (1918), who had larvae submitted to him which had been collected in a coal-mine, 300 ft. below the surface of the ground.

The atypical larvae from near Lake Edward were taken at the edge of Lake Bagusa, a crater-lake containing water of alkalinity 0·235 N., and also containing much sulphide; a few were also obtained from extremely foul muddy-brown water in hippo foot-prints on the shore of Lake Edward.

Culex (Culex) invidiosus Theobald.

Larva indistinguishable from that of *decens*.

Breeding-places.—The account of the breeding-places of *decens* given above includes also *invidiosus*, which was formerly considered to be merely a variety of *decens*. But some of the more unusual records (Mr. Beadle's from alkaline water, Dr. Haddow's from a leaf-pool, and the larvae from 300 ft. underground) definitely refer to *decens*.*

Culex (**Culex**) **trifoliatus** Edwards.

Larva and breeding--places unknown. Probably breeds in ground pools.

Culex (**Culex**) **ornatothoracis** Theobald.

Larva and breeding places unknown ; latter probably ground pools.

Culex (**Culex**) **perfuscus**) Edwards. (Figs. 197, 198.)

Both de Meillon and Rebêlo (1941, p. 74) and Lewis (1945) have shown that the larva described by me as *perfidiosus* (Hopkins, 1936, p. 227) is actually that of *perfuscus*. The material of both these species which I examined came from the British Museum and was collected by Dr. H. Galliard ; for this reason it seems possible that the names had been transposed before the larvae came into my hands—a suggestion which gains probability from the fact that the breeding-places recorded by Galliard (1931) for the two forms are similar in many cases.

The larva now known to be that of *perfuscus* greatly resembles those of *decens*, *univittatus* and *antennatus*, from all of which it may be separated by the fact that none of the pecten-spines possess more than 2 basal denticles, and by the more numerous subdorsal tufts on the siphon. It also much resembles *telesilla*, from which it is easily separated by the shape of the antenna.

Length about 6 mm. ; *colour* not recorded, head and siphon pale.

Head.—Antenna strongly spiculate ; tuft of about 30 plumose branches at about $\frac{7}{10}$. Setae A, B and C plumose, A with about 10 branches, B with 2–3 branches, C 2-branched ; *d* rather long, single. Mentum with a broad central tooth and 8 smaller teeth on each side.

Abdomen.—Comb a patch of about 25 narrow scales. Siphon with index about $6\frac{1}{2}$; pecten of about 12 spines extending to nearly $\frac{1}{3}$, more distal spines with 1 (sometimes 2), more proximal with 2 basal denticles ; 4 pairs of subventral tufts, a lateral, and 3 subdorsal pairs, each consisting of 3–4 very short and inconspicuous branches, first subventral tuft usually arising considerably proximal to distal end of pecten. Anal segment with a complete saddle ; upper caudal seta with 3–4 branches, lower single ; lateral seta very small, with 3–4 branches. Ventral brush composed of about 6 pairs of many-branched tufts. "Gills" broadly lanceolate, dorsal pair rather longer than ventral.

Breeding-places.—Galliard (1931) found *perfuscus* breeding in a variety of places, but for the most part in forest ; he mentions a spring containing green algae, a foul pool, a residual pool under shade, the bed of a temporary stream, the edge of a slow-flowing river and water in the bottom of an old canoe. It is not clear to what extent his records are based on larvae or on adults, but even if they were largely based on larvae the error would not be very serious because the breeding-places of

* Kartman *et al.* (1947) give a record referring specifically to *invidiosus* from a " small grassy pool with turbid water of high organic content and exposed to the sun."—P. F. M.

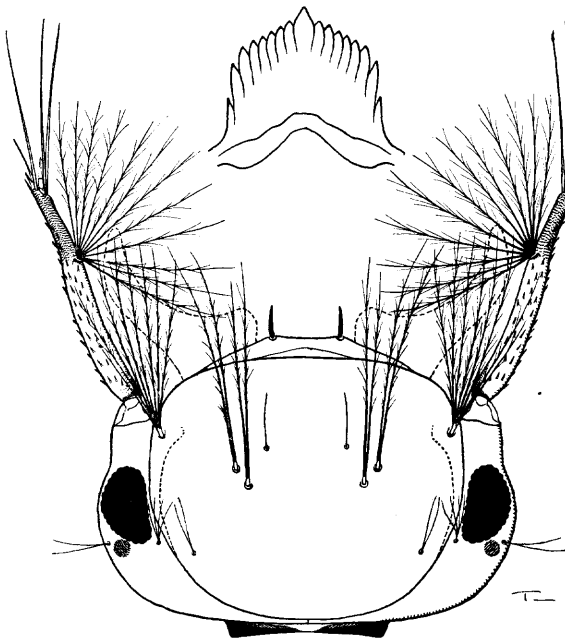

FIG. 197.—*Culex* (*Culex*) *perfuscus* Edw. Head and mentum.

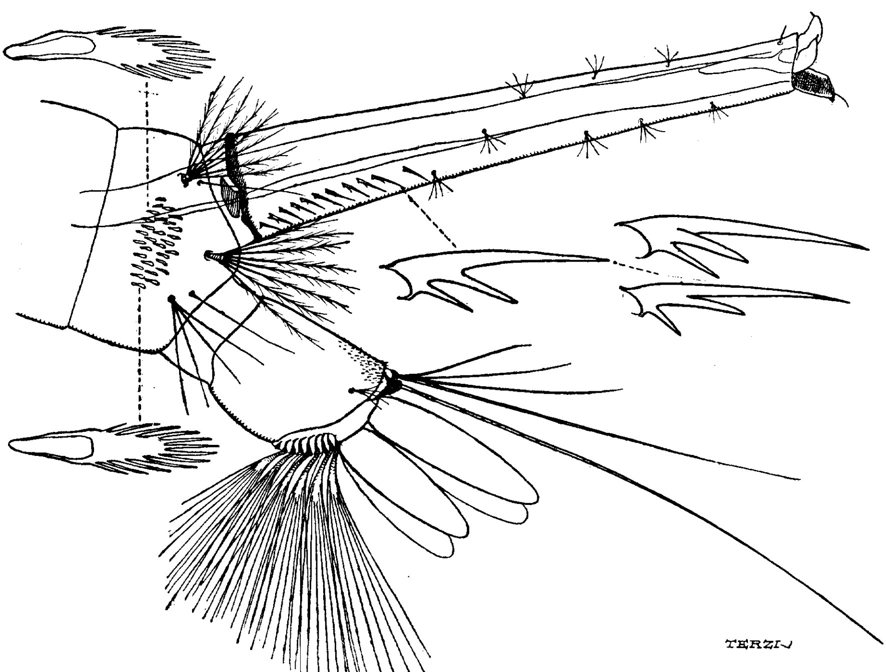

FIG. 198.—*Culex* (*Culex*) *perfuscus* Edw. Terminal segments.

perfuscus and *perfidiosus* appear to be essentially similar. De Meillon and Rebêlo bred *perfuscus* on two occasions from larvae found in "exposed pools in river beds."*

Culex (Culex) telesilla de Meillon and Lavoipierre. (Fig. 199.)

