

246

26203
(Dup.)

THE TAXONOMIC STATUS OF THE AEDES
LEUCOCELAENUS COMPLEX WITH
DESCRIPTIONS OF TWO
NEW FORMS
(Diptera, Culicidae)

By

PEDRO GALINDO, STANLEY J. CARPENTER
AND
HAROLD TRAPIDO

Reprinted from
ANNALS OF THE ENTOMOLOGICAL SOCIETY OF AMERICA
Vol. 45, No. 4, December, 1952.

THE TAXONOMIC STATUS OF THE AEADES
LEUCOCELAENUS COMPLEX WITH
DESCRIPTIONS OF TWO
NEW FORMS

(Diptera, Culicidae)^{1, 2}

PEDRO GALINDO,³ STANLEY J. CARPENTER,⁴
AND HAROLD TRAPIDO³

The incrimination of *Aedes leucocelaenus* Dyar and Shannon as a vector of sylvan yellow fever in Brazil has stimulated interest in this mosquito, since according to Lane (1939) it has a very wide range in the American tropics, extending from Panama south to Argentina.

The species was described by Lutz (1904) from females taken in the states of Rio de Janeiro and Sao Paulo, Brazil, under the name *leucomelas*. Since this name was preoccupied by *leucomelas* Meigen, 1804, Dyar and Shannon (1924) proposed the name *leucocelaenus*.

Dyar (1928) described what he thought was the male of this species from a specimen taken in Panama, but Komp (1938) in restudying Dyar's specimens and fresh material collected by himself in Panama, came to the conclusion that the Panama form represented a distinct species, and described it under the name *leucotaeniatus*. In the same publication Komp described and figured what he considered the male of *leucocelaenus* from "three specimens, one from Brazil, one from Argentina and one from Colombia," and also gave a description of the larva from specimens obtained "at Restrepo, Colombia and at Mazaruni, British Guiana."

Later, in a personal communication to the senior author, Komp stated that he had found two forms to be present in Panama. The authors (Galindo, Trapido and Carpenter, 1950) confirmed Komp's findings and reported two species from Panama, one which was definitely established as *Aedes leucotaeniatus* Komp, and the other which was assumed to be *Aedes leucocelaenus* D. & Sh. During the dry season of 1950 we had the opportunity of mounting a large series of male terminalia, larval skins, and pupal cases of what was thought to be *A. leucocelaenus* collected by us in Panama, in the course of sylvan yellow fever investigations. In studying this material we became impressed with some wide differences which we found between the male terminalia and larval skins of our specimens, and the descriptions and figures given by Komp for his South American material. In order to determine with certainty the identity of our species, we wrote Dr. Henry Kumm requesting reared material from Brazil. Dr. Kumm was able to send

¹Studies on The Forest Mosquitoes of Panama. VI.

²Publication costs paid by the Gorgas Memorial Institute.

³Gorgas Memorial Laboratory, Apartado 1252, Panama, R. de P.

⁴Colonel M.S.C., U. S. Army Caribbean, Fort Clayton, Canal Zone.

us, through the courtesy of Dr. Waldemar Antunes of the Yellow Fever Service of Brazil, a small series of males and females with corresponding larval and pupal skins taken at Tarauaca, Territorio do Acre, Brazil, on July 26th, 1949, at Feijo, Territorio do Acre, on September 4th, 1949, labeled "*Aedes (Finlaya) leucocelaenus* Dyar and Shannon." These specimens proved to be very different from the Panama form in characters of the male terminalia, larvae and pupae. The male terminalia also differed markedly from Komp's descriptions and figures.

At this time we also became impressed with the fact that the best characters to separate the species of this group are to be found in the pupa, particularly in the shape of the paddle, its terminal hair and hair 2 of segment I (terminology of Knight and Chamberlain, 1948).

Since Territorio do Acre is located more than a thousand miles from the type locality of *leucocelaenus*, we were then still uncertain as to the true identity of this species. We therefore wrote again to Dr. Kumm asking for reared material from the type locality of *leucocelaenus*. In the absence of Dr. Kumm, Dr. Ottis R. Causey shipped us a series of males and females from the States of Rio de Janeiro and Sao Paulo (type locality of the cotype series), but unfortunately he was unable to obtain pupal cases for us. The males from the type locality proved to have terminalia similar to the Panama males. At this time we also sent illustrations of the male terminalia, larvae, and pupae of the Panama and Territorio do Acre forms to Dr. John Lane of the University of Sao Paulo, asking him to compare them with topotypical material of *A. leucocelaenus* in his collection. This Dr. Lane kindly did. He has written to us (letter dated November 27th, 1950) as follows: "Our topotypical material of *Aedes leucocelaenus* is completely different from the species which you determined as such from material collected in Territorio do Acre, Brazil, as per exam of pupal pelts. It is near (but different) from your *Aedes* n. sp. collected in Panama and Costa Rica as per pupal pelts. The shape of the paddle (in *Aedes leucocelaenus* from Sao Paulo) is evenly ovoid and *does not* show the kink from which the apical hair inserts itself. The apical hair is, at most, half as long as the length of the paddle and not about one and a half times the length of the paddle as shown in your illustration. Based on pupal characters both your illustrations show other species which, to my way of thinking, are subspecies or, better still, new species."

