Contributions of the American Entomological Institute

Volume 7, Number 1, 1970

MOSQUITO STUDIES (Diptera, Culicidae)

XXII. A new subgenus and species of Aedes from Arizona. By Thomas J. Zavortink
XXIII. Additions and corrections to the revision of the Aedes terrens group. By Robert X. Schick

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(Continued on back cover)

MOSQUITO STUDIES (Diptera, Culicidae)

XXII. A NEW SUBGENUS AND SPECIES OF AEDES FROM ARIZONA[1]

by

Thomas J. Zavortink[2]

In June 1969, John F. Burger of the University of Arizona sent a single female of a very unusual mosquito with a mesonotal pattern superficially similar to that of *Aedes aegypti* to John N. Belkin at the University of California at Los Angeles. The specimen had been collected in the Coyote Mountains, Pima County, Arizona, by Martha L. Noller, also of the University of Arizona. Several members of the "Mosquitoes of Middle America" project staff examined the specimen and concluded that it was an undescribed species of *Aedes* so distinct from other known New World forms that it should probably be recognized at the subgeneric level. From the highly ornamented nature of the adult it was surmised that the immature stages would be found in treeholes or rockholes. After both Mr. Burger and Miss Noller kindly provided additional information about Mendoza Canyon, where the mosquito had been taken, and furnished directions for getting to the area, I visited the region and collected for a few days during the first week in September 1969. Although mosquito larvae and pupae were collected from numerous treeholes and rockholes and many biting adult mosquitoes were caught, the new form was not found. In late December 1969, Lewis T. Nielsen of the University of Utah and I revisited Mendoza Canyon and collected water and debris from a large number of treeholes. The material which we gathered was divided and portions of it were reared at the University of Utah and portions at the University of California at Los Angeles. Although no specimens of the unusual new species were recovered from the material reared in Utah, 2 males and 3 females with associated larval and pupal skins were reared in Los Angeles from eggs taken from an oak treehole by Dr. Nielsen. Study of these additional specimens, particularly the immature stages and males, supports the original conjecture that this new species should be placed into a separate subgenus of *Aedes*. The new subgenus, *Abraedes*, is briefly diagnosed and the species, *papago*, is fully described below.

The limited material presently available does not permit preparation of slides of adults and, consequently, no drawings of adult morphology are presented here. It is hoped that such drawings can be included in a future revision of the New World treehole and rockhole *Aedes*.

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[1] Contribution from project "Mosquitoes of Middle America" supported by U.S. Public Health Service Research Grant AI-04379 and U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478.

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I am grateful to John N. Belkin for his counsel in the preparation of this paper. I thank William A. Powder for help in the rearing and preparation of specimens, L. Margaret Kowalczyk for preparation of the preliminary and final illustrations and Caryle Abrams for typing the preliminary drafts and the final copy for lithoprinting. It is a pleasure to acknowledge the invaluable help of John F. Burger and Martha L. Noller of the University of Arizona and Lewis T. Nielsen of the University of Utah; without their cooperation, as noted above, the present study would not have been possible.

ABRAEDES, new subgenus

TYPE SPECIES: **Aedes (Abraedes) papago, n.sp.**

FEMALE. Highly ornamented; integument of head and thorax dark brown to black, strongly contrasting with yellowish to amber integument of abdomen.

Head: Eyes broadly separated above antennae, the space with broad flat silvery scales. Decumbent scales of vertex broad and flat. Erect scales of vertex few in number. Proboscis conspicuously longer than forefemur. Palpus short, 0.26-0.29 length of proboscis; apparently 4-segmented. Antenna subequal to proboscis in length.

Thorax: Long rows of acrostichal and dorsocentral bristles present. Mesonotum with narrow scales; dark with conspicuous pattern of white and silvery lines superficially similar to that of *Aedes aegypti*. Scutellar lobes with patches of large broad flat silvery scales. Paratergite moderately broad; with broad flat silvery scales in lower anterior portion. Pleural bristles absent on lower *mep*, few on *stp*. Pleuron with broad flat silvery scales in small dense patches or lines.

Legs: Disproportionately short. Tarsi conspicuously marked with white bands or rings. Claws simple.

Wing: Plume scales present on dorsum of veins Rs, R_{2+3}, R_2, R_3, middle 0.60-0.70 of M and sometimes apical portion of 1A.

Abdomen: Distal tergites and sternites with dense lateral patches of outstanding black and iridescent silvery scales; tergites VI and VII with large bristly submedian apical scaleless area. Sternite VIII large, exserted, nearly devoid of scales, but with numerous setae. Genitalia deeply retracted, only dark tips of cerci projecting from sternite VIII.

MALE. Similar to female except for sexual characters. Palpus subequal to proboscis in length; 5-segmented; segments 4 and 5 bent ventrad. Antenna slightly shorter than proboscis; torus enlarged; flagellum strongly plumose. Larger claw of foreleg and midleg toothed. Apical abdominal segments and genitalia bent ventrad. Tergite VIII short, only 0.70-0.78 length of sternite VIII; largely retracted; with only a few apical black scales.

MALE GENITALIA. Tergite IX very poorly developed, short, without lobes; 1 or 2 fine submedian setae on each side. Sidepiece without basal or apical lobes; sternomesal surface without specialized scales. Claspette filament developed, long, simple. Aedeagus subparallel-sided in basal half, bulbous in distal half in dorsal aspect. Proctiger unusually long in dorsal aspect; without the normal dorsal lobe of the basolateral sclerotization.

PUPA. No cephalothoracic hairs elongate. Trumpet short; tracheoid virtually absent. Hair 1-II farther from midline than 1-I. Hair 2-I-VII relatively long and strong;

usually mesocephalad of hair 1 on segments III-V. Hair 5-IV-VI shorter than corresponding tergite. Hair 9-II-VI relatively long and strong, becoming longer on posterior segments; usually cephalad of level of hair 6 on segments II-IV, cephalad or caudad of level of hair 6 on V, caudad of level of hair 6 on VI. Hair 9-VIII relatively far mesad of caudolateral angle of segment. Paddle deeply emarginate; outer margin distad of external buttress and inner margin with long filamentous spicules.

LARVA. Length and width of head subequal. Labial plate subquadrate. Hairs 5,7-C at about level of antennal base. Hairs 5-7-P on separate tubercles. Hair 2-III-V usually mesocephalad of hair 1. Hair 3-VII relatively short, not reaching base of siphon. Hair 12-I absent. Hair 13-VI relatively long, usually double or triple (2-4), laterad and usually caudad of 10-VI. Comb scales large; few (4 or 5); consisting of an elongate to oval plate from which 1 or rarely 2 large unfringed spines and several smaller spines project. Siphon short; without acus. Caudal margin of anal saddle without strong spines. Ventral brush weakly developed; with 5 pairs of hairs from irregular basal boss; hair 4a-X short, multiple.

DISCUSSION. See *papago* below.

Aedes (Abraedes) papago, n.sp.

Figs. 1,2

TYPES: *Holotype* male (UCLA 550-39) with slides of associated larval and pupal skins and genitalia, Mendoza Canyon, Coyote Mountains, Pima County, Arizona (31°59′ N, 111°30′ to 111°31′ W), elevation about 1070 m, egg obtained from a rothole in a living evergreen oak tree, 28 Dec 1969, L.T. Nielsen [USNM]. *Allotype* female (UCLA 550-33) with slide of associated larval and pupal skins, same data as holotype [USNM]. *Paratypes*: 1 lpM (550-36), 2 lpF (550-37,38), same data as holotype [UCLA]; 1 F, E slope Coyote Mts., Pima Co., Arizona, 3500 ft, 13 Aug 1968, M.L. Noller [ARIZ].

FEMALE. Wing: 3.15 mm. Proboscis: 2.06 mm. Forefemur: 1.65 mm. Abdomen: about 3.2 mm.

Head: Integument dark brown to black. Frontal bristles absent. Orbital bristles 10-13 pairs. Ocular border of broad flat silvery scales. Ornamentation complex, consisting of white median longitudinal line bordered on each side by 3 progressively smaller black patches alternating with 3 progressively smaller white to silver-white patches; posterior portion of submedian black patch usually with some white scales; occiput with narrow curved white scales. Underside of head usually with silver-white scales. Erect scales of vertex largely restricted to anterior portion of submedian dark patch, black, some elongate and narrow, some proclinate; erect scales of occiput numerous, entirely or largely black, moderately long and broad. Clypeus moderate in size, bare. Proboscis scales predominantly black with metallic coppery to green reflections; white speckles in middle portion, especially dorsally. Palpus black scaled with white patch at base of segment 3; white patch covering all of segment 4; usually with white speckles or patch on segment 2. Torus with large dorsomesal patch of broad silvery scales; flagellar segment 1 with mesal line of white scales.

Thorax: Integument largely dark brown to black. Mesonotum with numerous long, strong, dark bristles; humeral, lateral prescutal, posterior fossal, supraalar and parascutellar bristles present. Scutellum with 4-6 well developed bristles on midlobe and 3-7 well developed bristles on lateral lobe. Mesonotal background of small dark brown to black curved scales which become larger and broader laterally and posteriorly. Conspicuous pattern of narrow white or silvery lines as follows: (1) a long para-acrostichal line of narrow white to silver-white scales from anterior promontory to near level of wing root; becoming narrower and slightly converging towards its mate posteriorly, (2) a more or less continuous line of enlarged silvery scales from humeral angle to scutellum via scutal suture and outer posterior dorsocentral line; scales denser in posterior part of line; line not broadened in area of scutal angle, (3) a nearly transverse patch of large silvery scales in front of wing root, (4) a short median acrostichal line of white to silver-white scales from about level of end of para-acrostichal line to prescutellar bare space, (5) a tuft of silver-white scales on anterior promontory, (6) an irregular patch of large silvery scales behind scutal angle, and (7) sometimes enlarged silvery scales in a patch at anterior end of prescutellar bare space or in a narrow lateral prescutellar line. Pleuron with bristles on *apn*, *ppn*, *ppl*, *psp*, *stp*, *pra* and upper *mep*; *ssp* bristles absent. Pleural scales forming a long more or less continuous silvery diagonal line from upper anterior *apn* across lower *ppn*, *ssp* and upper middle *stp* to lower posterior portion of *mep*; additional silvery patches on upper and lower *pst*, *ppl*, upper portion of *pcx*, *pra*, lower posterior *stp* and upper *mep*; longer nearly horizontal silvery line across middle portion of *stp*; *ppn* usually with a few silvery scales, sometimes bare; *psp* and metameron usually without scales.

Legs: Integument of coxae dark brown to black. Coxal bristles normal. All coxae with patches of broad flat silvery scales, as follows: (1) forecoxa with upper and lower anterior patches, (2) midcoxa with small upper posterior, middle anterior and lower anterior patches, (3) hindcoxa usually with large patch from upper portion to middle of anterior surface and small lower anterior and lower posterior patches; forecoxa with black scales between silvery patches. All trochanters with black and white scales. Femora predominantly black scaled on all surfaces of all legs; many black scales, particularly on midfemur and hindfemur, with metallic silvery, light green, blue or violet reflections; forefemur with incomplete narrow subbasal oblique white band and numerous scattered white scales; midfemur and hindfemur with usually complete narrow subbasal oblique white ring and fewer scattered white scales. Knee spots small, usually incomplete on forefemur. Tibiae predominantly black scaled, with slight metallic green, blue or violet reflections; all tibiae with narrow to moderately broad dorsally incomplete basal white band; foretibia and midtibia with narrow white ring or band 0.25-0.33 distance from base; hindtibia with broader white ring 0.45-0.50 distance from base. Tarsi black scaled, with conspicuous white dorsal patches, bands or rings, as follows: (1) foretarsus with moderately broad patch or band at base of segment 1 and smaller patch at base of segment 2 and usually segment 3, (2) midtarsus with moderately broad basal band or ring on segment 1 and small patch at base of segment 2 and sometimes segment 3, and (3) hindtarsus with moderately broad subbasal white band or ring on segment 1, moderately broad basal band or ring on segments 2 and 3 and moderately broad basal patch or band on segments 4 and 5. Claws of all legs subequal in size, small, simple.

Wing: Dark scaled except for a white line in basal 0.16-0.20 of anterior surface of costal vein.

Haltere: Integument light tan. Stem black scaled distally. Knob black and white scaled.

Abdomen: Integument predominantly very light, yellowish white to amber. Silvery and, to lesser extent, dark scales with light metallic coppery, green, blue or violet reflections. Tergite I with numerous dark scales dorsally; laterotergite with large patch of silver-white scales. Tergites II-VIII predominantly dark scaled, with lateral basal or subbasal silvery patch followed distally by lateral patch of black scales; scales of lateral patches becoming progressively denser and more outstanding on distal segments; tergites VI and VII with outstanding black scales middorsally; tergite VIII with dense outstanding black scales and long apical setae which project beyond apices of cercal setae. Sternite I bare. Sternites II-IV variably scaled, sometimes largely bare, usually with at least a few dark or black scales apically, sometimes with small lateral subbasal or median silvery patch. Sternites V-VII usually at least partly bare basally, black scaled apically and with lateral median silvery patch; scales becoming progressively denser and more outstanding on distal segments.

MALE. Essentially as in female except for sexual characters.

Head: White speckling of proboscis reduced or absent. Palpal segments 2 and 3 ankylosed, long, making up about 0.67 length of palpus; segment 4 short, about 0.16 length of palpus; segment 5 short, about 0.12 length of palpus; slender except for slightly swollen apex of segment 3; apex of segment 3 and all of segments 4 and 5 with bristles; dark scaled except for conspicuous dorsal white patch or band near base of segment 2 and at base of segments 3-5. Torus with silvery scales dorsomesally; flagellar segment 1 with small scales.

Legs: Anterior foreclaw and midclaw large, with a single long slender subbasal tooth; posterior foreclaw and midclaw medium sized, simple; hindclaws small, simple.

Abdomen: Scaling of sternite VIII similar to tergite VIII of female.

MALE GENITALIA (fig. 1). Unusually colored, segment IX, proctiger, phallosome, claspette and clasper largely very weakly pigmented, yellowish; sidepiece and spiniform more deeply pigmented, light brown; apex of paraproct black.

Segment IX: Tergite without the normal integumentary spicules middorsally. Sternite well developed, long, with numerous strong setae distally.

Sidepiece: Well developed, relatively long and slender, more or less spindle shaped. Mesal surface membranous from base to apex. Basal tergomesal area not swollen, without clumped or enlarged bristles, but with normal bristles of dorsal surface of sidepiece shorter and slightly more numerous. Median sternomesal sclerite not developed. Distal dorsomesal surface with short setae; dorsal surface, distal lateral surface and ventral surface with long bristles. Dorsal surface with dark scales among bristles; basal portion of dorsolateral and lateral surfaces with dense broad silver-white scales with iridescent coppery, green, blue or violet reflections; distal portion of lateral surface with dense broad dark scales.

Claspette: Well developed. Stem moderately long, bent mesally in distal portion in dorsal aspect. Base and all but distal portion of stem spiculose. Mesal and mesoventral surface of stem with 3-6 weakly developed setae. Filament more or less evenly curved dorsally, subterete; without a ridge or retrorse barb on convex side.

Clasper: Simple, moderately long, curved inward distally. Broadest at base, tapering evenly to narrower apex. Dorsal basal portion spiculose. Surface not conspicuously wrinkled. Ventral surface with 2 setae near apex. Apical spiniform moderately long, about 0.30-0.35 length of clasper, slightly curved inward.

Phallosome: Aedeagus moderately long, without teeth. Ventral paramere appearing unusually short and broad in dorsal aspect.

Proctiger: Strongly developed. Paraproct with single large heavily sclerotized curved apical spine. Cercal setae fine, short, 2-4.

PUPA (fig. 1). Abdomen: about 4.0 mm. Trumpet: 0.54 mm. Paddle: 0.81 mm. Integument very lightly pigmented, uniformly light straw yellow, strongly contrasting with dark trumpet and hairs.

Cephalothorax: All hairs relatively short, stout, darkly pigmented and usually single or double. Hair 6-C usually as stout as or stouter than 7-C.

Trumpet: Dull brown in color except for slightly lighter apex of pinna. Tracheoid represented at extreme base of lateral (ventral) surface only. Index about 3.1-3.3; pinna about 0.22-0.33 of total length.

Metanotum and Abdomen: Integumentary reticulation and spiculation very inconspicuous on anterior segments, becoming slightly more pronounced on posterior segments. Most hairs relatively short, stout, darkly pigmented and single or double. Float hair (1-I) well developed, relatively short, with numerous dendritic branches; lateralmost branches of float hair usually diverging at an angle of less than 100 degrees. Hair 1-II-VII relatively short, usually subequally developed and single or double (1-3) on all segments, but sometimes enlarged and multibranched (5-7) on segment II. Hair 2 usually laterocephalad of hair 1 on segments II,VI, VII. Hair 3-I-III subequal in development, moderately long, single (1 or 2); hair 3-IV-VII subequal in development, usually single on V-VII, single or double on IV. Hair 4-II mesad of 5-II. Hair 5-II,III subequally developed, relatively short, distinctly finer than hair 3 of corresponding segment, usually single (1 or 2); hair 5-IV-VI subequally developed, subequal to or slightly longer than 3-I-III, about 0.7-0.9 length of corresponding tergite, usually single (1 or 2); hair 5-VII similar to 5-II,III or slightly longer and/or stronger, usually double (1 or 2). Hairs 6,7-I much finer and shorter than 3-I. Hair 6-II slightly thickened and elongate, single (1 or 2); hair 6-III-V usually distinctly shorter and finer than 6-II, usually single (1-3); hair 6-VI quite stout and elongate, single; 6-VII usually only slightly longer and stronger than 6-III-V, single. Hair 9-VII long and strong, double or single. Hair 9-VIII most strongly developed and longest hair of pupa, with 2-4 (2-5) primary branches. Hair 10 conspicuously more mesad and cephalad of hair 11 on segment VI than on segment VII.

Paddle: Shape as figured; length 1.30-1.55 of maximum width. Evenly light straw yellow in color. Midrib brighter and deeper yellow in color, extending to highly wrinkled area basad of apical emargination. Hair 1-P relatively long and strong, single.

LARVA (fig. 2). Head: 0.97 mm. Siphon: 0.72 mm. Anal Saddle: 0.28 mm. Strongly developed stellate hairs and conspicuous spicules absent.

Head: Integument smooth. Medium straw yellow in color except for slightly darker anterior portion of ventral surface and much darker collar. Ocular area not lightened. Mental plate normal, brown, with 8 or 9 (8-10) lateral teeth. Hair 1-C very stout, widened before middle, smooth. Hairs 4,6-C relatively far cephalad. Hair 4-C small, with 5-8 branches (4-9), located mesocephalad of hair 6 and mesad of hair 1. Hair 5-C single, laterad of 6-C. Hair 6-C single, usually slightly widened beyond base, slightly laterad of 1-C. Hair 7-C usually triple or double (1-3). Hair 11-C weakly developed, short, stellate, with 3-5 branches. Hair 14-C rather stout, usually triple (2 or 3). Hair 15-C located in anterior 0.25 of labial plate; long, extending beyond apex of mental plate, with 3 or 4 branches.

Antenna: Relatively short. Integument without spicules, but sometimes with conspicuous annular wrinkles. Medium straw yellow in color except for slightly darkened base. Hair 1-A usually single; unusually short, length only 1.5-2.0 diameter of antennal shaft at insertion of hair; inserted on dorsal or dorsomesal surface of shaft.

Thorax: Living larva white, without conspicuous pigmentation in epidermis or fat body. Integument without spicules. Hairs moderately pigmented. Hairs 1-3-P sometimes arising from a weakly sclerotized common plate. Hair 3-P much shorter and weaker than 1-P. Hair 4-P with 3-5 branches. Hairs 5,7-P long, usually with 4 or 5 branches (2-6), each sometimes with small basal plate. Hair 8-P relatively short, usually with 4-6 branches (3-7). Hair 11-P,M,T short, weak, usually double (1-3), much smaller than 9-P. Hair 1-M shorter than 3-M, with 2-4 branches. Hair 5-M double or single. Hair 14-M short, single to triple. Hairs 1,13-T subequal, small, usually with 2-4 branches (1-4). Hair 4-T usually longer and stronger than 1-T. Hair 5-T small, single to triple.

Abdomen: Coloration and spiculation as for thorax. Most hairs moderately pigmented. Hair 1-I,II subequally developed, moderate, usually with 3 or 4 branches (2-7); hair 1-III-V subequally developed, slightly longer than 1-I,II, with 3 or 4 branches; 1-VI,VII subequally developed, longer than 1-III-V, usually with 3 or 4 branches (3-5). Hair 2-I-VII relatively stout, usually triple (2 or 3) on I,II, usually single or double (1-3) on III-V, single on VI,VII; usually located laterocephalad of hair 1 on I,II,VI and VII. Hair 5-I-VII subequally developed, moderate, similar to 1-III-V, usually with 3 or 4 branches (2-6). Hairs 6,7-I with separate basal plates. Hair 6-I-V long, double or triple on I,II, double on III-V; hair 6-VI shorter, single or double. Hair 7-I long, 7-II-VI usually becoming progressively shorter; usually double (1 or 2) on I, double or triple (1-3) on II-VI. Hair 11-I moderately developed, usually with 4-7 branches (3-8). Hair 13-I relatively small, usually with 3 or 4 branches (1-4); hair 13-II larger, subequal to 11-I, usually double or triple (1-3); hair 13-III-V subequally developed, long, much longer than hair 1 of corresponding segment, usually triple (2-4).

Segment VIII: Integument smooth except for rows of inconspicuous spicules in area of comb scales. Hair 1-VIII moderately developed, usually with 4 or 5 branches (3-5), frequently arising from a small basal plate. Hair 3-VIII large, usually with 6 or 7 branches (5-8), arising from basal plate.

Siphon: Short, index apparently about 1.9-2.3 (determined from skins). Light yellow brown to light brown in color except for darker base, especially dorsally, and apex. Integument smooth to very weakly and indistinctly imbricate. Basal margin of siphon irregular and wavy. Pecten teeth moderate in size; usually 12-14 (12-18); brown except for hyaline apex; usually with 2-4 basal denticles. Pecten in straight, slightly curved or slightly sinuous row in basal 0.32-0.42 of siphon; often 1 or more of the basal teeth displaced dorsad or ventrad of row; no apical teeth detached. Hair 1-S arising beyond pecten row, about 0.38-0.52 distance from base; moderately developed, usually triple or double.

Anal Segment: Saddle moderate in size, extending to or slightly beyond middle of segment; ventral edge frequently irregular; more or less concolorous with siphon; integument smooth to weakly imbricate on body of saddle, slightly spiculose near distal margin dorsolaterally. Hair 1-X arising on saddle near apicoventral angle; strongly developed, relatively long, usually triple or double (1-4). Hair 2-X long, usually with 3 or 4 branches (3-7). Hair 3-X very long, single. Hair 4a-X short, usually with 4 or 5 branches (4-6); hairs 4b,c-X long, double or single; 4d-X moderately long, single; 4e-X short, double or single. Dorsal and ventral gills subequal in length, very long, at least 3.0-4.2 length of anal saddle (determined from skins); sausage-shaped; gills contiguous in living larva until shortly before pupation, when they become spreading.

SYSTEMATICS. This species is one of the most remarkable container breeding *Aedes* of the New World. The adult characters, in particular, are very striking. The diagnostic features of all stages are set forth above in the subgeneric description.

This species shows no obvious relationships to any other. It is apparently another one of the many unusual New World container breeding *Aedes*, most of which are currently placed, incorrectly in my opinion, in the subgenus *Finlaya*. The resemblance to the Old World subgenus *Stegomyia* is superficial only.

The living larva is white, rather elongate and is easily distinguished from others found in treeholes in southeastern Arizona by the apposition of its 4 long anal gills. The living pupa is macroscopically separated from others of the area by its weak movements and by the dark trumpets and float hairs which contrast strongly with its very light integument.

The only striking variation observed in any stage of the small series of specimens available is the development of abdominal hair 1-II of the pupa. This hair is usually short, single or double and developed similarly to 1-III-VII, but on both sides of 1 specimen and on 1 side of another, the hair is enlarged and has 5 to 7 branches.

BIONOMICS. The original adult female of *papago* was caught while attempting to bite. The larvae apparently occur in treeholes. The reared specimens were hatched from eggs unknowingly collected along with a relatively small amount of water and organic sludge from a small rothole in a living evergreen oak tree (*Quercus*). The nature of the treehole prevented scraping the cavity or collecting large pieces of debris in a deliberate attempt to obtain aedine eggs. Only a single young instar *Orthopodomyia* larva, presumably *kummi*, was present in the water at the time of collection. Upon arrival at the laboratory in Los Angeles the water from the rothole was placed into an enamel pan and diluted with tap water. A few aedine larvae appeared within the next few days, but all of them and the *Orthopodomyia* larva died when oil from an overhead refrigerating unit dripped into the pan. The pan was moved to a more favorable position in the rearing room and the water evaporated. After the debris had been dry for 7-10 days the pan was filled with distilled water. Several eggs hatched within the next 1 or 2 days. Most of the larvae, an undescribed species in the *Aedes kompi* group, matured rapidly. When the unusual attitude of its long gills was noticed macroscopically, the 1 slow-growing larva was examined microscopically and determined to be an unknown species. This was the first larva of *papago*. The debris was permitted to dry again and, after several days, was reflooded with distilled water and subjected to a vacuum of 20-25 inches of mercury for 30 minutes. Several additional eggs hatched; again, most larvae were the undescribed species near *kompi*, but 1 was *Aedes (Kompia) purpureipes*. After these larvae were reared, the debris was dried, reflooded with distilled water and subjected to the vacuum treatment 3 times in close succession without any additional hatch. Following this series of floodings the debris was left dry for 6 or 7 weeks. It was then flooded and subjected to the same vacuum treatment as before. Quite unexpectedly, numerous *Aedes* eggs hatched; among the larvae were more or less equal numbers of *purpureipes* and the undescribed species near *kompi* and fewer of *papago*. Four of the latter were successfully reared. As before, these larvae matured much more slowly than the accompanying species. The debris has been subjected to 1 additional drying and reflooding but no additional eggs hatched.

The oak bearing the rothole from which *papago* was collected was growing in a small lateral canyon formed along a fault in the north-facing wall of Mendoza Canyon. This oak was at an elevation near that of the main canyon bottom and was one of the lowest in the area. Since no specimens of *papago* were obtained in numerous collections of debris and water made from oaks higher on the canyon walls, the species may be restricted to the lower edges of the xeric evergreen forest. If so, this may explain why it has not been found earlier, for there is a tendency, at least on my part, when looking for mosquitoes, to go to higher elevations where oaks and other trees are more numerous and more easily accessible. The relatively long larval life may also restrict the number of treeholes suitable for breeding of this species.

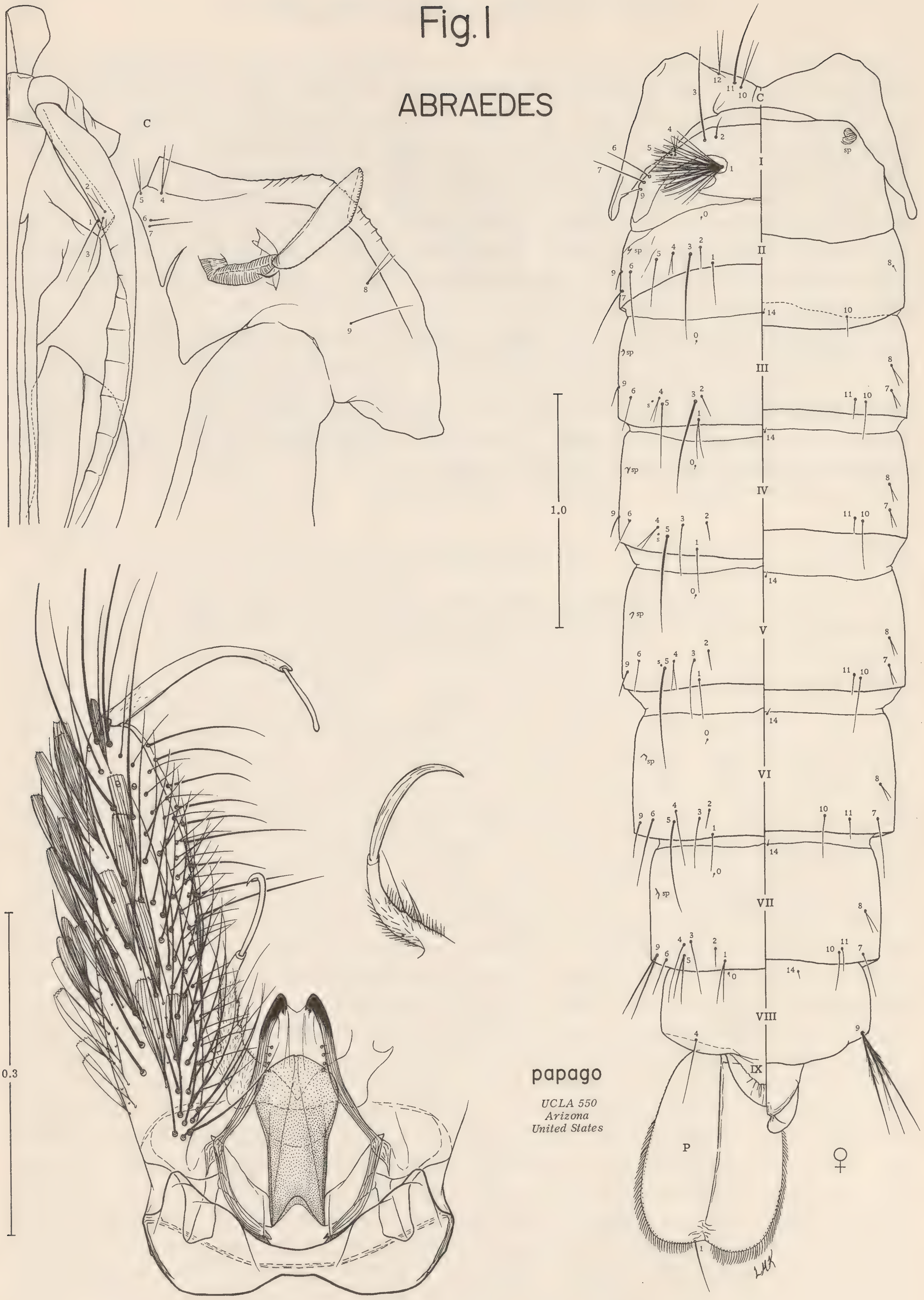
DISTRIBUTION. At present *papago* is known from only Mendoza Canyon, Coyote Mountains, Arizona. It undoubtedly occurs in northwestern Mexico and could be more widespread in southeastern Arizona where it may have been overlooked because few attempts have been made to collect treehole mosquitoes at elevations as low as 1100 m, the approximate elevation of Mendoza Canyon. All material examined is listed above in the type series.

FIGURES

1. *Aedes (Abraedes) papago*; male genitalia and pupa
2. *Aedes (Abraedes) papago*; larva

Fig. 1

ABRAEDES

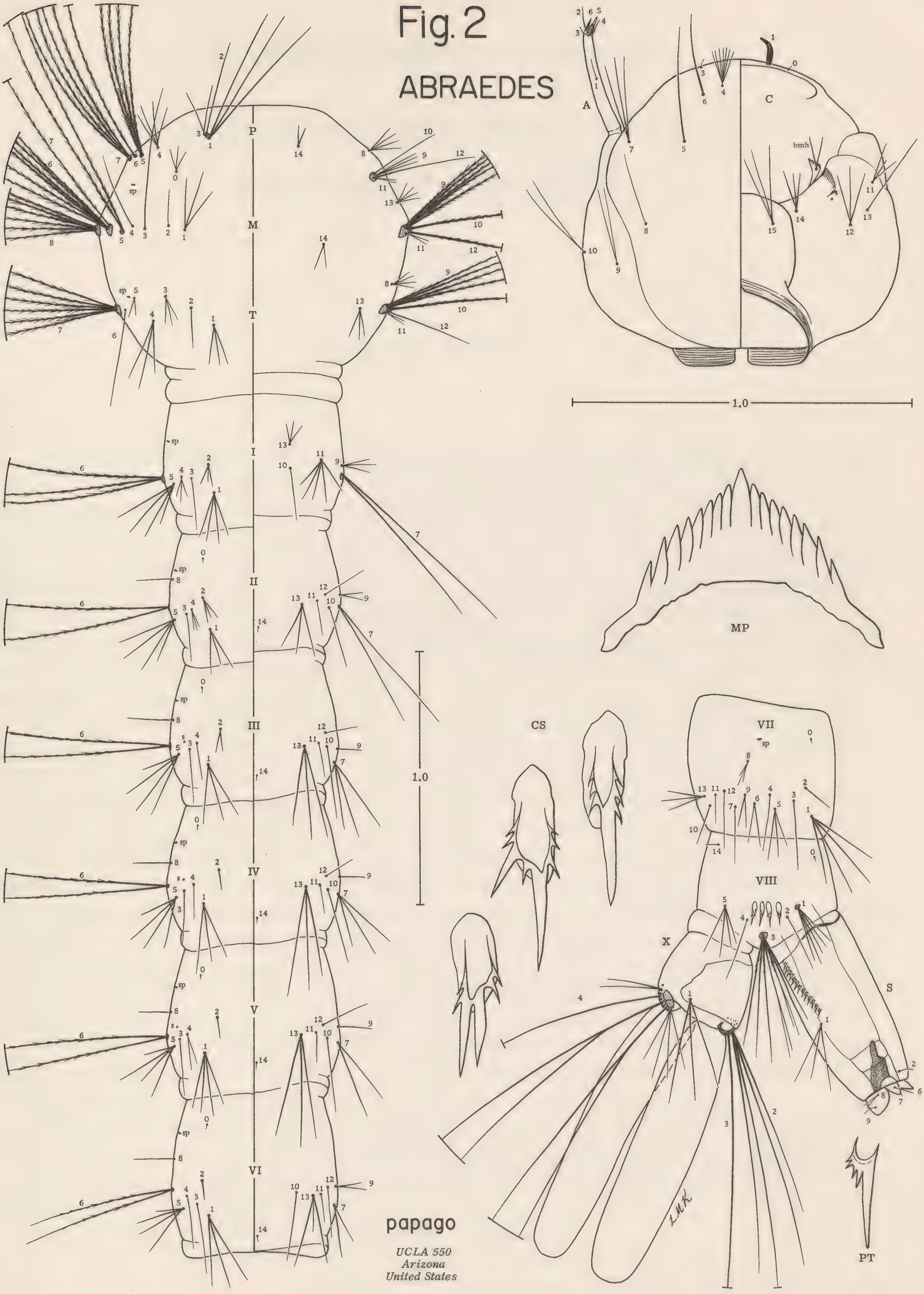


papago

UCLA 550
Arizona
United States

Fig. 2

ABRAEDES



papago

UCLA 550
Arizona
United States

MOSQUITO STUDIES (Diptera, Culicidae)

XXIII. ADDITIONS AND CORRECTIONS TO THE REVISION OF THE AEDES TERRENS GROUP[1]

by

Robert X. Schick[2]

The present additions and corrections to my recent revision of the Terrens Group (Schick, 1970a) are based upon collections obtained in Venezuela by a UCLA team and local collaborators in 1969; in Argentina by Osvaldo Casal, Miguel Garcia and associates in 1967-1969; in Colombia by Marston Bates in 1941 and 1944; and from these and other countries in South America by other workers. Described here are 1 new species, 2 new forms and the hitherto unknown immature stages and female of *braziliensis* Gordon & Evans and the male of *berlini* Schick. Important new records of previously described species are given, some revisions are made in the Terrens and Insolitus Subgroups and corrected keys are provided for the entire group.

The Terrens Group is still poorly known throughout most of South America. This is especially evident in northern Argentina from where there are several small collections of adults which do not agree with any of the known species.

The format and methods of this paper (Schick, 1970b) is similar to that of the earlier one except that (1) complete literature citations are not given for the previously treated species, (2) in the descriptions of the species only the diagnostic features are given, the less useful characters being omitted, (3) the length of the free portion of the midapical comb scales is given to the nearest 0.005 mm rather than to the nearest 0.001 mm, (4) the L/S to the nearest 0.1 rather than 0.01, and (5) an anterior view of femur III is included in the illustrations of the species in which the female is described to indicate the width of the dark bands. The figure numbers follow the sequence started in Schick (1970a). Figures 1-60 appeared in the latter paper and 61-68 are represented in the present one. The known geographic distributions are indicated by circumscribing lines on the maps but only the new records are spotted.

I thank Alan Stone for the loan of material in the U.S. National Museum; T.H.G. Aitken, Marston Bates and Osvaldo Casal for providing me with supplementary collection data; Margaret Kowalczyk for the drawings; and Caryle Abrams for the preparation of the manuscript.

The following are corrections in Schick (1970a):

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[1] Contribution from project "Mosquitoes of Middle America" supported by U.S. Public Health Service Research Grant AI-04379 and U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478.

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p. 58, line 38. Length of sidepiece should be corrected to 0.27-0.35 mm.
p. 59, line 6. Hair 4-C should read 5-C.
p. 60, line 28. *Cundinimarca* should read *Cundinamarca*.
p. 69, line 13. 12 lp♂ should read 12 lp♀.
p. 70, line 21. 352-12 should read 352-13.

Thorntoni Subgroup

2. Aedes (Finlaya) argyrothorax Bonne-Wepster & Bonne

Figs. 2,13,14,62

1920. *Aedes argyrothorax* Bonne-Wepster and Bonne, 1920:179.

Aedes (Finlaya) argyrothorax of Schick (1970a:36-38).

SYSTEMATICS. *Aedes argyrothorax*, previously known from the coastal lowlands of South America, from eastern Venezuela southward into the state of Rio de Janeiro, Brazil, with 1 possible record from Iquitos, Peru (fig. 2), is now recorded from the highlands of Colombia. The Colombian *argyrothorax* may be disjunct from the populations to the east since this species was not taken by the UCLA team in the northcentral state of Aragua, Venezuela, either along the coast or in the Cordillera de la Costa.

NEW RECORDS (fig. 62). Material examined: 6 specimens; 2 M, 1 F, 1 pupa, 2 larvae; 2 individual larval rearings.

COLOMBIA. *Meta*: Villavicencio [elev. ca 460 m], 1944, M. Bates, 2 lM (42-A, 42-7), 1 pF (57-AA) [USNM].

Terrens Subgroup

The following taxonomic changes are made in this subgroup: (1) *berlini* is removed, (2) *apollo* is synonymized with *terrens*, and (3) *terrens* and *braziliensis* are redefined. The subgroup consequently comprises 3 distinct species, *terrens*, *braziliensis* and *zavortinki*. In addition, a new form, the *Teresopolis form*, is recognized.

With the removal of *berlini*, 1 variable, the presence or absence of subspiracular scales, can be eliminated from the subgroup description (Schick, 1970a:39). All the species have these scales. However, another variable is introduced with the inclusion of the *Teresopolis form*. The primary branches of hair 1-I of the pupa of this form are predominantly single or double, whereas in the other species they are predominantly multiple.

The character of the color of the broad decumbent scales of the male vertex can be added to the subgroup description to further distinguish the Terrens and Insolitus Subgroups. In the former the scales are dark and in the latter they are silver. This character is of value in determining the species when the mesonotum is rubbed. These 2 subgroups can be generally separated in the larva by the number of hairs of the ventral brush. In the Insolitus Subgroup it is 11-13 and in the Terrens Subgroup, 13-17.

The undescribed form without a basal dark band on femur III mentioned in

Schick (1970a:43) is *casali*, actually a member of the Insolitus Subgroup.

4. Aedes (Finlaya) terrens (Walker)

Figs. 3,7,8,15,16,61

1856. *Culex terrens* Walker, 1856:429.
1970. *Aedes (Finlaya) apollo* Schick, 1970a:46-48. NEW SYNONYMY.

Aedes (Finlaya) terrens in part of Schick (1970a:41-43).
Aedes (Finlaya) apollo in part of Schick (1970a:46-48).

FEMALE (figs. 7,15). Vertex with all decumbent scales narrow curved; erect occipital setae generally pale or dark; complete acrostichal line absent; fossal macula variously developed, at fullest extent not interrupted laterally by dark scales and fairly broad, at least extent reduced to narrow submarginal, longitudinal band divided into anterior and posterior portions; *pra* hairs pale or dark; vein C with silver scales at base.

MALE (figs. 8,15). Vertex with all decumbent scales narrow curved; complete acrostichal line absent; mesonotal disc not transversely silvered or transversely silvered anteriorly for at most 0.25 length of fossa; fossal macula reaching mesal margin of fossa or not; *pra* hairs pale or dark.

MALE GENITALIA (fig. 15). Sidepiece length 0.31-0.38 mm; median sternomesal sclerite of sidepiece weakly developed; prosophallus width 0.11-0.15 mm.

PUPA (fig. 15). Cephalothorax without highly contrasting dark markings on wing and leg cases; hair 1-I with primary branches predominantly multiple; paddle rounded or slightly tapered apically.

LARVA (fig. 16). Head hair 5-C single to triple; 6-C single or double; 11-C much shorter than 7-C; L/S 2.0-2.4.

SYSTEMATICS. *Aedes terrens* is redefined here to include those forms of the Terrens Subgroup in which (1) all the decumbent scales of the vertex are narrow curved, (2) the mesonotum of the male is not transversely silvered or only very narrowly so, and (3) a complete acrostichal line is absent. These characters separate adult *terrens* from the other species of the subgroup except for the female of *zavortinki*. Female *terrens* can often be distinguished from *zavortinki* by the presence of a characteristic lateral dark area on the fossa but this dark area may or may not be developed in some populations of *terrens* including those of the Villavicencio area of Colombia where the 2 species are sympatric. I have identified female *terrens* from this region by the generally dark erect scales of the occiput, assuming that *zavortinki* here would show pale erect scales. The closest known population of *terrens* shows generally dark scales (Venezuela) and the closest one of *zavortinki*, generally pale scales (Panama). Further support for the *terrens* determination is the occurrence of a male and female *terrens* in the same lot (57xy). It should be noted that a female of the *zavortinki* type with pale erect scales is unknown from Colombia, but the total number of specimens of the subgroup from the country is small and male *zavortinki* is represented by only 2 specimens. The immature stages of *terrens* can be separated from those of *braziliensis* and the *Teresopolis form* (see) but apparently not from *zavortinki*.

A third species of the subgroup, *braziliensis*, also occurs in the Villavicencio area. Here both *terrens* and *braziliensis* share an unusual character for the Terrens

Group, the presence in both sexes of dark rather than pale hairs on the upper *mep*. This led me to incorrectly associate the female of *terrens* and the male of *braziliensis* of this region in my previous paper and to describe them as a distinct species, *apollo*. I did note, however, that 2 species were possibly involved (Schick, 1970a:47). Whether the occurrence of these dark hairs in both species is due to parallelism or hybridization is unknown. The former possibility is suggested by development of this character in the single female of *berlini* (Insolitus Subgroup) known from the Villavicencio area but not in the females from the other parts of its range.

Aedes terrens in my previous revision was recorded from Brazil south of the Amazon basin southward into northern Argentina. Owing to the generally broadened definition of this species, a northern strip in the Caribbean countries of South America is now added to this geographic range, but *terrens* is still unknown from the intervening Amazon basin.

The widely distributed *terrens* comprises several distinctive geographic populations. The majority can be grouped into 2 general types in which there is a concordance of most or all of the following characters.

Type A. *Female*: Occiput with erect scales generally dark; fossal macula relatively broad, usually not interrupted laterally by dark scales but when so interrupted dark scales forming at most small patch or narrow line; *pra* hairs dark. *Male*: Mesonotum transversely silvered anteriorly; fossal macula coextensive with fossa; *pra* hairs dark. *Larva*: Head capsule with conspicuous fine spicules; hair 5-I often shorter than 4-I; saddle often extending about 0.5 or less around anal segment; ventral brush usually with 15,16 hairs (14-17); hair 4a-X with 9-13 branches.

Type B. *Female*: Occiput with erect scales generally dark; fossal macula interrupted by relatively broad lateral area of dark scales, the macula consequently forming narrow submarginal longitudinal band; *pra* hairs usually pale, rarely dark. *Male*: Mesonotum not transversely silvered; fossal macula not reaching mesal margin of fossa; *pra* hairs pale. *Larva*: Head capsule without conspicuous fine spicules; hair 5-I subequal in length to or longer than 4-I; saddle extending more than 0.5 around anal segment; ventral brush usually with 13, 14 hairs (13-15; in 1 specimen, 17); hair 4a-X with 7-10 branches.

Type A *terrens* occurs in northern South America from Colombia eastward into French Guiana and disjunctly in the Salvador area of Brazil and in the General Enrique Mosconi (Vespucio) area of Argentina and type B in Brazil south of the Amazon basin southward into northern Argentina (Iguazu) and disjunctly in French Guiana. Type A would appear to represent the more primitive state since the fossal macula is not reduced and the distribution is more of a relict type. The populations of type B vary in the branching of hairs 5,6-C in the larva; in some they are usually single (1 or 2), in others usually double or triple (1-3). Only the former condition is developed in type A larvae.

NEW RECORDS (fig. 61). Material examined: 137 specimens; 20 M, 42 F, 48 pupae, 27 larvae (mounted); 45 individual rearings (25 larval, 20 pupal).

ARGENTINA. *Salta*: General Enrique Mosconi (Vespucio) [elev. ca 500 m], 18 Feb 1967, treehole, H. Fernandez, M. Garcia and O. Casal (ARG 601,603), 2 lpM (603-15,17), 3 lpF (601-10,11; 603-16), 1 pM (603-101), 3 pF (601-102,103; 603-100), 14 L (601-2), 40 L (603-1) [UCLA]. Tablillas, 7 km from (nearest town General Enrique Mosconi, elev. ca 500 m), 25 Feb 1967, O. Casal and M. Garcia (ARG 618), 1 lpM (618-14), 4 lpF (618-10,12,16,18), 3 pM (618-104,108,115A), 1 F, 2 p, more than 100 L (618-1); 6 June 1969 (ARG 773), 7 pF (773-102,103,105,106,110,114,115), 3 L (773-2) [UCLA]. *Tucuman*: Churqui, 4 Dec 1922, 1 F (IMR 29) [UCLA].

COLOMBIA. *Meta*: Finca Vanguardia (Schick, 1970a:48). Villavicencio [elev. ca 460 m], 2 June 1941, very low treehole, M. Bates, 1 F (277); June 1942, W. Komp, 1 F (207B-45); M. Bates, 1 lF (C-57AA), 2 F, 2 p (57-AA); same data, 1 M, 1 F, 2 l (57xy) [USNM]. Villacencio, river rd to Bosque Ocoa, 1 June 1942, treehole, 1 M (207B-10) [USNM].

FRENCH GUIANA. *Guyane*: Montabo (nearest town Cayenne), elev. 80 m, 30 Jan 1965, small treehole, height 1 m, T. Aitken, R. Martinez and A. Guerra (FG 1), 1 lpM (1-10), 1 lp (1-11) [UCLA]. *Locality not specified*: 1944, H. Floch, 2 M, 2 F (207E-1) [USNM].

VENEZUELA. *Aragua*: El Limon (nearest town Maracay), elev. 600 m, 15 July 1969, small treehole, height 2 m, J. Pulido and J. Valencia (VZ 211), 2 pM (211-100,101), 2 F (211-1) [UCLA]. El Ricon Bonita (nearest town Guigue), elev. 500 m, 24 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia (VZ 266), 1 lpM (266-20), 1 lpF (266-20), 2 lp (266-21,23) [UCLA]. Guamitas (8 km S Rancho Grande on rd to Maracay), elev. 700 m, 18 Aug 1969, small treehole, height 2 m, J. Pulido and J. Clavijo, 1 lpM (VZ 373-10) [UCLA]. Ocumare de la Costa, 2 km N on hwy 8, elev. 100 m, 12 July 1969, small treehole, height 2 m, J. Pulido and J. Valencia (VZ 178), 1 lpM (178-10), 2 lpF (178-11,12); 28 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia (VZ 272), 1 pM (272-100), 3 pF (272-100,102,120), 1 M, 4 F (272-2) [UCLA]; 15 Aug 1969, large treehole, height 1 m, J. Valencia, 2 lpF (VZ 307-10,50); same data, but small treehole, 2 lpF (307-10,11) [UCLA].

5. Aedes (Finlaya) braziliensis Gordon & Evans

Figs. 3,21,61,63,64

1922. *Aedes (Finlaya) oswaldi* var. *braziliensis* Gordon and Evans, 1922:329.

Aedes (Finlaya) braziliensis of Schick (1970a:43-44).
Aedes (Finlaya) apollo in part of Schick (1970a:46-48).

FEMALE (fig. 63). Vertex with an area of broad decumbent scales adjacent to narrow curved scales of median longitudinal line; occiput with erect scales generally pale; complete acrostichal line absent; fossal macula well developed, not interrupted by dark scales; *pra* hairs dark; vein C with silver scales at base.

MALE (fig. 21). Vertex with decumbent scales as in female; complete acrostichal line present; mesonotal disc transversely silvered anteriorly for at least 0.5 length of fossa; fossal macula reaching mesal margin of fossa; *pra* hairs dark.

MALE GENITALIA (fig. 21). Sidepiece length 0.30-0.34 mm; median sternomesal sclerite of sidepiece weakly developed; prosophallus width 0.11-0.13 mm.

PUPA (fig. 63). Wing pad with broad and dark subbasal band; leg cases with or without dark pigmentation; hair 1-I with primary branches predominantly multiple; paddle slightly tapered apically.

LARVA (fig. 64). Hair 5-C single or double; 6-C single; 11-C much shorter than 7-C; L/S 2.5-2.8.

SYSTEMATICS. *Aedes braziliensis*, as more broadly interpreted here, comprises those populations of the Terrens Subgroup in which there is a lateral area of broad scales on the vertex. The mesonotum of the male is broadly silvered anteriorly as in *zavortinki*. The ornately marked cephalothorax of the pupa may separate *braziliensis* from the other members of the subgroup but the reliability of this character cannot be determined without additional material. The larva generally differs from *terrens* and *zavortinki* in the greater L/S. In the Villavicencio area of Colombia *braziliensis* and *terrens* may be further distinguished by the length of hair 5-I; in *braziliensis* it is much shorter than 4-I and in *terrens* it is subequal.

Aedes zavortinki also occurs in the Villavicencio area but the larva is unknown from this region.

Aedes braziliensis was previously known only from Brazil and French Guiana at low elevations (fig. 3). The range is now extended into Colombia at moderately high elevations. This species, however, was not taken by the UCLA team in an intervening area, namely the state of Aragua, Venezuela.

NEW RECORDS (fig. 61). Material examined: 31 specimens; 6 M, 5 F, 6 pupae, 13 larvae; 1 individual larval rearing.

COLOMBIA. *Meta*: Villavicencio [elev. ca 460 m], 1944, M. Bates, 4 1 (24-4), 2 1 (24-78), 1 M, 3 p, 3 1 (C-24), 1 M, 4 F (24); same data, 1 1 (42♂8), 2 P (42♀6, 42♀8) (C-42-6); Komp, 1 M, 1 F (H-9-10) [USNM]. Villavicencio, Bosque Ocoa, 11 June 1944, 1 M [USNM].

FRENCH GUIANA. *Guyane*: Cabassou, elev. ca 30 m, 31 Jan 1945, small treehole, height 0.5 m, T. Aitken, R. Martinez and A. Guerra (FG 12,14), 1 lpF (12-14), 1 L (12-1), 1 L (14-1) [UCLA].

6. Aedes (Finlaya) zavortinki Schick

Figs. 3,8,9,61

1970. *Aedes (Finlaya) zavortinki* Schick, 1970a:45-46.

FEMALE (fig. 8). Vertex with all decumbent scales narrow curved; occiput with all or most erect scales pale; complete acrostichal line absent; fossal macula well developed, not interrupted laterally by dark scales; *pra* hairs dark; vein C with silver scales at base.

MALE (fig. 8). Vertex with decumbent scales as in female; mesonotal disc transversely silvered anteriorly for at least 0.5 length of fossa; fossal macula reaching mesal margin of fossa; *pra* hairs dark.

MALE GENITALIA (fig. 8). Sidepiece length 0.32-0.35 mm (0.27-0.42 mm); prosophallus width 0.14-0.15 mm (0.13-0.15 mm).

PUPA. Cephalothorax without highly contrasting dark markings on wing and leg cases; hair 1-I with primary branches predominantly multiple; paddle rounded apically.

LARVA (fig. 9). Head hair 5-C usually double (1-3); hair 6-C single; 11-C much shorter than 7-C; L/S 2.1-2.4.

SYSTEMATICS. The above description is essentially condensed from Schick (1970a) and the definition of the species remains unchanged.

Aedes zavortinki is very similar morphologically to some forms of *terrens* and generally can be separated from that species only by the mesonotal markings of the male (see *terrens*). The separation of *zavortinki* from *braziliensis* and the *Teresopolis form* is discussed under those species.

Aedes zavortinki, previously known only from the Canal Zone and eastern Panama at low elevations, 90 m or less (fig. 3), is now recorded from Colombia at an elevation of about 460 m.

NEW RECORDS (fig. 61). Material examined: 2 M.

COLOMBIA. *Meta*: Villavicencio [elev. ca 460 m], 17 May 1939, 1 M; 2 June 1941, very low treehole, M. Bates, 1 M (277) [USNM].

7. Aedes (Finlaya) sp., Teresopolis form

Figs. 61,65,66

Aedes (Finlaya) terrens in part of Schick (1970a:41-43).

FEMALE (fig. 65). Vertex with all decumbent scales narrow curved; occiput with erect scales pale; complete acrostichal line present; fossal macula with a narrow sublateral longitudinal band transversely divided into anterior and posterior portions; *pra* hairs pale; vein C without silver scales at base.

MALE (fig. 65). Vertex with all decumbent scales narrow curved; complete acrostichal line present; mesonotal disc not transversely silvered; fossal macula not reaching mesal margin of fossa; pleural hairs missing.

MALE GENITALIA (fig. 65). Sidepiece length 0.35 mm; median sternomesal sclerite of sidepiece broad and well developed; prosophallus width 0.14-0.16 mm.

PUPA (fig. 65). Cephalothorax without highly contrasting markings on wing and leg cases; hair 1-I with primary branches predominantly single or double; paddle broadly rounded apically.

LARVA (fig. 66). Hair 5-C triple or 4-branched; 6-C with 4-6 branches; 11-C subequal in length to 7-C; L/S 1.7-2.1.

SYSTEMATICS. The *Teresopolis form*, apparently most closely related to *terrens*, differs from that species in the following characters: (1) complete acrostichal line present in both sexes, (2) vein C of female without silver scales at base, (3) the median sternomesal sclerite of the sidepiece more strongly developed, (4) hair 1-I of the pupa with fewer secondary branches, (5) hair 6-C of the larva more highly branched, (6) hair 11-C of the larva much longer (longer than in any of the other species of the group), and (7) L/S tending to be lower (1.7-2.1 vs 2.0-2.4).

The male from Teresopolis is unusual in that the cercal setae are absent. These are present on the P 48-1 male (see distribution).

The *Teresopolis form* is not provided with a formal name at this time because of insufficient adult material and lack of collections from adjacent localities.

DISTRIBUTION (fig. 61). Brazil. Material examined: 9 specimens; 3 M, 1 F, 2 pupae, 3 larvae; 2 individual rearings (1 larval, 1 pupal).

BRAZIL. *Rio de Janeiro*: Fazenda Boa Fe, Teresopolis [elev. 500-1000 m], 13 Nov 1942, treehole, L. Gomes, 2 L (28773-3,4); same data, but habitat not specified, 1 lpF (28774-12); 12 Dec 1942, 1 pM (29078-1) [UCLA]. *Locality not specified*: 1 M (P 48-1); 1 M (P 100(1); lam. P 82/P 81 [genitalia slide missing) [UCLA].

Alboapicus Subgroup

9a. Aedes (Finlaya) sp., Chaco form

Figs. 62,63

FEMALE (fig. 63). Vertex with an area of moderately broad, dark decumbent scales adjacent to narrow curved scales of median longitudinal line; erect occipital scales dark; proboscis subequal in length to femur I; acrostichal setae absent; fossal macula reduced to small posterior spot about 0.5 length of fossa; supraalar macula small, very narrowly joined to fossal macula; *ssp* scales present; *pra* hairs dark; femora I and II with well-developed posterior patch of silver scales; femur I with small knee spot; tarsi 5-I-III silver; femur II with moderately broad knee spot, a few of the silver scales extending basad of subapical setae; tarsus 1-II with median dark band 0.75; femur III with broad basal dark band and very broad subapical dark band (about 0.42); veins C and R with silver lines subequal in length, neither reaching level of crossvein *h*.

MALE, PUPA, LARVA. Unknown.

SYSTEMATICS. The *Chaco form* is provisionally placed in the Alboapicus Subgroup because of the silvered 5th tarsal segments and the broad basal band of femur III. A less tenuous placement must await the discovery of the other stages.

The *Chaco form* differs from *alboapicus* in the completely silvered tarsus 1-I, the presence of a knee spot on femur I, the greater reduction of the fossal macula, the presence of well-developed posterior silver patches on femora I and II, the very broad subapical dark band of femur III and the long silver line on vein R. The presence of a knee spot on femur I and a silver line on vein R in the female are unusual characters for the Terrens Group. The former character occurs elsewhere only in *amabilis* and the latter only in *argyrothorax*.

DISTRIBUTION (fig. 62). Northern Argentina. Material examined: 1 F.

ARGENTINA. *Chaco*: Saenz Pena (rd to Tres Isletas) [elev. ca 100 m], 6 Apr 1963, in forest, biting in afternoon, M. Castro, 1 F (Ch 61b) [UCLA].

Insolitus Subgroup

Three species may now be recognized in this subgroup, *insolitus*, *berlini* (transferred from the Terrens Subgroup) and a new species, *casali*.

The description of the subgroup must be broadened to accommodate the latter 2 species. The additions to the description are indicated in *italics* in the following statements: (1) proboscis of female *usually longer* than femur I, (2) femur II with knee spot usually present, *narrow* to broad, (3) femur III with basal dark band *absent*, *incomplete* or complete, usually broad, and (4) sidepiece with median sternomesal sclerite weakly to *strongly* developed.

Further subgroup characters that are of value in separating this from the Terrens Subgroup are given under the latter.

Aedes casali occurs in northern Argentina, the southern limit of the geographic range of the Terrens Group, and is broadly disjunct from the other 2 species of the subgroup. The occurrence of such a relict species at the periphery of the range of the group supports the hypothesis that the Insolitus Subgroup is of relatively great antiquity (Schick, 1970a:20).

12. Aedes (Finlaya) insolitus (Coquillett)

Figs. 4,29,30,62

1909. *Verrallina insolita* Coquillett, 1906:62.

Aedes (Finlaya) insolitus of Schick (1970a:57-61).

SYSTEMATICS. *Aedes insolitus* was reported from Central America, Colombia and Trinidad, primarily at high elevations, in my previous paper (fig. 4). New records show that this species also occurs in northern Venezuela.

NEW RECORDS (fig. 62). Material examined: 82 specimens; 16 M, 21 F, 25 pupae, 20 larvae; 24 individual rearings (14 larval, 9 pupal, 1 incomplete).

COLOMBIA. *Meta*: Villavicencio [elev. 460 m], 19 June 1941, treehole, M. Bates, 1 F (278) [USNM].

VENEZUELA. *Aragua*: Carretera 2, 8.7 km S Choroni, elev. 300 m, 16 July 1969, cut bamboo, T. Zavortink et al, 1 M (VZ 228-2); 15.9 km S Choroni, elev. 650 m, 16 July 1969, cut bamboo, T. Zavortink et al (VZ 230), 1 pF (230-100), 1 M, 4 F (230-1); Cumbre de Choroni, elev. 900 m, 26 July 1969, cut bamboo, J. Pulido and J. Valencia (VZ 269), 1 lpM (269-50), 1 lpM (269-50), 1 lp (269-51), 1 M, 1 F, 2 l (269-5); 20 km N Maracay, elev. 800 m, 6 Aug 1969, cut bamboo, J. Valencia (VZ 314,315), 1 lpM (314-70), 1 pM (315-104); 4 km N Maracay, elev. 800 m, 6 Aug 1969, small treehole, height 1 m, J. Valencia (VZ 317), 1 lpM (317-10), 1 M, 1 F, 1 l (317-1) [UCLA]. Guamita (8 km S Rancho Grande), elev. 700-800 m, 15 July 1969, cut bamboo, T. and J. Zavortink (VZ 203), 1 lpM (203-54), 2 lpF (203-56,58), 1 lp (203-61); 11 Aug 1969, small treehole, height 1 m, J. Valencia (VZ 328), 1 lpF (328-12), 1 pM (328-105); 18 Aug 1969, cut bamboo, J. Pulido and J. Clavijo (VZ 371), 1 lpF (371-10), 2 pF (371-101,103); 18 Aug 1969, small treeholes, height 1-2 m, J. Pulido and J. Clavijo (VZ 372,373,375), 2 lpM (373-11,12), 3 lpF (373-13-15), 1 pM (372-100), 3 pF (373-100,101; 375-101), 1 lP (373-16), 1 l (375-1) [UCLA]. Turiamo [elev. near sea level], 11 Sept 1944, 1 M; date unknown, 2 M [UCLA].

12a. Aedes (Finlaya) casali Schick, n.sp.

Figs. 62,67,68

TYPES: *Holotype male* (ARG 618-108) with associated pupal skin, ca 7 km from Tablillas (nearest town General Enrique Mosconi (Vespucio), elev. ca 500 m), 25 Feb 1967, fallen tree, O. Casal and M. Garcia [USNM]. *Allotype female* (618-106) with associated pupal skin, same data as holotype [USNM]. *Paratypes*: 1 pM (618-103), 1 M (618-113), same data as holotype [UCLA]. This species is dedicated to Osvaldo Casal of the Instituto Nacional de Microbiologia, Buenos Aires, Argentina.

FEMALE (fig. 67). Vertex with broad decumbent scales usually forming variously developed dark patch surrounded by silver scales; infrequently all scales silver; anterior promontory silvered; acrostichal line absent; acrostichal setae present, most posterior seta at about 0.5 from anterior end; fossal macula moderately well developed (ARG 773-109) or reduced to small anterior patch (IMR 29); *ssp* scales present; *pra* hairs pale; femur II with knee spot narrow, often longitudinally divided anteriorly by streak of dark scales; tarsus 1-II with complete median dark band, usually about 0.4-0.6 (0.4-0.7); tarsus 2-II with complete dark apical band; femur III usually without basal dark band, incomplete when present.

MALE (fig. 67). Mesonotal disc transversely silvered anteriorly for about 0.5 length or up to prescutellar space; *ssp* scales present; tarsus 1-II with incomplete median dark band or band complete, as broad as 0.6; femur III with basal dark band as in female.

MALE GENITALIA (fig. 67). Sidepiece length 0.32-0.35 mm; median sternomesal sclerite weakly to strongly developed; prosophallus length 0.09-0.10 mm; filament ratio 0.55-0.80.

PUPA (fig. 67). Cephalothorax without pale inverted V-shaped marking; hair 1-I with primary branches predominantly single-double or double-triple; 2-II laterad of 3-II or mesad for as much as 0.4 the distance from 1-II to 3-II.

LARVA (fig. 68). Hairs 5,6-C single or double; 14-C, *bmh* usually double and branching from base (1-3); hair 11-P longer than 0.5 of 14-P; hair 14-P single; 4-M double; 7-II single to triple; 12-VII single; apical comb scale with free portion 0.035-0.040 mm; 2-VIII single; siphon length 0.67-0.92 mm; L/S 2.1-2.3.

SYSTEMATICS. *Aedes casali* is distinguished from the other species of the subgroup by the absence of a complete band at the base of femur III and by the coloration of the broad scales of the vertex of the female. The pupa is similar to that of the other species. The larva apparently shows no features that separate it from *insolitus* but can be distinguished from *berlini* by fewer branches in many of the hairs and by the smaller L/S.

DISTRIBUTION (fig. 62). Northwest Argentina at elevations of about 500 m. Material examined: 52 specimens; 9 M, 22 F, 11 pupae, 10 larvae; 6 individual pupal rearings.

ARGENTINA. *Salta*: Tablillas, ca 7 km from (nearest town General Enrique Mosconi (Vespucio), elev. ca 500 m), 25 Feb 1967, fallen tree, O. Casal and M. Garcia (ARG 618, type series), 2 pM (618-103,108), 1 pF (618-106), 1 M (618-113), 8 L (618-1) [USNM, UCLA]; 6 June 1969, treehole, O. Casal and M. Garcia, 3 pF (ARG 773-109,113,116) [UCLA]. *Tucuman*: Churqui, 4 Dec 1922 (IMR 29), 1 pF (slide 2217), 8 M, 17 F, 1 M gen (360), 4 p (2216), 2 L (2213) [UCLA].

(8) 12b. Aedes (Finlaya) berlini Schick

Figs. 3,21,22,62,63

1970. *Aedes (Finlaya) berlini* Schick, 1970a:48-49.

FEMALE (fig. 21). Vertex with decumbent scales usually all dark, some scattered silver scales sometimes present; anterior promontory silvered or dark; acrostichal line absent; acrostichal setae present or absent, most posterior seta at about 0.25 from anterior end or as far caudad as in posterior 0.5; fossal macula relatively well developed; *ssp* scales absent; *pra* hairs dark; femur II with broad knee spot, the silver scales extending well basad of anterior subapical setae; tarsus 1-II with complete median dark band, about 0.4-0.5; tarsus 2-II with complete dark apical band; femur III with complete and broad basal dark band.

MALE (fig. 63). Mesonotal disc transversely silvered anteriorly for about 0.5 length or up to prescutellar space; *ssp* scales absent; tarsus 1-II with incomplete or complete median dark band, as broad as 0.5; femur III with basal dark band as in female.

MALE GENITALIA (fig. 63). Sidepiece length 0.29-0.31 mm; median sternomesal sclerite weakly developed; prosophallus length 0.08 mm; filament ratio 0.90-1.10.

PUPA (fig. 21). Cephalothorax with or without pale inverted V-shaped marking; hair 1-I with primary branches usually predominantly double or triple, often multiple, sometimes single; 2-II mesad of 3-II for 0.2-0.5 the distance from 1-II to 3-II.

LARVA (fig. 22). Hairs 5,6-C single to triple; 14-C, *bmh* single or double, when double not branching from base; 11-P greater or less than 0.5 of 14-P; hair 14-P single or double; 4-M usually triple or 4-branched (2-4); hair 7-II with 4-7 branches; 12-VII single or double; apical comb scale with free portion 0.030-0.035 mm; 2-

VIII single or double; siphon length 0.80-0.92 mm; L/S 2.3-2.6.

SYSTEMATICS. *Aedes berlini*, previously known from only the type locality, the island of Tobago (fig. 3), is now recorded from Trinidad, Venezuela and Colombia. The populations fall into 2 types, Island (Trinidad, Tobago) and Mainland (Venezuela, Colombia). The former populations occur at elevations of up to 120 m and the latter from 700 to 900 m. They differ in the following 3 morphological characters (Island character state cited first): (1) acrostichal setae absent or when present not extending caudad of anterior 0.25 vs acrostichal setae always present, most posterior seta at 0.5 or in caudal 0.5, (2) hair 11-P of the larva less than 0.5 of 14-P vs subequal in length to 0.5, and (3) mesonotum of male transversely silvered up to prescutellar space vs to about 0.5-0.67 of length.

This broad treatment of *berlini* is consistent with that of *insolitus*. The latter species also occurs at a wide range of elevations and shows the same or a similar type of geographic variation in the above 3 characters.

Aedes berlini differs from the other species of the subgroup in the absence of *ssp* scales, the dark *pra* hairs of the female, and the single or nonbasally branched hairs 14-C and *bmh* of the larva. The fossal macula of the female, relatively well developed, is more constant in its degree of development than in the other species.

Emphasis was placed on the taxonomic value of the length of hair 7-VII of the pupa in Schick (1970a:49). Although long in all the new material examined, this character is variable enough to negate its taxonomic value at least as a species criterion in the Insolitus Subgroup.

Aedes berlini and *insolitus* are sympatric in Venezuela and Colombia and have been taken in the same treehole in the former country.

NEW RECORDS (fig. 62). Material examined: 114 specimens; 21 M, 19 F, 40 pupae, 34 larvae; 38 individual rearings (23 larval, 11 pupal, 4 incomplete).

COLOMBIA. *Cundinamarca*: Santander (Santandercito), 1 F (207D-6/2), 1 F (207D-8/3) [UCLA]. *Meta*: Forzosa Forest (ca 5 mi from Villavicencio, elev. ca 460 m), 12 June 1944, treehole 6, M. Bates, 1 lM [USNM]. Villavicencio, 1944, M. Bates, 1 lpF (78) [USNM].

TRINIDAD. *Saint George*: Grandwood (ca 2 km Chaguaramas), elev. ca 120 m, 11 June 1961, treehole, T.H.G. Aitken, 2 lpM (11-VI-61-8,13), 3 lpF (11-VI-61-11,12,14), 1 pM (11-VI-61-4), 7 lp (11-VI-61-5,7,9,10,15,16,18), 3 p (11-VI-61) [UCLA].

VENEZUELA. *Aragua*: Guamita (8 km S Rancho Grande), elev. 700-800 m, 15 July 1969, small treehole at ground level, T. and J. Zavortink (VZ 198), 1 lpM (198-10), 4 L (198-2) [UCLA]; small treehole, height 1 m (VZ 200,201), 3 lpM (200-10,13; 201-11), 2 lpF (200-11,12), 1 pM (200-100), 1 M, 1 l (200-1) [USNM, UCLA]; cut bamboo, height ca 1-2 m (VZ 203), 1 lpM (203-50), 4 lpF (203-51,52,60,64), 3 pM (203-100,103,110), 1 lp (203-53), 1 M, 2 L (203-6); 11 Aug 1969, small treehole, height 1 m, J. Valencia (VZ 328), 1 lpF (328-10), 1 pM (328-103), 1 pF (328-101); cut bamboo, height ca 1 m, J. Valencia and J. Clavijo (VZ 331), 1 lpF (331-11), 1 M (331-1); 18 Aug 1969, cut bamboo, height ca 1 m, J. Pulido and J. Clavijo, 1 pM (VZ 371-100); small treehole, height 1 m, 2 lpM (VZ 372-10,40); small treehole, height ca 2 m (VZ 374), 1 pF (374-100), 1 F (374-1) [UCLA]. Maracay, 4 km N on rd to Choroni, elev. 800 m, 6 Aug 1969, small treehole, height ca 1 m, J. Valencia, 1 pM (VZ 317-100) [UCLA]. Maracay, 20 km N on rd to Choroni, elev. 800 m, 6 Aug 1969, cut bamboo, height near soil level, J. Valencia, 1 lpF (VZ 314-71) [UCLA].

Podographicus Subgroup

25. Aedes (Finlaya) podographicus Dyar & Knab

Figs. 6,52-57

1906. *Aedes podographicus* Dyar and Knab, 1906:165.

Aedes (Finlaya) podographicus of Schick (1970a:82-86).

SYSTEMATICS. The *podographicus* of Schick (1970a) comprised coastal populations in Central America and Mexico which occurred at elevations of less than 300 m. A widely disjunct but apparently conspecific population, cited simply as belonging to the *podographicus* complex, was known from the Maracay area of Venezuela at higher elevations but was not treated as *podographicus* proper since the immature stages were not known. These are now available and show no striking differences from those of typical populations of Central America and Mexico.

Although *podographicus* abounds in the coastal areas to the north, it is apparently absent along the coast of South America. In recent UCLA collections in the state of Aragua, Venezuela, *podographicus* was taken only in the Maracay area, although another member of the Terrens Group (*terrens*) was commonly encountered on the coast.

NEW RECORDS. Material examined: 292 specimens; 81 M, 142 F, 37 pupae, 32 larvae; 33 individual rearings (24 larval, 9 pupal).

VENEZUELA. *Aragua*: Guayabita, elev. 560 m, 14 July 1927, 1 M (35.III.20a) [USNM]; 30 Aug 1966, automobile tire, E. Russian Vasquez, 1 F (VZ 29) [UCLA]. Hacienda Santa Clara (nearest town San Joaquin), elev. 400 m, 19 July 1969, large treehole near soil level, J. Pulido and J. Valencia (VZ 249), 1 lpM (249-21), 1 lpF (249-20) [UCLA]. Macaro (nearest town Turmero), elev. 500 m, 12 Aug 1969, small treehole, height 2 m, J. Valencia and J. Pulido, 1 lpM (VZ 335). Maracay [elev. 600 m], 10 Jan 1926 (1-10-26), M. Nunez Tovar, 7 F; 24 Aug 1926, M. Nunez Tovar, 1 F; 8 Sept 1926, M. Nunez Tovar, 6 F; 11 Sept 1926 (9-11-26), M. Nunez Tovar, 1 F; 13 Sept 1926, M. Nunez Tovar, 4 F; 18 Sept 1926, M. Nunez Tovar, 1 F; 1926, M. Nunez Tovar, 5 M, 1 F; 3 Aug 1927, M. Nunez Tovar, 1 M, 1 F [USNM]; 30 M, 12 F (VZR 252); 23 M, 86 F (VZR 257) [UCLA]. Maracay, Hacienda Militar de San Jacinto, elev. 550-600 m, 17 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia (VZ 233, 234,239,240), 4 lpM (233-12; 234-10; 239-20,21), 3 lpF (233-11; 234-12,13), 3 pM (233-101; 234-100,101), 1 pF (233-100), 1 lp (234-16), 1 l (233-1), 6 M, 3 F, 3 p, 3 l (234-1), 2 F (240-3) [UCLA]. Maracay, Universidad Facultad de Agronomia, elev. 600 m, 15 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia (VZ 205,206), 3 lpM (205-31; 206-10,11), 7 lpF (205-10,12-16,30), 2 pM (205-100,101), 3 pF (205-102,103; 206-100), 1 lp (205-17), 1 L, 2 l (205-1), 1 F, 1 p (206-1) [UCLA]. *Carabobo*: Mariara, 2 km E, elev. 400 m, 19 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia, 1 lpM (VZ 245-11) [UCLA]. Punta Palmita (nearest town Mariara), elev. 400 m, 19 July 1969, small treehole, height 1 m, J. Pulido and J. Valencia (VZ 244), 1 lpM (244-12), 1 lp (244-11), 1 l (244-1) [UCLA].

KEYS TO SPECIES

FEMALES

(15. **impostor** unknown)

1. Femur III with complete basal dark band *and* supraalar macula broadly reaching scutal suture (figs. 63, *braziliensis*; 65,67) 2

Without the above combination of characters; femur III sometimes with complete basal dark band and supraalar macula sometimes broadly reaching scutal suture but both conditions not developed simultaneously 13

2(1). Midtarsi and hindtarsi unmarked except for inconspicuous silver band at base of tarsi 1-II,III . . . . .10. **buenaventura**
Midtarsi and hindtarsi with prominent silver bands at base and apex of tarsi 1-II,III and at base of tarsi 2-II,III 3

3(2). Tarsi 5-II,III silvered . . . . 9. **alboapicus**, in part
Tarsus 5-II usually dark, rarely silverd; 5-III always dark 4

4(3). Vertex with decumbent scales along longitudinal midline all broad . . . 5
Vertex with decumbent scales along longitudinal midline all narrow curved 6

5(4). Mesonotal disc transversely silvered anteriorly (fig. 9); vein R without silver scales . . . . 1. **thorntoni**
Mesonotal disc not transversely silvered (fig. 13); vein R with small basal patch of silver scales . . . . 2. **argyrothorax**

6(4). *Ssp* scales absent 7
Ssp scales present 8

7(6). Vertex with all decumbent scales narrow curved, most or all along longitudinal midline dark . . . . 11. **metoecopus**
Vertex with an area of broad decumbent scales adjacent to narrow curved scales of median longitudinal line, latter scales silver . (8) 12b. **berlini**

8(6). Vertex with all decumbent scales narrow curved 9
Vertex with an area of broad decumbent scales adjacent to narrow curved scales of median longitudinal line 10

9(8). *Pra* hairs dark; fossal macula not strongly reduced, mesal margin sharply defined, evenly and gently curved or essentially straight (fig. 63) . . . . 5. **braziliensis**
Pra hairs pale; fossal macula usually markedly reduced and mesal margin indistinct and irregular, infrequently well developed as above or completely absent (fig. 29) . . . . 12. **insolitus**

10(8). Basal dark band of femur III narrow, at most about 0.05 (Mexico) . . . . 14. **homoeopus**, in part
Basal dark band of femur III broad, more than 0.10 (Panama, South America) 11

11(10). Complete acrostichal line present . . . . 7. **Teresopolis form**
Complete acrostichal line absent 12

12(11). Fossa without dark scales at lateral margin (fig. 17) (Panama, Colombia) . . . . 6. **zavortinki**
Fossa usually with at least a few dark scales at lateral margin, these often forming well developed patch or longitudinal band (fig. 15) (Colombia southward into Argentina) . . . . 4. **terrens**

13(1). Mesonotal disc transversely silvered anteriorly 14
Mesonotal disc not transversely silvered 15

14(13). Transverse silvered area of mesonotum extending caudad to about 0.5 (fig. 11); *ppn* silver scaled. . . . . **3. bertrami**
Transverse silvered area of mesonotum much narrower, extending caudad to less than 0.25 (fig. 39); *ppn* dark scaled . . . . **13. aitkeni**

15(13). Tarsus 5-III silvered 16
Tarsus 5-III dark 18

16(15). Tarsus 1-I with broad apical silver band, about 0.4; midlegs and hindlegs shaggy . . . . **28. diazi**
Tarsus 1-I with at most very narrow apical silver band, much less than 0.4; midlegs and hindlegs not shaggy 17

17(16). Fossal macula developed up to anterior margin of fossa (fig. 23); femur I without knee spot; tarsus 5-I at most only partly silvered . . . . **9. alboapicus**, in part
Fossal macula a small posterior spot (fig. 63); femur I with small knee spot; tarsus 5-I entirely silvered . . . . **9a. Chaco form**

18(15). Supraalar macula broadly reaching scutal suture (fig. 67) and mesal margin of fossal macula poorly defined (Argentina). . . . . . . **12a. casali**
Supraalar macula rarely broadly reaching scutal suture; mesal margin of fossal macula usually sharply defined (Mexico, Central America) . 19

19(18). Acrostichal setae absent; tarsus 1-II with median dark band usually incomplete or complete and narrow, at most about 0.33 20
Acrostichal setae present; tarsus 1-II with median dark band usually complete and broad, about 0.33 or greater 22

20(19). Proboscis shorter than or subequal in length to femur I; femur II with knee spot moderately broad, the silver scales at most just reaching anterior subapical setae . . . . **25. podographicus**
Proboscis longer than femur I; femur II with knee spot broad, the silver scales extending basad of anterior subapical setae 21

21(20). Vertex with all decumbent scales silver . . . . **26. tehuantepec**
Vertex with silver and dark decumbent scales, latter forming submedian patch . . . . **27. schroederi**

22(19). Femur II with or without knee spot, when present, narrow, a single row of apical scales; *ssp* scales absent 23
Femur II with broad knee spot, the scales extending basad of anterior subapical setae; *ssp* scales present or absent 24

23(22). Fossal macula reduced only mesally (figs. 48,50); supraalar macula reaching scutal suture; femora I,II with well developed posterior patch of silver scales . . . . **24. daryi**

Fossal macula reduced anteriorly and mesally (fig. 44); supraalar macula not reaching scutal suture; femora I,II without posterior patch of silver scales . . . . **22. galindoi; 23. campana**

24(22). *Ssp* scale patch absent although 1 or 2 scales sometimes present . . . . **20. vargasi**
Ssp scale patch present 25

25(24). Proboscis shorter than or subequal in length to femur I; midlobe of scutellum with silver scales 26
Proboscis usually longer than, sometimes subequal in length to femur I, when subequal midlobe of scutellum without silver scales 27

26(25). Acrostichal line absent or represented by scattered silver scales (fig. 39); midlobe of scutellum usually with a mixture of silver and dark scales, the dark scales usually predominating, infrequently all scales silver . . . . **19. sumidero**
Acrostichal line present, complete (fig. 35); midlobe of scutellum with all scales silver . . . . **17. gabriel**

27(25). Femur I with narrow knee spot; complete and strong acrostichal and posterior dorsocentral lines present (fig. 37) . . . . **16. amabilis**
Femur I without knee spot; complete and strong acrostichal and posterior dorsocentral lines usually absent, sometimes complete but weak . . 28

28(27). Vertex with an area of broad decumbent scales adjacent to narrow curved scales of median longitudinal line . . . . **18. idanus**
Vertex with all decumbent scales narrow curved 29

29(28). Midlobe of scutellum without silver scales; proboscis subequal in length to or longer than femur I . . . . **12. heteropus**
Midlobe of scutellum usually with silver scales; proboscis longer than femur I . . . . **14. homoeopus**, in part

MALES

(**3. bertrami**, **9a. Chaco form**, **13. aitkeni**, **16. amabilis**, **27. schroederi** and **28. diazi** unknown)

1. Vein C with basal line of silver scales reaching crossvein *h*; mesonotal disc usually transversely silvered 2
Vein C with small basal patch of silver scales or line reaching at most to about 0.5 to crossvein *h*; mesonotal disc not transversely silvered . 14

2(1). Vein R with basal line of silver scales much longer than that of vein C. . 3
Vein R with basal line of silver scales much shorter than that of vein C . 4

3(2). Median sternomesal area of sidepiece with well developed tuft and usually with well developed convexity and sclerite (fig. 31). . **14. homoeopus**
Median sternomesal area with these structures not strongly differentiated (fig. 33) . . . . **15. impostor**

4(2). *Ssp* scale patch absent 5
Ssp scale patch present 6

5(4). Midtarsi and hindtarsi unmarked except for inconspicuous silver band at base of tarsi 1-II,III . . . . **10. buenaventura**
Midtarsi and hindtarsi with prominent silver bands at base and apex of tarsi 1-II,III and at base of tarsi 2-II,III; tarsi 5-II,III and sometimes 5-I silvered . . . . **9. alboapicus**

6(4). Vertex with decumbent scales along longitudinal midline all broad . . . 7
Vertex with decumbent scales along longitudinal midline all narrow curved 8

7(6). Transverse silvered area of mesonotal disc not emarginate posteriorly (fig. 9); palpus 1 or 2 labellum lengths shorter than proboscis. Claspette filament not expanded distally (figs. 9,11) . . . . . . **1. thorntoni**
Transverse silvered area of mesonotal disc emarginate posteriorly (fig. 13); palpus 4-7 labellum lengths shorter than proboscis. Claspette filament expanded distally (fig. 13) . . . . **2. argyrothorax**

8(6). Vertex with an area of broad, silver decumbent scales adjacent to narrow curved scales of median longitudinal line; mesonotal disc usually transversely silvered anteriorly, the silvered area usually reaching caudad of fossa (fig. 29) and not emarginate caudally 9
Vertex with or without this lateral area of broad decumbent scales, these dark when present; mesonotal disc transversely silvered or not, the silvered area not reaching caudad of fossa and emarginate caudally (fig. 17) 11

9(8). Femur III without basal dark band or with incomplete band . **12a. casali**
Femur III with complete basal dark band 10

10(9). *Ssp* scales present . . . . **12. insolitus**
Ssp scales absent . . . . **(8) 12b. berlini**

11(8). Mesonotal disc not transversely silvered 12
Mesonotal disc transversely silvered anteriorly 13

12(11). Complete acrostichal line present (fig. 65) . . . . . **7. Teresopolis form**
Complete acrostichal line absent (fig. 15, Rio de Janeiro) . . . **4. terrens**

13(11). Vertex with an area of broad decumbent scales adjacent to narrow curved scales of median longitudinal line. . . . . **5. braziliensis**
Vertex with all decumbent scales narrow curved . . . . . **6. zavortinki**

14(1). Acrostichal setae absent 15
Acrostichal setae present 17

15(14). Occiput with erect scales dark . . . . **11. meteocopus**
Occiput with erect scales pale 16

16(15). Palpal segment 3 without prominent tuft of setae, the setae at ventrolateral apex shorter than segments 4 and 5 combined. Prosophallus with lateral portion of mesal lobe usually moderately inclined, between 15° and 30° from horizontal; stems usually bowed and convergent (figs. 52,54,56). . . . . **25. podographicus**

Palpal segment 3 with prominent tuft of setae as long as segments 4 and 5 combined. Prosophallus with lateral portion of mesal lobe slightly inclined, about 15° or less from horizontal; stems not bowed, divergent or essentially parallel (fig. 58) . . . . **26. tehuantepec**

17(14). Femur II without or with narrow knee spot, the silver scales a single row at apex of segment; *ssp* scale patch absent 18

Femur II with broad knee spot, the silver scales extending basad of anterior subapical setae; *ssp* scale patch present 20

18(17). Femora I,II with well developed posterior patch of silver scales. Sidepiece with median sternomesal tuft poorly differentiated and the setae not wavy (figs. 48,50) . . . . **24. daryi**

Femora I,II without posterior patch of silver scales. Sidepiece with median sternomesal tuft well differentiated and the setae wavy (figs. 44,46) 19

19(18). Prosophallus with median lobe projecting farther cephalad than lateral lobe (fig. 44) . . . . **22. galindoi**

Prosophallus with median lobe projecting to about same level as lateral lobe (fig. 46) . . . . **23. campana**

20(17). Median sternomesal area of sidepiece with sclerite and tuft well developed; hook of filament strongly angulate (figs. 35,37) 21

Median sternomesal area of sidepiece with sclerite and tuft absent or poorly developed; hook of filament not strongly angulate (figs. 39,40, 42) 22

21(20). Palpus subequal in length to or slightly longer than proboscis. Basal tergomesal area of sidepiece without dense patch of long setae (fig. 35) . . . . **17. gabriel**

Palpus about 2 labellum lengths shorter than proboscis. Basal tergomesal area of sidepiece with dense patch of long setae (fig. 37) . . **18. idanus**

22(20). *Ssp* scale patch absent; complete acrostichal or posterior dorsocentral lines absent (fig. 40); tarsus 1-II with median dark band incomplete . . . . **20. vargasi**

Ssp scale patch present; complete acrostichal or posterior dorsocentral lines present; tarsus 1-II with median dark band complete, about 0.33-0.4 23

23(22). Acrostichal line absent; posterior dorsocentral line complete (fig. 39); segment 3 of palpus with apical ventrolateral tuft not as long as segments 4 and 5 combined . . . . **19. sumidero**

Acrostichal line present, complete, sometimes weakly developed; posterior dorsocentral line incomplete (fig. 42); segment 3 of palpus with apical ventrolateral tuft as long as segments 4 and 5 combined . **21. heteropus**

LARVAE

(**3. bertrami, 9a. Chaco form, 16. amabilis** and **19. sumidero** unknown)

1. Hair 11-C subequal in length to 7-C . . . . **7. Teresopolis form**
Hair 11-C much shorter than 7-C 2

2(1). Hair 5-C usually with 4 or more branches (when fewer branches, only on 1 side) *and/or* 14-P branched 3
Hair 5-C usually single or double, sometimes triple (when more branches, only on 1 side) *and* 14-P usually single (when rarely branched, only on 1 side) 9

3(2). Hair 5-VII cephalad of 4-VII . . . . **10. buenaventura**
Hair 5-VII caudad of 4-VII 4

4(3). Hairs 4-VII and 3-VI branched . . . . **9. alboapicus**
Hair 4-VII single and 3-VI usually single (when rarely branched, only on 1 side) 5

5(4). Hair 2-II well mesad of 4-II (fig. 42); hair 14-P single 6
Hair 2-II mesad of 4-II for about only 1 alveolus width, often laterad of 4-II (fig. 44); hair 14-P branched 7

6(5). Hair 11-P less than half length of 14-P; hair 1-VIII shorter than 2-VIII; hair 6-C single or double; *bmh* single . . . . **18. idanus**
Hair 11-P about half length of 14-P; hair 1-VIII usually at least subequal in length to 2-VIII; hair 6-C usually with more than 2 branches; *bmh* usually branched but often single . . . . **21. heteropus**

7(5). Hair 14-C usually with 3 or more branches; 1-A usually branched but often single; free portion of apical scales ligulate, awl shaped or spatulate . . . . **24. daryi**
Hair 14-C usually with fewer than 3 branches; 1-A usually single (when branched, only on 1 side); free portion of apical scales spatulate . . . 8

8(7). Comb scales 35-47, in 4 rows; free portion of midapical scale longer than sessile portion . . . . **22. galindoi**
Comb scales 23-32, in 3 rows; free portion of midapical scale shorter than or subequal in length to sessile portion. . . . . **23. campana**

9(2). Hair 7-C short, less than half length of 6-C; hair 11-C short, less than length of mentum 10
Hair 7-C more than half length of 6-C; hair 11-C longer than mentum . 11

10(9). Hair 8-S single; 2-A about 2.0 distal portion of 6-A; anal saddle extending less than halfway around segment (fig. 14) . . . . . . **2. argyrothorax**

Hair 8-S multiple; 2-A about 3.0 or more length of distal portion of 6-A; anal saddle extending more than halfway around segment (figs. 10,12) . . . . **1. thorntoni**

11(9). Hairs 14-C and *bmh* usually basally branched, rarely single; 11-P usually at least 0.5 of 14-P . . . . **12. insolitus; 12a. casali**
Hairs 14-C and *bmh* usually single, when double usually branching about 0.25 or more from base; 11-P usually less than 0.5 of 14-P 12

12(11). Hair 4-VII at least double; 4-M and 3-III usually at least triple; hairs 10, 12-VII often branched 13
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13(12). Ventral brush usually with 12 hairs (11-13); hair 4a-X usually 6-8 branched (5-9) (northern South America, Trinidad, Tobago) . **(8) 12b. berlini**
Ventral brush usually with 14-16 hairs (13-17); hair 4a-X usually 10-12 branched (9-15) where sympatric with *berlini* 14

14(13). L/S 2.5-2.8 . . . . **5. braziliensis**
L/S 2.0-2.4 . . . . **4. terrens; 6. zavortinki**

15(12). Saddle extending around segment to at most moderate distance beyond horizontal midline, submarginal slit absent, ventral margin either with broad rounded incision or irregular in outline (fig. 52) . . . . **11. metoecopus; 14. homoeopus** . . . . . . **16. impostor; 17. gabriel; 20. vargasi; 26. podographicus**
Saddle extending around segment far beyond horizontal midline, with ventral submarginal or marginal slit (figs. 59,60) 16