The larva of this species is extremely like that of *perfuscus* (formerly misidentified as *perfidiosus*) except for the characteristic shape of its antenna, which will separate it not only from *perfuscus* but also from other species with which it might be con-

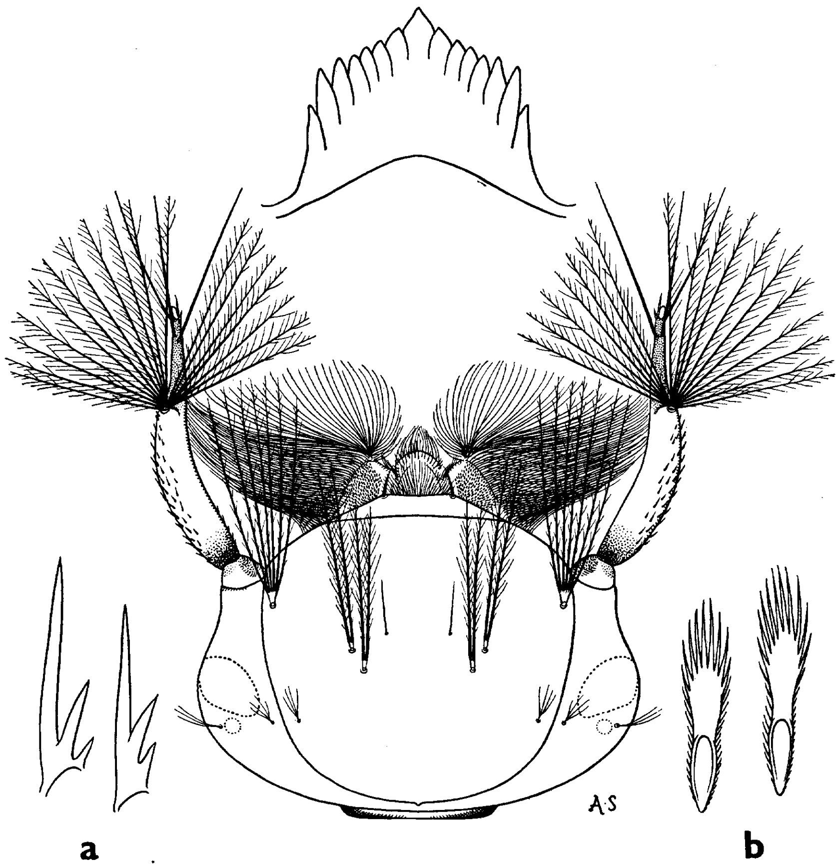

FIG. 199.—*Culex* (*Culex*) *telesilla* De M. & Lav. Head, mentum and comb and pecten teeth. *a*, pecten spines. *b*, comb scales.

fused. Other differences from *perfuscus* mentioned by de Meillon, Parent and Black (1945) are that the antenna is infuscated at the base as well as beyond the tuft, head-seta A has only 6 branches, the siphon is perhaps slightly shorter (the larva of *telesilla* is known only from pelts), and the subventral tufts of the siphon begin proximal to the last 3–4 pecten-spines and have 4–6 branches. The larva is described (de Meillon, Parent and Black, 1945) as follows :

* De Meillon (1947) states, however, that on re-examination these larvae proved to be *telesilla*.—P. F. M.

"*Head*.—Antenna spiculate, very broad as far as tuft and then tapering very suddenly. Infuscated at extreme base and beyond tuft. Tuft at about $\frac{2}{3}$, consisting of 27 to 33 plumose branches. Head seta A with 6 plumose branches; B and C as long as A and both with 2 plumose branches; seta *d* fairly long, single. Mentum with 7 smaller teeth on each side of the central tooth.

"*Abdomen*.—Comb of about 24 small, narrow scales. Siphonal index varies from 4·6–5·6. Pecten of 10–14 spines, some of which have 3 basal denticles, and some only 1. There are 5 pairs of subventral tufts, each tuft having 4–6 simple, short and inconspicuous branches. The subventral tufts are shorter than the diameter of the siphon. The first pair of tufts lies proximal to the last 3–4 pecten-spines. Anal segment with complete saddle. Upper caudal seta with 2–4 branches, one of which is always long. The short branches are just over $\frac{1}{4}$ the length of the long branch. Lower caudal seta single. Lateral seta minute with 4–6 branches. Ventral brush composed of 6 pairs of tufts each with about 9 branches (9–11). Gills missing."

Breeding-places not recorded.

Culex (Culex) perfidiosus Edwards. (Figs. 200, 201.)

The larva described below is that attributed in the first edition of this work (Hopkins, 1936) to *perfuscus*. There is no real evidence as to its true identity, but the fact that the larvae attributed to *perfuscus* and *perfidiosus* came from the

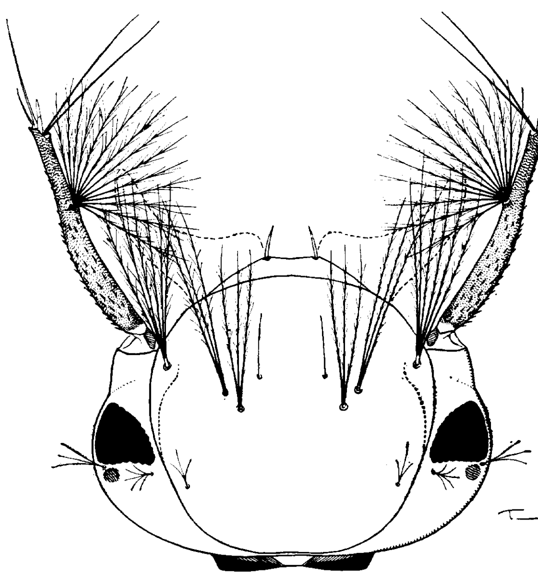

FIG. 200.—*Culex* (*Culex*) ? *perfidiosus* Edw. Head.

same source, coupled with the discovery that the larva formerly described as *perfidiosus* is that of *perfuscus*, suggests the possibility that the names were transposed by some means and that the present larva is that of *perfidiosus*.

The short siphon and long subventral tufts render the larva somewhat like those of *pipiens* and *fatigans*, both of which have much more numerous comb-scales and more numerous branches in head-setae B and C. Tuft A of the eighth segment has stouter branches than in any similar species.

Length about 7 mm.; *colour* not recorded.

Head.—Antenna strongly spiculate; tuft of about 30 plumose branches at $\frac{2}{3}$ Seta A with about 8 plumose branches, B and C both 3-branched, decidedly shorter than head, *d* single. Mentum with a large central tooth and about 8 smaller ones on each side.