Subsequently we obtained associated material from Sao Paulo, sent to us by Dr. Lane, and from Rio de Janeiro, through the courtesy of Dr. H. A. Penna of the Instituto Oswaldo Cruz. A comparative study of this material with Panamanian and Costa Rican specimens reveals that the Sao Paulo and Central American forms are strikingly different, particularly in pupal characters, but that, although the greater bulk of the material from Rio de Janeiro appears exactly like the Sao Paulo form, some specimens from this locality show various degrees of intergradation. Dr. W. H. W. Komp (*in litt.*) informs us that *leucocelaenus* material studied by him from Trinidad and from Rio de Janeiro resembles closely the Central American form.

These facts lead us to believe that we are dealing with but a single species which extends from Costa Rica along the east coast of South America to Argentina and which breaks up into two subspecies at the

extreme ends of its geographical distribution, with intergrading forms occurring throughout the rest of its range.

The present status of the *leucocelaenus* group of species, in our opinion, is then as follows:

1. There is one species of the complex extending from Costa Rica, along the east coast of South America, to Argentina. This species breaks up into two subspecies at the extreme ends of its range, namely *Aedes leucocelaenus leucocelaenus* Dyar and Shannon occurring in southern Brazil and Argentina and *Aedes leucocelaenus clarki* n. ssp. which has been found in Panama and Costa Rica.

2. In Territorio do Acre, on the eastern slopes of the Andes, there is a distinct species which we are describing in this paper as *Aedes leucophoebus* n. sp., which may be separated from the true *leucocelaenus* on larval, pupal and male terminalia characters.

3. In Panama and Costa Rica, besides *Aedes leucocelaenus clarki* n. ssp. there also occurs another species, namely, *Aedes leucotaeniatus* Komp which may readily be separated from other species of the complex by larval, pupal, female and male terminalia characters.

4. The male illustrated by Komp (*loc. cit.*) without definite locality neither corresponds with the topotypical males of true *leucocelaenus* in our collection, nor with the two new forms described in this paper. Komp has informed us (in a letter to H. T. dated April 18th, 1951) that this illustration was drawn from a male taken at Restrepo, Colombia, and that a comparison of males, larvae and pupae from Restrepo, with material and figures of *Aedes leucocelaenus*, ss. pp. *Aedes leucotaeniatus*, and *Aedes leucophoebus* n. sp., reveals that the Colombian form is distinct, representing the fifth member of the complex. This new species will be described by Komp separately.

***Aedes* (Finlaya) *leucocelaenus clarki* new subspecies**

Holotype Male.—Head: Proboscis long and slender, longer than fore femur, shining black. Palpi dark and long, about four-fifths the length of the proboscis. Antennae plumose, slightly more than half as long as the proboscis. Clypeus shining black. Occiput clothed with shining black ovoid scales and a few erect forked ones posteriorly, with a median stripe of silvery scales and a narrow line of snowy white scales bordering the eye and joining a broad silvery patch below.

Thorax (Plate I, fig. G): Anterior pronotal lobes with silvery scales on anterior half and shining black scales posteriorly. Mesonotum covered with metallic black scales except for a broad median stripe and four patches of snowy white scales, two small ones located just back of the anterior angles of the mesonotum and two large ones above and directly in front of the roots of the wings. Scutellum concolorous with mesonotum with some silvery scales medianly. Pleuron black except for the following patches of snowy white scales: a small spot on the propleuron, a patch on the posterior pronotum contiguous with the patch near the anterior angle of the mesonotum, a large patch cutting across the sternopleuron and joining the two patches mentioned above to form a long broad stripe. A quadrate patch on the upper sternopleuron joining through a small group of silvery scales on the para-

tergite with the large mesonotal patch above the roots of the wings, a long bar-shaped patch cutting diagonally across the mesepimeron. (In some paratype specimens there is a short spur pointing back towards the dorsoposterior angle of this sclerite.) This patch joins the patches on the upper sternopleuron, paratergite and mesonotum to form a second broad pleural stripe. Pleural chaetotaxy as follows: three posterior pronotals, no spiraculars, a single postspiracular, a single lower sternopleural, a patch of prealars and a single isolated seta located between the prealars and the lower sternopleural. Upper mesepimerals present. Coxae with a large patch of silvery scales on anterior half. Trochanters almost entirely clothed with silvery white scales. Femora, tibiae and tarsi iridescent black except for the following silvery white markings: fore femur with two short basal narrow lines of silvery scales on the anterodorsal and anteroventral surfaces. Mid-femur with a rounded snowy white spot on the outer third of the dorsal surface joining a narrow concolorous line on the anteroventral surface which runs from the spot back to the base of the femur. Tip of femur with a silvery white spot on the dorsal surface which almost rings the joint. Hind femur entirely silvery white scaled on the dorsal surface from base to outer third; tip broadly white. Postnotum covered with white pubescence. Wing scales elongate, dark.