16(15). Comb scales 33-54, in 4 rows, narrow (fig. 59) . . . . **27. tehuantepec**
Comb scales 20-29, in 2-3 rows, stout (fig. 60) . . . . . **28. schroederi**

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FINLAYA

Fig. 61

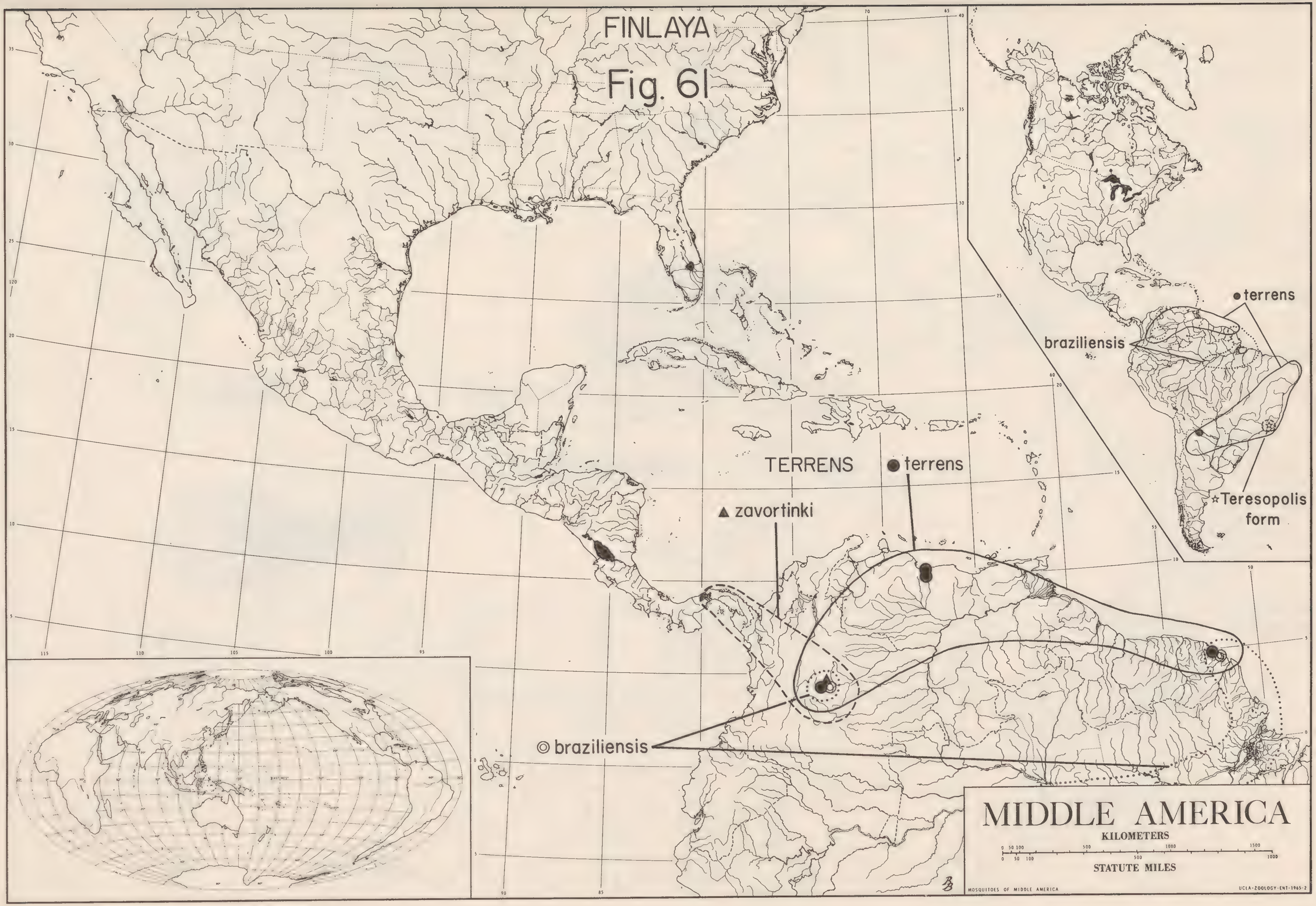

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Fig. 62

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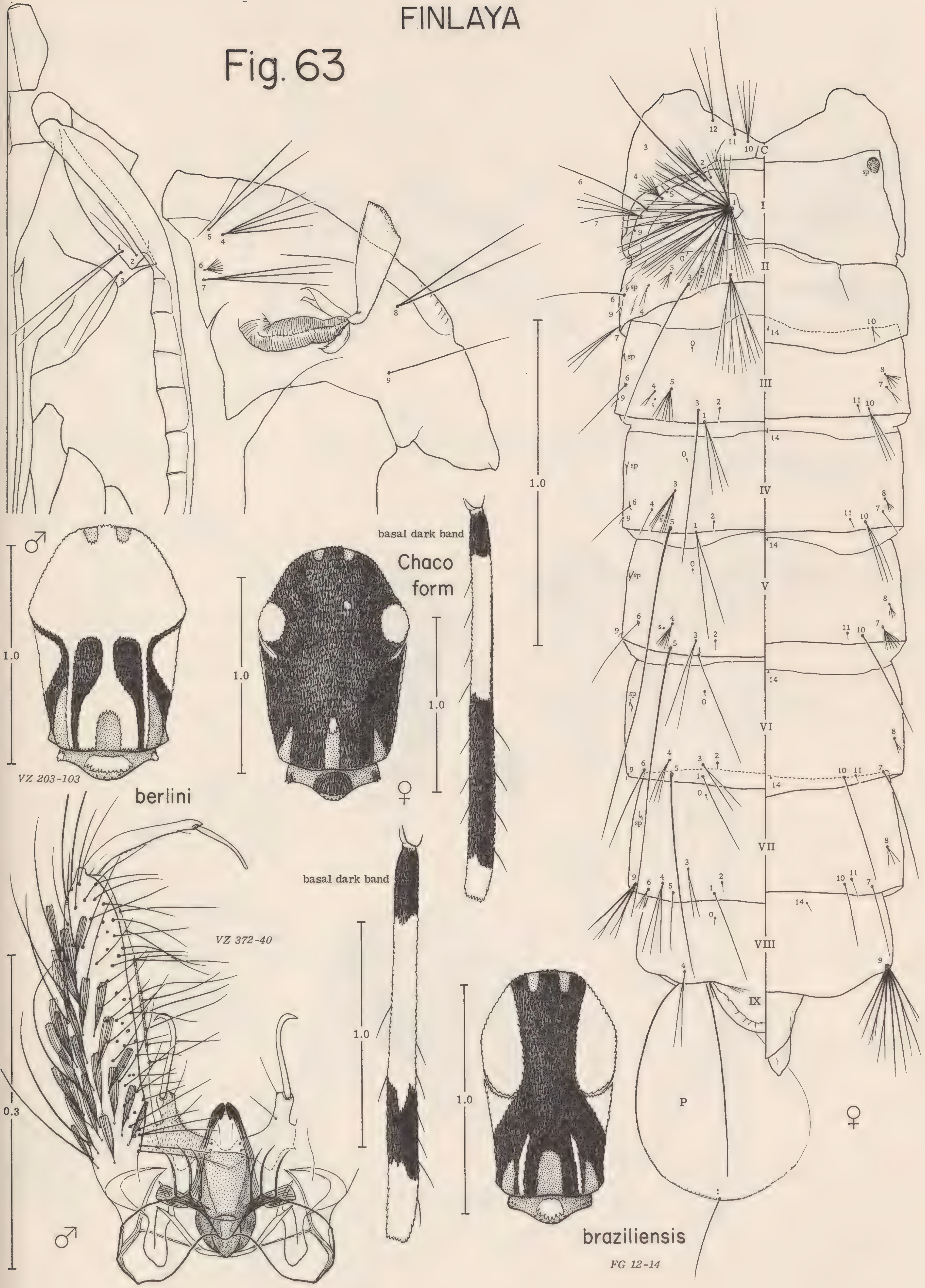
Fig. 63



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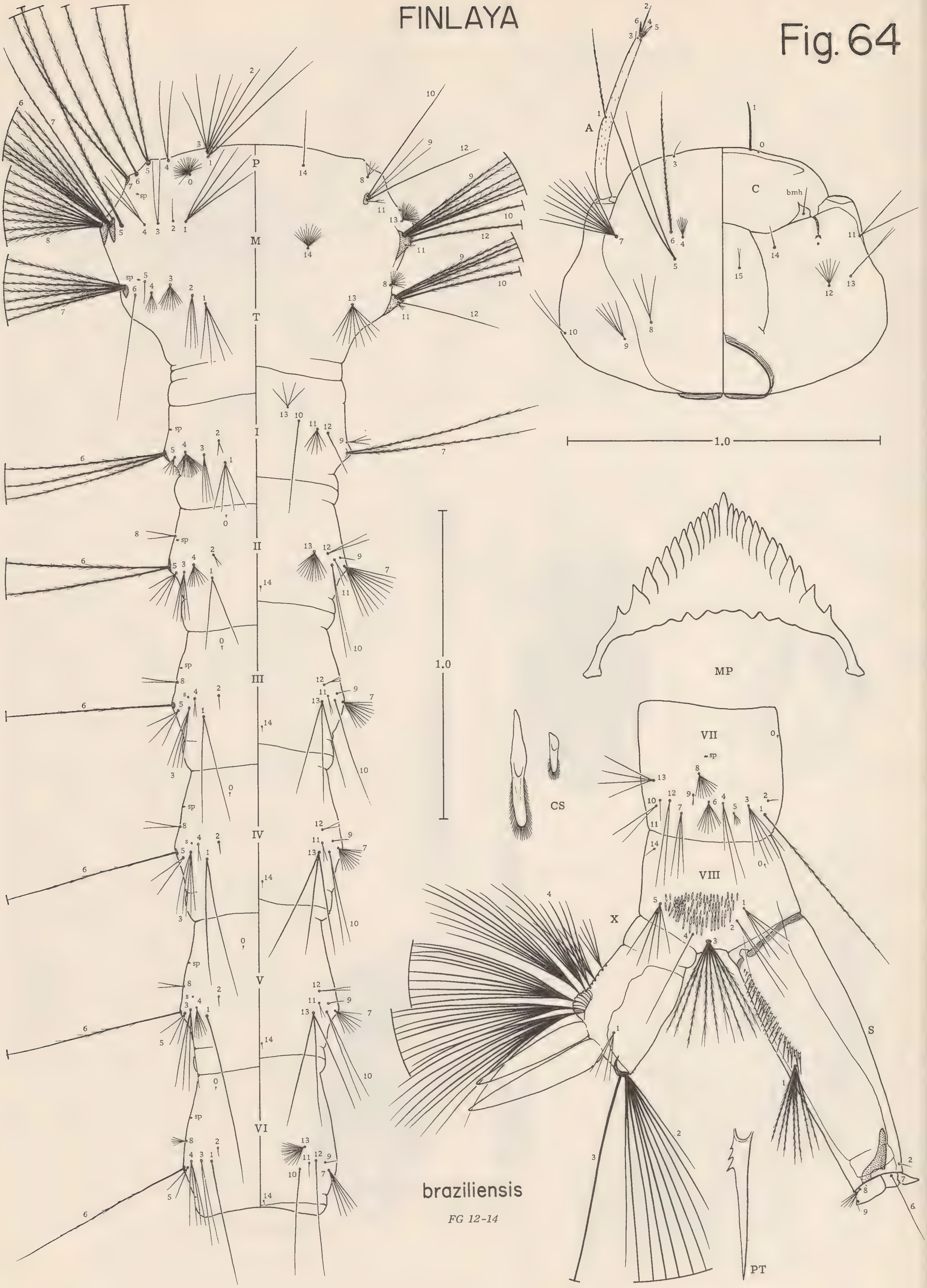

braziliensis

FG 12-14

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Fig. 65

Teresopolis form

Rio de Janeiro
Brazil

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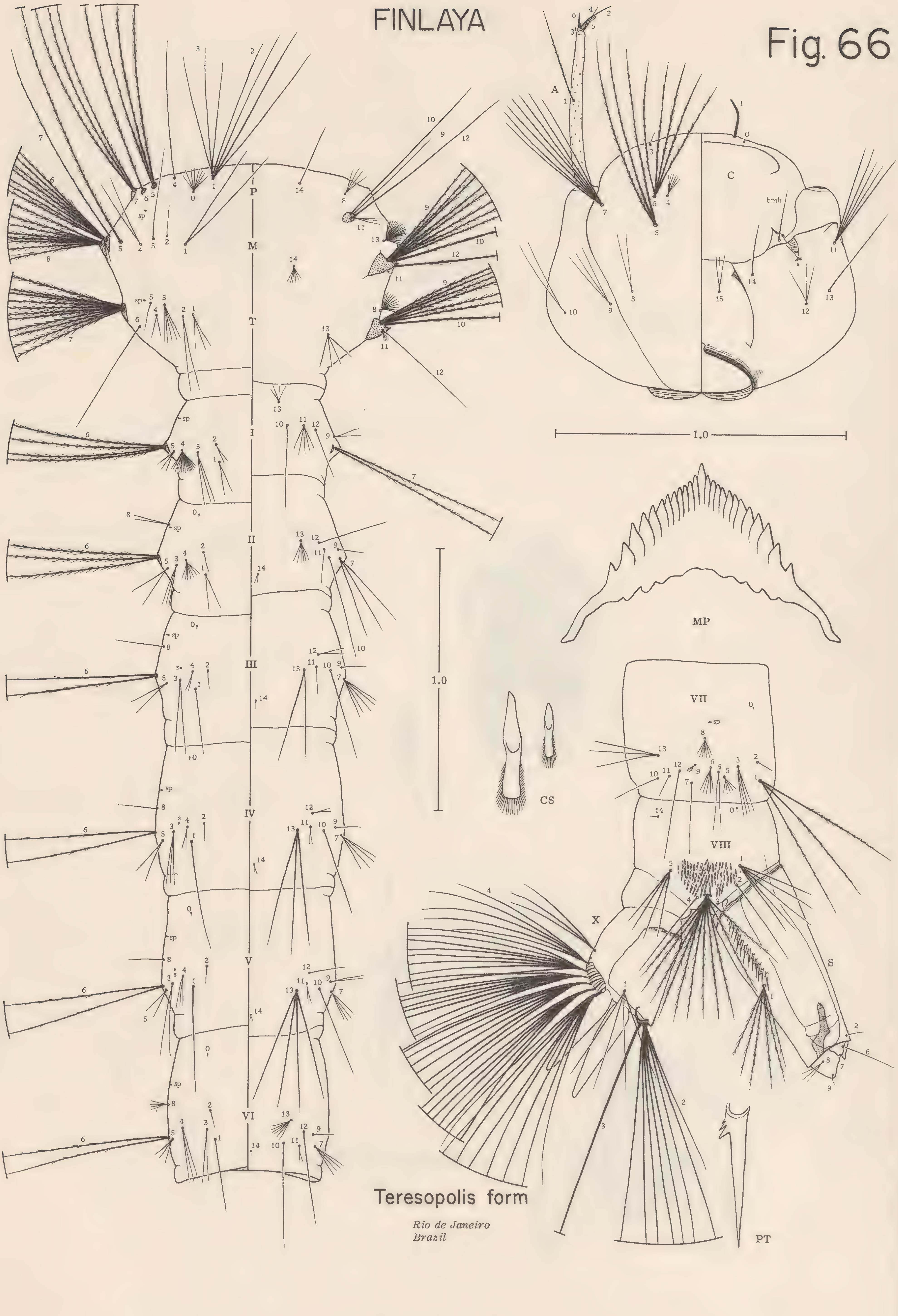
Fig. 66



Teresopolis form

Rio de Janeiro
Brazil

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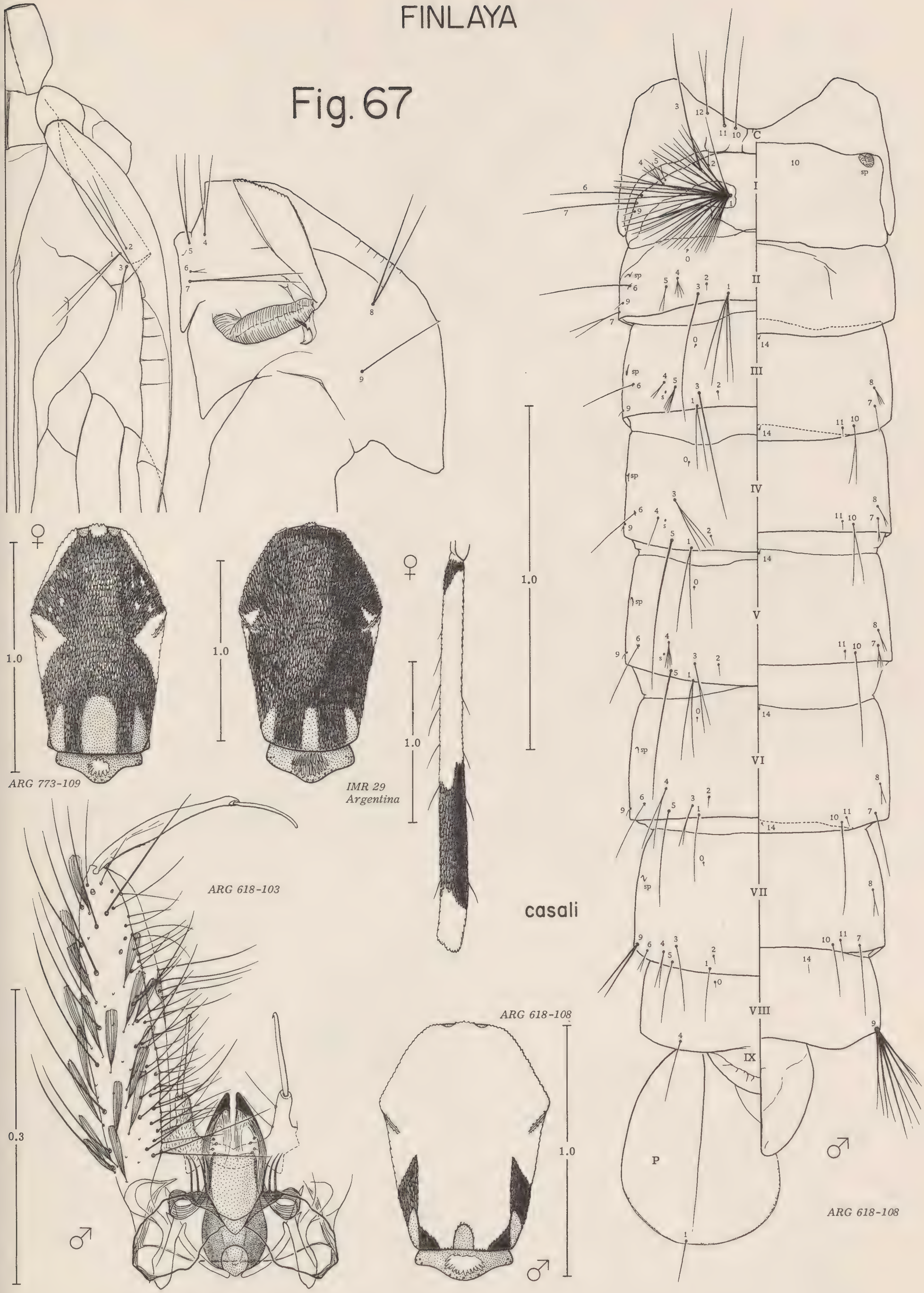
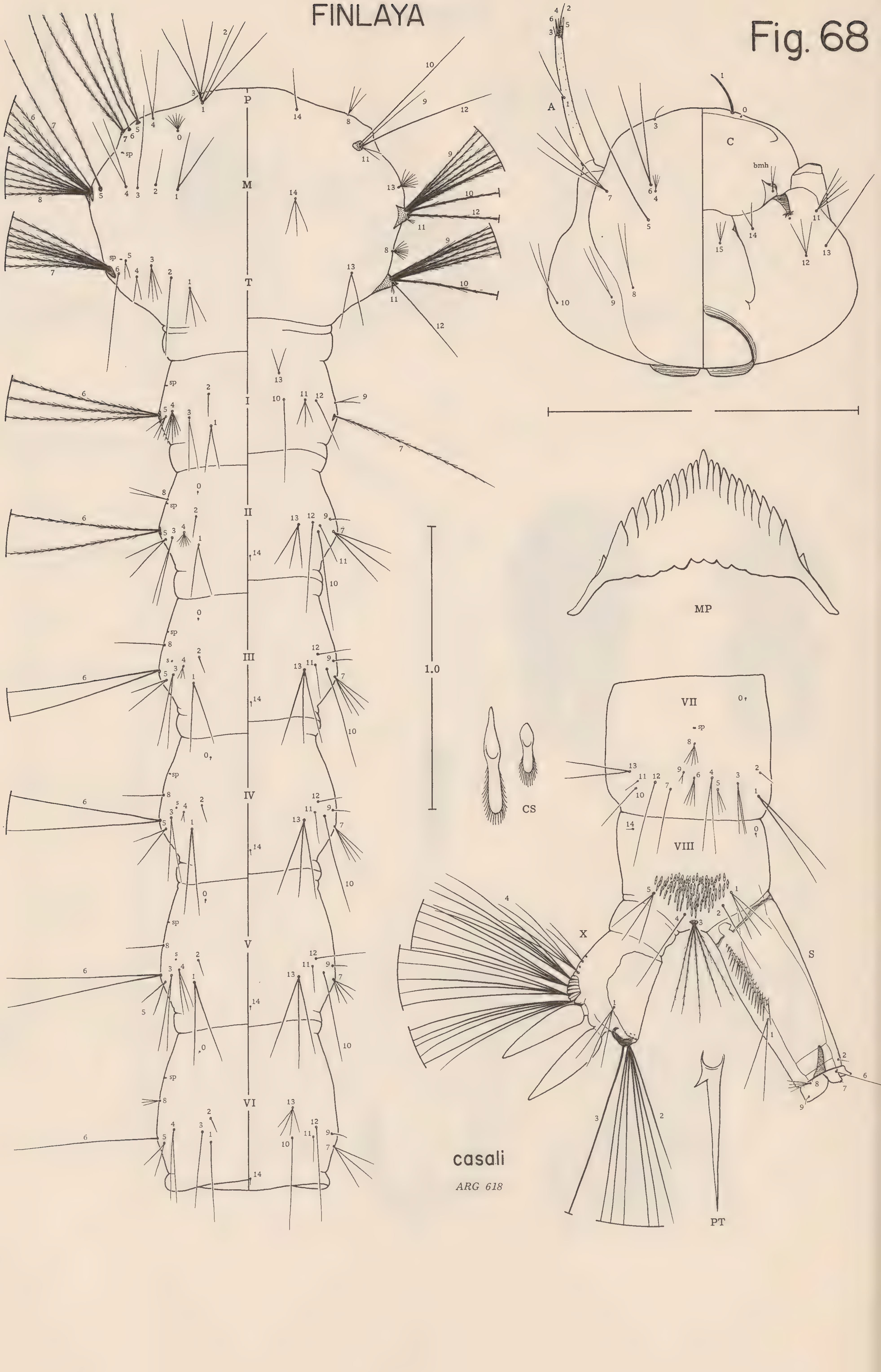
Fig. 67



casali

Fig. 68



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XXIV. A revision of the crabhole mosquitoes of the genus Deinocerites. By Abdiel J. Adames.

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MOSQUITO STUDIES (Diptera, Culicidae)

XXIV. A REVISION OF THE CRABHOLE MOSQUITOES OF THE GENUS *DEINOCERITES*[1]

by

Abdiel J. Adames[2]

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[1] Contribution from project "Mosquitoes of Middle America" supported by U.S. Public Health Service Research Grant AI-04379 and U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478. Based on PhD dissertation submitted to the University of California, Los Angeles.

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INTRODUCTION

In the 12 years since the appearance of Belkin and Hogue's review (1959) of the genus *Deinocerites* a great deal of material has accumulated and considerable information has been obtained on the bionomics and behavior of some of the species. Recent studies have shown *Deinocerites pseudes* to be naturally infected with the viruses of St. Louis encephalitis and of Venezuelan equine encephalomyelitis (Tempelis and Galindo, 1970:175). It was therefore considered appropriate to thoroughly revise this biologically interesting and potentially medically important genus. While Belkin and Hogue recognized 11 species (1 not named), in only 3 of these were both the larvae and pupae known and in 1 only was there definite association of all stages. In the present revision, I recognize 18 species and in 16 of these all the stages are known and associated through individual rearings.

I am indebted: to John N. Belkin for guidance in the study and the preparation of the manuscript; to present and past members of the project "Mosquitoes of Middle America", particularly Thomas J. Zavortink, O.G.W. Berlin, Robert X. Schick, also to my fellow students, Michael Nelson and Jose Valencia, for much assistance and stimulating discussions; and to William A. Powder and Sandra J. Heinemann for the preparation of material. For the loan of material I thank: Alan Stone, U.S. National Museum; Charles L. Hogue, Los Angeles County Museum of Natural History; Donald B. Bright, California State College, Fullerton; Bruce Eldridge, Walter Reed Army Institute of Research; Alfonso Diaz Najera, Instituto de Salubridad y Enfermedades Tropicales, Mexico City; Pablo Barreto, Universidad del Valle, Cali, Colombia; and Martin D. Young and Pedro Galindo, Gorgas Memorial Laboratory, Panama, who also provided laboratory facilities in the field. I am also grateful to the Organization of American States for a fellowship that allowed me to pursue the initial part of this study and to the National Science Foundation which supported some of the field work through grant GB 3871. For the preparation of the final illustrations I am indebted to Nobuko Kitamura and for the text copy for lithoprinting to Caryle Abrams.

MATERIAL AND METHODS

MATERIAL. Some 24,366 specimens were examined for this study, 3,005 males, 4,679 females, 13,298 larvae and 3,384 pupae; included were 2,009 individual rearings (1112 larval, 680 pupal, 217 incomplete) of the 16 of the 18 known species. The bulk of this material was collected for the project "Mosquitoes of Middle America" (Belkin, Schick et al, 1965, 1967) and is deposited at the University of California at Los Angeles [UCLA]. Other collections used were those of the U.S. National Museum [USNM] and of the project on tropical land crabs and their associates [LCBA] being conducted by Charles L. Hogue and Donald B. Bright. Smaller loans were also made available from the Instituto de Salubridad y Enfermedades Tropicales, Mexico [ISET], Universidad del Valle, Cali, Colombia, and Gorgas Memorial Laboratory in Panama. I collected additional material and made field observations specifically for this project in Honduras, Nicaragua, Panama and Colombia in August and September 1967.

TAXONOMIC PROCEDURE. The taxonomic methods used here are the classical comparative morphological ones. Species were first recognized on the basis of a series of constant correlated morphological characters in all stages. They were then compared minutely and those showing correlated features in common were assembled into primary phyletic lines called groups. In some instances smaller units, species complexes, were recognized. In the final interpretation of evolution in the group, distributional data were also taken into account.

DESCRIPTIONS. The method of presentation, terminology and abbreviations used in the description of the taxa in general follow Belkin (1962). A few special terms introduced in this revision are self-explanatory and are labelled on the figures.

ILLUSTRATIONS. For every species all the available stages are illustrated. The full chaetotaxy of the immature stages is figured, with a modal value of the hair branching based on 5-10 topotypic specimens (exact number specified in the description of each species). The illustrations of the adults show pertinent details only: male and female heads, male and female genitalia, female forefemur, and claws of foreleg and midleg of female. In addition, the female of *cancer*, the type species of the genus, is illustrated completely.

DISTRIBUTION. Only synoptic distributional data are given here: locality, collector, collection number (when available) and depository. Full data for every specimen examined have been entered in a permanent ledger and will be available on demand to interested parties on microfilm or other desired reproduction method from the Department of Zoology, University of California, Los Angeles.

TAXONOMIC CHARACTERS

The following morphological features of the different stages were found to be particularly useful as diagnostic specific characters as well as taxonomic or group characters. I have indicated whenever possible the primitive or derived states of the various characters. There is no absolute criterion for determining the nature of the character state without paleontological evidence but the derived state is usually indicated by the trend within a taxon and the primitive state by comparison with related taxa, in this case the subgenus *Culex* and the genus *Galindomyia* (see under affinities in the section on systematics).

GENERAL ADULT CHARACTERS. ***Coloration.*** – The color of the integument of the pleural sclerites as compared with that of the mesonotal integument is a useful diagnostic specific character but is of no value as a group character.

Antenna. – The elongation of the basal flagellar segments and the consequent elongation of the entire antenna are the most important taxonomic characters in the general external morphology of the adults. The trend within the genus is from an antenna similar in the 2 sexes and with only the first flagellar segment elongate to dissimilar and with additional flagellar segments elongated. The length of the antenna is expressed in terms of its extension beyond the proboscis with reference to specific flagellar segments. This was determined in slide preparations.

Proboscis. – The length of the proboscis, from the basal ventral bristles to the tip of the labella, was determined in slide preparations. As noted above, the proportional length of the antenna and proboscis is the most useful taxonomic character in the adults.

Mesepimeron. – The development of a large patch of scales on the mesepimeron is interpreted as a derived state in *Deinocerites*. It appears to have arisen independently in the Pseudes and Epitedeus Groups.

Forefemur. – The replacement of the simple bristles of the anteroventral and posterodorsal rows by short spiniforms is a derived condition. It appears to have arisen independently in the Pseudes and Epitedeus Groups.

FEMALE SEXUAL CHARACTERS. The female genitalia were studied in part only. The following characters showed taxonomic as well as diagnostic value.

Sternite VIII. – Excellent taxonomic characters are (1) presence (primitive) or absence of scales on the distal sclerotized part and (2) caudal margin without (primitive) or with strongly differentiated bristles.

Postgenital plate. – Primarily of diagnostic specific value. Only the distal part was studied, in lateral as well as ventral aspect.

Cercus. – The general shape as well as the differentiation (derived) of apical and subapical setae are excellent taxonomic as well as diagnostic specific characters.

MALE SEXUAL CHARACTERS. These characters are primarily diagnostic at the specific level but are of some value in classification except for the claws.

Claws. – The length, shape and dentition of the foreclaws and midclaws of nearly every species is uniquely developed.

Tergite IX. – The articulated lobe of tergite IX shows a characteristic development in most species. It is of value as a group character primarily in the Cancer Group where it is markedly flattened (derived).

Sidepiece. – The presence (primitive) or absence of scales on the sidepiece is correlated with a similar development of sternite VIII of the female and is an excellent group character.

Aedeagus. – The intromittent organ is basically similar throughout the genus except for the absence (primitive) of a dorsal basal articular process for the dorsal paramere in the Spanius Group.

Dorsal paramere. – As with the claws and IX tergite lobe, the dorsal paramere is characteristically developed in most species. It is differentiated into 2 parts (primitive) in the northern complex of the Spanius Group but is compact in all other species.

PUPA. The following pupal group characters are usually concordant with the group characters of the adults: (1) on the ***cephalothorax***, the increase (derived) in the length of and in the distance between hairs 2 and 3, the reduction (derived) in the length of hair 5, (2) on the ***metanotum***, the reduction (derived) in the length of hair 10, and (3) on the ***abdomen***, increase in length and reduction in the number of branches in hair 1-II (both derived), the displacement of 5-II mesad (derived), and the reduction (derived) in the length of 1-VII. Other important group characters are found in cephalothoracic hairs 5,7,8-C and abdominal hairs 1-II and 3-V. There are numerous diagnostic specific hair characters as indicated in the pupal key.

FOURTH INSTAR LARVA. There are numerous characters in the fourth instar larva that show congruent development with adult and pupal characters at the group level and are very useful in classification. Among these are (1) on the ***head***, reduction and lateral displacement (both derived) of hair 2-C, and reduction in number of branches and elongation (both derived) of 6-C and to lesser extent 5-C, (2) on the ***thorax***, branching (derived) of hair 9-P, (3) on the ***abdomen***, increase (derived) in the number of branches in hairs 6-II and 6-VI, and decrease (derived) in the length of 1-VII, (4) on the ***siphon***, decrease (derived) in the number of branches of hair 1-S, and (5) on the ***anal segment***, independent reduction (derived) in several lines of the number of hairs in the ventral brush from 7 to 6 pairs. There are also numerous specific differences in the branching of other hairs as indicated in the larval key.

SYSTEMATICS

TAXONOMY. The 18 species recognized in this revision fall into 5 well-defined groups on the basis of morphological similarities in 1 or more of the different stages. Two of these groups, Spanius and Cancer, are essentially as defined by Belkin and Hogue (1959); the Dyari Group of these authors is broadened to include 2 other species; and the Pseudes Group is split off from the Epitedeus Group.

Each of the groups is marked by 1 or more unique features or unique combinations of features in 1 or more stages. In all but the Spanius Group these features represent derived states. They are listed below in the diagnosis of each group and are only briefly reviewed here.

In the Spanius Group unique features are present in the adults (extensive scaling of the genitalia and short similar antennae in both sexes) and the larvae (abdominal hair 6-II single); all of these appear to be primitive. In the Dyari Group the best diagnostic features are found in the immature stages (reduced length of pupal hair 10-C and larval hair 1-VII). The Cancer Group is differentiated from the others most clearly by the genitalia in both sexes (flattening of IX tergite lobe in the male and spatulate specialized setae of the cercus in the female). The Epitedeus Group (in the present restricted sense) is the most derived of all and is clearly marked by (1) the absence of a strongly developed lower mesepimeral bristle in the adults and the great elongation of flagellar segments 1-4 of the antenna of the female, (2) the reduced length of hair 5-C and the long double or triple hair 1-II in the pupa, and (3) hair 9-P double or triple in the larva. Finally, the Pseudes Group shares with the Epitedeus Group the development of a patch of mesepimeral scales in the adults (absent in the other groups) but possesses the differentiated mesepimeral bristle; its immature stages however are more similar to those of the Cancer Group from which they are not always easily differentiated.

The Spanius Group appears to be the most ancient segregate of the *Deinocerites* stock because it is characterized largely by primitive and not derived features and because of its widely disjunct distribution. The Dyari Group has also retained many primitive features and in some respects appears to be transitional between the Spanius Group and the others with predominantly derived features, but as indicated above it too possesses unique derived features in the immature stages.

DISTRIBUTION. The genus is largely restricted to Middle America in the sense of Belkin, Schick et al (1965:2), i.e. Central America, the West Indies and adjacent portions of North America and South America. The only known extension from this area is on the Atlantic seaboard of South America down to the state of Maranhao, Brazil, south of the Amazon River.

All the species within a given group are allopatric except for the Pseudes Group where all 3 species have been recorded from a single locality. Only 1 species, *pseudes*, is known with certainty to be present both in the Atlantic and Pacific basins, all others are confined to either one or the other ocean basin.

Each of the groups has a characteristic distribution but 2 or more groups occur in 1 locality. The Cancer Group is confined to the Atlantic basin, centered around the Caribbean Sea but extending into the Bahamas and Florida in the north and into eastern South America south of the Amazon. The Dyari Group is known only from the Pacific shores from Nicaragua to central Colombia. The other 3 groups have been reported from both the Atlantic and Pacific coasts. The Pseudes Group is largely confined to the Pacific coast from the Gulf of California to the Gulf of Guayaquil with only *pseudes* itself invading the Atlantic basin northward from the Isthmus of Tehuantepec, Mexico, into southern Texas. The Epitedeus Group is equally represented on the Atlantic and Pacific sides of Central America and Colombia. Whereas the distributions of all these groups are probably continuous within their range, that of the Spanius Group is widely disjunct, with a pair of geminate Atlantic and Pacific species north of Tehuantepec and a similar pair south of Costa Rica.

All of the 5 groups are known from Panama, 4 on the Pacific side (Spanius, Dyari, Epitedeus and Pseudes) and 3 on the Atlantic (Spanius, Cancer and Epitedeus). Elsewhere at most 2 groups occur sympatrically in the Atlantic basin (Spanius and Pseudes, north of Tehuantepec; Cancer and Epitedeus, Central America; Spanius and Cancer, Colombia and Venezuela) and at most 3 in the Pacific basin (Spanius and Pseudes, north of Tehuantepec; apparently only Pseudes in Guatemala and Salvador and Pseudes and Dyari in Nicaragua; Pseudes, Epitedeus and Dyari in Costa Rica and Colombia; and only Pseudes in Ecuador and northern Peru). In Florida, Bahamas, Greater and Lesser Antilles, Trinidad and Tobago, and northeastern South America only the Cancer Group is represented.

AFFINITIES. The genus *Deinocerites* is undoubtedly a member of the tribe Culicini in the sense of Belkin (1962:117). Only 2 other genera are currently recognized in this tribe, the dominant worldwide *Culex* Linneaeus, 1758 and the monotypic *Galindomyia* Stone & Barreto, 1969 from Colombia.

Deinocerites and *Galindomyia* share the following features not exhibited by *Culex*: (1) flagellar segment 1 elongate in both sexes, (2) dorsal paramere developed in the male, and (3) general development of the subapical lobe of the sidepiece and of the clasper in the male. *Galindomyia leei* Stone & Barreto, 1969 resembles members of the most primitive group (Spanius) of *Deinocerites* in the small size, relatively short antenna and the type of articulation of the dorsal paramere with the aedeagus. Therefore, I consider it likely that *Deinocerites* and *Galindomyia* were derived from a common ancestral stock which separated very early from the stock that gave rise to the dominant genus *Culex*. However, the relationship between *Deinocerites* and *Galindomyia* cannot be determined with any degree of certainty without evidence from the immature stages. Unfortunately the latter are unknown for *leei*; it seems likely that they will be found in crabholes to which the adults appear to be confined as in the case of *Deinocerites*. For the present, *Galindomyia* is retained as a genus distinct from *Deinocerites* because of the following features not found in any of the groups of the latter: (1) absence of articulation between tergite and sternite IX, poor development of tergite lobe IX, and unique development of terminal flagellar segment of the antenna and of the foreclaw in the male, and (2) vertex of head with decumbent scales all broad and erect scales restricted to occiput in both sexes. In some respects *Galindomyia* appears to be annectent between *Deinocerites* and *Culex*, notably in the position and development of the subapical lobe of the sidepiece.

Dyar's view (1928:261,337) that *Deinocerites* was derived from *Culex* (*Tinolestes) latisquama* (Coquillett, 1906) was apparently based entirely on the mistaken homology of a process from the basolateral sclerotization of the proctiger with the IX tergite lobe of *Deinocerites* and the presence of a short palpus in the male, and the similarity in breeding sites. Actually there is little in the morphology of the adults of *latisquama* to suggest close relationship to *Deinocerites* and its immature stages are completely different and indicate affinity with the *Melanoconion* line of the genus *Culex*.

Of the major lines of *Culex*, the subgenus *Culex* appears to share the greatest number of similarities with *Deinocerites*. Among these are: (1) in the ***adults***, decumbent scales of vertex all narrow, erect scales numerous, (2) in the ***genitalia***, sidepiece of male and sternite VIII of female with scales, and (3) in the ***larva***, abdominal hairs 6-I-VI subequal, with 6-I,II not sharply differentiated, and siphon with only 1 lateral hair out of line.

SPECIATION AND PHYLOGENY. Although the interrelations of the various species are now better understood because of the knowledge of all the stages of 16 of the 18 species, the other data needed to determine the speciation and phylogeny of the genus are still fragmentary and little can be added to the speculations of Belkin and Hogue (1959:420-423) except at the species and group level (see).

Many areas are still not surveyed for *Deinocerites* and it is very probable that some of the existing gaps in distribution will eventually be filled. Accurate determination of distributions may be important to evaluate the places of origin and the relationship to former sea portals in the area for it appears that even dominant species of *Deinocerites* are incapable of crossing relatively small land and sea barriers and that dispersal occurs only through contiguous areas suitable for breeding. This is rather clearly seen in Panama where all the species are restricted either to the Atlantic or to the Pacific basin although there is less than an 80-kilometer gap between the basins and a connection by way of the canal. The few specimens in this area reported from the wrong basin are probably strays as there is no modern record of any species breeding outside of its normal basin.

The present allopatric pattern of species within groups of *Deinocerites* is highly suggestive that speciation in this genus has taken place primarily in conjunction with geographical isolation. Only in the Pseudes Group do the included species occur together and in case of *howardi* (see), as pointed out by Belkin and Hogue (1959:442), it is possible that speciation took place through hybridization or introgression (between *mcdonaldi* and *pseudes* stocks).

If the above pattern of allopatric speciation has occurred in *Deinocerites* in the past, then the present partially overlapping pattern of the distribution of the 5 groups represents subsequent dispersal of the original stocks over more or less contiguous areas of suitable breeding sites. Thus, it may be possible to get some suggestions as to barriers (sea portals) from the distributions of species within a group and both barriers and connections (or contiguities) from those of groups of *Deinocerites.* It is tempting to date these by correlating them with geological events. Unfortunately the historical geology of the area occupied by the genus is poorly known and subject to different interpretations, sometimes in part based circularly on the distribution of plants or animals. Up to now, no fossil material of *Deinocerites* is known and it is therefore impossible to date directly any of the events in the phylogeny of the genus.

However, the general sequence of events in the evolution of *Deinocerites* may have been as proposed by Belkin and Hogue (1959:423) with slight modifications as follows:

1. The origin of the Spanius Group stock on an island in the center of the Middle American area.

2. Subsequent connection of this island with both North and South America and the invasion of these areas by the Spanius Group.

3. Fragmentation of the central area into islands and the formation of 4 separate lines from the Spanius Group populations, each on a different island and giving rise in the southwest to the Dyari Group, the northeast to the Cancer Group, the northwest to the Pseudes Group and the southeast to the Epitedeus Group.

4. Subsequent connection of the islands containing the different stocks and further species differentiation in the groups by later fragmentation of portions of the various connected areas. This was probably a very complex series of events and extended over a long period of time. The latest fragmentation appears to have taken place in the region of Panama and northwestern South America, but the presence of an undifferentiated population of the dominantly Pacific *pseudes* in the Gulf of Mexico suggests that even more recently there was a gap (mangroves?) through the isthmus of Tehuantepec which allowed this species to cross over into the Atlantic basin.

BIONOMICS

All species of the genus *Deinocerites* normally utilize as breeding sites, as well as adult resting sites, burrows of land crabs of the families Gecarcinidae and Ocypodidae. In Cuba, *cancer* has been reported also from burrows of species of stream inhabitating crabs of the genus *Epilobocera* of the family Pseudothelphusidae (Montchadsky and Garcia, 1966:47). No conclusive evidence has yet been obtained as to the specificity of association of any given mosquito with a particular species of crab and relatively few positive identifications of the burrow makers have been reported. However, it appears that members of the Spanius Group are normally found in small burrows which are usually made by fiddler crabs of the genus *Uca* which contains small species of the family Ocypodidae; only 2 species have been identified, both associated with *mathesoni*: *Uca pugilator* (Bosc, 1802) and *Uca subcylindrica* (Stimpson, 1859). Two species of the Dyari Group (*dyari* and *nicoyae*) have been found associated with the Wide Red Land Crab, *Ucides occidentalis* (Ortmann, 1897), a medium-sized species of the family Ocypodidae. Species of the Cancer, Epitedeus and Pseudes Groups are usually found in large or medium-sized burrows made by members of the family Gecarcinidae, primarily the large *Cardisoma crassum* Smith, 1870 (Mouthless Crab; Pacific) or *Cardisoma guanhumi* Latreille, 1825 (Great Land Crab; Atlantic) and less frequently the medium-sized Atlantic Black Land Crab, *Gecarcinus lateralis* (Freminville, 1835).

The immature stages of species of *Deinocerites* have occasionally been reported from a variety of abnormal habitats such as postholes (Jennings *in* Howard, Dyar and Knab, 1915:209), rockholes (Wirth, 1945; Belkin, Heinemann and Page, 1970: 49), a beach pool (van der Kuyp, 1948a:748), treeholes (Peyton, Reinert and Peterson, 1964:454; Porter, 1964:222) and various artificial containers such as tin cans, a wooden bucket and an abandoned septic tank (Dyar, 1928:265; Porter, 1964:222). They have also been found in ground pools formed by the flooding of depressions containing crabholes.

It is not unusual to find the immature stages of more than 1 species of *Deinocerites* in the same crabhole but these always belong to different species groups except possibly in the case of *pseudes*, *howardi* and *mcdonaldi* which are partially sympatric members of 1 group. Frequently associated with species of *Deinocerites* are the immature stages of the other normally obligate crabhole mosquitoes. To date the following species have been recorded in such associations: *Culex (C.) janitor* Theobald, 1903; members of *Culex (C.) inflictus* Theobald, 1901 complex; *Culex (Melanoconion) carcinophilus* Dyar & Knab, 1906; *Culex (Mel.)* undescribed spp.; *Culex (Tinolestes) latisquama* (Coquillett, 1906). In exposed shallow crabholes, in flooded crabhole areas and other ground water situations, the following species have been found associated with various species of *Deinocerites*: *Aedes (O.) taeniorhynchus* (Wiedemann, 1821); *Aedes (O.) scapularis* (Rondani, 1848); *Anopheles (A.) eiseni* Coquillett, 1902; *Anopheles (A.) grabhamii* Theobald, 1901; *Anopheles (Nys.) albimanus* Wiedemann, 1821; *Culex (C.) bahamensis* Dyar & Knab, 1906; *Culex (C.) habilitator* Dyar & Knab, 1906; *Culex (C.) nigripalpus* Theobald, 1901; *Culex (Mel.) elevator* Dyar & Knab, 1906 complex; *Culex (Mel.) opisthopus* Komp, 1926; *Psorophora (G.) jamaicensis* Theobald, 1901. In treeholes or various artificial containers, 2 species of *Deinocerites* (*cancer* and *costaricensis*) have been reported to be associated once each with *Aedes (F.) triseriatus* (Say, 1823) complex; *Culex (C.) nigripalpus*; *Culex (Anoed.) conservator* Dyar & Knab, 1906; *Haemagogus chalcospilans* Dyar, 1921; *Orthopodomyia fascipes* (Coquillett, 1905); and *Corethrella (C.)* sp.

Immature stages of *Deinocerites* occur in crabholes near the seashore as well as in those at a considerable distance from the coast. The water in the burrows has been reported to vary from completely fresh to distinctly salty but the only published records of water analyses are for *mathesoni* and *pseudes* and show a range of chloride content from 1,115 to 8,430 ppm and pH from 7.2-7.6 (Fisk, 1941:547; Peyton, Reinert and Peterson, 1964:452).

The natural food of the larvae is unknown but may be, as speculated by Howard, Dyar and Knab (1915:200), "matter in suspension in the water, of which the excrement of the crab not improbably forms an important part". As pointed out by Belkin and Hogue (1959:415) the great development of the subantennal pouch, the peculiar basal and apical lobes of the mandible and the rudimentary mental plate suggest an unusual type of food and a peculiar method of feeding. In the laboratory, larvae have been reared through from eggs on Purina chow (Galindo, 1967) and half and half mixture of ground dog food and porcine liver powder (Gentry, Gerberg and Hopkins, 1970).

The length of the aquatic cycle under natural conditions is not known for any species of *Deinocerites*. Under laboratory conditions it has been determined only for *mathesoni*, *cancer* and *pseudes*. The reported length of the larval cycle varies from only 2 weeks to more than 8 weeks, while the pupal stage is stated to last from about 3-8 days. In the laboratory, eggs are laid singly in containers above the water level.

All available data indicate that adults of *Deinocerites* are crepuscular or nocturnal in activity and that during daylight hours they rest in the upper portions of crab burrows. If the adults are disturbed or driven out of the holes, they fly out a short distance only and return rapidly to the burrows. Dyar (1928:126) suggested that "the remarkably elongate antennae perhaps serve as special sensory organs to warn them of ... danger ... when the crustacean host enters". As the antennae are elongate in both sexes it is likely that they serve to monitor all the activities of the adults within the confines of the dark crabholes. As shown by Downes (1966) and Provost and Haeger (1967) the antennae of the males are involved in the mating behavior of *cancer*.

It appears that the adults have a relatively short flight range and that their activities are restricted to the immediate vicinity of their breeding sites in the crabholes. However, *mathesoni* (Fisk, 1941:544) and *cancer* (Branch, Logan et al, 1958:161) have been reported in light traps presumably several miles away from crabholes.

Earlier workers generally assumed that the majority of the species of *Deinocerites* do not take blood or at least not from warm blooded vertebrates (Howard, Dyar and Knab, 1915:200; Fisk, 1941:544). It is now known that a number of species are attracted to a variety of hosts in animal-baited traps and some will readily feed on man in the field. Recent studies on the blood meals of wild-caught females of 5 species of *Deinocerites* in Panama (Gorgas Memorial Institute, 1970: 20; Tempelis and Galindo, 1970) have revealed a wider spectrum of hosts for some of these species than has been known for any other group of mosquitoes previously studied, ranging from man and several domestic and wild mammals through birds of several orders, lizards, frogs and toads. Specific differences in host preference were also noted in these studies and also the unusually small blood meals taken by species of *Deinocerites*.

Early reports on the mating behavior of species of *Deinocerites* were based on field observations and indicated that swarming and mating take place above the crabholes (Busck, 1908:61; Howard, Dyar and Knab, 1915:207). Recently, observations have been made in laboratory colonies of *cancer* by Downes (1966) and Provost and Haeger (1967) and *pseudes* by Galindo (1967). In *cancer* 2 types of mating behavior were seen. In the first type, males exhibited "pupal attendance" on the water surface which is described here in the discussion of the bionomics of *cancer*. In the second type, males flew to the walls of the container and copulated with virgin females without pupal attendance. Galindo did not report either swarming or pupal attendance in the laboratory colony of *pseudes* but observed males performing nuptial flights involving hovering over females and contact between midtarsi of the males and the hindlegs of the females prior to copulation end to end. It remains to be seen if all the different types of behavior described occur in a single species in different situations in the field or if different species have developed different mating behavior patterns.

MEDICAL AND PEST IMPORTANCE

Recent data suggesting the potential importance of species of *Deinocerites* as vectors of arboviruses have been reviewed by Tempelis and Galindo (1970:177-

178). As noted in the section on bionomics, some species of the genus readily feed in nature on a variety of cold-blooded and warm-blooded vertebrates as well as man. That such "mosquitoes [are] promising suspects as vectors of viruses which have been isolated from both warm- and cold-blooded animals" (Gorgas Memorial Institute, 1970:20) has been demonstrated by the isolation from wild-caught *pseudes* of the virus of St. Louis encephalitis (SLE) and of Venezuelan equine encephalomyelitis (VEE) and by the transmission of the latter in the laboratory by the same species (Grayson, Sirihongse and Galindo, 1967; Gorgas Memorial Institute, 1970:19; Tempelis and Galindo, 1970:175). However, the importance of species of *Deinocerites* in the epidemiology of either arboviral infection has not been demonstrated as yet. Although some species are known to bite man rather freely, their activity appears to be confined largely to the vicinity of areas with crabholes. Therefore their importance both as pest species and as direct vectors of pathogens to man is probably limited.

In other recent studies in Panama (Gorgas Memorial Institute, 1970:20), *epitedeus* was found to be naturally infected with trypanosomes (60 specimens) and plasmodium-like sporozoites (2 specimens). The vertebrate hosts of these parasites have not been determined.

TAXONOMIC TREATMENT

Genus *DEINOCERITES* Theobald

1901. *Deinocerites* Theobald, 1901a:235 (15 July), no included species; 1901b:215 (23 Nov.). TYPE SPECIES: *Deinocerites cancer* Theobald, 1901, Jamaica; by subsequent monotypy.
1901. *Brachiosoma* Theobald, 1901a:235, no included species. TYPE SPECIES: *Deinocerites cancer* Theobald, 1901, Jamaica; designation of Coquillett (1910:515). Synonymy with *Deinocerites* by Blanchard (1905:414).
1901. *Brachiomyia* Theobald, 1901b:343-344. TYPE SPECIES: *Brachiomyia magna* Theobald, 1901, St. Lucia; by monotypy. Synonymy with *Deinocerites* by Theobald (1903:275).
1902. *Deinokerides* Giles, 1902:335,472. TYPE SPECIES: *Deinocerites cancer* Theobald, 1901, Jamaica. Unjustified emendation.
1905. *Dinocerites* Blanchard, 1905:413-414. TYPE SPECIES: *Deinocerites cancer* Theobald, 1901, Jamaica. Unjustified emendation.
1907. *Dinomimetes* Knab, 1907:120. TYPE SPECIES: *Dinomimetes epitedeus* Knab, 1907, Port Limon, Costa Rica; by monotypy. Synonymy with *Deinocerites* by Dyar (1918: 101).
1909. *Dinanamesus* Dyar and Knab, 1909:259. TYPE SPECIES: *Dinanamesus spanius* Dyar & Knab, 1909, Corozal, Panama, Canal Zone; by monotypy. Synonymy with *Deinocerites* by Dyar (1918:101).

Deinocerites of Theobald (1903:275-276; 1905b:37); Dyar (1905a:45-49; 1928:261); Felt (1905: 459,491); Dyar and Knab (1906:178,188; 1907a:48); Knab (1907b:121-123); Mitchell (1907b:223); Busck (1908:54); Coquillett (1910:531); Surcouf and Gonzalez-Rincones (1911:91); Howard, Dyar and Knab (1915:191); Dyar and Shannon (1924:477,485); Bonne and Bonne-Wepster (1925:168); Shannon (1931:4-5); Gerry (1932:43); King, Bradley and McNeel (1944:61,65,66,75,77; 1946b:5,7); Carpenter, Middlekauff and Chamberlain (1946: 25,34,274); Knight and Chamberlain (1948:7); Bates (1949:80,165,171,270,322); Lane (1953:535); Blanton, Keenan and Peyton (1955:41); Horsfall (1955:599-600); Perez Vigueras (1956:476); Peyton and Hill (1957:295); Belkin and Hogue (1959:411-451); Gibson and Carrillo (1959:166); Stone, Knight and Starcke (1959:284-285); Scott (1961:244);

Bachmann and Casal (1963:21); Dodge (1962:366; 1963:798,807; 1966:342-343,344-345); Evans (1962:255); Ross (1962:192; 1964:103,104); Forattini (1965:107,108); Diaz Najera (1965:57); Downes (1966:1173-1176); Provost and Haeger (1967:565,570-573); Lee and Barreto (1969:389).

Brachiomyia of Giles (1902:473-474).

FEMALES. Small to medium-sized species; mesonotum usually dark brown, sometimes contrasting with conspicuously lighter portions of pleural integument; without distinct ornamentation on legs or abdomen. ***Head***: Eyes contiguous above antennal bases. Decumbent scales on disc of vertex all narrow, a small patch of small broad scales laterally; a slight indication of a frontal tuft of elongate scales or scalelike bristles; orbital line without scales. Erect scales numerous. One pair of strongly developed interorbital (frontal) bristles and a continuous row of orbitals. Clypeus prominent, bare. Proboscis usually distinctly shorter than abdomen. Labium uniform in diameter; weakened beyond middle and often curved caudad; dark scaled and with numerous short bristles; labella small, elongate, with short bristles and usually a few scales. Palpus short, about 0.2 of proboscis; 3-segmented and with an indistinct palpifer; segment 3 elongate, dark scaled; all 3 segments with bristles but only a few well developed in distal part of segments 1 and 2. Antenna always distinctly longer than proboscis, but varied, exceeding proboscis from basal two-thirds of segment 5 to base of segment 11; scape distinct, visible under torus; torus small, with a few short hairs on anterior mesal surface and sometimes with 1 to several small broad scales; flagellar segment 1 without distinct whorl of bristles and always with numerous small broad appressed scales; segments 2-13 without scales except sometimes a few at base of segment 2, flagellar whorls short, composed usually of 8 bristles, dense vestiture of short hairs; flagellar segment 1 conspicuously elongated; segments 2-12 of varied length, either segments 2-12 subequal in length but progressively slightly shortened distad, or segments 2-4 markedly longer than segments 5-12 which are subequal in length but progressively slightly shortened distad; segment 13 longer than 12. ***Thorax***: Mesonotum and scutellum with narrow curved decumbent dark scales, some scales broader, particularly on lateral scutellar lobes. Acrostichal bristles absent on disc, sometimes slightly developed on anterior promontory; dorsocentrals, supraalars and marginal scutellars present and strongly developed; posterior fossals usually 1-3. Postnotals present or absent. Paratergite bare. ***Apn*** with strong bristles and with a group of weaker bristles posteriorly, usually arranged into a more or less transverse row; ***ppn*** with several bristles in dorsocaudal angle and with narrow curved decumbent scales on upper part followed sometimes by some broad scales caudoventrad, lower part usually with a few hairs, scales absent; ***ppl*** with several bristles and sometimes with 1 to several small translucent scales; ***psp*** bare; ***stp*** with numerous bristles arranged in a continuous curved row along dorsal and caudal margins and with a varied, usually extensive, patch of broad appressed translucent scales, sometimes with scattered hairs in addition; ***pra*** with several bristles; ***mep*** with or without a variable patch of broad translucent scales, with or without a few to numerous microsetae in addition, ***lmep*** with or without 1 very strong bristle, ***umep*** with a few to numerous bristles; meron and metapleuron simple; metameron either simple or with a few microsetae; usually a few microsetae near base of haltere. ***Legs***: Coxae with scales and bristles; anterior surface of forecoxa largely covered by scales and bristles, basolateral area with a few scales; midcoxa with scales anterolaterally and with 2 groups or rows of bristles laterally, the posterior stronger, upper lateroposterior surface with or without scales; hindcoxa with anterolateral surface with scales, lower lateral with bristles, upper lateroposterior with or without a few scales, posterior surface with bristles. Femora subequal in length and not markedly different in length from proboscis, frequently with variable lighter portions. Forefemur with anteroventral margin with several bristles, a complete row of bristles or a row of short spiniforms; posterodorsal margin with several strong bristles or a complete row of weaker bristles, latter sometimes replaced by spiniforms near base. Midfemur slightly swollen. Tibiae and tarsi dark scaled. Foretibia about equal to forefemur, midfemur and hindfemur slightly longer, subequal. Basal tarsal segments shorter than respective tibiae. Claws simple on all legs; empodium well developed, padlike but short and with setiform spicules; pulvilli small and with setiform spicules. ***Wing***: Membrane with microtrichia present. Veins entirely dark scaled. Base of vein R with a few (remigial) bristles; cell R_2 longer than its stem; vein 1A ending well distad of furcation of Cu, base without scales on ventral surface; fringe normal, dark except near base; alula with long narrow marginal scales and broader dorsal scales; upper calypter with a long marginal row of bristles. ***Haltere***: Stem light, dorsoapical part with several dark scales; knob dark scaled. ***Abdomen***: Tergite I extensively scaled. Tergites completely dark scaled. Sternites II-VII usually lighter than tergites, light scaling variable. ***Buccopharyngeal Armature***: A single row of blunt teeth on pharyngeal bar; a larger roughly hemispherical, strongly reticulate sclerite over point of articulation of cibarium and pharynx.

FEMALE GENITALIA. ***Segment VIII*** partly retracted into segment VII. Sternite VIII longer than tergite; with strongly sclerotized caudal band; scales present or absent; deeply emarginate midventrally on caudal margin, side of emargination sometimes produced into distinct angle with strongly differentiated marginal bristles. ***Tergite IX*** a distinct sclerite with or without setae. ***Tergite X*** variously developed, sometimes as a broad strong sclerite at base of cercus. ***Cercus*** long, extending beyond postgenital plate; more or less conical; usually completely retracted, sometimes with apex visible; with numerous setae but without scales on body, apex with more or less strongly and variously differentiated setae. ***Postgenital plate*** with poorly sclerotized cup-shaped basal part; distal part strongly sclerotized with median caudal emargination or notch and with more or less strongly differentiated lateral setose lobes; in lateral aspect lobe rounded or elongate and with variously differentiated dorsal subapical (1) and apical (1) setae. ***Cowl*** represented by a broad sclerotized arch articulating with tergite IX laterally, deeply emarginate on anterior margin midventrally where its caudal margin is more or less distinctly joined to base of postgenital plate; ***sigma*** poorly sclerotized, very narrow and indistinctly joined to cowl; ***insula*** poorly sclerotized, with several microsetae; atrial plate narrow, strongly sclerotized (cowl, sigma, insula and atrial plate studied in *cancer* only). Spermathecae 3, one larger than the others.

MALES. Essentially similar to females; labium with a more or less distinct joint distad of middle; palpal segment 3 longer. ***Antenna***: Distinctly longer but similar to that of female; varied in length, exceeding proboscis from apex of segment 10 to middle of flagellar segment 3; flagellar whorls essentially as in female but slightly longer, flagellar segments 1, 1 and 2, 1-3 or 1-4 with scales, segments 2-6 or 7 with variable number of shaft bristles of approximately same length as those in whorls; flagellar segment 1 distinctly longer, the others of variable length, either segments 2-12 subequal but progressively slightly shortened distad, or segments 2-7 markedly elongated, but progressively shortened distad and segments 7-12 subequal but progressively shortened distad; segment 13 either shorter, equal to slightly longer, but always broader than 12. ***Legs***: Claws of foreleg and midleg enlarged, either similar in shape or anterior member of a pair longer, with or without teeth; claws of hindleg always small and simple as in females; empodium of legs with enlarged claws very strongly developed and with branched processes.

MALE GENITALIA. Rather uniform throughout genus; short and thick. ***Segment VIII***: Well developed but normally retracted about half or more of its length into segment VII; without any special features except for broad median emargination of caudal border of tergite and development of numerous strong bristles on and near this border, particularly on lateral tergal area. ***Segment IX***: Strongly developed. Tergite represented by a pair of greatly developed lateral lobes articulated and movable on articulation with a lateral dorsal process of sternite; also articulating with a dorsomesal process of sidepiece and the basal piece; median part of tergite largely membranous; lobes variously developed and with numerous setae basomesally. Sternite long and with a median longitudinal apodeme, a caudolateral winglike lobe, and an anterolateral narrow sclerotized bar which extends dorsad on each side and articulates at its dorsal end with tergite. ***Sidepiece***: Conical, very thick, scales present or absent, tergal surface with variable number of strong bristles. Subapical lobe (median mesal lobe of Belkin and Hogue, 1959) about median in position, projecting dorsad; with 3 differentiated setae, 2 of which are always spiniform (***a*** more mesal, and ***b***) and the other (***c***) bristlelike or setiform; usually a thumb at dorsomesal angle; always a patch of short setae on base of lobe on dorsal surface; 3 well differentiated specialized setae on ventromesal surface, the 3 setae usually bristlelike and attenuated apically, except in 1 case (*nicoyae*) in which the 2 distal are spiniform, rather heavy and without apical attenuation; also a variable number of small hairs on ventromesal surface of lobe. A differentiated seta laterad of subapical lobe on tergal surface of sidepiece; a membranous area basad of subapical lobe; usually a distinct apicosternal bristly lobe, dorsad of which the clasper folds at rest against body of sidepiece, this area at least partly membranous; apicosternal lobe with or without differentiated long apical seta. ***Clasper***: Short, irregular in shape, with a dorsal inner postmedian angular shelflike process, a ventral inner apical tooth, and a dorsal outer apical process; inserted between the 2 apical projections is a heavy forked spiniform; dorsal surface with a dense vestiture of long hairlike spicules. ***Phallosome***: Complex, consisting of a ventral aedeagus and a pair each of ventral and dorsal parameres. Aedeagus more or less conical or cylindrical in tergal aspect with a pair of lateral sclerotized plates variously developed and connected by a basal sternal sclerotized bar and apparently by a sternal membrane not always detectable. Dorsal paramere (according to Belkin, 1968a:9) apparently homologous to the opisthophallus of some Dixinae, articulated ventrally with aedeagus and ventrolaterally with ventral paramere (ventral paramere articulating with aedeagus ventrally and basal piece laterally); dorsal parameres consisting of a pair of lateral toothed plates with an apical dorsal spine and ventrolateral teeth; the 2 sclerotized plates in tergal aspect are either closely approximated or widely separated and are often more or less connected by an incomplete dorsal sclerotized bridge. ***Proctiger***: Strongly developed, with basolateral and paraproct sclerotizations and with a slight dorsolateral process; without basal sternal process. Crown of paraproct with a single row of short, heavy, blunt and curved teeth. Cercal setae numerous (details not studied).

PUPAE. ***Cephalothorax***: All hairs present, variously developed; hairs 2,3-C approximated or widely spaced; 5-C usually the longest hair on cephalothorax, except in Epitedeus Group in which it is usually subequal to 8-C; hair 6-C always shorter than 7-C; hairs 6,7-C very close together; 8,9-C well caudad of trumpet and moderately close together. ***Trumpet***: Not placed on distinct tubercle; inserted about halfway between middorsal line and wing base; short to moderate in length; tracheoid for about 0.3-0.5 of trumpet length; pinna usually short. ***Metanotum***: Hair 10-C variously developed, from very short and weaker than 11-C to very strong and longer than 11-C; single to multibranched. ***Abdomen***: Hair 1-I with about 4-23 primary branches, fringed, barbed or secondarily dendritic; 1-II either very similar to or markedly different in appearance from 1-I, but always closer to midline, with 1 to many primary branches, simple, barbed or markedly secondarily dendritic; 2-II laterad of 3-II; hair 5-II laterad of 3-II except in Epitedeus Group in which it is mesad, usually single (1-4); hair 7-II ventral in position; 2-III-VII mesad of hair 1; hairs 5-III-VI long, similarly developed, 5-III usually single (1-3, except usually triple in *mathesoni*), 5-IV usually single (1 or 2), hairs 5-V,VI always single; 6-I-VII long, single, as well developed on VII as on other segments; 9-VII short, branched and caudad of hair 6; hair 9-VIII very long and single, arising ventrally at caudolateral angle. ***Terminal Segments***: Hair 1-IX not developed. Median caudal lobe well developed, in general with its posterior margin more or less rounded. Cercal lobe of female strongly developed. Male genital lobe projecting well beyond median caudal lobe; IX tergite lobe of adult developed inside the paddle. ***Paddle***: Midrib very strongly developed; external buttress slightly developed; margins without spicules. Hair 1-P subapical, long, subequal to or longer than paddle; 2-P absent.

FOURTH INSTAR LARVAE. ***Head***: Head capsule about as wide as or wider than long, widest at level of base of antenna owing to development of conspicuous lateral expansion on each side caudad of antenna and the absence of a distinct ocular bulge. A broad deep pouch open cephalad within this subantennal expansion, pouch with a membranous eversible inner wall into which projects a conspicuous fingerlike lobe of mandible with long hairlike spicules, wall withdrawn when lobe of mandible is abducted and expanded out and inflated when lobe of mandible is adducted eliminating pouch; mandible (Howard, Dyar and Knab, 1912, fig. 524) with curved fingerlike lobe densely covered with long hairlike spicules arising from anterolateral basal angle and projecting into lateral subantennal pouch, and with apical mesal angle below teeth developed into a long curved horn; maxilla (Howard, Dyar and Knab, 1912, fig. 479) large, normal, palpus short. Labrum not well differentiated dorsally, rounded on anterior margin; mental plate rudimentary, poorly sclerotized and with variously shaped marginal spicules; labial plate very long and narrow; maxillary suture complete and extended dorsolaterally caudad of posterior tentorial pit; collar not developed. Hair 1-C long, thin to moderately thick, widely spaced, arising on dorsal surface of labrum, not apically; 2-C poorly to well developed, usually distinctly mesad of level, or sometimes slightly mesad, in line or laterad of 1-C; hair 3-C when present usually represented by a spicule; 4-6-C in a group caudad of level of 7-C; hair 4-C minute, multiple; 5,6-C strongly developed; 10-C quite close to 9-C; hair 11-C dorsal, mesad of pouch; 12,13-C close together; 14-C removed from margin; 15-C in anterior half of labial plate; 16,17-C not developed. ***Antenna***: From about one-third to about half as long as head capsule, unsegmented, slender, gradually tapered apically; shaft either simple or with few to numerous spicules in basal part. ***Thorax***: Without any apparent outstanding features; hairs 1-3-P on poorly sclerotized connected basal tubercles or with poorly developed and unsclerotized common tubercle; 1,2-P long, single; 3-P shorter than 1,2-P, single to triple; 4-P well developed, branched; 5,6-P long, single; 7-P long, branched; 9-P long, single to triple; 10-P moderate; 12-P long, single; 13-P absent; 14-P single; 1,2-M short, 3,4-M moderate; 5-7-M long, single, 6-M heaviest; 8-M long, multiple, with heavy tubercle; 9-M long, multiple; 10,12-M long, single; 14-M short, dendritic; 1-6-T minute to small; 1,2-T placed far mesad; 1,5-T always minute; 6-T variously developed; 7-T large, multiple, with heavy basal tubercle; 9-T long, multiple; 10-T long, single; 13-T short, multiple. ***Abdomen***: Hairs 6-I-VI long; 7-I short to long, 7-II-VI always short; 1-I,II distinctly mesad of others, minute; 1-III moderately to strongly developed; 2-III-V mesad of 1; hairs 5-I-VII small, branched; 9-II-VI minute, single; 10-II-VI moderately to well developed, 10-II usually single (usually triple in *belkini*, 1-4), hair 10-III usually single or double (1-3), hair 10-IV usually single or double (1-3), hairs 10-V,VI usually single (1 or 2); hairs 13-III-V strong; 11,12-II-V laterad of 13. ***Segment VIII***: Comb of numerous scales in large triangular patch; individual scale long, parallel-sided, with expanded, fringed, spatulate apex; hair 1-VIII mesad of 2; hairs 2,4-VIII strongly developed, single. ***Siphon***: Elongate, without marked distal tapering. Index varied from 3.2-6.5; acus present, attached, with ventral process; valves moderate, normal; trachea well developed. Pecten not extending to middle of siphon; individual pecten tooth usually unequally bifid or trifid. Siphonal hairs always 3 lateral pairs, 1 large (1-S) near middle and 2 small (1ad-S dorsal and 1av-S ventral). ***Anal Segment***: Saddle usually represented by poorly defined, unconnected dorsal and ventral sclerotizations; spicules short, in a patch; acus absent. Gills a single pair, short to moderately long, either round and slightly emarginated on apex or more or less cone-shaped and slightly emarginated on ventral margin; without trachea. Hair 1-X small, not on saddle; 2-X moderately long, multiple; 3-X very long, single; 4-X all on grid, 6 or 7 pairs, well developed, multiple.

EGGS. Very brief descriptions have been made for the eggs of 3 species. Fisk (1941:547) describes the egg of *mathesoni* (as *spanius*) as "ovoid ... about 0.4 mm in length and resembling hens' eggs in shape"; Haeger and Phinizee (1959:35) found that of *cancer* to be "bullet-shaped, with the head in the blunt end. The grayish brown chorion and exochorion are very transparent ..."; and Galindo (1967:68) states that the egg of *pseudes* is "elliptical in shape and black in color, being very similar in structure to *Culex* ova".

DISCUSSION. For discussions of the systematics, bionomics and medical and pest importance, see the separate sections above dealing with these subjects.

The brief taxonomic history of *Deinocerites* has been reviewed by Belkin and Hogue (1959:416-417) and will not be repeated here. It is presented in synoptic form in the synonymy and taxonomic references given above for the genus.

KEYS TO GROUPS AND SPECIES

FEMALES

1. Mesepimeron with a patch of translucent scales 2
   Mesepimeron without scales 7

2(1). Lower mesepimeral bristle present; antenna with only flagellar segment 1 markedly longer than others (Pseudes Group) 3

Lower mesepimeral bristle absent; antenna with flagellar segments 1-4 markedly longer than others (Epitedeus Group) 5

Pseudes Group

3(2). Forefemur with anteroventral and posterodorsal margins with row of bristles only . . . . 18. ***mcdonaldi***

Forefemur with anteroventral margin with row of short spiniforms and posterodorsal margin with row of short spiniforms at base followed by bristles distad 4

4(3). Antenna exceeding proboscis at most from base of flagellar segment 8; tergite IX usually without setae, rarely 1 present . . . . . 16. ***pseudes***

Antenna longer, exceeding proboscis at least from basal two-thirds of flagellar segment 7; tergite IX with 2 or more setae (2-7) on each side . . . . 17. ***howardi***

Epitedeus Group

5(2). Forefemur with an anteroventral row of short spiniforms (Atlantic complex). . . . . 11. ***epitedeus***; 12. ***panamensis***; 13. ***colombianus***

Forefemur with an anteroventral row of bristles (Pacific complex) . . . 6

6(5). Cercus (in lateral aspect) with dorsal margin of sclerotized part distinctly longer than ventral; its basal width less than 0.5 of length of sclerotized ventral margin; 5 or 6 apical and subapical distinctly thickened setae with twisted apex . . . . 14. ***costaricensis***

Cercus (in lateral aspect) with dorsal and ventral margins of sclerotized part subequal in length; its basal width over 0.6 of length of sclerotized ventral margin; 5 or 6 apical or subapical setae slightly to moderately thickened and with apex simple or slightly twisted . . . . 15. ***curiche***

7(1). Cercus with 2 long spatulate apical or subapical specialized setae (Cancer Group) 8

Cercus without long spatulate specialized setae 10

Cancer Group

8(7). Specialized setae of cercus not inserted side by side, one apical and shorter, the other subapical; lateral lobe of postgenital plate elongate and with long apical bristle . . . . 10. ***magnus***

Specialized setae of cercus inserted side by side on apex and subequal; lateral lobe of postgenital lobe short and rounded, its apical bristle short 9

9(8). Distal part of postgenital plate (in ventral aspect) with width not more than 1.8 of its length, usually with a distinct median caudal notch as deep as wide and with lateral lobes well differentiated . . . . 8. ***cancer***

Distal part of postgenital plate (in ventral aspect) with width always more than 2.0 of its length, usually with only a broad shallow emargination and with lateral lobes appearing as small rounded protuberances . . . . 9. ***melanophylum***

10(7). Postnotum without setae; antenna relatively short, exceeding proboscis at most from base of flagellar segment 9; sternite VIII with distal sclerotized band uniformly broad and largely covered with scales (Spanius Group) 11

Postnotum usually with a few setae in lower part; antenna relatively longer, exceeding proboscis from base of flagellar segment 8; sternite VIII with distal sclerotized band narrow, tapering ventrad and with only a few scales (Dyari Group) 12

Spanius Group

11(10). Antenna relatively short, exceeding proboscis from base of flagellar segment 11; cercus (in lateral aspect) abruptly narrowed in distal half (southern complex) . . . . 1. ***spanius*** (Pacific); 2. ***atlanticus***

Antenna relatively longer, exceeding proboscis from apex of flagellar segment 9; cercus (in lateral aspect) evenly narrowed from base (northern complex) . . . . 3. ***mathesoni*** (Atlantic); 4. ***belkini*** (Pacific)

Dyari Group

12(10). Pleural integument almost uniformly dark brown, not markedly contrasting with dark mesonotal integument; distal part of postgenital plate (in ventral aspect) with margins of median caudal notch parallel . . . . 6. ***barretoi***

Pleural integument with whitish portions strongly contrasting with dark mesonotal integument; distal part of postgenital plate (in ventral aspect) with margins of median caudal notch diverging distad . . . 13

13(12). Tergite IX usually with 1 seta . . . . 7. ***nicoyae***

Tergite IX usually with 4 setae. . . . . 5. ***dyari***

MALES

1. Mesepimeron without scales 2

Mesepimeron with patch of translucent scales 9

2(1). Only flagellar segment 1 markedly elongate; antenna exceeding proboscis at most from apex of flagellar segment 9 (Spanius Group) 3

Flagellar segments 1-5 or 1-6 markedly longer than others; antenna exceeding proboscis from at least middle of flagellar segment 5 4

Spanius Group

3(2). Antenna relatively short, exceeding proboscis from base of flagellar segment 11 (southern complex) . . . . 1. ***spanius*** (Pacific); 2. ***atlanticus***

Antenna relatively longer, exceeding proboscis from apex of flagellar segment 9 (northern complex). . . . . 3. ***mathesoni*** (Atlantic); 4. ***belkini*** (Pacific)

4(2). Postnotum usually with a few bristles toward lower part; Pacific distribution (Dyari Group) 5

Postnotum without bristles; Atlantic distribution (Cancer Group) . . . 7

Dyari Group

5(4). Pleuron almost uniformly dark brown, not contrasting markedly with dark brown mesonotum; flagellar segments 1-5 markedly elongated . . . . 6. ***barretoi***

Pleuron with whitish portions strongly contrasting with dark brown mesonotum; flagellar segments 1-6 markedly elongated 6

6(5). Anterior claw of foreleg with a long, very slender tooth; anterior claw of midleg with a shorter, heavier tooth . . . . 5. ***dyari***

Anterior claws of foreleg and midleg both with a heavy tooth . 7. ***nicoyae***

Cancer Group

7(4). Pleuron usually whitish and distinctly contrasting with dark brown mesonotum; tooth of foreclaw and midclaw nearly basal; antenna exceeding proboscis from base of flagellar segment 5 . . . . 10. ***magnus***

Pleuron darker, only slightly or not at all contrasting with dark brown mesonotum; tooth of foreclaw and midclaw distinctly subbasal; antenna exceeding proboscis from distal third of flagellar segment 4 . . . 8

8(7). Anterior claws of foreleg and midleg dissimilar, that of foreleg with a shorter subbasal tooth; flagellar segment 13 slightly longer than 12 . . . . 9. ***melanophylum***

Anterior claws of foreleg and midleg similar, with large subbasal tooth; flagellar segment 13 subequal to 12 . . . . 8. ***cancer***

9(1). Lower mesepimeron without differentiated bristle (Epitedeus Group) . 10

Lower mesepimeron with 1 very strong bristle (Pseudes Group) . . . 12

Epitedeus Group

10(9). Forefemur with anteroventral row of bristles (Pacific complex) . . . . 14. ***costaricensis***; 15. ***curiche***

Forefemur with anteroventral row of short spiniforms (Atlantic complex) 11

11(10). Anterior claw of midleg simple . . . . 13. ***colombianus***

Anterior claw of midleg with a short tooth . 11. ***epitedeus***; 12. ***panamensis***

Pseudes Group

12(9). Forefemur with anteroventral and posterodorsal rows of bristles only . . . . 18. ***mcdonaldi***

Forefemur with anteroventral row of short spiniforms and with bristles of posterodorsal row replaced by short spiniforms near base . . . 13

13(12). Antenna exceeding proboscis from at least distal third of flagellar segment 3; claws of foreleg very slender and with a distinct very slender subbasal tooth . . . . 17. ***howardi***

Antenna exceeding proboscis at most from basal third of segment 4; claws of foreleg very heavy and usually with a minute submedian projection . . . . 16. ***pseudes***

MALE GENITALIA

1. Sidepiece with numerous scales; apicosternal lobe of sidepiece short, more or less rounded and without a long heavy, differentiated bristle, a short subapical bristle may be present (Spanius Group) 2
Sidepiece usually without scales, at most with 1 or 2 scales; apicosternal lobe of sidepiece prominent and with a long heavy, differentiated bristle 5

Spanius Group

2(1). Dorsal paramere in form of a small compact, uniformly and heavily sclerotized plate, its apical spine short to moderately long, slightly curved and gradually pointed (southern complex) 3
Dorsal paramere with 2 sclerotizations, tergal and sternal, connected by a narrow bridge very poorly sclerotized on the margins and membranous centrally, tergal sclerotization bearing the long, slender, strongly hooked apical spine (northern complex) 4

3(2). Dorsal paramere with apical spine moderately long and curved, ventral teeth represented by 2 or 3 strong, moderately long spines in caudal area; ninth tergite lobe with outer margin more or less straight except for a bent and angled apex (Pacific) . . . . 1. ***spanius***
Dorsal paramere with apical spine short and slightly curved, ventral teeth represented by 3 or 4 small denticles at caudosternal angle; ninth tergite lobe with outer margin curved and directed mesad, apex rounded (Atlantic) .2. ***atlanticus***

4(2). At least 1 of the dorsal parameres with 2 teeth (2 or 3) on sternal sclerotization; dorsal paramere wider than long (Atlantic) . . 3. ***mathesoni***
Dorsal parameres always with 3 or 4 teeth on sternal sclerotization; dorsal paramere as wide as long (Pacific) . . . . 4. ***belkini***

5(1). Ninth tergite lobe strongly flattened, not markedly angled laterad at base and dorsal in position (Cancer Group) 6
Ninth tergite lobe cylindrical, markedly angled laterad at base and more lateral in position 8

Cancer Group

6(5). Ninth tergite lobe short, not reaching base of subapical lobe of sidepiece; apical spine of dorsal paramere thick, not strongly differentiated from body of paramere. . . . . 10. ***magnus***
Ninth tergite lobe long, extending distad of base of subapical lobe of sidepiece; apical spine of dorsal paramere slender, strongly differentiated from body of paramere 7

7(6). Dorsal paramere with ventral teeth outstanding, arising from distinct distal process or lobe; its dorsal bridge broad and short; its apical spine rather short and only slightly curved . . . . 8. ***cancer***
Dorsal paramere with ventral teeth appressed; its dorsal bridge narrow and long; its apical spine long and strongly curved . 9. ***melanophylum***

Dyari, Epitedeus and Pseudes Groups

8(5). Ninth tergite lobe short, not reaching base of subapical lobe of sidepiece; its distal part more or less conical 9
Ninth tergite lobe longer, reaching at least base of subapical lobe of sidepiece, distal part variously shaped but not conical 11

9(8). Apical spine of dorsal paramere heavy and strongly curved, *in situ* reaching or crossing its mate; ninth tergite lobe with distal part distinctly attenuated or more or less pointed; apex of aedeagus rounded. 5. ***dyari***
Apical spine of dorsal paramere slender and not strongly curved, *in situ* widely separated from its mate; ninth tergite lobe with distal part not strongly attenuated, blunt; apex of aedeagus emarginate or angled . 10

10(9). Dorsal paramere with ventral teeth usually about 18, short to moderately long, and arising from an evenly convex ventrolateral border . . . . 14. ***costaricensis***
Dorsal paramere usually with about 25 long, moderately heavy ventral teeth arising from a distinct humplike expansion of ventrolateral border . . . . 15. ***curiche***

11(8). Dorsal paramere with a strong dentate process from ventrolateral border, *in situ* extending almost as far caudad as apical spine . . . 16. ***pseudes***
Dorsal paramere with ventral teeth arising from convex ventrolateral border, not from a distinct process 12

12(11). Ninth tergite lobe extending well beyond base of subapical lobe, strongly bent near the middle and with this slender distal part more or less paralleling sidepiece . . . . 12. ***panamensis***
Ninth tergite lobe not extending beyond base of subapical lobe . . . 13

13(12). Ventromesal surface of subapical lobe with the 2 distal setae rather heavy and spiniform and without apical attenuation; dorsal paramere with distal part expanded laterad as a broad hemispherical ledge . 7. ***nicoyae***
Ventromesal surface of subapical lobe with all 3 setae bristlelike and attenuated apically; dorsal paramere with its distal part not expanded as a broad hemispherical ledge 14

14(13). Dorsal paramere with apical spine long and slender, but not touching its mate *in situ*; at least the more distal ventral teeth of dorsal paramere as seen *in situ* long and conspicuously oriented in the same direction as the apical spine 15
Dorsal paramere with apical spine moderately long to long and heavy, usually intercrossing with its mate *in situ*; ventral teeth of dorsal paramere as seen *in situ* short and not oriented in the direction of the apical spine 16

15(14). Ninth tergite lobe with distal part broad and directed laterad; body of lobe broad in basal two-thirds, slightly attenuated in distal third . . . . 13. ***colombianus***

Ninth tergite lobe with distal part slender and directed mesad by distinct curvatures of inner and outer margins; body of lobe broad basally, constricted near middle and slender in distal half . . . **11. *epitedeus***

16(14). Ninth tergite lobe with apex simple; aedeagus in tergal aspect almost uniform in width except for a subbasal expansion, distally the 2 plates come together forming a rounded expansion; seta *c* of subapical lobe of sidepiece rather heavy and bent apically . . . . **6. *barretoi***

Ninth tergite lobe slightly hooked apically; aedeagus in tergal aspect variable in width because of highly sinuous outer margins, with a subapical constriction or sinuosity and narrowed and slightly emarginate apex; seta *c* of subapical lobe of sidepiece moderately heavy, attenuated but not bent apically . . . .**18. *mcdonaldi***; **17. *howardi***

PUPAE

(**1. *spanius*** and **6. *barretoi*** unknown)

1. Hair 1-II with 1-3 simple or barbed branches (either subequal to or longer than tergite III) 2

Hair 1-II multibranched *or*, if with less than 4 primary branches, then markedly secondarily dendritic and 10-C markedly multibranched (usually 1-II shorter than tergite III) 8

2(1). Hair 10-C strongly developed, distinctly longer than 11-C; hair 5-II always mesad and cephalad of 3-II; hair 5-C single, moderately long, at most equal in length to distance from its alveolus to base of trumpet and to length of trumpet (Epitedeus Group) 3

Hair 10-C poorly developed, always shorter than 11-C (0.3-0.5 of 11-C); hair 5-II always laterad of 3-II; hair 5-C single or double, strongly developed, longer than distance from its alveolus to base of trumpet, at least 1.5 of trumpet length (Dyari Group) 7

Epitedeus Group

3(2). Hair 10-C usually double; 1-III-VI branched (Atlantic) . **13. *colombianus***

Hair 10-C usually single; 1-III-VI forked 4

4(3). Hair 7-C single (Atlantic) . . . . **11. *epitedeus***

Hair 7-C usually double 5

5(4). Hair 3-V usually double (Atlantic) . . . . **12. *panamensis***

Hair 3-V usually single (Pacific) 6

6(5). Hair 5-I with 4-6 branches . . . . **14. *costaricensis***

Hair 5-I double or triple . . . . **15. *curiche***

Dyari Group

7(2). Hair 5-C single; 1-II single . . . . **5. *dyari***

Hair 5-C double; 1-II triple, the middle branch longest . . . **7. *nicoyae***

8(1). Hair 1-VII longer than tergite VIII, at least extending to middle of 4-VIII; hair 7-C usually 4 or 5 branched (Spanius Group) 9
Hair 1-VII shorter than or sometimes equal to tergite VIII, never exceeding the basal third of 4-VIII; hair 7-C usually double or triple . . . 11

Spanius Group

9(8). Hair 6-C single; 4-VI usually double or triple; 10-C usually 3 or 4 branched . . . . 2. ***atlanticus***
Hair 6-C usually double or triple; 4-VI usually 4 or 5 branched; 10-C single or double 10

10(9). Hair 8-C single; 10-C usually single; 3-VI single or double (Pacific) . . . . .4. ***belkini***
Hair 8-C double or triple; 10-C double; 3-VI with 3 or 4 branches (Atlantic) . . . . 3. ***mathesoni***

11(8). Hair 8-C usually 2-4 branched; 3-V usually double (Cancer Group) . . 12
Hair 8-C usually single; 3-V more often single than double (Pseudes Group) 14

Cancer Group

12(11). Tergal area between hairs 1-I darkly pigmented . . . 9. ***melanophylum***
Tergal area between hairs 1-I amber in color 13

13(12). Hair 3-II usually single; 7-C usually double; 10-C most often double . . . . 8. ***cancer***
Hair 3-II usually double or triple; 7-C usually 3 or 4 branched; 10-C usually 3-5 branched . . . . 10. ***magnus***

Pseudes Group

14(11). Hair 10-C distinctly longer than 11-C, markedly multibranched, resembling float hair 1-I; hair 5-VII usually reaching to about middle of tergite VIII; hair 4-C most often 4-6 branched . . . . 16. ***pseudes***
Hair 10-C subequal to 11-C, usually 2-4 branched, not resembling float hair 1-I; hair 5-VII not exceeding apex of tergite VII; hair 4-C most often double or triple 15

15(14). Hair 1-V usually double or triple; 8-III usually 4-6 branched . . . . .18. ***mcdonaldi***
Hair 1-V usually 4-6 branched; 8-III usually double or triple .17. ***howardi***

FOURTH INSTAR LARVAE

(**1.** ***spanius*** and **6.** ***barretoi*** unknown)

1. Hair 6-II single; 1-S usually 4-6 branched (Spanius Group) 2
Hair 6-II double; 1-S usually double or triple 4

Spanius Group

2(1). Hair 6-C single or double; 6-T usually single . . . . . . 2. ***atlanticus***
Hair 6-C usually 3 or 4 branched; 6-T always 2-4 branched 3

3(2). Siphon short, index less than 4.3; at least 1 of the branches of siphonal hair 1-S reaching alveolus of 1av-S; small ventral saddle absent; 3-IV with 2-4 branches (Atlantic) . . . . 3. ***mathesoni***
Siphon longer, index more than 5.0; none of the branches of siphonal hair 1-S reaching alveolus of 1av-S; small ventral saddle present; 3-IV with 5-7 branches (Pacific) . . . . .4. ***belkini***

4(1). Hair 1-VII poorly developed, shorter than or subequal to 3-VII, not reaching the base of segment VIII; hair 6-VI usually double; 2-C either slightly mesad, in line with or laterad of level of 1-C (Dyari Group). . 5
Hair 1-VII moderately to strongly developed, longer than 3-VII, always exceeding base of segment VIII and sometimes the base of siphon; 6-VI single; 2-C always markedly mesad of 1-C 6

Dyari Group

5(4). Ventral brush (4-X) with 7 pairs of hairs; 6-III with 3 or 4 branches; 6-IV usually triple . . . . 5. ***dyari***
Ventral brush (4-X) with 6 pairs of hairs; 6-III double; 6-IV usually double . . . . 7. ***nicoyae***

6(4). Hair 9-P double or triple; 2-C inconspicuous, about 0.25-0.33 of 1-C; hair 5-C usually double or triple (Epitedeus Group) 7
Hair 9-P single; 2-C at least 0.5 of 1-C; hair 5-C usually 4 branched . . 11

Epitedeus Group

7(6). Hair 1-VII double; 1-V double; 13-V with 4 or 5 branches (Atlantic) . . . . 13. ***colombianus***
Hair 1-VII single; 1-V single; 13-V single to triple 8

8(7). Ventral brush (4-X) with 6 pairs of hairs 9
Ventral brush (4-X) with 7 pairs of hairs 10

9(8). Hair 8-P double; 3-IV with 3-5 branches; 2-T usually 4 branched (Atlantic) . . . . 12. ***panamensis***
Hair 8-P single; 3-IV double; 2-T usually double or triple (Pacific) . . . . 15. ***curiche***

10(8). Hair 7-II usually single to triple; ventral margin of dorsal saddle reaching alveolus of 1-X (Atlantic). . . . . 11. ***epitedeus***
Hair 7-II with 4-6 branches; ventral margin of dorsal saddle not reaching alveolus of 1-X (Pacific) . . . . 14. ***costaricensis***

Pseudes Group

11(6). Head hair 6-C double or triple 12
Head hair 6-C always single 14

12(11). Ventral brush (4-X) with 6 pairs of hairs (some peripheral northern and southern populations) . . . . 16. ***pseudes*** (in small part)
Ventral brush (4-X) with 7 pairs of hairs 13

13(12). At least 1 of the branches of hair 1-S usually reaching alveolus of 1av-S; hair 3-VIII usually 5 or 6 branched; 1-VII often double or triple; 6-C usually double, very rarely triple on one side . . . . . 18. ***mcdonaldi***

Usually none of the branches of hair 1-S reaching alveolus of 1av-S; hair 3-VIII usually 3 or 4 branched; 1-VII usually single; 6-C often triple on at least one side . . . . 17. ***howardi***

14(11). Hair 1-VIII usually 5-7 branched; 1-VII usually long, frequently reaching the base of siphon (central populations) . . 16. ***pseudes*** (in large part)

Cancer Group

Hair 1-VIII usually 3 or 4 branched; 1-VII shorter, never reaching base of siphon 15

15(14). Ventral brush (4-X) with 7 pairs of hairs; 2-C usually longer than 1-C; hair 8-P usually double. . . . . 10. ***magnus***

Ventral brush (4-X) with 6 pairs of hairs; 2-C usually shorter than 1-C; hair 8-P usually single 16

16(15). Sum total of branches of hairs 3,4-P on both sides usually equal to or less than 10 *or* 4-P usually triple *and* 3-P usually single . . . . . 8. ***cancer***

Sum total of branches of hairs 3,4-P on both sides usually more than 10 *or* 4-P usually 4 branched *and* 3-P usually double. . 9. ***melanophylum***

SPANIUS GROUP

FEMALES. Small species, wing 2.5-2.7 mm. Mesonotum dark, always strongly contrasting with very distinct whitish portions of pleural integument. ***Antenna***: Flagellar segment 1 with scales, shorter than combined length of segments 2 and 3; segments 2-12 subequal in length but progressively slightly shortened distad; relatively short, at most exceeding proboscis from apex of flagellar segment 9. ***Thorax***: Postnotum without setae. ***Apn*** usually whitish; ***ppn*** usually whitish, scales all narrow; ***ppl*** whitish; ***psp***, ***ssp***, ***stp*** and ***pra*** usually slightly darker than rest of pleuron; paratergite whitish or very light brown; ***mep*** whitish and without translucent scales, ***lmep*** with 1 very strong bristle; meron, metameron and metapleuron whitish. ***Legs***: Coxal integument whitish. All of posteroventral surface of forefemur and midfemur and at least basal two-thirds of hindfemur whitish; anteroventral margin of forefemur without spiniforms, but with 4-6 bristles in distal two-thirds, posterodorsal margin with about 6-9 bristles. ***Abdomen***: Sternites II-VI and usually part of VII with pale scales.