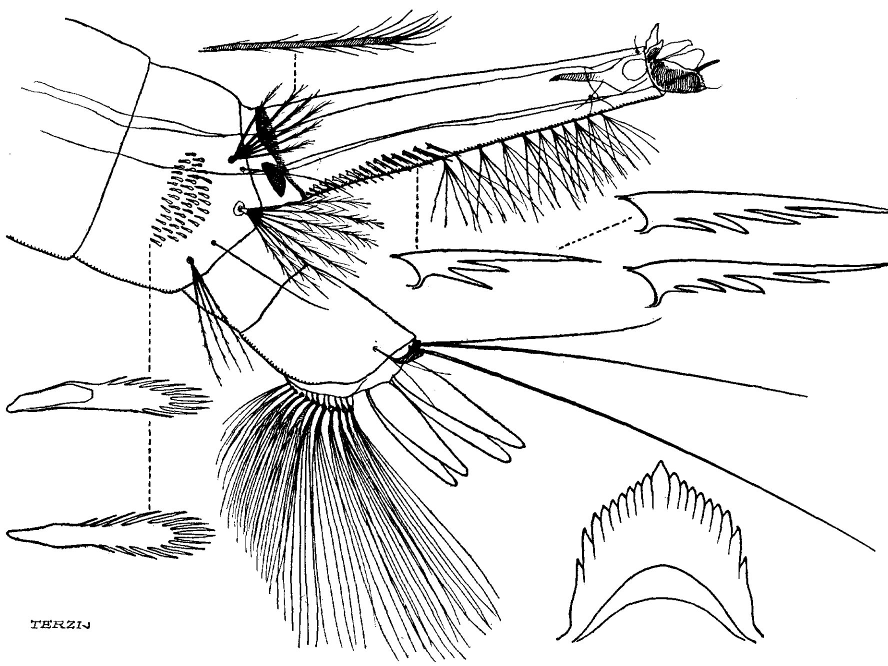

FIG. 201.—*Culex* (*Culex*) ? *perfidiosus* Edw. Terminal segments and mentum.

Abdomen.—Comb a patch of about 30 small dark-coloured scales; tuft A of eighth segment composed of unusually stout branches. Siphon short, somewhat convex dorsally, index about 4; pecten extending to about $\frac{1}{3}$, composed of about 15 rather large spines each with 3–4 large and conspicuous lateral denticles; 5 pairs of subventral tufts, each with about 6 simple branches which are longer than the diameter of the siphon; lateral tuft smaller but conspicuous and with 2–4 branches. Anal segment with complete saddle, distal margin smooth; upper caudal seta with 1 long and 1 short branch, lower caudal seta single; lateral seta small, 2-branched. Ventral brush composed of about 6 pairs of tufts, which arise from unusually wide bases and are composed of numerous branches. "Gills" lanceolate, dorsal pair slightly longer than saddle, ventral pair somewhat shorter than dorsal.

Breeding-places.—Galliard (1931) records finding larvae of *perfidiosus* in stagnant pools in forest, and in a canoe full of water. It is not clear whether these records are dependent on determinations of larvae or of adults, but the breeding-places of *perfuscus* and *perfidiosus* appear to be similar.

Culex (Culex) guiarti Blanchard. (Fig. 202.)

This larva should not be readily mistaken for any other, no other species having the combination of a long siphon, less than a dozen comb-spines, and subventral tufts longer than the diameter of the siphon.

The larva of this species is that described by Ingram and Macfie (1917) ; their identification has been confirmed by the breeding of many specimens from isolated

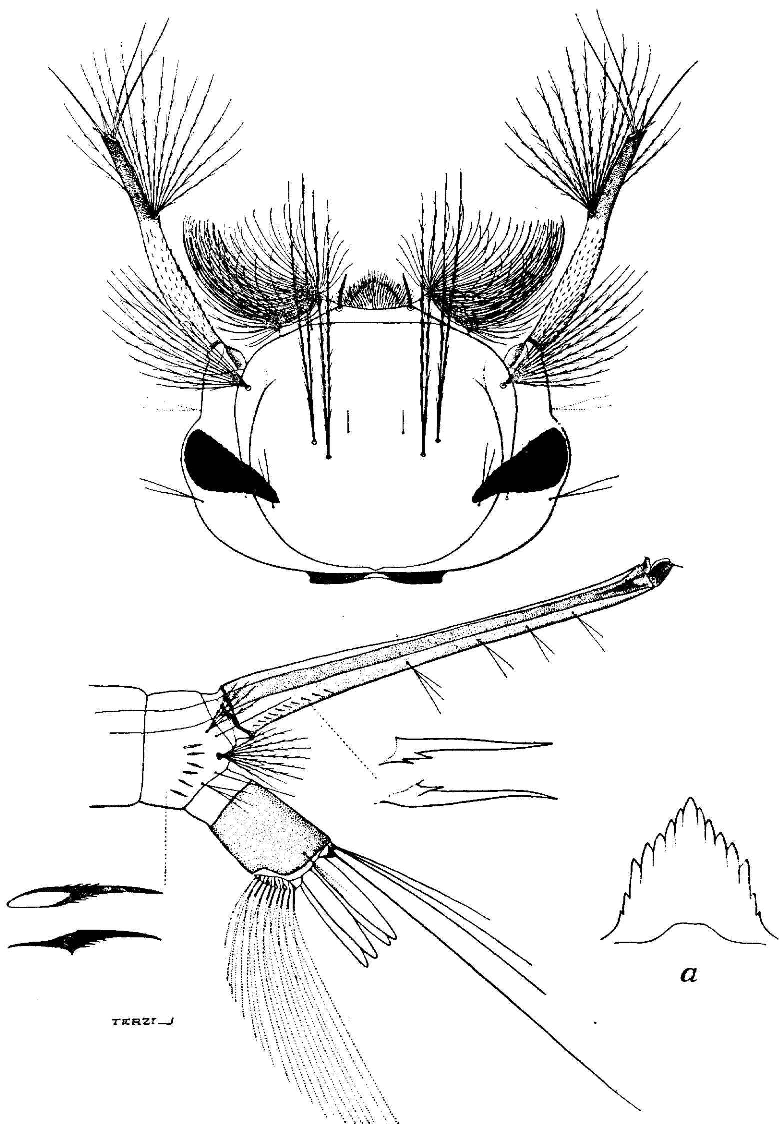

FIG. 202.—*Culex* (*Culex*) *guiarti* Bl. Head and terminal segments. *a*, mentum. The setae of the ventral brush are considerably shorter than indicated.

larvae in Uganda ; these agree exactly with those described and figured by Ingram and Macfie.

Length about $6\frac{1}{2}$ mm. ; *colour* green, head and siphon not dark.

Head.—Antenna strongly spiculate ; tuft at slightly before $\frac{3}{4}$, composed of about 30 plumose branches ; shaft beyond tuft deeply infuscate. Seta A with about 12 plumose branches, B and C plumose, 2-branched, nearly as long as head, *d* very small. Mentum small, with about 6 teeth on each side of the centre.

Abdomen.—Comb an irregular row of 6–9 spines with narrow basal fringes. Siphon long, index variable, usually about 8, sometimes not much more than 6 ; pecten of 8–10 small pale spines extending to about $\frac{1}{4}$; there are 4 (less commonly 5) pairs of subventral tufts, which vary a good deal in position, but of which the most proximal is always distal to the pecten ; these tufts have each 2–3 branches, which are simple and considerably longer than the diameter of the siphon ; lateral and subdorsal tufts absent. Anal segment with a complete saddle, which bears a few minute spicules at and near the dorsal angle of the distal margin ; upper and lower caudal setae 3-branched and single respectively ; lateral seta with 2–3 slender simple branches, which are less than half the length of the saddle. Ventral brush composed of 5 pairs of tufts, each with about 6 branches (these tufts were lost in the specimen figured and are actually considerably shorter than there indicated). " Gills " subequal, lanceolate, slightly longer than saddle.

Breeding-places.—Borrow-pits and water-holes, but only those in which the water is clean and which contain vegetation, also in ditches and the edges of swamps or lakes under similar conditions ; Dalziel's record of larvae in native pots is almost certainly accounted for by transportation. The above account refers to the typical form ; there is no information about the larva or breeding-places of ssp. *sudanicus* Edwards.