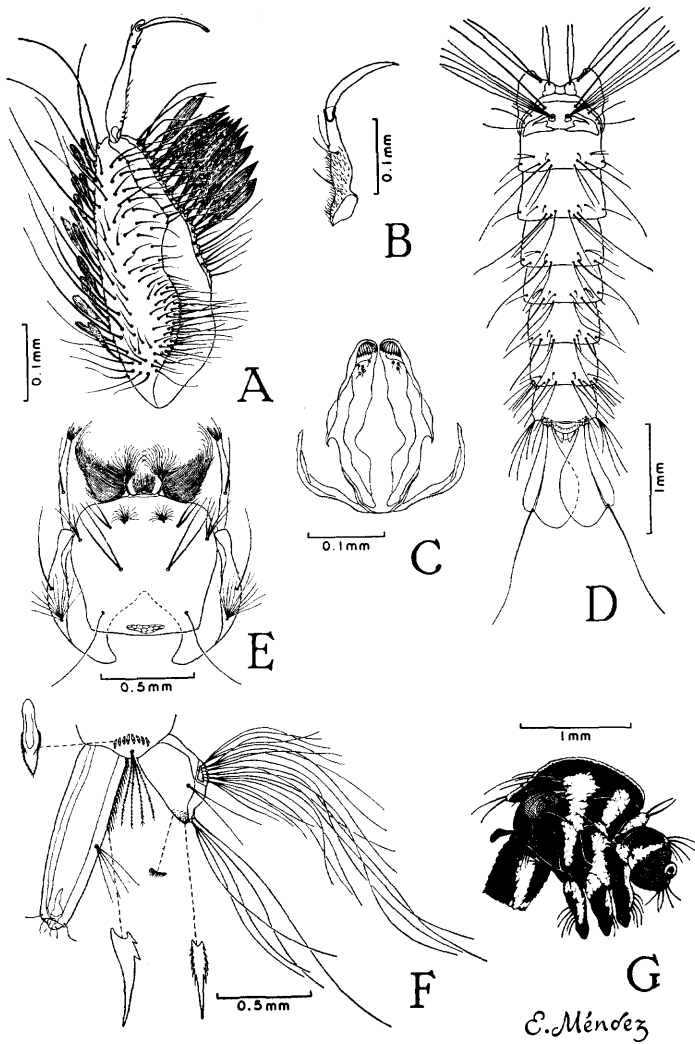
Abdomen: Tergites shining black with lateral basal white spots, those on first two segments confluent. Venter shining black with broad basal silvery white stripes, broad at the pleural line and narrowing medianly.

Male terminalia: Basistyle (Plate I, fig. A) about two and a half times longer than its greatest width. Dorsal surface with long stiff hairs and short, truncate ribbed scales. Ventral surface with abundant long petiolate ribbed pointed scales distally, and a row of long strong hairs which tend to form a patch basally. Dististyle between one-third and one-half the length of the basistyle, tapering from base to tip, with a row of fine pile on the basal ventral margin and two small setae just before the tip. Terminal spine very long more than half the length of the dististyle.

Claspette (Plate I, fig. B) short, stem curving sharply laterally before the middle so that in lateral view it appears to bulge at this point and then to taper to tip. Stem densely clothed with short hairs on basal two-thirds and with three modified setae from outstanding tubercles, (see taxonomic discussion), two from the dorsal surface, one near the base, one near the tip and a third on the ventral surface just basal to the apical dorsal seta. Filament sickle shaped, as long as the stem. Ninth tergite (Plate I, fig. C) formed by two lateral thin, broad plates united by a short thin membrane which tends to tear during dissection. Tenth sternites straight with hooded tips ending in a comb-like structure. Mesosome tubular with an excavation just before tip and two small chitinous bars on each side of it.

Female.—Coloration similar to male. Palpi short, antennae not plumose.

Larva (Plate I, fig. E).—Head globular, antennae small and glabrous, antennal hair single, inserted slightly basal of the middle of segment. Head hairs arranged as follows: "B" double, "C" single or double,



Aedes (Finlaya) leucocelaenus clarki n. sp. FIG. A. Style. FIG. B. Claspette.
FIG. C. Ninth tergite and tenth sternites. FIG. D. Abdomen of pupa (dorsal
view). FIG. E. Head of larva (dorsal view). FIG. F. Terminal segments of
larva. FIG. G. Lateral view of adult.

"A" double or triple, "e" single and long, "f" short and multiple, "d" short and multiple (Hopkins, 1936, terminology). Body integument glabrous. Subdorsal abdominal hairs in very weak, short tufts. Lateral abdominal hairs double on segments I and II, single and long on segments III to VII. Lateral comb of eighth segment (Plate I, fig. F) of eight scales in a single row. Individual scales spine-like, weakly and evenly fringed. Air-tube long for the subgenus, nearly four times as long as its basal width, slightly tapering on outer half, with some 15 to 18 pecten teeth and a short three-haired (four-haired in some paratypes) ventral tuft located slightly beyond the middle. Anal segment longer than wide, anal saddle not ringing the segment, covered with spinules on dorsoposterior angle. Anal hair as follows: dorsal tuft consisting of two branches inserted on a chitinous plate, dorsal branch a four-haired tuft, (varying from four- to eight-haired in the paratype series) ventral branch single. Lateral hair double. Ventral brush inserted on a chitinous arch which is preceded by a small triangular sclerotized plate.