FEMALE GENITALIA. ***Sternite VIII*** with distal sclerotized band broad and largely covered by scales; caudal margin not produced into a submedian ventral angle, this area without strongly differentiated marginal bristles. ***Tergite IX*** usually with at least 1 small seta on each side. ***Tergite X*** poorly differentiated dorsally and with a very small indistinct lateral sclerotization. ***Cercus*** with a few moderately strong apical or subapical normal bristles.

MALES. Extremely similar to females. ***Antenna***: Exceeding proboscis at most from apex of flagellar segment 9; flagellar segments essentially as in the females, only slightly longer. ***Legs***: Claws of foreleg and midleg enlarged, anterior member of a pair always larger and with a heavy subbasal tooth, posterior simple.

MALE GENITALIA. ***Segment IX***: Tergite lobe cylindrical; not markedly angled at base; basal one-third broad, distal two-thirds slender; directed inwards distally by a subapical curvature; apex exceeding the subapical lobe. ***Sidepiece***: Scales numerous. Apicosternal lobe short, more or less rounded, without differentiated long apical seta (short and subapical when present). ***Phallosome***: Dorsal parameres widely separated in tergal aspect, without a differentiated sclerotized dorsal bridge; articulated basoventrally directly with dorsal basal part of aedeagus.

PUPAE. ***Cephalothorax***: Hairs 2,3-C closely approximated, 2-C poorly developed, always weaker and shorter than 3-C; hair 5-C usually double (2 or 3), strongly developed, longer than distance from its alveolus to base of trumpet, 1.35-1.50 of trumpet length; 7-C usually with 4 or 5 branches (2-6); hair 8-C usually single or double (1-3). ***Metanotum***: Hair 10-C moderately to strongly developed, subequal to or longer than 11-C, branching varied (1-6). ***Abdomen***: Hair 1-II not reaching apex of tergite III, multibranched (4-13), usually dendritic; 1-III-VI branched; 5-II always cephalad and sometimes slightly mesad of 3-II; hair 3-V usually double or triple (2-4); hair 1-VII longer than tergite VIII, at least reaching middle of 4-VIII. ***Paddle***: Hair 1-P subequal to or slightly longer than paddle.

FOURTH INSTAR LARVAE. ***Head***: Hair 2-C about 0.5 of 1-C and always distinctly mesad of 1-C; hair 5-C with 4 or more barbed branches (4-7); hair 6-C variously branched (1-5), barbed, either equal to or slightly longer than 5-C. ***Thorax***: Prothoracic hair 9-P single. ***Abdomen***: Hair 6-II single; dorsal sensillum of segment V laterad of 4-V; hair 6-VI single; 1-VII moderately developed, longer than 3-VII, exceeding base of segment VIII but not reaching base of siphon; 1-VIII usually with 3 or 4 branches (2-4). ***Siphon***: Hair 1-S usually with 4-6 branches (3-7). ***Anal Segment***: Ventral brush (4-X) with 6 pairs of hairs. Gill slightly emarginate on apex; short, about one-half to two-thirds of dorsal saddle length. Dorsal saddle narrow, its ventral margin far from hair 1-X.

DISCUSSION. This is undoubtedly the most primitive group of the genus as it shows the least number of derived features and resembles more than any other group the other 2 genera of the tribe, *Culex* and *Galindomyia*. The adults have the shortest antennae in *Deinocerites*. In the male genitalia, the dorsal paramere articulates directly with the aedeagus whereas in other groups this articulation is with a process from the aedeagus. The genitalia of both sexes (sternite VIII in female and sidepiece in male) are densely covered with scales in the Spanius Group. These scales are lacking in the males of the other groups and are reduced to only a few or are completely absent in their females. In the larvae, head hairs 5 and 6 are relatively short, subequal and usually branched while in the other groups 6-C tends to become elongated and single.

The group has a unique distribution pattern and species composition with widely disjunct northern and southern complexes, each with 2 geminate Atlantic and Pacific species. The northern complex has been reported only from the states of Nayarit and Jalisco on the west coast of Mexico (*belkini*) and from southern Texas and possibly down to Veracruz, Mexico (*mathesoni*). The southern complex is known only from Aguadulce (Cocle) to Santa Fe (Darien) on the Pacific coast of Panama (*spanius*) and from a wider area on the Atlantic slope from the Canal Zone, Colombia and Venezuela (*atlanticus*). It is possible that *atlanticus* may consist of 2 or more species.

The 2 complexes are rather strongly differentiated in the structure of the dorsal paramere of the male genitalia, this being composed of 2 separate sclerotizations connected by a poorly sclerotized bridge in the northern complex, while in the southern complex it is formed as a compact uniformly sclerotized plate. I consider that the former condition is the primitive one. There are also good correlated morphological differences in the genitalia of the females, antennae of both sexes, larvae and pupae as indicated in the keys.

Although the adults of a geminate pair cannot be separated on external morphological features there are good male genitalic characters to distinguish them in both complexes. In the case of the northern complex there are also reliable features distinguishing *belkini* from *mathesoni* in the pupal and larval stages. Since the immature stages of *spanius* are still unknown it cannot be determined if a similar situation prevails in the southern complex.

The species of the group appear to be rare or at least are seldom collected as adults. The latter may be partially due to the superficial resemblance of both males and females to the females of the numerous unornamented species of the of the subgenus *Melanoconion* of *Culex* that at present are impossible to identify to species.

Little is known about the blood feeding habits of members of the group but apparently *atlanticus* may attack man in Panama. The immature stages of the Spanius Group have been collected only a few times, most frequently in small burrows made by fiddler crabs of the genus *Uca* and occasionally in large holes of *Gecarcinus lateralis.*

1. *Deinocerites spanius* (Dyar & Knab)

Figs. 3,8

1909. *Dinanamesus spanius* Dyar and Knab, 1909:259. TYPE: Lectotype female, Corozal, Panama, Canal Zone, 11 Dec 1907, crabhole, A.H. Jennings, 69 [USNM, 12052; designation of Stone and Knight, 1957:197].

Deinocerites spanius of Stone and Knight (1957:197).
Deinocerites spanius in part of Dyar (1925:154-155); Carpenter and LaCasse (1955:327-329); Belkin and Hogue (1959:427-428); Stone, Knight and Starcke (1959:285); Ross (1964:104).
Dinanamesus spanius in part of Howard, Dyar and Knab (1915:213-215).

FEMALE (fig. 8). Wing 2.70 mm. Proboscis 1.45 mm. Forefemur 1.27 mm. Abdomen about 2.65 mm. Apparently indistinguishable from *atlanticus*.

FEMALE GENITALIA (fig. 8). ***Tergite IX*** with or without 1 or 2 setae on each side. ***Cercus*** (in lateral aspect) very similar to that of *atlanticus* except for somewhat longer broadened basal part. Distal part of ***postgenital plate*** (in ventral aspect) deeply notched; lateral lobe elongate (in lateral aspect), its apical bristle convergent distally with its mate (in ventral aspect).

MALE (fig. 8). Wing 2.60 mm. Proboscis 1.58 mm. Forefemur 1.30 mm. Abdomen (not including genitalia) about 1.78. Essentially similar to female.

MALE GENITALIA (fig. 8). ***Segment IX***: Tergite lobe slender; middle part almost uniform in width, constricted subapically, then strongly expanded and with angled borders apically; outer margin more or less straight except for the very distal part which is bent mesad; ventral surface with a distinct premedian projection or expansion, visible *in toto* only in lateral aspect. ***Sidepiece***: Similar to *atlanticus*. ***Phallosome***: Dorsal paramere a compact uniformly sclerotized plate; apical spine moderately long, curved and gradually pointed, ventral teeth represented by 2 or 3 strong, moderately long spines in caudal area. Aedeagus in general similar to *atlanticus*.

PUPA and LARVA. Unknown.

SYSTEMATICS. This species is indistinguishable from *atlanticus* in external features of the adults but the male genitalia readily separate these 2 geminate species. *Deinocerites spanius*, the Pacific representative of the southern complex of the group, is the rarest of the 4 species and is still unknown in the immature stages. It is unfortunate that Stone and Knight (1957:197) in designating the lectotype of *spanius* chose the female syntype from Corozal, thus applying this name to the Pacific population in the Canal Zone and Panama. The much more common Atlantic population in this area is now provisionally assigned to *atlanticus* but this population too is still unknown in the immature stages.

BIONOMICS. The lectotype was said to have been reared from a larva collected in a crabhole. I have no information on the recent collections of this species other than the localities as noted below under distribution. *Deinocerites spanius* appears to be much less common than its sibling of the Atlantic coast, *atlanticus*.

DISTRIBUTION (fig. 3). Pacific coast of Panama from Cocle Province to Darien Province. Material examined: 14 specimens; 5 males, 9 females.

PANAMA AND CANAL ZONE. *Canal Zone*: Corozal, A.H. Jennings. Ft. Clayton, C.S. Ludlow [USNM]. *Cocle*: Aguadulce, GML [UCLA]. *Darien*: Santa Fe, GML [UCLA]. *Panama*: Juan Diaz, GML. Nueva Gorgona, GML [UCLA].

2. *Deinocerites atlanticus* Adames, n.sp.

Figs. 3,9-11

TYPES: *Holotype* male with associated pupal skin and genitalia slide (VZ 170-107), La Boca, Ocumare de la Costa, Aragua, Venezuela, 10 July 1969, T. Zavortink, J. Valencia and J. Pulido [USNM]. *Allotype* female with associated larval and pupal skins (VZ 170-30), same data as holotype [USNM]. *Paratypes*: 9 lpM (VZ 170-11-14,17,19,29,36,44), 6 lpF (170-16,18,37,40, 45,46), 3 pM (170-108-110), 4 pF (170-100,102,104,114), 2 lP (170-10,15), 2 lp (170-32,38), 1 l (170-28), 14 M, 3 F, 38 L (170), same data as holotype [BM, UCLA, USNM].

Deinocerites spanius of Dyar (1923a:179; 1928:265,537); Bonne and Bonne-Wepster (1925:176); Edwards (1932:222); Lane (1953:559); Horsfall (1955:599); Forattini (1965:108); Sutil and Pulido (1969:119-125); Barreto and Lee (1969:435).
Deinocerites spanius in part of Dyar (1925:154-155); Belkin and Hogue (1959:427-428); Stone, Knight and Starcke (1959:285); Ross (1964:104).
Dinanamesus spanius in part of Howard, Dyar and Knab (1915:213-215).
Culex (Deinocerites) spanius of Dyar (1918:101).

FEMALE (fig. 9). Wing 2.66 mm. Proboscis 1.73 mm. Forefemur 1.48 mm. Abdomen about 2.71 mm. ***Head***: Narrow decumbent scales of vertex creamy; erect scales yellowish or pale brown; lateral patch of broad decumbent scales whitish. ***Antenna***: Torus occasionally with 1 scale; proboscis reaching apex of flagellar segment 10 or base of 11. ***Thorax***: Middle and lower areas of ***ppn*** usually with 1 or more small bristles; ***ppl*** with a few bristles and sometimes a few scales; ***mep*** with a few scales in upper part, microsetae absent; metameron occasionally with 1 or 2 microsetae. ***Legs***: Anterior surface of forecoxa covered with bristles and translucent scales, basolateral area with a few bristles; midcoxa with scales anterolaterally and with 2 rows of bristles laterally, the posterior bristles stronger, posterolateral surface simple; hindcoxa with scales and several bristles laterally, posterior surface with bristles.

FEMALE GENITALIA (fig. 9). ***Tergite IX*** usually with at least 1 seta on each side, usually 1(0-2) in Venezuelan population and 4(2-5) in Panamanian. ***Cercus*** (in lateral aspect) broadened in basal half, abruptly narrowed in distal; sternal margin more or less convex, tergal margin distinctly concave in distal half; apex directed dorsad, usually with 4-6 apical and subapical bristles. Distal part of ***postgenital plate*** (in ventral aspect) usually deeply notched except in some Panamanian specimens; lateral lobe usually elongate (in lateral aspect) except in above mentioned Panamanian specimens in which it is rounded, its apical bristle convergent distally with its mate (in ventral aspect).

MALE (fig. 9). Wing 2.62 mm. Proboscis 1.86 mm. Forefemur 1.56 mm. Abdomen (not including genitalia) about 2.37 mm. Essentially similar to female.

MALE GENITALIA (fig. 10). ***Segment IX***: Tergite lobe very slender, slightly widened near middle, then constricted subapically and slightly expanded into a rounded apex; outer margin directed mesad by a well-defined distal curvature; ventral surface with a premedian projection similar to that of *spanius*. ***Sidepiece***: Subapical lobe with thumb; seta ***c*** a moderately heavy bristle attenuated apically. ***Phallosome***: Dorsal paramere a small compact uniformly sclerotized plate; apical spine short, broad at base, slightly curved and gradually pointed; ventral teeth represented by 2-4 small denticles at caudoventral angle. Aedeagus (in tergal view) broad at base, then constricted, lateral plates parallel and approaching each other distally.

PUPA (fig. 10). Abdomen 2.60 mm. Trumpet 0.58 mm. Paddle 0.66 mm. Diagnostic characters as in the key; general chaetotaxy based on 6 reared specimens. Hair 10-C about equal in length to 11-C; hair 1-VII extending to about middle of 4-VIII. ***Cephalothorax***: Integument light brown. Hair 1(2,2-3), 2(3,3-4), 3(2,2-3), 4(4,3-5), 5(2,2-3), 6(1), 7(4,3-5), 8(2,2-3), 9(2,1-3), 10(4,3-2), 11(2,2-3), 12(3,2-5). ***Trumpet***: Short; slightly broadening apically; index about 4.92-6.60. Integument brown distad, blackish on tracheoid; moderately contrasting with cephalothoracic integument. Tracheoid about 0.4 of trumpet length; border of pinna without distinct emargination. ***Abdomen***: Integument light brown. Segment I: hair 1 (11,8-13 primary branches), 2(2), 3(2,1-3), 4(5,4-6), 5(3,3-5), 6(1), 7(2,1-4), 9(1). Segment II: hair 0(1), 1(7,6-9), 2(1), 3(2,1-3), 4(4,2-4), 5(1,1-2), 6(1), 7(2,1-3), 9(1). Segment III: hair 0(1), 1(4,2-4), 2(1), 3(2,1-3), 4(2,1-2), 5(1), 6(1), 7(2,1-4), 8(4,3-6), 9(1), 10(2,1-2), 11(1), 14(1). Segment IV: hair 0(1), 1(2,1-3), 2(1), 3(3,2-3), 4(1), 5(1), 6(1), 7(2,1-2), 8(2,2-3), 9(1), 10(2,1-3), 11(1), 14(1). Segment V: hair 0(1), 1(2,1-3), 2(1), 3(2), 4(3,2-4), 5(1), 6(1), 7(4,3-4), 8(2), 9(1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(2,1-2), 2(1), 3(2,1-2), 4(2,2-3), 5(1), 6(1), 7(1,1-2), 8(2,2-4), 9(1), 10(2,1-2), 11(1,1-2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2,1-2), 5(1,1-2), 6(1), 7(1,1-2), 8(2,2-3), 9(4,2-5), 10(1,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1,1-2), 14(1). ***Paddle***: Width about 0.75 of length.

FOURTH INSTAR LARVA (fig. 11). Head 0.95 mm. Siphon 0.83 mm. Diagnostic characters as in the key; general chaetotaxy based on 6 reared specimens. ***Head***: Integument yellowish. Mental plate slightly wider than long, triangular, with a median terminal spicule, basal and lateral spicules with denticulate apex, terminal simple. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a minute spicule), 4(4,3-6), 5(4,4-5), 6(1-2), 7(11,9-11), 8(2,2-3), 9(4,3-5), 10(2,2-3), 11(2,2-6), 12(2), 13(3,2-4), 14(1), 15(2). ***Antenna***: Length about 0.38 of head; shaft simple, occasionally with 1 spicule on proximal part; hair 1(3,3-4). ***Thorax***: Prothorax: hair 0(4,3-6), 1(1), 2(1), 3(1,1-2), 4(3,2-4), 5(1), 6(1), 7(3,2-3), 8(2,1-4), 9(1), 10(1, 1-2), 11(2,1-3), 12(1), 14(1). Mesothorax: hair 1(1), 2(1,1-2), 3(1), 4(2,2-3), 5(1), 6(1), 7(1), 8(6,6-8), 9(8,7-8), 10(1), 11(2,1-3), 12(1), 13(6,5-8), 14(5-6). Metathorax: hair 1(1), 2(3,2-4), 3(4,4-5), 4(2,1-2), 5(1), 6(1,1-2), 7(8,7-9), 8(4,4-6), 9(8,6-9), 10(1), 11(2,1-2), 12(1), 13(4,3-4). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(8,6-8), 5(2,2-4), 6(2), 7(2,1-3), 9(2,1-3), 10(3,2-3), 11(2), 12(2,2-3), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(4,3-6), 5(2,1-2), 6(1), 7(3,2-4), 8(2,1-2), 9(1), 10(1), 11(2,2-3), 12(2,2-3), 13(?). Segment III: hair 0(1), 1 (2,1-2), 2(1), 3(2,2-3), 4(1), 5(1), 6(2), 7(5,4-6), 8(1,1-2), 9(1), 10(2,1-2), 11(1, 1-2), 12(1), 13(1,1-3), 14(1). Segment IV: hair 0(1), 1(1,1-2), 2(1), 3(4,3-4), 4 (1), 5(1), 6(2), 7(5,4-6), 8(1), 9(1), 10(1,1-2), 11(2), 12(1,1-2), 13(2,2-3), 14(1). Segment V: hair 0(1), 1(2), 2(1), 3(1), 4(5,4-6), 5(1,1-2), 6(2), 7(4,3-5), 8(1,1-2), 9(1), 10(1), 11(2), 12(1), 13(2), 14(1). Segment VI: hair 0(1), 1(3,2-3), 2 (1), 3(1,1-2), 4(4,2-4), 5(1), 6(1), 7(2,2-3), 8(2,1-3), 9(1), 10(1), 11(2), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(3,2-4), 4(1), 5(2,1-3), 6(7,5-9), 7(2,1-2), 8(6,6-9), 9(1), 10(1), 11(1), 12(1), 13(3,2-3), 14(1). ***Segment VIII***: Comb scales very slender in basal three-quarters, apex fringed. Hair 0(1), 1(3,2-4), 2(1), 3(5,4-6), 4(1), 5(4,3-5), 14(1). ***Siphon***: Integument yellowish. Index about 3.95-4.35. Pecten teeth usually 5(4-7), usually bifid, sometimes trifid, basal tooth shorter. Hair 1(6,4-6), hair 1ad(2,2-3), hair 1av(3,2-3); hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Small ventral saddle present. Gill about 0.5 of dorsal saddle length. Hair 1-X shorter than gill. Hair 1(2,1-3), 2(1), 3(6,4-7), 4a(10,9-13), 4b (9,8-10), 4c(8,8-10), 4d(10,8-11), 4e(11,8-13), 4f(10,7-10).

SYSTEMATICS. I am assigning provisionally to *atlanticus* all the Atlantic populations of the southern complex of the Spanius Group on the basis of similarity in the genitalia of all the males I have seen from the area. This species is indistinguishable from its geminate Pacific representative of the complex, *spanius*, in external features of the adults but is easily differentiated from it in the male genitalia as noted in the key and descriptions. The immature stages of *atlanticus* are known only from the type locality of Ocumare de la Costa and adjacent areas on the northcentral coast of Venezuela; those of *spanius* are completely unknown.

Deinocerites atlanticus, as currently interpreted, has a much wider distribution than any other species of the group, having been found in Panama, Canal Zone, Colombia, the mainland of Venezuela and its outlying island of Orchila. At least the Panamanian (including Canal Zone) population shows some differences in the female genitalia from the topotypic Venezuelan population, having more setae on the lobe of tergite IX, usually 4 (2-5) instead of 1 (0-2), and the postgenital plate less deeply notched and its lateral lobe slender. The status of this population, which was formerly confused with *spanius*, cannot be determined with certainty until its immature stages are found and compared thoroughly with those of topotypic *atlanticus*; but the fact that the single female I have seen from Colombia is intermediate in its genitalic characters between the Venezuelan and the Panamanian populations suggests that the differences noted may be clinal only and that only 1 rather variable species may be involved over the entire range of *atlanticus*.

BIONOMICS. The immature stages of *atlanticus* are definitely known only from the coast of Venezuela where they have been collected principally in small crabholes along water courses in coconut groves in areas of scrub and thorn forest. The records of *spanius* immatures from Panama in Dyar (1928:265) may pertain to *atlanticus* but there are no specimens to substantiate them and both larvae and pupae are still unknown from this area.

In Venezuela, adults have been collected together with the immature stages in the situations noted above. In Colombia, they were collected once in a house in Manaure in a thorn woodland. They have been collected on numerous occasions in the Canal Zone in the coastal rainforest but without any record of the type of crabhole. The only report of the biting habits of *atlanticus* is that of Dyar (1925:154, as *spanius*): "the species has lately been found to bite [man] freely". This record may refer to the females collected by D. Baker from October 1924 to May 1925.

This species, as currently interpreted, appears to be quite common in Panama. In Venezuela, its breeding associates are *melanophylum* and a member of the *Culex inflictus* complex.

DISTRIBUTION (fig. 3). Atlantic coast from the Canal Zone in Panama to the state of Aragua and the island of Orchila in Venezuela. Material examined: 648 specimens; 123 males, 160 females, 245 larvae, 120 pupae; 88 individual rearings (50 larval, 29 pupal, 9 incomplete).

COLOMBIA. *Guajira*: Uribia, Manaure, P. Barreto [USNM].

PANAMA AND CANAL ZONE. *Canal Zone*: Arenal River, C.S. Ludlow [USNM]. Cativa, J.B. Shropshire [USNM]. Ft. Davis, D. Baker [UCLA, USNM]. Ft. Randolph, J. Zetek [UCLA]; D. Baker [USNM]; W.P. Murdoch [UCLA]. Ft. Sherman, J. Zetek [UCLA, USNM], D. Baker [USNM]; W.H.W. Komp [UCLA]. France Field, C.S. Ludlow [USNM]. Locality not specified, J.B. Shropshire [USNM]. Margarita, J.B. Shropshire [USNM]. Toro Pt., J.B. Shropshire [USNM].

VENEZUELA. *Aragua*: Cuyagua (VZ 415) [UCLA]. Ocumare del la Costa (VZ 170,175, 346,363-365,385,386) [UCLA, USNM]. Puerto Colombia (VZ 216) [UCLA]. Turiamo, W.H.W. Komp [UCLA, USNM]. *Carabobo*: Moron (VZ 256-258) [UCLA]. *La Orchila, Isla*: F.M. Root (LAR 63) [UCLA, USNM].

3. *Deinocerites mathesoni* Belkin & Hogue

Figs. 3,12-14

1959. *Deinocerites mathesoni* Belkin and Hogue, 1959:426-427. TYPE: Holotype male, Brownsville, Texas, 8-9 Feb 1940, reared, F.W. Fisk [USNM, 64261].

Deinocerites mathesoni of Stone, Knight and Starcke (1959:285); Dodge (1963:803,811; 1966: 376); Peyton, Reinert and Peterson (1964:449-458); Ross (1964:104).

Deinocerites spanius of Fisk (1941:543-550); Fisk and LeVan (1941:945); McGregor and Eads (1943:939); Matheson (1944:251-252); Randolph and Neill (1944:81); Knight and Chamberlain (1948:10); Eads, Menzies and Ogden (1951:42,44); Breland (1956:95); Pratt (1956:8); Evans (1962:255).

Deinocerites spanius in part of Carpenter and LaCasse (1955:327-329).

?*Deinocerites spanius* of Vargas (1956:30).

FEMALE (fig. 12). Wing 2.50 mm. Proboscis 1.23 mm. Forefemur 1.22 mm. Abdomen about 2.54 mm. ***Antenna***: Torus without scales; tip of proboscis reaching from apex of flagellar segment 9 to base of 10. ***Thorax***: ***Ppl*** sometimes with 1 or more scales; metameron without microsetae. ***Legs***: Scaling and bristles as described for *atlanticus*.

FEMALE GENITALIA (fig. 12). ***Tergite IX*** with 2-5 setae on each side. ***Cercus*** in lateral aspect broadened at base and evenly narrowed distally, sternal margin convex, tergal margin almost straight throughout except for a slight concavity in distal half; apex slightly upturned, with 3-5 apical or subapical bristles. Distal part of ***postgenital plate*** (in ventral aspect) distinctly notched; lateral lobe elongate (in lateral aspect), its apical bristle convergent distally with its mate (in ventral aspect).

MALE (fig. 12). Wing 2.39 mm. Proboscis 1.41 mm. Forefemur 1.27 mm. Abdomen (not including genitalia) about 1.83 mm. Essentially similar to female.

MALE GENITALIA (fig. 13). ***Segment IX***: Tergite lobe slender, flattened beyond basal part, constricted subapically and then expanded, sometimes widened near middle; ventral surface with a basal projection. ***Sidepiece***: Similar to *atlanticus*. ***Phallosome***: Dorsal paramere with 2 sclerotizations, tergal and sternal, connected by a narrow bridge very poorly sclerotized on the margins and membranous centrally; tergal sclerotization bearing the long slender apical spine which is strongly hooked apically; sternal sclerotization usually with 2 or sometimes 3 outstanding teeth. Width of dorsal paramere about 0.6 of the length of tergal sclerotization. Aedeagus in general similar to *atlanticus*.

PUPA (fig. 13). Abdomen 2.56 mm. Trumpet 0.38 mm. Paddle 0.53 mm. Diagnostic characters as in the key; general chaetotaxy based on 6 reared specimens. Hair 10-C about twice the length of 11-C; hair 1-VII extending beyond apex of 4-VIII. ***Cephalothorax***: Integument yellowish. Hair 1(2,2-4), 2(3,3-4), 3(3,3-4), 4 (6,4-7), 5(2), 6(2,1-3), 7(5,4-6), 8(2,2-3), 9(3,3-4), 10(2), 11(4,3-4), 12(4,3-5). ***Trumpet***: Short, almost uniform in width throughout except for slight broadening apically; index about 5.76-6.16. Integument yellowish distad, medium brown on tracheoid, not markedly contrasting with cephalothoracic integument. Tracheoid about 0.4 of the trumpet length; border of pinna with a distinct emargination. ***Abdomen***: Integument yellowish. Segment I: hair 1(8-15, primary branches), 2(1,1-2), 3(2), 4(4,3-4), 5(5,4-7), 6(1), 7(4,4-6), 9(1). Segment II: hair 0(1), 1 (11,7-11), 2(2,2-3), 3(?), 4(3-4), 5(1), 6(1), 7(3,2-4), 9(1). Segment III: hair 0(1), 1(6,5-6), 2(1), 3(2,2-3), 4(1,1-2), 5(3,1-3), 6(1), 7(2,1-3), 8(6,4-6), 9(1), 10(3-4, 3-6), 11(1), 14(1). Segment IV: hair 0(1), 1(4,3-6), 2(1), 3(4,3-5), 4(1,1-2), 5(1, 1-2), 6(1), 7(2,1-2), 8(3,1-4), 9(1), 10(3,2-5), 11(1,1-2), 14(1). Segment V: hair 0(1), 1(4,2-5), 2(1), 3(3,1-3), 4(5,4-6), 5(1), 6(1,1-2), 7(5,3-6), 8(2,2-3), 9(1), 10(2,1-3), 11(1), 14(1). Segment VI: hair 0(1), 1(4,3-5), 2(1), 3(3,3-4), 4(5,4-5), 5(1), 6(1), 7(2,1-2), 8(2,2-3), 9(1), 10(3,2-3), 11(1), 14(1). Segment VII: hair 0(1), 1(1,1-2), 2(1), 3(2,2-3), 4(3,2-4), 5(3,1-3), 6(1,1-2), 7(2,1-2), 8(3,2-3), 9(5, 4-5), 10(2,1-2), 11(2,1-2), 14(1). Segment VIII: hair 0(1), 4(3), 9(1), 14(1). ***Paddle***: Width about 0.67 of length.

FOURTH INSTAR LARVA (fig. 14). Head 0.72 mm. Siphon 0.71 mm. Diagnostic characters as in the key; general chaetotaxy based on 4 reared specimens. Hair 6-III always single as opposed to *atlanticus* and *belkini* in which it is either single or double. ***Head***: Integument yellowish. Mental plate distinctly wider than long, triangular, with or without a median terminal spicule; basal spicule shorter; all spicules with denticulate apex. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a spicule), 4(7,6-7), 5(6,5-6), 6(4,3-4), 7(10,8-11), 8(8,2-3), 9(3,2-7), 10(2,2-3), 11(4,3-6), 12(2,1-3), 13(3,3-4), 14(1), 15(2,2-3). ***Antenna***: Length about 0.46 of head; shaft with a few spicules on proximal part; hair 1(4,5-7). ***Thorax***: Prothorax: hair 0(7,4-7), 1(1), 2(1), 3(2,1-2), 4(4,3-5), 5(1), 6(1), 7(4,3-5), 8(2,2-3), 9(1), 10(1), 11(4), 12(1), 14(1). Mesothorax: hair 1(1), 2(1), 3(1,1-2), 4(3,1-4), 5(1), 6(1), 7(1), 8(9,6-11), 9(8,8-14), 10(1), 11(2), 12(1), 13(?). Metathorax: hair 1(1), 2(2), 3(4,3-4), 4(1,1-2), 5(1), 6(3,2-3), 7(9-14), 8(6), 9(10,7-11), 10 (1), 11(2), 12(1), 13(4,3-5). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(3,2-3), 4

(5,5-9), 5(1,1-3), 6(2,2-3), 7(3,2-3), 9(2,1-3), 10(2,1-2), 11(2,2-5), 12(3,2-3), 13 (2,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(4,3-5), 4(3), 5(1,1-3), 6(1), 7(4,3-4), 8(3,2-5), 9(1), 10(1,1-4), 11(3,1-3), 12(2), 13(?). Segment III: hair 0(1), 1(3), 2(1), 3(3,2-3), 4(2), 5(1), 6(1), 7(6), 8(1,1-2), 9(1), 10(2,1-2), 11(2), 12(2,1-2), 13(1), 14(1). Segment IV: hair 0(1), 1(1), 3(4,2-4), 4(1), 5(1), 6(2,1-2), 7(4,3-7), 8(1), 9(1), 10(1,1-2), 11(2,1-2), 12(2), 13(2), 14(1). Segment V: hair 0(1), 1(1), 2(1), 3(1), 4(5,4-5), 5(1), 6(2,1-2), 7(3,3-6), 8(1), 9(1), 10(1), 11(2,1-2), 12(1,1-2), 13(2), 14(1). Segment VI: hair 0(1), 1(2), 2(1), 3(1), 4(4,3-4), 5(2), 6(1), 7(2), 8(2,2-3), 9(1), 10(1), 11(2), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-3), 4(1), 5(2), 6(6,6-7), 7(1,1-2), 8(6,5-6), 9(2,1-2), 10(1), 11(1), 12(1), 13(2,2-4), 14(1). ***Segment VIII***: Comb scales slender basally, slightly widened around middle, apex fringed. Hair 0(1), 1(4,3-4), 2(1), 3(5,3-7), 4(1), 5(4, 3-5), 14(1). ***Siphon***: Integument yellowish. Index about 3.6-4.3. Pecten teeth 4 (3-6), usually bifid, sometimes trifid; basal tooth shorter. Hair 1(4,3-7), hair 1ad (4,1-5), hair 1av(4,3-4); hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Gill about 0.5 of dorsal saddle length. Hair 1-X about the same length as gill. Hair 1(1), 2(5,5-8), 3(1), 4a(10,9-12), 4b(8,8-9), 4c(8,7-9), 4d(9,8-10), 4e(9,8-10), 4f(7,6-9).

SYSTEMATICS. *Deinocerites mathesoni* is the Atlantic member of the northern complex of the Spanius Group. Its adults are indistinguishable from those of its geminate Pacific species, *belkini*, in external features but the 2 species are easily separated by male genitalic, pupal and larval characters as noted in the keys and descriptions.

This species is definitely known only from southern Texas but it is very likely that it occurs along the Atlantic coast of Mexico and that the records of *spanius* from the states of Tamaulipas and Veracruz (Vargas, 1956:30) pertain to it.

There is no doubt, now that the Spanius Group has been shown to consist of 4 distinct species, that *mathesoni* is indigenous to Texas and that it was not introduced there by aircraft as suggested by Fisk (1941:548) who first recorded this species (as *spanius*) from the United States.

BIONOMICS. The bionomics of *mathesoni* have been investigated by Fisk (1941, as *spanius*) and by Peyton, Reinert and Peterson (1964). Fisk reported the immature stages from holes of the fiddler crab, *Uca pugilator*, and Peyton et al found them very commonly in the holes of *Uca subcylindrica* and less frequently in those of the Black Land Crab, *Gecarcinus lateralis*. *Deinocerites mathesoni* appears to prefer holes ranging from ¾ to 1¼ inches but occasionally has been found in holes of only ½ inch diameter. Chloride content determinations varied from 8,430 ppm for a single composite sample by Fisk and from 1,115 to 2,603 ppm for several individual samples by Peyton et al. The range of pH values, determined colorimetrically by Fisk and Peyton et al was 7.2-7.6.

Females of *mathesoni* have not been reported to feed on man and Fisk fed them on a small turtle. He reports finding both sexes several miles from any obvious breeding site. Fisk also observed mating of reared individuals in the morning of the eighth day after the first adults emerged.

Deinocerites pseudes is the only species reported to be associated with *mathesoni* to date (Peyton, Reinert and Peterson (1964)).

DISTRIBUTION (fig. 3). Atlantic coast in Texas from Corpus Christi to Brownsville and probably southward into Mexico, at least to Veracruz. Material examined: 78 specimens; 26 males, 28 females, 18 larvae, 6 pupae; 4 individual larval rearings.

TEXAS. *Cameron County*: Brownsville, F.W. Fisk [UCLA, USNM]; T.N. Burns; E.S. Ross [USNM]; J.F. Reinert; M.D. Huettel (TEX 13-16,19,20); D. Eyles (KO 32-7) [UCLA]. Harlingen [USNM]. Laguna Vista, S.R. Telford (MT 10) [UCLA]. Locality not specified [USNM]. *Nueces County*: Corpus Christi, F.R. du Chanois [USNM]. *Willacy County*: Tenerias triangulation station, M.D. Huettel (TEX 10,11) [UCLA].

4. *Deinocerites belkini* Adames, n.sp.

Figs. 3,15-17

TYPES: *Holotype* male with associated larval and pupal skins and genitalia slide (MT 4-12), Barra de Navidad, Jalisco, Mexico, 13 July 1963, S.R. Telford, Jr. [USNM]. *Allotype* female with associated larval and pupal skins (MT 4-10), same data as holotype [USNM]. *Paratypes*: 9 lpM (MT 4-13,14,20,25,30,31,33,35,37), 8 lpF (4-11,22-24,26,32,34), 3 pM (4-16,17,27), 2 pF (4-19,28), 1 lP (4-36), 22 L (4), same data as holotype [BM, UCLA, USNM].

FEMALE (fig. 15). Wing 2.57 mm. Proboscis 2.52 mm. Forefemur 1.53 mm. Abdomen about 2.09 mm. Apparently indistinguishable from *mathesoni*.

FEMALE GENITALIA (fig. 15). Tergite IX with 1-6 setae on each side. Cercus and postgenital plate essentially similar to *mathesoni*.

MALE (fig. 15). Wing 2.41 mm. Proboscis 1.27 mm. Forefemur 1.47 mm. Abdomen (not including genitalia) about 2.29 mm. Essentially similar to female.

MALE GENITALIA (fig. 16). ***Segment IX***: Tergite lobe slender, slightly widened near middle, flattened beyond basal part, constricted subapically and then expanded; ventral surface with a very strong premedian projection, visible *in toto* only in lateral aspect. ***Sidepiece***: Similar to *atlanticus*. ***Phallosome***: Dorsal paramere essentially as in *mathesoni* except for usually 3 or 4 teeth on sternal sclerotization and the width which is about 0.5 of the length of tergal sclerotization. Aedeagus in general similar to *atlanticus*.

PUPA (fig. 16). Abdomen 2.57 mm. Trumpet 0.61 mm. Paddle 0.61 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. Hair 10-C about 1.3 length of 11-C; hair 1-VII as in *mathesoni*. ***Cephalothorax***: Integument yellowish. Hair 1(2,2-3), 2(3,2-3), 3(2,2-4), 4(4,3-5), 5(2,2-3), 6(2,1-3), 7(4,3-6), 8(1), 9(3,2-4), 10(1,1-2, forked when double), 11(3,3-4), 12(4, 3-5). ***Trumpet***: Moderately long and slender, almost uniform in width throughout except for broadened apex; index about 8.7-11.0. Integument yellowish distad, medium brown on tracheoid; not markedly contrasting with cephalothoracic integument. Tracheoid about 0.4 of trumpet length; border of pinna without a distinct emargination. ***Abdomen***: Integument yellowish. Segment I: hair 1(14,12-16 primary branches), 2(1,1-2), 3(2), 4(3,2-3), 5(5,3-8), 6(1), 7(3,3-5), 9(1). Segment II: hair 0(1), 1(4-9), 2(2), 3(1,1-2), 4(4,3-6), 5(1), 6(1), 7(2,1-3), 9(1). Segment III: hair 0(1), 1(6,4-7), 2(1), 3(2), 4(2,1-4), 5(1,1-3), 6(1), 7(2,1-3), 8(7,6-10), 9(1), 10(2,2-3), 11(1), 14(1). Segment IV: hair 0(1), 1(5,4-6), 2(1), 3(4,4-5), 4 (2,1-3), 5(1,1-2), 6(1), 7(3,2-4), 8(3,2-4), 9(1), 10(3,2-4), 11(1), 14(1). Segment V: hair 0(1), 1(4,3-5), 2(1), 3(3,2-3), 4(5,4-6), 5(1), 6(1,1-3), 7(5,4-5), 8(3,2-3), 9(1), 10(2), 11(1), 14(1). Segment VI: hair 0(1), 1(2,1-3), 2(1), 3(2,1-2), 4(5, 3-6), 5(1), 6(1), 7(2,1-3), 8(3,2-5), 9(1), 10(2,1-2), 11(1). Segment VII: hair 0 (1), 1(2), 2(1), 3(2,1-2), 4(2,2-3), 5(2,1-3), 6(1), 7(2,1-2), 8(3-4,2-4), 9(6,1-8), 10(2,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2,2-3), 9(1), 14(1). ***Paddle***: Width about 0.75 of length.

FOURTH INSTAR LARVA (fig. 17). Head 0.94 mm. Siphon 1.19 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens.

Head: Integument yellowish. Mental plate distinctly wider than long, without median terminal spicule; all spicules with denticulate apex, basal and lateral spicules longer than terminal. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(7,5-7), 5(5,5-7), 6(3,2-4), 7(10,9-11), 8(3,2-3), 9(4,3-5), 10(2,2-3), 11(5,3-7), 12(4,2-4), 13(5,4-6), 14(1), 15(3,2-3). ***Antenna***: Length about 0.45 of head; shaft with several spicules on proximal part; hair 1(4,3-5). ***Thorax***: Prothorax: hair 0(6,6-7), 1(1), 2(1), 3 (2,1-2), 4(4,3-5), 5(1), 6(1), 7(4,4-5), 8(3,2-3), 9(1), 10(1), 11(2,1-4), 12(1), 14 (1,1-3). Mesothorax: hair 1(1), 2(1), 3(1), 4(3,3-4), 5(1), 6(1), 7(1), 8(8,6-8), 9 (8,7-9), 10(1), 11(2,1-3), 12(1), 13(11,10-11), 14(3-5 primary branches). Metathorax: hair 1(1), 2(3,2-4), 3(4,3-6), 4(2,2-3), 5(1), 6(3,2-4), 7(10,8-12), 8(7,5-7), 9(9,6-10), 10(1), 11(2,2-3), 12(1), 13(5,4-5). ***Abdomen***: Segment I: hair 1(1), 2 (1), 3(3,2-4), 4(8,8-10), 5(3,2-4), 6(2), 7(3,2-3), 9(3,2-3), 10(3,2-4), 11(2,2-3), 12(2,1-3), 13(1,1-2). Segment II: hair 0(1), 1(1), 2(1,1-2), 3(4,3-4), 4(6,5-6), 5 (2,2-3), 6(1), 7(4,3-6), 8(3,3-4), 9(1), 10(3,3-4), 11(2,2-3), 12(2,2-3), 13(12,10-13). Segment III: hair 0(1), 1(3,2-3), 2(1), 3(3,2-3), 4(2,1-2), 5(1,1-3), 6(1,1-2), 7(5,4-6), 8(2,1-3), 9(1), 10(2), 11(2), 12(2), 13(1), 14(1). Segment IV: hair 0(1), 1(1,1-2), 2(1), 3(5,5-7), 4(2,1-2), 5(1,1-2), 6(2,2-3), 7(6,4-6), 8(1,1-2), 9 (1), 10(2,1-2), 11(2,2-3), 12(2,1-2), 13(2), 14(1). Segment V: hair 0(1), 1(1), 2(1), 3(1), 4(7,4-7), 5(1,1-2), 6(2,1-2), 7(5,5-7), 8(2,1-2), 9(1), 10(1,1-2), 11(2, 2-3), 12(1), 13(2), 14(1). Segment VI: hair 0(1), 1(2,1-3), 2(1), 3(1), 4(4,3-5), 5(2,2-3), 6(1), 7(3,2-3), 8(3,3-5), 9(1), 10(1), 11(2), 12(1), 13(16-22), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(1), 5(2,1-3), 6(10,10-12), 7(2,1-2), 8(9,6-11), 9(1,1-2), 10(1,1-2), 11(1,1-2), 12(1), 13(3,2-5). ***Segment VIII***: Comb scales with basal two-thirds narrow, distal third wide and fringed. Hair 0(1), 1(3,3-4), 2(1), 3(5,5-6), 4(1), 5(4,3-5), 14(1). ***Siphon***: Integument yellowish. Index about 5.2-6.4. Pecten teeth 4(4-5), all teeth about the same size, usually bifid, sometimes trifid. Hair 1(4,3-6), hair 1ad(2,2-3), hair 1av(2,1-3); hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Gills about two-thirds of dorsal saddle length. Hair 1-X about same length as gill. Hair 1(2,1-3), 2(4,3-5), 3(1), 4a(10,7-12), 4b(8,7-10), 4c(7,6-8), 4d(7,6-10), 4e(8,7-9), 4f(8,5-10).

SYSTEMATICS. *Deinocerites belkini* is the Pacific member of the northern complex of the Spanius Group. It is easily differentiated from its Atlantic twin, *mathesoni*, in the male genitalia, pupae and larvae but cannot be separated from it on external features of the adults.

This species is known to date only from the 3 localities in the states of Nayarit and Jalisco, Mexico, but it is very likely that it occurs southward of this area toward the isthmus of Tehuantepec.

BIONOMICS. Immature stages of *belkini* have been found only once, in small crabholes which may have been made by fiddler crabs. Adults have been collected twice in large crabholes in association with the adults of *mcdonaldi*.

DISTRIBUTION (fig. 3). Pacific coast of Mexico in the states of Nayarit and Jalisco. Material examined: 94 specimens; 16 males, 11 females, 42 larvae, 25 pupae; 25 individual rearings (19 larval, 5 pupal, 1 incomplete).

MEXICO. *Nayarit*: Matanchen, San Blas (MF 6) [UCLA]. *Jalisco*: Barra de Navidad (MT 4) [BM, UCLA, USNM]. Puerto Vallarta (MEX 466) [UCLA].

DYARI GROUP

FEMALES. Small species, wing 2.6-3.0 mm. Mesonotum dark, pleuron with strongly contrasting whitish portions or almost uniformly dark brown not contrasting with mesonotal integument (*barretoi*). ***Antenna***: Flagellar segment 1 with scales, about equal to combined length of segments 2, 3 and two-thirds of 4; segments 2-12 subequal in length but progressively slightly shortened distad; moderately long, exceeding proboscis from base of flagellar segment 8. ***Thorax***: Postnotum usually with a few setae in lower part. ***Apn*** light, slightly darkened anteriorly or entirely dark brown; ***ppn*** either light or brown, scales all narrow; ***ppl*** light, slightly darkened or brownish; ***psp***, ***ssp***, ***stp*** and ***pra*** either markedly darkened or concolorous with most of pleuron; paratergite dark; ***mep*** light or brown and without translucent scales, ***lmep*** with 1 very strong bristle; meron light or brown; metameron and metapleuron either light or pale brownish. ***Legs***: Coxal integument either light, slightly darkened or brownish. Entire posteroventral surface of all femora whitish; anteroventral margin of forefemur without spiniforms but with 4-9 bristles, posterodorsal margin with weaker bristles. ***Abdomen***: Sternites III-VII dark scaled, II sometimes pale scaled.

FEMALE GENITALIA. ***Sternite VIII*** with sclerotized distal band narrow and with only a few scales, gradually shortened ventrad; caudal margin not produced into a submedian ventral angle, this area without strongly differentiated marginal bristles. ***Tergite IX*** with at least 2 small setae on each side. ***Tergite X*** poorly differentiated dorsally and with a very small indistinct lateral sclerotization. ***Cercus*** with a few moderately strong apical or subapical normal bristles.

MALES. Essentially similar to females. ***Antenna***: Exceeding proboscis from at least middle of flagellar segment 5; flagellar segments 1, 2 and base of 3 with scales; segments 1-5 or 1-6 markedly elongated but progressively shorter distad; segment 1 always shorter than combined length of segments 2 and 3; segments 7-12 subequal but progressively slightly shortened distad; segment 13 slightly wider than 12. ***Legs***: Claws of foreleg and midleg enlarged; anterior member of a pair always larger and with a subbasal tooth, posterior simple.

MALE GENITALIA. ***Segment IX***: Tergite lobe cylindrical; angled laterad at base; distal part varied in shape and length, apex at most reaching base of subapical lobe. ***Sidepiece***: Without scales. Apicosternal lobe prominent; long, slender and with a long apical seta. ***Phallosome***: Dorsal parameres widely separated in tergal aspect, with a slight indication of a very short, narrow, incomplete sclerotized dorsal bridge; articulated ventrally with a subbasal dorsal sclerotized projection of aedeagus.

PUPAE. ***Cephalothorax***: Hairs 2,3-C closely approximated, 2-C poorly developed, shorter than 3-C; hair 5-C single or double, strongly developed, longer than distance from its alveolus to base of trumpet, at least 1.5 of trumpet length; 7-C usually double (1-3); hair 8-C single. ***Metanotum***: Hair 10-C poorly developed, always shorter than 11-C (0.3-0.5), usually single (1 or 2). ***Abdomen***: Hair 1-II usually not reaching apex of tergite III, single or triple, barbed; 1-III-VI branched; 5-II always laterad of 3-II; hair 3-V usually double (1-4); hair 1-VII shorter than tergite VIII, at most reaching base of 4-VIII. ***Paddle***: Hair 1-P as long as or longer than paddle.

FOURTH INSTAR LARVAE. ***Head***: Hair 2-C short, inconspicuous, about 0.20-0.25 of 1-C, either slightly mesad, in line with or laterad of 1-C; hair 5-C usually with 3 or 4 barbed branches (2-5); hair 6-C single and barbed, about 1.25-1.33 of 5-C. ***Thorax***: Prothoracic hair 9-P single. ***Abdomen***: Hair 6-II double; dorsal sensillum of segment V laterad of 4-V; hair 6-VI usually double (1 or 2); hair 1-VII short, shorter than 3-VII and not reaching base of segment VIII; hair 1-

VIII usually with 4-6 branches (4-7). ***Siphon***: Hair 1-S usually double or triple. ***Anal Segment***: Ventral brush (4-X) with 6 or 7 pairs of hairs. Gill slightly emarginate on apex or towards ventral margin; short, about 0.60-0.70 of dorsal saddle length. Dorsal saddle narrow; its ventral margin far from hair 1-X.

DISCUSSION. The Dyari Group shows fewer derived features than any other group except Spanius and in some respects may be regarded as transitional between the latter and the other groups of the genus. The adults are small species, only slightly larger than those of the Spanius Group, but they have distinctly longer antennae than the latter and show sexual dimorphism in the flagellum as do all the groups other than Spanius. In general external features, the adults show more resemblance with the Cancer Group than with the 2 other derived groups (Epitedeus and Pseudes). They are usually readily distinguished from the Cancer Group by the presence of postnotal bristles. The male genitalia do not show any distinctive characters on a group level but sternite VIII of the female is uniquely developed. The immature stages provide the most reliable diagnostic features for the group in the reduced length of pupal hair 10-C and larval hair 1-VII.

The Dyari Group as now understood is diagnosed in the adults essentially as it was by Belkin and Hogue (1959:428) except that a few scales may be present in the female genitalia and the ninth tergite lobe of the male is not always short as in *dyari*. It consists of 3 allopatric species with complementary known distributions extending from Nicaragua and Costa Rica (*nicoyae*) through Panama and northern Colombia (*dyari*) to central Colombia (*barretoi*). The group as a whole has the most restricted range in the genus and is confined to the Pacific basin.

On the basis of the development of the dorsal paramere (expanded external surface) and subapical lobe of the sidepiece (ventromesal spiniforms), *nicoyae* is sharply differentiated from the other 2 species and it appears likely that it was separated early from the stock which gave rise to the *dyari-barretoi* complex. It would appear also that the short tergite IX lobe of *dyari* is a derived state since *barretoi* has this lobe similar to that of *nicoyae*.

The species of the group appear to be uncommon as they have seldom been collected even as adults. Because of the elongate antennae they are not as likely to be confused with unornamented species of the subgenus *Melanoconion* of *Culex* as species of the Spanius Group. Recent studies have shown that *dyari* females have a definite preference for reptilian blood but nothing is known of the blood feeding habits of the other 2 species. The immature stages of the Dyari Group are apparently very difficult to locate and only a few collections of *nicoyae* and *dyari* have been made to date. Both of these species were found in the medium-sized burrows of *Ucides occidentalis*. The immature stages of *barretoi* are unknown.

5. *Deinocerites dyari* Belkin & Hogue

Figs. 4,18-20

1959. *Deinocerites dyari* Belkin and Hogue, 1959:428-429. TYPE: Holotype male, Corozal, Panama, Canal Zone, 20 Apr 1919, J. Zetek, 1183 [USNM, 64262].

Deinocerites dyari of Stone, Knight and Starcke (1959:284); Gorgas Memorial Institute (1970: 20); Tempelis and Galindo (1970).

FEMALE (fig. 18). Wing 2.67 mm. Proboscis 1.22 mm. Forefemur 1.53 mm.

Abdomen about 2.55 mm. Mesonotum dark brown, pleuron with strongly contrasting whitish portions. ***Head***: Narrow decumbent scales of vertex creamy; erect scales brown to very dark brown; lateral patch of broad decumbent scales whitish. ***Antenna:*** Torus occasionally with 1 scale. ***Thorax***: ***Apn*** light or slightly darkened anteriorly; ***ppn*** light and often with a few scales in middle; ***ppl*** light or slightly darkened, with several bristles and frequently a few scales; ***psp***, ***ssp***, ***stp*** and ***pra*** usually markedly darker than rest of pleuron; ***mep*** light, with a few scales in upper part, microsetae absent; metameron simple; meron, metameron and metapleuron light. ***Legs***: Coxal integument usually light; anterior surface of forecoxa covered with bristles and translucent scales, basolateral area with a few bristles; midcoxa with scales anterolaterally, with 2 groups of bristles laterally, the anterior bristles irregular, the posterior in a row and stronger, posterolateral surface simple; hindcoxa with scales and several bristles laterally, posterior surface with bristles.

FEMALE GENITALIA (fig. 18). ***Tergite IX*** usually with 4 setae on each side (2-5). ***Cercus*** (in lateral aspect) broadened basally, gradually narrowing distally, sternal margin convex, tergal margin more or less straight throughout except for a slight subapical concavity; apex slightly upturned, usually with 4-6 moderately strong apical or subapical bristles. Distal part of ***postgenital plate*** (in ventral aspect) deeply notched, margins of notch diverging distad; lateral lobe elongate (in lateral aspect), its apical bristle slightly converging with its mate (in ventral aspect), its small dorsal bristle not converging.

MALE (fig. 18). Wing 2.61 mm. Proboscis 1.88 mm. Forefemur 1.78 mm. Abdomen (not including genitalia) about 1.88 mm. Flagellar segments 1-6 markedly elongated. Anterior claw of foreleg with a long, very slender tooth, anterior claw of midleg with a shorter and heavier tooth.

MALE GENITALIA (fig. 19). ***Segment IX***: Tergite lobe with distal part short, more or less pointed and conical, not reaching more than halfway to subapical lobe. ***Sidepiece***: Subapical lobe with a distinct thumb; seta ***c*** rather heavy and spiniform but with an apical attenuation; the 3 setae of ventromesal surface bristlelike and attenuated apically. ***Phallosome***: Dorsal paramere with apical spine long and strongly curved, ventral teeth large and arising from convex caudolateral border. Aedeagus (in tergal aspect) almost uniform in width except for a subbasal expansion; distally the 2 plates come together forming a globular expansion.

PUPA (fig. 19). Abdomen 3.52 mm. Trumpet 0.51 mm. Paddle 0.71 mm. Diagnostic characters as in the key; general chaetotaxy based on 8 reared specimens. Hair 5-IV usually reaching spiracular sensillum of segment V. ***Cephalothorax***: Integument light brown. Hair 1(2), 2(2,2-4), 3(2,1-2), 4(3,1-4), 5(1), 6(1), 7(2,1-2), 8(1), 9(2,1-2), 10(1,1-2), 11(2,1-3), 12(2,1-3). ***Trumpet***: Short, index 3.6-5.0. Integument brown distad, darker on tracheoid, contrasting with cephalothoracic integument. Tracheoid about 0.36 of trumpet length. ***Abdomen***: Integument light brown. Segment I: hair 1(8,4-13 primary branches), 2(1), 3(2,1-2), 4(4,2-4), 5(2,1-3), 6(1), 7(2,2-4), 9(1), 10(1), 11(1). Segment II: hair 0(1), 1(1), 2(1,1-2), 3(1), 4(2,1-4), 5(1), 6(1), 7(1,1-2), 9(1). Segment III: hair 0(1), 1(4,2-5), 2(1), 3(2,1-2), 4(1, 1-2), 5(1,1-2), 6(1), 7(2,1-3), 8(3,2-6), 9(1), 10(2,1-2), 11(1), 14(1). Segment IV: hair 0(1), 1(2,1-5), 2(1), 3(3,2-3), 4(1), 5(1), 6(1), 7(2,1-2), 8(2,1-2), 9(1), 10 (2,1-2), 11(1), 14(1). Segment V: hair 0(1), 1(2,1-3), 2(1), 3(2,1-4), 4(3,2-4), 5 (1), 6(1), 7(2,2-4), 8(2,1-2), 9(1), 10(2,1-2), 11(1), 14(1). Segment VI: hair 0(1), 1(2,2-3), 2(1), 3(1,1-3), 4(3,2-3), 5(1), 6(1), 7(1,1-2), 8(1,1-2), 9(1), 10(2,1-2), 11(1), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2,1-2), 5(1), 6(1), 7(2), 8(2,2-3), 9(3,3-5), 10(2,1-2), 11(1), 14(1). Segment VIII: hair 0(1), 4(2, 1-2), 9(1), 14(1). ***Paddle***: Width about 0.73 of length; apex usually slightly produced; hair 1-P longer than paddle.

FOURTH INSTAR LARVA (fig. 20). Head 1.11 mm. Siphon 1.07 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens. ***Head***: Integument light brown. Mental plate more or less rectangular, marginal spicules sharply pointed. Hair 0(1), 2(1), 3(not detectable), 4(3,2-4), 5(3,3-5), 6(1), 7(9,7-11), 8(3,2-4), 9(5,5-6), 10(2,1-4), 11(3,2-4), 12(2,1-3), 13(4,4-6), 14(1), 15(3,2-3). ***Antenna***: Length about 0.38 of head; shaft with several spicules on proximal part. Hair 1(5,4-7). ***Thorax***: Prothorax: hair 0(5,5-7), 1(1), 2(1), 3(1,1-2), 4(3,2-4), 5(1), 6(1), 7(3), 8(2,2-3), 9(1), 10(1), 11(3,2-4), 12(1), 14(1). Mesothorax: hair 1(1), 2(2), 3(1), 4(3,2-4), 5(1), 6(1), 7(1), 8(6,5-7), 9(5,4-7), 10(1), 11(3,2-3), 12(1), 13(8,6-8), 14(6,4-7). Metathorax: hair 1(1), 2(3,3-4), 3(4,3-5), 4(2,2-4), 5(1), 6(2,1-3), 7(9,7-10), 8(7,7-10), 9(8,6-9), 10(1), 11(3,2-3), 12(1), 13(4,4-6). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(3,3-4), 4(6,5-7), 5(3,2-4), 6(2,2-4), 7(2), 9(3,3-4), 10(4,3-5), 11(3,2-4), 12(3,2-4), 13(1,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(3,2-3), 4(3,2-4), 5(4,3-5), 6(2), 7(3,2-3), 8(2,1-4), 9(1), 10(1,1-2), 11(2,2-4), 12(3,3-5), 13(7,7-9). Segment III: hair 0(1), 1(2,2-3), 2(1), 3(2,1-3), 4(1,1-2), 5(4,3-6), 6(3,3-4), 7(4,3-5), 8(2,1-3), 9(1), 10(2), 11(2,1-2), 12(2,1-2), 13(1,1-2), 14(1). Segment IV: hair 0(1), 1(2), 2(1), 3(4,2-4), 4(1), 5(3,2-4), 6(3), 7(5,5-6), 8(1), 9(1), 10(2,1-2), 11(2,1-2), 12(2,1-2), 13(2), 14(1). Segment V: hair 0(1), 1(2,1-2), 2(1), 3(1), 4(4,4-5), 5(2,1-3), 6(2,2-3), 7(5,3-6), 8(1), 9(1), 10(1), 11(2,1-2), 12(1), 13(2), 14(1). Segment VI: hair 0(1), 1(3,3-4), 2(1), 3(1), 4(4,3-4), 5(2,2-4), 6(2,1-3), 7(3,2-3), 8(2), 9(1), 10(1,1-2), 11(2), 12(1), 13(13,9-14), 14(1). Segment VII: hair 0(1), 1(2), 2(1), 3(3,3-4), 4(1), 5(2,2-3), 6(7,6-8), 7(2,1-2), 8(5,4-7), 9(2,1-2), 10(2,1-2), 11(1,1-2), 12(1), 13(2,2-3), 14(1). ***Segment VIII***: Comb scales with body very slender, apex slightly wider and fringed. Hair 0(1), 1(4,4-5), 2(1), 3(4,3-6), 4(1), 5(3,3-4), 14(1). ***Siphon***: Integument medium brown. Index about 4.6-5.8. Pecten teeth 4(3-5), usually bifid, sometimes trifid, both blades very slender, size variable. Hair 1(2,2-3), hair 1ad(2), hair 1av(2,1-2); hairs 2,6,7,8,9 all single. ***Anal Segment***: Gill about 0.7 of dorsal saddle length. Hair 1-X shorter than gill. Hair 1(3), 2(8,6-9), 3(1), 4a(12,11-14), 4b(10,10-11), 4c(11,9-12), 4d(11,10-14), 4e(13,11-14), 4f(12,11-14).

SYSTEMATICS. This species appears to be the most derived one of the group judging by the reduction of the IX tergite lobe of the male genitalia. In other respects the male genitalia are very similar to those of *barretoi* and I therefore consider that these 2 species are closely related. As noted above in the description and in the keys, the adults of *dyari* are readily distinguished from *barretoi* by the lighter pleural integument which strongly contrasts with the dark mesonotum.

BIONOMICS. The immature stages of *dyari* are known only from Curiche, Colombia, where they were found in large crabholes in a mangrove area. On 1 occasion adults were found in this locality in a hole in which a Wide Red Land Crab, *Ucides occidentalis*, was also collected (COA 26).

Studies on the blood feeding habits of species of *Deinocerites* in Panama indicate that *dyari* has a definite preference for reptiles (Gorgas Memorial Institute, 1970:20; Tempelis and Galindo, 1970).

This species has been found associated with *pseudes*.

DISTRIBUTION (fig. 4). Pacific coast from the Canal Zone, Las Perlas islands southward to Curiche, Colombia. Material examined: 116 specimens; 35 males, 30 females, 32 larvae, 19 pupae; 19 individual rearings (9 larval, 5 pupal, 5 incomplete.

COLOMBIA. *El Choco*: Curiche (COA 22,24-29) [BM, UCLA, USNM].

PANAMA AND CANAL ZONE. *Canal Zone*: Corozal, J. Zetek [UCLA, USNM]. La Boca, A. Busck [USNM]. *Darien*: Boca Lava, B.F. Eldridge [USNM]. *Isla San Jose* (Archipielago de las Perlas), J.P.E. Morrison [USNM]. *Panama*: Punta Paitilla, Panama City, GML [UCLA].

6. *Deinocerites barretoi* Adames, n.sp.

Figs. 4,21

TYPES: *Holotype* male with genitalia slide (COL 47f), mouth of Raposo River, Valle, Colombia, 31 Mar 1955, V.H. Lee [USNM]. *Allotype* female with genitalia slide (COL 47a), same data as holotype [USNM]. *Paratypes*: 2 M (COL 47h,g), 3 F (47c-e), same data as holotype [UCLA, USNM].

Deinocerites dyari of Barreto and Lee (1969:435,436).

FEMALE (fig. 21). Wing 3.06 mm. Proboscis 1.88 mm. Forefemur 1.78 mm. Abdomen about 2.60 mm. Mesonotum dark brown; pleuron almost uniformly dark brown, not markedly contrasting with mesonotum. ***Antenna***: Torus without scales. ***Thorax***: ***Apn*** dark brown; ***ppl*** dark brown, with a few scales in middle; ***ppl*** dark brown, with several bristles and at least 1 scale; ***psp***, ***ssp***, ***stp*** and ***pra*** dark brown and concolorous with most of pleuron; ***mep*** dark brown, with a few scales in upper part; microsetae absent; metameron simple; meron brown; metameron and metapleuron lighter than adjacent portions of pleuron. ***Legs***: Coxal integument slightly brownish; scaling and bristles as described for *dyari*.

FEMALE GENITALIA (fig. 21). ***Tergite IX*** with 1-4 setae on each side. ***Cercus*** (in lateral aspect) broadened basally and evenly narrowing distally; sternal and tergal margins convex; apex not upturned, with 4 or 5 moderately strong apical or subapical bristles which may be twisted apically. Distal part of ***postgenital plate*** (in ventral aspect) deeply notched, margins of notch parallel; lateral lobe elongate (in lateral aspect), its apical and dorsal bristles converging with their mates (in ventral aspect).

MALE (fig. 21). Wing 2.72 mm. Proboscis 1.78 mm. Forefemur 1.73 mm. Abdomen (not including genitalia) about 2.14 mm. Flagellar segments 1-5 markedly elongated. Anterior claws of foreleg and midleg similar to those of *dyari*.

MALE GENITALIA (fig. 21). ***Segment IX***: Tergite lobe with distal part long, cylindrical, slender and reaching base of subapical lobe but not extending beyond. ***Sidepiece***: Subapical lobe with a distinct thumb; seta ***c*** rather heavy, spiniform and bent apically; the 3 setae of ventromesal surface bristlelike and attenuated apically. ***Phallosome***: Dorsal paramere only known in tergal aspect, apical spine long and strongly curved. Aedeagus apparently similar to that of *dyari*.

PUPA and LARVA. Unknown.

SYSTEMATICS. *Deinocerites barretoi* appears to be closely related to *dyari* on the basis of general similarity in the male genitalia. However, it has an elongate IX tergite lobe, a primitive character state in my opinion. Therefore I consider that *barretoi* is probably the earlier derivative of this phyletic line. The adults of *barretoi*, as noted above and in the keys, are readily separated from the other 2 species of the group by the dark pleural integument. The male of *barretoi* also differs from the others in having only flagellar segments 1-5 elongated instead of segments 1-6.

BIONOMICS. Adults of *barretoi* have been collected from crabholes in a mangrove area at the mouth of the Raposo River in Colombia. On 1 occasion a female was caught in a treehole in the same area.

DISTRIBUTION (fig. 4). Pacific coast of Colombia near Buenaventura. Material examined: 13 specimens; 5 males, 8 females.

COLOMBIA. *Valle*: Rio Raposo (COL 47), type series [BM, UCLA, USNM]; (VL 26,69) [VALLE].

7. *Deinocerites nicoyae* Adames & Hogue

Figs. 4,22-24

1970. *Deinocerites nicoyae* Adames and Hogue, 1970:9. TYPE: Holotype male (CR 254-21) with associated larval and pupal skins and genitalia slide, Estero El Mero, Boca del Rio Barranca, Puntarenas Province, Costa Rica, 11 Feb 1969, C.L. Hogue and D.B. Bright [USNM].

FEMALE (fig. 22). Wing 2.79 mm. Proboscis 1.69 mm. Forefemur 1.61 mm. Abdomen about 2.83 mm. Apparently indistinguishable from *dyari*.

FEMALE GENITALIA (fig. 22). ***Tergite IX*** usually with 1 seta on each side (0-3). ***Cercus*** (in lateral aspect) broadened basally, gradually narrowing distally, sternal margin convex, tergal margin more or less concave; apex upturned, usually with 4-6 moderately strong apical or subapical bristles. Distal part of ***postgenital plate*** (in ventral aspect) deeply notched, margins of notch diverging distad; lateral lobe elongate (in lateral aspect), its apical bristle converging with that of its mate (in ventral aspect), its small dorsal bristle not converging.

MALE (fig. 22). Wing 2.91 mm. Proboscis 1.90 mm. Forefemur 1.90 mm. Abdomen (not including genitalia) about 1.67 mm. Flagellar segments 1-6 markedly elongated. Anterior claws of foreleg and midleg both with a heavy tooth.

MALE GENITALIA (fig. 23). ***Segment IX***: Tergite lobe with distal part reaching base of subapical lobe, directed mesad distally by a distinct deep mesal curvature or constriction, expanded distally. ***Sidepiece***: Subapical lobe with distinct thumb; seta ***c*** rather heavy and spiniform, with an apical attenuation; the most anterior seta of ventromesal surface bristlelike and attenuated apically, the 2 posterior setae spiniform, rather heavy and without apical attenuation. ***Phallosome***: Dorsal paramere with caudoventral margin expanded laterad as a broad hemispherical ledge; apical spine short, heavy and strongly curved dorsad, visible *in toto* only in lateral aspect; ventral teeth large, heavy and progressively shorter toward apex. Aedeagus (in tergal aspect) broad in middle, then constricted; apex truncate and poorly sclerotized but well defined by a subapical necklike constriction.

PUPA (fig. 23). Abdomen 3.56 mm. Trumpet 0.51 mm. Paddle 0.71 mm. Diagnostic characters as in the key; general chaetotaxy based on 6 reared specimens. Hair 5-IV not reaching spiracular sensillum of segment V. ***Cephalothorax***: Integument light brown. Hair 1(2), 2(2,1-3), 3(2,1-3), 4(3,2-4), 5(2), 6(1,1-2), 7(2,2-3), 8(1), 9(2), 10(1,1-2), 11(2), 12(2,2-3). ***Trumpet***: Short, index about 4.5-4.6. Integument brown distad, darker on tracheoid; markedly contrasting with cephalothoracic integument. Tracheoid about 0.45 of trumpet length. ***Abdomen***: Integument light brown. Segment I: hair 1(13-14,8-15 primary branches), 2(1,1-2), 3(2,1-2), 4(3,2-5), 5(3,2-4), 6(1), 7(2,2-3), 9(1). Segment II: hair 0(1), 1(3), 2(2,1-2), 3(1), 4(3,2-4), 5(1), 6(1), 7(2,1-2), 9(1). Segment III: hair 0(1), 1(4,3-5), 2(1), 3(2,1-2), 4(1,1-2), 5(1,1-2), 6(1), 7(2,1-3), 8(4,4-6), 9(1), 10(2), 11(1,1-2), 14(1). Segment IV: hair 0(1), 1(2,2-4), 2(1), 3(3,2-3), 4(1,1-2), 5(1), 6(1), 7(2, 1-3), 8(2,1-3), 9(1), 10(2), 11(1), 14(1). Segment V: hair 0(1), 1(2,2-3), 2(1), 3(2,1-2), 4(3,2-4), 5(1), 6(1), 7(4,2-4), 8(2,1-3), 9(1), 10(2,1-2), 11(1), 14(1). Segment VI: hair 0(1), 1(2,2-4), 2(1), 3(2,2-3), 4(3,2-4), 5(1), 6(1), 7(2,1-2), 8 (2,1-2), 9(1), 10(2,1-2), 11(1), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2), 5(1,1-2), 6(1,1-2), 7(1,1-2), 8(2,1-2), 9(3,2-4), 10(2,1-2), 11(1), 14(1). Segment VIII: hair 0(1), 4(2), 9(1), 14(1). ***Paddle***: Width about 0.70 of length; apex more or less rounded; hair 1-P usually as long as paddle.

FOURTH INSTAR LARVA (fig. 24). Head 1.05 mm. Siphon 1.14 mm. Diagnostic characters as in the key; general chaetotaxy based on 8 reared specimens. ***Head***: Integument yellowish to very light brown. Mental plate triangular, wider than long, basolateral spicules sometimes denticulate, all others sharply pointed. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(3,3-5), 5(4,2-5), 6(1,1-2), 7(9,7-11), 8(3,2-5), 9(3,3-5), 10(2,2-4), 11(4,2-4), 12(2,2-3), 13(4,2-4), 14(1,1-2), 15(2,2-3). ***Antenna***: Length about 0.33 of head; shaft with a few minute spicules on proximal part. Hair 1(4,4-7). ***Thorax***: Prothorax: hair 0(5,5-8), 1(1), 2(1), 3(2), 4(3, 2-3), 5(1), 6(1), 7(4,2-4), 8(2), 9(1), 10(1), 11(4,2-5), 12(1), 14(1). Mesothorax: 1(1), 2(2,1-3), 3(1), 4(3,2-4), 5(1), 6(1), 7(1), 8(7,6-8), 9(6,5-7), 10(1), 11(4,2-4), 12(1), 13(11,8-11), 14(9,8-10). Metathorax: hair 1(1), 2(2,2-4), 3(5,3-5), 4(4, 2-5), 5(1), 6(2,1-3), 7(7,7-9), 8(7), 9(7,5-8), 10(1), 11(2,2-3), 12(1,1-2), 13(4,3-5). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(6,4-7), 5(3,2-4), 6(2,2-3), 7(2,2-3), 9(4,3-4), 10(4,3-4), 11(3,2-4), 12(3,2-3), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(4,3-4), 5(4,3-5), 6(2), 7(3,2-4), 8(3,2-4), 9(1), 10(1), 11 (2,2-3), 12(3,3-4), 13(6,5-8). Segment III: hair 0(1), 1(3,2-3), 2(1), 3(2,2-3), 4 (2,1-2), 5(3,2-4), 6(2), 7(4,4-5), 8(2), 9(1), 10(2), 11(2), 12(2,2-3), 13(1), 14(1). Segment IV: hair 0(1), 1(1,1-2), 2(1), 3(4,3-5), 4(1,1-2), 5(2,1-2), 6(2,2-3), 7(5, 4-5), 8(1), 9(1), 10(2), 11(2), 12(2,1-2), 13(2), 14(1). Segment V: hair 0(1), 1 (1,1-2), 2(1), 3(1), 4(4,4-5), 5(2,1-2), 6(2), 7(4,4-5), 8(1), 9(1), 10(1), 11(2), 12 (1), 13(2), 14(1). Segment VI: hair 0(1), 1(3,2-4), 2(1), 3(1), 4(4,3-4), 5(2,1-2), 6(2,1-2), 7(3,2-3), 8(2), 9(1), 10(1), 11(2), 12(1), 13(8,8-9), 14(1). Segment VII: hair 0(1), 1(2,1-2), 2(1), 3(2,2-3), 4(1), 5(2), 6(6,4-6), 7(1), 8(5,3-5), 9(1,1-3), 10(1), 11(1), 12(1), 13(2), 14(1). ***Segment VIII***: Comb scales similar to those of *dyari*. Hair 0(1), 1(6,5-7), 2(1), 3(6,5-7), 4(1), 5(3,3-4), 14(1,1-2). ***Siphon***: Integument medium brown. Index about 4.7-5.3. Pecten teeth 5(4-6), usually bifid, sometimes trifid, both blades very slender; distal teeth generally slightly longer. Hair 1(3,2-3), hair 1ad(2), hair 1av(2,1-3); hairs 2,6,7,8,9 all single. ***Anal Segment***: Gill about 0.6 of dorsal saddle length. Hair 1-X shorter than gill. Hair 1(3,2-5), 2(7,5-7), 3(1), 4a(12,10-13), 4b(9,8-11), 4c(10,9-11), 4d(11,10-12), 4e(14,10-14), 4f(11,9-11).

SYSTEMATICS. *Deinocerites nicoyae* clearly belongs to a different phylad than the other 2 species of the group. This is particularly evident in the male genitalia (shape of paramere; spiniform setae of ventromesal surface of subapical lobe; IX tergite lobe) but is also suggested in the larva (reduction of ventral brush and branching of hairs 6-III,IV). It seems likely therefore that *nicoyae* represents the earliest offshoot of the group.

I have tentatively assigned to *nicoyae* a single female collected in a light trap at Puerto Somoza, Nicaragua. It is possible that this specimen could represent a distinct species but this cannot be determined without males and immature stages.

BIONOMICS. *Deinocerites nicoyae* has been collected in mangrove areas most frequently in the burrows of the Wide Red Land Crab, *Ucides occidentalis*. The immature stages were found on 1 occasion only, when the water level in these burrows was considerably depressed. Occasionally associated with *nicoyae* was *pseudes*, which more frequently utilizes the burrows of *Cardisoma crassum*.

DISTRIBUTION (fig. 4). Pacific coast from Puerto Somoza, Nicaragua, to the mouth of the Gulf of Nicoya in Costa Rica. Material examined: 422 specimens; 151 males, 93 females, 167 larvae, 11 pupae; 11 individual rearings (6 larval, 3 pupal, 2 incomplete).

COSTA RICA. *Puntarenas*: Boca del Rio Barranca, Estero El Mero (CR 238,420,254; LCBA-188) [BM, LACM, UCLA, USNM]. La Angostura (CR 3,27) [UCLA].

NICARAGUA: *Leon*: Puerto Somoza (NI 20) [UCLA].

CANCER GROUP

FEMALES. Medium-sized species, wing 2.78-3.01 mm. Mesonotum dark; pleural integument whitish to dark, distinctly, slightly or not contrasting with mesonotal integument. ***Antenna***: Flagellar segment 1 with scales, about equal to combined length of segments 2-4; segments 2-12 subequal in length but progressively slightly shortened distad; moderately long, exceeding proboscis from at least basal half of flagellar segment 9. ***Thorax***: Postnotum without setae. ***Apn*** whitish to dark brown; ***ppn*** usually whitish to dark brown, scales all narrow; ***ppl*** whitish to dark brown; ***psp***, ***ssp***, ***stp*** and ***pra*** slightly (usually) or markedly darker than rest of pleuron; paratergite either light brown or dark brown; ***mep*** whitish to dark brown and without translucent scales, ***lmep*** with 1 very strong bristle; meron, metameron and metapleuron whitish to light brown. ***Legs***: Coxal integument whitish to brownish. Basal two-thirds of posteroventral surface of all femora pale; anteroventral margin of forefemur without spiniforms but with 6-8 strong bristles on distal two-thirds, posterodorsal margin with a rwo of weak bristles. ***Abdomen***: Sternites II-IV paler than tergites.

FEMALE GENITALIA. ***Sternite VIII*** with sclerotized distal band broad and without scales; caudal margin produced into a distinct submedian ventral angle, with several very strong marginal bristles. ***Tergite IX*** without setae. ***Tergite X*** represented dorsally by a poorly sclerotized cuplike area and laterally by a broad strong sclerite at base of cercus. ***Cercus*** with 2 long apical or subapical spatulate setae.

MALES. Essentially similar to females. ***Antenna***: Exceeding proboscis from at least base of flagellar segment 5; flagellar segments 1-4 with scales; segments 1-6 markedly elongated but progressively shorter distad; segment 1 always shorter than combined length of segments 2 and 3; segments 7-12 subequal but progressively slightly shortened distad; segment 13 either shorter, equal or slightly longer, but always slightly broader, than 12. ***Legs***: Claws of foreleg and midleg enlarged; anterior member of a pair larger and with a variable subbasal to almost basal tooth, posterior with or without subbasal tooth.

MALE GENITALIA. ***Segment IX***: Tergite lobe not markedly angled laterad at base; distal part strongly flattened, widened; apex sometimes exceeding the subapical lobe. ***Sidepiece***: Without scales. Apicosternal lobe prominent, with a long apical seta. ***Phallosome***: Dorsal parameres connected by a variable, but well differentiated dorsal sclerotized bridge; articulated ventrally with a dorsal sclerotized projection from basal third of aedeagus.

PUPAE. ***Cephalothorax***: Hairs 2,3-C closely approximated, 2-C weaker and shorter than 3-C; hair 5-C double, strongly developed, longer than distance from its alveolus to base of trumpet, about 1.3-1.5 of trumpet length; 7-C usually double or triple (2-5); hair 8-C usually with 2-5 branches (1-6). ***Metanotum***: Hair 10-C moderately to strongly developed, always longer than 11-C, branching varied (1-7). ***Abdomen***: Hair 1-II not reaching apex of tergite III, multibranched (6-30), sometimes dendritic and barbed; 1-III-VI branched; 5-II always laterad of 3-II; hair 3-V usually double (1-4); hair 1-VII shorter or sometimes equal to tergite VIII, never exceeding basal third of 4-VIII. ***Paddle***: Hair 1-P longer than paddle.

FOURTH INSTAR LARVAE. ***Head***: Hair 2-C varied in length from 0.5 to longer than 1-C, always markedly mesad of 1-C; hair 5-C usually with 4 barbed branches (2-5); hair 6-C single and barbed, about 1.33-1.50 of 5-C. ***Thorax***: Prothoracic hair 9-P single. ***Abdomen***: Hair 6-II double; dorsal sensillum of segment V laterad of 4-V; hair 6-VI single; 1-VII moderately developed, longer than 3-VII, exceeding base of segment VIII but not reaching base of siphon; 1-VIII usually with 3 or 4 branches (2-5). ***Siphon***: Hair 1-S usually double (1-5). ***Anal Segment***: Ventral brush (4-X) with 6 or 7 pairs of hairs. Gill slightly emarginate on apex; short, about 0.45-0.60 of dorsal saddle length. Dorsal saddle narrow, its ventral margin far from hair 1-X.

DISCUSSION. The Cancer Group is well marked by unique features in both male (IX tergite lobe) and female (cercal setae) genitalia. The immature stages of this group are very similar to those of the Pseudes Group from which, however, they can usually be separated by the characters given in the keys.

On the basis of morphological features of the adults (length of antenna) and larvae (ventral brush), the clearly marked *magnus* appears to be the representative of the primitive stock of the group. The other 2 species of the group, *cancer* and *melanophylum*, are obviously closely related and show derived states in these characters.

The group is apparently restricted to the Atlantic basin and its distribution is centered around the Caribbean Sea with extensions northward into the Bahamas and Florida and southward to the state of Maranhao in Brazil. The 3 species have complementary allopatric distributions with a possible gap in eastern Venezuela: *cancer* in Central America down to at least Almirante, Panama, in the western Antilles through Hispaniola, and in the Bahamas and southern Florida; *melanophylum* from central Panama through Colombia to central Venezuela; and *magnus* in the eastern Antilles from Mona and Puerto Rico through the Lesser Antilles, Trinidad and Tobago, the Guianas and in Brazil south of the Amazon. Over much of the group's distribution (West Indies, Bahamas, Florida, eastern South America) either *cancer* or *magnus* is the only representative of the genus.

The species of the group are usually common in areas where no other species of the genus are present. Considerable information has been accumulated on the bionomics of *cancer* in recent years but little is known about the other species. All 3 species may occasionally bite man but in Panama *cancer* appears to have a preference for avian blood and *melanophylum* for reptilian blood. The immature stages of all 3 species are usually found in large crabholes, probably largely those made by *Cardisoma guanhumi*.

8. *Deinocerites cancer* Theobald

Figs. 1,5,25-28

1901. *Deinocerites cancer* Theobald, 1901b:215-216,356. TYPE: Lectotype female, Spanish

Town Road, Kingston, Jamaica, 8 Feb 1900, M. Grabham [BM; designation of Belkin and Hogue, 1959:432].

1909. *Deinocerites tetraspathus* Dyar and Knab, 1909:260. TYPE: Lectotype female with genitalia slide (472), Bluefields, Nicaragua [USNM, 12109; designation of Stone and Knight, 1957:197]. Synonymy with *cancer* by Dyar (1928:262).

Deinocerites cancer of Pazos (1904:135); Dyar (1905b:24; 1905c:27; 1905d:53; 1905e:109; 1922:8); Felt (1905:491,492); Coquillett (1906:26; 1910:531); Mitchell (1906:19,20; 1907a: 13; 1907b:264); Knab (1907a:121); Dyar and Knab (1918:183); Johnson (1919:422); Gowdey (1926:73); Gerry (1932:43,44,71); King, Bradley and McNeel (1944:4,61,68,79,81); Middlekauff and Carpenter (1944:89); Roth and Young (1944:84); Pratt, Wirth and Denning (1945: 426); Wirth (1945:200); Carpenter and Chamberlain (1946:88); Carpenter, Middlekauff and Chamberlain (1946:275-277); Pritchard (1947:13); Thompson (1947:78); Hill and Hill (1945: 2; 1948:51-52); Thurman, Haeger and Mulrennan (1949:171); de la Torre, Alayo and Calderon (1956:80); Pratt (1956:8); Branch, Logan, Beck and Mulrennan (1958:161,162); Belkin and Hogue (1959:432-434); Branch and Seabrook (1959:216); Evans (1962:255); Dodge (1963: 798,811; 1966:375); Ross (1964:104); Porter (1964:222); Forattini (1965:108); Downes (1966:1169-1177); Montchadsky and Garcia Avila (1966:47); Provost and Haeger (1967:565-574); Gentry, Gerberg and Hopkins (1970:68-70); Gorgas Memorial Institute (1970:20); Tempelis and Galindo (1970).

Deinocerites cancer in part of Theobald (1903:276-281; 1905a:35-36; 1905b:37; 1910:553); Dyar and Knab (1906:188); Surcouf and Gonzalez-Rincones (1911:91); Howard, Dyar and Knab (1915:201-205); Bonne and Bonne-Wepster (1925:173-174); Dyar (1928:262-263); Edwards (1932:222); Matheson (1944:250-251); Lane (1953:554-556); van der Kuyp (1953b: 144,146); Carpenter and LaCasse (1955:325-327); Horsfall (1955:599-600); Perez Vigueras (1956:476-483); Forattini (1958:175); Stone, Knight and Starcke (1959:284).

?*Deinocerites cancer* of Martini (1935:57); Vargas (1956:30).

?*Deinocerites cancer* in part of Knab (1907:95-97).

Dinocerites cancer in part of Blanchard (1905:414).

Deinokerides cancer in part of Giles (1902:472-473).

Culex (Deinocerites) cancer of Dyar (1918:102).

Deinocerites tetraspathus of Howard, Dyar and Knab (1915:209-210); Bonne and Bonne-Wepster (1925:175).

Deinocerites melanophylum in part of Dyar (1925:155).

Brachiomyia magna in part of Giles (1902:474).

FEMALE (figs. 1,25,26). Wing 2.88 mm. Proboscis 2.09 mm. Forefemur 1.73 mm. Abdomen about 3.11 mm. Mesonotum dark brown, pleural integument slightly contrasting with mesonotal integument or concolorous. ***Head***: Narrow decumbent scales of vertex creamy to brownish; erect scales brown to dark brown; lateral patch of broad decumbent scales whitish. ***Antenna***: Torus occasionally with 1 scale; variable in length, exceeding proboscis from at least basal half of flagellar segment 9 to apex of segment 8. ***Thorax***: ***Apn*** pale brown to dark brown; ***ppn*** pale brown to dark brown, usually with several scales in middle and lower part; ***ppl*** pale brown to brown, with several bristles and scales; ***psp***, ***ssp***, ***stp*** and ***pra*** brown to dark brown; paratergite brown to dark; ***mep*** brown to dark brown, upper part with several bristles, microsetae absent; metameron simple; meron, metameron and metapleuron very pale brown to medium brown. ***Legs***: Coxal integument very pale brown to medium brown; anterior surface of forecoxa covered with bristles and translucent scales, basolateral area with a few bristles; midcoxa with scales anterolaterally, with 2 rows of bristles laterally, the anterior bristles more irregular in order, the posterior ones stronger, posterolateral surface simple; hindcoxa with scales and several bristles laterally, posterior surface with bristles. ***Haltere***: Stem with dorsoapical part with several bristles.

FEMALE GENITALIA (fig. 26). ***Sternite VIII*** with differentiated marginal bristles largely restricted to sternal margin, at most continued dorsad on one-third of caudolateral border. ***Cercus*** (in lateral aspect) with sternal margin more or less convex but slightly sinuous subapically, tergal margin more or less straight but slightly downturned apically; apex downturned; the 2 specialized setae inserted side by side on apex and subequal in length; tergal and sternal surfaces each with a moderately strong normal bristle, the sternal shorter and closer to apex. Distal part of ***postgenital plate*** (in ventral aspect) with width not more than 1.8 of length, usually with notch as deep as wide; lateral lobe short and more or less rounded (in lateral aspect), its apical bristle subequal to total length of lobe and displaced mesad and proximad of apex, convergent with its mate (in ventral aspect), its small dorsal and subapical bristles appearing almost apical.

MALE (fig. 25,26). Wing 3.34 mm. Proboscis 2.60 mm. Forefemur 2.40 mm. Abdomen (not including genitalia) about 3.0 mm. Flagellar segment 4 with very few scales, segment 13 subequal to 12. Proboscis extending to distal third of flagellar segment 4. Anterior claws of foreleg and midleg similar, with a large subbasal tooth.

MALE GENITALIA (fig. 27). ***Segment IX***: Tergite lobe extending beyond subapical lobe, with the external and internal margins rather evenly curved, distal part very broad. ***Sidepiece***: Subapical lobe without a distinct thumb; seta *c* rather heavy, spiniform and with apex bent and attenuated. ***Phallosome***: Dorsal paramere closely approximated tergally and with a broad dorsal, almost complete bridge; apical spine slender, moderately curved; ventral teeth slender, long and arising from a distinct process from the convex caudolateral border, two or more teeth often with a common base, several additional smaller denticles removed from border. Aedeagus (in tergal aspect) with outer margins sinuous, expanded before middle, constricted near middle and expanded subapically, apex more or less rounded.