Culex (Culex) weschei Edwards. (Fig. 203.)

The peculiar pecten separates this larva sharply off from all other known species. It has some resemblance to that of *ingrami*, particularly the form of that species found in Uganda, but lacks entirely the patch of appressed spines at the apex ; the comb is entirely different in the two species.

Length about $7\frac{1}{2}$ mm., of which nearly 2 mm. is taken up by the siphon ; *colour* not recorded.

Head.—Antenna spiculate ; tuft of about 20 plumose branches at $\frac{5}{8}$. Seta A with 8 plumose branches, B and C missing in the available material ; *d* single, *e* and *f* each with about 3 branches. Mentum with about 4 large teeth on each side of the centre.

Abdomen.—Comb an irregular row of 8–9 rather small sharp-pointed spines with fringed bases. Siphon with index about 7, tapering very sharply just beyond base, then more gradually ; subventral tufts reduced to single delicate setae ; pecten highly characteristic, extending to beyond $\frac{3}{4}$, and composed entirely of simple spines which are set at a much more obtuse angle with the siphon than is normal. Anal segment with complete saddle, distal edge smooth ; upper caudal seta 2-branched from distinctly beyond base, lower single ; lateral seta trifid. Ventral brush com-

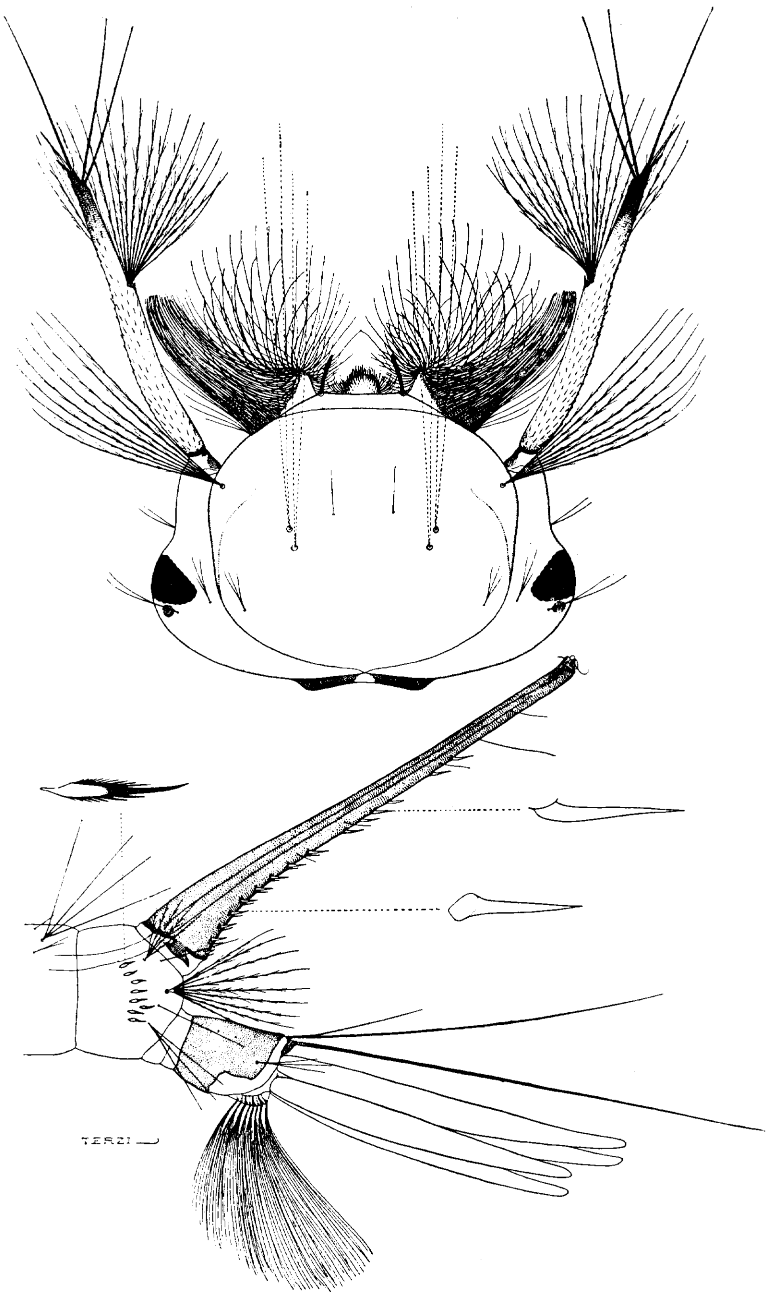

FIG. 203.—*Culex* (*Culex*) *weschei* Edw. Head and terminal segments. Head-setae B and C lost.

posed of numerous multiple tufts. Dorsal pair of "gills" slightly longer than ventral, about four times length of saddle.*

Breeding-places.—The larva described was collected by Dr. Graham in a borrow-pit (Wesché). The larva and breeding-places of *weschei gediensis* Edwards are unknown.

Culex (Culex) ingrami Edwards. (Figs. 204, 205.)

The larva of *C. ingrami* occurs in at least two forms, which may be distinguished from any other known Ethiopian *Culex* by the presence of appressed spines on the ventral side only of the tip of the siphon.

Larvae from the Gold Coast are as follows:

Length about 7 mm.; *colour* light green.

Head.—Antenna spiculate, infuscate beyond tuft; tuft of about 20 plumose branches at $\frac{2}{3}$. Seta A with about 6 plumose branches; B and C each double, plumose, and more than $1\frac{1}{2}$ times length of head; *d* single, *e* and *f* each with several branches.

Abdomen.—Comb a patch of about 50 rather small scales. Siphon with index 14; pecten extending to about $\frac{1}{3}$, formed of about 12 pairs of barbed spines, of which the last 2 pairs are widely separated, and beyond these 2–4 unpaired mid-ventral simple spines which are very widely spaced, also a ventro-lateral group of 5–6 simple appressed spines situated a little before the apex; subventral tufts (3 pairs) minute, with 2–3 simple branches. Anal segment with complete saddle; upper caudal seta trifid, lower single; lateral seta 3-branched, about three-quarters length of saddle. Ventral brush composed of about 7 pairs of multiple tufts "Gills" narrowly lanceolate with rounded tips, about twice length of saddle, ventral pair very slightly shorter than dorsal.

Larvae found in Kampala (Fig. 205) have a siphon which differs markedly from that of specimens from the Gold Coast, but appear to be similar in all other respects. The siphon is distinctly shorter (index 8–10), and the pecten is composed of about 25 paired and slightly barbed spines, which become simple and alternate distally (these more distal spines presumably take the place of the unpaired spines present beyond the true pecten of the form described from the Gold Coast); the pecten appears to extend almost the entire length of the siphon, and merges into the patch of about 6 closely appressed subapical and ventrolateral spines which is present in both forms.

The differences are noted from 6 skins and many whole larvae. In addition to these, hundreds of specimens have been encountered in the course of routine examinations; no specimens of the Gold Coast form or intermediates have been met with.†

Galliard (1932) has published a description and figure of a larva from Gabun which he states is probably *ingrami*. This larva appears to differ from the form of *ingrami* found in Uganda chiefly by the much greater length of the subventral tufts of the siphon; it is quite probable that the larva may be a form of *ingrami*, but there is no evidence for or against the attribution.