Pupa (Plate I, fig. D).—Trumpet long and tubular, about five times as long as its greatest width. Abdominal chaetotaxy as follows (Knight and Chamberlain, 1948, terminology): hair 2 on segment I a long tuft with five branches, longer than the sum of the lengths of segments II and III. Hair 5 single on segments II to VII, very long on segments II, III and IV, usually as long or longer than the sum of the lengths of the two segments posterior to the one on which it is inserted, shorter on segments V, VI and VII where it only exceeds the length of the segment immediately posterior to the one on which it is inserted. Hair 2 double on segments II to VII slightly less than half the size of hair 5 on segments II, III and IV and about equal in size to this hair on segments V, VI and VII. Hairs 7 and 8 double on segment VII. Hair 8 a four-haired tuft on segment VIII. Paddles long, longer than segments VII and VIII together and fan-shaped, with an indentation at the point where the apical hair is inserted. Midrib broadening from base to apex and dividing the paddle into a narrow outer portion and a broad and rounded inner part. Apical hair single and very long, being about one and one-half times the length of the paddle.

Type Material.—*Holotype*: Pinned male with terminalia, larval and pupal skins mounted on two slides, reared from eggs laid by a female taken biting man in the forest at Tucue, Province of Cocle, Republic of Panama, on September 5th, 1950. *Allotype*: Pinned female with larval and pupal skins mounted on a slide; same data as holotype. *Paratypes*: One whole pinned male with larval and pupal skins mounted on one slide; same data as holotype. Two whole pinned males, five pinned males with terminalia mounted on slides, and four pinned females, with corresponding larval and pupal skins mounted on slides taken at La Victoria, (altitude 400 feet), Province of Panama, Republic of Panama, on June 14th, 1949; August 23rd, 1949; November 8th, 1949, January 31st 1950. One pinned male and one pinned female with male terminalia, larval and pupal skins mounted on slides taken at La Victoria, (altitude 1000 feet) on August 3rd, 1949. The types are to be deposited at U. S. National Museum, Washington, D. C.

We take pleasure in naming this subspecies for Dr. Herbert C. Clark, Director of the Gorgas Memorial Laboratory.

***Aedes (Finlaya) leucophoebus* n. sp.**

Holotype Male.—Coloration and morphology as described for *A. leucocelaenus clarki* except for the silvery patch on mesepimeron which in the holotype and one paratype male shows a more pronounced spur pointing back toward the dorsoposterior angle of the sclerite, being thus intermediate between *A. leucocelaenus clarki* and *A. leucocelaeniatus* (Plate II, fig. G).

Male terminalia (Plate II, fig. A): Basistyle short, sharply tapering toward tip. Ventral distal margin with abundant long, petiolate ribbed scales and a row of long, strong, evenly distributed hairs. A patch of long, very strong hairs near the base. Dorsal surface with scattered long setae (no scales were noted in this area in the two preparations examined). Dististyle between one-third and one-half the length of the basistyle, sinuate and narrow with a row of fine pile on the inner margin extending for two-thirds of its length, and a stronger seta on the lateral inner aspect just before the tip. Terminal spine very long about one half the length of the clasper. Claspette (Plate II, fig. B) slender, stem curving laterally before the middle and then bending ventrally just before apex, densely clothed on basal two-thirds with fine setae and bearing two stronger differentiated hairs on the dorsal margin, one rather long arising near the base of the stem, and the second one weaker and shorter arising just before the ventral curvature of the stem on the outer third. Filament sickle-shaped tapering abruptly from base to tip, about two-thirds the length of the stem. Ninth tergite (Plate II, fig. C) with two thin, broad lateral plates joined in the center by a long sclerotized bar. Tenth sternites and mesosome as in *A. leucocelaenus clarki*.

Female.—Similar in shape and coloration to male. Antennae not plumose. Palpi very short.

Larva (Plate II, fig. E).—Head as in *A. leucocelaenus clarki*. Thorax and abdomen with integument glabrous. Subdorsal abdominal hairs in long strong tufts. Lateral abdominal hairs double or triple on first and second segments, double on third to sixth segments, single on seventh. Lateral comb of eighth segment (Plate II, fig. F) of six scales (eight in paratype) in a single row; individual scales tapering to tip, weakly and evenly fringed. Air-tube short, about two and one-half times as long as wide at the base, slightly tapering beyond the middle. Pecten of some eighteen evenly spaced teeth reaching slightly beyond the middle and followed by a tuft of three short hairs. Anal segment slightly longer than broad, not ringed by the anal saddle, which extends well down the sides of the segment and is fringed on its dorso-posterior angle by short spinules. Dorsal tuft consisting of two branches which originate on a small chitinous plate; dorsal branch long and double, ventral branch single and somewhat longer. Lateral hair double. Ventral brush inserted on a chitinous arch which is preceded by a small, triangular sclerotized plate.