PUPA (fig. 27). Abdomen 3.64 mm. Trumpet 0.53 mm. Paddle 0.76 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. Also differing from *melanophylum* in hair 10-C usually being double or triple (1-7) instead of usually with 4-6 branches (2-8). ***Cephalothorax***: Integument yellowish. Hair 1(2,2-3), 2(4,3-5), 3(2), 4(3,2-4), 5(2), 6(1), 7(2), 8(2,2-4), 9(2,1-3), 10 (2), 11(2,1-3), 12(3,2-5). ***Trumpet***: Short, slightly widening apically; index about 4.1-5.1. Integument brown distad, slightly darker on tracheoid; contrasting with cephalothoracic integument. Tracheoid about 0.36 of trumpet length. ***Abdomen***: Integument light to medium brown. Segment I: hair 1(16,12-19), 2(1,1-2), 3(2, 1-2), 4(4,3-5), 5(5,3-7), 6(2,1-2), 7(3,2-4), 9(1,1-3). Segment II: hair 0(1), 1(7, 5-8), 2(1,1-2), 3(1), 4(3,3-5), 5(1,1-2), 6(1), 7(2,1-2), 9(1). Segment III: hair 0 (1), 1(4,3-6), 2(1), 3(2,2-3), 4(2,1-2), 5(1,1-2), 6(1), 7(2,2-3), 8(3,2-5), 9(1), 10 (2,1-3), 11(1), 14(1). Segment IV: hair 0(1), 1(3,2-6), 2(1), 3(6,4-7), 4(1,1-2), 5(1), 6(1), 7(2,1-3), 8(2,1-3), 9(1), 10(2,2-3), 11(1), 14(1). Segment V: hair 0 (1), 1(3,1-3), 2(1), 3(2,1-2), 4(3,3-5), 5(1), 6(1), 7(3,1-4), 8(3,2-4), 9(1), 10(1, 1-2), 11(1), 14(1). Segment VI: hair 0(1), 1(3,2-4), 2(1), 3(2,1-3), 4(2,2-3), 5(1), 6(1), 7(1,1-2), 8(2,2-3), 9(1), 10(2,1-3), 11(1), 14(1). Segment VII: hair 0(1), 1 (1), 2(1), 3(2), 4(2,1-4), 5(2,1-3), 6(1), 7(1), 8(2,2-3), 9(3,2-5), 10(2,1-3), 11(1), 14(1). Segment VIII: hair 0(1), 4(2), 9(1), 14(1). ***Paddle***: Width about 0.71-0.81 of length, apex more or less rounded.

FOURTH INSTAR LARVA (fig. 28). Head 1.16 mm. Siphon 1.25 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens.

Head: Integument yellowish to light brown. Mental plate wider than long, triangular, lateral spicules denticulate, terminal ones sharply pointed, median terminal conspicuously produced. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a minute spicule), 4(4,2-6), 5(4,3-5), 6(1), 7(8,6-8), 8(3,3-4), 9(5,3-6), 10(2,2-3), 11(5,2-5), 12(2,2-4), 13(5,3-6), 14(1), 15(2,1-3). ***Antenna***: Length about 0.41 of head; shaft with a few spicules on proximal part. Hair 1(5,4-6). ***Thorax***: Prothorax: hair 0(8,4-10), 1(1), 2(1), 3(1,1-2), 4(3,2-3), 5(1), 6(1), 7(3,2-3), 8(1), 9(1), 10(1), 11(3,2-5), 12(1), 14(1). Mesothorax: hair 1(1), 2(2,2-3), 3(1), 4(3,2-3), 5(1), 6(1), 7(1), 8(6,5-7), 9(7,5-9), 10(1), 11(3,2-4), 12(1), 13(8,8-12), 14(8,6-10). Metathorax: hair 1(1), 2(3,1-4), 3(4,3-6), 4(4,3-6), 5(1), 6(2,1-2), 7(8,6-9), 8(6,6-8), 9(7,5-9), 10(1), 11(2,2-3), 12(1), 13(4,3-5). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(3,2-3), 4(6,4-8), 5(4,2-4), 6(2), 7(2), 9(2,1-3), 10(2,1-3), 11(2,2-4), 12(2,2-3), 13(2,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(3,2-3), 4(5,4-7), 5(3,2-3), 6(2,2-3), 7(5,4-6), 8(3,2-4), 9(1,1-2), 10(1), 11(3,2-3), 12(3,2-3), 13(8,6-11). Segment III: hair 0(1), 1(3,2-4), 2(1), 3(1,1-2), 4(2,1-4), 5(2,2-3), 6(2), 7(6,4-6), 8(2,1-3), 9(1), 10(1), 11(2,2-3), 12(1), 13(1,1-2), 14(1). Segment IV: hair 0(1), 1(1), 2 (1), 3(3,3-4), 4(1,1-2), 5(2,1-3), 6(2), 7(4,4-7), 8(1), 9(1,1-2), 10(1), 11(2,2-3), 12(2), 13(2), 14(1). Segment V: hair 0(1), 1(1), 2(1), 3(1), 4(5,4-7), 5(2,1-3), 6(2), 7(6,4-6), 8(1), 9(1,1-2), 10(1), 11(1,1-2), 12(2,1-2), 13(2), 14(1). Segment VI: hair 0(1), 1(3,2-3), 2(1), 3(1), 4(3,2-4), 5(2,2-4), 6(1), 7(3,2-4), 8(2,2-4), 9(1), 10(1), 11(2), 12(1,1-2), 13(12,8-14), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,2-4), 4(1), 5(3,2-3), 6(8,6-8), 7(1,1-2), 8(5,4-7), 9(1,1-3), 10(1), 11(1), 12(1), 13(2,1-3), 14(1). ***Segment VIII***: Comb scales slender at base, wider apically, fringe restricted to apex. Hair 0(1), 1(4,3-4), 2(1), 3(4,3-5), 4(1), 5(3,2-3), 14(1,1-2). ***Siphon***: Integument light brown. Index about 4.4-5.7. Pecten teeth 5(5-7), usually bifid, sometimes trifid, longest blade wider; basal tooth shorter, others progressively longer apically. Hair 1(2,2-3), hair 1ad(2), hair 1av(1,1-2), hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Gill about 0.60 of dorsal saddle length. Hair 1-X longer than gill. Hair 1(1), 2(6,5-7), 3(1), 4a(11,11-13), 4b(10,9-11), 4c(9,8-10), 4d(9,8-11), 4e(11,10-13), 4f(11,6-13).

SYSTEMATICS. *Deinocerites cancer* appears to be the dominant and most widespread derivative of the group. It is very similar to *melanophylum*, particularly in the female and larva. However it can usually be separated from *melanophylum* in all stages by the key characters, except as noted under *melanophylum* for some Venezuelan larvae.

I have found no significant differences between the Antillean and Central American populations of *cancer* and I am convinced that only 1 species is involved. Such a pattern of distribution is known for a number of other mosquitoes (Belkin, Heinemann and Page, 1970:9, Middle American element) and suggests that the present large water gaps between these areas are relatively recent (Belkin and Hogue, 1959:430).

BIONOMICS. *Cardisoma guanhumi* appears to be the only species of crab definitely identified as the maker of the burrows utilized by the immature stages of *cancer* (Pratt, Wirth and Denning, 1945:246; Haeger and Phinizee, 1959:34). In Cuba, the immatures of *cancer* have been reported from burrows of *Cardisoma* and unidentified species of stream inhabiting crabs of the genus *Epilobocera* (family Pseudothelphusidae) by Montchadsky and Garcia (1966:47). Belkin, Heinemann and Page (1970:49) state that in Jamaica *cancer* has been collected only in crabholes of medium to large size and never in smaller ones like those made by fiddler crabs. The immature stages of *cancer* have been reported several times from outside their normal breeding sites: from rockholes by Wirth (1945:200) and by Belkin, Heinemann and Page (1970:49); from a treehole by Porter (1964:222); from a tin can (T.E. Duffey record in Carpenter, Middlekauff and Chamberlain, 1946: 277); from a wooden bucket, an abandoned septic tank and a tin can (Porter, 1964:222, records of F.H. Stutz and J.H. Heidt); and from flooded areas with crabholes by several workers.

The normal associates of the immature stages of *cancer* are other normally obligate breeders in crabholes that occur sympatrically: *Culex (C.) janitor* and *Culex (Mel.) carcinophilus* in the West Indies; *D. epitedeus*, *Culex (Tin.) latisquama* and 1 or more species of the *Culex (C.) inflictus* complex in Central America and Panama. Other species occasionally found associated with *cancer* in unusual breeding sites, including shallow or flooded crabholes, are: *Aedes (O.) taeniorhynchus*, *Anopheles (A.) grabhamii*, *Anopheles (Nys.) albimanus*, *Culex (C.) nigripalpus*, *Culex (C.) bahamensis*, *Culex (Mel.) elevator* complex, *Culex (Mel.) opisthopus* and *Psorophora (G.) jamaicensis* in various ground pools (Belkin, Heinemann and Page, 1970:49; Pratt, Wirth and Denning, 1945:246; Wirth, 1945:200); *Aedes (F.) triseriatus* complex and *Culex (C.) nigripalpus* in treeholes or containers (Carpenter, Middlekauff and Chamberlain, 1946:277; Porter: 1964:222).

The bionomics of *cancer* have been studied by Haeger and Phinizee (1959) in an autogenous colony from the Florida Keys and by Gentry, Gerberg and Hopkins (1970) in Baltimore in a colony established from material collected on Grand Cayman Island. According to the latter authors larval development requires 3 to 4 weeks at 27° C while Haeger and Phinizee (1955:35) state that it took about 2 to 3 weeks.

Howard, Dyar and Knab (1915:205) attribute to M. Grabham the statement that *cancer* feeds only at night and is “a voracious bloodsucker”. Hill and Hill (1948:52) dealing with the same topotypic Jamaican population of *cancer* report that: ”while they probably feed on crabs, we have caught them full of blood in animal-baited traps and occasionally they will bite man.” Forattini (1965:108) does not specify the source of his statement that *cancer* attacks animals such as horses and man. Gentry, Gerberg and Hopkins (1970:79) report feeding females on chickens and indicate that although a bared forearm was offered on numerous occasions, bites were experienced only 4 times; no full engorgement was noted either on chicken or human hosts. Haeger and Phinizee (1959:37) found that in their colony females would not feed on man or animals until a batch of autogenous eggs was laid. After that a few would bite man and would also feed to a limited extent on both land crab and salt water blue crab haemolymph to produce a second batch of eggs. Studies on the blood feeding habits of *cancer* in Almirante, Panama, have shown that this population has a definite preference for avian blood (Gorgas Memorial Institute, 1970:20; Tempelis and Galindo, 1970).

The unusual mating behavior of *cancer* has been studied in detail by Downes (1966) and by Provost and Haeger (1967). The males exhibit a so-called “pupal attendance behavior” during which they walk on the surface of the water with the antennae directed down to the surface. When a female pupa is encountered its trumpets are touched by the tips of the antennae and it is seized and held by the claws of the male. Copulation takes place before the female is completely free of the pupal skin. More than 1 male may attempt to copulate with 1 female and some females may emerge unattended but are soon contacted by 1 or more males.

DISTRIBUTION (fig. 5). From Florida and the Bahamas through Cuba and Hispaniola to the Atlantic coast of Central America from the Yucatan Peninsula in Mexico to the Bocas del Toro Province in Panama. Material examined: 5773 specimens; 668 males, 1294 females, 2868 larvae, 943 pupae; 635 individual rearings (250 larval, 333 pupal, 52 incomplete).

BAHAMA ISLANDS. *Abaco*: Marsh Harbor, G.M. Stokes [USNM].

BRITISH HONDURAS. Belize, D.S. Bertram [LOND, UCLA]; [USNM]. Trapp's Key, W.H. Sligh [USNM].

CAYMAN ISLANDS. Grand Cayman (CAY 10A,11A,12,13,19,127) [UCLA].

COSTA RICA. *Limon*: Cahuita (LCBA 233,234,237,238,240-243) [LACM, UCLA].

CUBA. *Guantanamo*: U.S. Naval base, K.L. Knight (461,462) [UCLA, USNM]. *La Habana*: Habana, J.R. Taylor [USNM]. Marianao, H.P. Carr [UCLA, USNM]. *Pinar del Rio*: Mariel, J.R. Taylor [USNM].

DOMINICAN REPUBLIC. *Azua*: Azua, P.A. Ricart [USNM]. *Montecristi*: Montecristi, P.A. Ricart [UCLA, USNM]. *San Pedro de Macoris*: San Pedro de Macoris, P.A. Ricart [USNM]. *Santo Domingo*: Santo Domingo, A. Busck (1136,580113-11); F.E. Campbell (10.1,10.2,10.4) [UCLA, USNM].

FLORIDA. *Beach County*: Boca Raton, Wanamaker [USNM]; [UCLA, USNM]. *Broward County*: Ft. Lauderdale, W.W. Wirth and D.G. Denning [UCLA, USNM]. Hollywood [USNM]. *County not specified*: (1173,1282,1302,1719-8,1946,1990) [USNM]. *Dade County*: Coral Gables [USNM]. Miami, G.F. Moznette [UCLA, USNM]; [USNM]; W.W. Wirth [USNM]. Miami Beach W.W. Wirth [USNM]. *Martin County*: Jupiter Island, Wanamaker [USNM]. *Monroe County*: Key West Banks [USNM]. *St. Lucie County*: Ft. Pierce [USNM]; N.G. Piatte [USNM].

GUATEMALA. *Izabel*: Puerto Matias (GUA 5) [UCLA].

HAITI. *Department not specified*: W.H.W. Komp, leg (No. T.5) [USNM]; S.S. Cook [USNM]. *Ouest*: Gode (HAT 12) [UCLA]. Gressier (HAT 3,4) [UCLA]. Riviere Froide (HAT 1) [UCLA]. *Sud*: Les Cayes (HAT 14) [UCLA].

HONDURAS. Puerto Castilla, R.X. Maxwell (100) [UCLA, USNM]; (HON 8,9) [UCLA]. Puerto Cortes (HON 62,66,69,71-75,77,79,81-84,86,87,89,91) [UCLA]. Tela, W.H.W. Komp [USNM].

JAMAICA. Near the coast all around the island. For specific localities see Belkin, Heinemann and Page (1970:50).

MEXICO. *Cozumel, Isla de*: Espiritu Santo Bay [USNM].

NICARAGUA. *Zelaya*: Bluefields (NI 34,51) [UCLA].

PANAMA. *Bocas del Toro*: Almirante (PA 1033, GML 03690) [UCLA].

SAN ANDRES, ISLA DE (Colombia). (ISA 209,211,214) [UCLA].

9. *Deinocerites melanophylum* Dyar & Knab

Figs. 5,29-31

1907. *Deinocerites cancer melanophylum* Dyar and Knab, 1907b:200. TYPE: Lectotype male, Colon, Panama, A. Busck, 213 [USNM, 10865; designation of Stone and Knight, 1957: 197].

1925. *Deinocerites monospathus* Dyar, 1925:155. TYPE: Holotype female, Fort Sherman, Panama, Canal Zone, 24 April 1925, D. Baker; unique (mounted on same slide with normal female of *melanophylum*) [USNM, 12128]. Synonymy with *melanophylum* by Belkin and Hogue (1959:434).

Deinocerites melanophylum of Busck (1908:60-61); Howard, Dyar and Knab (1915:207-209); Dyar (1923:179); Stone and Knight (1957:197); Belkin and Hogue (1959:434-435); Stone, Knight and Starcke (1959:285); Downes (1966:1173); Gorgas Memorial Institute (1970:20); Tempelis and Galindo (1970).

Deinocerites melanophylum in part of Dyar (1925:155).

?*Deinocerites melanophylum* of van der Kuyp (1953a:38).

?*Deinocerites melanophylum* in part of Bonne and Bonne-Wepster (1925:175); van der Kuyp (1948b:895-897; 1953b:144,146; 1954:39,46,56,57,64,67,71,72,73,76,82,84,86,88,90,95,96, 112).

Culex (Deinocerites) melanophylum of Dyar (1918:102).

Deinocerites monospathus of Dyar (1928:263); Horsfall (1955:599); Stone and Knight (1957: 197).

Deinocerites cancer of Anduze (1941:17); Anduze, Pifano and Vogelsang (1947:16); Arnett (1950:107); Carpenter and Peyton (1952:677,681); Komp (1956:349-351).

Deinocerites cancer in part of Lane (1953:554-556); Carpenter and LaCasse (1955:327); Horsfall (1955:599-600); Forattini (1958:175); Stone, Knight and Starcke (1959:284).

?*Deinocerites pseudes* of Anduze (1941:17); Anduze, Pifano and Vogelsang (1947:16).

FEMALE (fig. 29). Wing 3.01 mm. Proboscis 1.98 mm. Forefemur 1.73 mm. Abdomen about 2.70 mm. Essentially similar to *cancer* except for the antenna exceeding the proboscis from base of antennal flagellar segment 8.

FEMALE GENITALIA (fig. 29). Essentially as in *cancer* except for the following. Distal part of ***postgenital plate*** (in ventral aspect) with width always more than 2.0 of length, notch often poorly differentiated, anterior border with a distinct median cephalic sclerotized projection; lateral lobe poorly differentiated, usually appearing only as a small rounded protuberance.

MALE (fig. 29). Wing 3.0 mm. Proboscis 2.39 mm. Forefemur 1.63 mm. Abdomen (not including genitalia) about 2.35 mm. Flagellar segment 4 with several scales, segment 13 slightly longer than 12. Proboscis extending to distal one-third of flagellar segment 4. Anterior claw of foreleg with a small subbasal tooth, that of midleg with a longer and heavier tooth.

MALE GENITALIA (fig. 30). ***Segment IX***: Tergite lobe essentially as in *cancer* except not quite as broad apically and with more sinuous margins. ***Sidepiece***: Essentially as in *cancer* except that seta ***c*** usually less attenuated apically. ***Phallosome***: Dorsal parameres widely separated in tergal aspect and with a long narrow incomplete dorsal bridge; apical spine long, slender and strongly curved; ventral teeth short and heavy to minute and in several rows, directed parallel to convex margin so that they appear appressed to body of paramere. Aedeagus in tergal aspect expanded before middle, constricted near middle then expanded subapically; apex blunt.

PUPA (fig. 30). Abdomen 3.34 mm. Trumpet 0.45 mm. Paddle 0.68 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. ***Cephalothorax***: Integument yellowish to medium brown. Hair 1(2,2-5), 2(4,3-5), 3(2,2-3), 4(4,3-5), 5(2), 6(1), 7(2,1-2), 8(3,1-6), 9(2,1-3), 10(6,4-7), 11(3,2-5), 12 (2,2-4). ***Trumpet***: Short, slightly widening apically; index about 3.4-4.3. Integument brown distad, slightly darker on tracheoid; contrasting with cephalothoracic integument. Tracheoid about 0.38 of trumpet length. ***Abdomen***: Integument light to medium brown. Segment I: hair 1(16,12-23, primary branches), 2(1), 3(2,1-3), 4(3,3-5), 5(3,3-7), 6(1), 7(3,2-4), 9(1). Segment II: hair 0(1), 1(11-17), 2(2,1-3), 3(1), 4(4,1-6), 5(1,1-4), 6(1), 7(2,1-3), 9(1). Segment III: hair 0(1), 1(6,3-7), 2 (1), 3(4,1-7), 4(1,1-2), 5(1), 6(1), 7(2,1-4), 8(2,1-5), 9(1), 10(2,1-2), 11(1), 14 (1). Segment IV: hair 0(1), 1(3,2-5), 2(1), 3(6,3-7), 4(1), 5(1), 6(1), 7(2,1-3), 8 (1,1-2), 9(1), 10(2,1-3), 11(1), 14(1). Segment V: hair 0(1), 1(2,1-4), 2(1), 3(2, 2-3), 4(3,2-6), 5(1), 6(1), 7(4,2-5), 8(2,1-2), 9(1), 10(1,1-2), 11(1), 14(1). Segment VI: hair 0(1), 1(2,1-3), 2(1), 3(2,1-3), 4(4,3-5), 5(1), 6(1), 7(1,1-2), 8(2, 1-3), 9(1), 10(2,1-2), 11(1), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2,1-2), 5(1,1-3), 6(1,1-3), 7(1), 8(2,1-3), 9(4,3-6), 10(2,1-2), 11(1), 14(1). Segment VIII: hair 0(1), 4(2,1-3), 9(1), 14(1). ***Paddle***: Width about 0.70 of length; apex more or less rounded.

FOURTH INSTAR LARVA (fig. 31). Head 1.16 mm. Siphon 1.31 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens. ***Head***: Integument yellowish to light brown. Mental plate wider than long; shape of spicules variable, apex either simple or denticulate. Hair 0(1), 1(1), 2(1), 3 (sometimes developed as a spicule), 4(7,6-8), 5(5,4-6), 6(1), 7(10,8-12), 8(4,3-4), 9(4,4-5), 10(3,2-5), 11(5,3-6), 12(3,2-3), 13(4,3-6), 14(1), 15(3,2-4). ***Antenna***: Length about 0.43 of head; shaft with several spicules on proximal part; hair 1 (6,4-9). ***Thorax***: Prothorax: hair 0(9,7-12), 1(1), 2(1), 3(2,2-3), 4(4,3-5), 5(1), 6 (1), 7(4,2-5), 8(1,1-2), 9(1), 10(1), 11(3,3-4), 12(1), 14(1). Mesothorax: hair 1 (1), 2(3,2-4), 3(1), 4(2,2-3), 5(1), 6(1), 7(1), 8(7,4-8), 9(6,5-8), 10(1), 11(3,2-3), 12(1), 13(?), 14(10,8-12). Metathorax: hair 1(1), 2(4,3-6), 3(6,4-7), 4(5,3-5), 5 (1), 6(1), 7(9,8-10), 8(7-10), 9(6-10), 10(1), 11(4), 12(1), 13(6,5-7). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(3,2-4), 4(9,7-11), 5(3,2-4), 6(2), 7(2,1-3), 9(4,3-4), 10(2,2-3), 11(3,2-6), 12(3,2-4), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(3,2-4), 4(7,6-9), 5(4,2-5), 6(2,2-3), 7(4,4-7), 8(3,2-4), 9(1), 10(1), 11(2,2-3), 12(3,2-3), 13(7,7-12). Segment III: hair 0(1), 1(3,1-3), 2(1,1-2), 3(1,1-2), 4(2,1-3), 5(3,2-4), 6(2), 7(6,6-8), 8(2,2-3), 9(1), 10(1,1-2), 11(2,1-3), 12(3,2-3), 13(1), 14(1). Segment IV: hair 0(1), 1(2,1-2), 2(1), 3(4,3-5), 4(2,1-3), 5(3,2-4), 6(2), 7(6,6-8), 8(1), 9(1), 10(1), 11(2,2-3), 12(2,1-2), 13(2), 14(1). Segment V: hair 0(1), 1(2, 1-2), 2(1), 3(1), 4(7,5-9), 5(3,3-5), 6(2), 7(8,7-9), 8(1,1-2), 9(1), 10(1), 11(2), 12(1,1-2), 13(2,2-3), 14(1). Segment VI: hair 0(1), 1(4,3-5), 2(1), 3(1), 4(3,2-4), 5(5,4-5), 6(1), 7(4,3-5), 8(3,2-3), 9(1), 10(1,1-2), 11(2,2-3), 12(1), 13(13-17), 14 (1). Segment VII: hair 0(1), 1(1), 2(1), 3(5,4-5), 4(1), 5(2,2-3), 6(10,9-12), 7(1, 1-2), 8(5,4-6), 9(4,2-4), 10(1), 11(1), 12(1), 13(2,2-4), 14(1). ***Segment VIII***: Comb scales slender, slightly wider near middle, fringe conspicuous at apex, less developed in distal half. Hair 0(1), 1(4,3-5), 2(1), 3(4,4-5), 4(1), 5(3,3-4), 14(1). ***Siphon***: Integument light brown. Index about 5.3-6.5. Pecten teeth 6(5-8), usually bifid, occasionally trifid, blades slender, size variable throughout. Hair 1(3,2-4), hair 1ad(2,2-3), hair 1av(2,2-3); hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Gill about 0.45 of dorsal saddle length. Hair 1-X longer than gill. Hair 1(2,1-2), 2(9, 6-11), 3(1), 4a(11,11-14), 4b(10,10-12), 4c(10,10-12), 4d(12,11-12), 4e(10,11-13), 4f(11,10-11).

SYSTEMATICS. *Deinocerites melanophylum* is very similar to *cancer* in all stages but it can usually be separated from it by the key characters. In some larvae from Venezuela (VZ 216-218,257) the diagnostic features of *melanophylum* break down.

The interpretation that *melanophylum* is distinct from *cancer* is supported by the difference in blood hosts found in recent investigations in Panama (see bionomics). The preference for reptilian hosts by *melanophylum* suggests also that this species is the earlier derivative of the complex.

It is not known at present if *melanophylum* comes in contact with *cancer* in Panama and with *magnus* in Venezuela, as no collections of *Deinocerites* have been made in these relatively wide gaps (particularly in Venezuela).

BIONOMICS. Komp's (1957:350) record of the immature stages of *melanophylum* (as *cancer*) from the burrows of a large land crab, probably *Cardisoma guanhumi*, on the right bank of the lower Chagres River in the Canal Zone is the only more or less definite association of this mosquito with a specific crab. Elsewhere *melanophylum* has usually been found in large crabholes except in Venezuela where it has been collected also in small crabholes.

In Panama, *melanophylum* has been found associated with *panamensis* and with a member of the *Culex (C.) inflictus* complex; in Colombia, with *colombianus*; and in Venezuela, with *atlanticus* and a member of the *Culex (C.) inflictus* complex.

Busck (1908:61) reported this species not to bite man in the Canal Zone but Carpenter and Peyton (1952:677) report occasional specimens (as *cancer*) taken in horse-baited traps in this area. Recent studies at the Gorgas Memorial Laboratory indicate that *melanophylum* has a marked preference for reptilian blood in Panama (Gorgas Memorial Institute, 1970:20; Tempelis and Galindo, 1970).

According to Busck (1908:61), *melanophylum* (as *cancer*) adults come out at dusk "and swarm above the hole for copulation". However, it seems very likely that this species exhibits the same pupal attendance and mating behavior as its very close relative, *cancer*, as suggested by the observations of Komp (1957:350) who noted several pairs of newly emerged adults copulating in the container in which he had placed several pupae (and larvae) the night before.

DISTRIBUTION (fig. 5). Atlantic coast from Canal Zone to state of Aragua in Venezuela. Two records of *melanophylum* in Belkin and Hogue (1959:434) are probably erroneous. The specimen from Bocas del Toro is probably from Panama and not Colombia and in that case should be *cancer*; however this cannot be determined because of its poor condition. The record from Maracay, which was interpreted as indicating the presence of this species in Lago Valencia, has not been confirmed in extensive recent search and is probably based on mislabelled material. Material examined: 1045 specimens; 170 males, 195 females, 522 larvae, 158 pupae; 139 individual rearings (110 larval, 19 pupal, 10 incomplete).

COLOMBIA. *Antioquia*: Atrato River delta (COA 30) [UCLA]. Turbo (COA 34-41) [UCLA].

PANAMA AND CANAL ZONE. *Canal Zone*: Cristobal [UCLA]. Ft. Randolph, J. Zetek; D. Baker [USNM]. Ft. Sherman, various collectors [UCLA, USNM]. France Field, J. Zetek [USNM]; W.P. Murdoch [UCLA]. Locality not specified, A.H. Jennings (248,352) [USNM]; W.H.W. Komp [UCLA]. Margarita, J.B. Shropshire [USNM]. Mt. Hope, S.J. Carpenter [UCLA]. Toro Pt., J.B. Shropshire [USNM]. *Colon*: Calderas Island, Portobelo Bay, A.H. Jennings [USNM]. Colon, A. Busck [USNM]; (PA 1012,1014-1016,1029,1032) [UCLA]. *San Blas*: Cuadi River, B.F. Eldridge [USNM].

VENEZUELA. *Aragua*: Cuyagua (VZ 414,415) [UCLA]. Maracay (locality questionable), M. Nunez-Tovar [USNM]. Ocumare de la Costa, M. Nunez-Tovar [USNM]; (VZ 134,170,173,174, 346,351,363,364,386) [UCLA]. Puerto Colombia (VZ 214,216-218) [UCLA]. Turiamo, W.H.W. Komp (32-19,22); E.B. Winston [UCLA]. *Carabobo*: Moron (VZ 256,257) [UCLA]. Puerto Cabello (VZ 260) [UCLA].

10. *Deinocerites magnus* (Theobald)

Figs. 5,32-34

1901. *Brachiomyia magna* Theobald, 1901:344-345. TYPE: Holotype male (described as female), St. Lucia, Low, per Daniels [BM; specimen presumably lost, see Belkin, 1968: 22].

1909. *Deinocerites troglodytus* Dyar and Knab, 1909:260. TYPE: Lectotype female, Trinidad, W.I., June, A. Busck [USNM, 12128; designation of Stone and Knight, 1957: 197]. Synonymy with *magnus* by Belkin and Hogue (1959:431).

Deinocerites magnus of Belkin and Hogue (1959:431); Stone, Knight and Starcke (1959:285); Fauran (1961:44,45); Downes (1966:1173); Fleming and Walsh (1966:425,426); Porter (1967:

39,40); Aitken, Spence, Jonkers and Downs (1969:210).

Deinocerites magna of Theobald (1905:37).

Brachiomyia magna in part of Giles (1902:474).

Deinocerites cancer of Aiken and Rowland (1906:37); Aiken (1907:76; 1909:25); Root (1922:405); Senevet (1936:133,134; 1938:189); Cerqueira (1938:289-291); Pritchard and Pratt (1944:233); Weatherbee (1944:645); Floch and Abonnenc (1947:12); van der Kuyp (1948a:748, 749; 1953:144,146); Pratt and Seabrook (1952:27); Fox (1953:179); Fox and Maldonado-Capriles (1953:165); Maldonado-Capriles, Pippin and Kuns (1958:68).

Deinocerites cancer in part of Theobald (1903:276-281; 1905a:35-36; 1910:553); Surcouf and Gonzalez-Rincones (1911:91); Howard, Dyar and Knab (1915:201-205); Bonne and Bonne-Wepster (1925:173-174); Dyar (1928:262-263); Edwards (1932:222); Matheson (1944:250-251); Lane (1953:554-556); van der Kuyp (1953b:144,146; 1954:39,46,56,57,64,65,67,71, 72,73,76,82,84,86,88,90,95,96,112); Carpenter and LaCasse (1955:325-327); Horsfall (1955:599-600); Perez Vigueras (1956:476); Forattini (1958:175); Stone, Knight and Starcke (1959:284); Porter (1967:39,40).

Deinokerides cancer in part of Giles (1902:472-473).

Dinocerites cancer in part of Blanchard (1905:414).

Deinocerites troglodytus of Howard, Dyar and Knab (1915:206,207); Urich (1917:525-530); Bonne-Wepster and Bonne (1923:124); Bonne and Bonne-Wepster (1925:171-173); Floch and Abonnenc (1945:38,39,40); Stone and Knight (1957:197).

Culex (Deinocerites) troglodytus of Dyar (1918:101).

FEMALE (fig. 32). Wing 2.78 mm. Proboscis 2.04 mm. Forefemur 1.68 mm. Abdomen about 2.55 mm. Mesonotum dark; pleural integument usually whitish, distinctly contrasting with mesonotal integument. ***Head***: Narrow decumbent scales of vertex creamy; erect scales yellowish to brownish; broad decumbent scales in lateral patch whitish. ***Antenna***: Torus occasionally with 1 scale; exceeding proboscis from apex of flagellar segment 8. ***Thorax***: ***Apn*** whitish (pale); ***ppn*** whitish, with a few scales in middle; ***ppl*** whitish, with bristles and sometimes a few scales; ***psp***, ***ssp***, ***stp*** and ***pra*** usually slightly darker than rest of pleuron; paratergite light brown; ***mep*** whitish, upper part with several bristles, microsetae absent; metameron simple; meron, metameron and metapleuron whitish. ***Legs***: Coxal integument whitish; scaling and bristles as in *cancer*.

FEMALE GENITALIA (fig. 32). ***Sternite VIII*** with strong marginal bristles continued about halfway dorsad on caudolateral border. ***Cercus*** with sternal margin convex, tergal margin more or less concave; apex slightly upturned; the 2 specialized cercal bristles not inserted side by side, 1 distinctly apical and shorter; tergal and sternal surfaces each with a moderately strong normal bristle, tergal more apical. Distal part of ***postgenital plate*** (in ventral aspect) deeply notched; lateral lobe elongate (in lateral aspect), its apical bristle markedly longer than total length of lobe, parallel not convergent with its mate (in ventral aspect), not markedly displaced from apex of lobe.

MALE (fig. 32). Wing 2.78 mm. Proboscis 2.19 mm. Forefemur 2.18 mm. Abdomen (not including genitalia) about 2.60 mm. Flagellar segment 13 slightly shorter than 12. Proboscis extending to base of flagellar segment 5. Both claws of foreleg with a heavy almost basal tooth; anterior claw of midleg with a nearly basal tooth.

MALE GENITALIA (fig. 33). ***Segment IX***: Tergite lobe barely reaching base of subapical lobe, very broad and with sinuous external and internal margins. ***Sidepiece***: Subapical lobe with a distinct thumb; seta *c* spiniform, apex not markedly attenuated. ***Phallosome***: Dorsal parameres closely approximated in tergal aspect, with a broad, short dorsal bridge; apical spine heavy, long and only slightly curved; ventral teeth few in number, short, heavy, and arising in a single row along the truncate lateral border. Aedeagus in tergal view slender, expanded in basal third then narrowing apically; apex rounded.

PUPA (fig. 33). Abdomen 3.46 mm. Trumpet 0.48 mm. Paddle 0.73 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. ***Cephalothorax***: Integument yellowish to medium brown. Hair 1(2,2-3), 2(3,2-4), 3(2,1-3), 4(4,2-6), 5(2,2-4), 6(1), 7(3,2-5), 8(3,2-5), 9(3,2-3), 10(4-5,3-5), 11(3, 3-4), 12(3,2-5). ***Trumpet***: Short, slightly widening apically, index about 4.4-5.2. Integument brown distad, slightly darker on tracheoid. Tracheoid about 0.33 of trumpet length. ***Abdomen***: Integument medium brown. Segment I: hair 1(20,11-30 primary branches), 2(1), 3(2), 4(3,2-4), 5(5,4-6), 6(1), 7(4,2-4), 9(1). Segment II: hair 0(1), 1(10,6-12), 2(2,2-3), 3(1), 4(5,4-6), 5(1,1-2), 6(1), 7(2,2-3), 9(1). Segment III: hair 0(1), 1(4,2-6), 2(1), 3(3,1-3), 4(2,2-3), 5(2,1-2), 6(1), 7(4,2-5), 8(3,2-6), 9(1), 10(2,2-3), 11(1), 14(1). Segment IV: hair 0(1), 1(2,2-4), 2(1), 3 (4,3-6), 4(1), 5(1), 6(1), 7(2,2-3), 8(2,1-2), 9(1), 10(3,2-4), 11(1), 14(1). Segment V: hair 0(1), 1(2,2-3), 2(1), 3(2,2-4), 4(5,2-5), 5(1), 6(1), 7(4,3-5), 8(2,2-4), 9 (1), 10(2,1-3), 11(1), 14(1). Segment VI: hair 0(1), 1(2,2-3), 2(1), 3(2,2-3), 4(4, 2-5), 5(1), 6(1,1-2), 7(2,1-3), 8(2,1-3), 9(1), 10(2,2-3), 11(1), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2), 5(2,1-3), 6(1,1-2), 7(1), 8(2,1-2), 9(3,2-4), 10(2,1-2), 11(1), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1,1-2). ***Paddle***: Width about 0.61 of length; apex slightly produced.

FOURTH INSTAR LARVA (fig. 34). Head 1.14 mm. Siphon 1.11 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens. Hairs 2-C often closer to each other on midline than they are to 1-C as opposed to *cancer* and *melanophylum* in which hairs 2-C are closer to 1-C than they are to each other. ***Head***: Integument yellowish to light brown. Mental plate distinctly wider than long, triangular, at least all distal spicules sharply pointed; median terminal spicule slightly produced or about level with others. Hair 0(1), 1(1), 2 (1), 3(sometimes developed as a minute spicule), 4(5,3-6), 5(4,3-4), 6(1), 7(8,8-10), 8(3,3-4), 9(5,4-5), 10(3,2-3), 11(5,3-5), 12(2,2-3), 13(5,5-6), 14(1), 15(3,1-3). ***Antenna***: Length about 0.41 of head; shaft with several spicules on proximal part. Hair 1(5,4-6). ***Thorax***: Prothorax: hair 0(7,6-9), 1(1), 2(1), 3(2), 4(5,4-5), 5(1), 6(1), 7(3,2-4), 8(2,1-3), 9(1), 10(1), 11(4,3-5), 12(1), 14(1). Mesothorax: hair 1(1), 2(4,2-4), 3(1), 4(3,2-4), 5(1), 6(1), 7(1), 8(6,5-9), 9(7,6-9), 10(1), 11 (2,1-3), 12(1), 13(8,8-12), 14(12,10-13). Metathorax: hair 1(1,1-2), 2(4,2-4), 3(5, 5-6), 4(3,3-5), 5(1), 6(1), 7(8,8-13), 8(7,4-9), 9(8,7-15), 10(1), 11(3,2-3), 12(2, 1-3), 13(5,4-6). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(8,7-12), 5(5, 5-7), 6(2,2-4), 7(2), 9(3,2-5), 10(3,2-4), 11(3,2-4), 12(2,2-3), 13(2,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(3,2-5), 4(5,3-6), 5(3,2-4), 6(2,2-3), 7(3,2-5), 8(2,2-4), 9(1), 10(1,1-2), 11(2,2-3), 12(3,2-4), 13(8,6-10). Segment III: hair 0(1), 1(2,2-3), 2(1), 3(1,1-2), 4(2,2-3), 5(2,2-3), 6(2,2-3), 7(4,3-6), 8(2,2-4), 9(1,1-2), 10(2,2-3), 11(2,2-3), 12(2,2-3), 13(1), 14(1). Segment IV: hair 0(1), 1(2,1-2), 2(1), 3(3,2-4), 4(1,1-2), 5(3,2-4), 6(2,2-3), 7(6,3-6), 8(1,1-2), 9(1), 10(2,2-3), 11(2,1-2), 12 (2,2-3), 13(2), 14(1). Segment V: hair 0(1), 1(2,1-2), 2(1), 3(6,3-7), 4(1), 5(2, 2-3), 6(2), 7(5,5-7), 8(1,1-2), 9(1), 10(1), 11(1,1-2), 12(2), 13(2,2-3), 14(1). Segment VI: hair 0(1), 1(4,2-5), 2(1), 3(1), 4(3,3-5), 5(3,2-4), 6(1,1-2), 7(3,2-4), 8 (3,2-4), 9(1), 10(1), 11(2,2-3), 12(1), 13(12,9-13), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(3,2-4), 4(1), 5(3,2-4), 6(8,7-11), 7(1,1-2), 8(4,4-8), 9(3,2-3), 10(1), 11(1,1-2), 12(1), 13(2,1-2), 14(1). ***Segment VIII***: Comb scales slender, wider apically; fringe conspicuous at apex; less developed in distal half. Hair 0(1), 1(4,3-4), 2(1), 3(4,3-5), 4(1), 5(3,2-3), 14(2,1-2). ***Siphon***: Integument light brown. Index about 3.8-5.1. Pecten teeth 6(5-7), usually bifid, sometimes trifid, both blades slender, basal shorter, rest variable in size. Hair 1(3), hair 1ad(2,2-3), hair 1av(2,2-3); hairs 2,6,7,8 and 9 all single. ***Anal Segment***: Gill about 0.5 of dorsal saddle length. Hair 1-X longer than gill. Hair 1(1,1-2), 2(8,6-9), 3(1), 4a(12,11-13), 4b(11,9-12), 4c(9,8-11), 4d(9,7-10), 4e(9,8-10), 4f(9,7-12), 4g(12,11-12).

SYSTEMATICS. *Deinocerites magnus* is clearly differentiated from the *cancer-melanophylum* complex and is probably an earlier offshoot from the original stock of the Cancer Group as shown by the absence of the conspicuous derived features in the adults (increased antennal length) and the larva (reduced ventral brush) found in *cancer* and *melanophylum*.

In spite of the extensive fragmentation of *magnus* into insular populations over much of its range no significant differentiation has occurred. All the populations I have examined conform to the diagnostic features given above and no significant variation has been noted.

I have not seen the material reported as *cancer* from the state of Maranhao by Cerqueira (1938:289-291) but judging by his figures it can be unquestionable referred to *magnus*.

BIONOMICS. There is no published record of a specific identification of a crab with which *magnus* may be associated but its immature stages have usually been found in large crabholes and only occasionally in smaller ones. In addition to these normal breeding sites, *magnus* has been reported from a beach pool in Sint Maarten (van der Kuyp, 1948a:748, as *cancer*) and has been taken recently in ground pools (flooded crabhole areas) in Trinidad and Grenada.

As in the case of other members of the group, the reports on the blood feeding habits of the females are conflicting. Theobald (1903:279, as *cancer*) quotes a report from Dr. Low that the latter could not induce this species to bite on Barbados and never saw any traces of blood in the stomachs of specimens from St. Vincent. In Trinidad, Urich (1913:527, as *troglodytus*) found the species to be a timid biter in the field and to rarely enter houses to feed. In recent years females have been caught in Trinidad no. 10 traps baited with mice in Trinidad (once) and baited with chicks in Antigua, Dominica, St. Lucia and Trinidad. Females were also collected biting man in the evening in St. Vincent. In Surinam, Bonne and Bonne-Wepster (1925:175, as *troglodytus*) captured females indoors and reported their bite as painful and giving "a peculiar sensation different from one of the ordinary house mosquitoes in Surinam". Floch and Abonnenc (1947: 11, as *cancer*) report a female biting man in French Guiana.

Busck (reported in Howard, Dyar and Knab, 1915:207) observed this species to swarm at dawn and evening and "frequently noted copulation at such times." This appears to be the only information available on the mating habits of *magnus*.

Over much of its range *magnus* appears to be the only normal obligate crabhole breeder, its various known associates being largely encountered in marginal environments. It has been found with *Aedes (O.) taeniorhynchus* in Anguilla and Antigua; with *Culex (C.) habilitator* in Montserrat and Nevis; with *Culex (C.) inflictus* Theobald, 1901 in Dominica and Trinidad; with species of *Culex (C.)* and *Culex (Mel.)* in Dominica; and with a member of the *Aedes (O.) scapularis* complex in Trinidad.

DISTRIBUTION (fig. 5). From Mona Island and Puerto Rico eastward and southward throughout the Lesser Antilles, Trinidad and Tobago, the Guianas and the state of Maranhao in Brazil. Material examined: 2138 specimens; 250 males, 1027 females, 627 larvae, 234 pupae; 151 individual rearings (97 larval, 33 pupal, 21 incomplete).

BARBADOS. Bridgetown (BAR 3,5,8) [UCLA]. Gracine Hall swamp (BAR 25) [UCLA]. Locality not specified, A. Busck [USNM].

BRITISH VIRGIN ISLANDS. *Tortola*: Road Harbor, F.M. Root (LAR 5) [USNM]. *Virgin Gorda*: Locality not specified, F.M. Root (LAR 8,8A) [USNM].

DOMINICA. Cabrit swamp, W.W. Wirth [USNM]; (DOM 76,94,99,100,155,156,165) [UCLA]. Layou, W.W. Wirth; D.F. Bray [USNM]; (DOM 76) [UCLA]. Macoucheri, W.W. Wirth [USNM]. Portsmouth, D.F. Bray [USNM]; F.M. Root (LAR 19a) [USNM].

FRENCH GUIANA. Stoupan (FG 58B) [UCLA].

GRENADA. Pt. Saline (GR 5,6,8) [UCLA].

GRENADINES. *Canouan*, F.M. Root (LAR 33e). *Carriacou*, F.M. Root (LAR 36b-2). *Little Martinique*, F.M. Root (LAR 35). *Little St. Vincent*, F.M. Root (LAR 35b). *Mustique*, F.M. Root (LAR 33d). *Saline*, F.M. Root (LAR 37,37A) [USNM].

GUADELOUPE. *Desirade*: Baie Mahault (FWI 218). Leproserie (FWI 220) [UCLA]. *Island not specified*: A. Busck [USNM]. *Grande Terre*: Port-Louis (FWI 199,200) [UCLA]. *Marie Galante*: Grand Bourg (FWI 232). Grande Anse (FWI 224) [UCLA].

GUYANA. New Amsterdam (GUY 18) [UCLA].

LEEWARD ISLANDS. *Anguilla*: Little Harbour (ANG 12,13) [UCLA]. *Antigua*: Ballast Bay (ANT 99,100) [UCLA]. Bethesda (ANT 20,22) [UCLA]. Bolands (ANT 4) [UCLA]. English Harbour, J.F.G. Clark; R.H. Darsie [USNM]. Fitches Creek (ANT 87,88) [UCLA]. St. Johnston (ANT 56) [UCLA]. *Barbuda*: Codrington (BAB 2,4) [UCLA]. *Montserrat*: Fox's Bay (MNT 44,45,57,83,87,90) [UCLA]. Iles Bay Estate (MNT 16) [UCLA]. Old Road Estate (MNT 53) [UCLA]. *Nevis*: Charlestown, F.M. Root (LAR 13,14a) [USNM]; between Ft. Charles and Pinney's Estate (NEV 3,32,34,49,60) [UCLA]. *St. Kitts*: Frigate Bay Estate (KIT 36,40,41) [UCLA].

MARTINIQUE. Locality not specified, A. Busck; F.M. Root (LAR 28A) [UCLA, USNM].

NETHERLANDS WEST INDIES. *Sint Maarten*: Philipsburg, E. van der Kuyp [USNM].

PUERTO RICO. *Mona*: W.F. Pippin [USNM]. *Puerto Rico*: Catano, H.D. Pratt [USNM]; T.H.G. Aitken [UCLA]. Central Aguire, G.S. Tulloch [USNM]. Dorado, G.S. Tulloch [USNM]. Ft. Buchanan, H.D. Pratt [USNM]. Isla Verde [UCLA]. Mayaguez, G.S. Tulloch [USNM]. Playa de Humacao (PR 23-26) [UCLA]. Roosevelt Roads NS, H.C. Hurt [UCLA, USNM]. San Juan, H.D. Pratt [USNM].

ST. LUCIA. Choc swamp (LU 48,49,51,54,153,155) [UCLA]. Cul de Sac Estate (LU 129) [UCLA]. Marigot Harbour, R.H. Darsie [USNM]. Port Volet swamp (LU 107,117) [UCLA]. Reduit swamp (LU 76) [UCLA]. Roseau Sugar Estate (LU 24,25,27) [UCLA]. Vieux Fort (LU 95) [UCLA].

ST. VINCENT. Kingstown, F.M. Root (LAR 29B) [USNM]. Young's Island (VT 73) [UCLA].

TRINIDAD AND TOBAGO. *Tobago*: Bon Accord Estate (TOB 12,20) [UCLA]. Crown Pt. (Brown's), R.H. Darsie [USNM]. *Trinidad*: Chaguanas (TR 769) [UCLA]. Chaguaramas (U.S. Naval Base), J. Leacock; K.L. Knight [USNM]. Guayaguayare (TR 794,800) [UCLA]. Locality not specified, A. Busck; F. Urich [USNM]. Matelot (TR 185) [UCLA]. Monos Island (TR 592) [UCLA]. Nariva Swamp, T.H.G. Aitken [UCLA]. Port of Spain, F.M. Root (LAR 54) [USNM]. San Souci (TR 156) [UCLA].

VIRGIN ISLANDS. *St. Croix*: Locality not specified, M.A. Beatty [UCLA, USNM]. *St. John*: Caneel Bay, T.H.G. Aitken [UCLA]. *St. Thomas*: Charlotte Amalie (VI 21-23,25,26,29) [UCLA]. Locality not specified, C. Cregue [USNM].

EPITEDEUS GROUP

FEMALES. Medium-sized species, wing 2.83-3.98 mm. Mesonotum dark brown, pleuron usually tan and not strongly contrasting with mesonotal integument. ***Antenna***: Flagellar segment 1 with numerous scales, about equal to combined length of segment 2 and about one-half of 3; segment 2 with a few scales; segments

1-4 greatly elongated; segments 5-12 subequal in length but progressively slightly shortened distad; extremely long, exceeding proboscis from at least distal third of flagellar segment 5. ***Thorax***: Postnotum with or without bristles on lower part. ***Apn*** usually tan; ***ppn*** usually tan or slightly paler, scales broad on caudoventral area; ***ppl*** tan; ***psp***, ***ssp***, ***stp*** and ***pra*** tan or brownish; paratergite tan or brownish; ***mep*** usually tan and with a patch of or almost completely covered with translucent scales, ***lmep*** without bristle; meron, metameron and metapleuron usually dark tan. ***Legs***: Coxal integument usually tan. Forefemur completely dark, basal two-thirds of posteroventral surface of midfemur often pale, basal half of anteroventral and posteroventral surfaces of hindfemur slightly paler; anteroventral margin of forefemur with a row of spiniforms or bristles, posterodorsal margin with a row of weak bristles. ***Abdomen***: Sternites II-VII lighter than tergites.

FEMALE GENITALIA. ***Sternite VIII*** with sclerotized distal band broad and with several scales; caudal margin not produced into a submedian ventral angle, this area without strongly differentiated marginal bristles. ***Tergite IX*** with 1 to several setae on each side. ***Tergite X*** poorly differentiated dorsally, laterally with a very small indistinct sclerotization. ***Cercus*** with a few moderately strong apical or subapical normal bristles or with 5 or 6 apical and subapical specialized setae with twisted apex.

MALES. Essentially similar to females. ***Antenna***: Exceeding proboscis from apical third of flagellar segment 4; flagellar segments 1-4 with scales; segments 1-6 markedly elongated but progressively shorter distad; segment 1 about equal to combined length of segment 2 and one-third of 3; segments 7-13 subequal but progressively slightly shortened distad; segment 13 slightly expanded subapically. ***Legs***: Claws of foreleg markedly enlarged, anterior slightly larger and with a variable submedian tooth, posterior simple or with a very small denticle; claws of midleg not markedly enlarged and very similar in shape, anterior slightly larger and either simple or with a small submedian tooth or denticle, posterior simple.

MALE GENITALIA. ***Segment IX***: Tergite lobe cylindrical; angled at base; distal part variously shaped; apex sometimes reaching base of subapical lobe. ***Sidepiece***: Without scales. Apicosternal lobe prominent, with a long apical seta. ***Phallosome***: Dorsal parameres widely separated but always with an indication of an incomplete dorsal bridge; articulated ventrally with a dorsal sclerotized projection from basal third of aedeagus.

PUPAE. ***Cephalothorax***: Hairs 2,3-C not closely approximated, 2-C as strongly developed and as long as or longer than 3-C; hair 5-C single, moderately long, at most equal in length to distance from its alveolus to base of trumpet and to length of trumpet; 7-C usually single or double (1-4); hair 8-C usually triple (2-5). ***Metanotum***: Hair 10-C strongly developed, always longer than 11-C, single or double. ***Abdomen***: Hair 1-II long, exceeding apex of tergite III, usually double or triple (1-3), simple; 1-III-VI usually forked (except in *colombianus*); 5-II always mesad and cephalad of 3-II; hair 3-V usually single or double (1-3); hair 1-VII shorter than tergite VIII, at most reaching alveolus of hair 4-VIII. ***Paddle***: Hair 1-P longer than paddle.

FOURTH INSTAR LARVAE. ***Head***: Hair 2-C short, inconspicuous, about 0.25-0.33 of 1-C, always mesad of 1-C; hair 5-C usually double, rarely triple (1-3), with a few very inconspicuous barbs; 6-C single and usually simple, barbs at most few and inconspicuous, length about 1.5 of 5-C. ***Thorax***: Prothoracic hair 9-P double or triple. ***Abdomen***: Hair 6-II double; dorsal sensillum of segment V mesad of 4-V; hair 6-VI single; 1-VII very long, always longer then 3-VII and exceeding base of siphon; 1-VIII usually with 3 or 4 branches (2-4). ***Siphon***: Hair 1-S usually double (1 or 2). ***Anal Segment***: Ventral brush (4-X) with 6 or 7 pairs of hairs. Gill slightly emarginate on ventral margin; long, from 0.5-1.0 of dorsal saddle length. Dorsal saddle at least moderately broad, its ventral margin sometimes reaching alveolus of hair 1-X.

DISCUSSION. This group shows more unique derived characters than any other. The adults share with the Pseudes Group the presence of mesepimeral scales but are unique in the loss of the lower mesepimeral bristle. In the pupae, the hairs are more strongly developed than in the other groups and abdominal hair 1-II is rather long and double or triple instead of being multibranched as in the Spanius, Cancer and Pseudes Groups. The larvae are distinct from all the other groups in a double or triple hair 9-P (always single in the others) and a double hair 5-C (at least triple in the others).

The Epitedeus Group consists of a pair of clearly marked geminate complexes, 1 restricted to the Atlantic basin and the other to the Pacific basin. The species within each complex show complementary allopatric distributions and are very similar to each other but are readily distinguished by male genitalic characters as well as those in the larvae and pupae. In both complexes the northernmost species appears to be the dominant one and also has retained 7 pairs of hairs in the ventral brush of the larva: *epitedeus* (Atlantic), *costaricensis* (Pacific). The degree of morphological differentiation and the distribution of the species suggest that the original stock of the group first split into an Atlantic and Pacific component and that later both of these were subdivided.

The Atlantic complex of 3 species (*epitedeus*, *panamensis*, *colombianus*) is characterized in the adults by the presence of spiniforms instead of simple bristles in the anteroventral margin of the forefemur. The IX tergite lobe of the male genitalia of this complex is varied in shape but not conical and it always reaches the base of the subapical lobe of the sidepiece. *Deinocerites epitedeus* occupies the northern part of the distribution of the complex from the Gulf of Honduras to at least as far south as Almirante, Bocas del Toro, Panama; *panamensis* is known from the central part of Panama in the region of the Canal Zone; and *colombianus* has been found in the region of San Blas, Panama, and Turbo, Colombia.

The Pacific complex consists of 2 known species only (*costaricensis* and *curiche*). It is characterized in the adults by the presence of simple bristles in the anteroventral row of the forefemur and by a short conical IX tergite lobe not reaching the subapical lobe of the sidepiece in the male genitalia. *Deinocerites costaricensis* is known to date only from Costa Rica but it is possible that it will be found to the north as well as to the south; *curiche* is currently known only from the area of the same name in northern Colombia. There are no records of the Pacific complex from Panama but it is very likely that it is represented there by either or both of the species and possibly a third one as well which might occupy the intermediate area as in the case of the Atlantic complex.

All but 2 species of the complex appear to be rare. *Deinocerites epitedeus* is apparently the dominant species of *Deinocerites* on the Atlantic coast of Central America from the Gulf of Honduras to the province of Bocas del Toro, Panama; and *panamensis* is common on the Atlantic coast of the Canal Zone. The only reliable information on the blood feeding habits is for *epitedeus* in Almirante, Panama, where it has been shown to utilize a wide range of vertebrate hosts from amphibians to mammals. The immature stages of the group have been collected only in large crabholes. The species of crab (*Cardisoma crassum*) has been identified only in the case of *costaricensis*.

11. *Deinocerites epitedeus* (Knab)

Figs. 6,35-37

1907. *Dinomimetes epitedeus* Knab, 1907:120-121. TYPE: Lectotype male (344a), with genitalia on slide (286), Port Limon, Costa Rica, F. Knab [USNM, 10291; designation of Stone and Knight, 1957:197].

Deinocerites epitedeus of Bonne and Bonne-Wepster (1925:174); Kumm and Ruiz (1940:392, 402); Stone and Knight (1957:197); Ross (1962:192); Gorgas Memorial Institute (1970:20); Tempelis and Galindo (1970).
Deinocerites epitedeus in part of Dyar (1925:154,156; 1928:264,537); Horsfall (1955:599); Forattini (1958:176); Belkin and Hogue (1959:438-441); Stone, Knight and Starcke (1959:284).
Dinomimetes epitedeus of Surcouf and Gonzalez-Rincones (1911:92).
Dinomimetes epitedeus in part of Howard, Dyar and Knab (1915:197-199).
Deinocerites cancer in part of Knab (1906:95-97).
Culex (Deinocerites) epitedeus of Dyar (1918:101).

FEMALE (fig. 35). Wing 3.93 mm. Proboscis 2.75 mm. Forefemur 2.77 mm. Abdomen about 3.52 mm. ***Head***: Narrow decumbent scales of vertex creamy, erect scales brownish. ***Antenna***: Torus sometimes with a few scales; exceeding proboscis from middle to apex of flagellar segment 5. ***Thorax***: Postnotum usually with 2 or more bristles near lower end; ***ppn*** with several bristles on middle and lower areas; ***ppl*** with numerous bristles and sometimes with a few scales; ***mep*** with a patch of translucent scales usually in upper half, ***umep*** bristles numerous, body of sclerite with scattered microsetae; metameron sometimes with a few small bristles. ***Legs***: Anterior surface of forecoxa largely covered by bristles and scales, basolateral area with some bristles; midcoxa with outer surface covered with translucent scales, except for a lower posterior area, and 2 groups of bristles, those in anterior group more numerous and scattered, those in posterior group in a row and stronger; hindcoxa with anterolateral surface with scales, lower lateral with bristles, upper lateroposterior with a few scales, posterior surface with numerous bristles; forefemur with a row of spiniforms in anteroventral margin.

FEMALE GENITALIA (fig. 35). ***Sternite VIII*** sometimes with several scales. ***Tergite IX*** with 3-6 setae on each side. ***Cercus*** in lateral aspect with sternal margin convex; tergal margin slightly sinuous at base and slightly concave distally; apex slightly upturned, usually with 4 moderately strong apical or subapical normal bristles. Distal part of ***postgenital plate*** (in ventral aspect) with deep notch; lateral lobe (in lateral aspect) moderately elongate, its apical bristle only slightly convergent with its mate (in ventral aspect).

MALE (fig. 35). Wing 3.93 mm. Proboscis 3.01 mm. Forefemur 2.65 mm. Abdomen (not including genitalia) about 3.21 mm. Anterior claw of foreleg with a moderately large submedian tooth; that of midleg with a small tooth.

MALE GENITALIA (fig. 36). ***Segment IX***: Tergite lobe with distal part slender, reaching base of subapical lobe but not extending beyond it; directed mesad by distinct curvatures of inner and outer margins; body of lobe broad basally, constricted near middle and slender in distal half. ***Sidepiece***: Subapical lobe with rather small thumb; seta *c* spiniform and attenuated apically. ***Phallosome***: Dorsal parameres with broad but short incomplete bridge; apical spine long and slender; ventral teeth usually long, frequently several joined at base. Aedeagus in tergal aspect with external margins sinuous, narrower apically after a constriction distad of middle, apex rounded.

PUPA (fig. 36). Abdomen 4.36 mm. Trumpet 0.91 mm. Paddle 0.86 mm. Diagnostic characters as in the key; general chaetotaxy based on 8 reared specimens. Hair 1-C forked at about 0.4 from base. Hair 9-C usually forked. ***Cephalothorax***: Integument yellowish to medium brown. Hair 1(2), 2(2,1-2), 3(2), 4(1), 5(1), 6 (3,2-4), 7(1), 8(3), 9(2-3,2-4), 10(1), 11(2,2-3), 12(3,2-4). ***Trumpet***: Moderately long, width almost uniform throughout except for slight widening apically; index about 5.3-7.6. Integument brown distad, darker on tracheoid; markedly contrasting with cephalothoracic integument. Tracheoid about 0.4 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(13,9-19), 2 (1), 3(2,2-3), 4(5,3-6), 5(3,3-5), 6(1), 7(1,1-2), 9(1,1-2). Segment II: hair 0(1), 1(2,2-3), 2(2), 3(1), 4(6,4-6), 5(1), 6(1), 7(1), 9(1). Segment III: hair 0(1), 1(5, 2-6), 2(1), 3(2,2-3), 4(2,2-3), 5(1), 6(1), 7(3,2-5), 8(5,3-5), 9(1), 10(1), 11(1), 14(1). Segment IV: hair 0(1), 1(4,3-6), 2(1), 3(5,3-6), 4(2,1-2), 5(1), 6(1), 7(3, 2-4), 8(3,2-4), 9(1), 10(1), 11(1), 14(1). Segment V: hair 0(1), 1(4,2-5), 2(1), 3(1), 4(5,3-5), 5(1), 6(1), 7(5,2-7), 8(2,1-3), 9(1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(3,2-6), 2(1), 3(1,1-2), 4(3,2-3), 5(1), 6(1), 7(1), 8(2), 9(1), 10 (1), 11(1,1-2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2), 4(2), 5(3,3-6), 6 (1), 7(1), 8(4,2-4), 9(5,4-6), 10(1,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1). ***Paddle***: Width about 0.76 of length.

FOURTH INSTAR LARVA (fig. 37). Head 1.21 mm. Siphon 1.52 mm. Diagnostic characters as in the key; general chaetotaxy based on 8 reared specimens. ***Head***: Integument light brown. Mental plate almost as long as wide, triangular; marginal spicules usually sharply pointed, sometimes denticulate. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(3,3-5), 5(2,2-3), 6(1), 7(5,4-11), 8(3,1-4), 9(5,4-6), 10 (3,2-3), 11(4,3-4), 12(1,1-2), 13(5,4-5), 14(1), 15(4,3-4). ***Antenna***: Length about 0.63 of head; shaft with numerous spicules on proximal part. Hair 1(3,3-4). ***Thorax***: Prothorax: hair 0(10,8-12), 1(1), 2(1), 3(1), 4(3), 5(1), 6(1), 7(3,2-3), 8(1, 1-2), 9(3,2-3), 10(1), 11(4,4-10), 12(1), 14(1). Mesothorax: hair 1(1), 2(3,2-4), 3(1), 4(1), 5(1), 6(1), 7(1), 8(6,5-7), 9(7,5-8), 10(1), 11(2,2-4), 12(1), 13(11-16), 14(6,6-10). Metathorax: hair 1(1), 2(4,3-5), 3(6,4-8), 4(4,3-5), 5(1), 6(1), 7(7,6-9), 8(10-19), 9(7,6-8), 10(1), 11(3,2-3), 12(1), 13(6,5-6). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(1,1-2), 4(8,8-10), 5(3,3-5), 6(2,2-3), 7(2), 9(3,2-3), 10(1), 11 (3,2-4), 12(3,2-3), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(2,1-3), 4(8,7-9), 5 (4,3-5), 6(2), 7(2,1-4), 8(4,3-4), 9(1), 10(1), 11(3,2-3), 12(2,2-5), 13(9,8-11). Segment III: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(2), 5(3,2-5), 6(2), 7(6,5-9), 8(2,1-3), 9(1), 10(1), 11(2,2-3), 12(2,2-4), 13(1), 14(1). Segment IV: hair 0(1), 1(1), 2(1), 3(3,2-4), 4(2), 5(3,2-4), 6(2), 7(8,5-10), 8(2,1-2), 9(1), 10(1), 11(2), 12(3,2-3), 13(2,1-2), 14(1). Segment V: hair 0(1), 1(1), 2(1), 3(1), 4(7,6-9), 5(4,3-5), 6(2), 7(10,6-10), 8(2), 9(1), 10(1), 11(1), 12(3,2-4), 13(2), 14(1). Segment VI: hair 0(1), 1(5,2-6), 2(1), 3(1), 4(1,1-2), 5(4,2-7), 6(1), 7(4,3-5), 8(3,2-4), 9(1), 10(1), 11(3,2-4), 12(1), 13(19-28), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(4,4-6), 4(1), 5(4,2-6), 6(12,10-15), 7(1), 8(9,8-12), 9(2,2-4), 10(1), 11(2,2-3), 12(1), 13 (2), 14(1). ***Segment VIII***: Comb scales slender at base, fringe restricted mainly to the apex. Hair 0(1), 1(3,2-4), 2(1), 3(4,3-5), 4(1), 5(2,2-3), 14(1). ***Siphon***: Integument light brown. Index about 4.1-5.2. Pecten teeth 5(4-6), bifid, both blades narrow apically, longer blade wider; distal teeth slightly increasing in size. Hair

1(2,1-2), hair 1ad(4,2-6), hair 1av(4,2-6); hairs 2,6,7,9 all single; 8(2,2-4). ***Anal Segment***: Gill subequal to dorsal saddle length. Ventral margin of dorsal saddle reaching alveolus of hair 1-X. Hair 1-X shorter than gill. Hair 1(1,1-5), 2(6,6-8), 3(1), 4a(11,10-12), 4b(11,9-11), 4c(10,9-12), 4d(10,9-12), 4e(12,10-13), 4f(13,10-14), 4g(10,7-14).

SYSTEMATICS. This is the dominant species of the Atlantic complex of the group and occupies the largest part of its known range from the Gulf of Honduras to the province of Bocas del Toro in Panama. It is most readily differentiated from the other species of the complex by the shape and length of the IX tergite lobe in the male genitalia and by the presence of 7 pairs of hairs instead of 6 in the ventral brush of the larva. The female cannot be distinguished from those of *panamensis* and *colombianus* but the pupa is usually readily separated from all the other species of the group by the key characters.

BIONOMICS. All the records of the immature stages of *epitedeus* are from large crabholes but without any indication of the species of crab involved. The original collection of *epitedeus* was made by F. Knab (1906:95, as *cancer*) in crabholes on the side of a hill near Port Limon, Costa Rica, at a considerable elevation above sea level. These crabholes contained fresh water supplied by a small brook. Recently, *epitedeus* has been collected in the same general area near Port Limon, in a cacao grove about 2 mi from the sea (CR 73), and at another locality about ¼-½ mi from the sea (CR 76). Although no determination of the chloride content was made, it is very likely that the water in these crabholes was fresh.

Deinocerites epitedeus has been found associated with the following species: *cancer* in Guatemala and Nicaragua; 1 or more species of the *Culex (C.) inflictus* complex in Guatemala, Nicaragua and Costa Rica; *Culex (Tin.) latisquama* in Nicaragua; and with a species of *Culex (Mel.)* in Costa Rica.

Only 2 reports have appeared on the blood feeding habits of *epitedeus*. Kumm, Komp and Ruiz (1946:392) caught 11 females on horse bait in Puerto Viejo, Costa Rica. In Panama, *epitedeus* has been found to have a very wide range of hosts ranging from amphibians to mammals (Gorgas Memorial Institute, 1970:20; Tempelis and Galindo, 1970).

DISTRIBUTION (fig. 6). Atlantic coast from the Gulf of Honduras to Bocas del Toro Province in Panama. Material examined: 984 specimens; 132 males, 119 females, 531 larvae, 202 pupae; 49 individual rearings (30 larval, 15 pupal, 4 incomplete).

COSTA RICA. *Limon*: Cahuita (LCBA 232,234,235,238-240,243). Cieneguita, near P. Limon [USNM]. Puerto Limon, F. Knab, type series; (K 344A) [USNM]. Puerto Viejo (181) [USNM]. Westfalia, near P. Limon (CR 73,76) [UCLA].

GUATEMALA. *Izabel*: Puerto Matias (GUA 5,5A,6) [UCLA].

NICARAGUA. *Zelaya*: Bluefields (NI 34,51,67-70,72,73) [UCLA].

PANAMA. *Bocas del Toro*: Almirante (PA 271,274,1031) [UCLA].

12. *Deinocerites panamensis* Adames, n.sp.

Figs. 6,38-40

TYPES: *Holotype* male with associated larval and pupal skins (PA 598-101), Portobelo, Colon, Panama, 9 Dec 1963, A. Quinonez [USNM]. *Allotype* female with associated larval and pupal skins and genitalia slide (PA 598-104), same data as holotype [USNM]. *Paratypes:* 4 lpM (PA 598-102,109,110), 2 lpF (598-105,108), 4 pF (598-106,112-114), 1 lP (598-111), 1 l (598-103), same data as holotype [BM, UCLA, USNM].

Deinocerites epitedeus of Dyar (1923:180); Arnett (1948:193).

Deinocerites epitedeus in part of Dyar (1925:154,156; 1928:264,537); Lane (1953:556,557,558, 559); Horsfall (1955:599); Forattini (1958:176); Belkin and Hogue (1959:438-441); Stone, Knight and Starcke (1959:284).

Dinomimetes epitedeus of Busck (1908:75).

Dinomimetes epitedeus in part of Howard, Dyar and Knab (1915:197-199).

FEMALE (fig. 38). Wing 3.41 mm. Proboscis 2.50 mm. Forefemur 1.98 mm. Abdomen about 2.9 mm. Apparently indistinguishable from *epitedeus*.

FEMALE GENITALIA (fig. 38). Essentially similar to *epitedeus* except for the following. Tergite IX with 2-4 setae on each side. Distal part of postgenital plate (in ventral aspect) with a deeper notch; lateral lobe basically similar and its apical bristle parallel with or diverging from its mate.

MALE (fig. 38). Wing 3.21 mm. Proboscis 2.65 mm. Forefemur 2.60 mm. Abdomen (not including genitalia) about 2.5 mm. Apparently indistinguishable from *epitedeus*.

MALE GENITALIA (fig. 39). Differing from *epitedeus* apparently only in IX tergite lobe with distal part very long and very slender, angled laterad at base, then bent mesad to parallel sidepiece and extending beyond base of subapical lobe.

PUPA (fig. 39). Abdomen 3.58 mm. Trumpet 0.73 mm. Paddle 0.76 mm. Diagnostic characters as in the key; general chaetotaxy based on 5 reared specimens. Hair 1-C branched; 9-C usually forked. ***Cephalothorax***: Integument yellowish. Hair 1(2,2-3), 2(2), 3(2), 4(1), 5(1,1-2), 6(3,2-3), 7(2), 8(3), 9(3,2-3), 10(1,1-2), 11 (2), 12(2). ***Trumpet***: As in *epitedeus*; index about 6.2-8.1, tracheoid about 0.50 of trumpet length. ***Abdomen***: Integument yellowish. Segment I: hair 1(13,13-18), 2(1,1-2), 3(2,2-3), 4(4,3-5), 5(5,3-5), 6(1), 7(2), 9(1,1-2). Segment II: hair 0(1), 1(3,1-3), 2(2), 3(1), 4(6,3-7), 5(1), 6(1), 7(1), 9(1). Segment III: hair 0(1), 1(5, 3-6), 2(1), 3(2), 4(2,1-3), 5(1), 6(1), 7(3,3-4), 8(5,4-6), 9(1), 10(1), 11(1), 14 (1). Segment IV: hair 0(1), 1(5,4-5), 2(1), 3(4,3-5), 4(1,1-2), 5(1), 6(1), 7(2,2-3), 8(2,2-3), 9(1), 10(1), 11(1), 14(1). Segment V: hair 0(1), 1(5,4-5), 2(1), 3 (2,1-3), 4(5,4-6), 5(1), 6(1), 7(5,4-6), 8(2,2-3), 9(1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(4,3-4), 2(1), 3(2,1-2), 4(2,2-4), 5(1), 6(1), 7(1), 8(3,2-3), 9(1), 10(1,1-2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(2,1-2), 5 (2,2-3), 6(1,1-2), 7(1), 8(3,2-4), 9(5,4-6), 10(2,1-2), 11(2,1-3), 14(1). Segment VIII: hair 0(1), 4(2), 9(1), 14(1). ***Paddle***: Width about 0.86 of length.

FOURTH INSTAR LARVA (fig. 40). Head 1.18 mm. Siphon 1.52 mm. All measurements from skins. Diagnostic characters as in the key; general chaetotaxy based on 5 reared specimens. ***Head***: Integument yellowish to light brown. Mental plate similar to that of *epitedeus*. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(4, 3-5), 5(2,1-2), 6(1), 7(5,4-7), 8(4,4-6), 9(6,3-6), 10(3,1-3), 11(4,4-5), 12(2), 13 (6,5-7), 14(1), 15(2,2-3). ***Antenna***: Length about 0.50 of head; shaft with numerous spicules on proximal part. ***Thorax***: Prothorax: hair 0(12,10-12), 1(1), 2(1), 3(1), 4(4,4-5), 5(1), 6(1), 7(3,2-4), 8(2), 9(2,1-2), 10(1,1-2), 11(4,3-5), 12(1), 14 (1). Mesothorax: hair 1(1), 2(3,2-4), 3(1), 4(2,1-2), 5(1), 6(1), 7(1), 8(7,6-8), 9 (9,7-9), 10(1), 11(3,2-3), 12(1), 13(?), 14(?). Metathorax: hair 1(1), 2(4), 3(6, 6-8), 4(4,3-5), 5(1), 6(1), 7(8,8-11), 8(?), 9(10,8-10), 10(1), 11(2,2-3), 12(1), 13 (6,5-6). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(9,8-11), 5(4,3-6), 6(3, 2-3), 7(2,1-2), 9(3,2-4), 10(2,1-2), 11(2,2-3), 12(4,2-4), 13(1,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(9,8-10), 5(4,3-5), 6(2,2-3), 7(4,3-4), 8(4,3-4), 9 (1), 10(1), 11(3,2-3), 13(3,2-4), 13(8-11). Segment III: hair 0(1), 1(2,2-3), 2(1), 3(1), 4(2,2-3), 5(3,2-3), 6(2), 7(5-7), 8(2), 9(1), 10(1), 11(2), 12(3,2-3), 13(1), 14(1). Segment IV: hair 0(1), 1(1,1-2), 2(1), 3(3,3-5), 4(2), 5(3,2-4), 6(2), 7(8-9), 8(2,1-2), 9(1), 10(1), 11(2,2-3), 12(3,2-3), 13(2,1-2), 14(1). Segment V: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(8,6-9), 5(4,3-4), 6(2), 7(9,9-11), 8(2), 9(1), 10(1), 11(2,2-3), 12(1,1-2), 13(2,1-3), 14(1). Segment VI: hair 0(1), 1(4,4-5), 2(1), 3 (1), 4(3,2-3), 5(4), 6(1), 7(4,3-6), 8(3,3-4), 9(1), 10(1), 11(3,2-3), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(4,4-5), 4(1), 5(3,3-4), 6(12,11-13), 7(1), 8(8,5-9), 9(2,2-3), 10(1), 11(2), 12(1), 13(2,1-2), 14(1). ***Segment VIII***: Comb scales similar to those of *epitedeus*. Hair 0(1), 1(3,3-4), 2(1), 3(4,4-5), 4(1), 5(4, 2-4), 14(1). ***Siphon***: Integument light brown. Index about 4.8-6.0. Pecten teeth 5(4-6), shape and size similar to those of *epitedeus*. Hair 1(2), hair 1ad(4,1-4), hair 1av(4,1-5); hairs 2,6,7,9 all single; 8(2,1-2). ***Anal Segment***: Gill length probably about the same as in *epitedeus*. Ventral margin of dorsal saddle reaching alveolus of hair 1-X. Hair 1-X shorter than gill. Hair 1(1,1-2), 2(7,6-9), 3(1), 4a (14,11-15), 4b(12,11-16), 4c(14,10-15), 4d(13,11-16), 4e(14,12-17), 4f(14,10-15).

SYSTEMATICS. *Deinocerites panamensis* occupies a restricted central part of the range of the Atlantic complex of the group in Central Panama and Canal Zone where it seems to be as common as *epitedeus* is to the north. It is readily differentiated from the other members of the complex by the shape and length of IX tergite lobe of the male genitalia. Its larva has only 6 pairs of hairs in the ventral brush as does *colombianus* as well as *curiche* but it can be distinguished from both by the key and diagnostic characters given above. The female is indistinguishable from the other 2 members of the Atlantic complex (*epitedeus* and *colombianus*) but the pupa is usually readily separated by the key characters from all the species of the group.

At the present time, there are wide gaps between the known distributions of *epitedeus*, *panamensis* and *colombianus* on the inaccessible Atlantic coast of western and eastern Panama respectively and it is not known if these species actually come in contact.

BIONOMICS. This species has been collected only in large crabholes. There is no definite information about the blood feeding habits of *panamensis*, the only reference to them being that of Busck (1908:75, as *epitedeus* from Colon, Panama) who stated, "Though possessing a well-developed proboscis, this species probably does not bite man; but this should be definitely ascertained by observations."

Deinocerites panamensis has been found associated with the following species: *melanophylum*, species of the *Culex (C.) inflictus* complex, *Culex (Tin.) latisquama* and *Anopheles (A.) eiseni*.

DISTRIBUTION (fig. 6). Atlantic coast of central Panama and Canal Zone. Material examined: 195 specimens; 51 males, 96 females, 23 larvae, 25 pupae; 23 individual rearings (20 larval, 2 pupal, 1 incomplete).

PANAMA AND CANAL ZONE. *Canal Zone*: Ancon (?), J. Zetek [USNM]. Arenal River, C.S. Ludlow [USNM]. Caldera, A.H. Jennings (160) [USNM]. Cativa, J.B. Shropshire [UCLA]. Ft. Davis, D. Baker [USNM]. Ft. Gulick, S.J. Carpenter [UCLA]. Ft. Lorenzo, J.B. Shropshire [USNM]. Ft. Randolph, H.G. Dyar and R.C. Shannon [USNM]. Ft. Sherman, S.J. Carpenter [UCLA]; W.H.W. Komp (KO 32-22); J. Zetek; L.H. Dunn [USNM]. France Field, J. Zetek [USNM]. Locality not specified, A.H. Jennings (129,150,158,177,180) [USNM]. Majagual, J. B. Shropshire [UCLA, USNM]. *Colon*: Colon, A. Busck (213) [USNM]. El Corredor (PA 1013, 1016) [UCLA]. Lagarto [UCLA, USNM]. Maria Chiquita (PA 1006,1008) [UCLA]. Portobelo (PA 585,598) [UCLA]. Salud (PA 573) [UCLA].

13. *Deinocerites colombianus* Adames, n.sp.

Figs. 6,41-43

TYPES: *Holotype* male with associated larval and pupal skins and genitalia slide (COA 40-27), La Punta, Turbo, Antioquia, Colombia, 30 Aug 1967, A.J. Adames and A. Quinonez [USNM]. *Allotype* female with associated larval and pupal skins and genitalia slide (COA 40-22), same data as holotype [USNM]. *Paratypes*: 2 lpM (COA 39-10,13), 1 lpF (39-11), 2 lpF (40-20,28), 1 F (38), 2 L (35), 8 L (39), 1 L (40), same data as holotype [BM, UCLA, USNM].

FEMALE (fig. 41). Wing 3.67 mm. Proboscis 2.09 mm. Forefemur 2.14 mm. Abdomen about 3.41 mm. Essentially similar to *epitedeus* from which it is apparently indistinguishable.

FEMALE GENITALIA (fig. 41). Sternite VIII sometimes with a few scales. Tergite IX with 4-6 setae on each side. Cercus essentially similar to *epitedeus*. Distal part of postgenital plate basically similar to *epitedeus* except for slight differences in contour of lateral lobe (in ventral aspect), apical bristle parallel with its mate.

MALE (fig. 41). Wing 3.13 mm. Proboscis 2.70 mm. Forefemur 2.50 mm. Abdomen (not including genitalia) about 2.24 mm. Anterior claw of foreleg as in *epitedeus*, that of midleg simple.

MALE GENITALIA (fig. 42). Differing from *epitedeus* apparently only in IX tergite lobe with distal part broad and directed laterad; body of lobe broad in basal two-thirds, slightly attenuated in distal third; reaching base of subapical lobe but not extending beyond it.

PUPA (fig. 42). Abdomen 4.05 mm. Trumpet 0.71 mm. Paddle 0.76 mm. Diagnostic characters as in the key; general chaetotaxy based on 5 reared specimens. Hairs 1-C and 9-C branched. ***Cephalothorax***: Integument yellowish to medium brown. Hair 1(2), 2(2), 3(2), 4(1), 5(1,1-2), 6(2,1-3), 7(2,1-4), 8(3), 9(3,2-3), 10 (2,1-2), 11(2,2-3), 12(2). ***Trumpet***: As in *epitedeus*; index about 5.2-6.1. Tracheoid about 0.45 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(16,14-18), 2(1,1-2), 3(2), 4(4,3-5), 5(3,3-4), 6(1,1-2), 7(2), 9(1). Segment II: hair 0(1), 1(2,2-3), 2(2), 3(1), 4(4,2-4), 5(1), 6(1,1-2), 7(1), 9(1). Segment III: hair 0(1), 1(3,3-4), 2(1), 3(2), 4(1,1-2), 5(1), 6(1), 7 (3,2-4), 8(4,4-6), 9(1), 10(1), 11(1), 14(1). Segment IV: hair 0(1), 1(4,3-4), 2(1), 3(4,3-6), 4(1), 5(1), 6(1), 7(2,1-2), 8(2,2-3), 9(1), 10(1), 11(1), 14(1). Segment V: hair 0(1), 1(3,2-4), 2(1), 3(1,1-2), 4(5,3-6), 5(1), 6(1), 7(4,2-5), 8(2,2-3), 9 (1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(2,2-4), 2(1), 3(1,1-2), 4(2,2-3), 5(1), 6(1), 7(1,1-2), 8(2,1-2), 9(1), 10(1,1-2), 11(1), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(2,1-2), 5(2,2-3), 6(1), 7(1), 8(2,2-3), 9(5,5-7), 10(2, 1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2), 9(1), 14(1). ***Paddle***: Width about 0.8 of length.

FOURTH INSTAR LARVA (fig. 43). Head 1.27 mm. Siphon 1.52 mm. Diagnostic characters as in the key; general chaetotaxy based on 6 reared specimens. ***Head***: Integument light brown. Mental plate similar to that of *epitedeus* except for the subapical spicules which are usually denticulate. Hair 0(1), 1(1), 2(1), 3 (not detectable), 4(4,3-5), 5(2,2-3), 6(1), 7(7,5-8), 8(4,4-5), 9(5,4-6), 10(3,2-4), 11(5,4-6), 12(2,1-3), 13(7,5-8), 14(1), 15(3,2-4). ***Antenna***: Length about 0.45 of head; shaft with numerous spicules on proximal part. Hair 1(4,3-6). ***Thorax***: Prothorax: hair 0(12,9-12), 1(1), 2(1), 3(1,1-2), 4(4,3-5), 5(1,1-2), 6(1), 7(4,3-4), 8 (2,2-3), 9(2,2-3), 10(1), 11(3,3-4), 12(1), 14(1). Mesothorax: hair 1(1), 2(2,2-3), 3(1), 4(2), 5(1), 6(1), 7(1), 8(8), 9(7-9), 10(1), 11(2,2-3), 12(1), 13(?), 14(8-

12). Metathorax: hair 1(1), 2(2,2-3), 3(5,4-7), 4(4,3-4), 5(1), 6(1), 7(9,8-9), 8(?), 9(9,8-9), 10(1), 11(4), 12(1), 13(5,4-6). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(3,2-3), 4(9,8-9), 5(3,3-4), 6(3,2-3), 7(2), 9(2,1-3), 10(1), 11(2), 12(3,3-4), 13 (1). Segment II: hair 0(1), 1(1), 2(1), 3(2), 4(7,7-12), 5(4,3-5), 6(2,2-3), 7(2,2-4), 8(4,2-4), 9(1), 10(1), 11(2,2-3), 12(2), 13(?). Segment III: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(2,2-3), 5(2,2-3), 6(2,2-3), 7(9,5-9), 8(1,1-2), 9(1), 10(1,1-2), 11 (2), 12(2), 13(2), 14(1). Segment IV: hair 0(1), 1(2), 2(1), 3(2,2-3), 4(2,2-3), 5(3,2-3), 6(2), 7(8-10), 8(1), 9(1), 10(1), 11(2,1-2), 12(1), 13(4,3-5), 14(1). Segment V: hair 0(1), 2(2), 3(1), 4(7,6-9), 5(3,3-4), 6(2), 7(10,7-10), 8(1), 9(1), 10(1), 11(2,1-2), 12(2,2-3), 13(4,4-5), 14(1). Segment VI: hair 0(1), 1(5,3-5), 2 (1), 3(1), 4(3,2-4), 5(5,3-5), 6(1), 7(3,3-4), 8(2,2-3), 9(1), 10(1), 11(2), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(2), 3(4,3-4), 4(1), 5(3-4), 6(13,12-14), 7(1), 8(7-9), 9(3), 10(1), 11(2,2-3), 12(1), 13(2,2-3), 14(1). ***Segment VIII***: Comb scales similar to those of *epitedeus*. Hair 0(1), 1(4,3-4), 2(1), 3(4,4-5), 4(1), 5 (5,5-6), 14(1). ***Siphon***: Integument light brown. Index about 5.1-5.6. Pecten teeth 3(2-5); shape and size as in *epitedeus*. Hair 1(2), hair 1ad(4,3-4), hair 1av(4,3-4); hairs 2,6,7,9 all single; 8(2,1-3). ***Anal Segment***: Gill about 0.53 of dorsal saddle length. Ventral margin of dorsal saddle reaching alveolus of hair 1-X. Hair 1-X longer than gill. Hair 1(1), 2(8,7-12), 3(1), 4a(13,12-17), 4b(12,11-14), 4c(12,10-13), 4d(12,10-14), 4e(13,12-14), 4f(9,9-10).

SYSTEMATICS. *Deinocerites colombianus* is the most clearly marked of the 3 members of the Atlantic complex of the group. Its female however cannot be differentiated from the other 2 species. In addition to the diagnostic features in the keys, the larva of *colombianus* is distinguished from *epitedeus* by the reduction of the ventral brush to 6 pairs of hairs (from 7 pairs in the latter). This species occupies the southern part of the range of the complex from the San Blas area of Panama into the Turbo area of Colombia.

BIONOMICS. The immature stages of *colombianus* have been collected in large crabholes in association with *melanophylum* and *Culex (Tin.) latisquama*. Nothing is known of the blood feeding habits of this species.

DISTRIBUTION (fig. 6). Atlantic coast of eastern Panama and western Colombia. Material examined: 99 specimens; 47 males, 23 females, 20 larvae, 9 pupae; 9 larval individual rearings.

COLOMBIA. *Antioquia*: Atrato delta (COA 31) [UCLA]. Turbo (COA 35,39,40), type series [BM, UCLA, USNM].

PANAMA. *San Blas*: Cuadi River, B.F. Eldridge [UCLA, USNM].

14. *Deinocerites costaricensis* Adames & Hogue

Figs. 6,44-46

1970. *Deinocerites costaricensis* Adames and Hogue, 1970:12. TYPE: Holotype female (CR 28-213) with associated larval and pupal skins, 1 km north Boca del Rio Barranca, Hacienda Bonilla, Puntarenas Province, Costa Rica, 17 Nov 1962, C.L. Hogue and W.A. Powder [USNM].

Deinocerites species A of Belkin and Hogue (1959:438); Ross (1962:192); Hogue and Wirth (1968:6).

FEMALE (fig. 44). Wing 3.98 mm. Proboscis 2.37 mm. Forefemur 2.24 mm.

Abdomen about 3.77 mm. ***Head***: Narrow decumbent scales creamy; erect scales usually yellowish. ***Antenna***: Torus sometimes with a few scales; exceeding proboscis at least from middle of flagellar segment 5. ***Thorax***: Postnotum without hairs. Middle and lower parts of ***ppn*** with numerous bristles; ***ppl*** bristles very numerous, scales few; ***mep*** with translucent scales usually covering most of the sclerite, body of sclerite also with very numerous microsetae, ***umep*** bristles numerous; metameron with several small hairs. ***Legs***: Scaling similar to *epitedeus* except for more numerous scales in lateroposterior surface of hindcoxa; forefemur with anteroventral margin with a row of bristles.

FEMALE GENITALIA (fig. 44). ***Sternite VIII*** usually without scales, at most 1 present. ***Tergite IX*** with 1-3 setae on each side. ***Cercus*** (in lateral aspect) with dorsal margin of sclerotized part distinctly longer than ventral, its basal width less than 0.5 of length of sclerotized ventral margin; ventral margin convex, dorsal margin more or less straight but slightly directed ventrad distally; apex directed caudad, with 5 or 6 apical or subapical specialized setae with twisted apex. Distal part of ***postgenital plate*** (in ventral aspect) with deep round notch, apicolateral margins more or less conical; lateral lobe (in lateral apsect) elongate, its apical bristle parallel with its mate (in ventral aspect).

MALE (fig. 44). Wing 3.13 mm. Proboscis 2.71 mm. Forefemur 2.37 mm. Abdomen (not including genitalia) about 2.79 mm. Anterior claw of foreleg with a very long slender tooth, posterior claw with a very small denticle; anterior claw of midleg with a small denticle.

MALE GENITALIA (fig. 45). ***Segment IX***: Tergite lobe broad at base and cone shaped distally; apical part not strongly attenuated and not reaching base of subapical lobe. ***Sidepiece***: Subapical lobe with rather small thumb; seta ***c*** spiniform, with an apical attenuation. ***Phallosome***: Dorsal parameres widely separated but with a slight indication of an incomplete dorsal bridge; apical spine long and slender; ventral teeth about 18, short to moderately long, slender, arising from an evenly convex ventrolateral border. Aedeagus (in tergal aspect) more or less uniform in width but with a premedian constriction and an apical expansion.

PUPA (fig. 45). Abdomen 4.07 mm. Trumpet 0.76 mm. Paddle 0.48 mm. General chaetotaxy based on 10 reared specimens. Except for diagnostic characters in the key apparently indistinguishable from *curiche*. Hair 1-C forked, main stem about 0.4 of total length, 9-C usually slightly forked. ***Cephalothorax***: Integument yellowish. Hair 1(2,1-2), 2(2), 3(2,1-2), 4(1), 5(1,1-2), 6(2,2-5), 7(1), 8(3,3-4), 9(2,1-4), 10(1), 11(2,1-3), 12(2,1-3). ***Trumpet***: As in *epitedeus*; index about 5.3-7.6. Tracheoid about 0.5 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(15,7-20), 2(1,1-2), 3(2), 4(3,2-4), 5(5,4-6), 6 (1), 7(2,1-3), 9(1), 10(occasionally present, 1), 11(occasionally present, 2,1-3). Segment II: hair 0(1), 1(2,2-3), 2(2), 3(1), 4(4,4-6), 5(1), 6(1), 7(1), 9(1). Segment III: hair 0(1), 1(5,4-7), 2(1), 3(2,2-4), 4(2,1-3), 5(1), 6(1), 7(3,2-5), 8(5, 4-6), 9(1), 10(1), 11(1,1-3), 14(1). Segment IV: hair 0(1), 1(5,3-6), 2(1), 3(3, 2-6), 4(2,1-2), 5(1), 6(1), 7(3,2-4), 8(2,2-3), 9(1), 10(1), 11(1,1-2), 14(1). Segment V: hair 0(1), 1(4,2-5), 2(1), 3(1), 4(4,2-6), 5(1), 6(1), 7(4,2-5), 8(3,1-3), 9(1), 10(1), 11(1,1-2), 14(1). Segment VI: hair 0(1), 1(4,2-5), 2(1), 3(1), 4(2, 1-2), 5(1), 6(1), 7(1), 8(2,1-4), 9(1), 10(1), 11(2,1-2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(1,1-2), 5(3,1-5), 6(1), 7(1), 8(2,2-3), 9(4,3-6), 10(1), 11(2,1-2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1). ***Paddle***: Width about 0.8 of length.