* Pereira (1946) describes a pelt from Portuguese East Africa which differs as follows: "Seta A with 12–13 branches; comb with 6–7 spines; siphonal index 9·6—P. F. M.

† Mattingly (1947) found larvae of both Uganda and Gold Coast types in Southern Nigeria.—P. F. M.

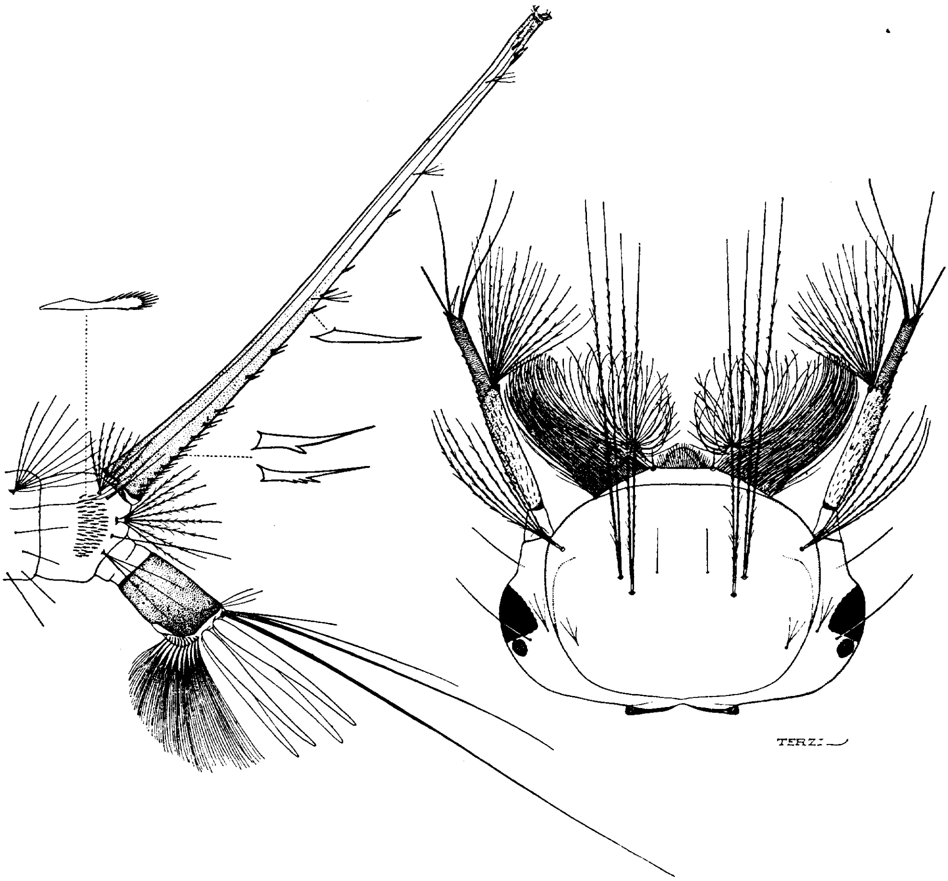

FIG. 204.—*Culex* (*Culex*) *ingrami* Edw. Head and terminal segments.

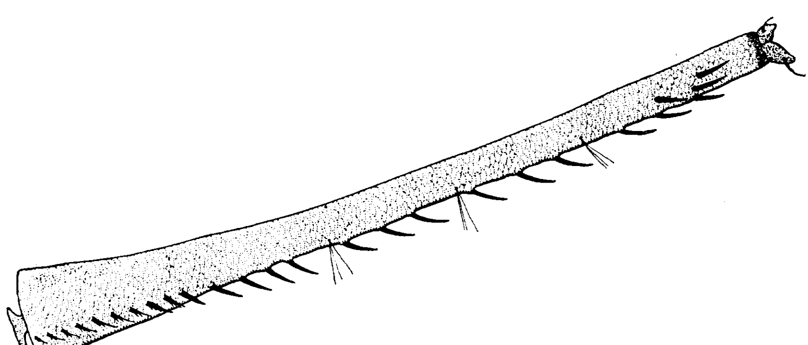

FIG. 205.—*Culex* (*Culex*) *ingrami* Edw., var. Siphon.

Breeding-places.—Macfie and Ingram (1916*a*) discovered larvae of the Gold Coast form in deep pools of clear water in thick forest; they also record pupae (1923) in a small pool in a borrow-pit. The Uganda form has been found in a wide variety of breeding-places, but only occasionally in pools in forest. It is much more frequent in borrow-pits, water-holes and ditches, and somewhat uncommon in swamp pools. The water in which it is found is always stagnant or nearly so, and may be clean, but is more commonly muddy or a brown infusion of decayed vegetable matter; vegetation, though commonly present, is by no means a constant feature of the breeding-places.

Culex (Culex) schwetzi Edwards.

Larva and breeding-places unknown. Likely to breed in ground pools.

Culex (Culex) grahami Theobald. (Figs. 206, 207.)

This larva should not readily be confused with any other; the enormous length of the siphon is shared only by *ingrami*, and to some extent by *argenteopunctatus* and *striatipes*. The first-named differs by the possession of a very long pecten and of appressed spines at the apex of the siphon, *argenteopunctatus* by the form of the spine on the dorsal valves of the siphon, and *striatipes* by the characters given in the key (p. 247).

Length about 10 mm. (nearly $\frac{1}{3}$ of this is represented by the siphon); *colour* usually an extremely characteristic golden yellow, with a slight greenish tinge on the thorax; in a batch of living larvae it is often very easy to pick out those of *grahami* by this character alone, but olive-green forms also occur.

Head.—Antenna highly spiculate, infuscate at extreme base and beyond tuft, nearly as long as the head; tuft of about 25 plumose branches at about $\frac{2}{3}$. Seta A with 8–12 plumose branches, B and C with 2–3 and 3–5 such branches respectively; *d* single, *e* and *f* usually with 3 and 4 branches respectively. Mentum with 5–6 large coarse teeth on each side of the centre, that next to the median tooth on each side closely applied to it.

Abdomen.—Comb an irregular patch of 14–25 (usually about 20) small slender spines with a delicate basal fringe. Siphon with index 12–15, tapering very gradually except at base; pecten of 6–9 slightly curved spines, which are entirely simple, not extending beyond $\frac{1}{7}$; subventral tufts excessively minute, about 4 in number, 1–2-branched. Anal segment with complete saddle; upper caudal seta 3–6-branched, lower single; lateral seta less than $\frac{1}{3}$ length of saddle, 3–4-branched. Ventral brush composed of about 7 pairs of many-branched tufts. "Gills" subequal (dorsal pair sometimes slightly longer than ventral), lanceolate, slightly longer than saddle.

Larvae from Uganda agree exactly with those described by Macfie and Ingram (1922–23) from the Gold Coast.

Breeding-places and habits.—Macfie and Ingram (*l. c.*) found larvae in a swamp pool; they note the fact that in water the larva rests with the siphon almost vertical to the surface, the body almost at right angles to the siphon and the head bent downwards. In Uganda we have found larvae in abandoned brick-pits, usually in clean water and always with a certain amount of vegetation. Dalziel records the species from borrow-pits and surface pools, and (occasionally) from wells; his finding it once in a barrel is almost certainly accidental.