Pupa (Plate II, fig. D).—Trumpet tubular and dark, about three to four times the length of the greatest width. Abdominal chaetotaxy as follows: hair 2 on segment I a short palmate tuft. Hairs 2 and 5 on segments II to VII, short two to five-haired tufts, in each case shorter

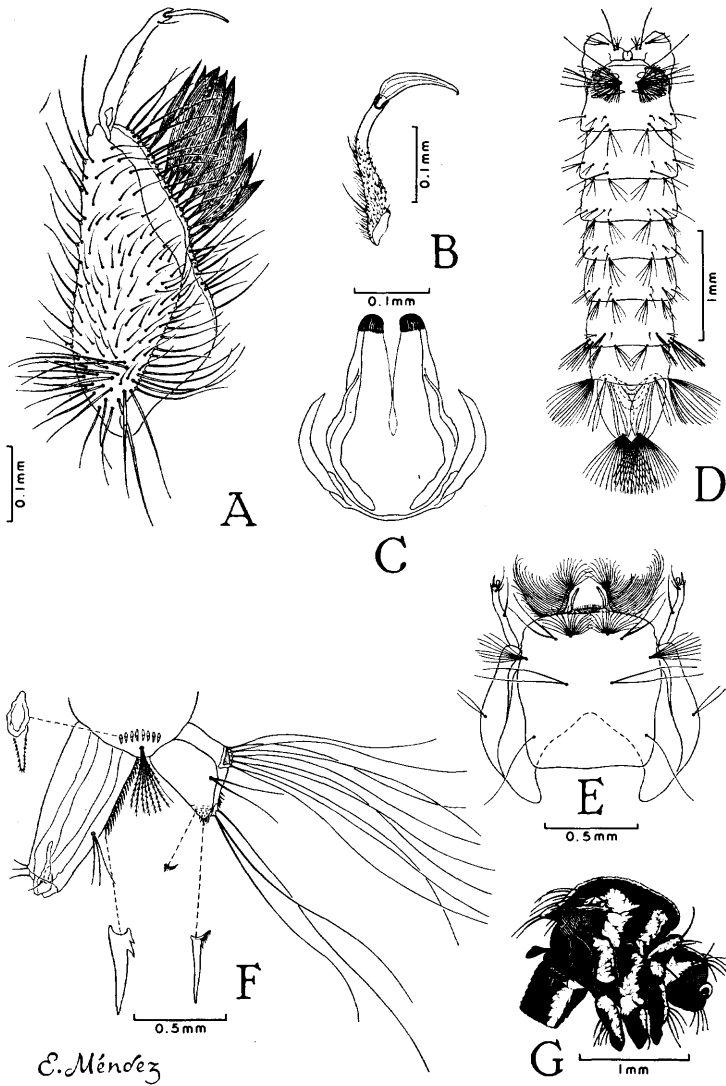
than the segment immediately posterior to the one on which they are inserted. Hair 4 single on segments II to VII, the one on segment II about as long as segment III, those on other segments progressively smaller. Hairs 7 and 8 on segment VII short four- or five-branched tufts. Hair 8 on segment VIII a conspicuous multiple tuft. Paddles narrow, elliptical, with inner borders barely overlapping. Midrib running down the center of a wide clear space, splitting paddle into nearly equal halves. Apical hair a conspicuous multiple tuft about the length of paddle and inserted slightly subapically.

Type Material.—*Holotype*: Pinned male, with terminalia, larval and pupal skins mounted on two slides. Taken at Feijó, Territorio do Acre, Brazil, on August 4th, 1949. *Allotype*: Pinned female with larval and pupal skins mounted on a slide. Taken at Tarauacá, Territorio do Acre, Brazil, on July 26th, 1949. *Paratype*: Pinned male with terminalia mounted on a slide, and with same data as holotype. All type material collected by the Yellow Fever Service of Brazil and sent to the authors through the courtesy of Dr. Waldemar Antunes and Dr. Henry Kumm. Holotype to be deposited with Dr. John Lane at the Faculdade de Higiene e Saude Publica, University of Sao Paulo, Sao Paulo, Brazil. Allotype and paratype at the U. S. National Museum, Washington, D. C.

Aedes (*Finlaya*) *leucotaeniatus* Komp

Male.—Coloration as in *A. leucocelaenus clarki* except for silvery white patch on mesepimeron which is angled, taking the shape of an inverted reversed "L" (Plate III, fig. G).