FOURTH INSTAR LARVA (fig. 46). Head 1.22 mm. Siphon 1.43 mm. Diagnostic characters as in the key; general chaetotaxy based on 9 reared specimens. ***Head***: Integument yellowish to light brown. Mental plate almost as wide as long, triangular, with apical and subapical spicules denticulate, lateral ones usually sharply pointed, sometimes denticulate. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(3, 2-5), 5(2), 6(1), 7(6,4-8), 8(5,3-6), 9(5,3-5), 10(3,2-4), 11(3,2-4), 12(2,1-2), 13 (6,5-8), 14(1), 15(4,3-5). ***Antenna***: Length about 0.33 of head; shaft with numerous minute spicules on proximal part. Hair 1(4,3-5). ***Thorax***: Prothorax: hair 0(9,9-13), 1(1), 2(1), 3(1), 4(3,2-4), 5(1), 6(1), 7(3,2-4), 8(1,1-2), 9(3,2-3), 10 (1), 11(4,4-6), 12(1), 14(1). Mesothorax: hair 1(1), 2(3,2-5), 3(1), 4(1,1-2), 5 (1), 6(1), 7(1), 8(8,6-8), 9(8,7-10), 10(1), 11(3,2-4), 12(1), 13(16,12-19), 14(?). Metathorax: hair 1(1), 2(3,2-4), 3(5,4-7), 4(4,3-6), 5(2,1-2), 6(1), 7(9,7-9), 8(12, 12-24), 9(10,8-10), 10(1), 11(3,3-5), 12(1), 13(6,5-7). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,1-2), 4(9,7-12), 5(5,4-6), 6(2,2-3), 7(2,1-2), 9(2,2-3), 10(2,1-2), 11(2,1-4), 12(2), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(2), 4(9,5-10), 5(5, 4-5), 6(2,2-3), 7(5,4-6), 8(4,2-5), 9(1), 10(1), 11(3,2-4), 12(2,2-3), 13(14,12-16). Segment III: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(2), 5(3,2-4), 6(2), 7(7,5-12), 8(2, 1-2), 9(1), 10(1), 11(2,1-3), 12(2,2-3), 13(1), 14(1). Segment IV: hair 0(1), 1 (2,1-2), 2(1,1-2), 3(2,1-3), 4(2), 5(4,2-5), 6(2), 7(10,7-10), 8(2,1-2), 9(1), 10(1), 11(2,2-5), 12(2,1-3), 13(1,1-2), 14(1). Segment V: hair 0(1), 1(1), 2(1), 3(1), 4 (6,5-8), 5(5,2-5), 6(2), 7(6,5-9), 8(2,2-3), 9(1), 10(1), 11(3,2-3), 12(1), 13(2,1-2), 14(1). Segment VI: hair 0(1), 1(5,3-7), 2(1), 3(1), 4(2,1-2), 5(5,3-5), 6(1), 7(4,2-5), 8(3,2-4), 9(1), 10(1), 11(3,3-4), 12(1), 13(16-25), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(5,4-7), 4(1), 5(2,2-4), 6(11,9-13), 7(1), 8(7,7-11), 9(3,2-5), 10(1), 11(2,1-4), 12(1), 13(1,1-2), 14(1). ***Segment VIII***: Comb scales slender at base, apex fringed, slightly fringed on lateroapical margin. Hair 0(1), 1(3,3-4), 2(1), 3(4,4-5), 4(1), 5(2), 14(1). ***Siphon***: Integument light brown. Index about 3.8-5.6. Pecten teeth 6(4-6), similar to those of *epitedeus*. Hair 1(2,1-2), hair 1ad (3,2-5), hair 1av(3,3-4); hairs 2,6,7 and 9 all single; 8(2,1-2). ***Anal Segment***: Gill subequal to dorsal saddle length. Ventral margin of dorsal saddle not reaching alveolus of hair 1-X. Hair 1-X shorter than gill. Hair 1(2,1-3), 2(9,6-10), 3(1), 4a (12,12-15), 4b(13,11-14), 4c(12,9-15), 4d(13,12-15), 4e(13,12-15), 4f(14,12-16), 4g(12,11-14).

SYSTEMATICS. *Deinocerites costaricensis* is the better known of the 2 species comprising the Pacific complex of the group and occupies the northern part of its range in Costa Rica. It is possible that it occurs also in northern Panama. The females of the 2 species are usually readily differentiated by the key characters. Of particular interest are the specialized setae of the cercus which are better developed in the female of *costaricensis*. These specialized setae, I believe, have arisen independently and are not indicative of any relationship with the Cancer Group which has a single pair of spatulate cercal setae. Therefore, I reject the suggestion of Belkin and Hogue (1959:438) that *costaricensis* (as species A) is a species of hybrid origin between the Cancer Group and the *mcdonaldi* stock.

The 2 species of the complex cannot be differentiated on external features of the adults but are usually readily separated in the other stages and the male genitalia by the key characters. The larva of *costaricensis* retains the primitive condition of 7 pairs of hairs in the ventral brush while that of *curiche* has the brush reduced to 6 pairs of hairs.

At present there is a wide gap between the distribution of *costaricensis* and that of *curiche* from the Osa Peninsula in Costa Rica to northern Colombia. It is probable that 1 or more species of the complex will be found in this area, 1 or both of the known species and possibly a third one which would occupy the central area of the distribution of the Pacific complex as in the case of the Atlantic complex of the group.

BIONOMICS. All records of *costaricensis* are from the burrows of the Mouthless Crab, *Cardisoma crassum*, where it is usually associated with the more common *pseudes*. It has also been found associated with a species of the *Culex (C.) inflictus* complex and a species of *Culex (Mel.)*. There is also a record of a single larva from a mangrove treehole (CR 130) in association with *Culex (Anoed.) conservator*, *Haemagogus chalcospilans*, *Orthopodomyia fascipes* and *Corethrella (C.) sp.*

DISTRIBUTION (fig. 6). Pacific coast of Costa Rica. Material examined: 689 specimens; 31 males, 41 females, 528 larvae, 89 pupae; 38 individual rearings (23 larval, 5 pupal, 10 incomplete).

COSTA RICA. *Puntarenas*: Boca del Rio Barranca (LCBA 111,155,156,158,159,174) [UCLA]. Boca del Rio Baru (CR 34,43) [UCLA]. Hacienda Bonilla (CR 28,106,107) [BM, LACM, UCLA, USNM]. Rincon, Peninsula de Osa (CR 122-124,130,135,136,142) [UCLA]. Tarcoles (835) [USNM].

15. *Deinocerites curiche* Adames, n.sp.

Figs. 6,47-49

TYPES: *Holotype* male with associated larval and pupal skins (COA 50-14), El Naranjo, Curiche, El Choco, Colombia, 31 Aug 1967, A.J. Adames and A. Quinonez [USNM]. *Allotype* female with associated larval and pupal skins (COA 50-11), same data as holotype [USNM]. *Paratypes*: 2 lpM (COA 50-12,19), 1 pF (50-100), 2 lP (50-10,18), 9 L (50), same data as holotype [BM, UCLA, USNM].

FEMALE (fig. 47). Wing 2.83 mm. Proboscis 2.75 mm. Forefemur 2.39 mm. Abdomen about 2.5 mm. Apparently indistinguishable from *costaricensis*.

FEMALE GENITALIA (fig. 47). ***Sternite VIII*** sometimes with several scales. ***Tergite IX*** with 1-3 setae on each side. ***Cercus*** (in lateral aspect) with the dorsal and ventral margins of sclerotized part subequal; its basal width over 0.6 of length of sclerotized ventral margin; ventral and dorsal margins convex; apex directed caudad; 5 or 6 weak to moderately strong apical or subapical bristles, with or without twisted apex. Distal part of ***postgenital plate*** basically as in *costaricensis* except for a shallower notch (in ventral aspect).

MALE (fig. 47). Wing 3.16 mm. Proboscis 2.42 mm. Forefemur 2.24 mm. Abdomen (not including genitalia) about 2.50 mm. Apparently indistinguishable from *costaricensis* except for posterior claw of foreleg which appears to be single.

MALE GENITALIA (fig. 48). ***Segment IX***: Tergite lobe similar to that of *costaricensis* except for a more sinuous inner margin and blunter apex. ***Sidepiece***: As in *costaricensis*. ***Phallosome***: Dorsal paramere with about 25 ventral teeth, usually long, moderately heavy and arising from a distinct humplike expansion of ventrolateral border. Aedeagus similar to that of *costaricensis*.

PUPA (fig. 48). Abdomen 4.61 mm. Trumpet 0.84 mm. Paddle 0.78 mm. General chaetotaxy based on 5 reared specimens. Except for diagnostic key characters indistinguishable from *costaricensis*. Hair 1-C usually forked, main stem about 0.4 of total length, 9-C sometimes slightly forked. ***Cephalothorax***: Integument medium brown. Hair 1(2), 2(2), 3(2), 4(1), 5(1), 6(2,2-4), 7(2,1-2), 8(3), 9(3,1-3), 10(1), 11(2), 12(1). ***Trumpet***: As in *epitedeus*; index about 5.4-7.1. Tracheoid about 0.3-0.4 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(13,10-15), 2(1,1-2), 3(2), 4(3,1-4), 5(2,2-3), 6(1), 7(2,1-2), 9 (1), 10(occasionally present, 1), 11(occasionally present, 1). Segment II: hair 0 (1), 1(2,1-2), 2(2,1-2), 3(1), 4(3,1-4), 5(1), 6(1,1-2), 7(1), 9(1). Segment III: hair 0(1), 1(4,4-6), 2(1,1-2), 3(2,1-3), 4(2), 5(1), 6(1), 7(2,2-4), 8(5,4-7), 9(1), 10(1), 11(1), 14(1). Segment IV: hair 0(1), 1(5,5-6), 2(1), 3(3,1-4), 4(1), 5(1), 6(1), 7(3,2-3), 8(3,1-3), 9(1), 10(1), 11(1), 14(1). Segment V: hair 0(1), 1(6,4-8), 2 (1), 3(1,1-2), 4(6,2-6), 5(1), 6(1), 7(3,3-7), 8(3,2-4), 9(1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(5,4-7), 2(1), 3(1), 4(2), 5(1), 6(1), 7(1,1-2), 8(2,2-3), 9(1), 10(1), 11(2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(1,1-2), 4(2,1-2), 5(3,2-5), 6(1), 7(1), 8(2,1-2), 9(4,4-5), 10(2), 11(2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1). ***Paddle***: Width about 0.8 of length.

FOURTH INSTAR LARVA (fig. 49). Head 1.27 mm. Siphon 1.31 mm. Diagnostic characters as in the key; general chaetotaxy based on 5 reared specimens. ***Head***: Integument yellowish to light brown. Mental plate similar to that of *costaricensis*, except for lateral spicules which are usually all denticulate. Hair 0(1), 1(1), 2(1), 3(not detectable), 4(3,2-5), 5(2), 6(1), 7(6,5-7), 8(4,4-6), 9(5,4-7), 10 (3,1-3), 11(3,2-5), 12(1), 13(6,5-7), 14(1), 15(3,3-4). ***Antenna***: Length about 0.44 of head; shaft with numerous spicules on proximal part. Hair 1(4). ***Thorax***: Prothorax: hair 0(8,8-10), 1(1), 2(1), 3(1), 4(3,2-4), 5(1), 6(1), 7(3,2-3), 8(1), 9(2), 10(1), 11(3), 12(1), 14(1,1-2). Mesothorax: hair 1(1), 2(3,2-4), 3(1), 4(1,1-2), 5(1), 6(1,1-2), 7(1), 8(8-9), 9(6-9), 10(1), 11(3), 12(1), 13(?), 14(?). Metathorax: hair 1(1), 2(2,2-3), 3(5,5-7), 4(3,2-4), 5(1,1-2), 6(1), 7(8,8-9), 8(?), 9(7-9), 10(1), 11(2-3), 12(1), 13(7). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,1-2), 4 (7-9), 5(4,3-4), 6(2), 7(2,1-2), 9(2,2-3), 10(1), 11(2,2-3), 12(2,2-3), 13(1). Segment II: hair 0(1), 1(1), 2(1), 3(1,1-2), 4(6,6-7), 5(3,3-5), 6(2), 7(4,1-4), 8(4, 4-5), 9(1), 10(1), 11(2,2-3), 12(2,2-3), 13(?). Segment III: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(2,2-3), 5(3), 6(2), 7(5,3-6), 8(2,2-3), 9(1), 10(1), 11(2,2-3), 12(2), 13(1), 14(1). Segment IV: hair 0(1), 1(1), 2(1), 3(2), 4(2), 5(3,2-3), 6(2), 7(7, 7-8), 8(2), 9(1), 10(1), 11(2), 12(2), 13(1,1-2), 14(1). Segment V: hair 0(1), 1 (1), 2(1), 3(1), 4(7,6-8), 5(3,3-4), 6(2), 7(6,6-7), 8(2), 9(1), 10(1), 11(3,2-3), 12 (1,1-2), 13(2), 14(1). Segment VI: hair 0(1), 1(5,5-6), 2(1), 3(1), 4(2), 5(3,3-4), 6(1), 7(5,4-5), 8(3,2-4), 9(1), 10(1), 11(3,2-5), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(2), 2(1), 3(5,4-6), 4(1), 5(3,3-4), 6(10,9-10), 7(1), 8(6,6-7), 9(2,2-3), 10(1), 11(3,2-3), 12(1), 13(2), 14(1). ***Segment VIII***: Comb scales slender at base and fringed only apically. Hair 0(1), 1(3,2-4), 2(1), 3(4,3-4), 4(1), 5(3), 14 (1). ***Siphon***: Integument light brown. Index about 4.4-4.9. Pecten teeth 5(4-7), similar to those of *epitedeus*. Hair 1(2), hair 1ad(3,2-3), hair 1av(4,2-4); hairs 2, 6,7,9 all single; 8(2). ***Siphon***: Gill about 0.76 of dorsal saddle length. Ventral margin of dorsal saddle not reaching alveolus of hair 1-X. Hair 1-X shorter than gill. Hair 1(1), 2(6,6-8), 3(1), 4a(12,11-14), 4b(11,11-14), 4c(12,11-12), 4d(12,11-14), 4e(13,12-15), 4f(11,10-14).

SYSTEMATICS. This species is the southern member of the Pacific complex of the group. As indicated under its close relative *costaricensis*, it can usually be readily separated from that species in all stages except on external features of the adults. Its distribution is probably more extensive than reported here.

BIONOMICS. All the collections of *curiche* are from large crabholes. This species has been found associated with *pseudes* and *Culex (C.) inflictus*. Nothing is known of its blood feeding habits.

DISTRIBUTION (fig. 6). Pacific coast of northern Colombia. Material examined: 71 specimens; 7 males, 9 females, 34 larvae, 21 pupae; 19 individual rearings (9 larval, 5 pupal, 5 incomplete).

COLOMBIA. *El Choco*: Curiche (COA 10,15,17,43,48,50) [BM, UCLA, USNM].

PSEUDES GROUP

FEMALES. Medium-sized species, wing 3.0-3.4 mm. Mesonotum dark brown; pleural integument usually tan or brownish and not strongly contrasting with mesonotal integument. ***Antenna***: Flagellar segment 1 with scales, length varied, about equal to combined length of segments 2-4 or 2-5; segments 2-12 subequal in length but progressively slightly shortened distad; length varied, exceeding proboscis from base of flagellar segment 9 to distal half of 7. ***Thorax***: Postnotum without bristles or with bristles in middle (usually in *mcdonaldi*). ***Apn*** usually tan to brownish; ***ppn*** usually light tan to brownish, scales broad on caudoventral area; ***ppl*** usually light tan to brownish; ***psp***, ***ssp***, ***stp*** and ***pra*** usually brownish; paratergite usually brownish; ***mep*** usually lighter than ***stp***, and with a patch of translucent scales, ***lmep*** with 1 very strong bristle; meron, metameron and metapleuron usually lighter than ***stp***. ***Legs***: Coxal integument usually lighter than ***stp***. Only posteroventral two-thirds of hindfemur pale, other femora dark; anteroventral margin of forefemur with or without spiniforms; when latter present then a row of short spiniforms near base of posterodorsal margin also present, when absent then a row of bristles present on both anteroventral and posterodorsal margins. ***Abdomen***: Sternites II,III or (usually) II-VI paler than tergites.

FEMALE GENITALIA. ***Sternite VIII*** with sclerotized distal band broad and without or with only a few scales; caudal margin not produced into a submedian ventral angle, this area without strongly differentiated marginal bristles. ***Tergite IX*** usually with a few setae on each side. ***Tergite X*** poorly differentiated dorsally and with a very small lateral sclerotization. ***Cercus*** with a few moderately strong apical or subapical normal bristles.

MALES. Essentially similar to females. ***Antenna***: Length varied, exceeding proboscis from base of flagellar segment 5 to middle of segment 3; flagellar segments 1 and 2 to 1-4 with scales; segments 1-7 markedly elongated but progressively shortened distad; segment 1 subequal to combined length of segments 2 and one-half of 3; segments 8-13 subequal but progressively slightly shortened distad; segment 13 sometimes slightly broader than 12. ***Legs***: Claws of foreleg strongly enlarged, similar in shape, either slender or heavy, usually both with a very minute submedian projection or a very minute slender subbasal tooth; claws of midleg slightly enlarged, similar in shape and simple.

MALE GENITALIA. ***Segment IX***: Tergite lobe cylindrical; angled laterad at base; apex always at least reaching base of subapical lobe. ***Sidepiece***: Without scales. Apicosternal lobe prominent, with a long apical seta. ***Phallosome***: Dorsal parameres with an incomplete dorsal bridge; articulated ventrally with a dorsal sclerotized projection from basal third of aedeagus.

PUPAE. ***Cephalothorax***: Hairs 2,3-C closely approximated, 2-C weaker and shorter than 3-C; hair 5-C double, strongly developed, longer than distance from its alveolus to base of trumpet, about 1.3-1.5 of trumpet length; 7-C usually double or triple (1-3); hair 8-C usually single (1 or 2). ***Metanotum***: Hair 10-C moderately to strongly developed, equal to or longer than 11-C, variously branched, usually double or triple (in *howardi* and *mcdonaldi*) to markedly multibranched (*pseudes*). ***Abdomen***: Hair 1-II not reaching apex of tergite III, usually multibranched (3-10 primary branches), if single or double then markedly secondarily dendritic; 1-III-VI branched; 5-II always laterad of 3-II; hair 3-V often single (1 or 2); hair 1-VII shorter than tergite VIII, at most reaching base of 4-VIII. ***Paddle***: Hair 1-P subequal to longer than paddle.

FOURTH INSTAR LARVAE. ***Head***: Hair 2-C at least subequal to 0.5 of 1-C, always markedly mesad of 1-C; hair 5-C usually with 4 barbed branches (3-5); hair 6-C single to triple, barbed, length varied, about 1.2 to 1.4 of 5-C. ***Thorax***: Prothoracic hair 9-P single. ***Abdomen***: Hair 6-II double; dorsal sensillum of segment V laterad of 4-V; hair 6-VI single; 1-VII moderately to strongly developed, always longer than 3-VII and exceeding base of segment VIII, sometimes reaching base of siphon; 1-VIII usually with 5 branches (2-7). ***Siphon***: Hair 1-S usually triple (2-4). ***Anal Segment***: Ventral brush (4-X) with 6 or 7 pairs of hairs. Gill short to moderately long, either round and slightly emarginate on apex or more or less cone-shaped and slightly emarginate on ventral margin. Length varied, about 0.45 to 0.9 of dorsal saddle length. Dorsal saddle narrow to moderately broad, its ventral margin sometimes near base of hair 1-X.

DISCUSSION. The Pseudes Group is proposed here for *pseudes*, *howardi* and *mcdonaldi* which were included by Belkin and Hogue (1959) in their Epitedeus Group. The new group contains the most complex and intriguing elements in the genus. The Pseudes Group shares with the restricted Epitedeus Group the development of a patch of mesepimeral scales in the adults but is distinguished from the latter by the presence of a strongly differentiated lower ***mep*** bristle. Its immature stages resemble those of the Cancer Group and their separation from that group is sometimes rather tenuous.

The group is known only from the Pacific basin except for the Atlantic intrusion of *pseudes* into the Gulf of Mexico. It is the only group whose species are not allopatric in distribution. All 3 have been found in 1 locality in the Bahia de Banderas area near the mouth of the Gulf of California.

Of the 3 included species, *mcdonaldi* appears to be the most primitive as it lacks the spiniforms of the forefemur in the adults (present in the other 2 species) and has 7 pairs of hairs in the ventral brush of the larva. This species appears to be restricted to the region of the Gulf of California in Mexico on the mainland as well as the tip of Baja California. *Deinocerites pseudes* is the modern dominant species of the entire genus with a distribution extending from the Gulf of California and the Gulf of Mexico to the Gulf of Guayaquil. It is thus the only species in the genus definitely known to be present in both the Atlantic and Pacific basins and it is the only one to show considerable variation especially on the periphery of its range. The third species, *howardi*, shows a remarkable mixture of morphological characters of different stages of *mcdonaldi* and *pseudes* and may have been produced through hybridization or introgression between these species as suggested by Belkin and Hogue (1959:436). The range of *howardi* is now known to extend from Bahia de Banderas, Mexico, to Nicaragua.

Two of the species, *mcdonaldi* and *howardi*, appear to be rare or uncommon, but *pseudes* is the most common species of the genus. Nothing is known of the bionomics of *mcdonaldi* or *howardi* but considerable information has been gathered on *pseudes* which has been colonized in Panama. The latter species will bite man and has been shown to have a wide variety of blood hosts including mammals, birds, lizards and amphibians. The immature stages of all 3 species have been found primarily in large crabholes (*Cardisoma* and *Gecarcinus*); *pseudes* has also been recorded from the smaller holes made by *Ucides* and even *Uca*.

16. *Deinocerites pseudes* Dyar & Knab

Figs. 7,50-52

1909. *Deinocerites pseudes* Dyar and Knab, 1909:260. TYPE: Lectotype female, Ancon, Panama, Canal Zone, A.H. Jennings, 378 [USNM, 12053; designation of Stone and Knight, 1957:197].

Deinocerites pseudes of Howard, Dyar and Knab (1915:210-213); Dunn (1917:167-168); Dyar (1923a:180; 1925:155; 1928:263-264,537); Bonne and Bonne-Wepster (1925:176); Edwards (1932:222); Martini (1935:57); Kumm and Zuniga (1942:406); Arnett (1950:107); Carpenter and Peyton (1952:677-681); Lane (1953:556,557); Horsfall (1955:599); Vargas (1956:30); Stone and Knight (1957:197); Forattini (1958:176); Stone, Knight and Starcke (1959:285); Diaz Najera (1963:190,191); Peyton, Reinert and Peterson (1964:449-458); Galindo (1967:187-190); Grayson, Shrihongse and Galindo (1967:204); Stone (1967:218); Hogue and Wirth (1968:6); Gorgas Memorial Institute (1970:20); Tempelis and Galindo (1970); Reinert (1970).
Culex (Deinocerites) pseudes of Dyar (1918:101).
Deinocerites cancer in part of Knab (1906:95-97).
Deinocerites epitedeus of Rueger and Druce (1950:60,62); Breland (1956:95); Evans (1962:255); Vargas (1956:30; 1960:342).
Deinocerites epitedeus in part of Lane (1953:559, U.S.A. record); Forattini (1958:176).

FEMALE (fig. 50). Wing 2.24-3.4 mm. Proboscis 1.93-2.29 mm. Forefemur 1.53-1.98 mm. Abdomen about 2.55-3.52 mm. Highly variable in size. ***Head***: Narrow decumbent scales creamy; erect scales yellowish to brownish; broad decumbent scales of lateral patch whitish. ***Antenna***: Torus without scales; flagellar segment 1 equal to combined length of segments 2-4 or 2 to basal third of 5; exceeding proboscis from base of flagellar segment 9 to base of segment 8. ***Thorax***: Postnotum without bristles; ***ppn*** with several bristles in lower part; ***ppl*** with numerous bristles and occasionally a few scales; ***mep*** with translucent scales usually covering most of the sclerite, also with numerous microsetae; ***umep*** bristles numerous; metameron simple. ***Legs***: Anterior surface of forecoxa largely covered by bristles and scales, basolateral area with several bristles; midcoxa with scales anterolaterally, laterally with 2 rows of bristles, the anterior row more or less irregular, posterior bristles stronger, posterolateral surface simple; hindcoxa with scales and bristles, upper lateroposterior surface with scales, posterior surface with bristles; forefemur with spiniforms in anteroventral and at base of posterodorsal rows.

FEMALE GENITALIA (fig. 50). ***Sternite VIII*** usually without scales, rarely with 1. ***Tergite IX*** occasionally with 1 seta on each side. ***Cercus*** (in lateral aspect) with ventral margin convex, dorsal margin slightly sinuous in basal part and slightly concave distally; apex slightly upturned, usually with 3 or 4 moderately strong apical or subapical bristles. Distal part of ***postgenital plate*** (in ventral aspect) with a very deep notch with parallel margins ending in a more or less round base; lateral lobe (in lateral aspect) elongate, its apical bristle parallel with its mate (in ventral aspect).

MALE (fig. 50). Wing 2.6-3.9 mm. Proboscis 2.2-3.0 mm. Forefemur 1.7-2.7 mm. Abdomen (not including genitalia) about 2.3-3.7 mm. Highly variable in size. Flagellar segments 1-3 with scales. Proboscis reaching basal third of flagellar segment 4 to base of segment 5. Claws of foreleg heavy, usually with a very minute submedian projection.

MALE GENITALIA (fig. 51). ***Segment IX***: Tergite lobe extremely variable, usually not extending beyond subapical lobe, with or without a distinct curvature and expansion. ***Sidepiece***: Subapical lobe with a large thumb; seta ***c*** spiniform and usually rather heavy. ***Phallosome***: Dorsal parameres with a very slight indication of a narrow incomplete dorsal bridge; apical spine short and broad; ventral teeth short and heavy and on a prominent lobe which in tergal aspect projects about as far caudad as the apical spine. Aedeagus, as seen in tergal aspect, with very sinuous outer margins, markedly constricted beyond middle and narrowing apically; apex slightly swollen.

PUPA (fig. 51). Abdomen 4.0 mm. Trumpet 0.45 mm. Paddle 0.76 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. Hair 5-III usually exceeding the spiracular sensillum and sometimes the alveolus of hair 4 of the second segment following. Hairs 5-IV,V usually reaching and/or exceeding alveolus of hair 4 of the second segment following. ***Cephalothorax***: Integument yellowish. Hair 1(2), 2(4,2-5), 3(2,1-2), 4(4,4-6), 5(2), 6(1), 7(2), 8(1, 1-2), 9(2,1-2), 10(multibranched), 11(4,2-4), 12(3,3-5). ***Trumpet***: Short, progressively widening apically; index about 2.75-3.28. Integument strongly pigmented, contrasting with cephalothoracic integument, slightly darker on tracheoid, brown distad. Tracheoid about 0.3 and pinna about 0.26 of trumpet length. ***Abdomen***: Integument yellowish. Segment I: hair 1 (multibranched), 2(1), 3(2,2-4), 4(4,3-5), 5(6,3-7), 6(1), 7(4,2-6), 9(1), 10(occasionally present, 1), 11(occasionally present, 2). Segment II: hair 0(1), 1(usually multibranched, if single or double then markedly secondarily dendritic), 2(1,1-2), 3(1), 4(4-5,3-5), 5(1), 6(1), 7(2,1-3), 9(1). Segment III: hair 0(1), 1(5,3-6), 2(1), 3(2,1-4), 4(2,1-3), 5(1), 6(1), 7(2, 2-3), 8(4-5,2-6), 9(1), 10(2,2-3), 11(1), 14(1). Segment IV: hair 0(1), 1(3,3-4), 2(1), 3(4,3-5), 4(1), 5(1), 6(1,1-2), 7(2,1-3), 8(2,1-4), 9(1), 10(2,1-2), 11(1), 14 (1). Segment V: hair 0(1), 1(2,2-3), 2(1), 3(1,1-2), 4(4-5), 5(1), 6(1), 7(4,3-7), 8(2,2-4), 9(1), 10(1), 11(1), 14(1). Segment VI: hair 0(1), 1(2,2-4), 2(1), 3(1, 1-2), 4(2,2-3), 5(1), 6(1), 7(1), 8(1,1-3), 9(1), 10(1,1-2), 11(2,1-3), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(1), 5(2,1-3), 6(1,1-2), 7(1), 8(2,2-4), 9(4,3-5), 10(2,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(1,1-2), 9(1), 14 (1). ***Paddle***: Width about 0.77 of length; hair 1-P longer than paddle.

FOURTH INSTAR LARVA (fig. 52). Head 1.27 mm. Siphon 1.44 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. Length of hairs often variable throughout. ***Head***: Integument light brown. Mental plate wider than long, triangular; marginal spicules usually sharply pointed. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a minute spicule), 4(6,5-8), 5(4,3-4), 6(usually single, except in the northernmost populations [Brownsville, Texas] and 1 of the southernmost [Playas, Ecuador] in which they are single to triple, see systematics), 7(10,9-12), 8(4,3-5), 9(5,4-8), 10(2,2-3), 11(4,4-5), 12(2,1-2), 13(6, 5-6), 14(1), 15(2,1-3). ***Antenna***: Length about 0.46 of head; shaft with numerous spicules on proximal part. Hair 1(6,5-7). ***Thorax***: Prothorax: hair 0(15,10-16), 1 (1), 2(1), 3(2,2-3), 4(5,4-5), 5(1), 6(1), 7(4,4-5), 8(1,1-2), 9(1), 10(1,1-2), 11(4, 3-5), 12(1), 14(1). Mesothorax: hair 1(1), 2(2,2-3), 3(1), 4(3,2-3), 5(1), 6(1), 7 (1), 8(7,5-7), 9(8,6-8), 10(1), 11(4,3-5), 12(1), 13(7-19), 14(11-14). Metathorax: hair 1(2,1-2), 2(3,2-4), 3(6,4-7), 4(4,2-6), 5(1), 6(1,1-2), 7(9,8-10), 8(14-20), 9 (8,7-10), 10(1), 11(3,2-4), 12(1), 13(5,4-7). ***Abdomen***: Segment I: hair 1(1), 2 (1), 3(3,2-3), 4(9,8-13), 5(5,3-6), 6(2,2-3), 7(2,2-3), 9(3,2-3), 10(2,2-3), 11(3,2-

4), 12(2,2-3), 13(2,1-2). Segment II: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(7,5-7), 5 (4,4-5), 6(2), 7(4,3-5), 8(4,1-4), 9(1,1-2), 10(1), 11(2,1-3), 12(2,1-3), 13(?). Segment III: hair 0(1), 1(2,2-4), 2(1), 3(1), 4(2,1-3), 5(3,2-4), 6(2,1-2), 7(8,6-10), 8(2,1-3), 9(1), 10(1,1-2), 11(2,1-2), 12(2,2-3), 13(1), 14(1). Segment IV: hair 0 (1), 1(2), 2(1), 3(3,3-4), 4(1,1-2), 5(3,2-5), 6(2,2-3), 7(8,6-9), 8(1), 9(1), 10(1), 11(2,1-3), 12(2,2-3), 13(4,2-4), 14(1). Segment V: hair 0(1), 1(2,1-2), 2(1), 3 (1), 4(6,5-8), 5(4,2-5), 6(2), 7(7,7-10), 8(1), 9(1), 10(1), 11(2,2-3), 12(1,1-2), 13 (4,2-4), 14(1). Segment VI: hair 0(1), 1(4,3-7), 2(1), 3(1), 4(4,3-5), 5(4,3-6), 6 (1,1-2), 7(3,2-4), 8(3,2-4), 9(1), 10(1), 11(2,2-4), 12(1), 13(?), 14(1). Segment VII: hair 0(1), 1(1-2), 2(1), 3(4,1-5), 4(1), 5(5,2-5), 6(16,15-20), 7(2,1-2), 8(10, 9-13), 9(3,2-4), 10(1,1-2), 11(2), 12(1), 13(2,2-3), 14(1). ***Segment VIII***: Comb scales with fringe conspicuous at apex, less developed in distal half. Hair 0(1), 1(6,5-7), 2(1), 3(5,4-7), 4(1), 5(4,3-5), 14(2,2-3). ***Siphon***: Integument light brown. Index about 5.2-5.6. Pecten teeth 4(3-6), usually bifid, sometimes trifid, longest blade markedly wider; size variable, basal tooth usually shortest. Hair 1(4,3-4), hair 1ad(3,2-4), hair 1av(3,2-4); hairs 2,6,7,8,9 all single. ***Anal Segment***: Gill length about 0.56-0.9 of dorsal saddle length; gill either round and slightly emarginate on apex (usually in the northern and southernmost populations) or more or less conical and slightly emarginate on ventral margin (usually in central populations, see systematics). Dorsal saddle moderately broad and with its ventral margin near base of hair 1-X only when gill is conical. Length of hair 1-X variable as compared to gill length. Hair 1(1-2), 2(9,8-12), 3(1), 4a(15,14-17), 4b(12,12-16), 4c (11,10-14), 4d(12,11-13), 4e(13,13-15), 4f(13,13-16).

SYSTEMATICS. *Deinocerites pseudes* is the most widespread and the dominant species of the genus, with a range extending from the Gulf of Mexico (from south Texas) to the isthmus of Tehuantepec in the Atlantic basin and from the Gulf of California to the southern shores of the Gulf of Guayaquil in northern Peru in the Pacific basin. There are a few specimens apparently collected in the Atlantic basin of Panama but these may be strays or erroneously labelled as no recent specimens are known from this area.

The most characteristic and constant features of *pseudes* are the development of the dorsal paramere and the claws of the male, and of hair 10-C of the pupa. In most other characters, including size, *pseudes* shows a great deal of variation that is not found to any extent in any other species of the genus. The variability reaches its peak in the peripheral populations in the north and in the south.

In the adults, there is very striking variation in size, even in the same collection. I found no correlation between size and any other variation noted in the adults or the immature stages and consider that it is probably dependent on the nutrition of the larva. Another striking variation in the adults is in the relative length of the basal flagellar segments in both sexes. This variation affects greatly the proportional length of the antenna and proboscis as noted in the description.

The immature stages show a great deal of variability also and tend to be conspicuously differentiated at the periphery of the range in the north and in the south. It appears that in these peripheral populations there is a tendency for the same phenotypes to predominate possibly because of the marginal or severe environmental conditions encountered by the species in these areas.

At the northern periphery of the range only the populations in the Atlantic basin from Tampico northward show striking departures from the central populations. In the northernmost population in Texas, the larvae have hair 6-C usually double (1-3) and only slightly longer than 5-C, whereas in the central populations it is apparently always single and markedly longer than 5-C. Abdominal hair 1-VII tends to be poorly developed and shorter than in the central populations in which it is usually extremely long, often reaching the base of the siphon. The siphon in these northern populations is uniformly short, whereas in central populations it is variable. The anal gill is more or less round and with a slight apical emargination in the north while this condition is only rarely found in the central populations which normally have the gill more or less conical and with a slight ventral emargination. Specimens from Tampico show gills tending toward the type in Texas while those from Veracruz are more like the central populations, suggesting a clinal variation in the expression of this character. Both populations have a moderately long siphon. The length of the pupal hairs tends to be slightly reduced in these northern populations.

Of the peripheral southern populations, I have studied 1 each on the north and the south shores of the Gulf of Guayaquil. In the population from Playas, Ecuador (north), the larvae are similar to those from Texas with hair 6-C usually double and 1-VII, gill and siphon similarly developed. In the population from Tumbes, Peru, the larvae are essentially the same as in Playas except that hair 6-C is usually single and occasionally double but of the same relative length as in the Texas and Ecuador populations. The pupae in both populations have the hairs only slightly reduced in length.

BIONOMICS. Considerable additional information on the bionomics of this dominant and widespread species has been published since the summaries in Howard, Dyar and Knab (1915:212) and Belkin and Hogue (1959:449).

Knab (1906:95) reared adults of *pseudes* (as *cancer*) from immature stages collected in the burrows of *Cardisoma crassum* at Rio Aranjuez near Puntarenas, Costa Rica (336,339). Peyton, Reinert and Peterson (1964:451) recorded *pseudes* immatures from the holes of *Uca subcylindrica*, *Cardisoma guanhumi* and *Gecarcinus lateralis* in several localities in Texas. Other specific records of immature stages are from the burrows of *Cardisoma crassum* in Colombia (COA 23) and Costa Rica (CR 28) and of adults only from burrows of *Ucides occidentalis* in Colombia (COA 26). Other general records indicate that *pseudes* usually, but not always, breeds in large crabholes. Peyton, Reinert and Peterson (1964:453-454) report that *pseudes* in Texas appears to prefer crabholes of a diameter of 2 inches or more. These authors also recorded 2 unusual collections of immatures, 1 in a grassy pool containing a crabhole in Texas, the other from a treehole in Mexico (collection of R.B. Eads). They found the same range of pH (7.2-7.6) and chloride content (1,115-2,603 ppm) in the holes containing *pseudes* as in those utilized by *mathesoni*.

Through its extensive range, *pseudes* has been found to breed in association with a variety of mosquitoes: *mathesoni* in Texas (Peyton, Reinert and Peterson, 1964); *howardi* in Nicaragua (NI 3,5,14,15,26,27); *costaricensis* in Costa Rica (CR 28, 106,107,118); *curiche* and *dyari* in Colombia (COA 10,17,25,27,28,48,50); 1 or more members of the *Culex (C.) inflictus* complex in Costa Rica, Panama and Colombia; *Culex (Tin.) latisquama* in Panama; *Culex (Mel.) sp.* in Costa Rica and Panama; *Aedes (O.) taeniorhynchus* in Nicaragua and *Anopheles (A.) eiseni* in Colombia.

Galindo (1967) colonized *pseudes* in Panama and found that the eggs were laid singly above the water surface in a hollow cylinder of plaster of Paris simulating a crabhole. Hatching took place without flooding 48-60 hours after oviposition, larvae breaking out of the eggshell and either dropping or sliding down the sides of the container to the water below. At a constant temperature of 76° F, the larval cycle from hatching to pupation lasted 3 or 4 weeks and the pupal stage 3 or 4 days. In Texas, Peyton, Reinert and Peterson (1964:454) found that larvae collected in the field required 2-2½ months to complete their development and the pupae 7 or 8 days. Furthermore, they noted that fourth instar larvae collected during the latter part of November and in December did not pupate for at least 2 months whereas those collected in March pupate within 30 days or less. No first instar larvae were found during the winter months.

Considerable information has accumulated regarding the blood feeding habits of *pseudes* since Dyar's (1925:155) statement that "the adults are not known to bite". The species has been taken in horse-baited traps in Costa Rica (Kumm, Komp and Ruiz, 1940:392) and inside houses in El Salvador (Kumm and Zuniga, 1942:406). Peyton, Reinert and Peterson (1964:455) reported that in Texas *pseudes* will readily bite man from dusk to midnight. They also noted that a number of specimens reported as *Deinocerites* sp. from horse-baited traps in Panama (Blanton, Keenan and Peyton, 1955) were actually *pseudes*. Galindo (1967) found Panamanian *pseudes* to feed readily on man in the field as well as the laboratory and provided his colony with a source of blood from golden hamsters, guinea pigs and domestic chicks. More recent investigations on the blood feeding habits of *Deinocerites* in Panama (Gorgas Memorial Institute, 1970:20; Tempelis and Galindo, 1970) have shown that *pseudes* has a wide range of hosts including mammals, birds, lizards and amphibians.

The mating behavior of *pseudes* in the laboratory is described in some detail by Galindo (1967) who did not find either swarming or pupal attendance in this species.

DISTRIBUTION (fig. 7). Pacific coast from Bahia de Banderas, Jalisco, Mexico, to Gulf of Guayaquil in northern Peru; also Atlantic coast from Texas to state of Campeche, Mexico. Material examined: 9285 specimens; 951 males, 1239 females, 6054 larvae, 1041 pupae; 567 individual rearings (375 larval, 141 pupal, 51 incomplete).

COLOMBIA. *El Choco*: Curiche (COA 1,3,6-12,21,23,25-27,42-48,50) [UCLA]. *Narino*: Tumaco (PBR 989.65,67,68; 991.41; 994.8,9) [VALLE].

COSTA RICA. *Guanacaste*: El Coco (CR 201-212) [UCLA]. Samara (CR 195,198) [UCLA]. *Puntarenas*: Aranjuez, Rio, F. Knab (336) [USNM]. Boca de Barranca (CR 98,99,101-107,118, 233,235,237-244,248,251-254;LCBA2-4,12,104-106,111,112,115-118,122-124,126,135,137-143, 145,146,148,150,154,161,167,168,174,188,190,230); F.S. Truxal [LACM, UCLA]. Bonilla, Hacienda, H.W. Kumm (75) [USNM]; (CR 28,29) [UCLA]. Jicoral, H.W. Kumm et al (982) [USNM]. La Angostura (CR 111,115) [UCLA]. Puntarenas, H.W. Kumm et al (440) [USNM].Rincon,Osa Peninsula (CR 142) [UCLA]. San Lucas, Isla, H.W. Kumm et al (1117) [USNM].

ECUADOR. *Guayas*: Playas, 7 km E, near Data (ECU 157) [UCLA]; (LCBA 513,514) [LACM; UCLA].

EL SALVADOR. Espiritu Santo, H.W. Kumm (570) [USNM]. Estero Ticuiclapa [? Ticuistate], W.H.W. Komp (791, KO 32-29) [USNM].

GUATEMALA. *Escuintla*: San Jose [USNM].

HONDURAS. *Choluteca*: Trujillo, Rio Negro [USNM].

MEXICO. *Campeche*: Cuidad del Carmen, 36 km W (MF 14,15) [UCLA]. *Guerrero*: Puerto Marquez, near Acapulco (MEX 142,144,145) [UCLA]. Zihuatanejo, A. Duges [USNM]. *Jalisco*: Barra de Navidad (MT 1,4) [UCLA]. Puerto Vallarta [as Las Penas], A. Duges [UCLA, USNM]. *Tabasco*: Paraiso, near Puerto Ceiba [ISET]. *Tamaulipas*: Laguna de Chareil, Tampico (MEX 207A) [UCLA]. La Pesca (TEX 29,30,32) [UCLA]. Tampico (MEX 6-10) [UCLA]; A. Martinez [ISET]; J. Goldberger [USNM]. *Veracruz*: Boca del Rio, near Veracruz (MEX 80,85-88) [UCLA]. Coatzacoalcos (MEX 113) [UCLA]. Nautla, A. Duges [USNM]. Tuxpan (TEX 22-27) [UCLA]. Veracruz, on steamer [USNM].

NICARAGUA. *Chinandega*: Corinto, P.A. Woke (779,793,794,806). K.R. Maxwell (14) [USNM]. Punta San Jose [as Monypenny Pt.], Bahia el Rosario, W.H.W. Komp [USNM]. *Leon*: Puerto Somoza (NI 1,4,5,14,15,20,26,27) [UCLA]. *Rivas*: San Juan del Sur, P.A. Woke (KO 32-9) [USNM].

PANAMA AND CANAL ZONE. *Canal Zone*: Albrook Field, W.H.W. Komp [UCLA, USNM]; (PA 737,743,934) [UCLA]. Ancon, A.H. Jennings (69,352,371,378,411,440,464); L. Roth [USNM]. Cocoli, W.H.W. Komp [USNM]. Corozal, J. Zetek [UCLA, USNM]; L.H. Dunn; W.H.W. Komp [USNM]. Ft. Sherman, L.H. Dunn, 1 M [USNM]. Gatunella River, J. Zetek [USNM]. Howard Air Force Base (PA 468) [UCLA]. Monte Lirio, 2 F [UCLA, USNM]. Rodman Naval Station (PA 880,885-892,894,906-910) [UCLA]. *Darien*: El Real (PA 618,620,621) [UCLA]. Jaque (PA 608,611,615) [UCLA]. *Locality not specified*: (55-1, 64-1) [UCLA]. *Panama*: El Libano, Corozal (PA 484,565,566) [UCLA]. Juan Diaz (PA 569,1018-1023) [UCLA]. La Chorrera (ASM 11-1). Nueva Gorgona (PA 998,1001) [UCLA]. Panama (49-57-1) [UCLA]. L.H. Dunn [USNM]. *Perlas, Archipielago de las*: Contadora, Isla, GML (PA 1045-1047) [UCLA]. San Jose, Isla, J.P.E. Morrison [USNM]. *Tobaga, Isla*: A. Busck [USNM].

PERU. *Tumbes*: Tumbes, Playa Hermosa (PER 15) [UCLA]; (LCBA 505-510) [LACM].

TEXAS. *Cameron County*: Boca Chica Beach, E.L. Peyton [USNM]. Laguna Vista (MT 10) [UCLA]. Stell-Lind Banco, E.L. Peyton, J.F. Reinert and N.E. Peterson [USNM]; (TEX 1-7, 12) [UCLA].

17. *Deinocerites howardi* Belkin & Hogue

Figs. 7,53-55

1959. *Deinocerites howardi* Belkin and Hogue, 1959:441-442. TYPE: Holotype male, Las Penas (Puerto Vallarta), Jalisco, Mexico, 10 May 1903, A. Duges [USNM, 64264].

Deinocerites howardi of Stone, Knight and Starcke (1959:284); Ross (1962:192).

FEMALE (fig. 53). Wing 3.16 mm. Proboscis 2.16 mm. Forefemur 1.88 mm. Abdomen about 3.11 mm. Essentially similar to *pseudes* except for antenna which exceeds proboscis from at least distal third of segment 7.

FEMALE GENITALIA (fig. 53). ***Sternite VIII*** usually with a few scales. ***Tergite IX*** with more than 2 setae on each side (3-7). ***Cercus*** (in lateral aspect) basically similar to that of *pseudes*. Distal part of ***postgenital plate*** basically as in *pseudes* except margins of notch converging to a round base; apical bristle of lateral lobe slightly converging basally, then parallel with its mate (in ventral aspect).

MALE (fig. 53). Wing 3.01 mm. Proboscis 2.29 mm. Forefemur 2.29 mm. Abdomen (not including genitalia) about 2.75 mm. Flagellar segments 1-3 with scales. Proboscis at most reaching distal third of segment 3. Claws as in *mcdonaldi*.

MALE GENITALIA (fig. 54). Apparently indistinguishable from *mcdonaldi*.

PUPA (fig. 54). Abdomen 3.69 mm. Trumpet 0.56 mm. Paddle 0.66 mm. Diagnostic characters as in the key; general chaetotaxy based on 10 reared specimens. Hairs 5-III-V moderately long, usually not reaching the spiracular sensillum of the second segment following. ***Cephalothorax***: Integument yellowish. Hair 1(2,2-3), 2 (4,3-6), 3(2,2-3), 4(2,2-3), 5(2,1-2), 6(1), 7(2,2-3), 8(1,1-2), 9(2,1-2), 10(3,2-4), 11(3,2-3), 12(3,2-4). ***Trumpet***: As in *mcdonaldi*; index about 4.0-6.0. Tracheoid about 0.3 and pinna 0.12 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(18,13-22 primary branches), 2(1,1-3), 3(1-2), 4(2,2-5), 5(5,3-5), 6(1,1-2), 7(4,3-5), 9(1,1-2), 10(occasionally present, 1), 11(occasionally present, 2,1-3). Segment II: hair 0(1), 1(5,3-9 primary branches), 2(1, 1-2), 3(1), 4(4,2-5), 5(1), 6(1), 7(2,2-3), 9(1). Segment III: hair 0(1), 1(6,3-10), 2(1), 3(2,1-3), 4(2,1-3), 5(1,1-2), 6(1), 7(3,1-3), 8(3,2-5), 9(1), 10(2,1-2), 11(1), 14(1). Segment IV: hair 0(1), 1(6,4-7), 2(1), 3(4,2-5), 4(1,1-2), 5(1,1-2), 6(1), 7(2,1-3), 8(2,2-3), 9(1), 10(2), 11(1,1-2), 14(1). Segment V: hair 0(1), 1(5,2-6), 2(1), 3(1,1-2), 4(4,2-5), 5(1), 6(1), 7(3,1-5), 8(2,1-3), 9(1), 10(2,1-2), 11(2,1-3), 14(1). Segment VI: hair 0(1), 1(3,1-4), 2(1), 3(2,1-2), 4(3,2-3), 5(1), 6(1), 7(1), 8(2,1-3), 9(1), 10(1,1-2), 11(1,1-3), 14(1). Segment VII: hair 0(1), 1(1,1-2), 2 (1), 3(2,1-3), 4(1,1-2), 5(2,2-4), 6(1), 7(1), 8(2,1-3), 9(4,1-5), 10(1,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1). ***Paddle***: Width about 0.82 of length; hair 1-P subequal to paddle.

FOURTH INSTAR LARVA (fig. 55). Head 1.11 mm. Siphon 1.52 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens. ***Head***: Yellowish to light brown. Mental plate as broad as long, triangular; terminal spicules long and filamentous, lateral shorter and denticulate. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a minute spicule), 4(6,4-6), 5(4,4-5), 6(2-3), 7 (9,8-11), 8(3,2-5), 9(6,4-7), 10(2,1-2), 11(4,3-7), 12(2,2-3), 13(8,6-8), 14(1), 15 (2,2-3). ***Antenna***: Length about 0.46 of head; shaft with numerous spicules on proximal part. Hair 1(5,4-6). ***Thorax***: Prothorax: hair 0(8,8-11), 1(1), 2(1), 3(1), 4(4,2-4), 5(1), 6(1), 7(3,2-4), 8(1,1-2), 9(1,1-2), 10(1), 11(3,3-4), 12(1), 14(1). Mesothorax: hair 1(1), 2(3,2-3), 3(1), 4(2,1-3), 5(1), 6(1), 7(1), 8(7,6-9), 9(7,6-9), 10(1), 11(3,2-4), 12(1), 13(12,9-12), 14(11,5-13). Metathorax: hair 1(1,1-2), 2(3,2-3), 3(5,5-6), 4(4,4-6), 5(1,1-2), 6(1), 7(8,7-8), 8(11-14), 9(9,7-9), 10(1), 11 (3,1-4), 12(1), 13(4,4-5). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(7,7-10), 5(3,1-5), 6(2,2-3), 7(2,1-2), 9(2,2-3), 10(1,1-2), 11(2,1-3), 12(1,1-2), 13(1, 1-2). Segment II: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(6,4-8), 5(5,3-5), 6(2), 7(3,2-4), 8(4,3-6), 9(1), 10(1), 11(3,3-4), 12(1), 13(11-13). Segment III: hair 0(1), 1 (2,1-2), 2(1), 3(1), 4(1), 5(3,3-5), 6(2), 7(5,3-6), 8(2,1-2), 9(1), 10(1), 11(2), 12 (2), 13(1), 14(1). Segment IV: hair 0(1), 1(2,1-2), 2(1,1-2), 3(3,1-3), 4(1), 5(3, 2-4), 6(2), 7(6,3-7), 8(1), 9(1), 10(1), 11(2,1-3), 12(1), 13(2), 14(1). Segment V: hair 0(1), 1(2,1-2), 2(1), 3(1), 4(4,4-5), 5(4,3-5), 6(2), 7(6,6-7), 8(1), 9(1), 10(1), 11(1), 12(2,2-4), 13(3,2-4), 14(1). Segment VI: hair 0(1), 1(3,2-3), 2(1), 3(1), 4(3,3-4), 5(4,3-4), 6(1), 7(3,2-3), 8(4,3-6), 9(1), 10(1), 11(2,2-3), 12(1), 13 (15,14-18), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,2-3), 4(1), 5(4,4-5), 6 (10,8-12), 7(1), 8(5,4-7), 9(2), 10(1), 11(2), 12(1), 13(1,1-2), 14(1). ***Segment VIII***: Comb scales similar to those of *mcdonaldi*. Hair 0(1), 1(5,4-7), 2(1), 3(3, 2-5), 4(1), 5(3,3-4), 14(2,1-4). ***Siphon***: Integument light brown. Index about 4.3-5.6. Pecten teeth 5(2-6), in general similar to those of *pseudes*. Hair 1(3,3-4), hair 1ad(3,2-4), hair 1av(3,2-3); hairs 2,6,7,9 all single; 8(2,1-2). ***Anal Segment***: Hair 1-X and gill length probably similar to *mcdonaldi*. Hair 1(2,1-3), 2(7,6-10), 3(1), 4a(11,8-12), 4b(8,7-11), 4c(9-10,7-12), 4d(8,6-10), 4e(9,7-9), 4f(9,8-11), 4g(11,10-14).

SYSTEMATICS. The nature or origin of *howardi* is the most intriguing and possibly the most significant problem in the genus. Belkin and Hogue (1959:442) suggested that *howardi* was formed through hybridization or introgression between the ancient *mcdonaldi* stock and the modern dominant *pseudes* because of the peculiar combination in *howardi* adults of general external features (spiniforms of forefemur and lack of postnotal bristle) indistinguishable from those of *pseudes* and of genitalia and claws of the male indistinguishable from those of *mcdonaldi* and because of the sympatric occurrence of the 3 species. I have studied the immature stages of *howardi* (unknown to Belkin and Hogue) and have found them to be so similar to *mcdonaldi* that separation of the 2 is sometimes not feasible on the basis of the combination of characters in the keys. Belkin and Hogue (loc. cit.) also noted that the antennae of both sexes were longer than in *pseudes* or *mcdonaldi*, implying this to be a manifestation of hybrid vigor. I find that in the female of *howardi* there are usually more numerous setae on IX tergite lobe of the genitalia than in the other 2 species.

I tend to agree with Belkin and Hogue as to the probable origin of *howardi* through hybridization for the reasons given below. First, the presence of some larval characters of *pseudes* in some larvae of *mcdonaldi* (see) suggests that introgression may occur occasionally between these 2 species. Second, such hybridization could occur in an isolated area marginal to both species (Bahia de Banderas) where a hybrid might have a selective advantage. Should such a hybrid become stabilized it would probably be reproductively isolated from both *mcdonaldi* and *pseudes*, thus explaining the unique situation in *Deinocerites* of the sympatric occurrence of 3 members of the same group.

Alternative derivation of *howardi* either from *mcdonaldi* or *pseudes* or independently of the others from a stock common to all 3 species would involve the development of identical combinations of characters in different lines or acquisition and subsequent loss of several characters in 1 line and would appear to be a more tenuous and less probable explanation.

The problem of the origin of *howardi* might possibly be resolved in the future through experimental hybridization and cytogenetic analysis.

BIONOMICS. The immature stages of *howardi* have been collected in large crabholes. In Mexico these were associated with *Aedes (O.) taeniorhynchus* and in Nicaragua with *taeniorhynchus* and *pseudes*. Nothing is known of the blood feeding habits of *howardi*.

DISTRIBUTION (fig. 7). Pacific coast from Bahia de Banderas, Mexico, to Nicaragua. Material examined: 196 specimens; 50 males, 25 females, 81 larvae, 40 pupae; 39 individual rearings (25 larval, 13 pupal, 1 incomplete.

EL SALVADOR. Estero Ticuiclapa [? Ticuistate], W.H.W. Komp (791, KO 32-29) [USNM].

MEXICO. *Colima*: Manzanillo, M. Rueda [ISET]. *Guerrero*: Puerto Marquez, near Acapulco (MEX 144) [UCLA]. *Jalisco*: Barra de Navidad (MT 1) [UCLA]. Puerto Vallarta [as Las Penas], A. Duges [UCLA, USNM].

NICARAGUA. *Chinandega*: Corinto, P.A. Woke (806) [USNM]. Punta San Jose [as Monypenny Pt.], Bahia el Rosario [USNM]. *Leon*: Puerto Somoza (NI 3,5,14,15,26,27) [UCLA].

18. *Deinocerites mcdonaldi* Belkin & Hogue

Figs. 7,56-58

1959. *Deinocerites mcdonaldi* Belkin and Hogue, 1959:437-438. TYPE: Holotype male (UCLA 199-116) with associated larval and pupal skins, San Blas, Nayarit, Mexico, 26 June 1956, W.A. McDonald [USNM, 64263].

Deinocerites mcdonaldi of Stone, Knight and Starcke (1959:285).

FEMALE (fig. 56). Wing 3.01 mm. Proboscis 2.09 mm. Forefemur 1.73 mm. Abdomen about 2.5 mm. ***Head***: Narrow decumbent scales of vertex creamy; erect scales yellowish to pale brown; broad decumbent scales of lateral patch whitish. ***Antenna***: Torus usually with 1 scale; flagellar segment 1 slightly longer than segments 2-4 combined; exceeding proboscis from base of flagellar segment 9. ***Thorax***: Postnotum usually with 1 bristle near middle; ***ppl*** with several bristles; ***mep*** with a patch of translucent scales usually in upper two-thirds, body of sclerite with a few microsetae; only a few ***umep*** bristles; metameron simple. ***Legs***: Scaling similar to *pseudes* except for upper lateroposterior scales on hindcoxa which are absent; forefemur with bristles only in anteroventral and posterodorsal rows.

FEMALE GENITALIA (fig. 56). ***Sternite VIII*** with a few scales. ***Tergite IX*** with 1-3 setae on each side. ***Cercus*** in lateral aspect basically similar to that of *pseudes*. Distal part of ***postgenital plate*** basically as in *pseudes* except for shallower notch and bristles of lobes converging (in ventral aspect).

MALE (fig. 56). Wing 3.11 mm. Proboscis 2.24 mm. Forefemur 2.24 mm. Abdomen (not including genitalia) about 2.75 mm. Flagellar segments 1 and 2 with scales. Proboscis reaching base of flagellar segment 4. Claws of foreleg slender, with a very minute slender subbasal tooth.

MALE GENITALIA (fig. 57). ***Segment IX***: Tergite lobe with distal part moderately long, slender, reaching base of subapical lobe but not extending beyond; slightly hooked apically. ***Sidepiece***: Subapical lobe with a distinct thumb; seta ***c*** spiniform and attenuated apically. ***Phallosome***: Dorsal paramere with short, broad incomplete dorsal bridge; apical spine moderately long, heavy and markedly curved; ventral teeth short, arising from the evenly convex ventrolateral border. Aedeagus with highly sinuous margins and with a subapical necklike constriction; apex narrow and slightly emarginate.

PUPA (fig. 57). Abdomen 3.03 mm. Trumpet 0.61 mm. Paddle 0.66 mm. Diagnostic characters as in the key; general chaetotaxy based on 8 reared specimens. Hairs 5-III-V moderately long, usually reaching and sometimes slightly exceeding sensillum of the second segment following, 5-III usually slightly longer than 5-IV,V. ***Cephalothorax***: Integument yellowish. Hair 1(2,1-3), 2(3,2-5), 3(2), 4(2,1-3), 5(2,1-2), 6(1), 7(2,1-2), 8(1), 9(2,1-3), 10(2,2-4), 11(2,1-4), 12(2,2-4). ***Trumpet***: Short, slightly widening apically; index about 4.5-5.6. Integument brown distad, darker on tracheoid; contrasting with cephalothoracic integument. Tracheoid about 0.33 and pinna about 0.12 of trumpet length. ***Abdomen***: Integument yellowish to medium brown. Segment I: hair 1(18,16-22, primary branches), 2(2, 1-3), 3(2,1-2), 4(5,4-6), 5(6,4-6), 6(1), 7(2,2-4), 9(1), 10(occasionally present, 1), 11(occasionally present, 1,1-3). Segment II: hair 0(1), 1(6,3-8), 2(1), 3(1), 4(4, 4-6), 5(1), 6(1), 7(2,1-3), 9(1). Segment III: hair 0(1), 1(4,4-6), 2(1), 3(2,2-5), 4(2), 5(1), 6(1), 7(3,3-4), 8(6,4-6), 9(1), 10(2), 11(1), 14(1). Segment IV: hair 0(1), 1(4,2-5), 2(1), 3(4,3-5), 4(1,1-2), 5(1), 6(1), 7(2,2-3), 8(2,2-3), 9(1), 10(2), 11(1), 14(1). Segment V: hair 0(1), 1(2,2-4), 2(1), 3(1,1-2), 4(5,4-6), 5(1), 6(1), 7(4,3-6), 8(2,2-3), 9(1), 10(1,1-2), 11(1,1-2), 14(1). Segment VI: hair 0(1), 1(2, 1-3), 2(1), 3(1,1-2), 4(3,2-4), 5(1), 6(1,1-2), 7(1), 8(2,2-3), 9(1), 10(1), 11(2,1-2), 14(1). Segment VII: hair 0(1), 1(1), 2(1), 3(2,1-2), 4(1,1-2), 5(2,1-3), 6(1), 7(1,1-2), 8(3,1-4), 9(3,1-4), 10(1,1-2), 11(1,1-2), 14(1). Segment VIII: hair 0(1), 4(2,1-2), 9(1), 14(1,1-2). ***Paddle***: Width about 0.82 of length; hair 1-P as long as or slightly longer than paddle.

FOURTH INSTAR LARVA (fig. 58). Head 1.11 mm. Siphon 1.16 mm. Diagnostic characters as in the key; general chaetotaxy based on 7 reared specimens. ***Head***: Integument yellowish to light brown. Mental plate triangular; length variable, either as broad as or broader than long, spicules long and usually filamentous, sometimes lateral ones denticulate. Hair 0(1), 1(1), 2(1), 3(sometimes developed as a minute spicule), 4(6,6-9), 5(4,4-5), 6(2), 7(10,8-11), 8(2,2-3), 9(5, 4-6), 10(2,1-2), 11(4,3-6), 12(2), 13(7,6-7), 14(1), 15(3,2-4). ***Antenna***: Length about 0.46 of head; shaft with a few spicules on proximal part. Hair 1(6,4-8). ***Thorax***: Prothorax: hair 0(9,8-10), 1(1), 2(1), 3(2,1-2), 4(4,3-5), 5(1), 6(1), 7(4, 2-4), 8(1,1-3), 9(1), 10(1), 11(4,3-5), 12(1), 14(1). Mesothorax: hair 1(1), 2(3, 2-3), 3(1), 4(2,2-3), 5(1), 6(1), 7(1), 8(8,8-9), 9(8,6-12), 10(1), 11(3,2-4), 12(1), 13(11,10-13), 14(11,9-12). Metathorax: hair 1(1,1-2), 2(2,2-3), 3(5,4-7), 4(4,3-6), 5(1), 6(1), 7(9,7-10), 8(9-14), 9(9,8-10), 10(1), 11(3,2-4), 12(1), 13(5,5-9). ***Abdomen***: Segment I: hair 1(1), 2(1), 3(2,2-3), 4(10,7-10), 5(3,3-4), 6(2,1-3), 7(2), 9(3,2-3), 10(1,1-2), 11(2,2-3), 12(2,1-3), 13(2). Segment II: hair 0(1), 1(1), 2(1), 3(2,1-3), 4(7,6-8), 5(4,4-6), 6(2), 7(4,3-6), 8(4,3-4), 9(1), 10(1), 11(4,2-4), 12 (1), 13(12,12-15). Segment III: hair 0(1), 1(2,1-2), 2(1), 3(1), 4(1), 5(4,3-5), 6 (2), 7(5,5-6), 8(2), 9(1), 10(1), 11(2), 12(2), 13(1,1-2), 14(1). Segment IV: hair 0(1), 1(2), 2(1), 3(2,1-3), 4(1), 5(4,3-5), 6(2), 7(6,6-8), 8(1), 9(1), 10(1), 11(2), 12(2), 13(2,2-3), 14(1). Segment V: hair 0(1), 1(1,1-2), 2(1), 3(1), 4(6,4-6), 5 (4,3-6), 6(2), 7(7,6-8), 8(1,1-2), 9(1), 10(1), 11(2,2-3), 12(1), 13(3,2-4), 14(1). Segment VI: hair 0(1), 1(3,3-4), 2(1), 3(1), 4(3,3-4), 5(5,3-6), 6(1), 7(3,2-3), 8 (3,2-4), 9(1), 10(1), 11(2,2-3), 12(1), 13(18,15-19), 14(1). Segment VII: hair 0 (1), 1(2,1-3), 2(1), 3(3,2-3), 4(1), 5(4,3-5), 6(12,9-12), 7(1), 8(6,5-8), 9(3,2-5), 10(1), 11(2), 12(1), 13(2,1-3), 14(1). ***Segment VIII***: Comb scales with slender body, fringe conspicuous at apex, less developed in distal half. Hair 0(1), 1(5, 2-5), 2(1), 3(5,4-6), 4(1), 5(3,3-4), 14(2,2-3). ***Siphon***: Integument light brown. Index about 3.2-4.6. Pecten teeth 5(4-6), in general similar to those of *pseudes*. Hair 1(3,2-4), hair 1ad(3,3-4), hair 1av(3,2-4); hairs 2,6,7 and 9 all single; 8(2, 1-2). ***Anal Segment***: Gill about 0.45 of dorsal saddle length. Hair 1-X usually subequal to gill length. Hair 1(2,1-2), 2(9,8-10), 3(1), 4a(12,11-14), 4b(11,11-12), 4c(10,10-11), 4d(10,10-11), 4e(12,9-12), 4f(12,11-14), 4g(12,8-15).

SYSTEMATICS. *Deinocerites mcdonaldi* is sharply differentiated from the other members of the group in the adults by the presence of only simple bristles on the forefemur instead of spiniforms. The genitalia and claws of its male are indistinguishable from *howardi* and it also shares with the latter species a ventral brush of 7 pairs of hairs. I interpret *mcdonaldi* as the earliest derivative of the Pseudes Group stock.

It has been suggested that *howardi* (see) arose through hybridization or introgression between *mcdonaldi* and the modern dominant *pseudes*. That introgression between the latter 2 species may occur is also suggested in a sample of larvae of *mcdonaldi* (MEX 476) which contains some specimens with hair 6-C single and strongly developed and 1-VII long as in *pseudes* while all the other characters are typical of *mcdonaldi*.

The surmise of Belkin and Hogue (1959:438) that the population from Baja California is not differentiated from that of the mainland of Mexico is confirmed here on the basis of larvae, pupae and adults.

BIONOMICS. Immature stages of *mcdonaldi* have been collected most frequently in large crabholes. In several collections in San Jose del Cabo, Baja California, Mexico, the species of crab inhabiting the burrows was identified as *Cardisoma crassum*, the pH was found to be 7.6-8.0 and the chloride content ranged from 2,350-8,400 ppm. In Puerto Vallarta, Jalisco, Mexico, *mcdonaldi* was found associated with *belkini*, *Aedes (O.) taeniorhynchus* and a member of the *Culex (C.) inflictus* complex. Nothing is known of the blood feeding habits of *mcdonaldi*.

DISTRIBUTION (fig. 7). Mouth of the Gulf of California on mainland and lower part of Baja California. Material examined: 2506 specimens; 287 males, 272 females, 1506 larvae, 441 pupae; 183 individual rearings (76 larval, 62 pupal, 45 incomplete).

MEXICO. *Baja California Sur*: Isla Espirutu Santo, Bahia San Gabriel [LACM]. San Jose del Cabo, W.G. Downs [USNM]; (MEX 389-393) [UCLA]. *Jalisco*: Puerto Vallarta [as Las Penas], A. Duges [UCLA, USNM]; (MEX 460-484) [UCLA, USNM]; (LCBA 532) [LACM]. *Nayarit*: San Blas, Matanchen (UCLA 199,204) [UCLA, USNM]; (MF 4,6) [UCLA]. *Sinaloa*: Mazatlan (3176,3179,3325) [ISET].

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FIGURES

1. *Deinocerites cancer*; female
2. Distribution of the genus *Deinocerites*
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5. Distribution of the Cancer Group
6. Distribution of the Epitedeus Group
7. Distribution of the Pseudes Group
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9. *Deinocerites atlanticus*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
10. *Deinocerites atlanticus*; male genitalia and pupa
11. *Deinocerites atlanticus*; larva
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13. *Deinocerites mathesoni*; male genitalia and pupa
14. *Deinocerites mathesoni*; larva
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17. *Deinocerites belkini*; larva
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19. *Deinocerites dyari*; male genitalia and pupa
20. *Deinocerites dyari*; larva
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22. *Deinocerites nicoyae*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
23. *Deinocerites nicoyae*; male genitalia and pupa
24. *Deinocerites nicoyae*; larva
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26. *Deinocerites cancer*; male claws, female legs and genitalia
27. *Deinocerites cancer*; male genitalia and pupa
28. *Deinocerites cancer*; larva
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30. *Deinocerites melanophylum*; male genitalia and pupa
31. *Deinocerites melanophylum*; larva
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34. *Deinocerites magnus*; larva
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36. *Deinocerites epitedeus*; male genitalia and pupa
37. *Deinocerites epitedeus*; larva

38. *Deinocerites panamensis*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
39. *Deinocerites panamensis*; male genitalia and pupa
40. *Deinocerites panamensis*; larva
41. *Deinocerites colombianus*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
42. *Deinocerites colombianus*; male genitalia and pupa
43. *Deinocerites colombianus*; larva
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45. *Deinocerites costaricensis*; male genitalia and pupa
46. *Deinocerites costaricensis*; larva
47. *Deinocerites curiche*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
48. *Deinocerites curiche*; male genitalia and pupa
49. *Deinocerites curiche*; larva
50. *Deinocerites pseudes*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
51. *Deinocerites pseudes*; male genitalia and pupa
52. *Deinocerites pseudes*; larva
53. *Deinocerites howardi*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
54. *Deinocerites howardi*; male genitalia and pupa
55. *Deinocerites howardi*; larva
56. *Deinocerites mcdonaldi*; male and female heads, female forefemur and genitalia, and male foreclaws and midclaws
57. *Deinocerites mcdonaldi*; male genitalia and pupa
58. *Deinocerites mcdonaldi*; larva

Fig. 1

DEINOCERITES

cancer

JA 736
Kingston &
St. Andrew
Jamaica

N. Kitamura

Fig. 2

DEINOCERITES

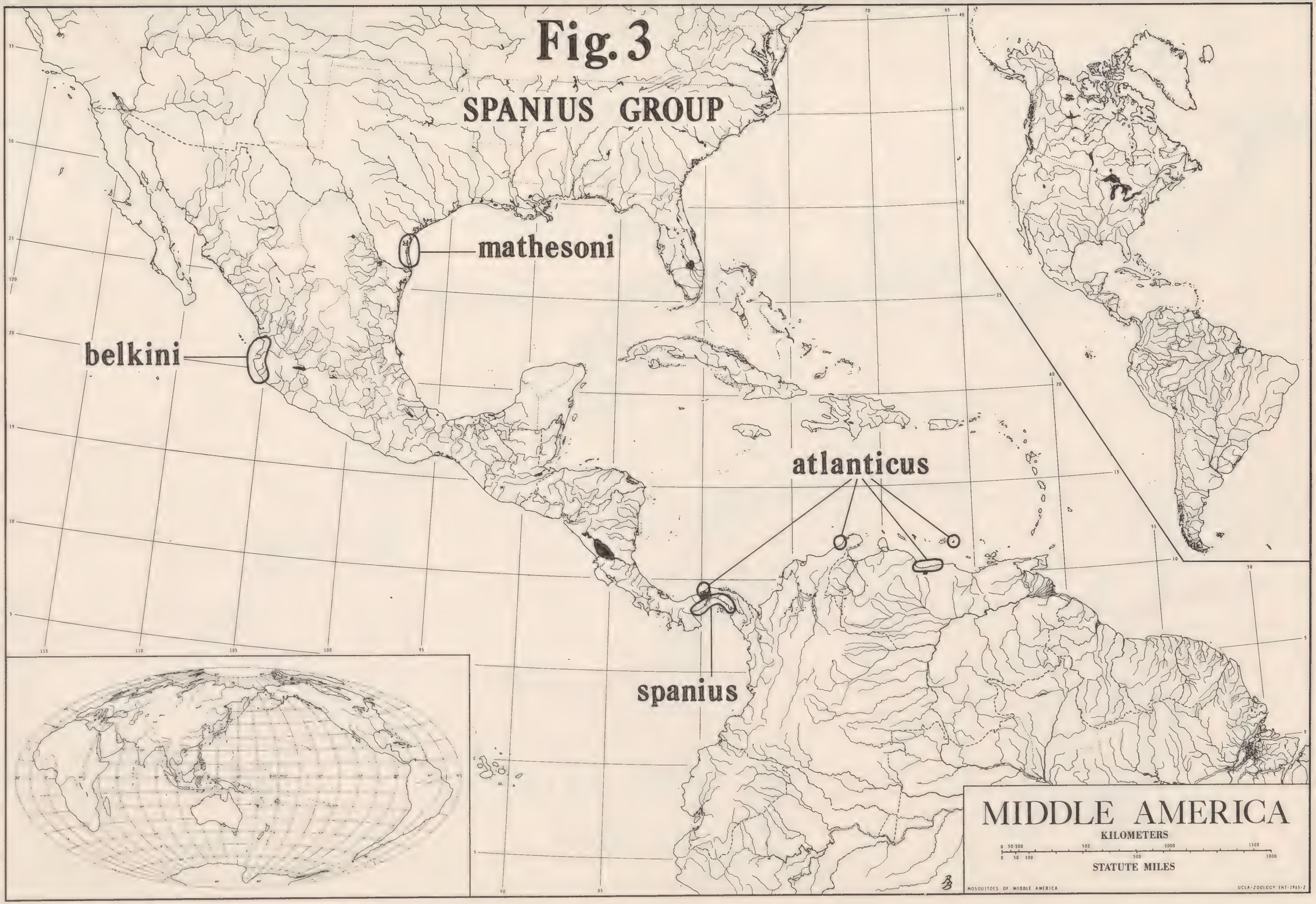


Fig. 3

SPANIUS GROUP

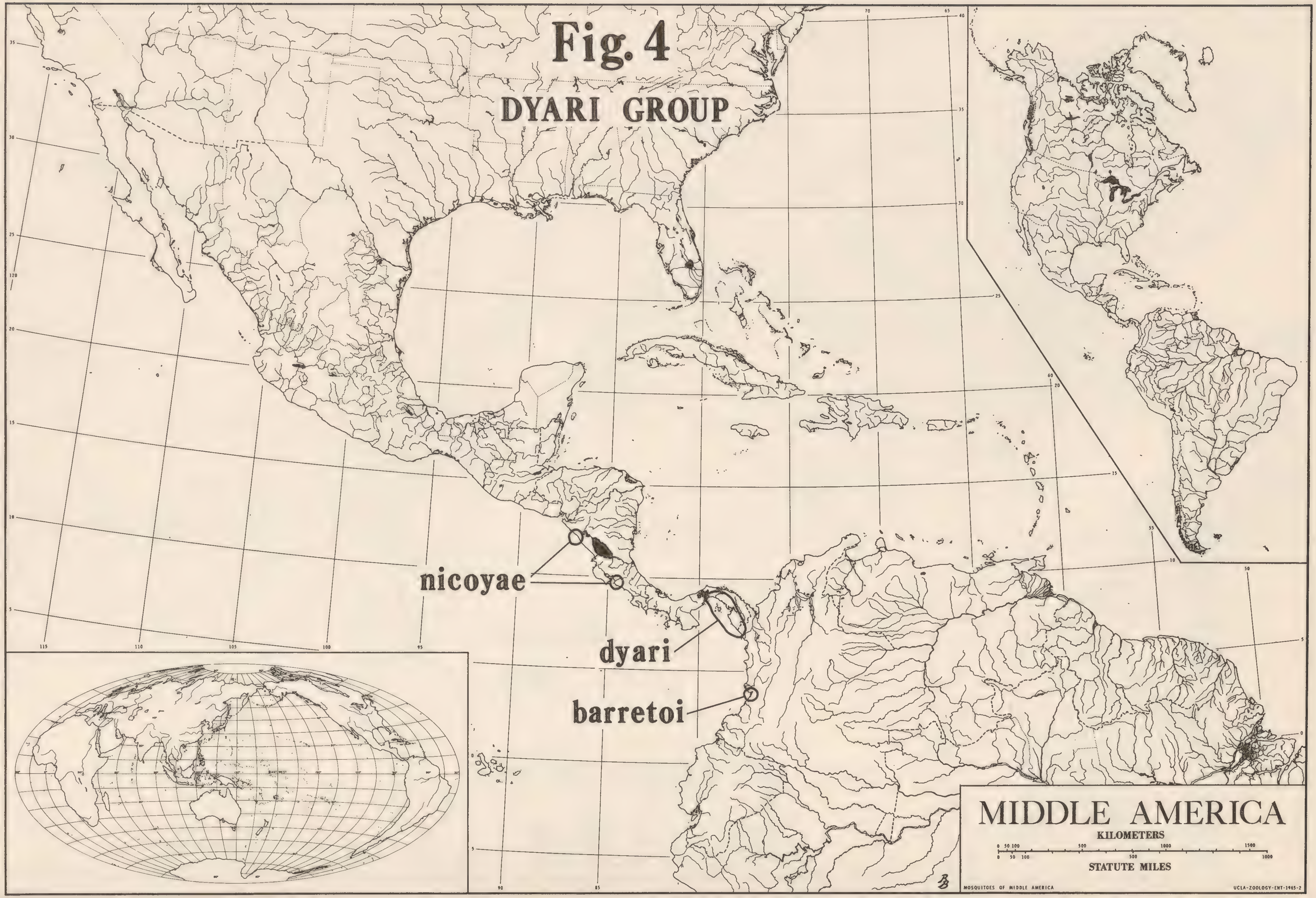


Fig. 4

DYARI GROUP

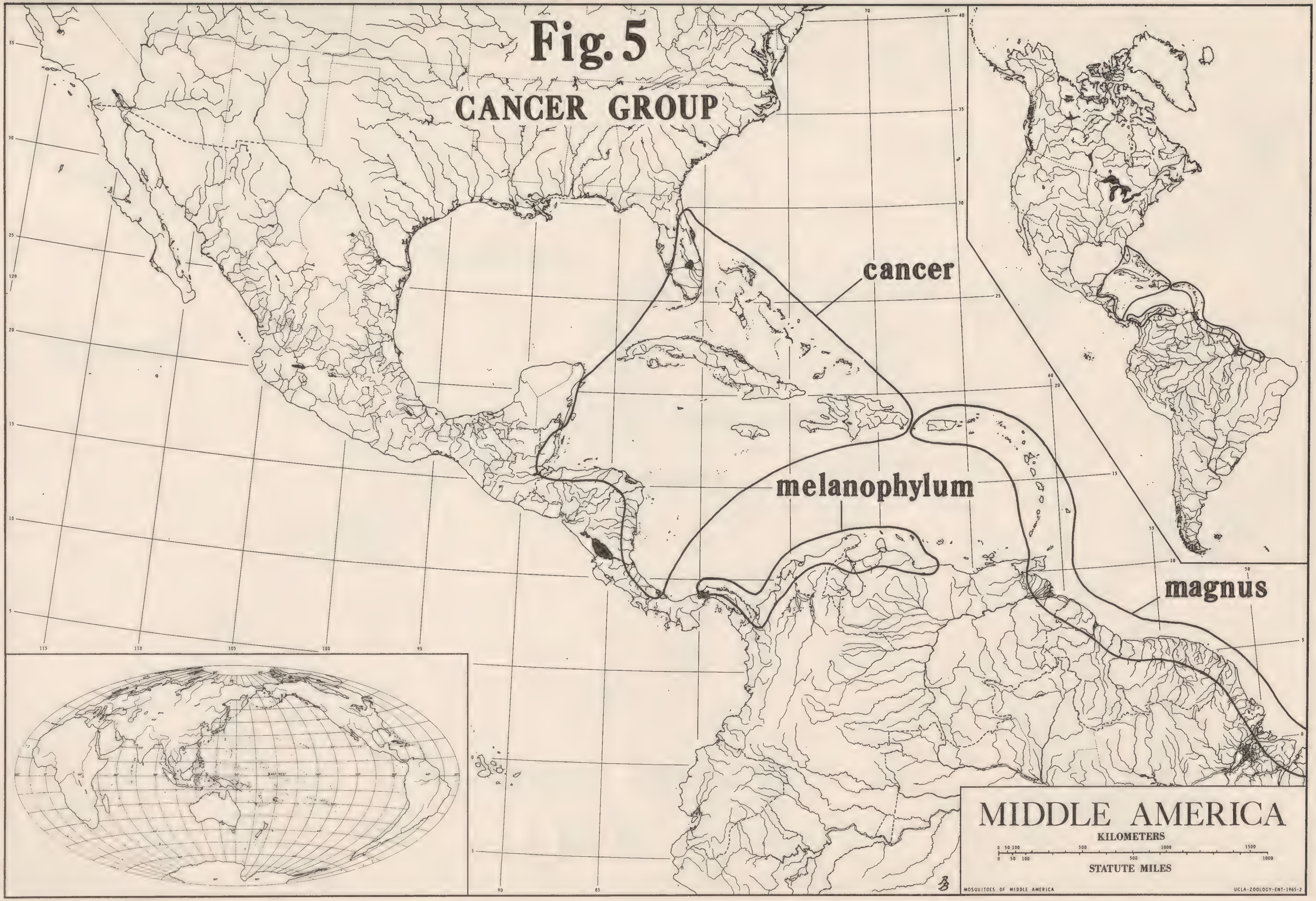


Fig. 5
CANCER GROUP

Fig. 6

EPITEDEUS GROUP

Fig. 7

PSEUDES GROUP

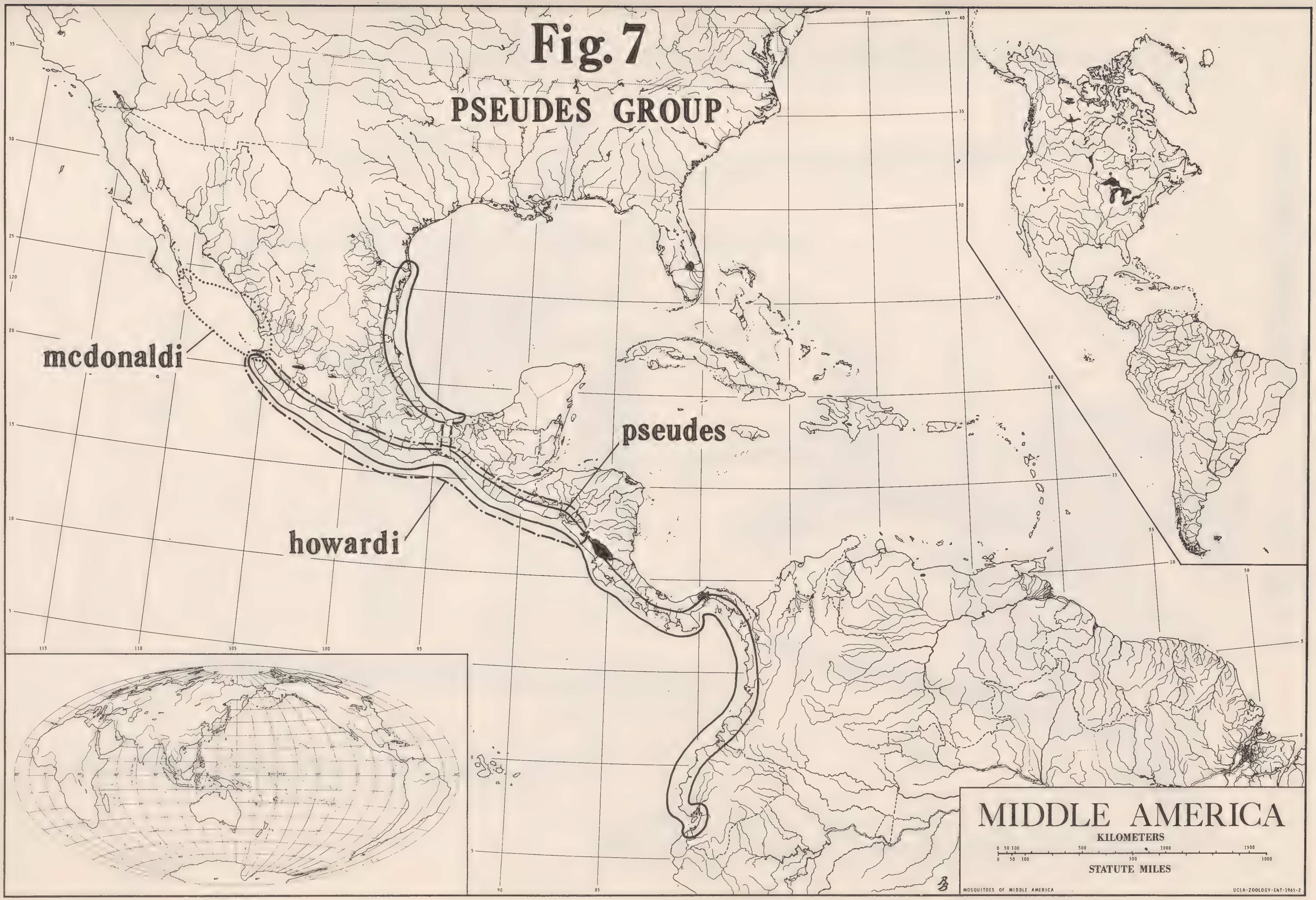
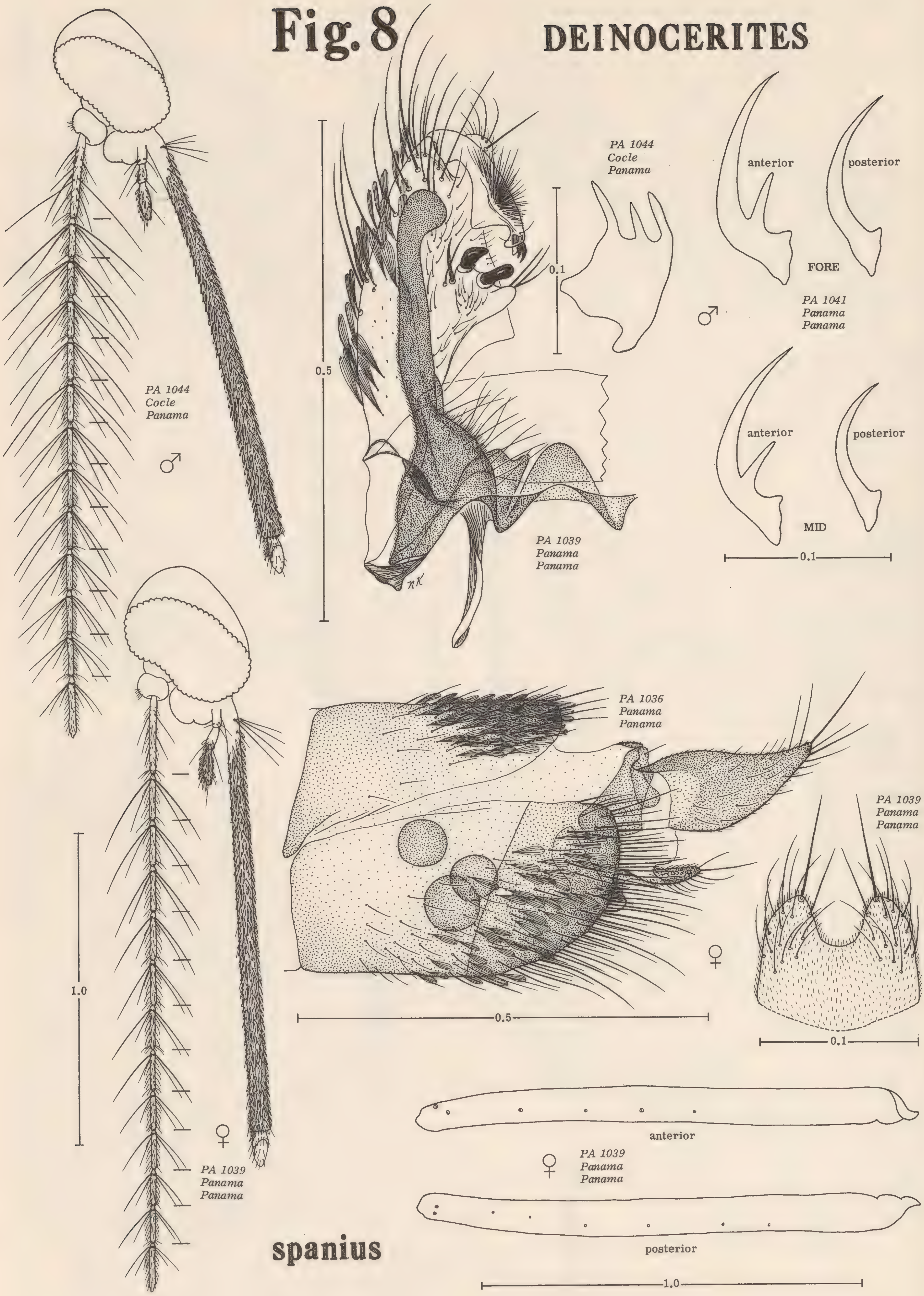
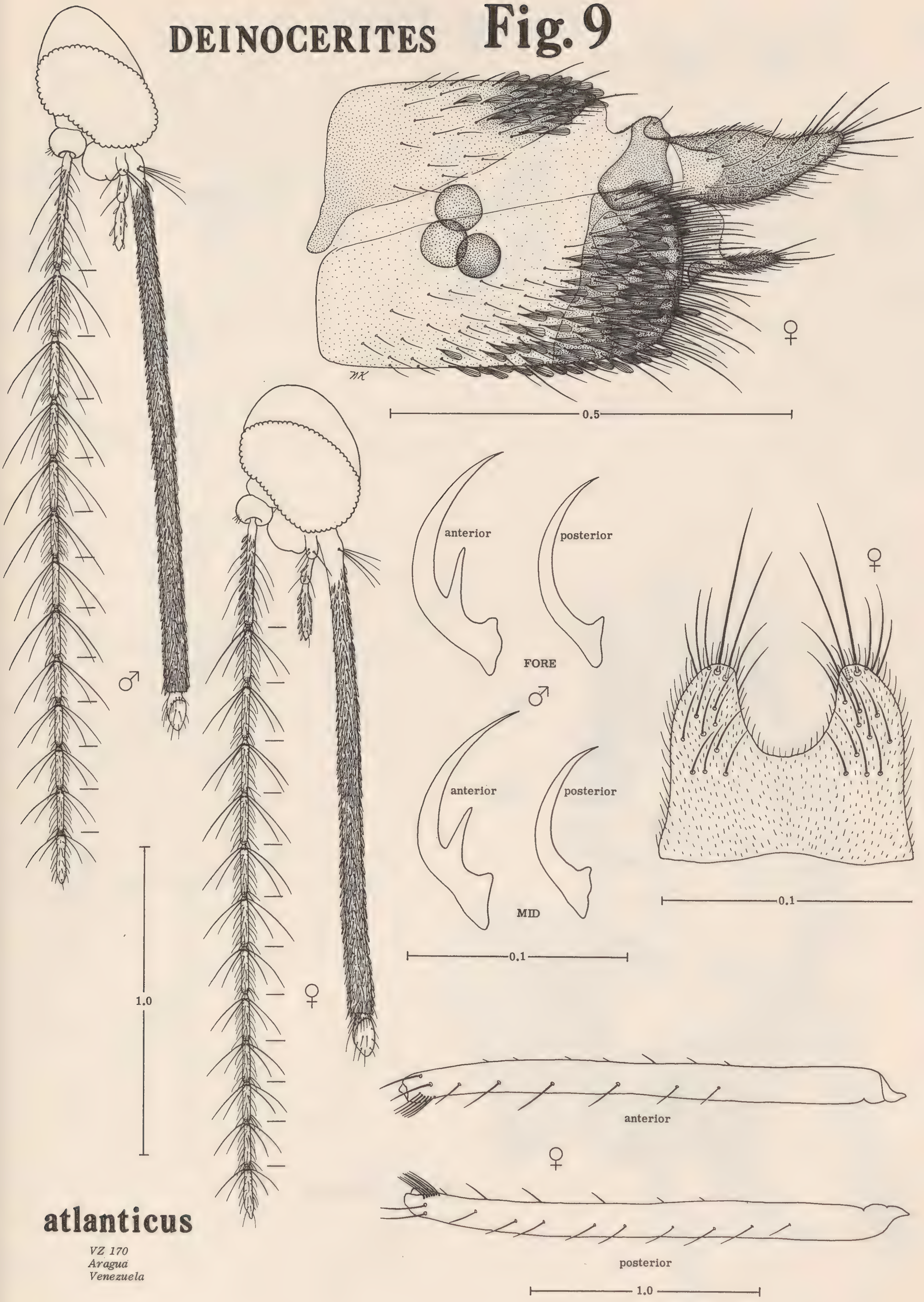