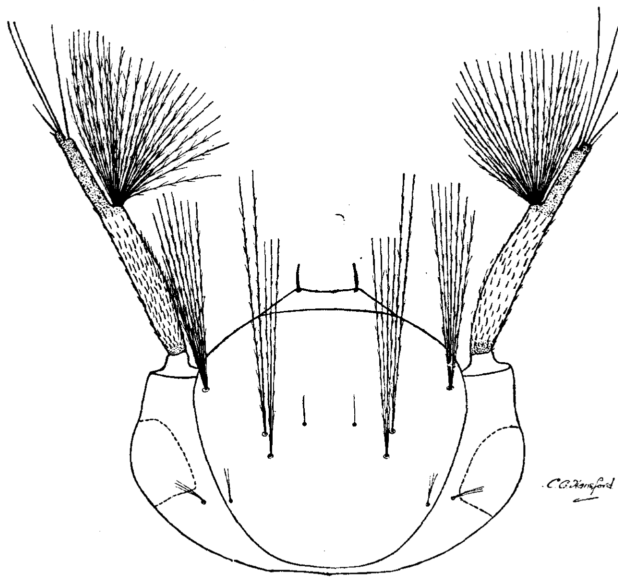

FIG. 206.—*Culex* (*Culex*) *grahami* Theo. Head.

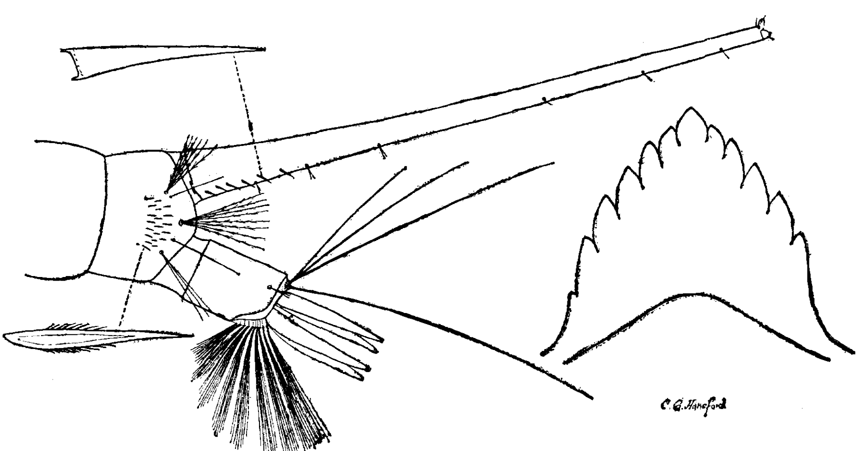

FIG. 207.—*Culex* (*Culex*) *grahami* Theo. Terminal segments and mentum.

Culex (Culex) pruina Theobald. (Figs. 208, 209)

This larva is unlikely to be confused with that of any other except *C. philipi*; from the latter it is most easily separated by the much more extensive pecten, and by the presence of a dense covering of conspicuous spicules on at least the ventral surface of the siphon.

The doubt as to the true larva of this species has been cleared up by the breeding of an adult male of var. *eschirasi* from an isolated larva by Dr. H. Galliard. The receipt of this skin proves the larva of *pruina* to be that attributed to it by Macfie and Ingram (1916*a*).

Length about 7 mm.; *colour* pale, distal third of siphon much darker than proximal two-thirds.

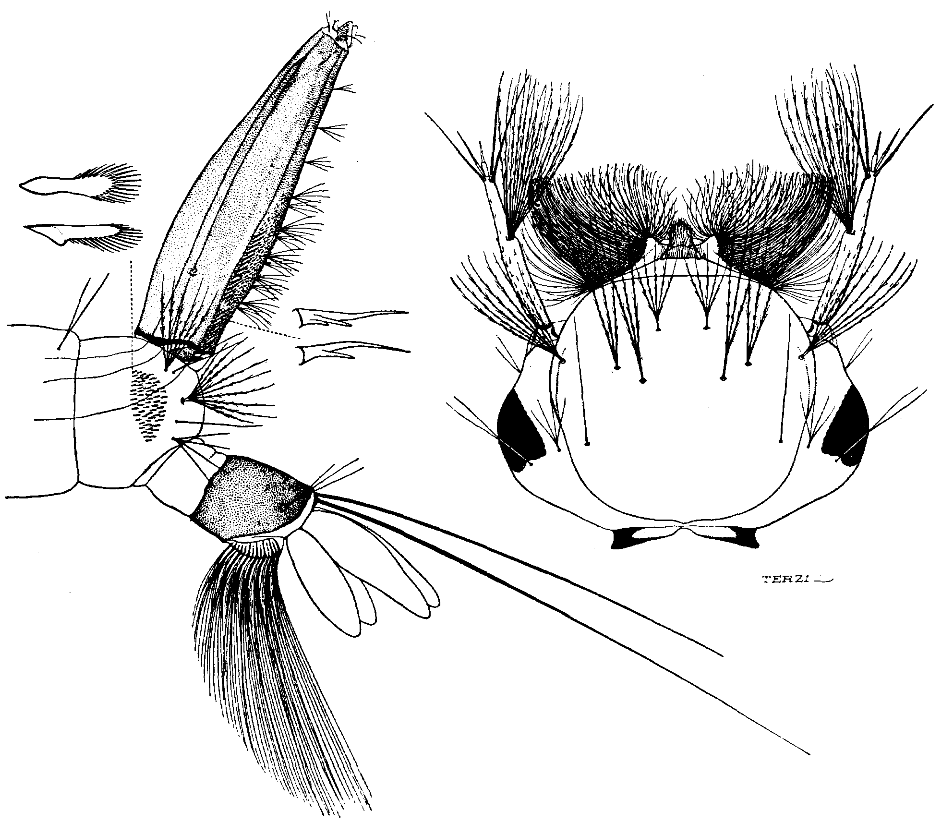

FIG. 208.—*Culex* (*Culex*) *pruina* Theo. Head and terminal segments.

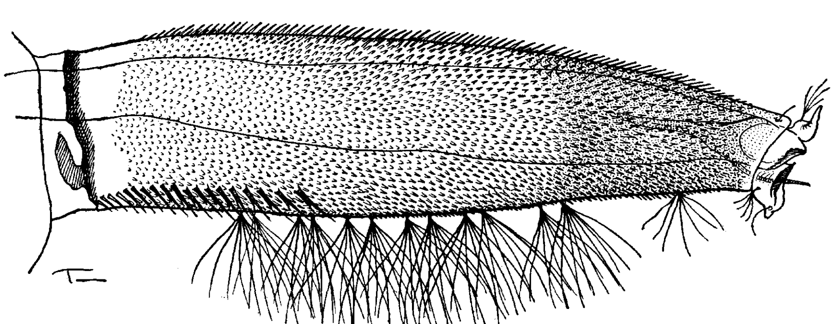

FIG. 209.—*Culex* (*Culex*) *pruina* var. *eschirasi* Galliard. Siphon.

Head.—Antenna spiculate ; tuft of numerous plumose branches at about $\frac{3}{5}$. Setae A, B and C all plumose, A with about 8 branches, B and C each with 3–4 branches ; *d* unusually large, 4–5-branched from beyond base, and plumose (a most exceptional character) ; *e* long and single, *f* with about 4 branches. Mentum small, and forming a rather regular triangle, about 12 teeth on each side of the centre.