Male terminalia (Plate III, fig. A): Basistyle slightly over twice as long as its greatest width, tapering to the tip. Ventral distal margin with many long lanceolate ribbed nearly sessile scales, and with abundant hairs forming two definite patches, a small one near the apex and a large one which extends from the base, two-thirds the length of the basistyle. Dorsal aspect with many narrow truncate ribbed scales and some stiff long hairs. Dististyle sinuate, between one-third and one-half as long as the basistyle. Inner and outer margins with rows of very fine pile extending for two-thirds of its length. A short seta from a conspicuous base is present on the inner aspect near the apex. Spine moderate, one-third the length of the dististyle, tapering to tip. Claspette (Plate III, fig. B) with long and slender stem slightly curving ventrally and laterally just beyond the middle, clothed nearly to apex with very fine and short hairs and bearing four modified setae as follows: one short straight hair on the basal third of the dorsal margin, arising from a slight prominence on the stem; two very strong and long curved setae on the ventral aspect near the tip of the stem, arising from conspicuous and closely appressed bases and reaching nearly to the tip of the filament; a fourth seta arises from the dorsal margin just below the level of the two strong ventral setae. Filament broad, with flat upper surface, about half as long as the stem and with a retrorse point on the posterodorsal corner and with fine striations all along its surface. Ninth tergite (Plate III, fig. C) a broad chitinous bar with two lateral membranous lobes densely clothed with very fine and short hairs.



Aedes (Finlaya) leucophoebus n. sp. FIG. A. Style. FIG. B. Claspette. FIG. C. Ninth tergite and tenth sternites. FIG. D. Abdomen of pupa (dorsal view). FIG. E. Head of larva (dorsal view). FIG. F. Terminal segments of larva. FIG. G. Lateral view of adult.

Tenth sternites normal, hooded at tip and terminating in a comb-shaped structure. Mesosome as in *clarki* and *leucophoebus*.

Larva (Plate III, fig. E).—Head as in *clarki* and *leucophoebus*, except for hairs "B" and "C" which are single instead of double. Integument of body glabrous. Lateral abdominal hairs triple on segments I and II, double on segments III to VI and single or double on segment VII. Subdorsal abdominal hairs in long tufts. Lateral comb of eighth segment (Plate III, fig. F) of from six to eight scales in a single row. Individual scales tapering to an obtuse point and weakly fringed. Air tube slightly bulging at the middle and then tapering to tip, three times as long as its basal width. Pecten of some fifteen to twenty closely appressed evenly spaced teeth reaching slightly beyond the basal third of tube, and followed by a tuft of two long hairs inserted at about middle of tube. Anal segment longer than wide. Anal saddle not ringing the segment but reaching well down the sides of it, fringed on its posterodorsal angle with a patch of spinules. Dorsal tuft arising in two branches from a small chitinous plate, dorsal branch four-haired, ventral branch single. Lateral anal hair double, long. Ventral brush arising from a chitinous arch which is preceded by a small, triangular sclerotized plate.

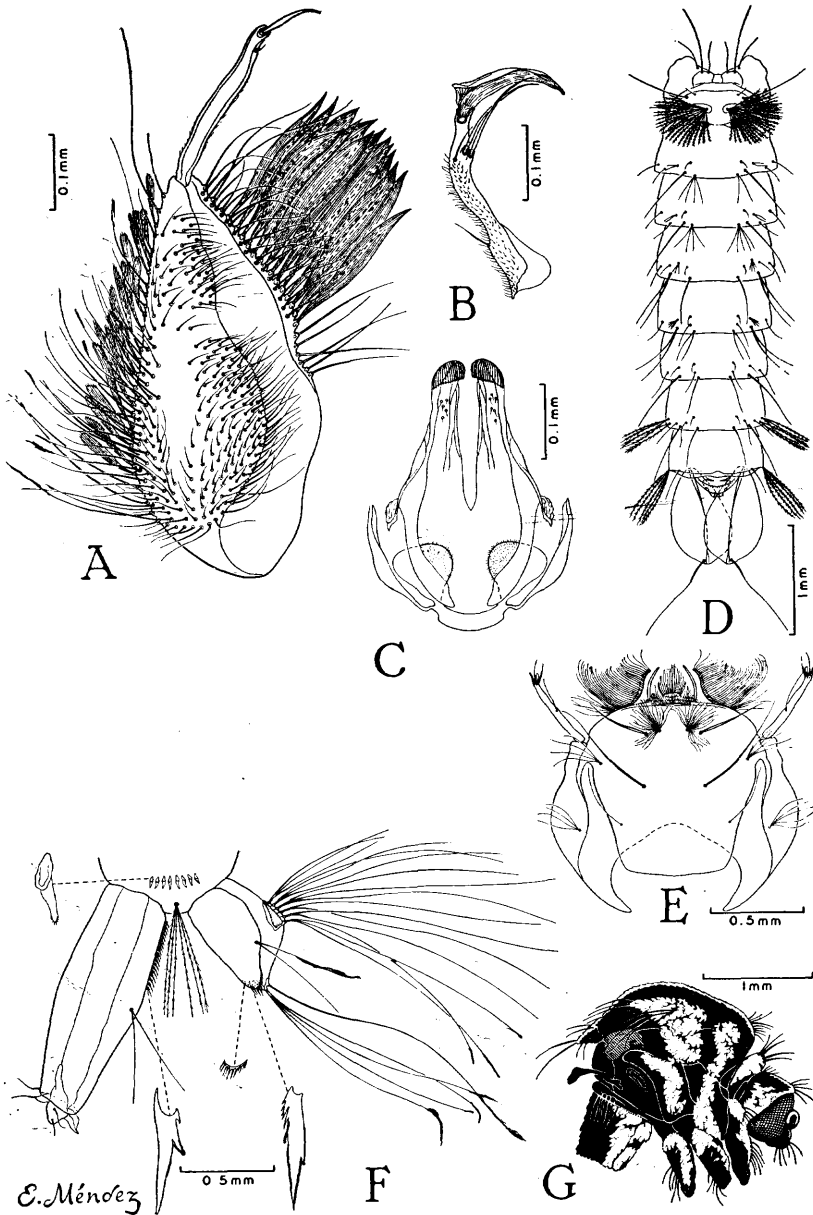
Pupa (Plate III, fig. D).—Trumpets short, barely three times as long as their greatest width. Dorsal abdominal chaetotaxy as follows: hair 2 of segment I a large, multiple palmate tuft. On segments II and III this hair is two- to four-branched and short, being approximately half the length of the succeeding segment; on segments IV to VII it is single or double and slightly shorter than the length of segment immediately following. Hair 5 single on segments II and III, single or double on segments IV to VII, slightly longer than the length of the segment immediately following the one on which it is inserted. Hair 8 on segment VIII a multiple conspicuous frayed tuft. Paddles ovoid and fairly long, being as long as the total length of segments VII and VIII. Midrib narrow but quite pronounced, splitting the paddle into two nearly equal halves. Apical hair single, about the length of the paddle and inserted slightly subapically.