Fig. 8 DEINOCERITES



spanius

DEINOCERITES **Fig. 9**

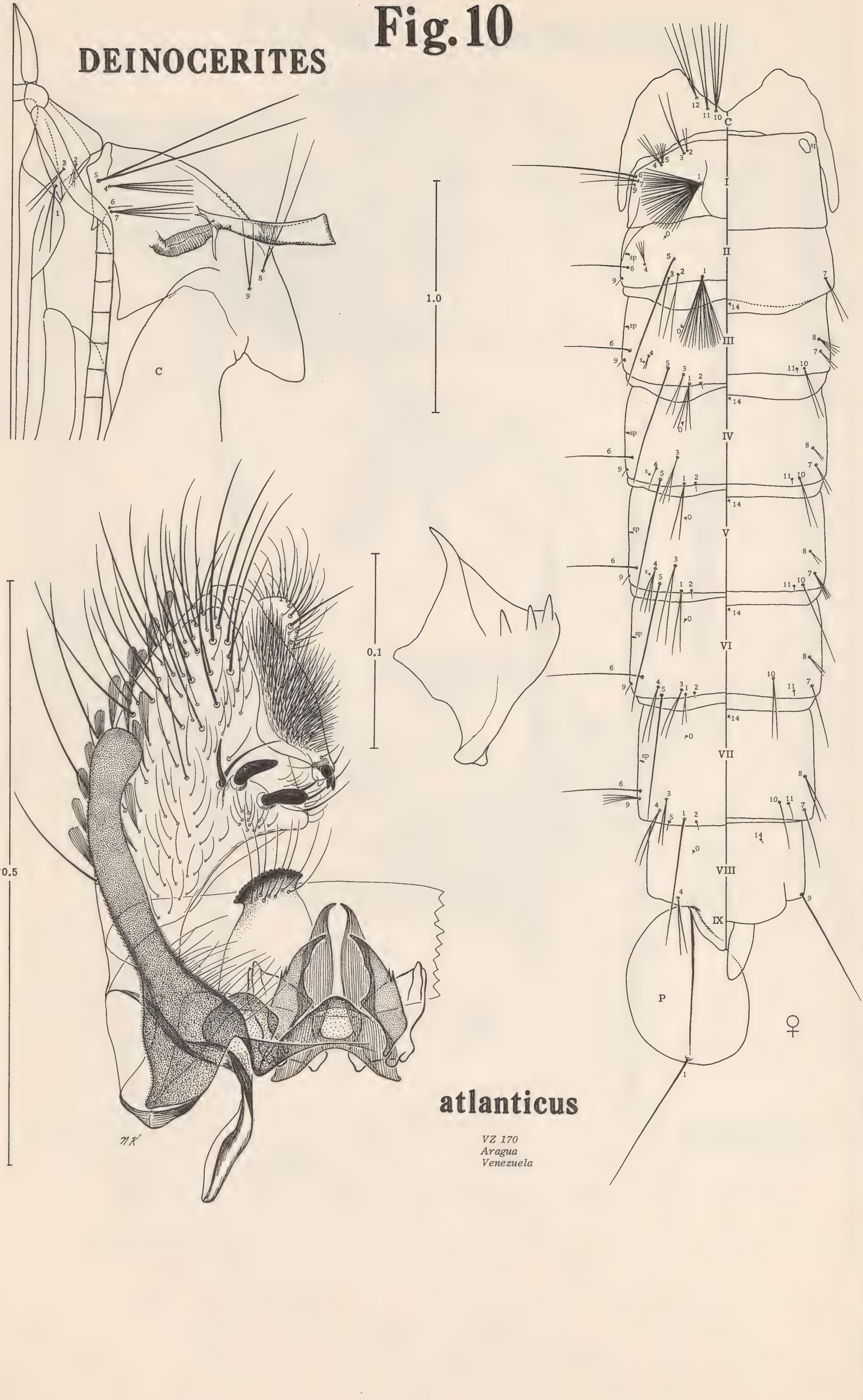


atlanticus

VZ 170
Aragua
Venezuela

Fig. 10

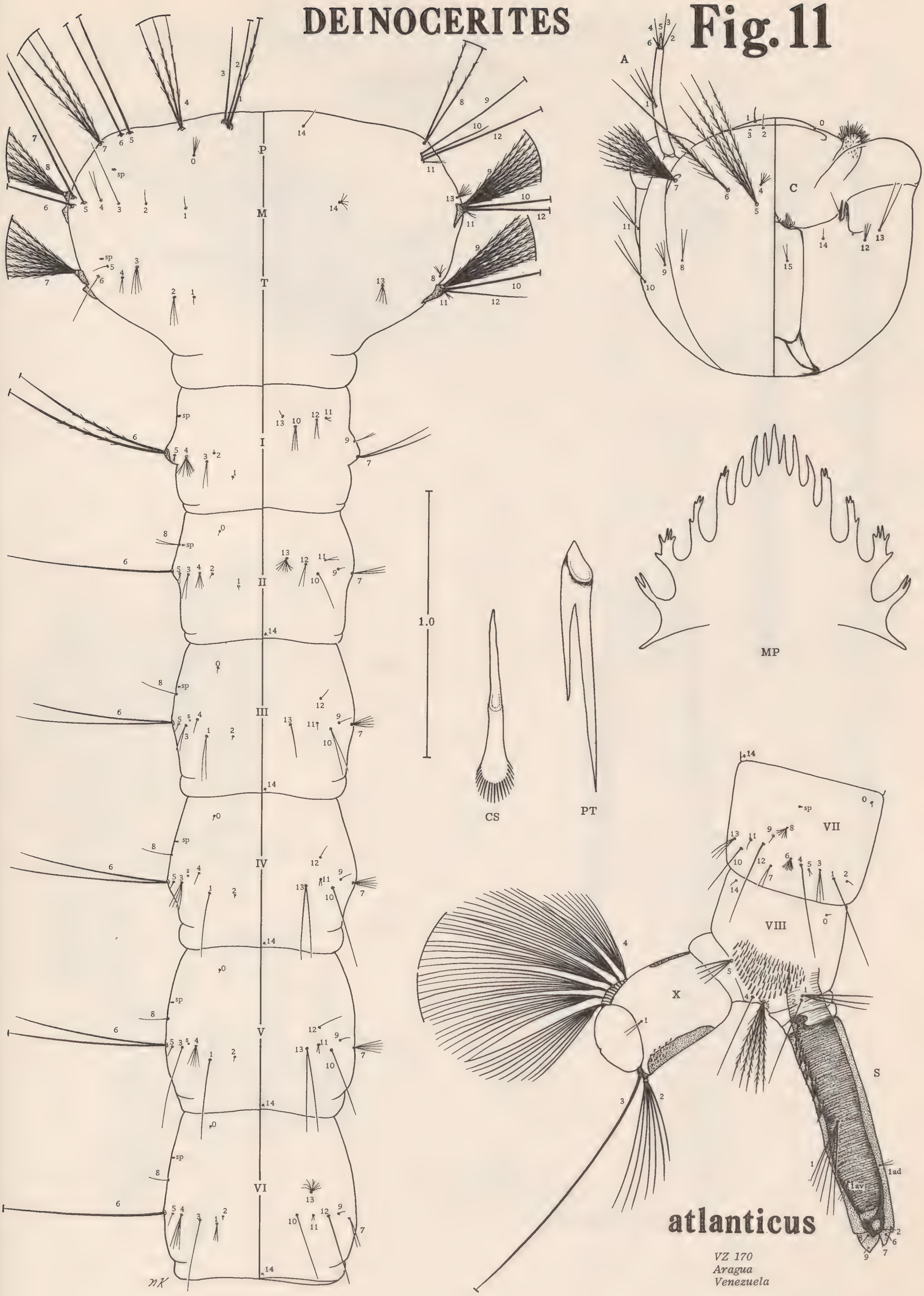
DEINOCERITES



atlanticus

VZ 170
Aragua
Venezuela

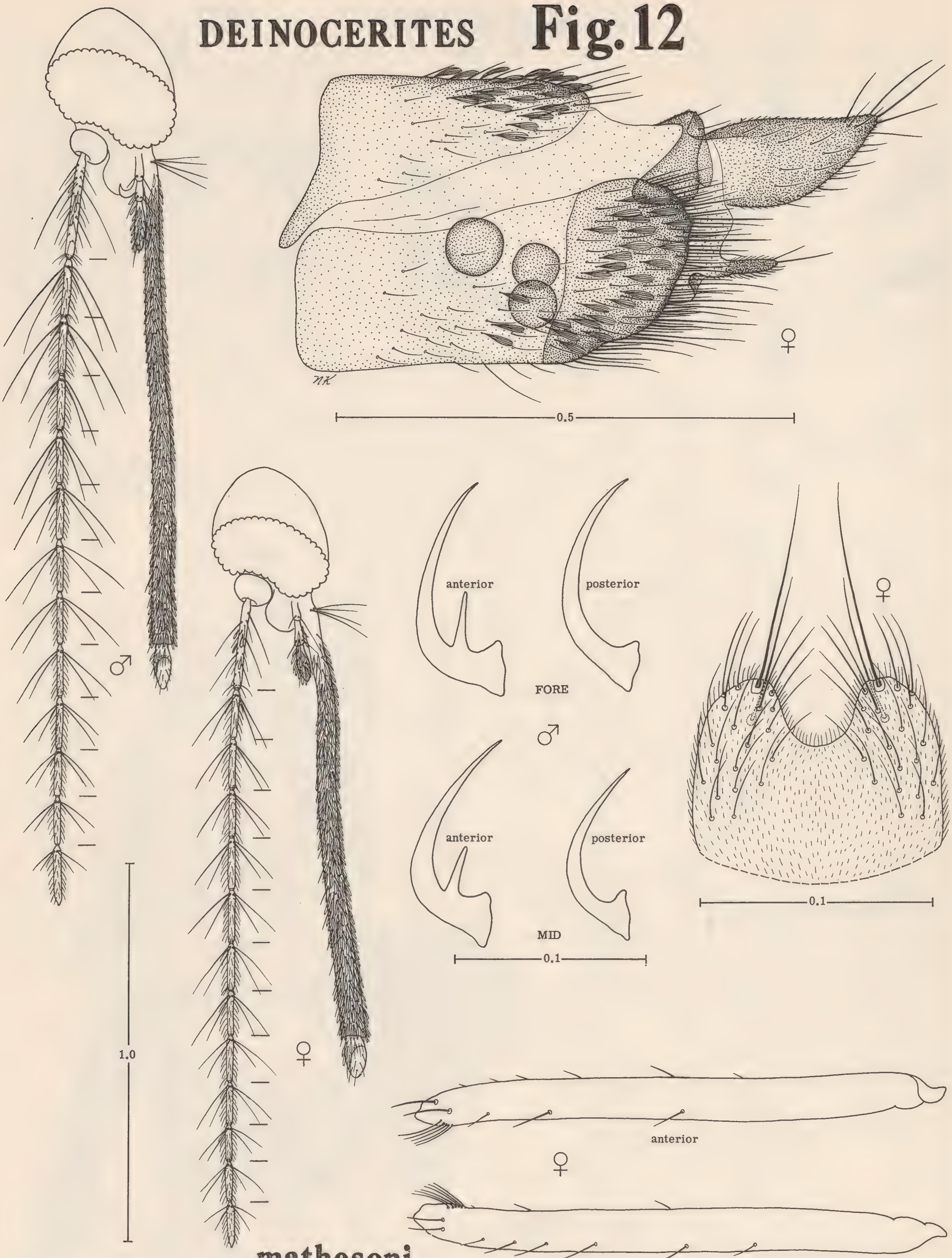
DEINOCERITES **Fig. 11**



atlanticus

VZ 170
Aragua
Venezuela

DEINOCERITES Fig.12

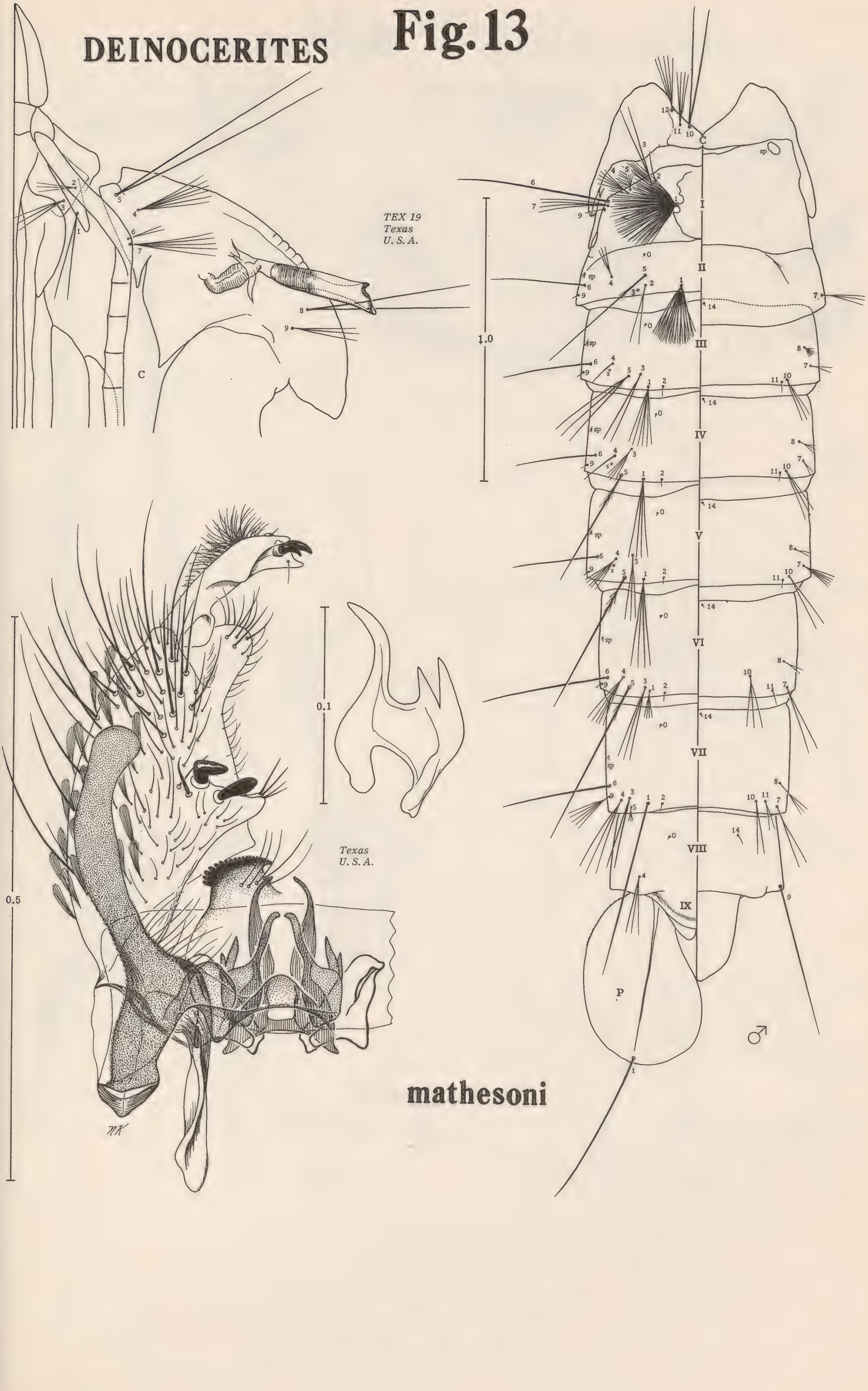


mathesoni

TEX 19
Texas
U. S. A.

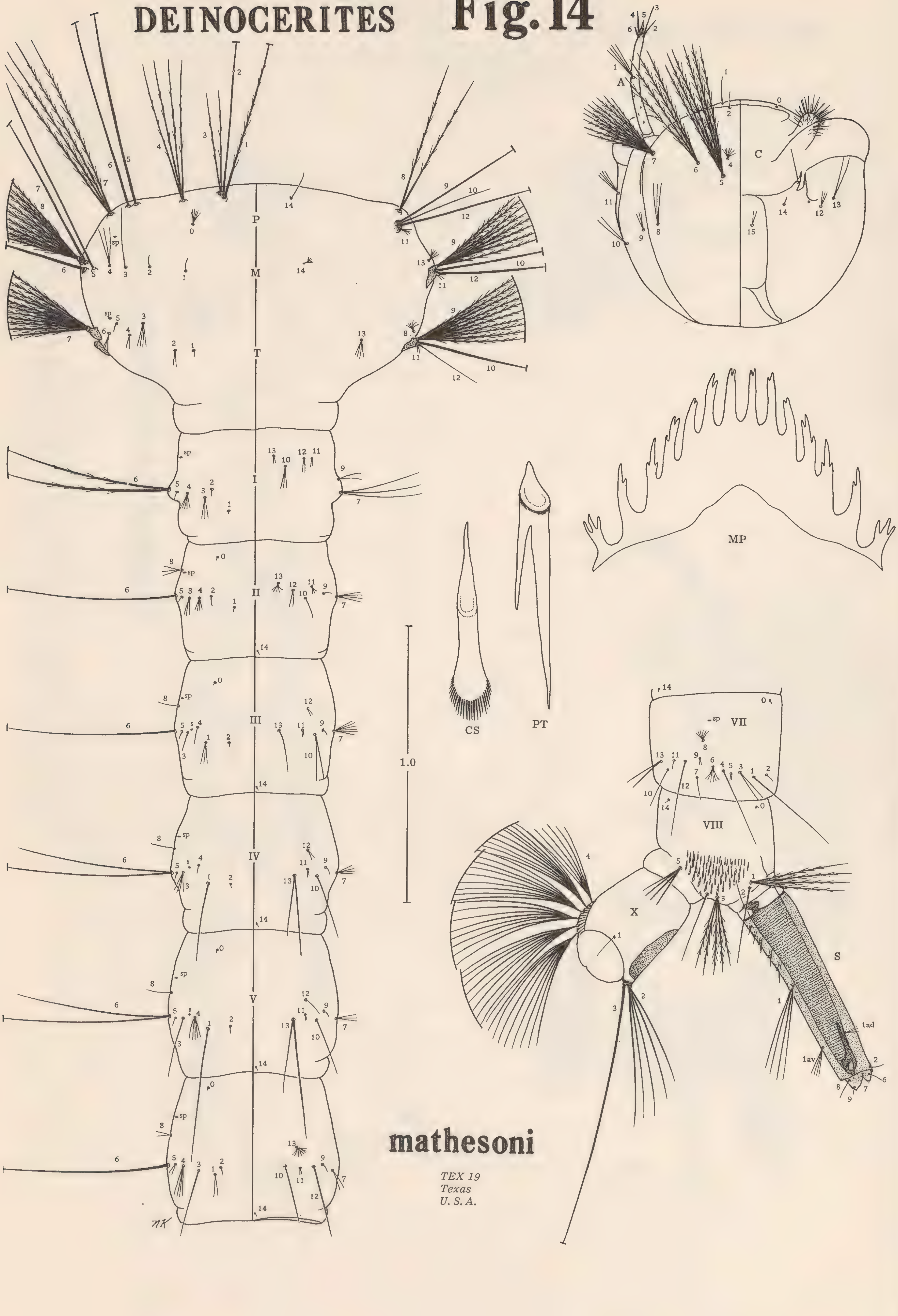
DEINOCERITES

Fig. 13



mathesoni

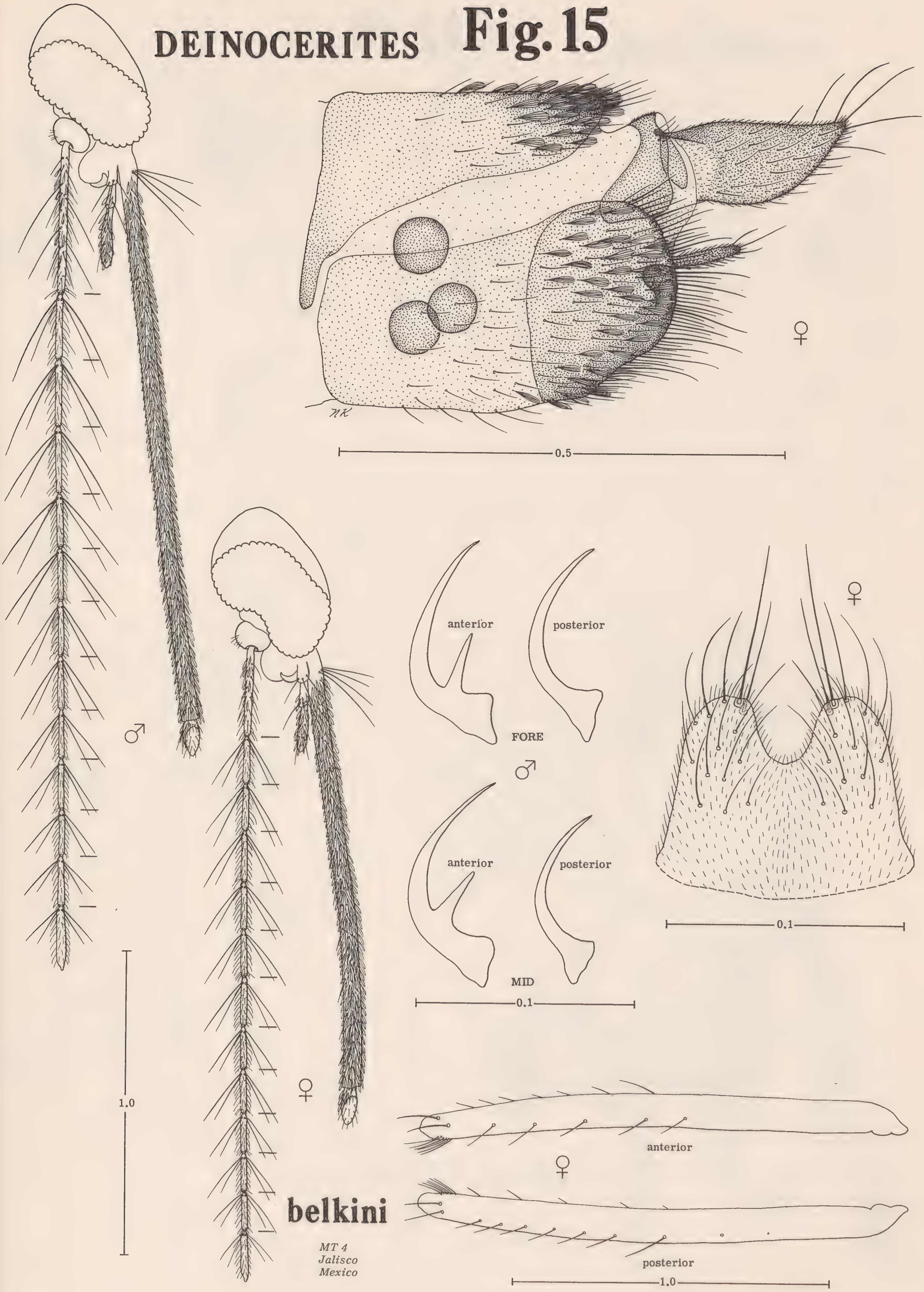
DEINOCERITES **Fig. 14**



mathesoni

TEX 19
Texas
U. S. A.

DEINOCERITES **Fig. 15**

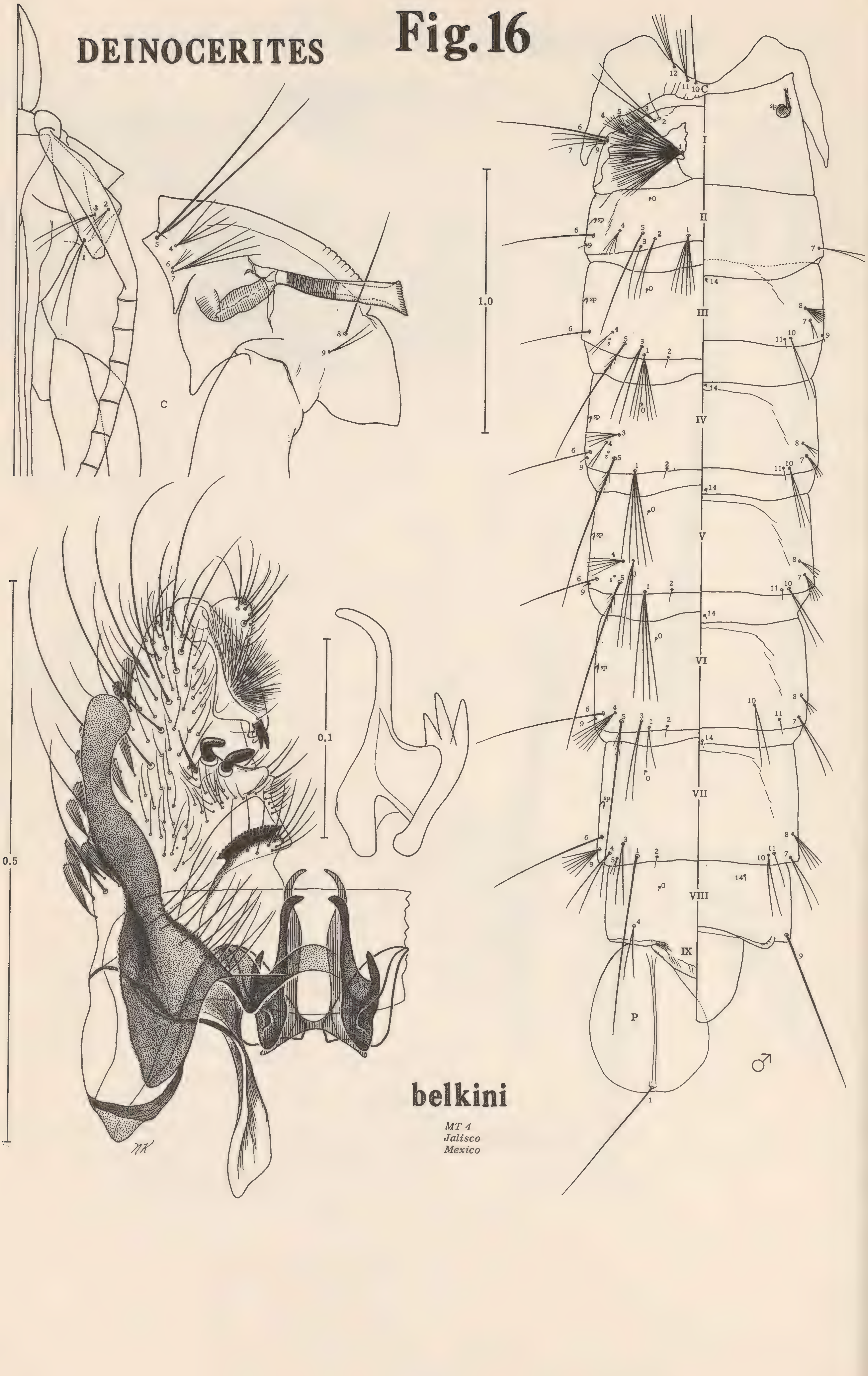


belkini

MT 4
Jalisco
Mexico

DEINOCERITES

Fig. 16

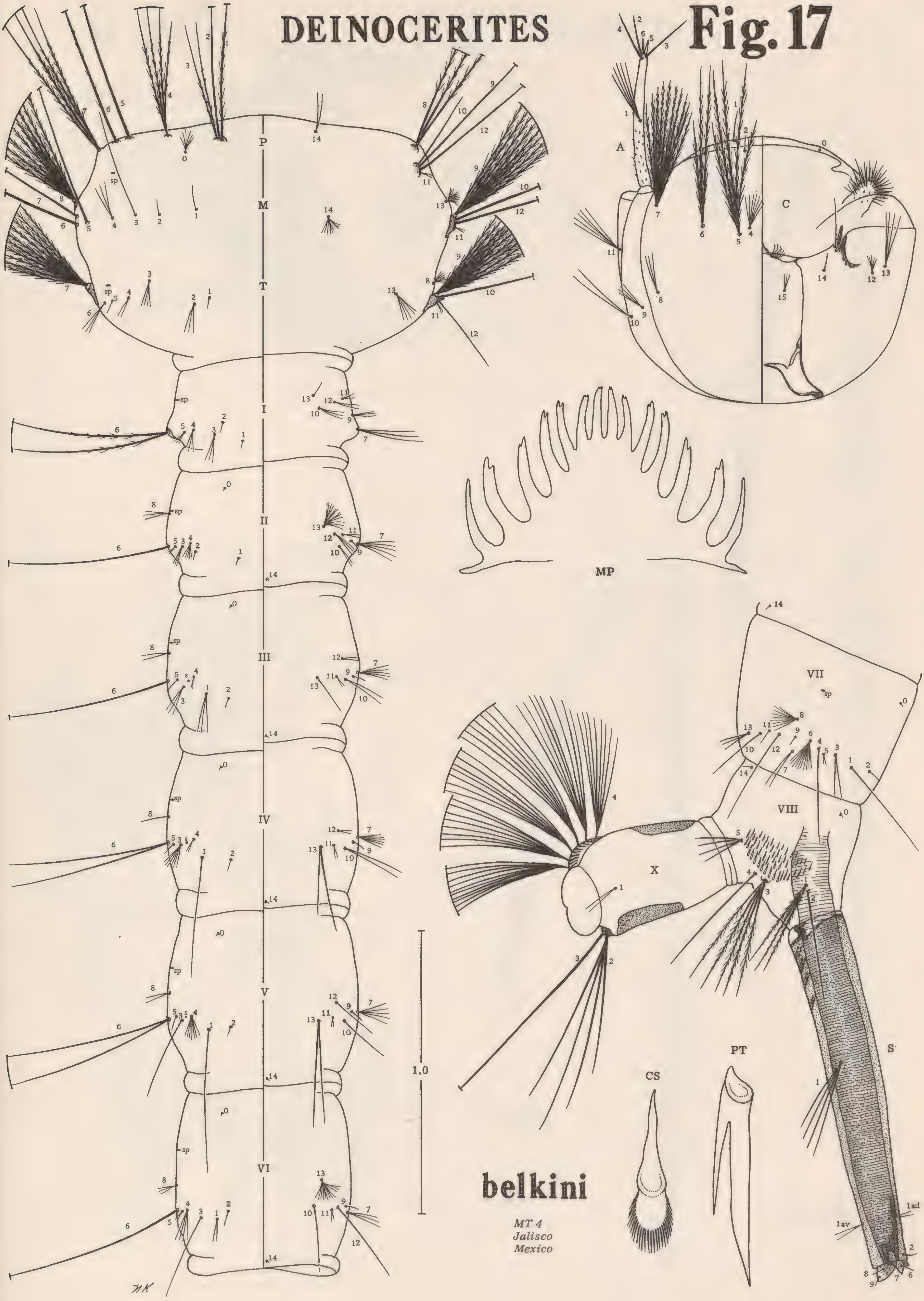


belkini

MT 4
Jalisco
Mexico

DEINOCERITES

Fig. 17

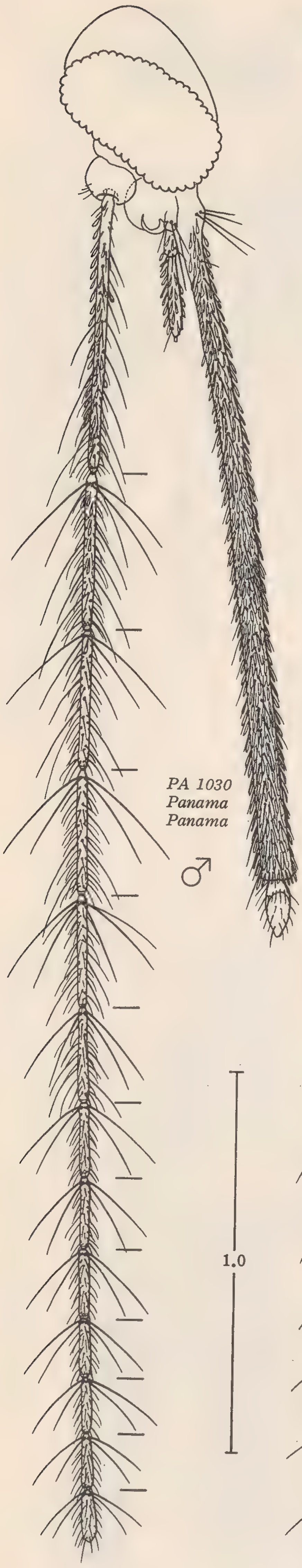


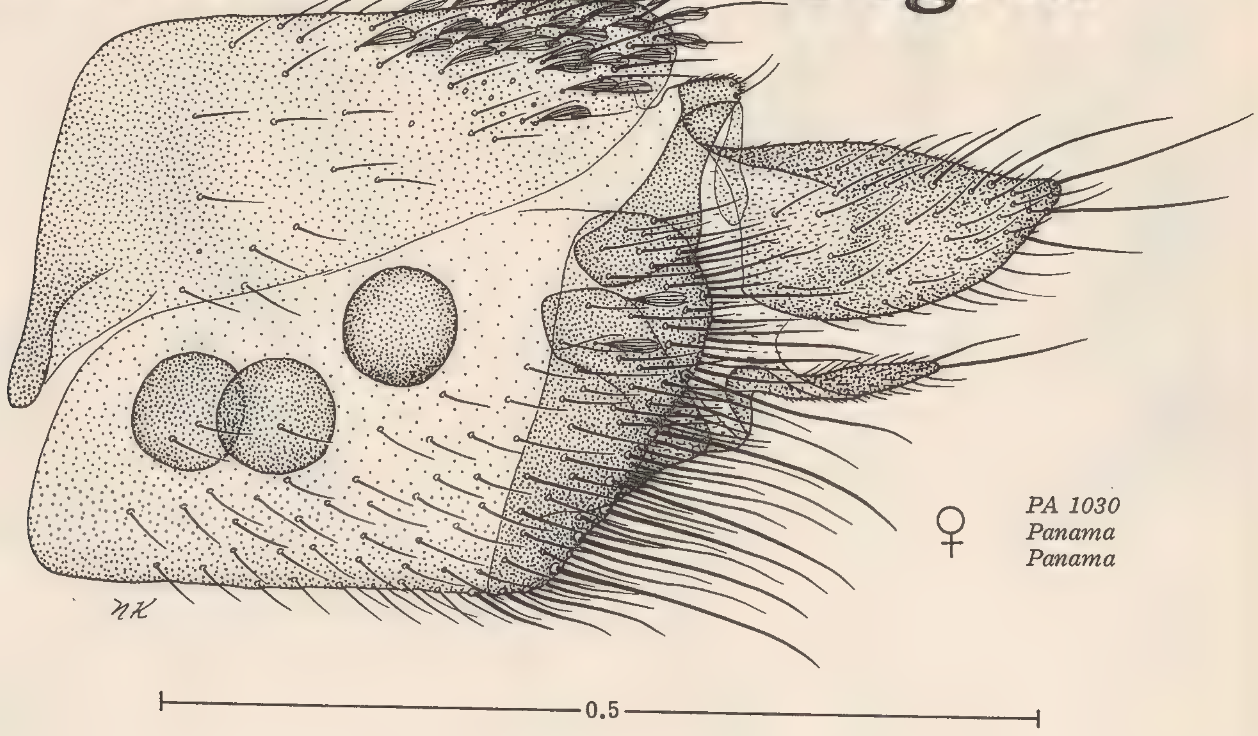
belkini

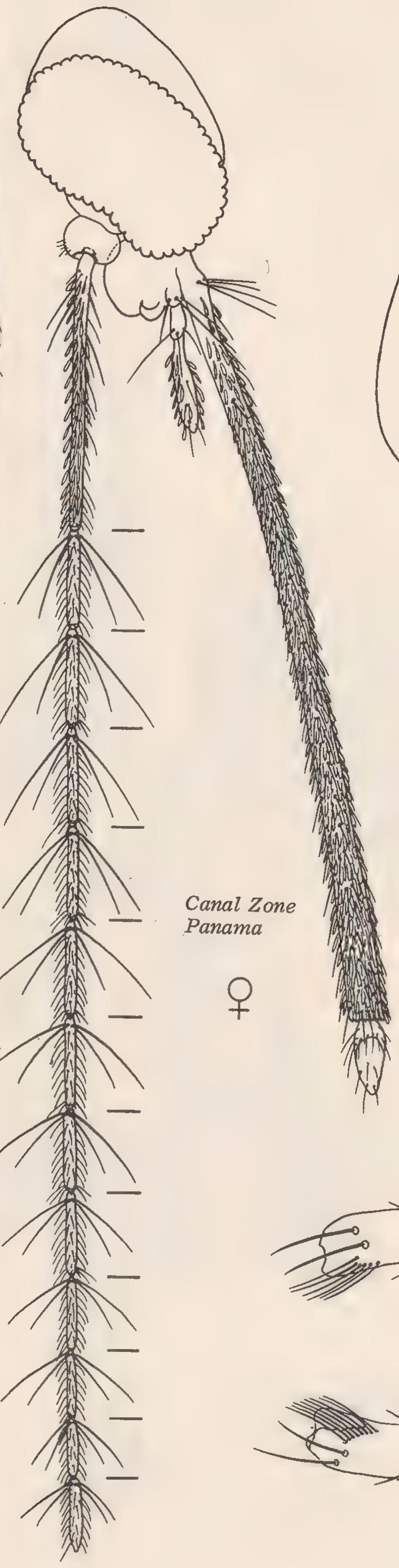
MT 4
Jalisco
Mexico

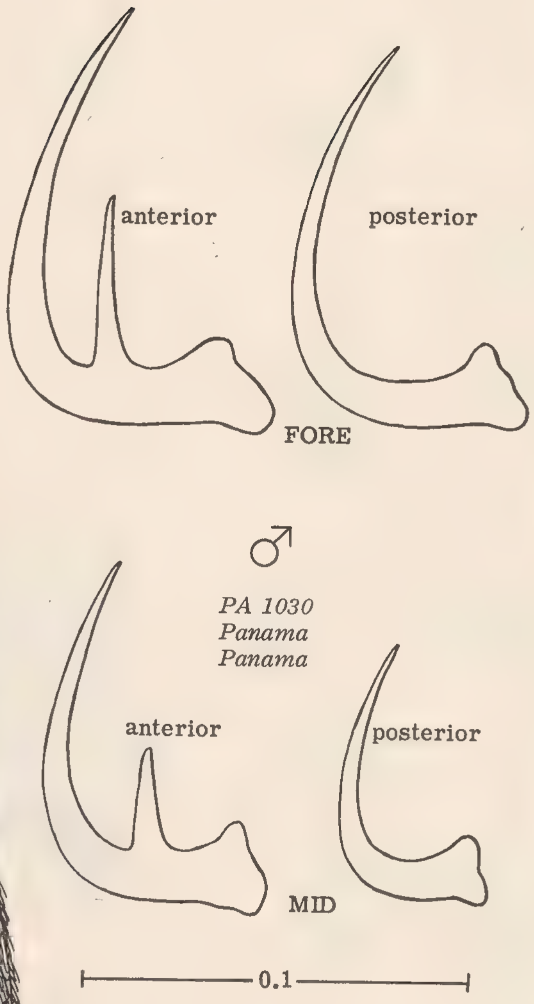
DEINOCERITES

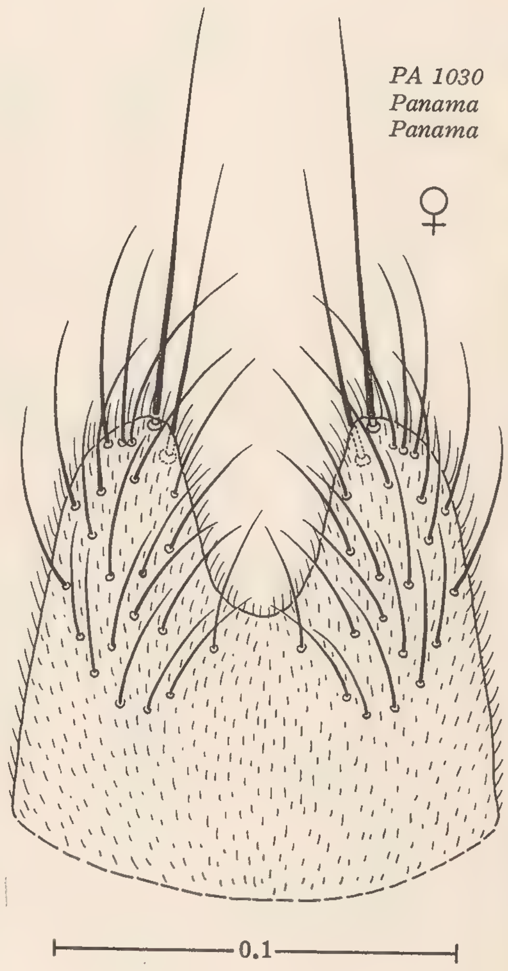
Fig. 18

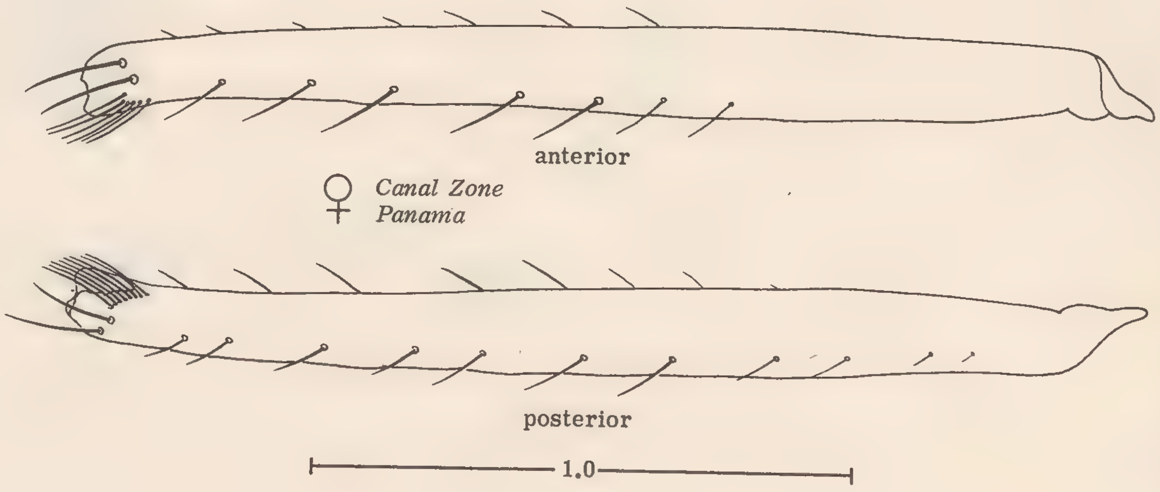








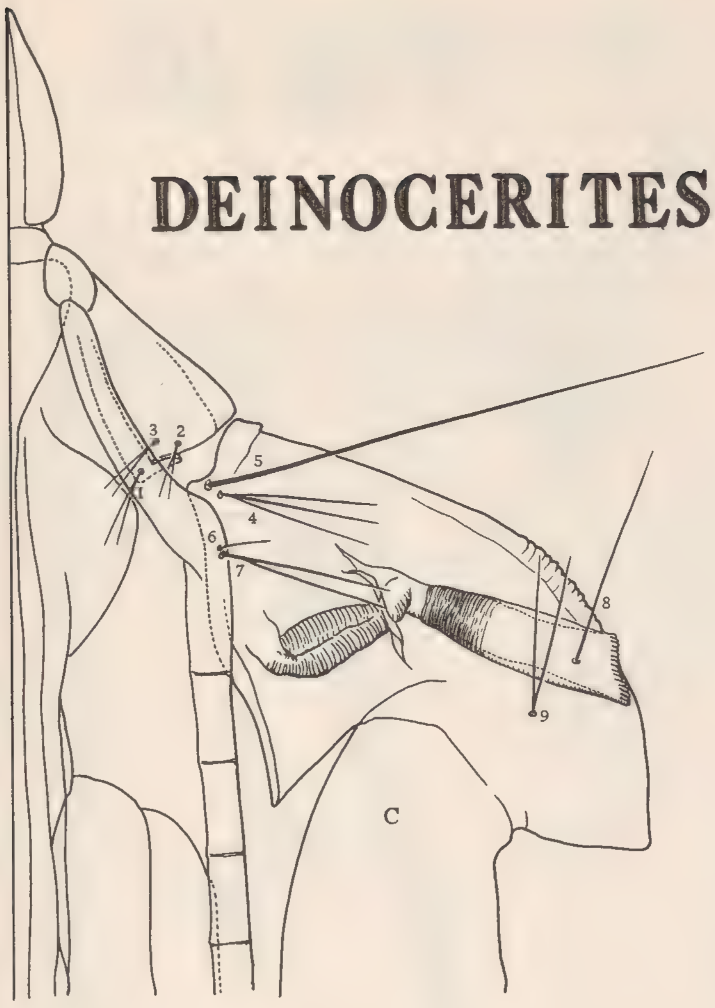




dyari

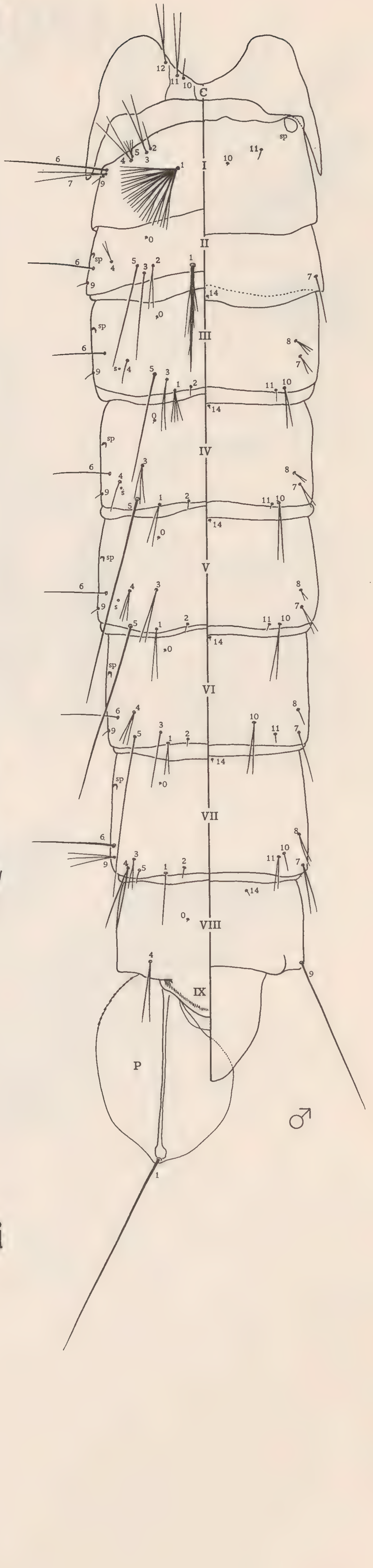
Fig. 19

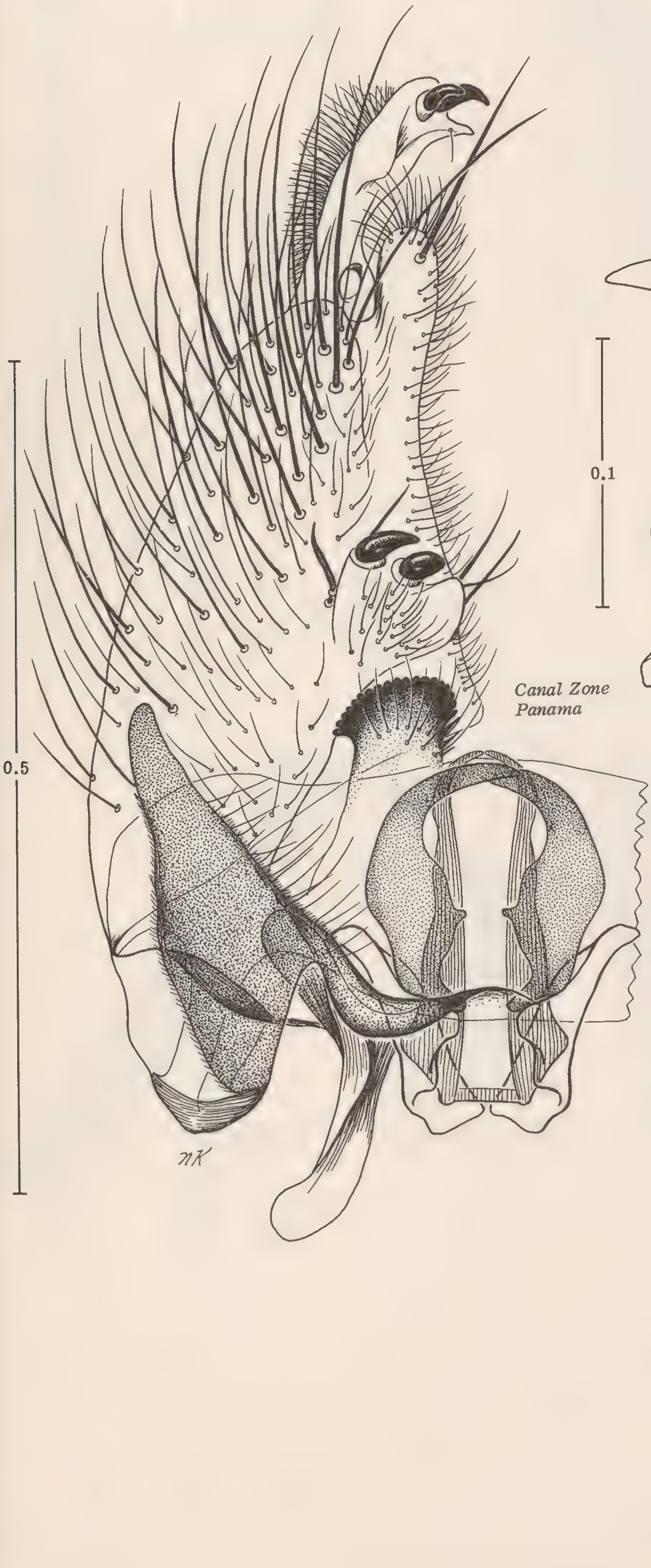
DEINOCERITES



COA 24
El Choco
Colombia

1.0



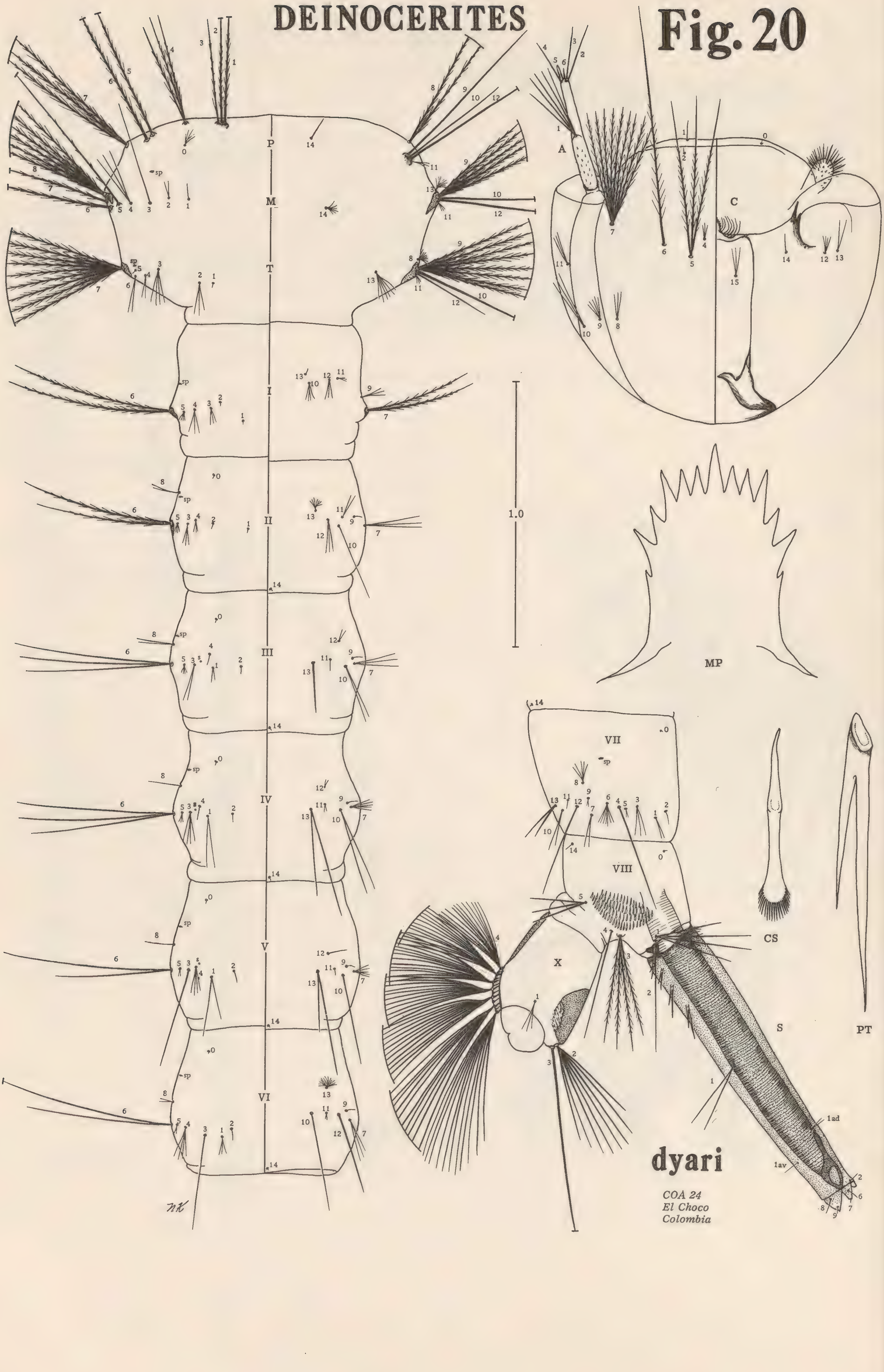


Canal Zone
Panama

dyari

DEINOCERITES

Fig. 20

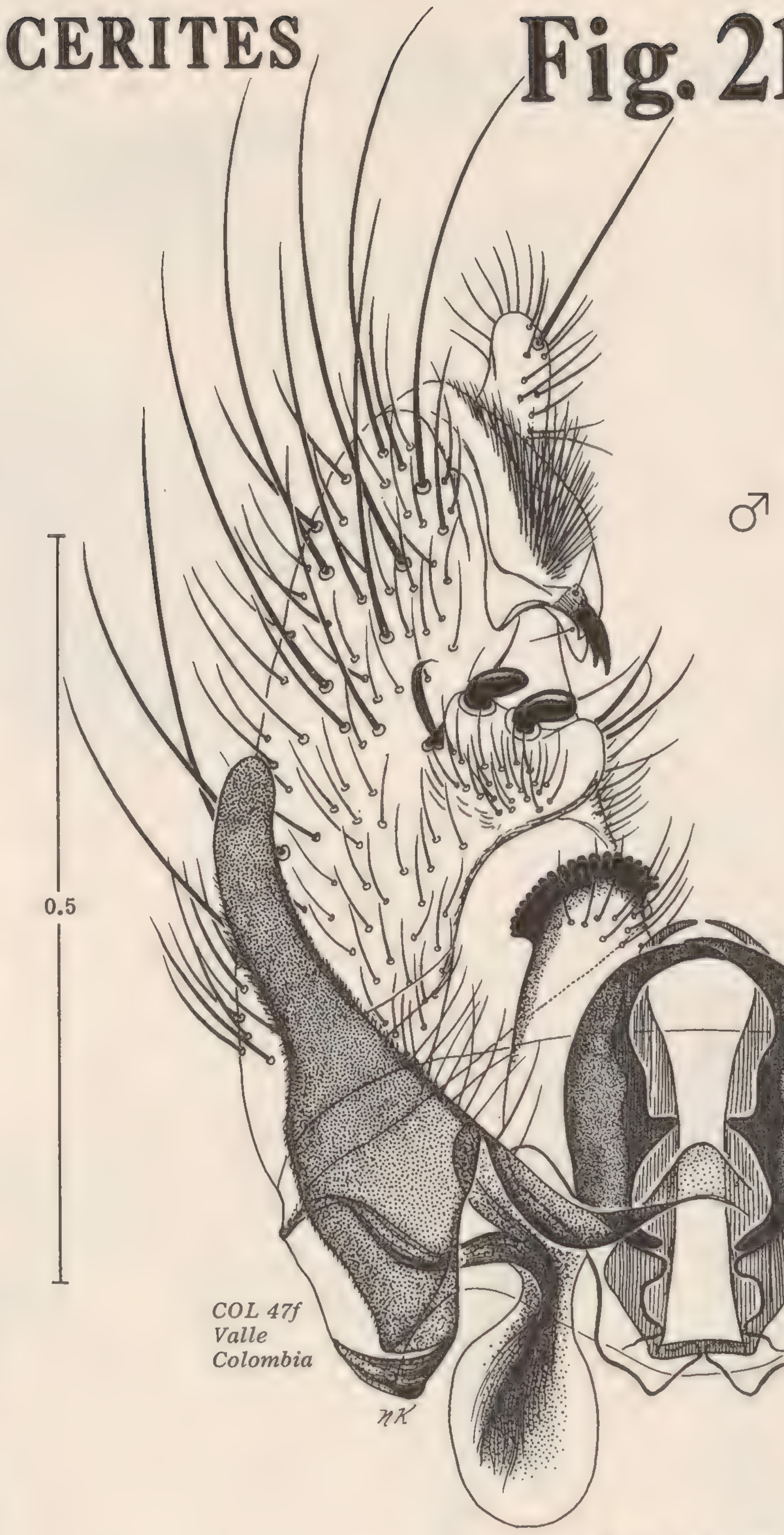


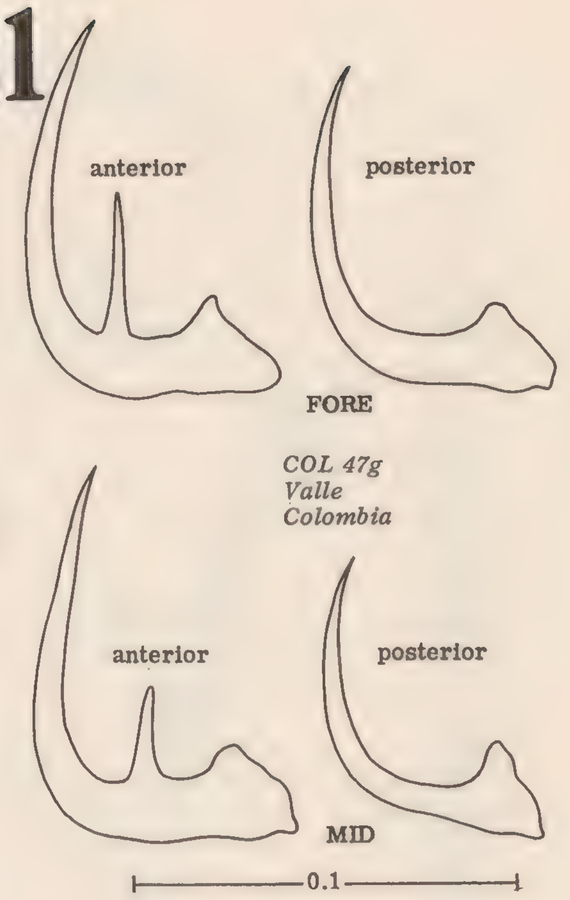
dyari

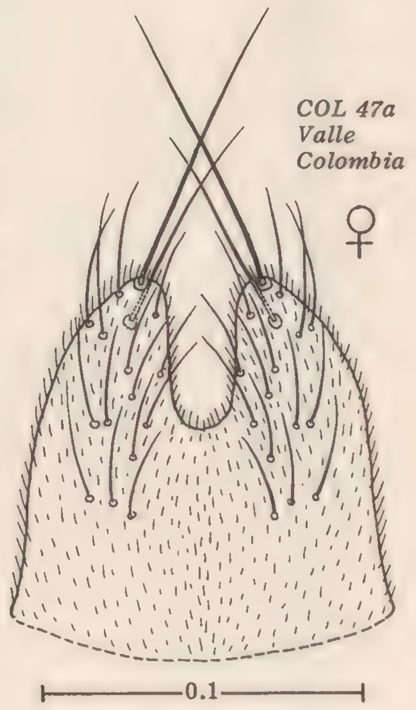
COA 24
El Choco
Colombia

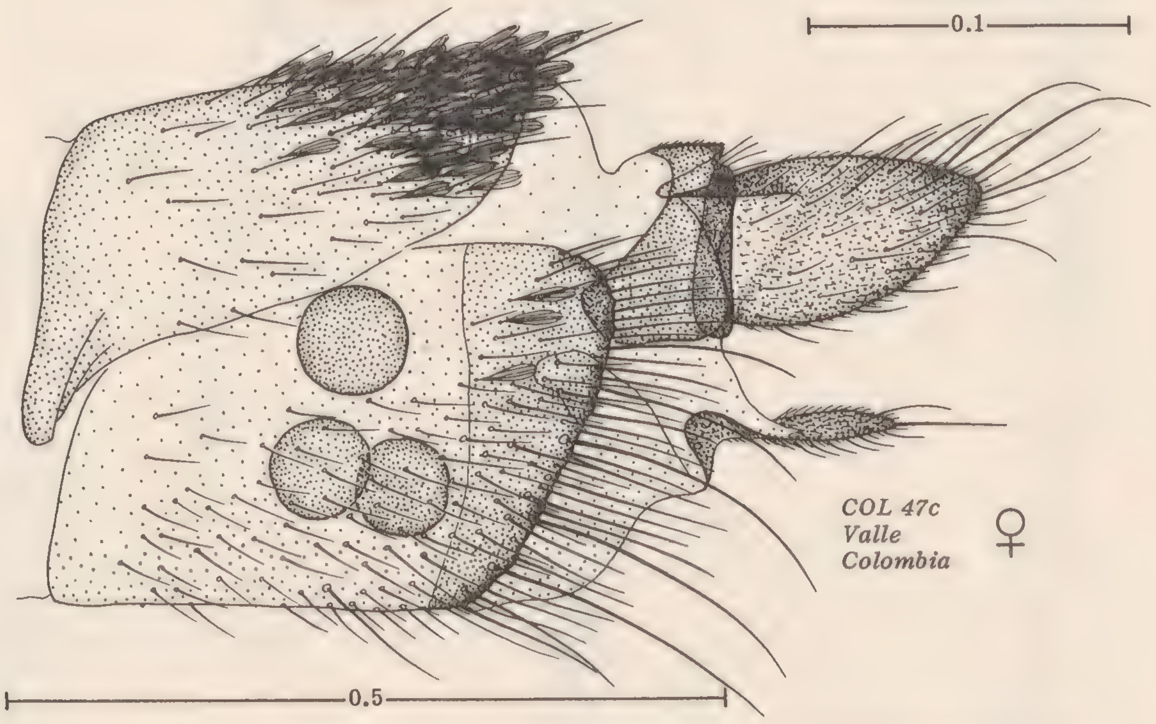
DEINOCERITES

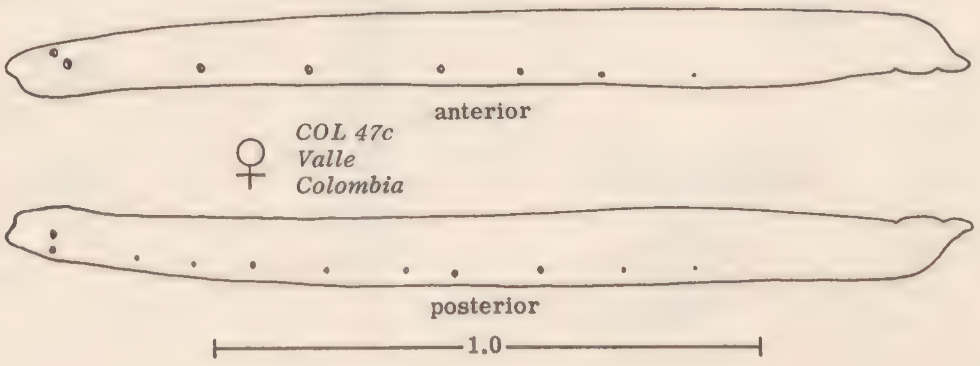
Fig. 21







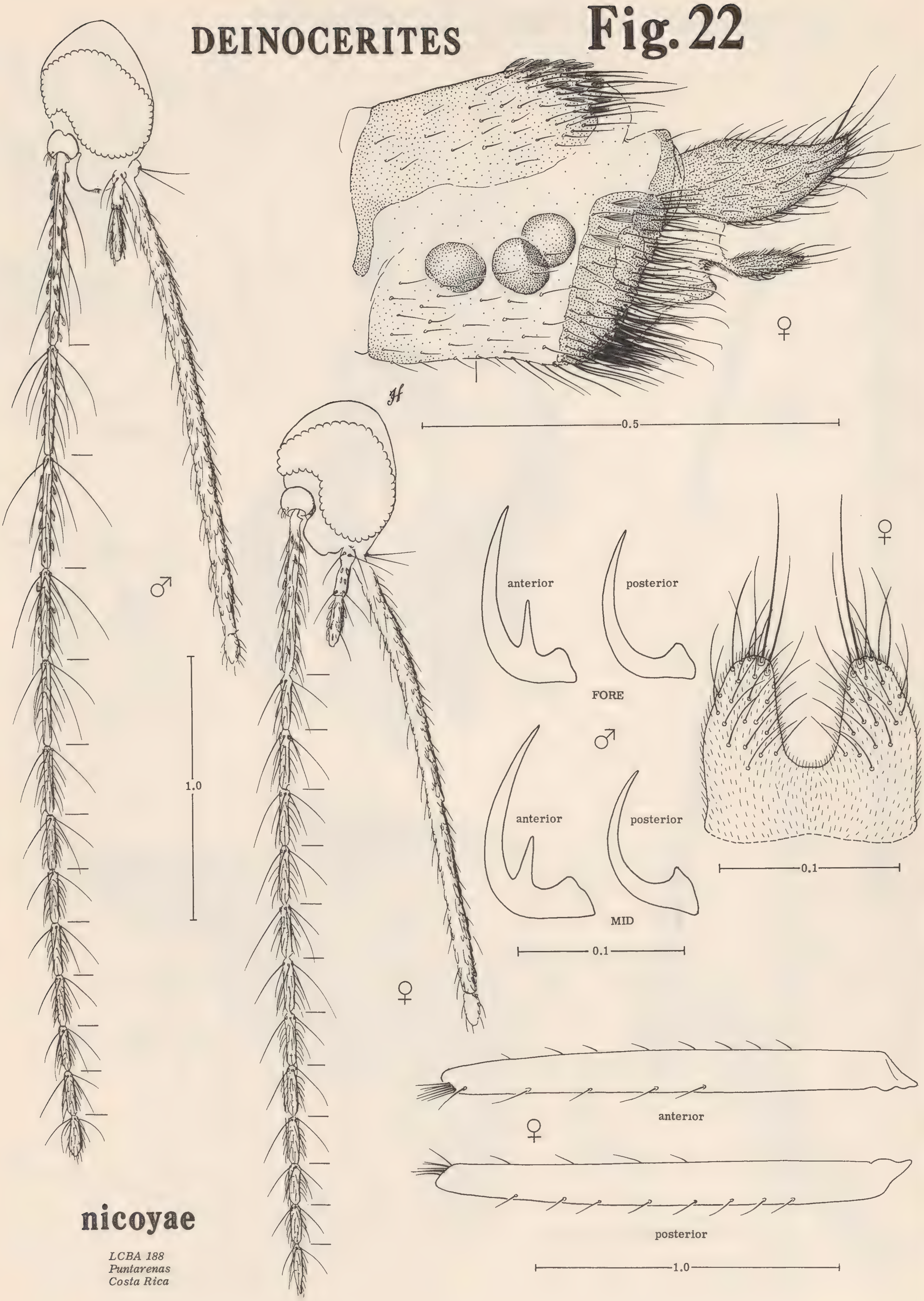




barretoi

DEINOCERITES

Fig. 22

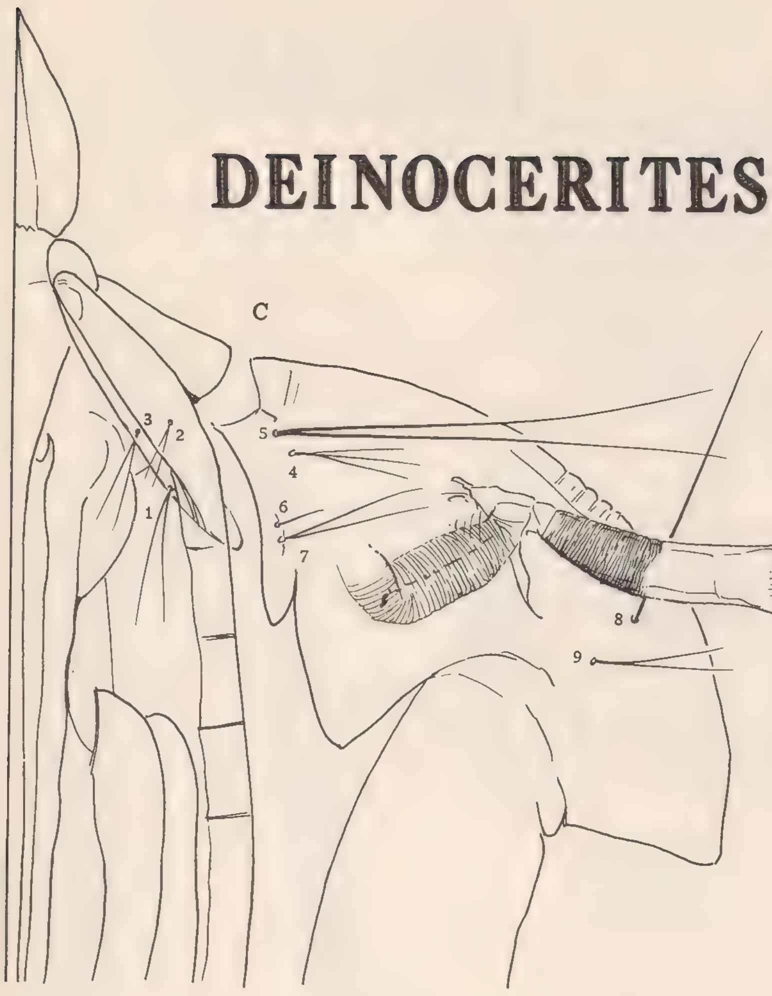


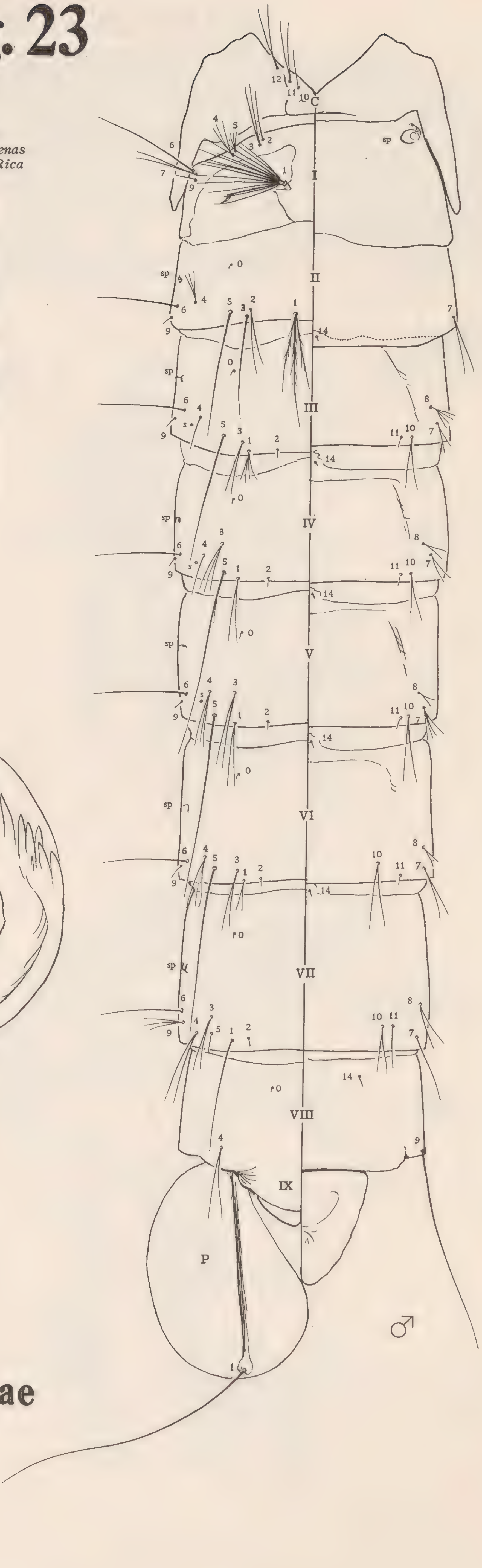
nicoyae

LCBA 188
Puntarenas
Costa Rica

Fig. 23

DEINOCERITES

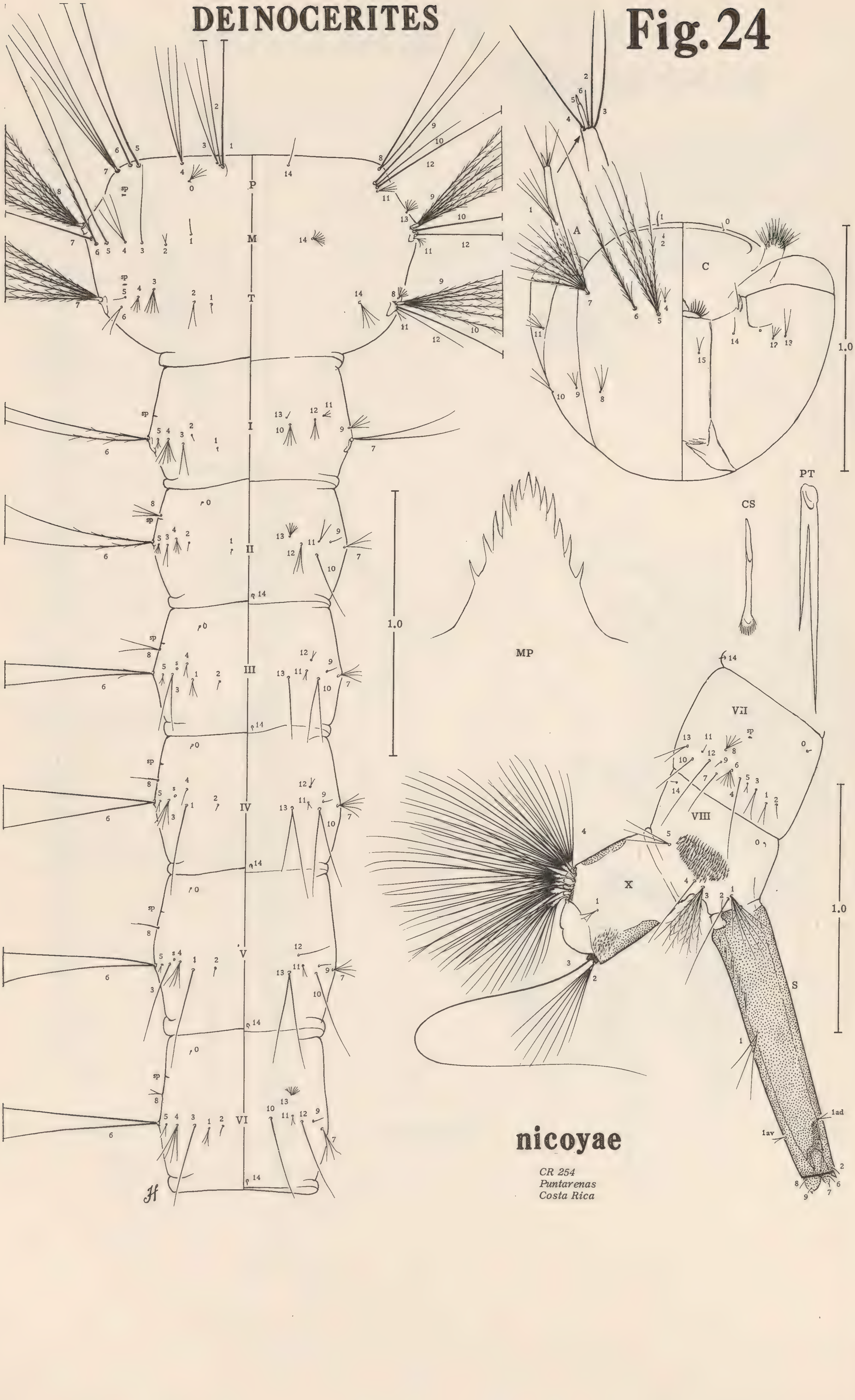




nicoyae

DEINOCERITES

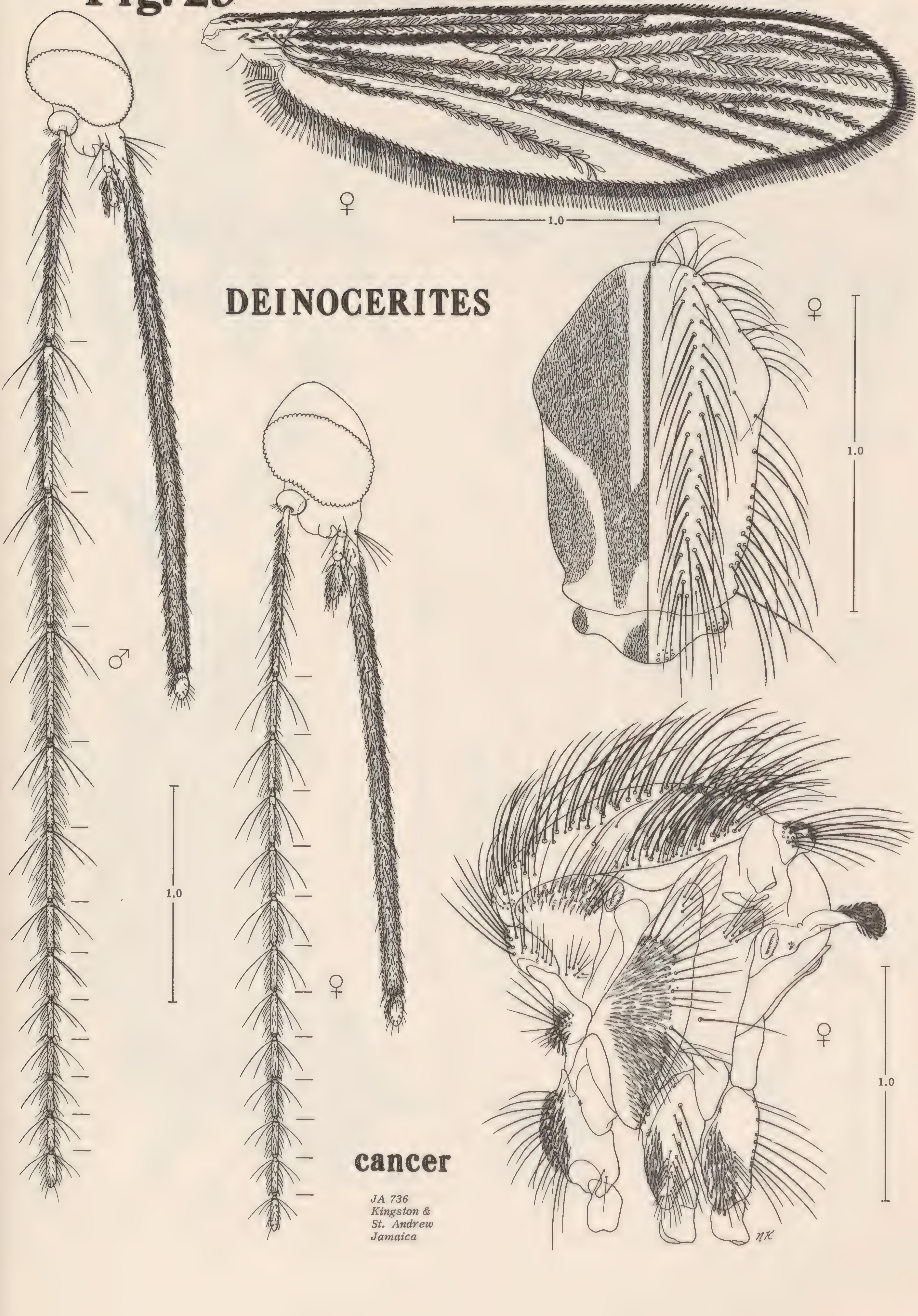
Fig. 24



nicoyae

CR 254
Puntarenas
Costa Rica

Fig. 25

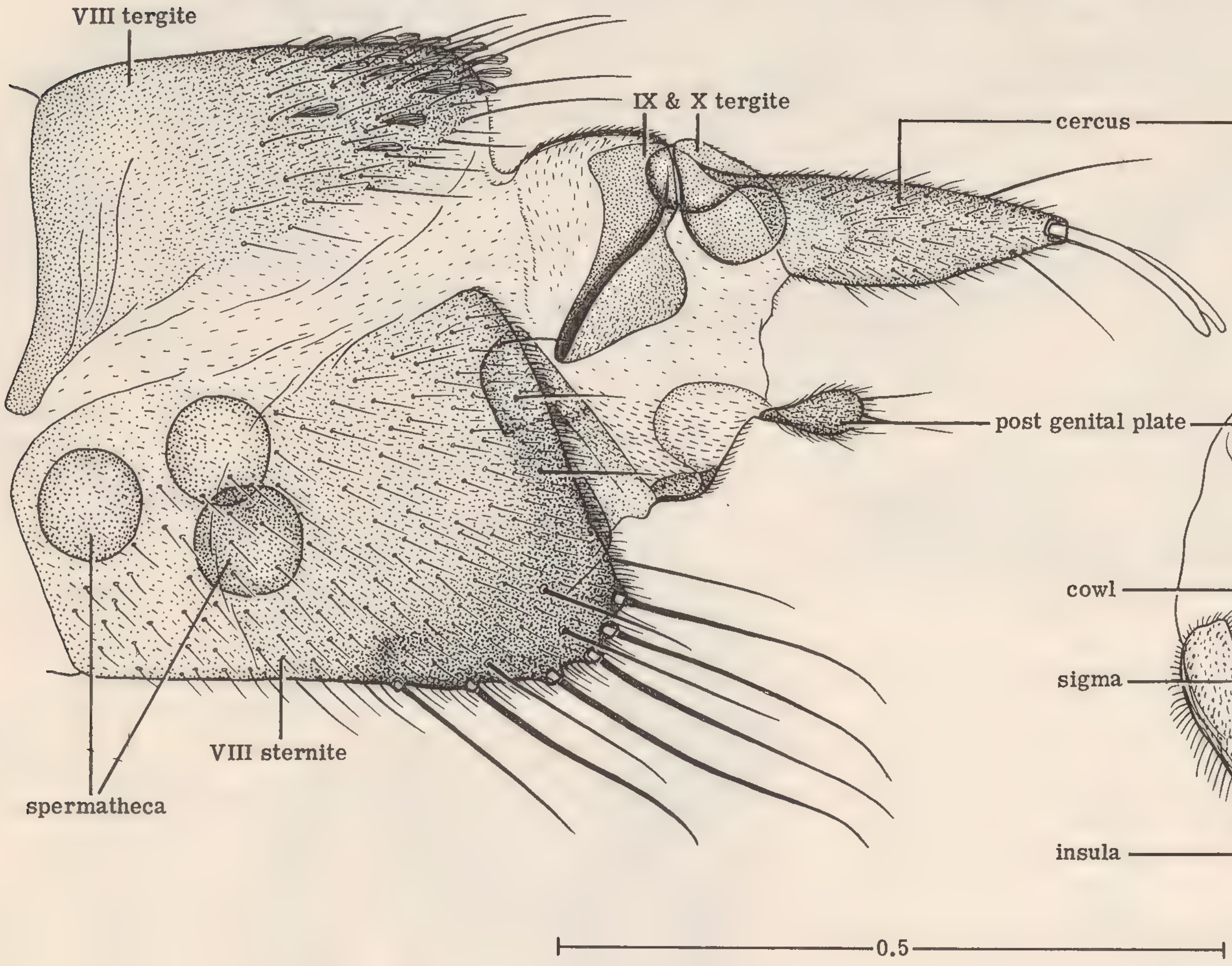


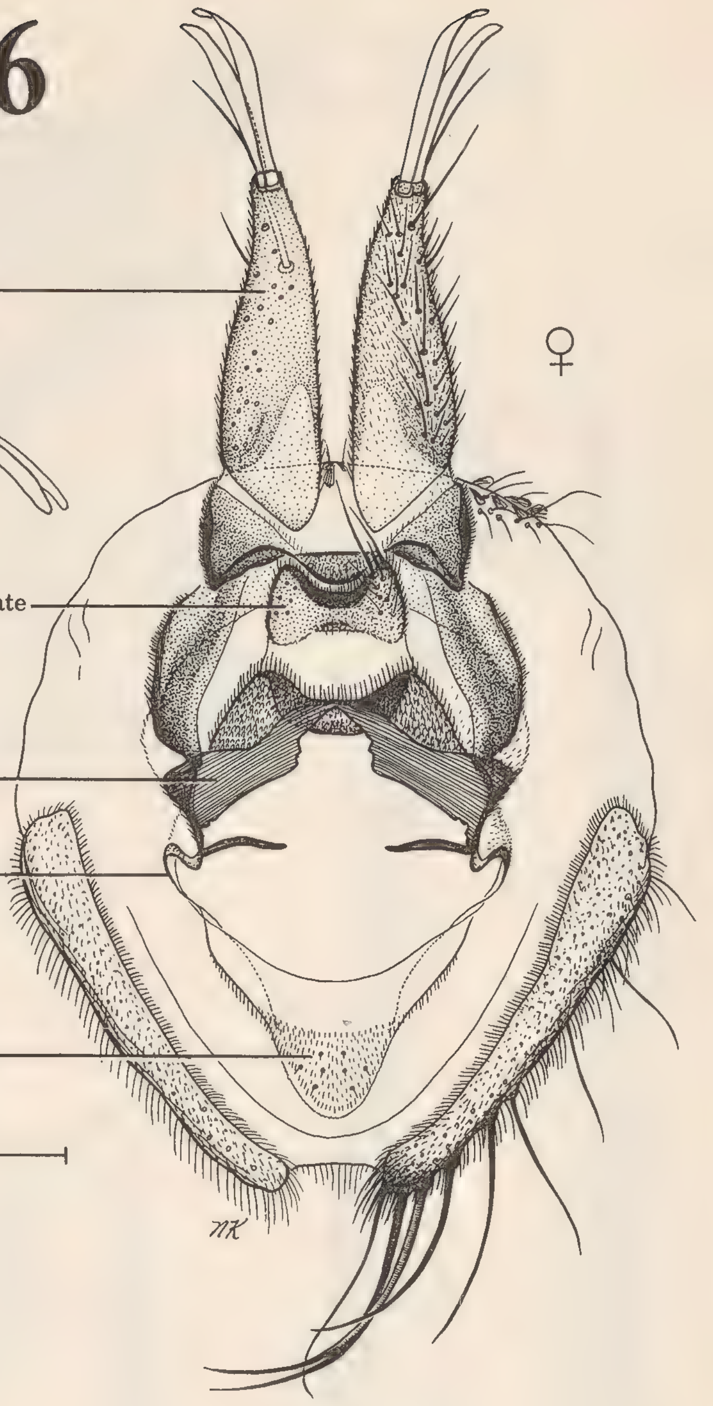
DEINOCERITES

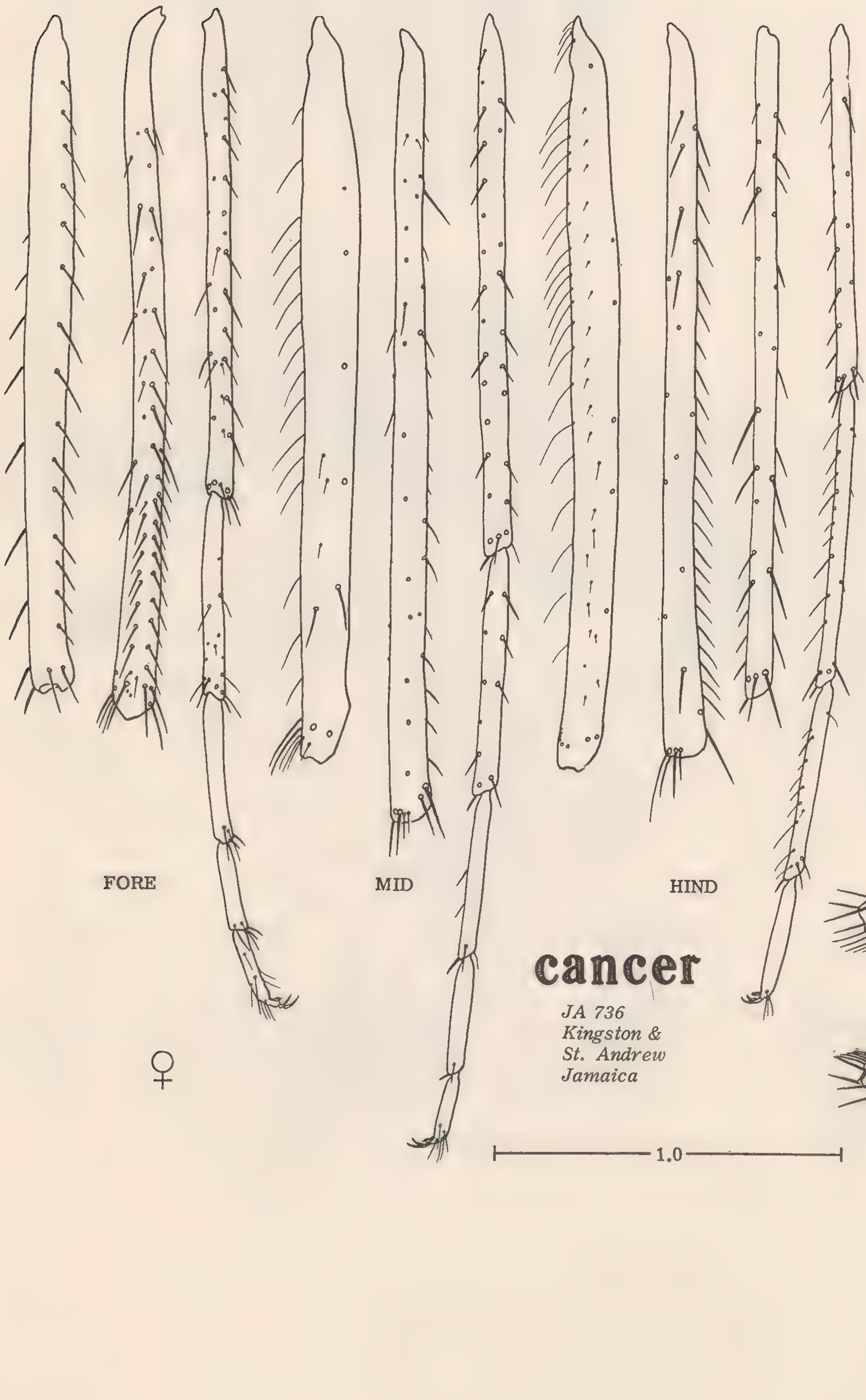
cancer

JA 736
Kingston &
St. Andrew
Jamaica

DEINOCERITES Fig. 26

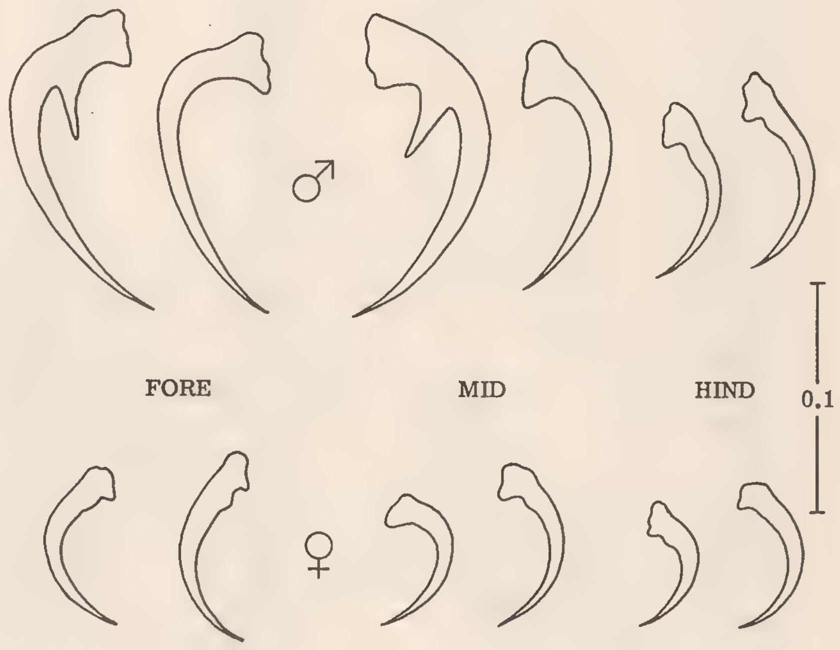






cancer

JA 736
Kingston &
St. Andrew
Jamaica



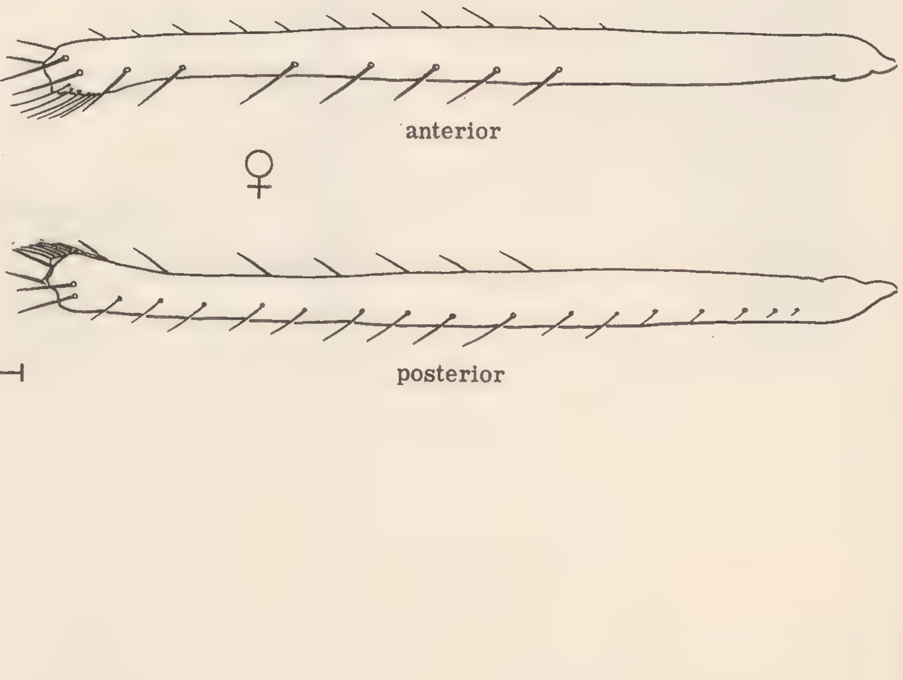
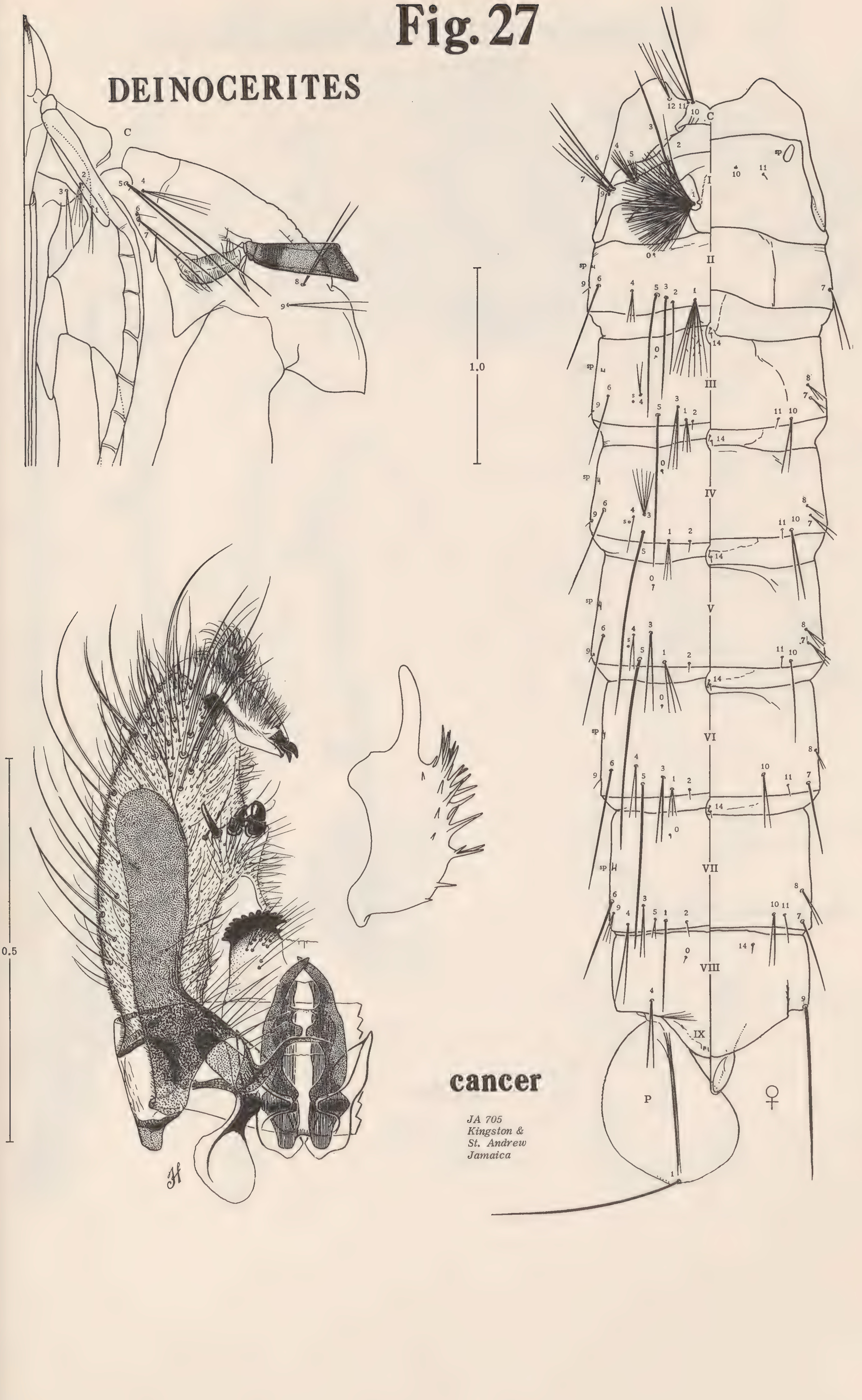