Abdomen.—Comb a patch of 35–40 scales. Siphon somewhat barrel-shaped, widest at about $\frac{1}{3}$, index about 4 ; pecten extending to a little beyond $\frac{1}{3}$ and composed of about 20 spines, which each possess 1–2 basal denticles ; about 6 pairs of subventral tufts, each with numerous simple branches, which are much shorter than the diameter of the siphon ; ventral surface of the siphon in the neighbourhood of the pecten with a dense covering of stout and conspicuous spicules. Anal segment with a complete saddle, the dorso-apical angle of which is slightly spiculate ; upper and lower caudal setae both single ; lateral seta about as long as saddle, 3-branched. Ventral brush with about 7 pairs of multiple tufts. " Gills " unequal, dorsal pair a little less than twice length of saddle.

Var. *eschirasi* Galliard differs in that the spiculation of the siphon (Fig. 209) is not confined to the ventral side, but extends over the whole surface, and that the skin of the entire body, with the partial exception of the eighth abdominal segment, is finely spiculate ; head-seta *d* has 5–7 branches.*

Breeding-places.—Macfie and Ingram (*l. c.*) bred *C. pruina* from " water of a dark brown colour containing decaying leaves and vegetable matter, filling a hollow in the concrete foundation for the erection of a pump." Dunn (1927-28) records finding it three times in crab-holes, and Schwetz (1930*b*) from rock-holes (7 times), a native pot, and holes in sand (twice). Bequaert bred specimens from a hole in a fallen tree in a forest clearing. Galliard (1931) records it from holes dug at the side of a river, residual pools, and in iron pots for macerating cassava ; he obtained var. *eschirasi* in stagnant water in the bed of a stream.

Culex (Culex) pseudopruina E. C. C. van Someren.

Larva and breeding-places unknown.—P. F. M.

Culex (Culex) philipi Edwards.

Described from several skins and 5 whole larvae from Takoradi, Gold Coast (A. W. J. Pomeroy). The skins are badly damaged, but are sufficient to identify the adults with the whole larvae.

This larva resembles that of *C. pruina* extremely closely but differs as follows :

Colour.—Apical third of siphon not markedly darker than remainder.

Head.—Antennal tuft with fewer (about 12) and shorter branches. Seta C 2-branched, *d* small, single or double, *e* much shorter than in *pruina* and with 2–3 branches. Mentum less regularly triangular, and with the teeth somewhat larger and much broader, about 10 on each side of the centre.

Abdomen.—Siphon with rather fewer subventral tufts, and with pecten consisting

* Many larvae of " var. *eschirasi* " were taken together with those of the type form in Southern Nigeria by Mattingly (1947). The degree of spiculation of the siphon varied considerably and many intermediates were encountered.—P. F. M.

of only 9–13 spines, the last 2 or 3 of which are markedly wider spaced than the remainder; ventral surface of siphon entirely without the conspicuous spicules found in *pruina*. Upper caudal seta 2-branched, lateral seta variable but much shorter than that of *pruina*. "Gills" very variable in length, much more sausage-shaped than those of *pruina*.

Breeding-places.—The type-series was bred from larvae found in crab-holes (Edwards, 1929); Pomeroy (M.S.) gives a number of records from tubs, and one from a grass-edged pool.

Culex (Culex) moucheti Evans. (Figs. 210, 211.)

Sharply distinguished from any other known mosquito larva by the complete absence of any trace of the ventral brush.

Edwards (1929) established the identity of this larva by comparison of the pupal hairs under the integument of pupescent larvae with those of the pupae; he identified the latter with the adult by dissecting out the male hypopygia from pupae which contained adults almost ready to emerge. His identification has been confirmed by the rearing of adults from isolated larvae in Toro, Uganda.

Larvae from Uganda agree in every particular with those described and figured by Edwards; much of the description below is quoted from that published by him.

Length about 8 mm.; *colour* whitish, often with a pinkish tinge, head and siphon yellow brown.

Head little broader than long. Antenna about $\frac{1}{4}$ length of head, smooth, basal half cylindrical, distal half tapering very slightly; tuft at about $\frac{2}{5}$, with 4–5 simple branches, which are little longer than the diameter of the antenna; subapical and apical setae all placed at the tip, short and equal; apical papilla stout. Clypeal spines slender and bristle-like. Setae A, B and C all short and with simple branches, placed far forward near the level of the insertion of the antennae; A 4–5-branched from base; B and C 2–3-branched at a little beyond base; *d* very minute and placed far forwards; *e* small, 2–3-branched. Mentum with about 7 large equal teeth on each side of the centre.

Thorax.—Dorsal hairs of prothorax numerous and moderately long, longest just reaching front margin of head; the innermost 3 tufts of each side (1 triple, the other 2 double) arise from a pair of conspicuous chitinous plates; outside these plates on each side are 4 tufts with 3, 2, 1 and 4–5 branches respectively; pleural setae of prothorax placed ventrally, one moderately long, single, 2 short and single, 1 minute and branched. Mesothorax with 1 slender dorsal seta on each side; lateral setae large, with 6–8 plumose branches, which are somewhat shorter than diameter of thorax; pleural setae arising from a distinct chitinous plate, the posterior margin of which is produced and dentate; two of the setae long, stout, single and subplumose, one forming a large tuft of about 8 plumose branches, which are not much shorter than the single setae, fourth absent. Metathorax without dorsal setae; lateral setae similiar to those of mesothorax; pleural setae set on a plate similar to that of the mesothorax; two of the setae (one single, one double) very long and stout, third short, slender and simple, fourth absent.

Abdomen.—First segment with 2 lateral setae only, dorsal 3–4 branched, ventral single or double and about as long as diameter of abdomen. Second segment also with lateral setae only, but dorsal and ventral both 4–5-branched and somewhat longer than those of first segment. Third segment with lateral setae similar to those of second, but in addition with conspicuous pairs of dorsal and ventral setae,