Material Examined.—Eighteen males and twenty-four females with associated larval and pupal skins, taken at La Victoria, Province of Panama; Buena Vista, Province of Colon; Cerro Campana, Province of Panama; Tucue, Province of Coclé and Bijao, Province of Chiriquí: all in the Republic of Panama.

TAXONOMIC DISCUSSION

As was pointed out in the introduction, there appear to be at least five forms in the *Aedes leucocelaenus* complex, four of which are discussed in this paper, namely: *Aedes (Finlaya) leucocelaenus leucocelaenus* Dyar and Shannon, 1924; *Aedes (Finlaya) leucocelaenus clarki* n. ssp.; *Aedes (Finlaya) leucotaeniatus* Komp, 1938; *Aedes (Finlaya) leucophoebus* n. sp., which may be separated from each other by the characters described below.

Adult.—Adults of *leucotaeniatus* and *leucocelaenus clarki* may be separated with relative ease by the white marking on the mesepimeron. In *leucotaeniatus* this marking takes the form of an inverted reversed



Aedes (Finlaya) leucotaeniatus Komp. FIG. A. Style. FIG. B. Claspette. FIG. C. Ninth tergite and tenth sternites. FIG. D. Abdomen of pupa (dorsal view). FIG. E. Head of larva (dorsal view). FIG. F. Terminal segments of larva. FIG. G. Lateral view of adult.

"L" (Plate III, fig. G) while in *leucocelaenus clarki* it is bar-shaped (Plate I, fig. G), occasionally showing a small spur pointing back toward the dorsoposterior angle of the sclerite, but never approaching the form of the inverted reversed "L" which we have noted for *leucotaeniatus*. In the field these two species can be easily separated by size alone, as *leucotaeniatus* is a large species, the average specimen being twice as large as the average specimen of *leucocelaenus clarki*. We have not had an adequate series of *leucocelaenus leucocelaenus* or *leucophoebus* to judge possible variations in the shape of the white mesepimeral marking, but in the specimens examined of both species, the shape of this marking appears intermediate between the conditions found in *leucotaeniatus* and *leucocelaenus clarki*, but possibly closer to *leucotaeniatus*. In size *leucophoebus* and *leucocelaenus leucocelaenus* also appear to be intermediate between the other two members of the complex.

Male terminalia.—We have not been able to find any characters of the male terminalia to separate with certainty *leucocelaenus clarki* from *leucocelaenus leucocelaenus*. The number of setae on the stem of the claspette seems to separate the great majority of the specimens, but it is a variable character. We have mounted and studied the terminalia of thirty-seven specimens of *leucocelaenus clarki* from Panama; of these, thirty-four have but three outstanding setae on the stem of the claspette, two specimens have four setae on one claspette and three on the other, while one specimen has four setae on both claspettes. Of the nine terminalia studied from Rio de Janeiro and Sao Paulo, Brazil, seven show four setae on both claspettes, while two appear with four setae on one claspette and three on the other, these two specimens being from Rio de Janeiro.

The two subspecies of *leucocelaenus* may be separated from *leucophoebus* by the following characters. In *leucocelaenus* the blade of the claspette is about the size of the stem, while in *leucophoebus* it is much shorter than the stem. The shape of the blade also differs in these species as shown in the figures. In *leucocelaenus* the stem of the claspette has a single curvature while in *leucophoebus* it curves laterally and ventrally. In *leucocelaenus* there are three or four outstanding setae on the stem of the claspette while in *leucophoebus* there are only two of these setae. The species may be also separated on the morphology of the ninth tergite; in *leucocelaenus* the ninth tergite is made up of two lateral thin, broad plates joined in the center by a short and thin membrane which tends to tear during dissection, while in *leucophoebus* the two lateral plates are joined by a rather long sclerotized bar.