Fig. 27

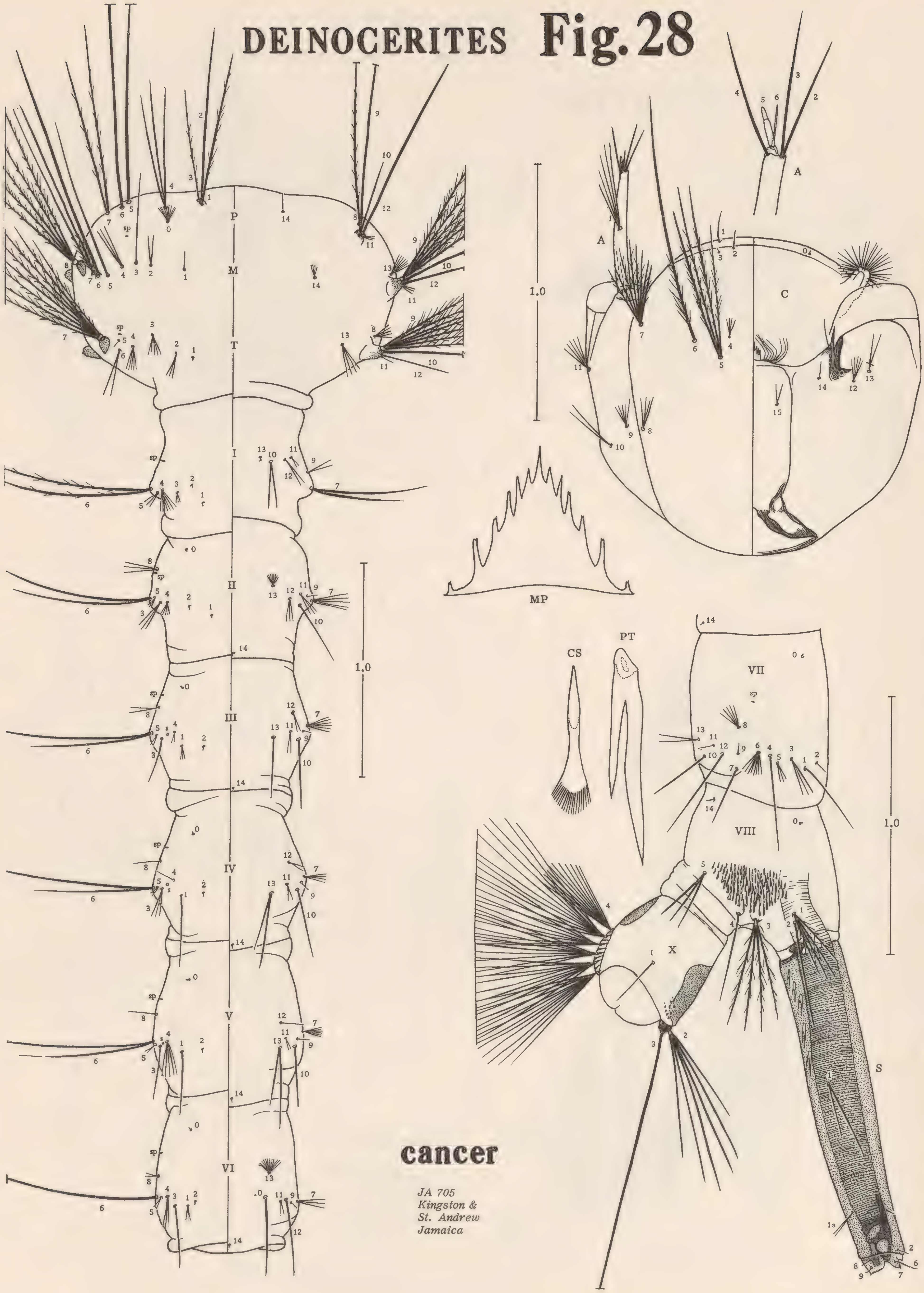
DEINOCERITES



cancer

JA 705
Kingston &
St. Andrew
Jamaica

DEINOCERITES Fig. 28

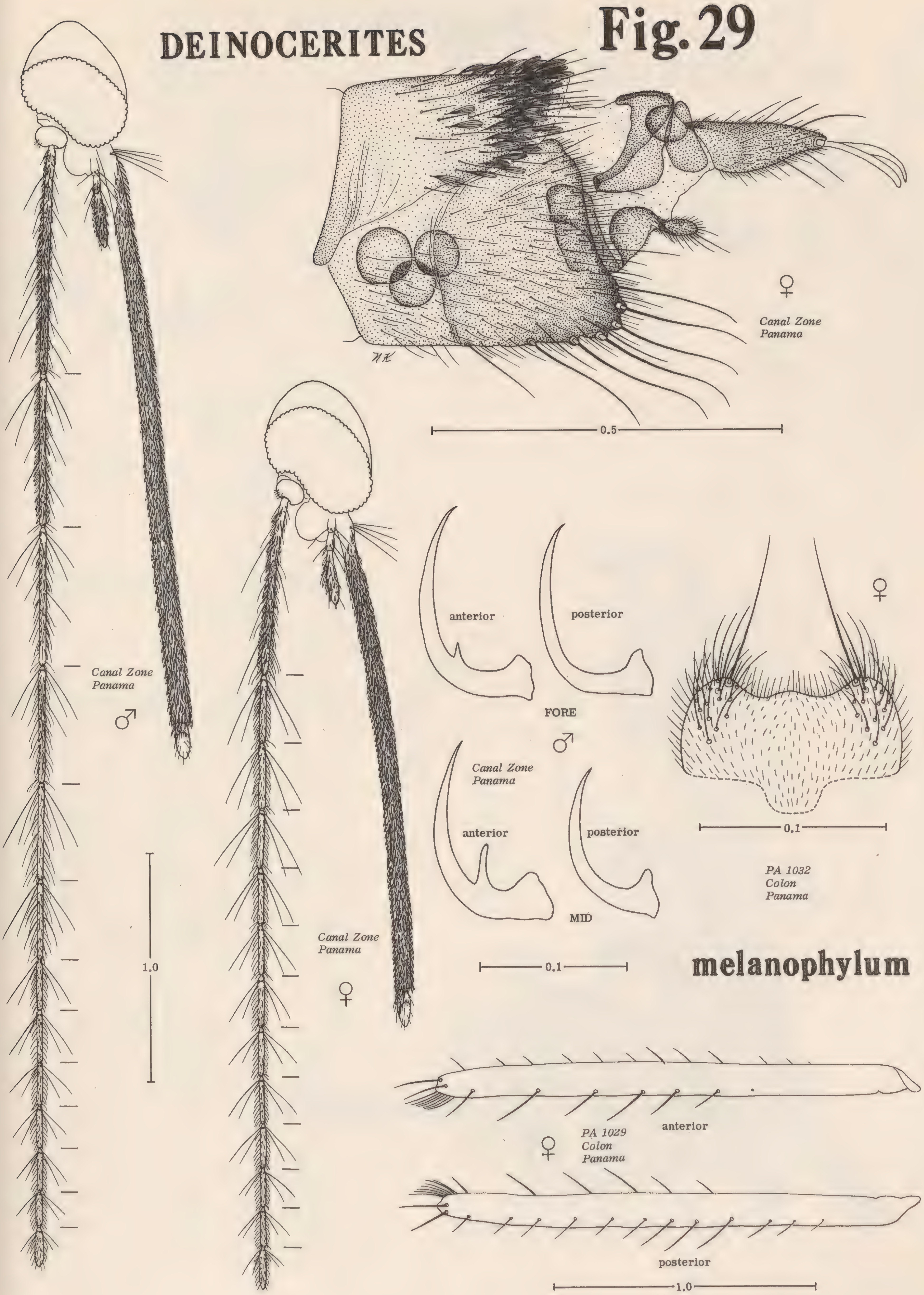


cancer

JA 705
Kingston &
St. Andrew
Jamaica

DEINOCERITES

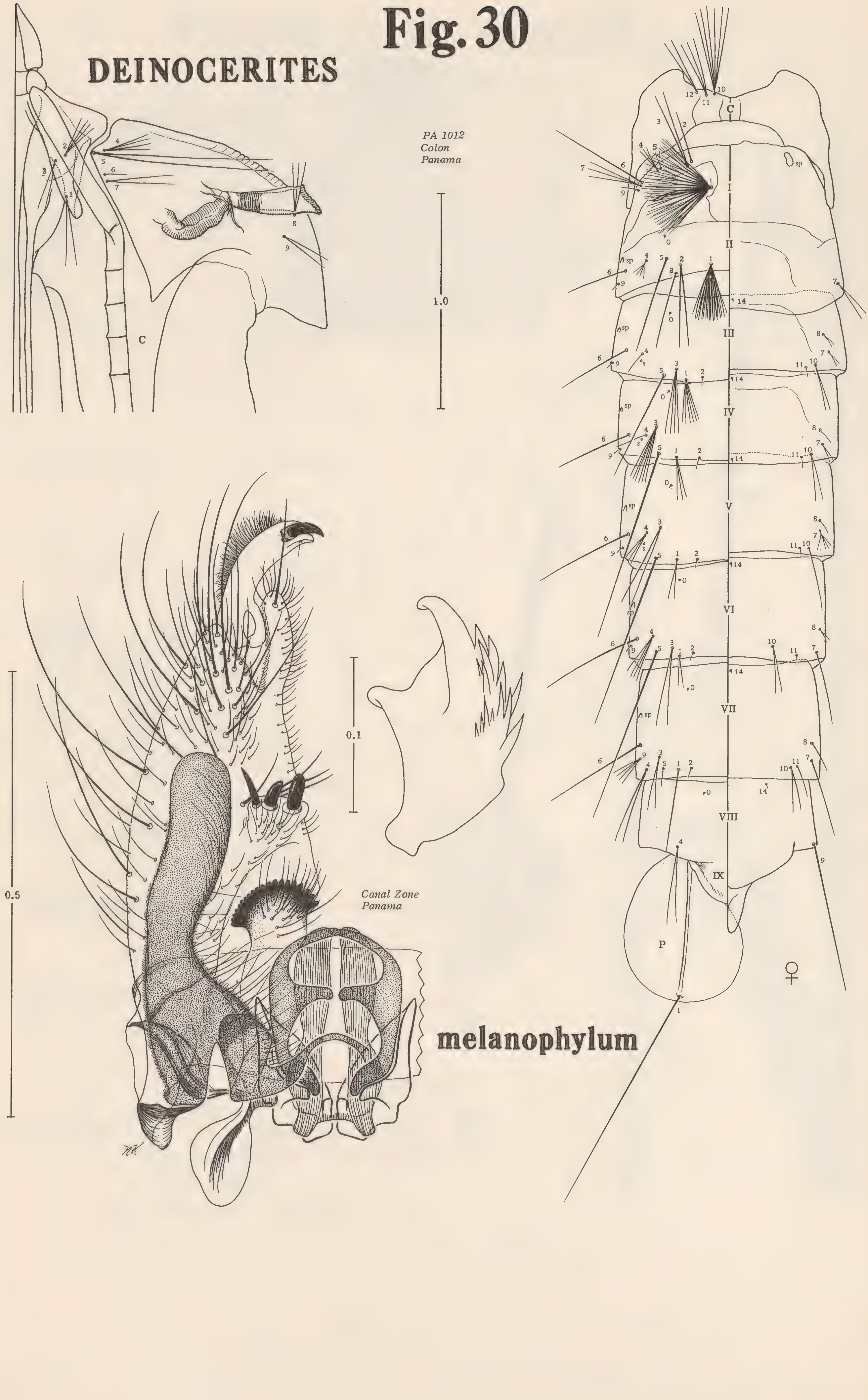
Fig. 29



melanophylum

Fig. 30

DEINOCERITES



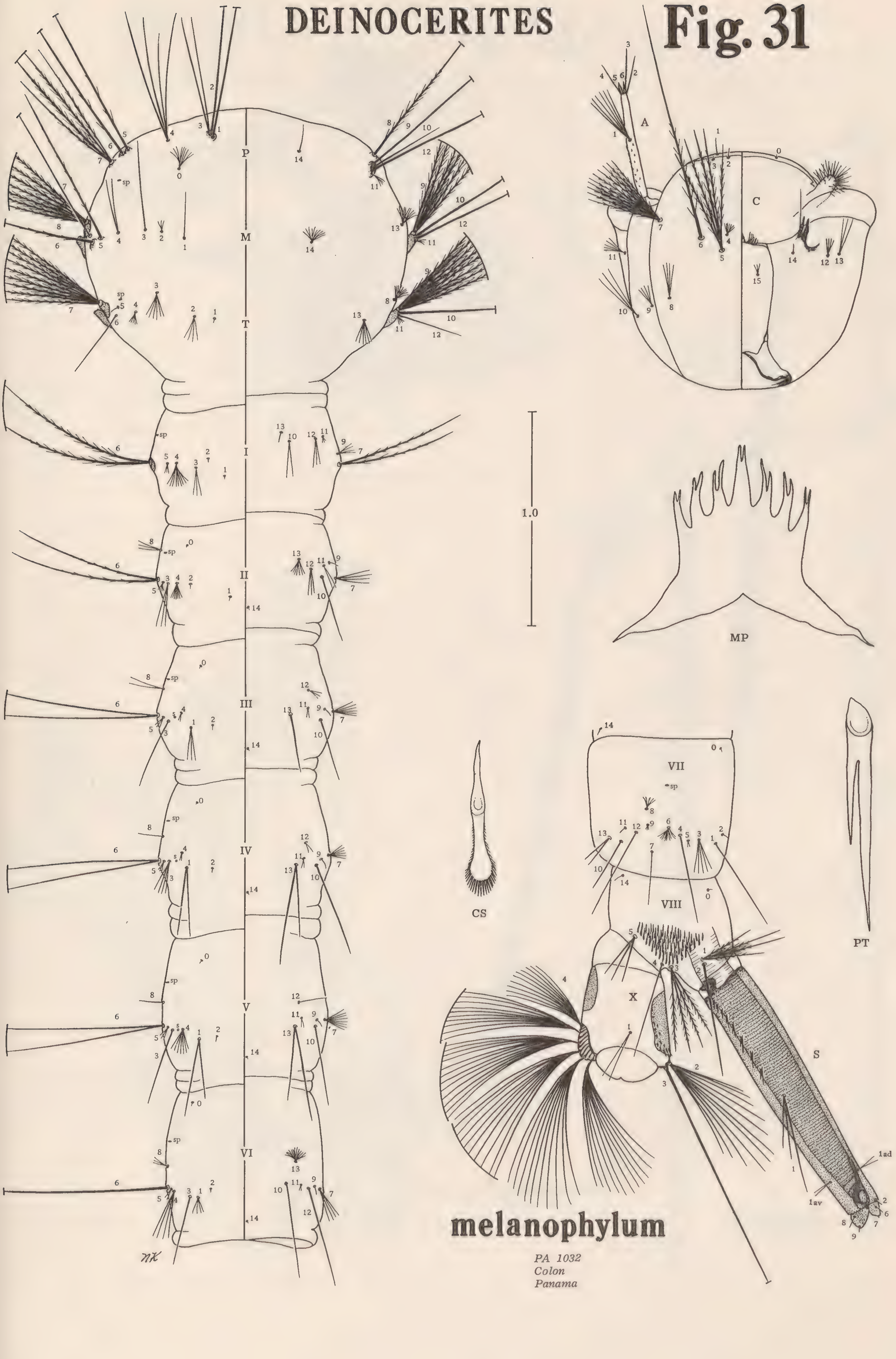
PA 1012
Colon
Panama

Canal Zone
Panama

melanophylum

DEINOCERITES

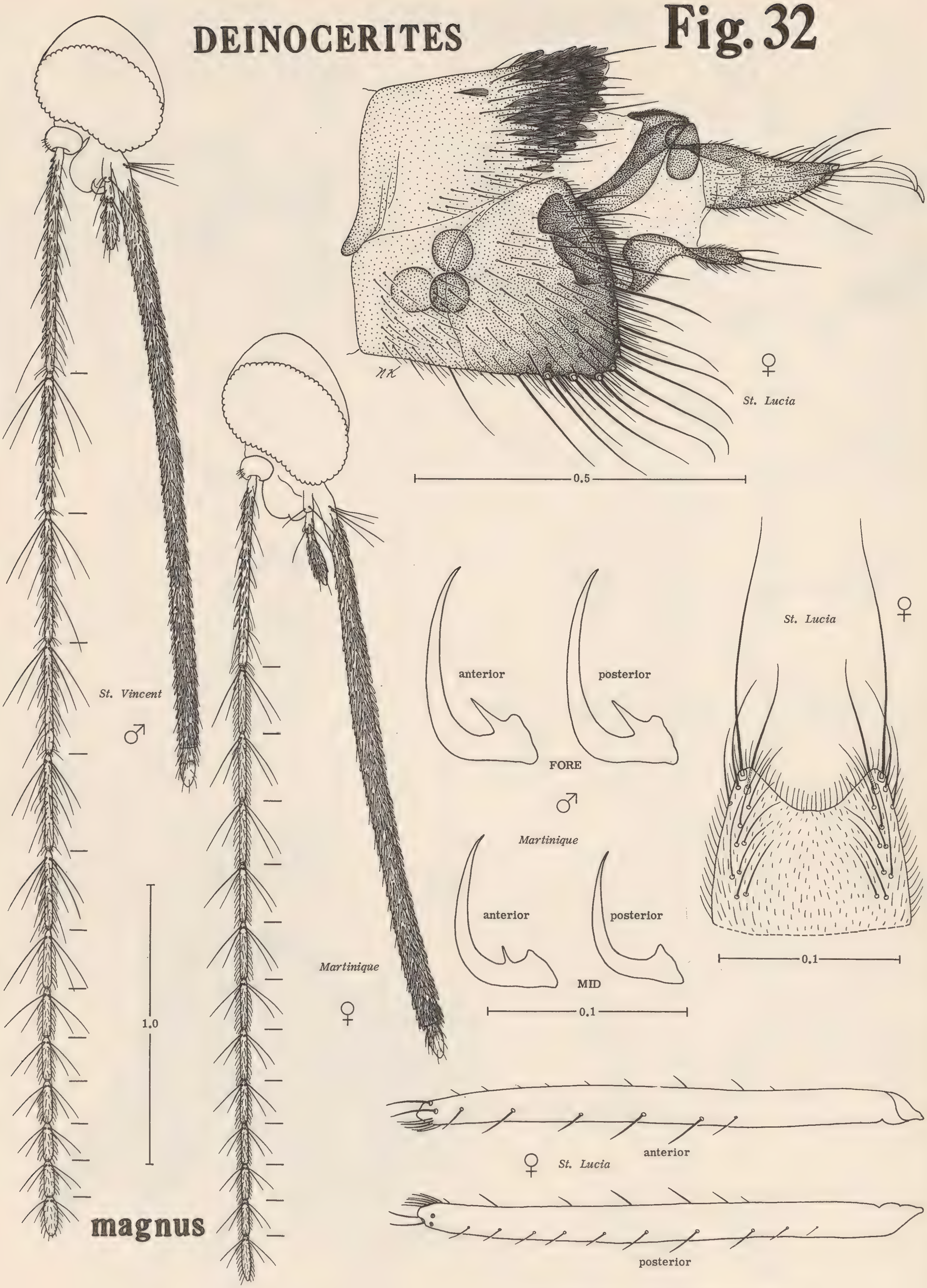
Fig. 31



melanophylum

PA 1032
Colon
Panama

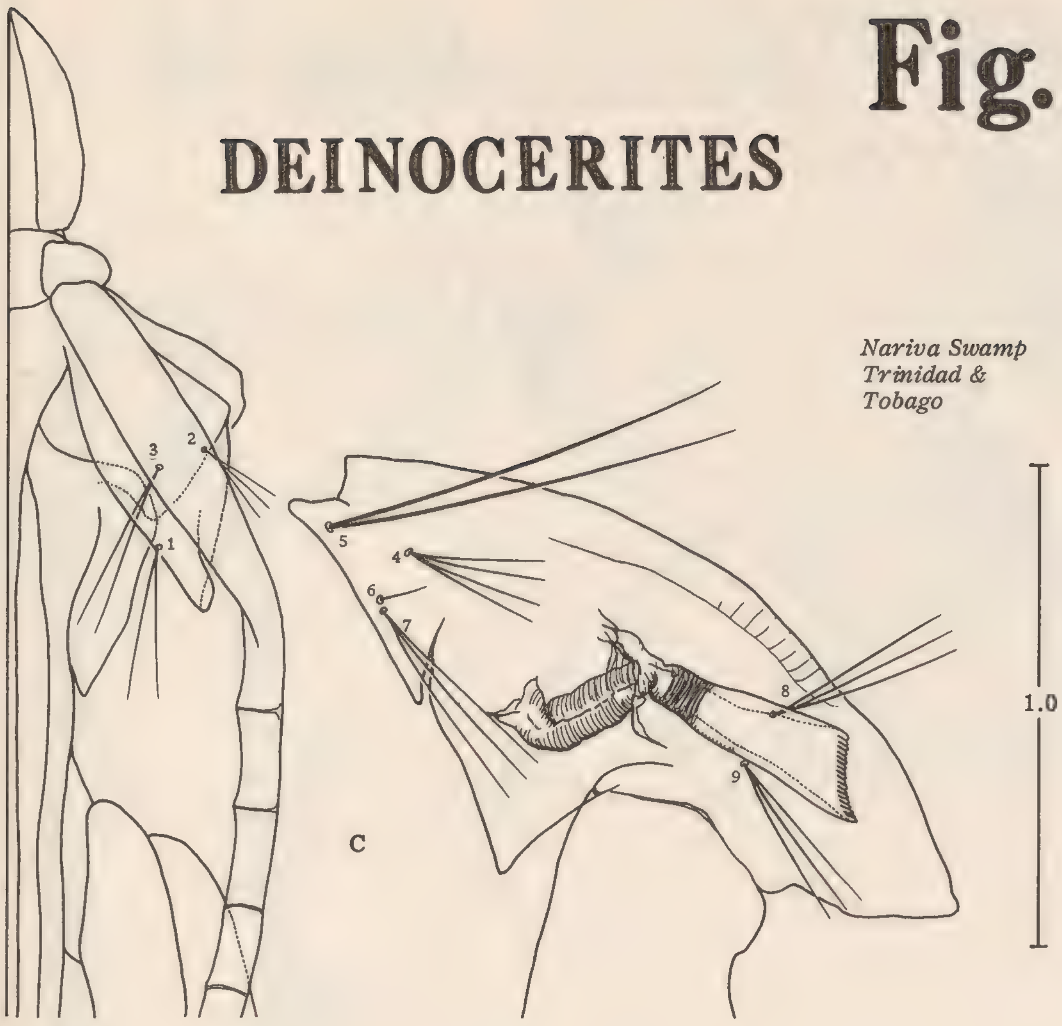
DEINOCERITES **Fig. 32**

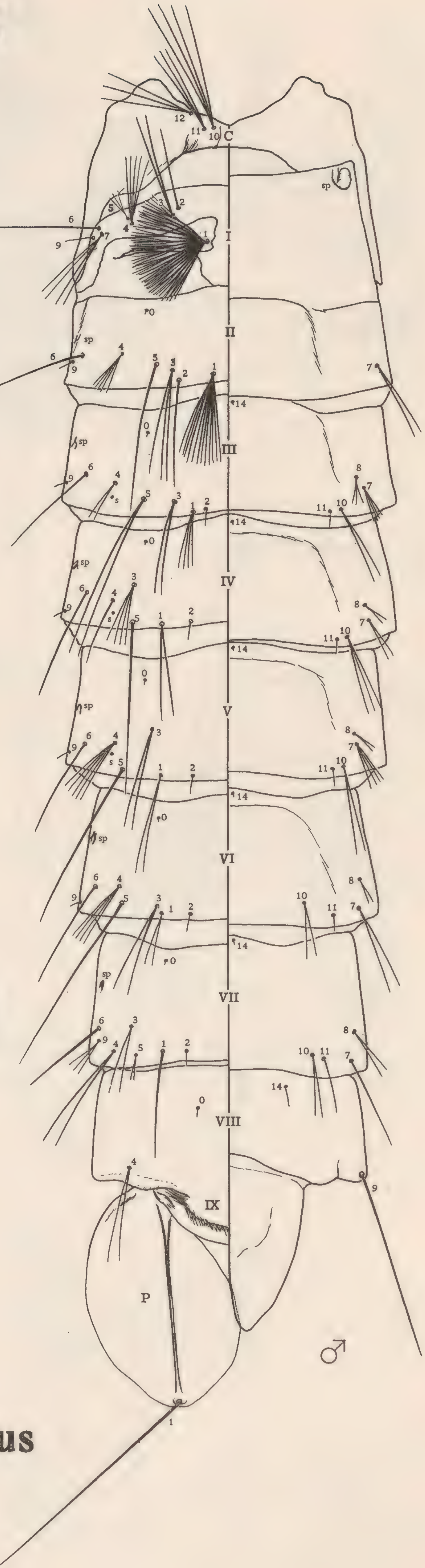


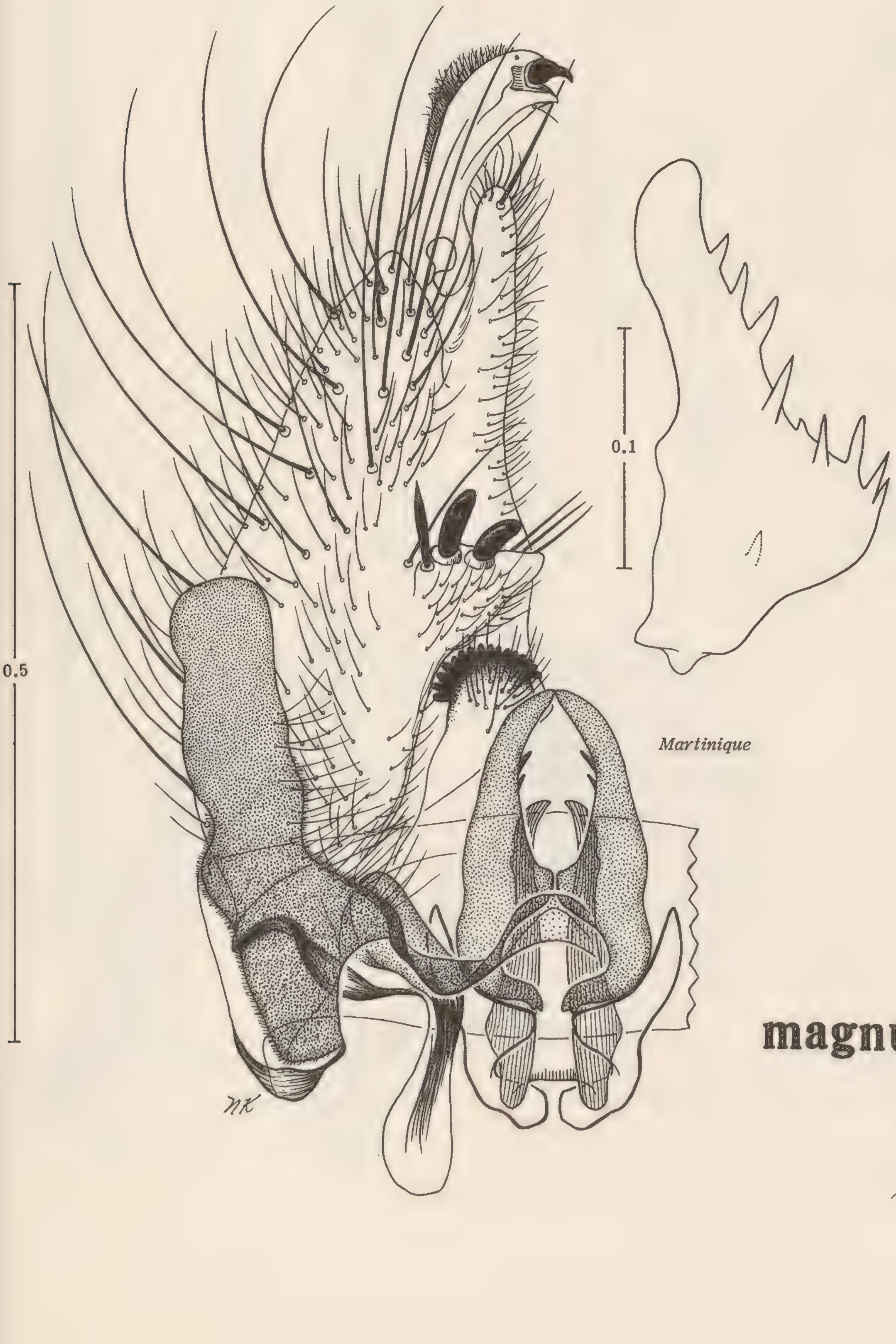
magnus

Fig. 33

DEINOCERITES



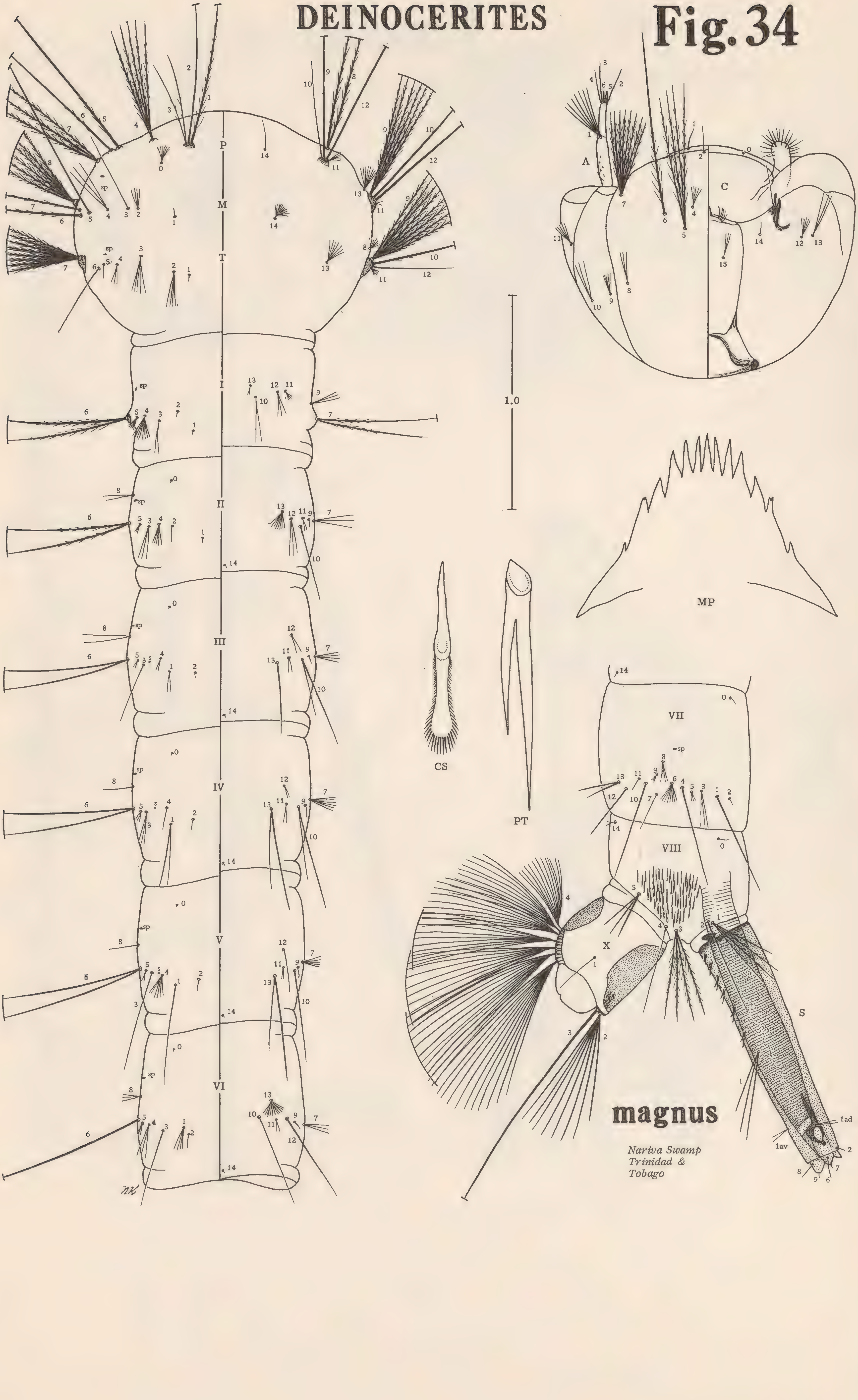




magnus

DEINOCERITES

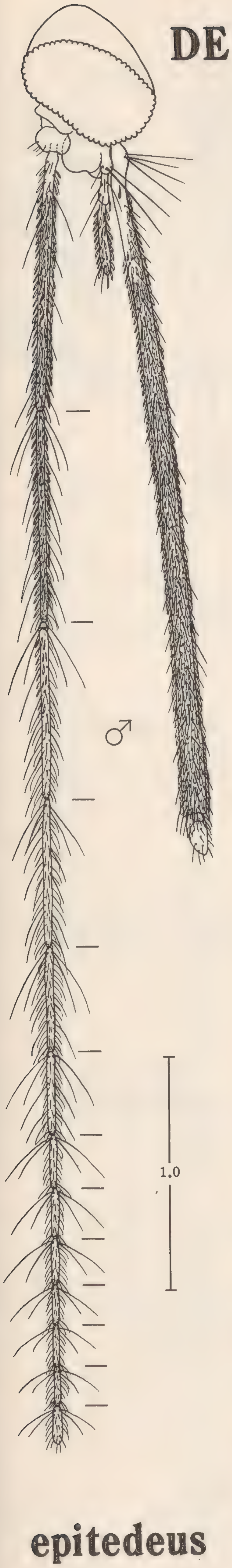
Fig. 34

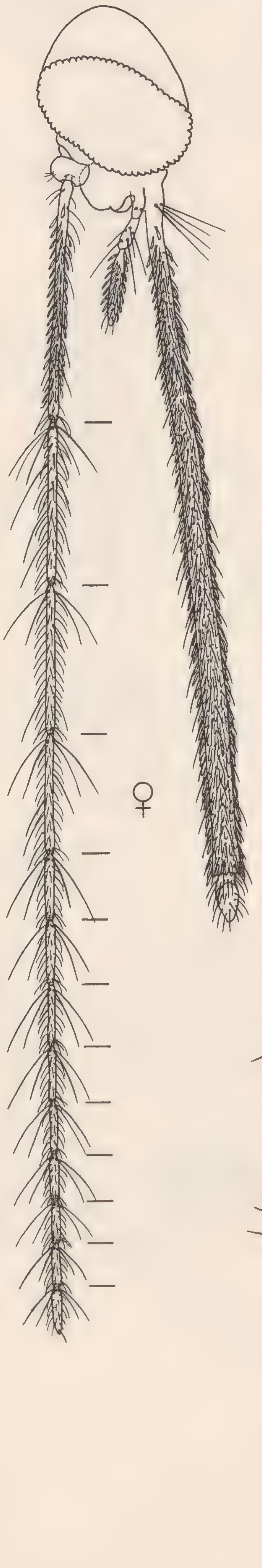


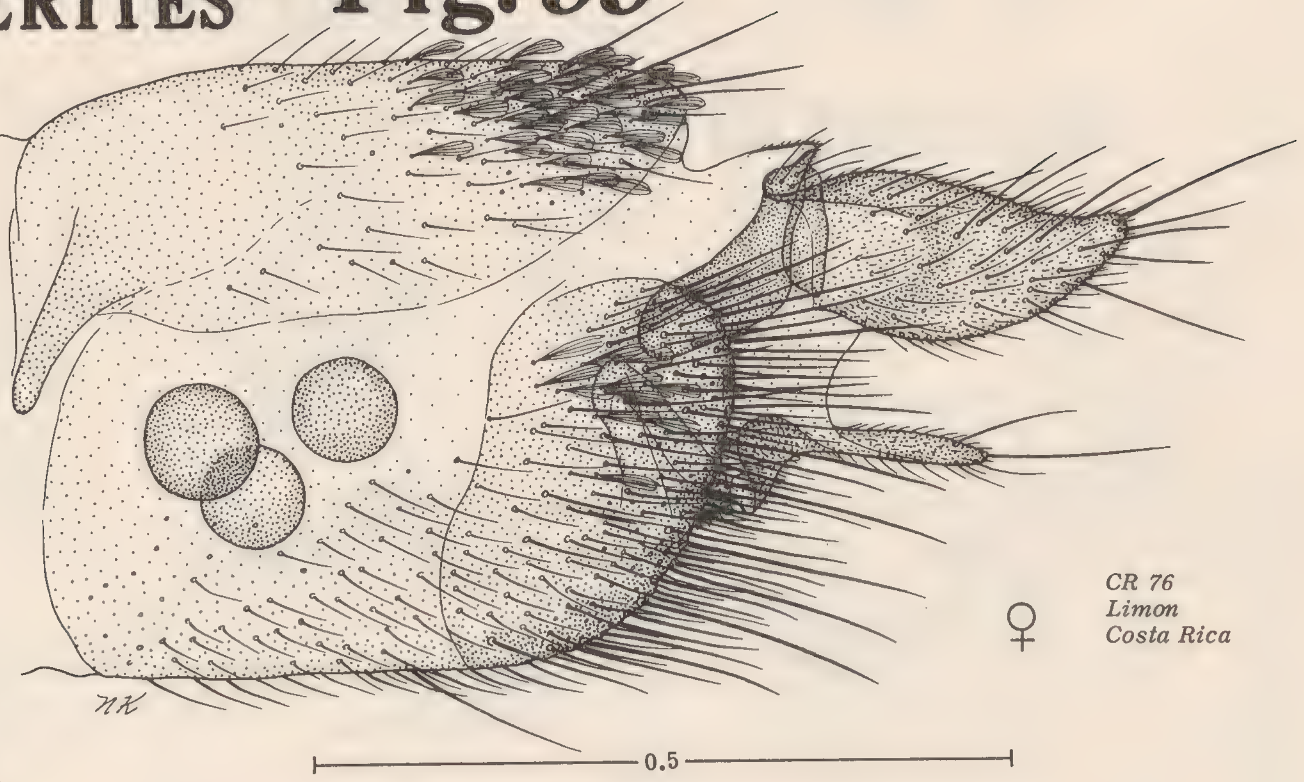
magnus

Nariva Swamp
Trinidad &
Tobago

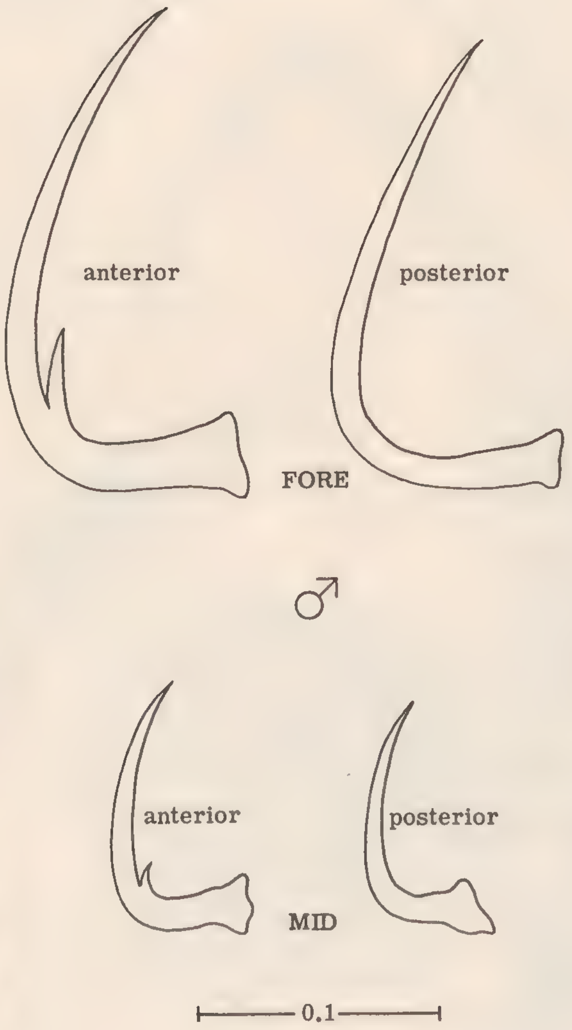
DEINOCERITES **Fig. 35**

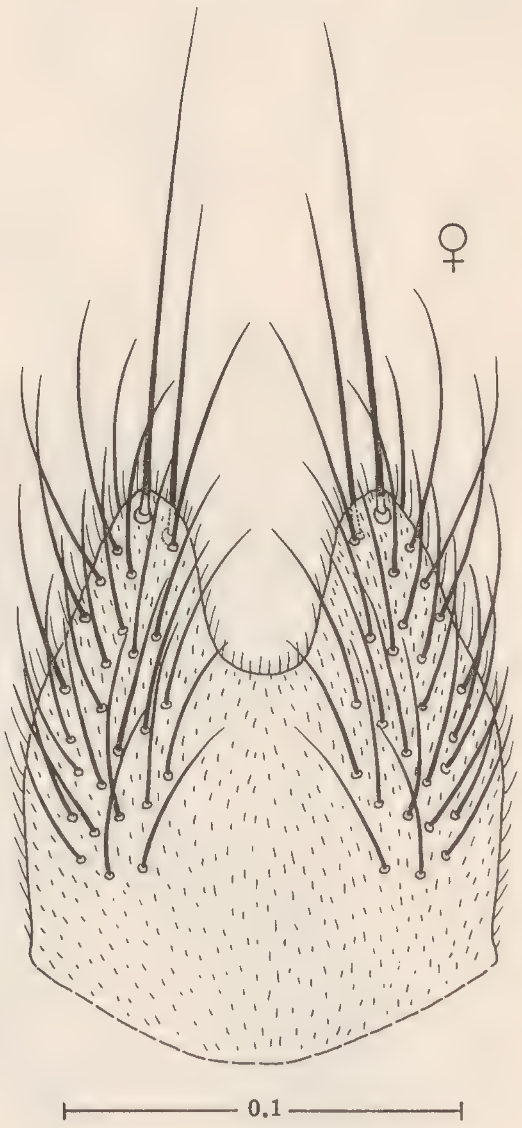


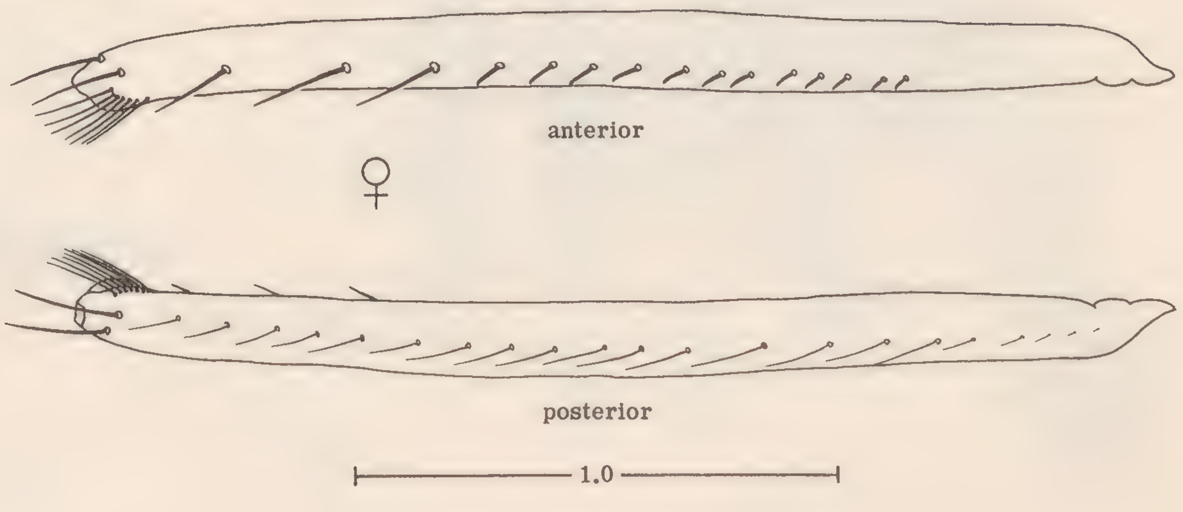




CR 76
Limon
Costa Rica





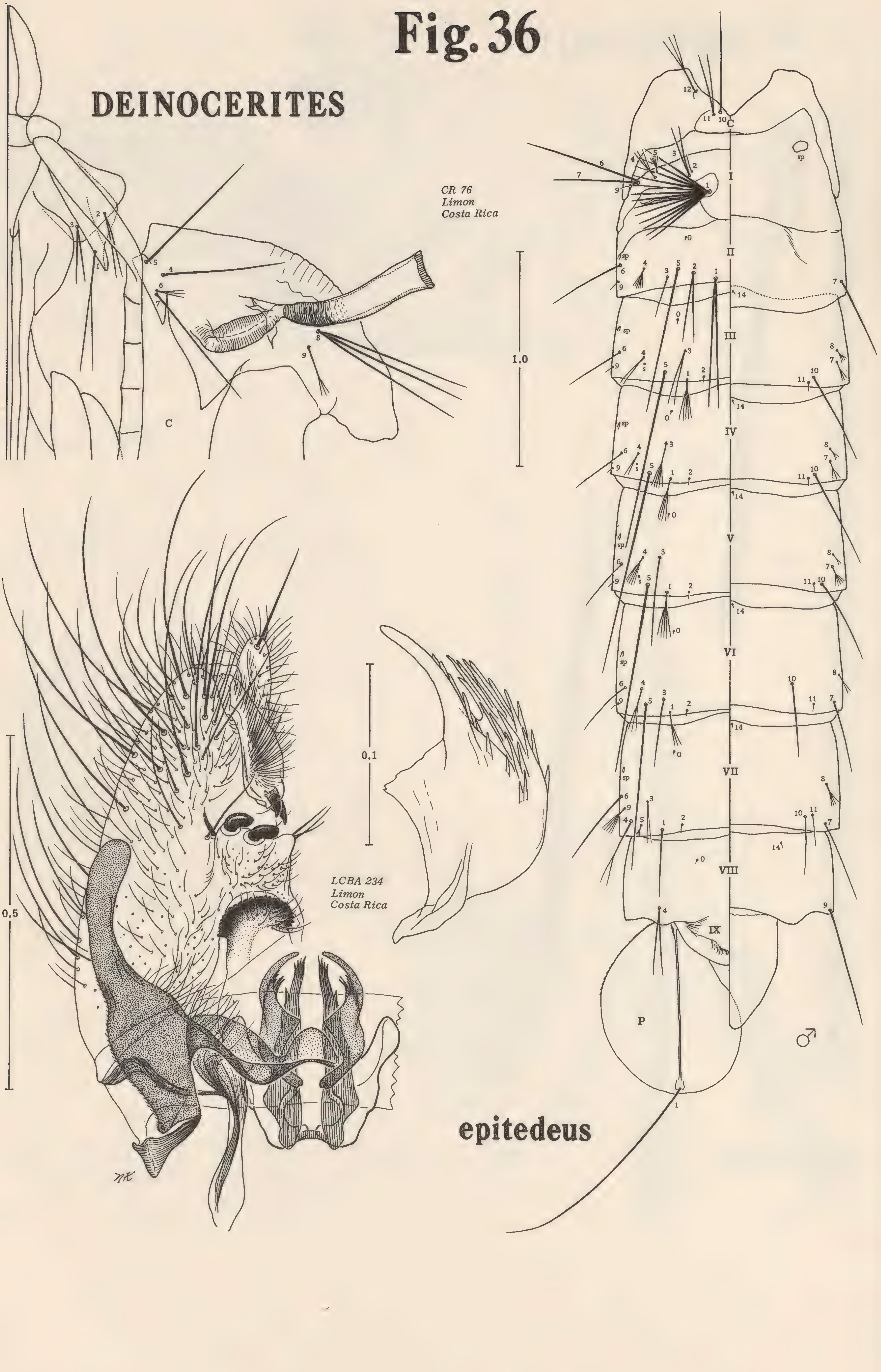


epitedeus

LCBA 234
Limon
Costa Rica

Fig. 36

DEINOCERITES



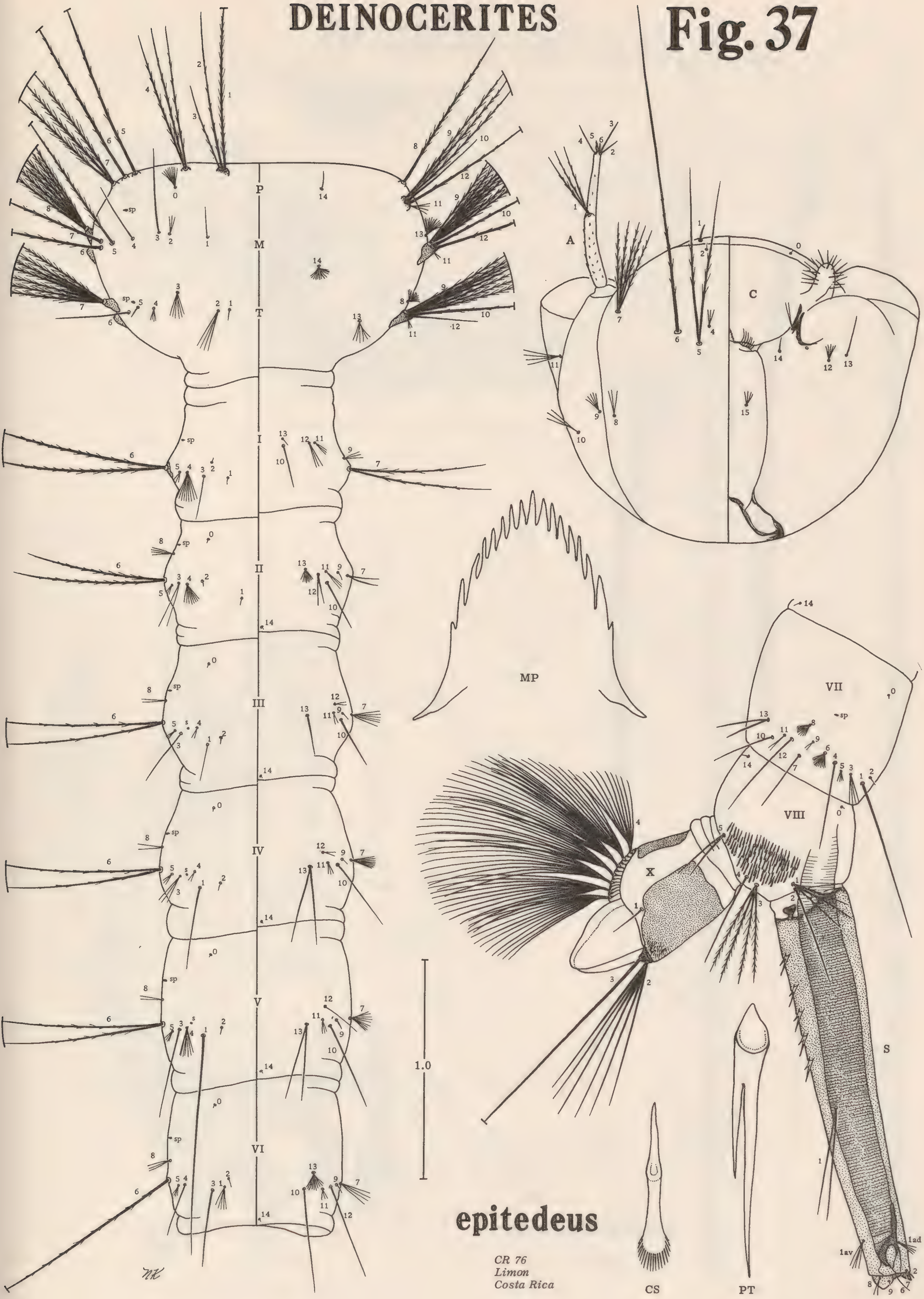
CR 76
Limon
Costa Rica

LCBA 234
Limon
Costa Rica

epitedeus

DEINOCERITES

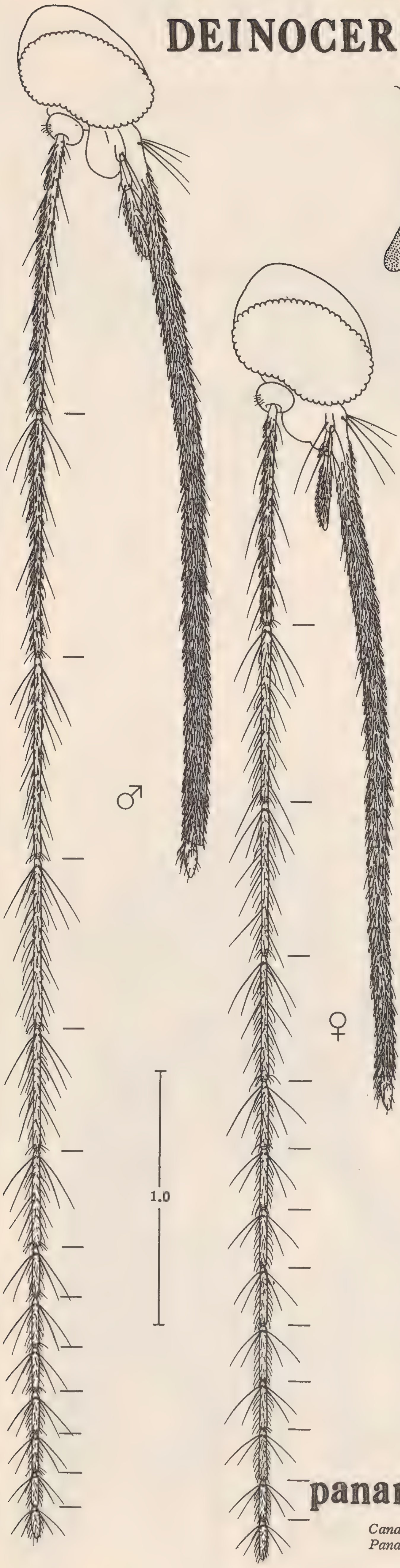
Fig. 37

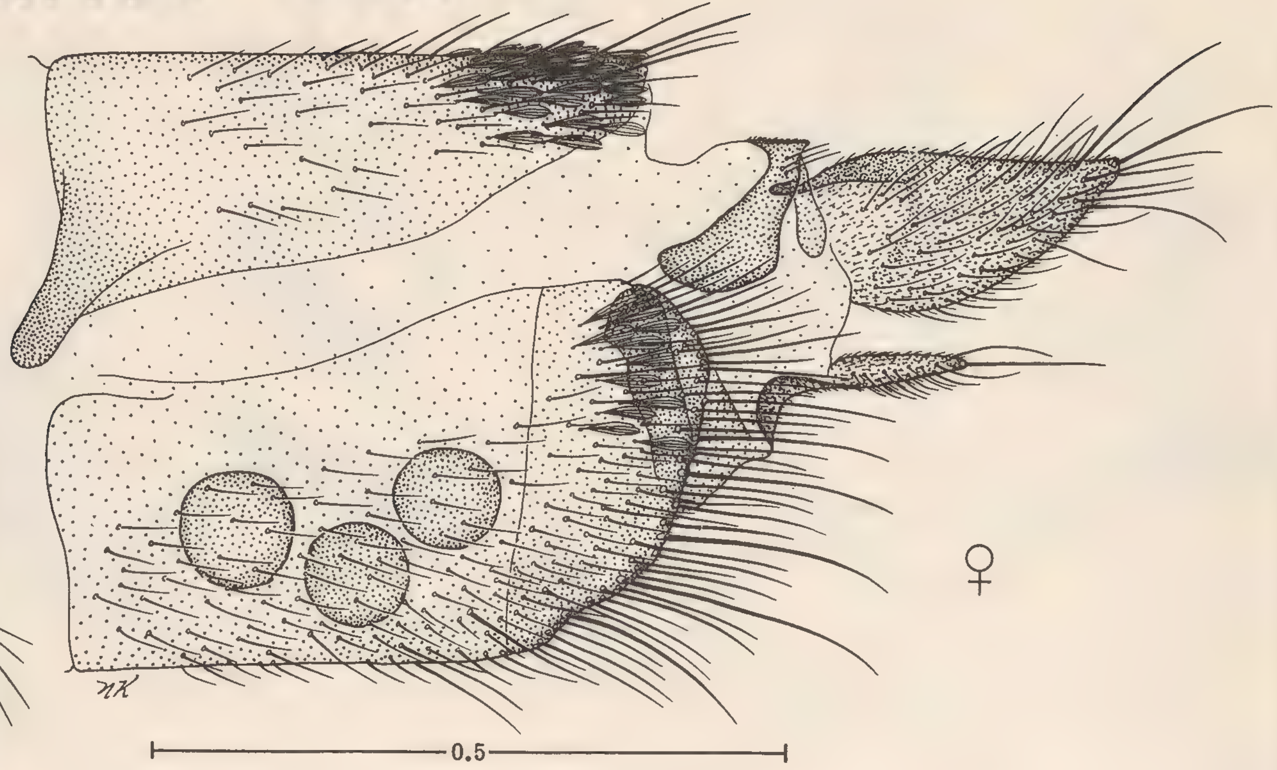


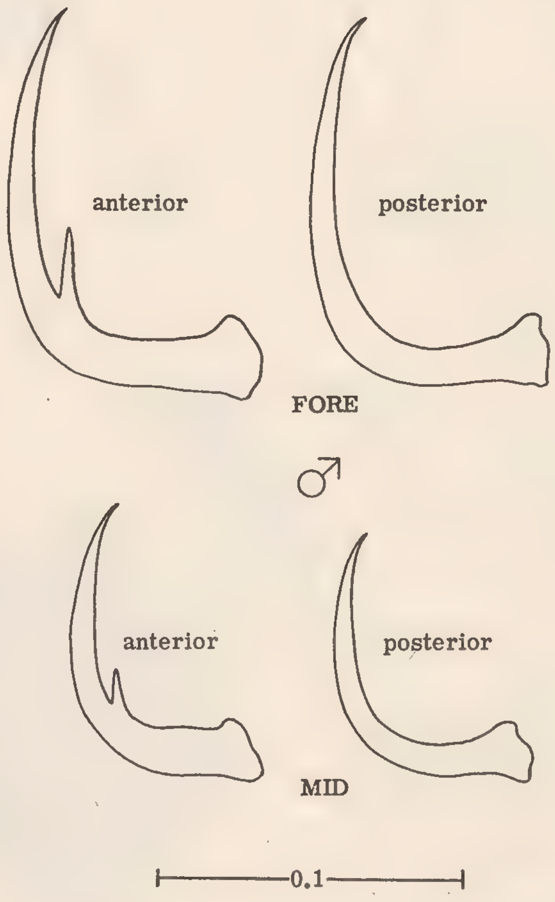
epitedeus

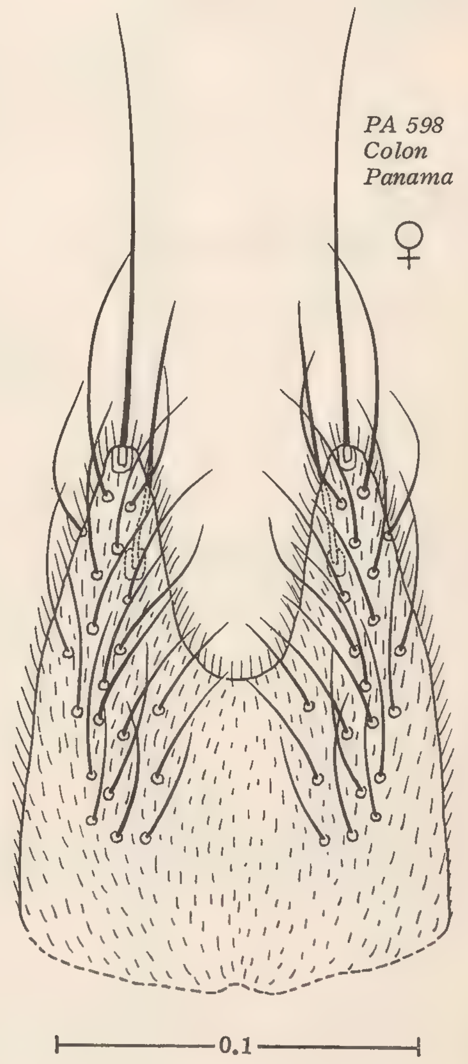
CR 76
Limon
Costa Rica

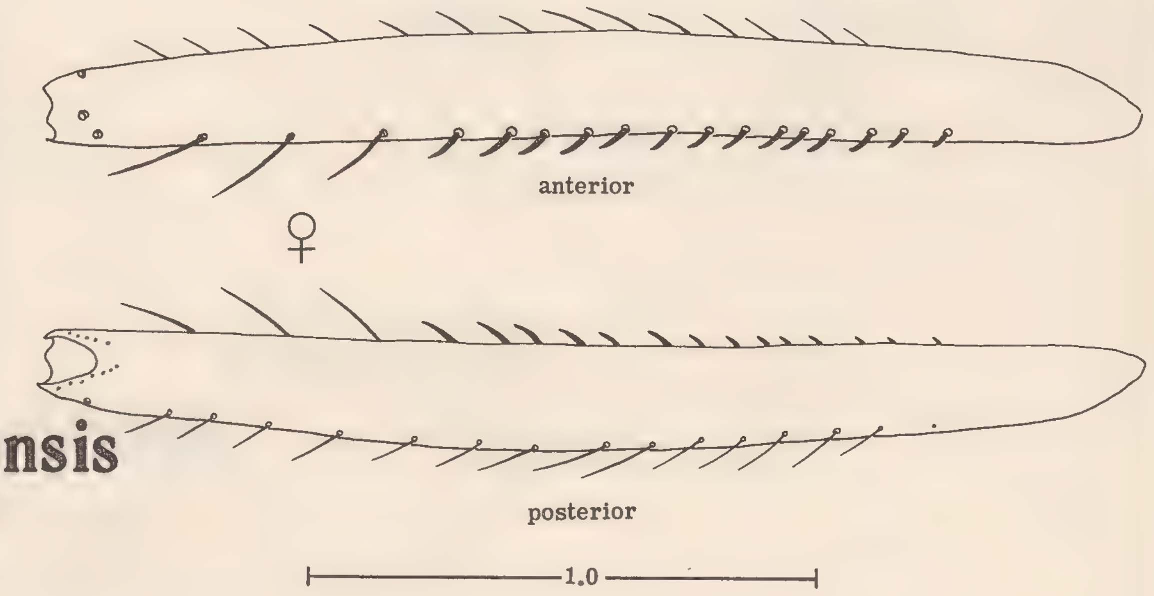
DEINOCERITES Fig. 38









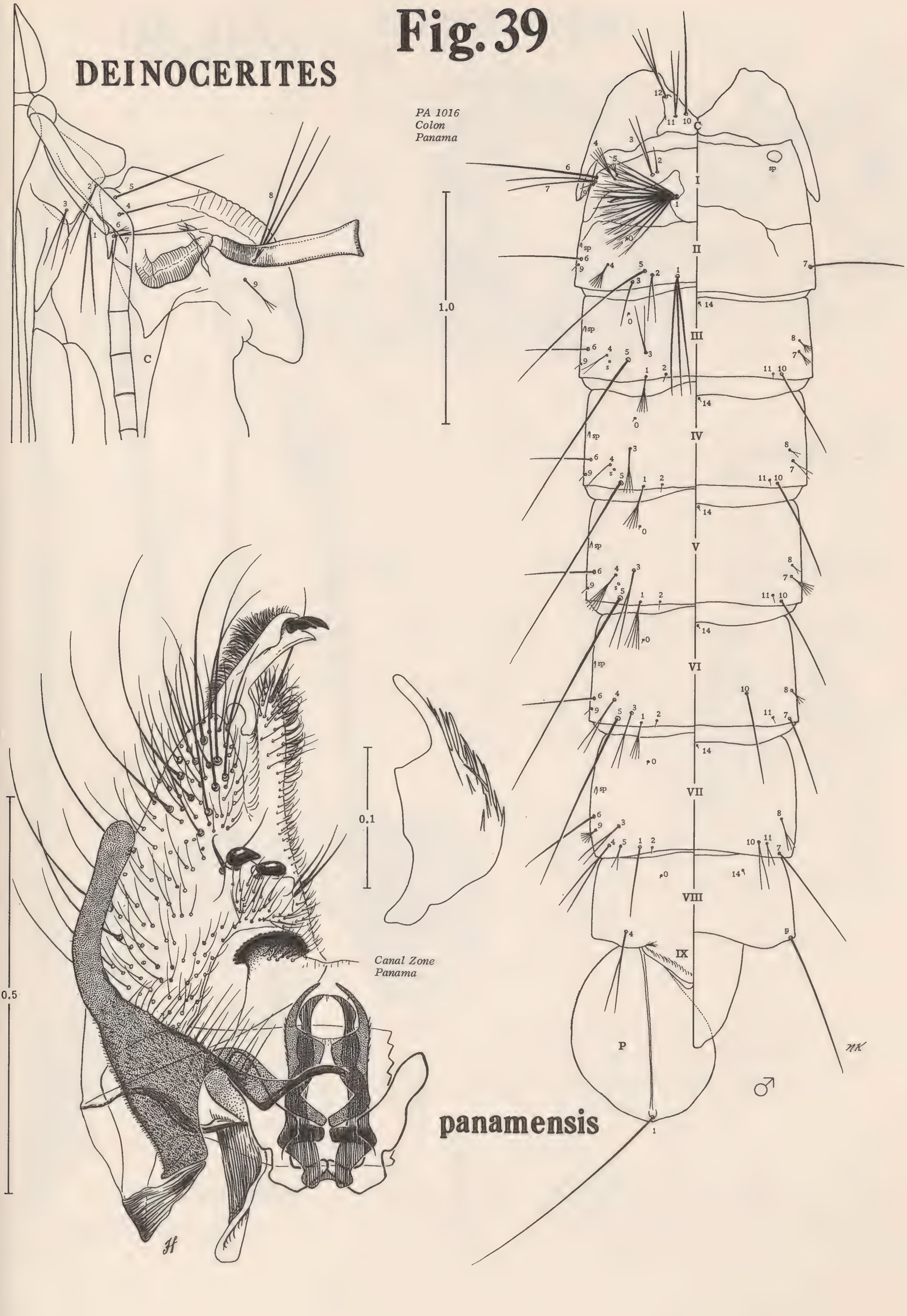


panamensis

Canal Zone
Panama

Fig. 39

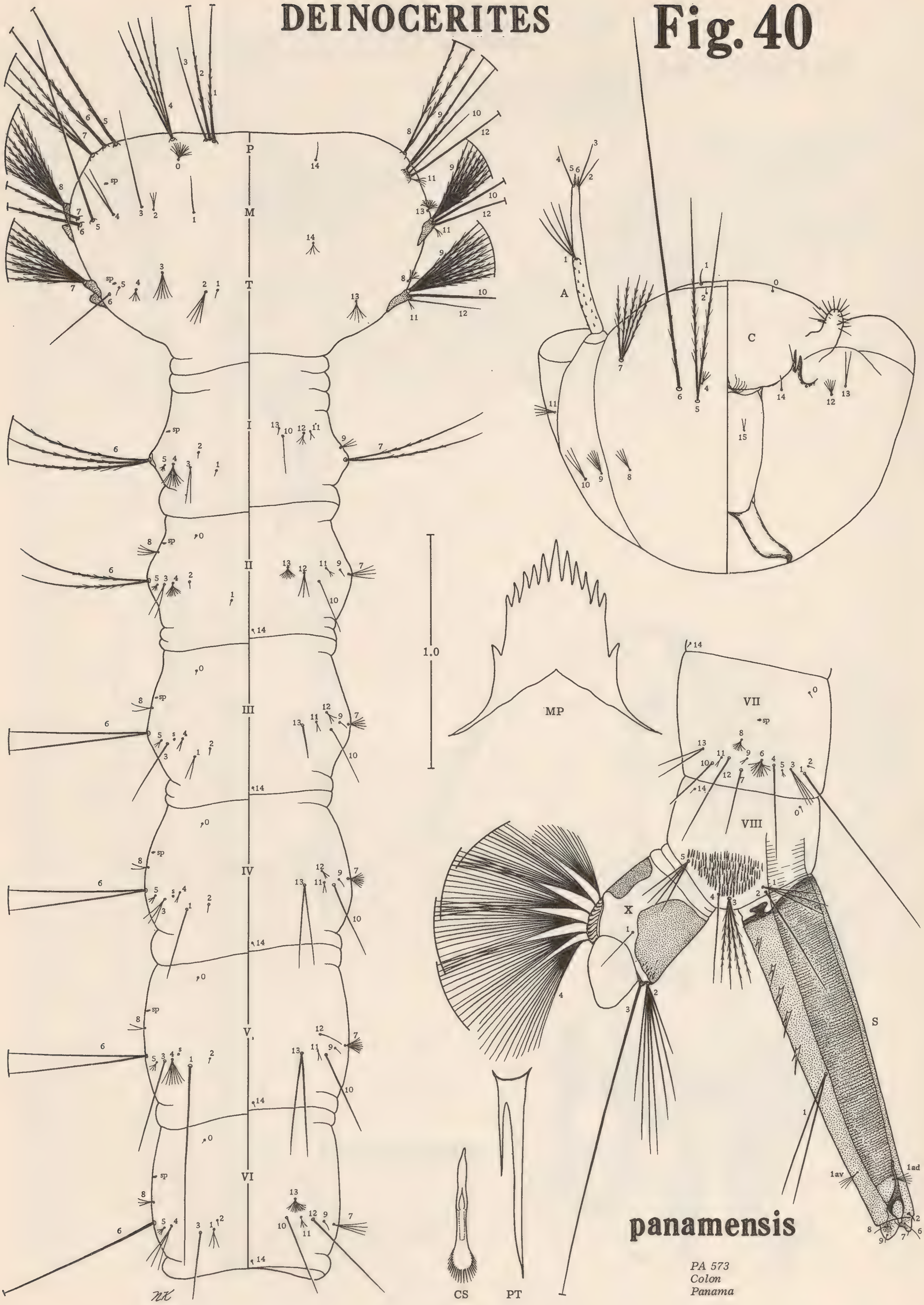
DEINOCERITES



panamensis

DEINOCERITES

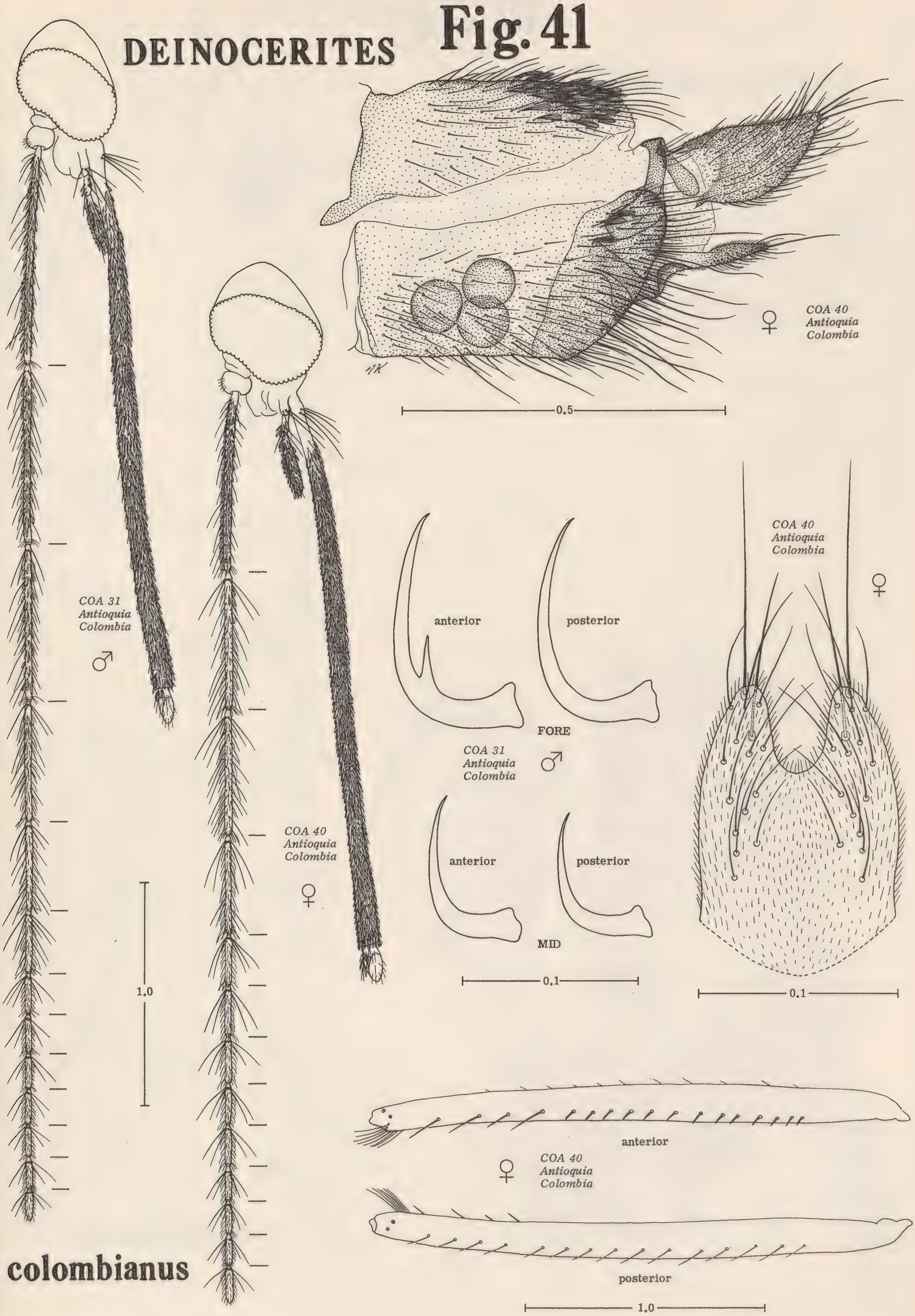
Fig. 40



panamensis

PA 573
Colon
Panama

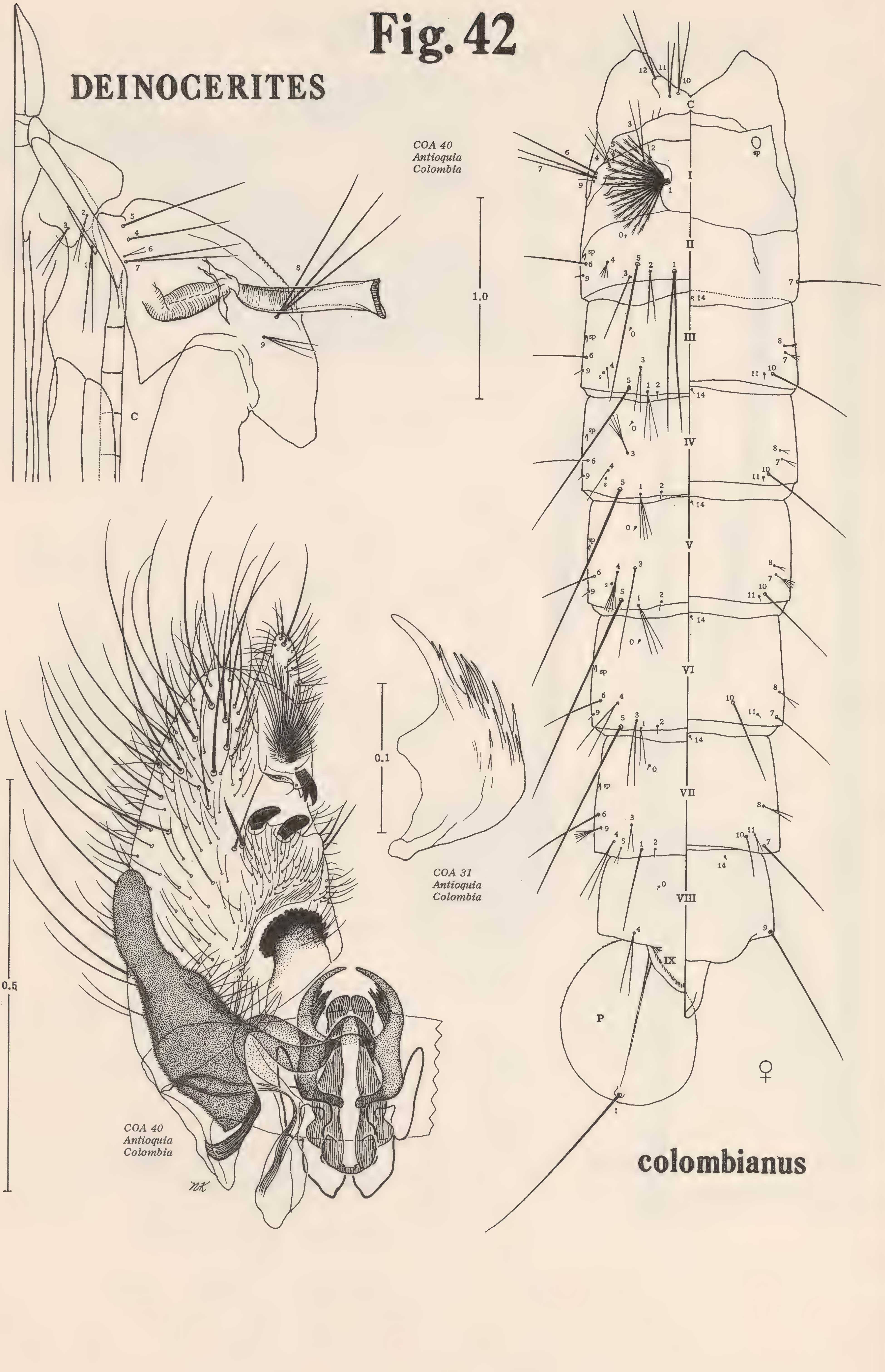
DEINOCERITES **Fig. 41**



colombianus

Fig. 42

DEINOCERITES



COA 40
Antioquia
Colombia

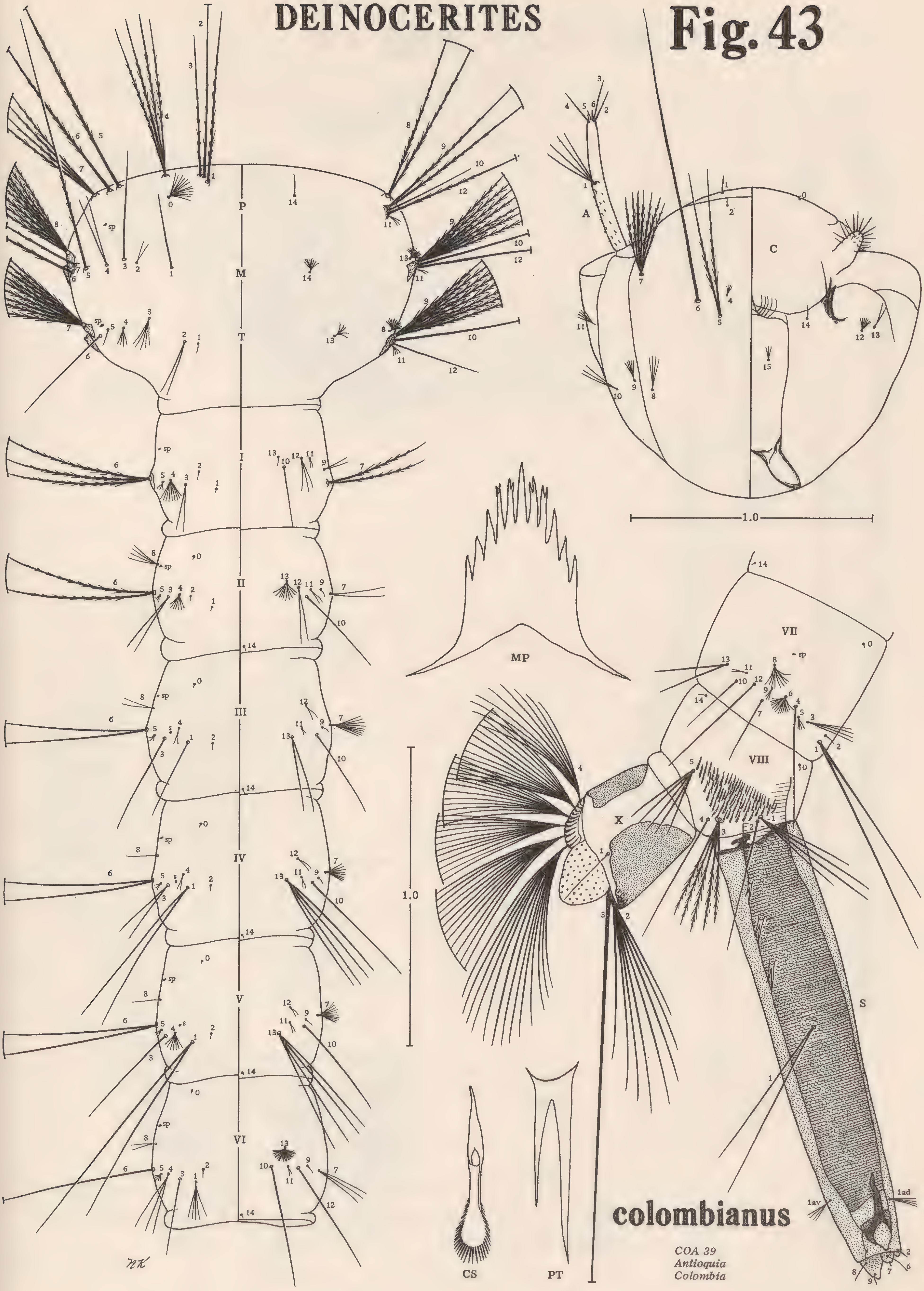
COA 31
Antioquia
Colombia

COA 40
Antioquia
Colombia

colombianus

DEINOCERITES

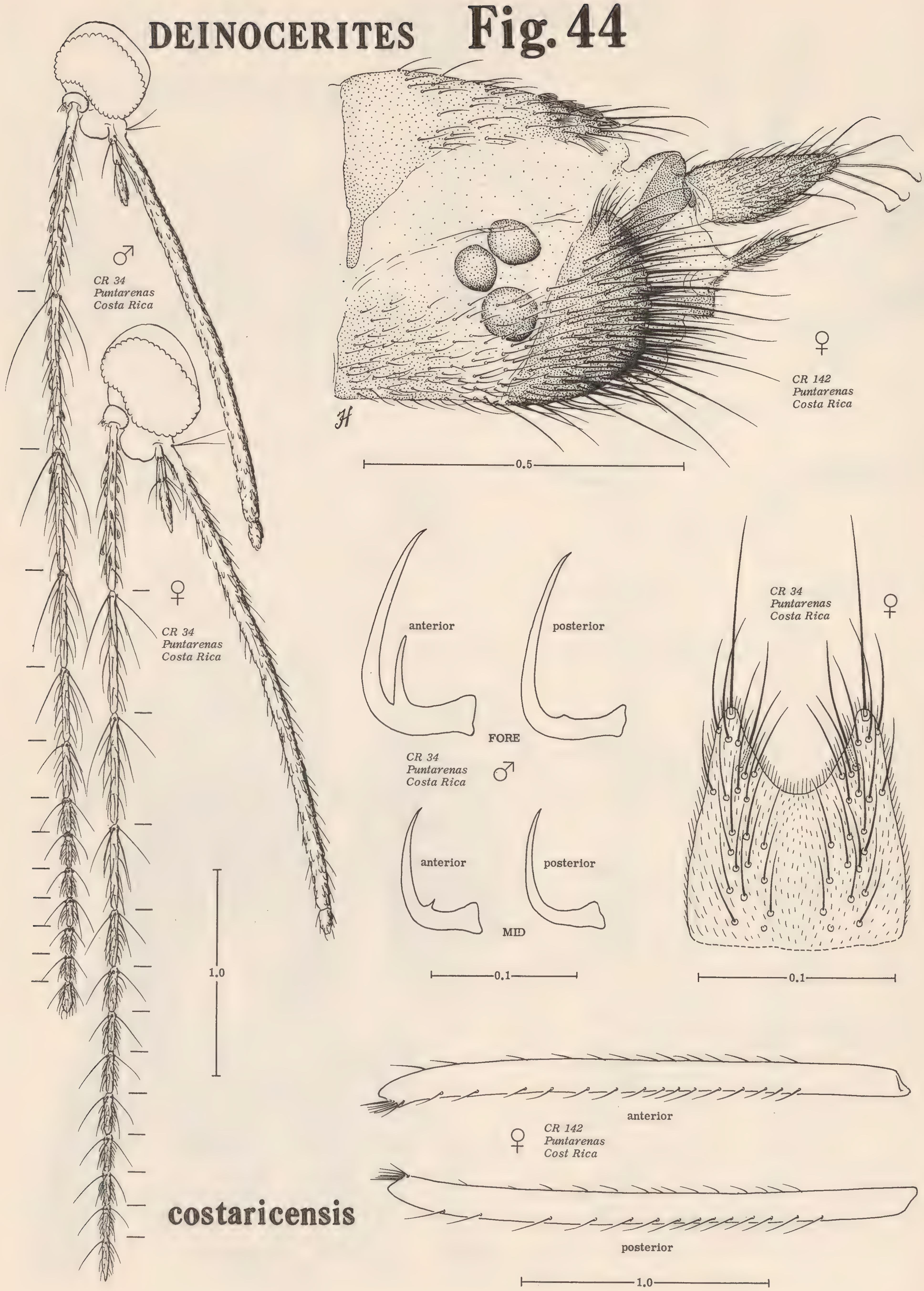
Fig. 43



colombianus

COA 39
Antioquia
Colombia

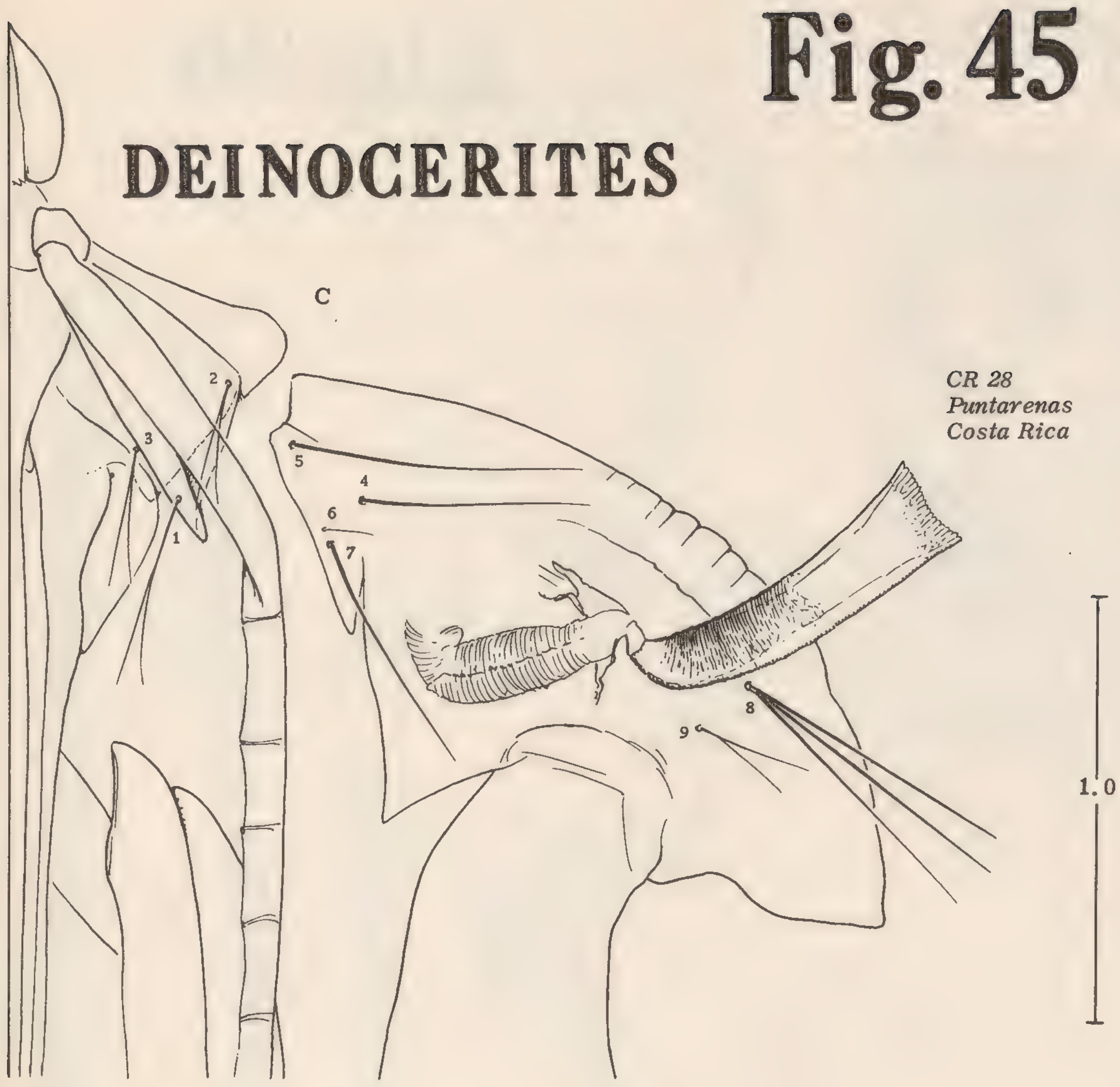
DEINOCERITES Fig. 44



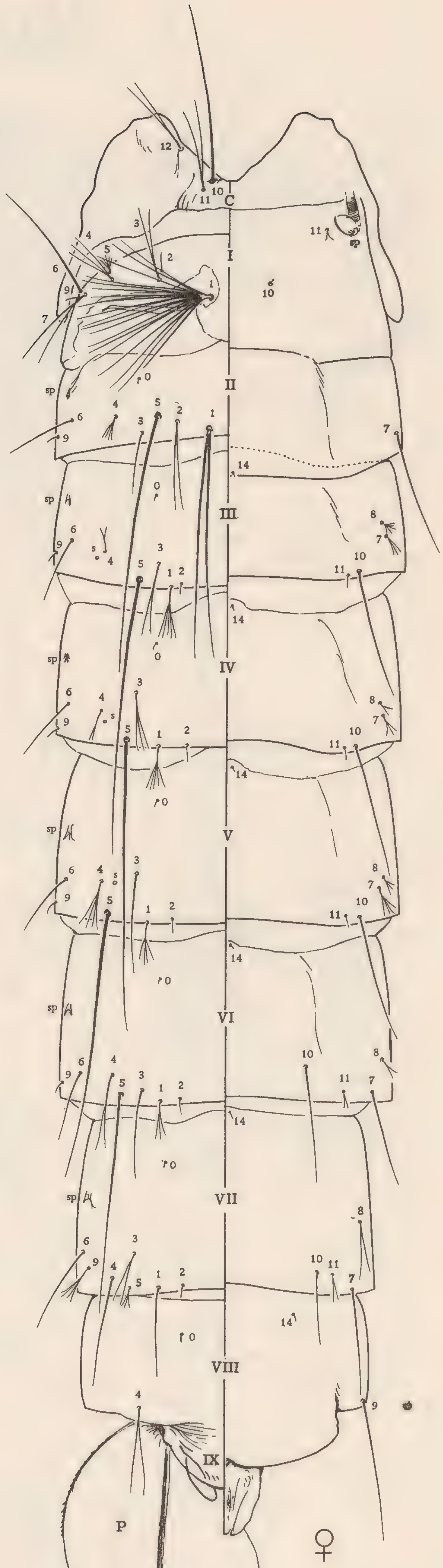
costaricensis

Fig. 45

DEINOCERITES



CR 28
Puntarenas
Costa Rica



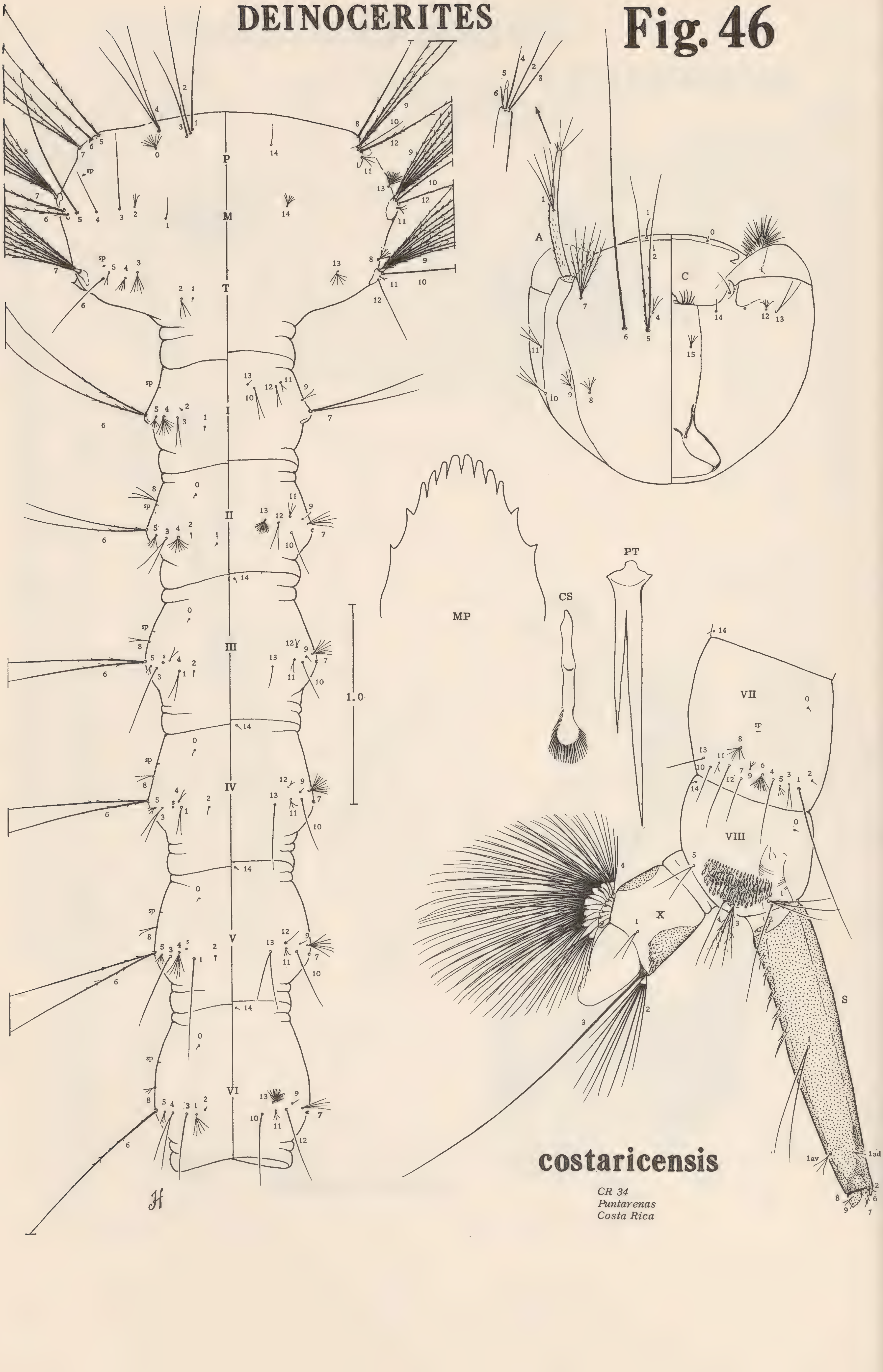
CR 28
Puntarenas
Costa Rica

CR 142
Puntarenas
Costa Rica

costaricensis

DEINOCERITES

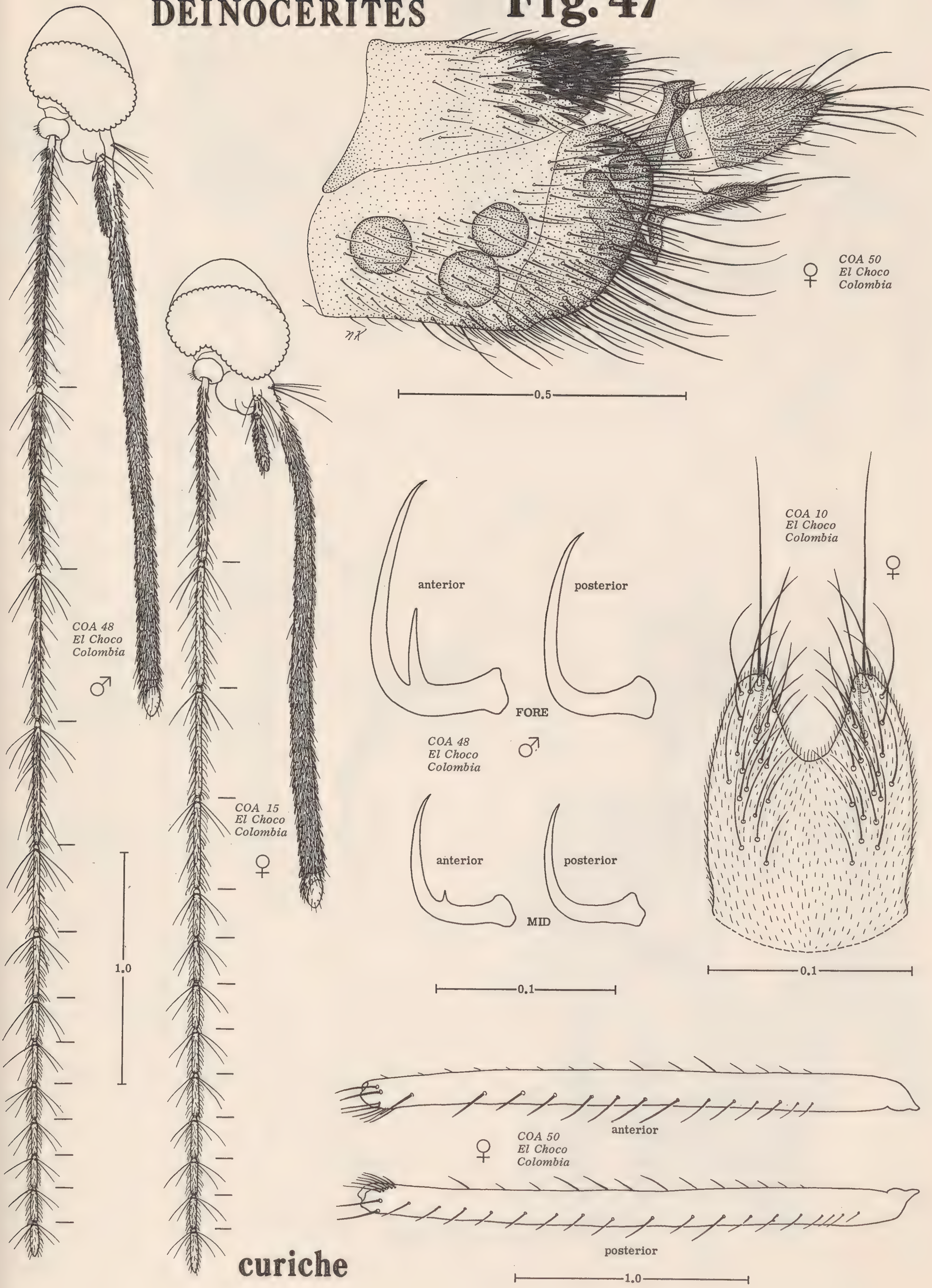
Fig. 46



costaricensis

CR 34
Puntarenas
Costa Rica

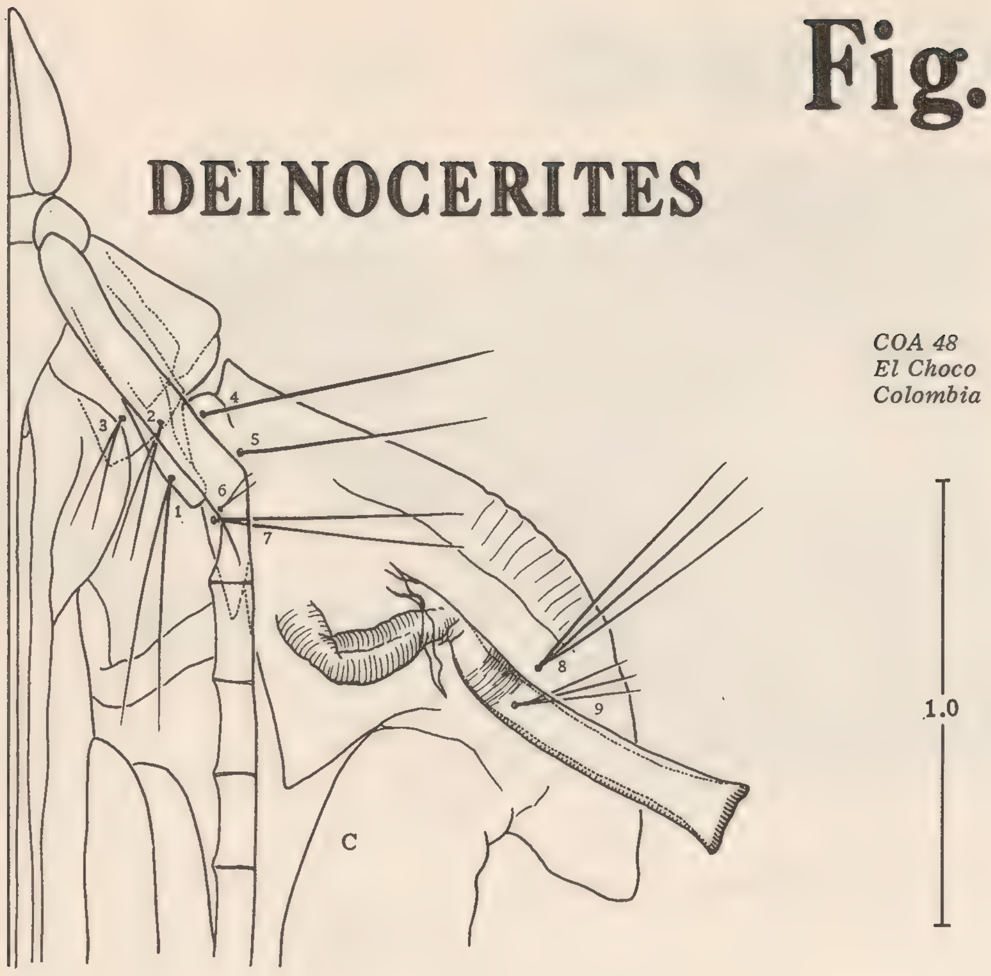
DEINOCERITES **Fig. 47**



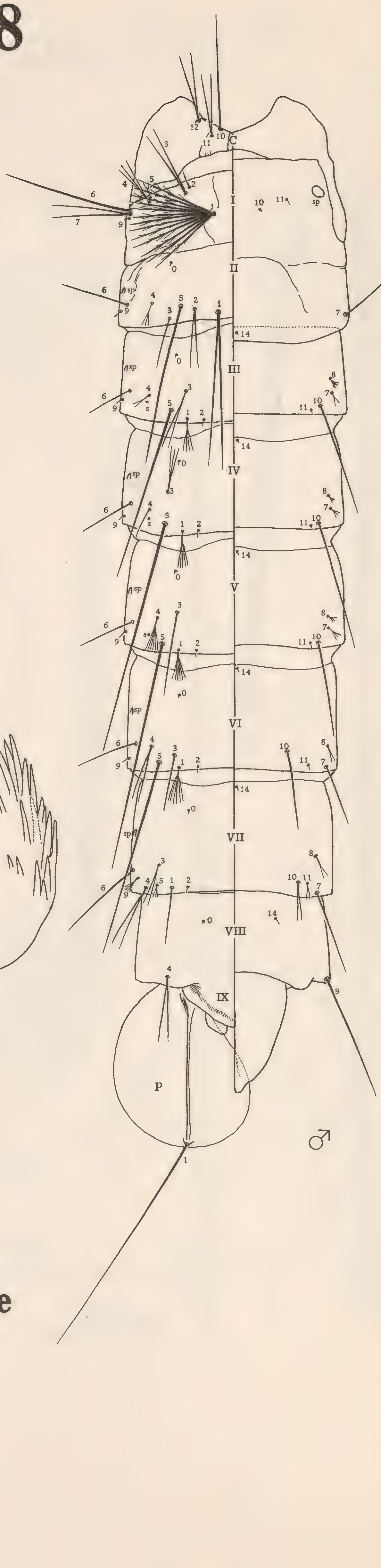
curiche

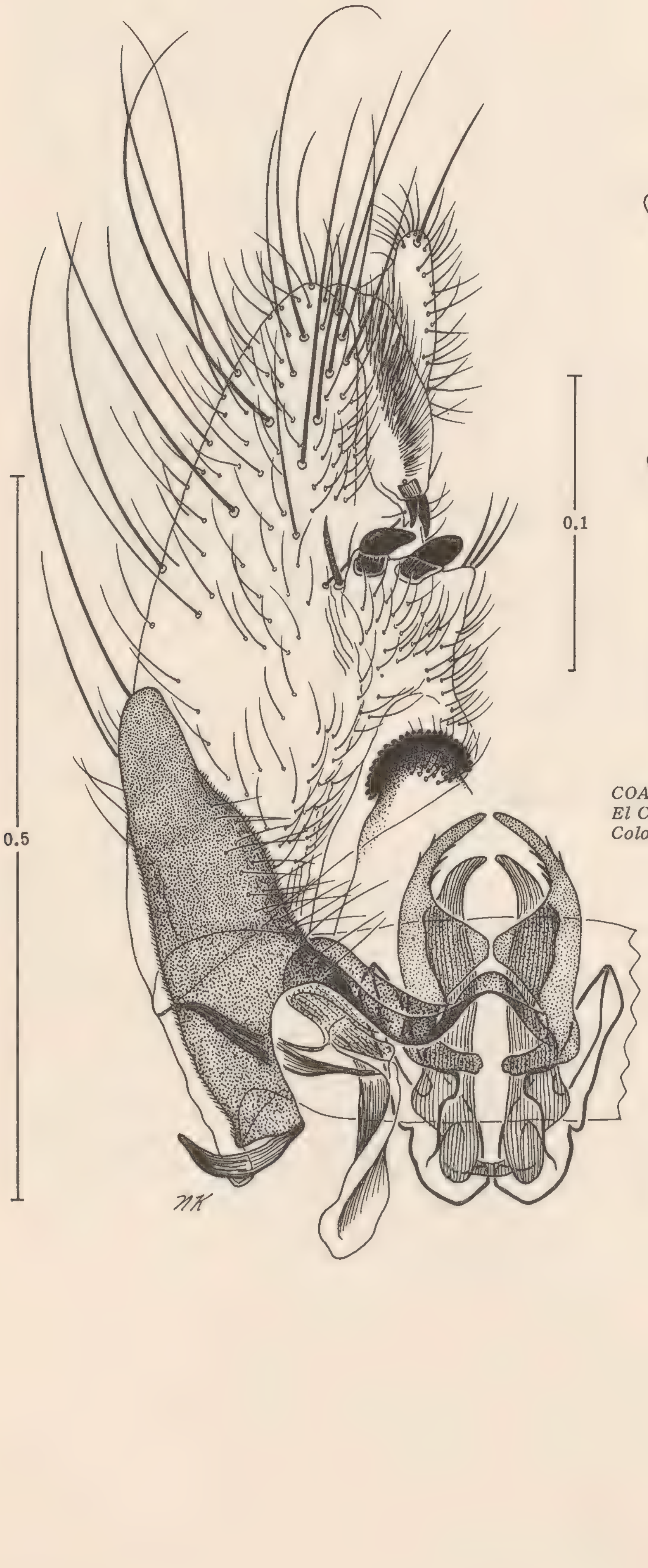
Fig. 48

DEINOCERITES



COA 48
El Choco
Colombia



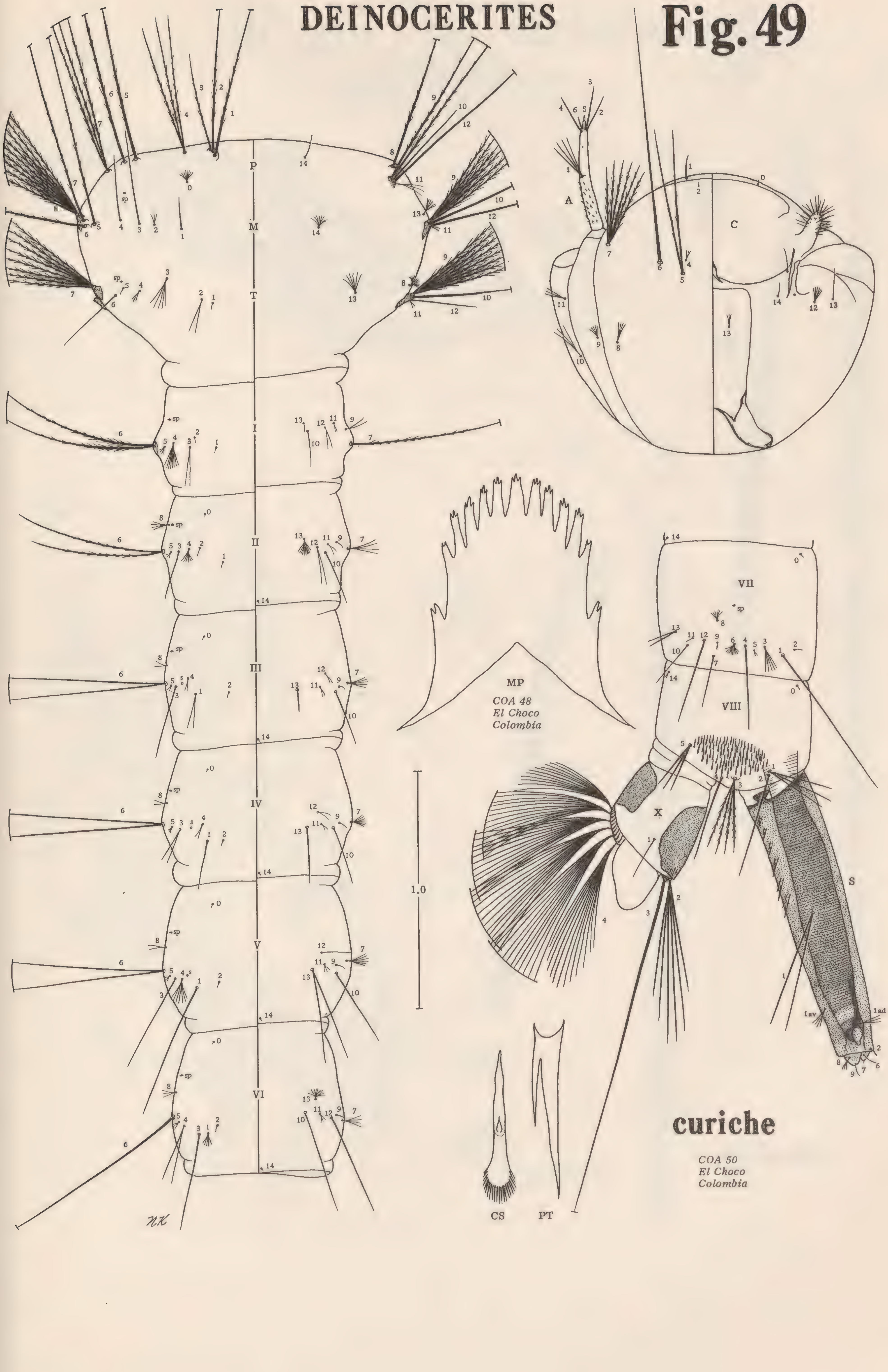


COA 43
El Choco
Colombia

curiche

DEINOCERITES

Fig. 49

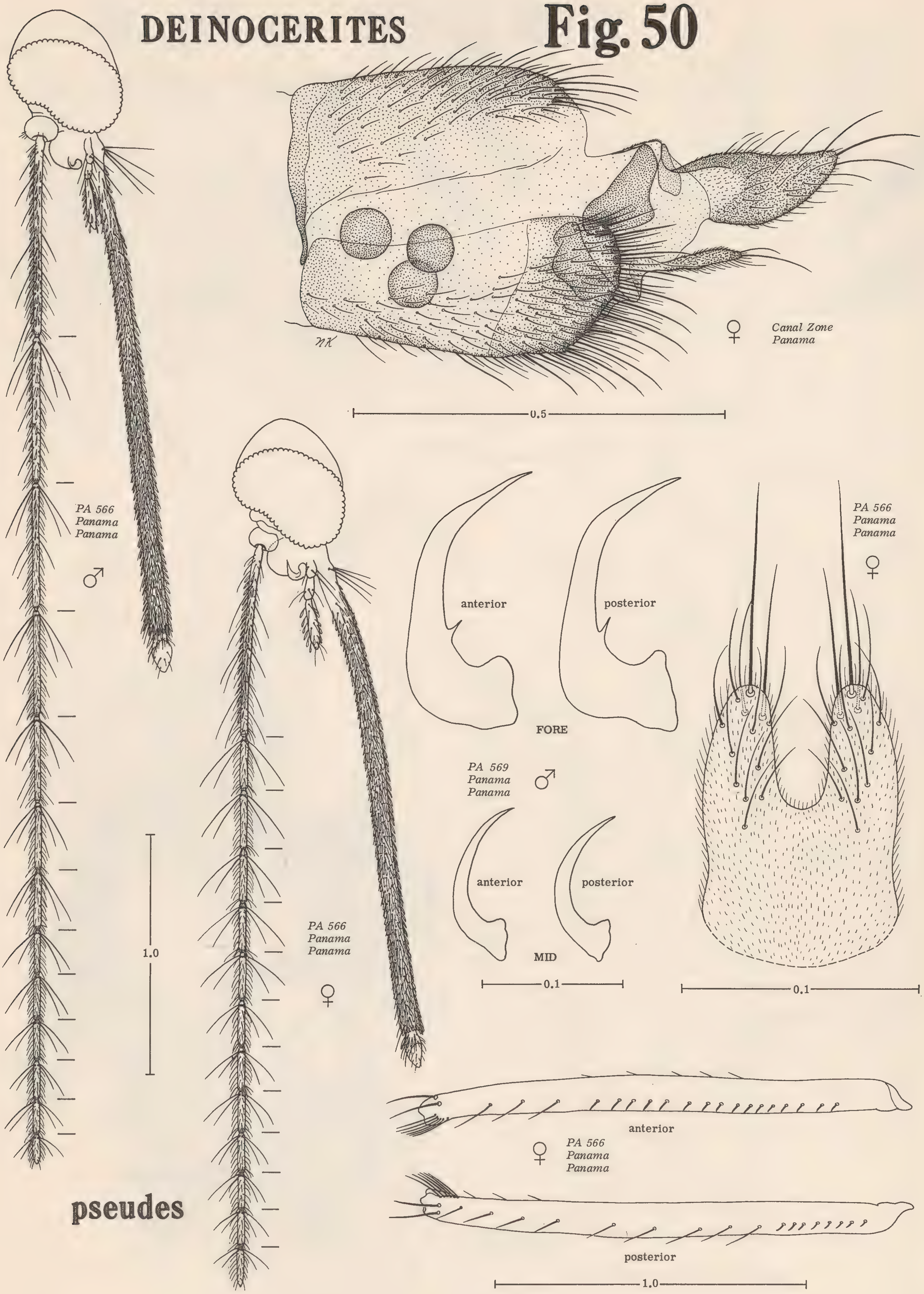


curiche

COA 50
El Choco
Colombia

DEINOCERITES

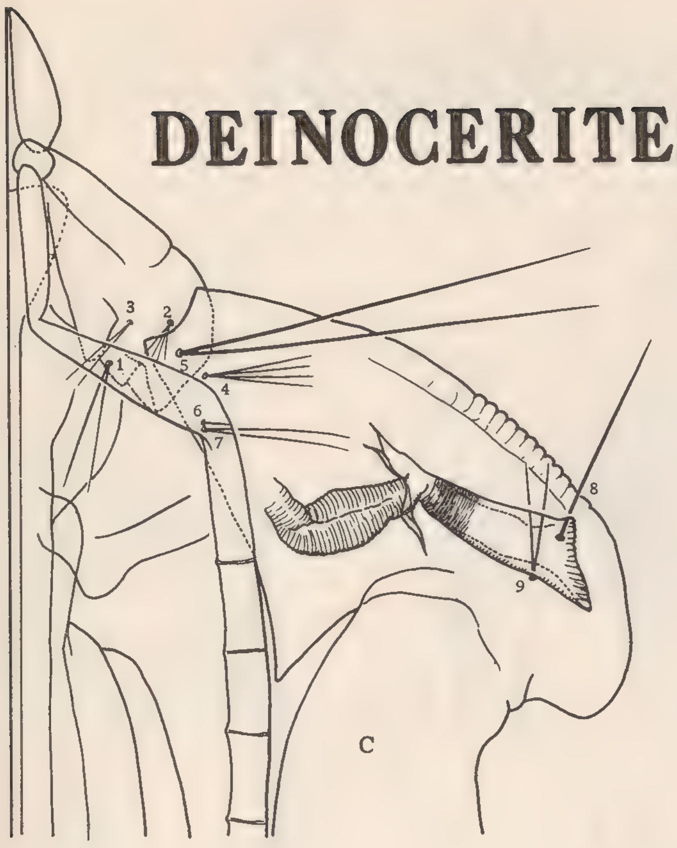
Fig. 50



pseudes

Fig. 51

DEINOCERITES



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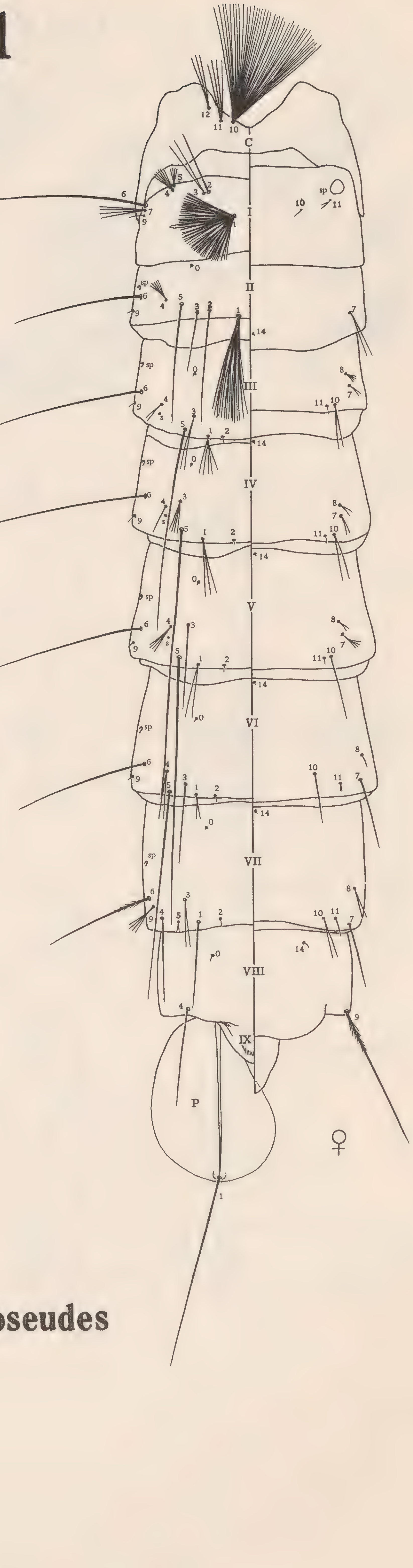

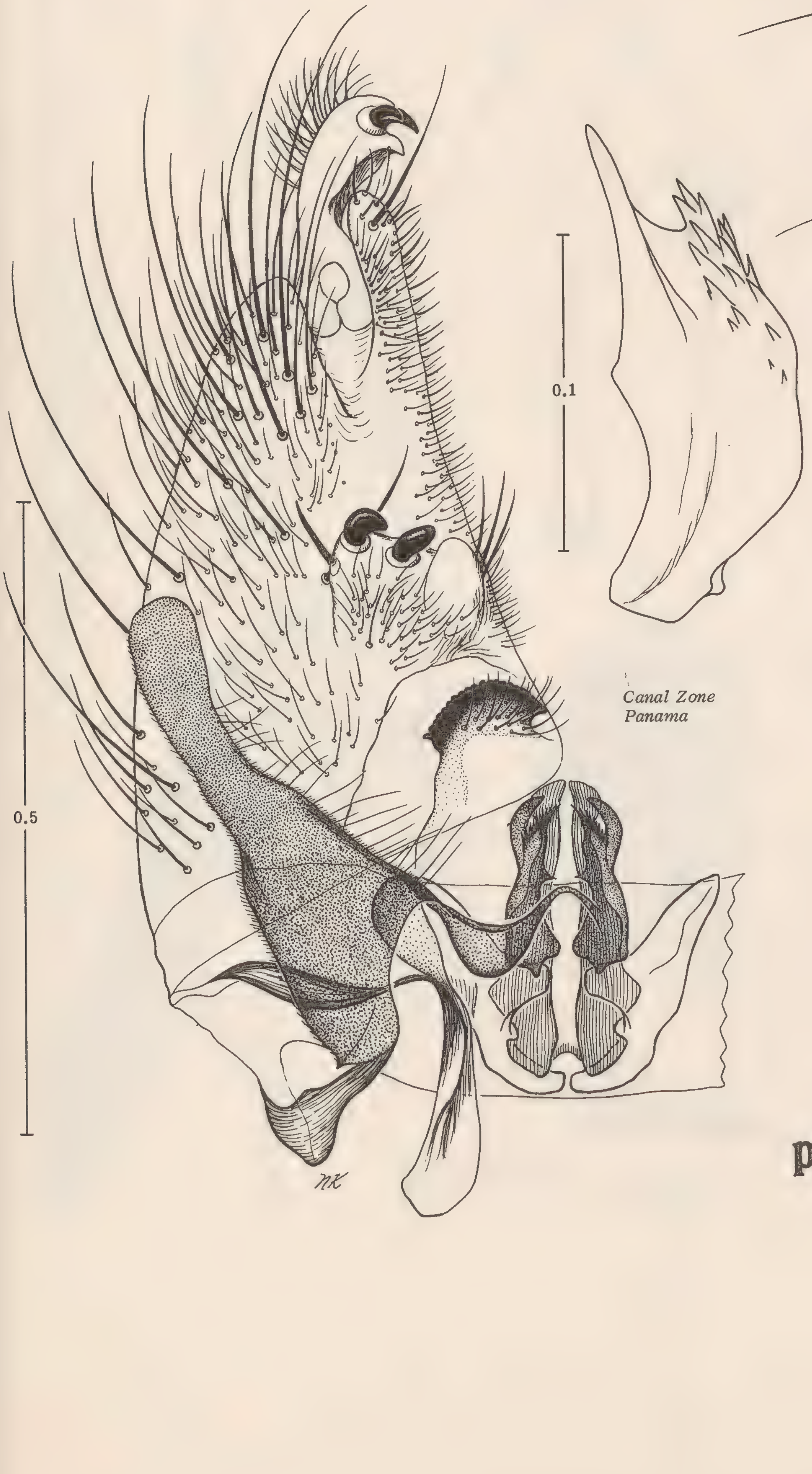

Canal Zone
Panama

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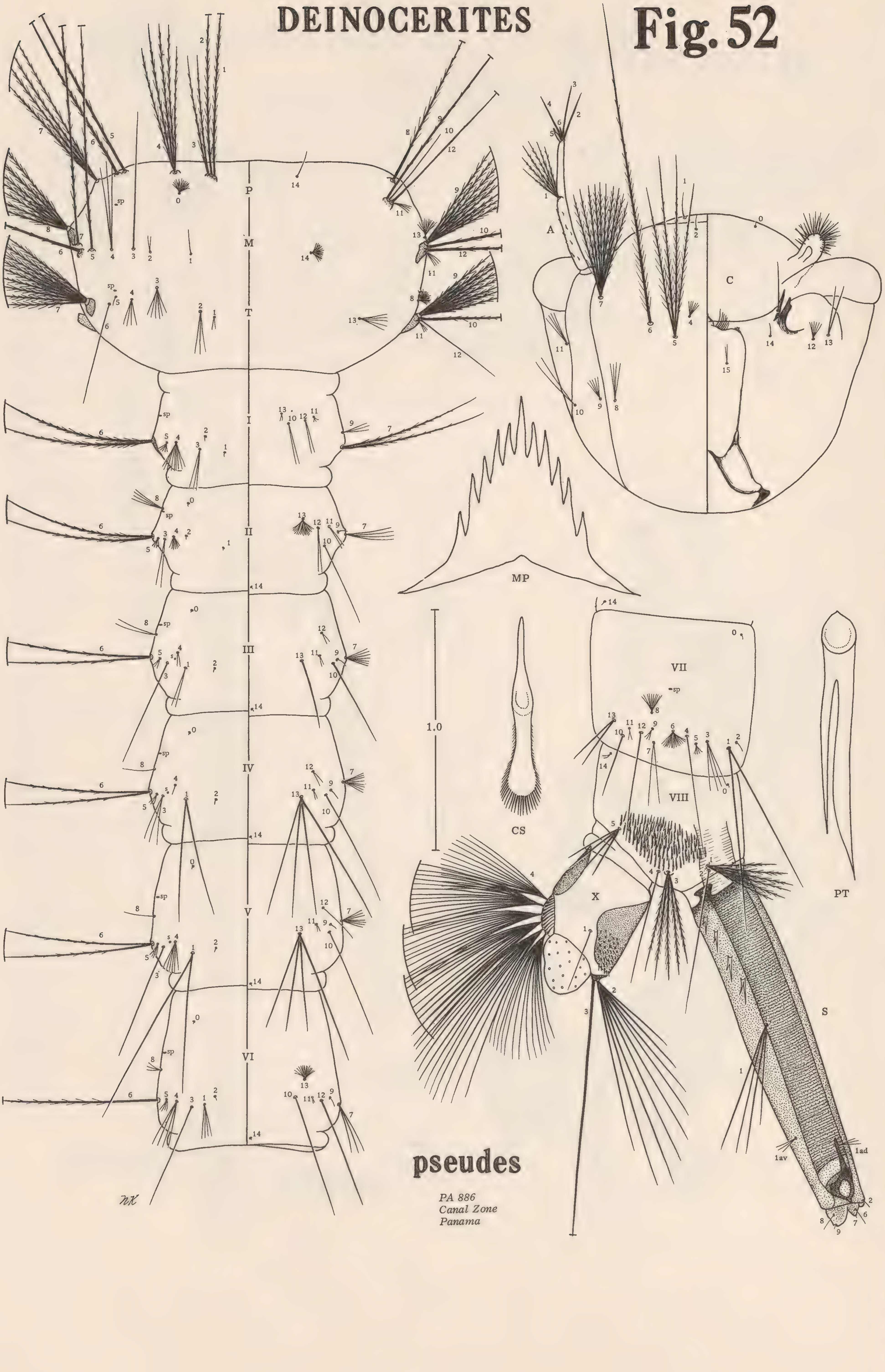
Fig. 52



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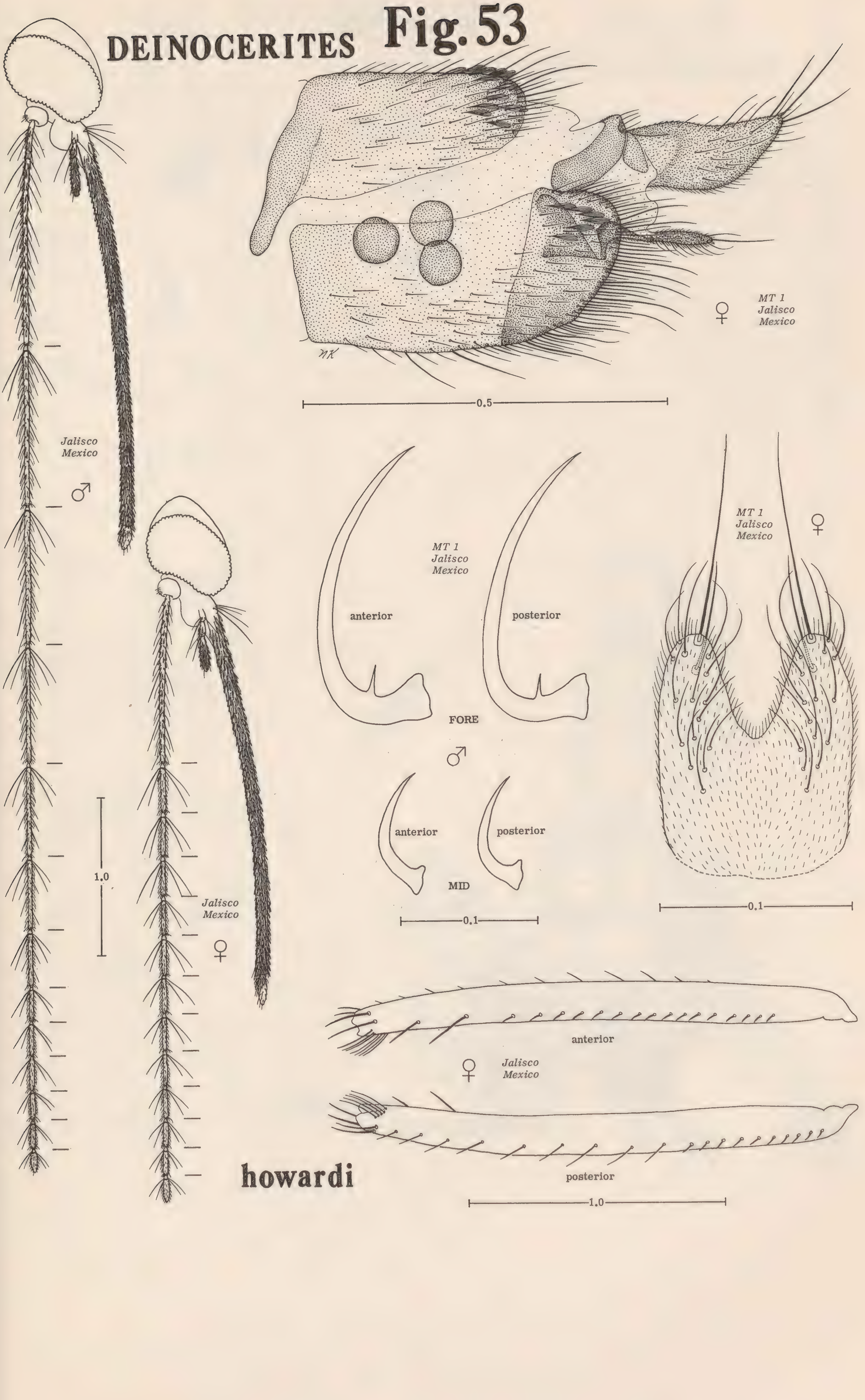

howardi

Fig. 54

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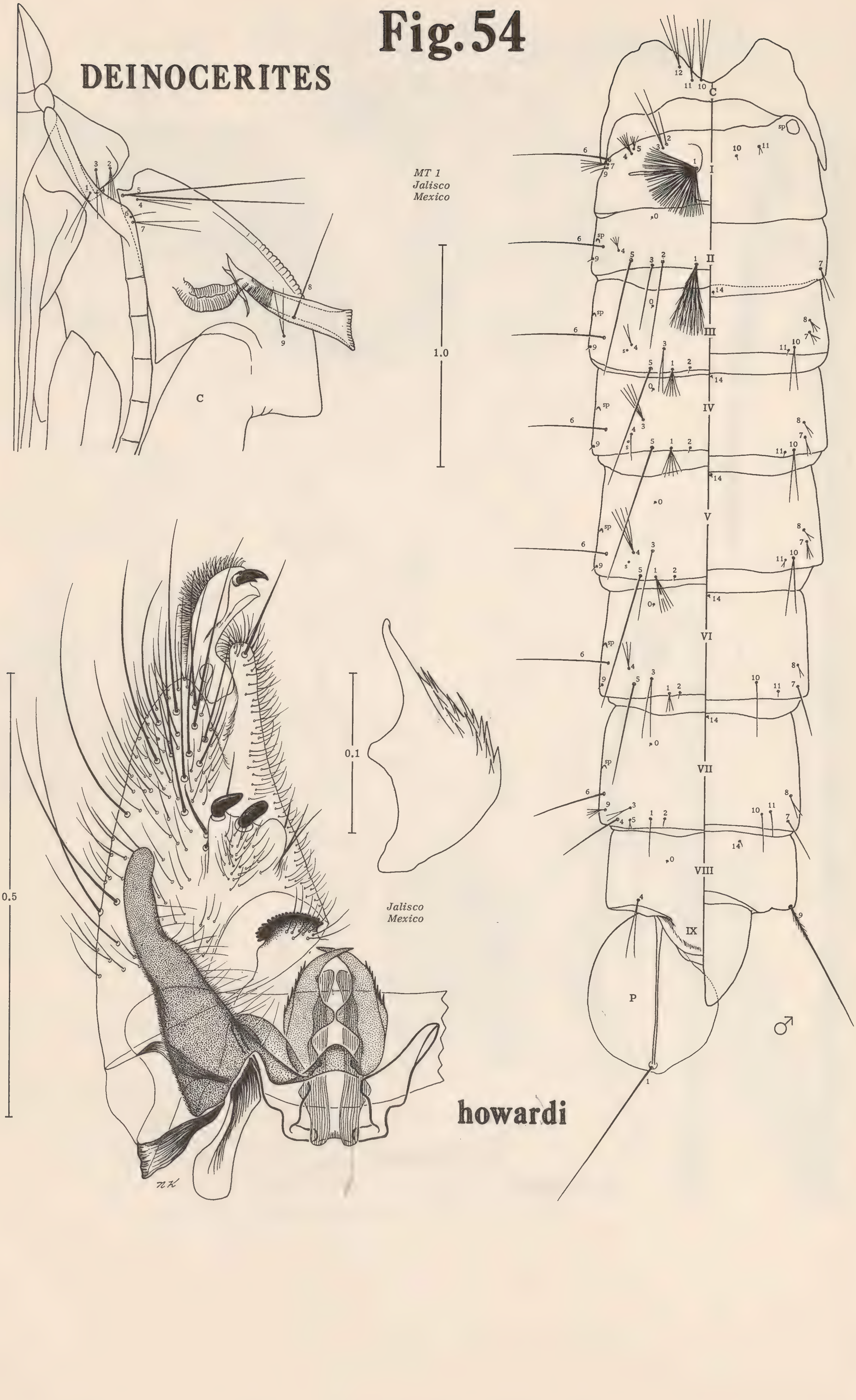

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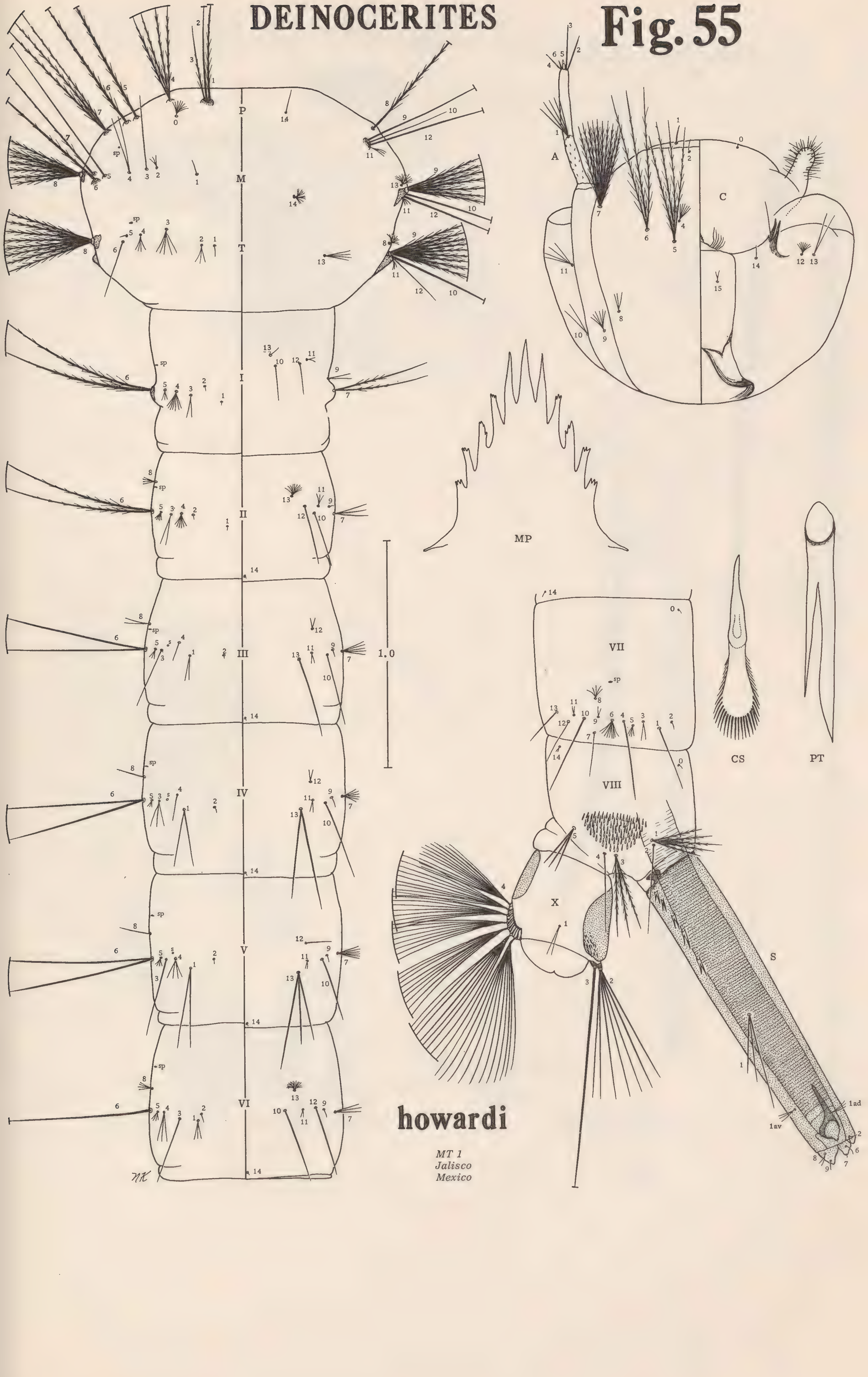
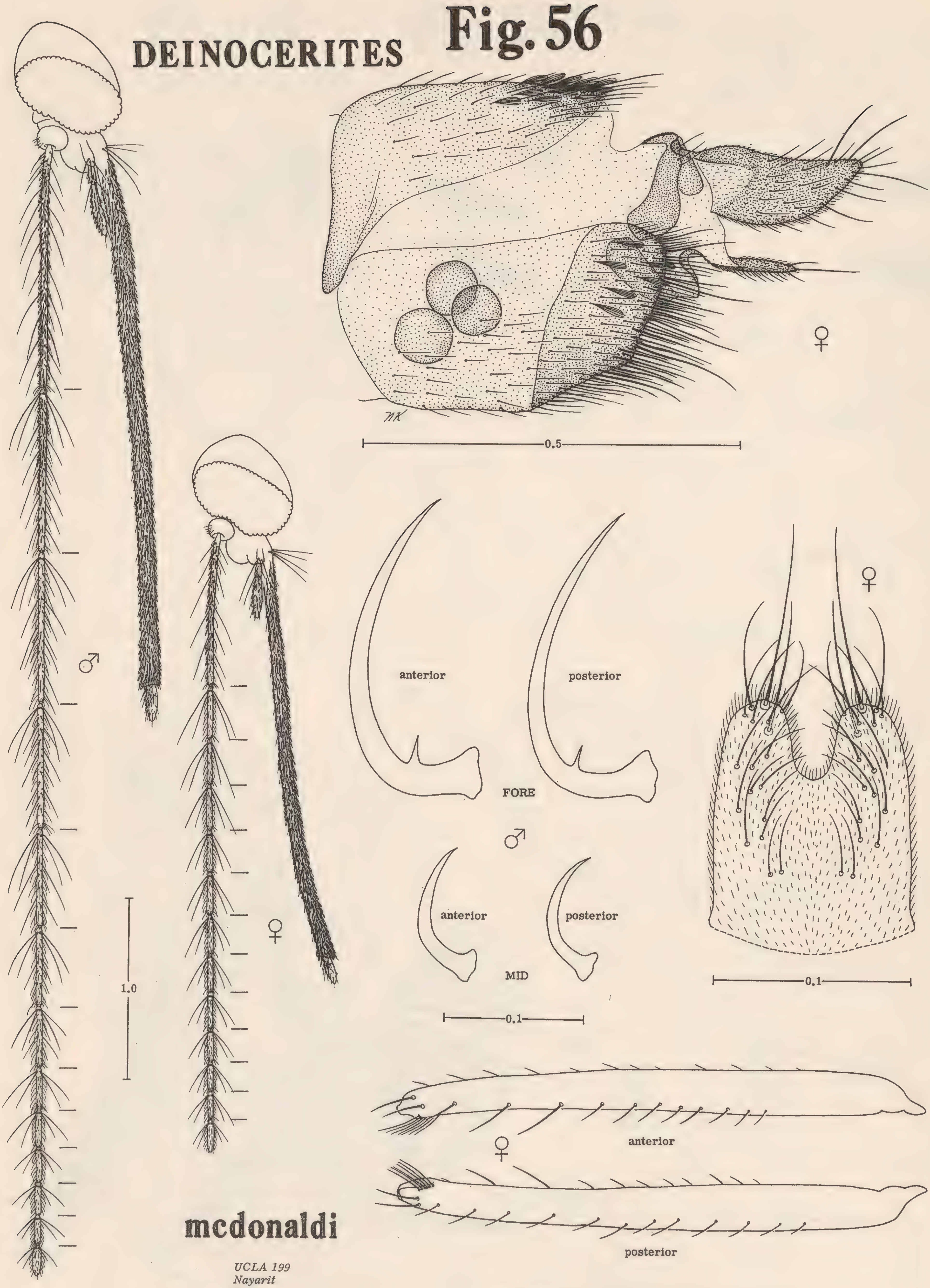


howardi

MT 1
Jalisco
Mexico

DEINOCERITES **Fig. 56**



mcdonaldi

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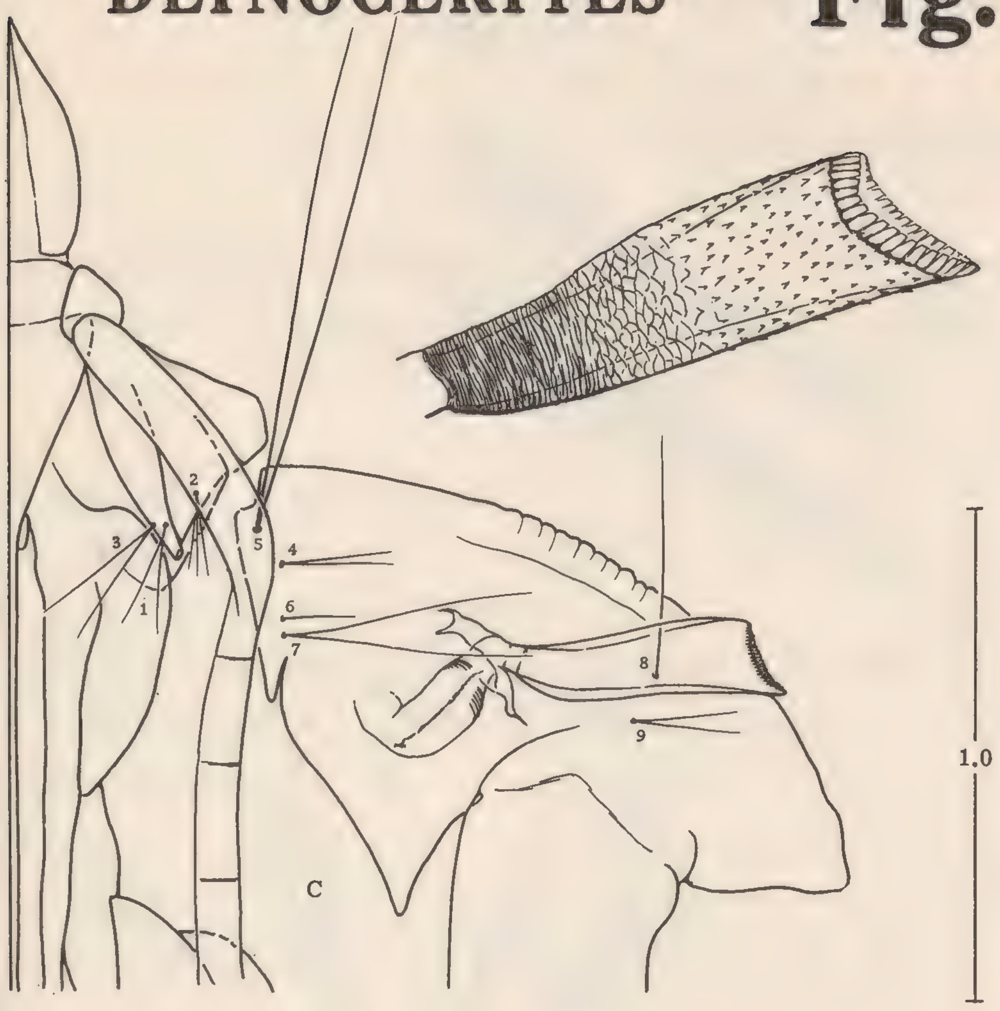

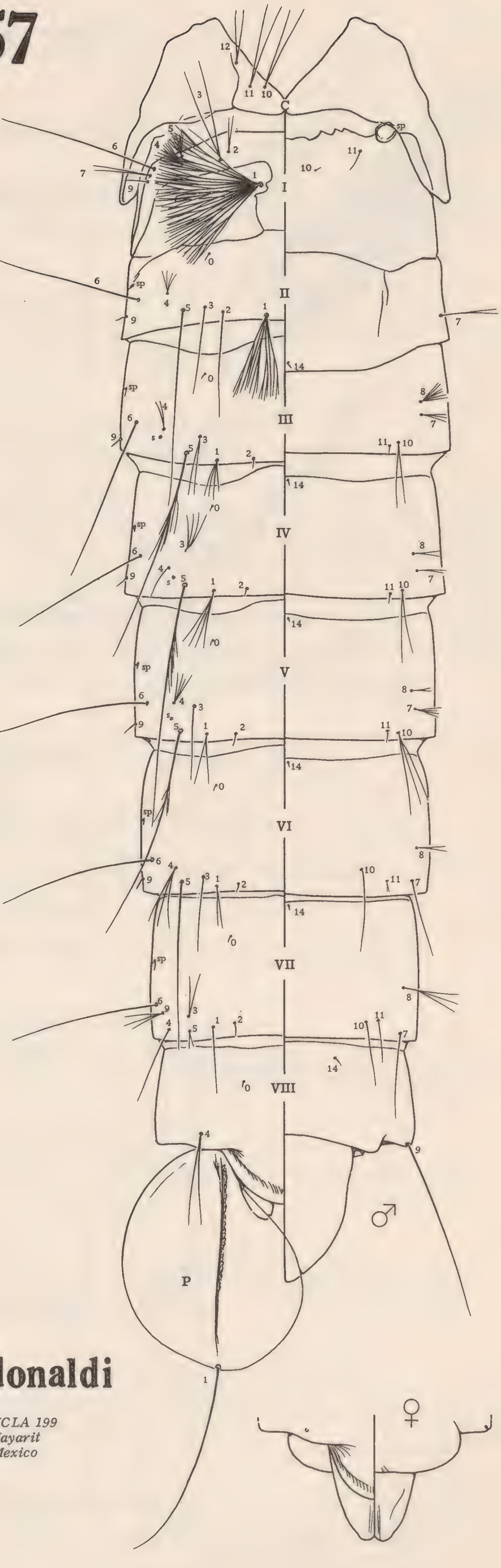

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Mexico

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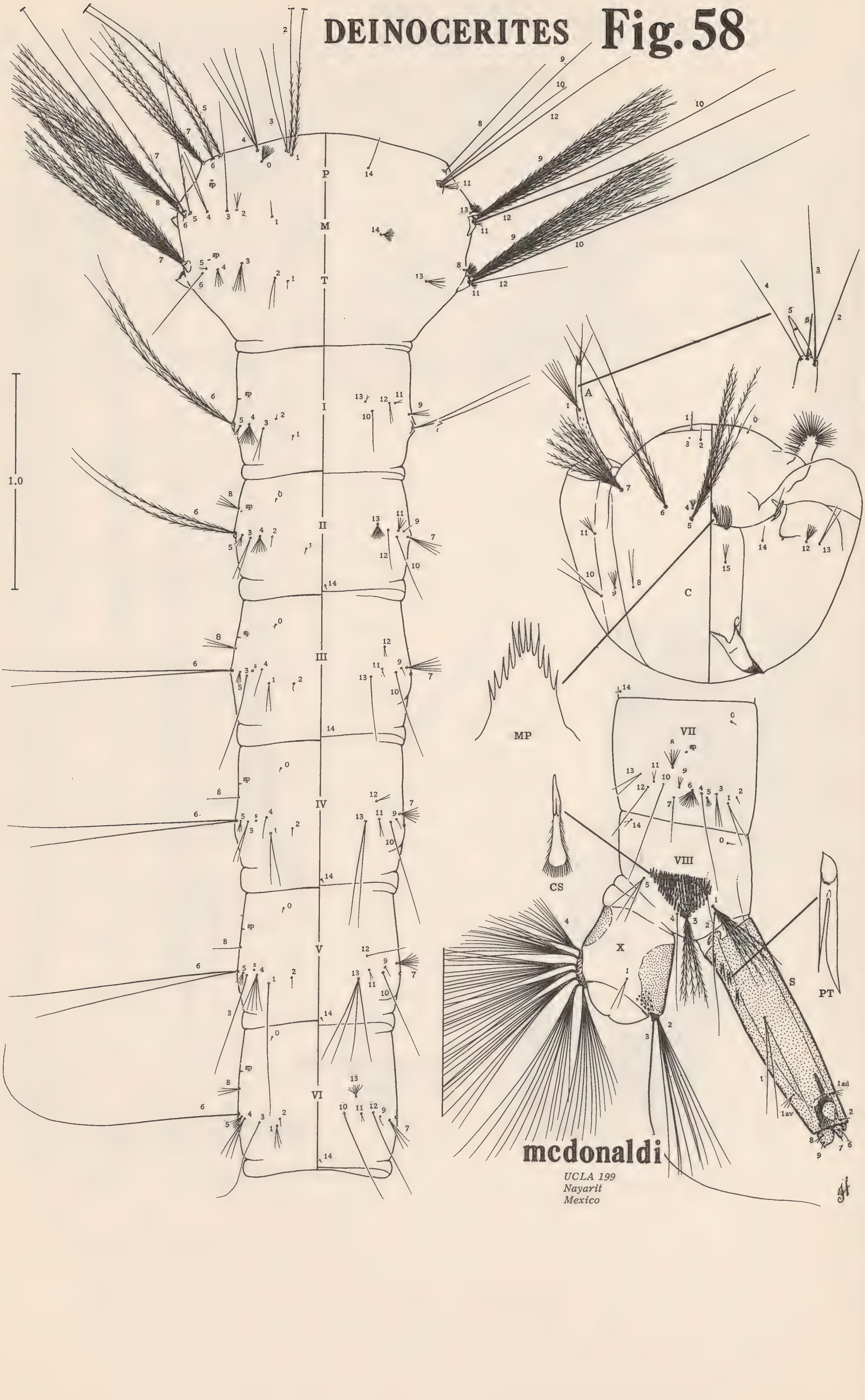

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THE GENUS *ORTHOPODOMYIA* THEOBALD IN SOUTHEAST ASIA[1]

By

Thomas J. Zavortink[2]

INTRODUCTION

This paper treats the 7 species of *Orthopodomyia* which occur in the Southeast Asian area. Although it has been largely extracted from a more comprehensive study of the entire genus (Zavortink 1968), several significant changes and additions have been made. These include the following: keys to species have been rewritten and made more artificial; descriptions of the species have been shortened and restricted to characters which are diagnostic or at least characteristic of one or more species; discussions and group descriptions have been modified to pertain only to species found within the Southeast Asian region; descriptions have been corrected, where necessary, to accomodate variations observed during examination of additional specimens; sections on distribution and biology now include more extensive data for the Thailand collections; and a recently described species has been included.

The terminology of the present paper generally conforms to that of Belkin (1962) and the format to that of Bram (1967), Delfinado (1967, 1968), and Knight (1968). An asterisk following the abbreviations used (♂ = male, ♀ = female, P = pupa, and L = larva) indicates that all or some portion of that sex or stage is illustrated. Abbreviations used for the references to the literature conform to the World List of Scientific Periodicals, 3rd ed., Academic Press, 1952. Types of the included species which are in the British Museum (Natural History) and the United States National Museum have been studied by me.

In addition to material accumulated by the Southeast Asia Mosquito Project, specimens from the following institutions were examined: Bernice P. Bishop Museum; British Museum (Natural History); Liverpool School of Tropical Medicine; Taiwan Provincial Malaria Research Institute; United States National Museum; University of California at Davis; and, University of California at Los Angeles.

Orthopodomyia is a small genus of container breeding mosquitoes with a nearly world wide distribution. Eight species groups have been recognized (Zavortink 1968), but only one of these, the *albipes* group, occurs in the Oriental region. The *albipes* group is, however, the largest and most diverse in the genus. It is the only group in which sympatry of species is common and it is the group in which the greatest discordance between classifications based on adults and immature stages is found.

Knight and Mattingly (1950) were the first to study this group of mosquitoes. Their *anopheloides* subgroup is nearly coextensive with that portion of the *albipes* group considered in the present paper.

---

[1] Contribution from the Southeast Asia Mosquito Project supported by U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2672.

[2] Department of Zoology, University of California, Los Angeles, California 90024.

GENUS *ORTHOPODOMYIA* THEOBALD

Orthopodomyia Theobald 1904, Entomologist 37: 236-237. Type species: *O. albipes* Leicester 1904.

FEMALE. *Head.* , Frons narrow, with light decumbent scales; vertex and occiput with numerous narrow decumbent and broad erect scales; decumbent scales light, erect scales dark posteriorly, light or light-tipped anteriorly; dorsolateral, lateral and ventral surfaces with broad flat scales; clypeus small, normally bare; labium slightly swollen apically, dark scaled with light scales usually in a narrow to broad band near or distad of middle, in a dorsal preapical spot, and streaked on ventral surface from or basad of band to or near apex; palpus long, 0.4 to 0.6 length of proboscis, 4 or 5 segmented, dark scaled with 2 or 3 light patches beyond the base; antenna longer than proboscis, pedicel and flagellomere 1 with light scales. *Thorax.* Paratergite moderately broad, bare; mesonotal bristles unusually numerous, strongly developed, and long; scutum largely covered with light and dark scales of various sizes in a complicated and variable pattern; scutellar lobes with long narrow light scales; *apn, ppn, ppl,* lower *stp,* and upper *mep* bristles present, *pra* bristles present or absent, *sp* and *psp* bristles absent; *apn, ppn, pst, ppl, ssp, pra, stp,* and upper and lower *mep* scales present, *psp* and *pcx* scales absent. *Legs.* Coxae with light and sometimes dark scales; femora, tibiae, and, to a lesser extent, tarsomere 1 with light and dark scales in a complicated pattern of streaks, spots, bands and speckles; fore and mid legs with tarsomere 1 longer than the remaining 4 tarsomeres combined and tarsomere 4 shorter than 5; hind tarsomere 5 all white; claws simple. *Wing.* Dark scaled with conspicuous light patches on costa and other veins, the number and size of light patches, especially at base of costa, exceedingly variable. *Halter.* Scales light or dark. *Abdomen.* Terga dark with light scales in distinct or connected basolateral and apicolateral patches which become smaller on distal segments and in small to moderately large median subdorsal patches on all or more distal segments. *Terminalia.* Segment VIII not retractile; cerci large, compressed.

MALE. Similar to female. *Head.* Proboscis dark with light scales in complete or incomplete band basad of middle; palpus straight, 0.7 to 0.9 length of proboscis, 5 segmented, dark scaled with 4 light patches; antenna subequal to proboscis, strongly plumose, flagellomeres 1 to 4 or 5 with tufts of light scales. *Legs.* Anterior fore and mid claws large and unidentate, posterior fore and mid claws and hind claws simple. *Abdomen.* Usually more extensively light scaled than in female. *Terminalia.* Tergum VIII with distinct lobe on posterior margin; tergum IX not strongly sclerotized, without lobes, usually with fine setae; basimere well developed, long conical, without apical or basal lobes; basal mesal lobe with 6-8 terete apical bristles, the more ventral usually finer and more strongly curved; distimere simple, with numerous setae and usually 1 simple terminal appendage; phallosome simple; aedeagus large, varied in shape, sclerotization, and dentition; paraproct with 2-5 apical teeth; cercal setae fine, 1-6.

PUPA. *Cephalothorax.* Hairs 6, 7-C close together; 8, 9-C relatively close together, far caudad of trumpet, and in line perpendicular to middorsal ridge. *Trumpet.* Widely spaced; moderate in length; tracheoid portion absent; meatus without slit. *Abdomen.* Hair 1-I strongly developed and strongly dendritic; hair 1-II generally well developed and with many branches; hair 9-II-VIII cephalad of caudolateral angle of segment, on II-VI small and single, on VII moderately to strongly developed and 7-13b, on VIII strongly developed and usually 11-16b (9-19). *Terminal Segments.* Hairs 1-IX, X absent. *Paddle.* Longer than broad; without spicules; hair 1-P present, small, usually branched; 2-P absent.

LARVA. *Head.* Slightly to distinctly broader than long; mental plate well developed, usually with 8-13 teeth on each side; integument without ornamentation. *Antenna.* Short to moderately long, smooth; hair 1-A in basal 0.3-0.5, moderately developed, and usually 4-9b. *Thorax.* Deep red or purple epidermal pigment usually present; 1 pair of conspicuous tracheal dilations present. *Abdomen.* Mature fourth instar larva with large sclerotized plates on segments VII and VIII; hair 6-I, II strongly developed and multiple, 6-III, V, VI very long and single, 6-IV shorter and usually double; comb scales in 2 rows, those of posterior row larger; siphon moderately long to quite long, pecten absent; only hair 1-S well developed, placed in basal 0.3-0.5; anal saddle complete, margin without spicules; 1-X small to moderately developed, 2-X very strongly developed and multiple, 3-X long and single; ventral brush well developed, usually with 7 pairs of hairs.