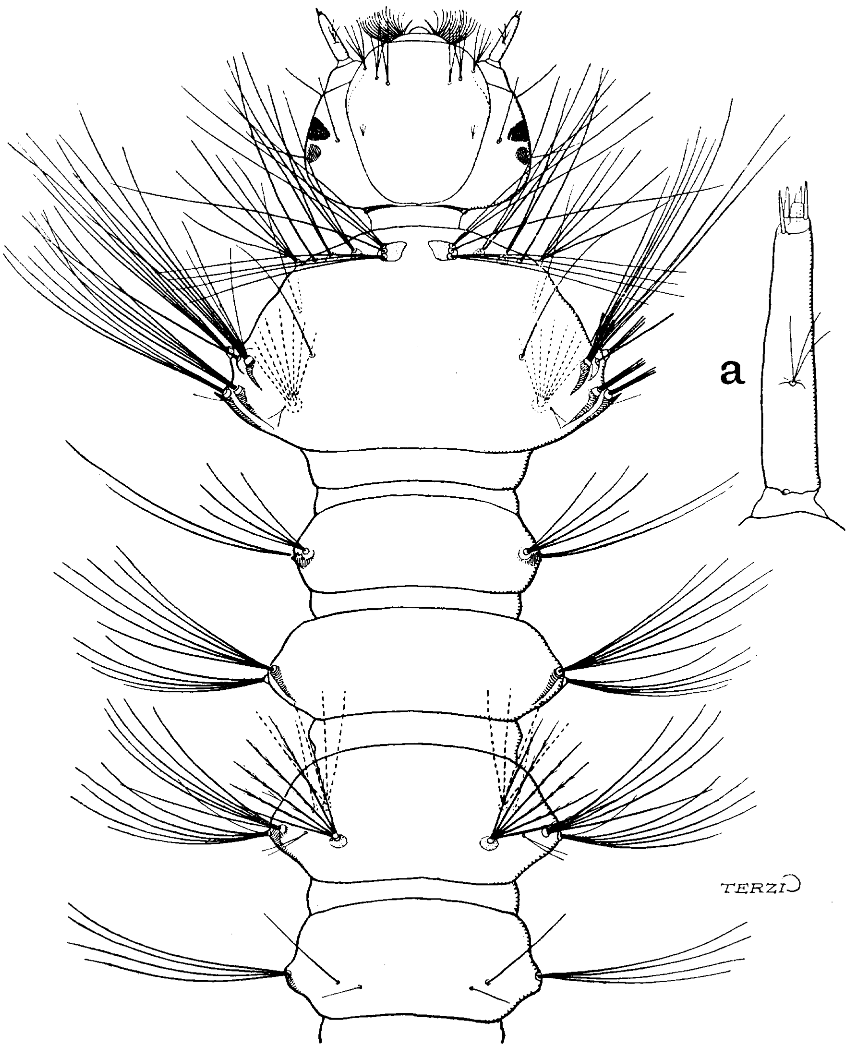

FIG. 210.—*Culex* (*Culex*) *moucheti* Evans. Head, thorax and first four abdominal segments. *a*, antenna.

forwardly directed and each 4–5-branched. Fourth segment with only 1 distinct lateral 3-branched seta (dorsal lateral seta minute), and pairs of fine, single dorsal and ventral setae. Fifth and sixth segments with lateral setae very much shorter than on preceding segments, only about $\frac{1}{3}$ as long as diameter of abdomen ; setae on seventh segment still shorter. Eighth segment with tuft B large, of 7–8 stout branches, and a pair of ventrilateral setae, ventrally directed and 2–3-branched, branches lying very close together ; the other 3 tufts present, but very minute. Comb represented by only 2 (or occasionally 3) very peculiarly shaped scales. Siphon disproportionately small, cylindrical, exceptionally short (index about 1·2) ; acus moderately large ; pecten completely absent ; subventral tufts reduced to 2 pairs, one near the base and the other (more ventrally placed) near the middle ; these tufts very short (less than $\frac{1}{4}$ diameter of siphon), but with 5–6 plumose branches. Anal segment with saddle small and not covering half lateral area of segment,

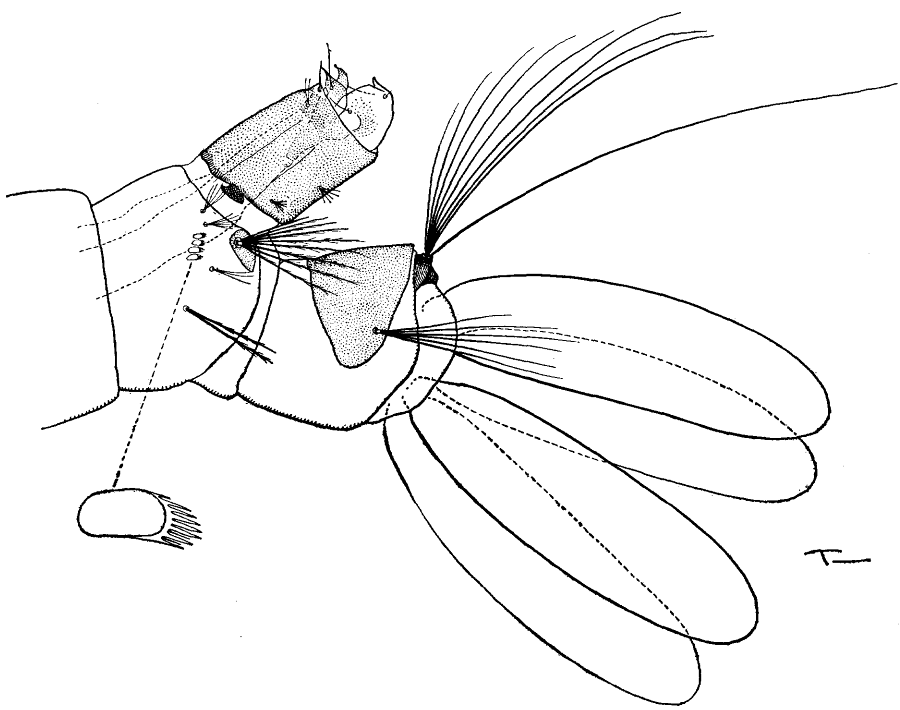

FIG. 211.—*Culex (Culex) moucheti* Evans. Terminal segments.

without spicules ; upper caudal seta 6-branched, lower single ; lateral seta very large, with 5–6 plumose branches which are considerably longer than the saddle. Ventral brush not represented by any trace whatsoever. "Gills" sausage-shaped, subequal, usually at least five times length of saddle (I suspect that the variability in size of the "gills" noted by Edwards is partly due to preservation ; the living specimens which I have seen all had them much longer than the specimen figured).

Many of the peculiar features of this larva are paralleled by other tree-hole-breeding species of *Culex*, though in the present instance we see the modifications carried to the extreme. The reduced antenna, short siphon and very long sausage-shaped "gills" are all found to some extent in *C. hancocki*, *C. nebulosus* and *C. cinereus*. These species also exhibit a tendency (specially marked in *hancocki*, where the barred area is obsolete) to reduction of the ventral brush ; reduction of the comb is marked in *hancocki*, and less so in *cinereus* ; in all the three species mentioned the pecten is considerably reduced (as I consider, in conformity with the shortening of the siphon), the number of spines varying between 3 and 6.

Breeding-places and habits.—Larvae were collected by Dr. Schwetz on two occasions from holes in fallen papaya trees (Edwards, 1929) ; the larvae obtained in Toro were found (on numerous occasions) under similar circumstances. Mr. Gillett kindly permits me to record that he once found many larvae in the evil-smelling liquid in a pit-latrine in Bwamba county, Toro, Uganda. The latrine was about 6 ft. deep and was in use. (M. Rageau has sent me larvae found in banana axils in Fr. Cameroons.—P. F. M.)

Edwards (*l. c.*) notes the presence in several mounted larvae of numerous broken hairs in the gut, and suggests (somewhat tentatively in view of his finding that the mandibles, maxillae and mouth-brushes resemble those of more normal larvae of the genus) that the larvae are predaceous. I have seen no evidence of this in larvae kept in captivity, and incline to the belief that the hairs were picked up in browsing round the bottom of the holes in which the larvae were found. This habit (so common in *Aëdes*) is also present to a marked extent in some of the tree-hole-breeding species of *Culex* ; I have often seen larvae of these species (including *C. moucheti* on the one occasion on which it has been observed) browsing on the debris at the bottom of the container, this debris including cast skins and partially decomposed bodies of their deceased comrades.

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(*Main references in bold type.*)