Aedes leucotaeniatus may be easily separated from the other members of the complex on male terminalia characters as shown in the figures. The main characters for separation are to be found in the shape and chaetotaxy of the claspette. There are also present in *leucotaeniatus* two lateral hairy, membranous lobes on the ninth tergite, as noted by Komp (*loc. cit.*), which are absent in the other species.

Larva.—The larva of *leucocelaenus clarki* may easily be separated from the other members of the complex by the relative length of the air-tube. In *leucocelaenus clarki* the tube is long, being four times as long as its basal width, while in the other known members of the complex the proportion of length to basal width is three to one at most. Larvae

of *leucocelaenus clarki* can further be separated from those of *leucocelaenus leucocelaenus* and of *leucophoebus* by the branching of the dorsal anal hair. In *clarki* this hair has from four to eight branches while in *leucocelaenus leucocelaenus* and *leucophoebus* it only has two or three ramifications.

The larva of *leucophoebus* differs from that of *leucocelaenus leucocelaenus* and of *leucotaeniatius* by the following characters. In *leucophoebus* the air tube is about two and one-half times as long as its basal width, while in *l. leucocelaenus* and *leucotaeniatius* the proportion is three to one. In *leucophoebus* the ventral tuft of the air-tube is short and three-haired, being much shorter than the length of the anal segment, while in *l. leucocelaenus* and in *leucotaeniatius* this tuft is longer than the anal segment and has two branches. Finally the dorsal anal tuft has two branches in *leucophoebus*, three in *l. leucocelaenus* and four in *leucotaeniatius*.

Pupa.—*Aedes leucocelaenus clarki* n. ssp. may be separated from *leucocelaenus leucocelaenus*, *leucophoebus* and *leucotaeniatius* by the shape of the paddles which in *l. clarki* are fan-shaped and markedly asymmetrical, showing a concave indentation at the point where the apical hair is inserted, while in the other three members of the complex the paddles are elliptical or ovoid in shape and barely asymmetrical. *A. leucocelaenus clarki* also differs in that hair 2 of segment I is represented by a long four to six-haired tuft pointing forward over the cephalothorax. This hair tuft is longer than the sum of the lengths of segments II and III, while in the other species it is the usual palmate tuft.

As pointed out in the introduction, pupae of *leucocelaenus* from Rio de Janeiro show various degrees of intergradation between typical *leucocelaenus* from Sao Paulo and typical *clarki* from Panama, particularly in the shape of the paddles and in hair 2 of segment I.

Aedes leucophoebus may be differentiated from all other members of the complex by the shape of the paddles which are small and elliptical and by the apical hair which is a short, multiple tuft.

The pupae of typical *l. leucocelaenus* and of *leucotaeniatius* appear very close and the only reliable character which we have found to separate them with certainty is the pigmentation of the integument of abdominal segments II and III. In *leucotaeniatius* these segments are evenly colored, while in *l. leucocelaenus* they appear with a pigmented area of varying size and intensity extending lengthwise along the middle of these segments.

LITERATURE CITED

- Dyar, Harrison G. 1928. The mosquitoes of the Americas. Carnegie Inst. Washington, Pub. no. 387: 1-616, pls. i-cxxii.
- Dyar, Harrison G., and R. C. Shannon. 1924. The subfamilies, tribes and genera of American Culicidae. Jour. Washington Acad. Sci., 14: 472-486.
- Galindo, Pedro, Harold Trapido, and S. J. Carpenter. 1950. Observations on diurnal forest mosquitoes in relation to sylvan yellow fever in Panama. (Studies on forest mosquitoes of Panama. II.) Amer. Jour. Trop. Med., 30(4): 533-574.
- Hopkins, G. H. E. 1936. Mosquitoes of the Ethiopian region. I. Larval biology of mosquitoes and taxonomy of culicine larvae. Pp. viii+250, 158 figs. Brit. Mus. (Nat. Hist.).

- Knight, K. L., and R. W. Chamberlain.** 1948. A new nomenclature for the chaetotaxy of the mosquito pupae, based on a comparative study of the genera. (Diptera, Culicidae). *Proc. Helminth. Soc. Washington*, 15: 1-18.
- Komp, W. H. W.** 1938. *Aedes leucotaeniatus*, a new species of *Aedes* allied to *A. leucocelaenus* D. & S.; and descriptions of the male and larva of *A. leucocelaenus* D. & S. (Diptera, Culicidae). *Proc. Ent. Soc. Washington*, 40(8): 260-266.
- Lane, John.** 1939. Catalogo dos mosquitos neotropicos. *Bol. Biol., Sao Paulo. Ser. Monogr. I.* Pp. xiv+218.
- Lutz, A.** 1904. *In* Bourroul, C., Mosquitos do Brasil. Faculdade de Medicina da Bahia, These de Doutorado. Bahia, Brasil.