DISTRIBUTION. The Oriental *albipes* group of the genus *Orthopodomyia* is found from India, southern China, and southern Japan, south to Ceylon, the Malay Archipelago, and northeastern Australia.

TAXONOMIC DISCUSSION. The *albipes* group of *Orthopodomyia* contains 10 species. Seven of these, *albipes* Leicester, *andamanensis* Barraud, *anopheloides* (Giles), *lanyuensis* Lien, *madrensis* Baisas, *siamensis* Zavortink and *wilsoni* Macdonald, are found within the Southeast Asian area. The 3 exotic species are *flavicosta* Barraud and *flavithorax* Barraud from coastal southwestern India and Ceylon and *papuensis* Zavortink from Ceram and New Guinea.

The 10 species of the *albipes* group fall into 4 subgroups. All 4 of these, the *albipes*, *anopheloides*, *flavicosta*, and *wilsoni* subgroups, occur in the Southeast Asian region and the monotypic *albipes* and *wilsoni* subgroups are restricted to it.

Adults of all species treated in this paper are very similar and those of each species are quite variable, particularly in ornamentation of the proboscis, wing, abdomen, and hind leg. Consequently, specific identification is frequently difficult or impossible. The male terminalia of most species are distinct, but the differences between them are not of sufficient magnitude to make identification easy. The immature stages show the greatest divergence and the species and subgroups are defined largely on the basis of differences in these stages. Unfortunately, the variation in the chaetotaxy of both the pupa and larva for several of the species is so great that identification, even to subgroup, is often not simple. Despite the difficulties encountered in identifying any single stage, specific determinations are quite reliable when made from a combination of larval, pupal, and adult characters.

BIOLOGY. The immature stages of species in the *albipes* group occur in water which accumulates in bamboo stumps, bamboo internodes, rot cavities in trees, and artificial containers. Adults are rarely encountered in the field. Females of 2 species, *albipes* and *andamanensis*, are known to bite man.

KEYS TO THE SOUTHEAST ASIAN SPECIES

ADULTS

1. *Pra* usually with 1 bristle; *ssp* scale patch forked or angled (Fig. 1a) 2
   Pra without bristles; ssp scale patch simple (Figs. 1b, 2b). 3

2(1). Joint between hind tarsomeres 1 and 2 without a broad white ring . . . . *madrensis* (p. 6)
   Joint between hind tarsomeres 1 and 2 with a broad white ring . . . . *lanyuensis* (p. 8)

3(1). Hind tarsomere 2 with a conspicuous subequal white ring at each end (Fig. 1g); tergum II or terga II and III of female usually with a large middorsal basal light patch (Fig. 1c) . . . . *wilsoni* (p. 11)
Hind tarsomere 2 usually entirely or largely dark at either base or apex (Figs. 1d, e, f); terga II and III of female without a large middorsal basal light patch (Fig. 2e) 4

4(3). Hind tarsomere 2 usually with more extensive white scaling at base than apex (Fig. 1d); palpus of female with 3 light patches beyond the base (Fig. 2a) . . . . *albipes* (p. 12)
Hind tarsomere 2 with more extensive white scaling at apex than base (Figs. 1e, f); palpus of female with 2 light patches beyond the base 5

5(4). Hind tarsomere 4 with a dark spot or ring distad of middle (Fig. 1e) . . . . *anopheloides* (in part) (p. 16)
Hind tarsomere 4 entirely white scaled (Fig. 1f) . . *siamensis* (p. 9)
andamanensis (p. 14)
anopheloides (in part) (p. 16)

MALE TERMINALIA

1. Aedeagus with a pair of sclerotized teeth on ventral surface and without a conspicuous projection between or below ventral parameres 2
Aedeagus without sclerotized teeth on ventral surface and with a conspicuous projection between or below ventral parameres 5

2(1). Basal mesal lobe with 7 to 9 more or less equally developed stout apical bristles (Fig. 3a) . . . . *madrensis* (p. 6)
lanyuensis (p. 8)
Basal mesal lobe with 4 or 5 stout and 1 or 2 finer apical bristles (as in Fig. 5a). 3

3(2). Aedeagus not pyriform, broadest in apical half (Fig. 5b) . . . . *siamensis* (p. 9)
Aedeagus more or less pyriform, broadest in basal half (as in Fig. 6b) 4

4(3). Mesal surface of basimere distad of basal mesal lobe with strong, elongate, specialized bristles (Fig. 4a). . . . . *albipes* (p. 12)
These bristles weaker and shorter (Fig. 6a) . . . . . *wilsoni* (p. 11)

5(1). Basal projection of aedeagus usually extending conspicuously between ventral parameres (Fig. 7a) . . . . *anopheloides* (p. 16)
Basal projection of aedeagus usually directed more ventrally and not extending conspicuously between ventral parameres (Fig. 8a) . . *andamanensis* (p. 14)

PUPAE

1.	Trumpet nearly cylindrical	2
	Trumpet not cylindrical	3
2(1).	Hair 5-C strongly developed, usually 5, 6b(3-8); hair 2-II-IV thickened (Fig. 9)	*siamensis* (p. 9)
	Hair 5-C moderately developed, usually single or double (1-3b); hair 2-II-IV fine (Fig. 9)	*wilsoni* (p. 11)
3(1).	Trumpet broadening to nearly maximum width in basal portion, remainder almost parallel sided (Fig. 10)	*albipes* (p. 12)
	Trumpet broadening gradually from base to apex	4
4(3).	Hair 5-VI usually single or double and long, extending nearly to or beyond alveolus of hair 4-VIII (Fig. 11)	*madrensis* (p. 6) *lanyuensis* (p. 8)
	Hair 5-VI usually 3-7b(2-8) and short, extending nearly to or slightly beyond alveolus of hair 4-VII, longer in hairy forms	5
5(4).	Hair 1-III usually 12-14b(10-17); hair 9-C usually 2, 3b(2-5) (Fig. 10)	*andamanensis* (p. 14)
	Hair 1-III usually 5-7b(3-11); hair 9-C usually single (single, double) (Fig. 11)	*anopheloides* (p. 16)

FOURTH STAGE LARVAE

1.	Branches of hair 6-I, II usually at least as stout as 6-III; hair 1-M, T single and short, subequal in length to 3-M or 2-T, and posterior comb scales expanded at apex and with 5-7 elongate spines	2
	Branches of hair 6-I, II finer than 6-III; hair 1-M, T branched and/or long, much exceeding 3-M or 2-T, and/or posterior comb scales narrow at apex and with a single elongate spine	3
2(1).	Branches of 6-I, II tapering to a fine apex and barbed from near base to near apex; segment VI of mature larva with dorsal sclerotized plate	*siamensis* (p. 9)
	Branches of 6-I, II coarse to near apex and barbed only in basal portion (Fig. 3); segment VI of mature larva without a sclerotized plate	*madrensis* (p. 6) *lanyuensis* (p. 8)
3(1).	Posterior comb scales narrow at apex and with only 1 spine of fringe elongated (Figs. 4, 6); sclerotized body parts exclusive of siphon largely straw-colored to tan	4
	Posterior comb scales expanded at apex and with fan-like fringe of several elongate spines (Figs. 7, 8); sclerotized body parts exclusive of siphon largely brown to dark brown	5

4(3). Elongate spine of posterior comb scales usually very long; siphon long and thin, index usually 7.0-12.0 (Fig. 6) . . . . *wilsoni* (p. 11)
Elongate spine of posterior comb scales shorter; siphon broader, index usually 4.0-6.0 (3.6-7.5) (Fig. 4) . . . . *albipes* (p. 12)

5(3). Hair 6-I usually 9,10b(7-10); hair 6-II usually 9-11b(7-12) . . . . *andamanensis* (p. 14)
Hair 6-I usually 5-8b; hair 6-II usually 4-8b (Fig. 7) . . . . *anopheloides* (p. 16)

DESCRIPTIONS OF THE SUBGROUPS AND SPECIES

FLAVICOSTA SUBGROUP

PUPA. *Trumpet.* Varied. *Abdomen.* Hair 1-II strongly developed, long and usually with 9-20 mostly simple branches, some much finer than others, arising from the base; 5-V, VI usually long, extending to or beyond alveolus of hair 4 of second following segment; 5-VI usually single (single, double).

LARVA. *Thorax.* Hair 1-M, T single, short, usually subequal in length to 3-M and 2-T. *Abdomen.* Hair 6-I, II with branches as stout as or stouter than 6-III, form varied; posterior comb scales expanded at apex and usually with 5-7 large spines.

DISTRIBUTION. Species in this subgroup are found in southwestern India, Ceylon, peninsular Thailand, *Luzon,* and *Lanyu.*

TAXONOMIC DISCUSSION. As currently interpreted, the *flavicosta* subgroup contains the 5 species *flavicosta, flavithorax, lanyuensis, madrensis,* and *siamensis.* Only the last 3 of these occur in the Southeast Asian region.

O. lanyuensis and *madrensis* are very similar to each other in all stages. *O. siamensis* is quite distinct from them, but is largely indistinguishable in the adult stage from *andamanensis* and *anopheloides,* 2 Southeast Asian species in the *anopheloides* subgroup.

The *flavicosta* subgroup is probably the oldest in the *albipes* group. The species, except for *madrensis* and *lanyuensis*, are relatively well marked and all have very limited, relictual distributions in areas characterized by extremely heavy precipitation. Additional species undoubtedly exist on biological islands in and around the periphery of the Southeast Asian area.

BIOLOGY. Larvae and pupae are usually found in tree-holes. Habits of the adults are unknown.

ORTHOPODOMYIA MADRENSIS BAISAS

(Figures 1a, 3, 11)

Orthopodomyia madrensis Baisas 1946, Mon. Bull. Bur. Hlth. Philipp., Manila 22:41 (♂*, ♀, P*, L*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52:17 (♂, ♀, L); Delfinado 1966, Mem. Amer. ent. Inst. 7:68 (♂, ♀, P, L); Zavortink 1968, Contr. Amer. ent. Inst. 3(2):122 (♂*, ♀, P*, L*).

FEMALE. (Figure 1a) *Head.* Dorsolateral scales yellow; labial light scales white to yellow, band near middle, preapical spot sometimes completed ventrally, and sometimes with additional light scales in dorsal streak basad of middle band; palpus 0.42 length of proboscis, light scales white to yellow, in 2 patches beyond the base. *Thorax. Pra* usually with 1 bristle; pleural scales largely pure white; *ssp* scale patch well developed, a moderately long forked or angled row (upper extension erroneously called hypostigial scales by Zavortink (1968)). *Legs.* Fore and mid tarsomeres 2 and 3 usually light scaled at both ends; hind tarsomere 1 dark scaled at apex; hind tarsomere 2 with at most a few light scales at base, broadly white ringed at apex; hind tarsomere 3 entirely white or with dark patch or ring; hind tarsomere 4 all white. *Wing.* Vein Sc without presectoral light patch; 1A dark at base. *Abdomen.* Light scales white or rarely yellowish; terga sometimes with additional light scales in weak narrow basal band or middorsal basal patch; sternum II or sterna II and III light scaled, III-V or IV, V light scaled with median lateral dark patch, VI-VIII dark scaled with light basolateral patch and sometimes light median streak.

MALE. *Head.* Proboscis with additional light scales in broad preapical band, usually in ventral streak joining 2 bands and sometimes scattered dorsally; palpus 0.77 length of proboscis. *Abdomen.* Generally as in female. *Terminalia.* (Fig. 3) Tergum VIII lobe with apex emarginate and serrate; basimere with strong sinuous bristles distad of basal mesal lobe; basal mesal lobe with 7 or 8 more or less equally developed stout bristles; aedeagus weakly sclerotized, more or less irregularly oval in dorsal aspect, with a pair of nearly contiguous to widely separated ventral teeth about 0.55-0.67 distance from base and without a conspicuous projection between or below ventral parameres.

PUPA. (Fig. 11) *Cephalothorax.* Hair 1-C moderately developed, single or double; 2-C moderately developed, usually 2, 3b(2-4); 3-C strongly to very strongly developed, usually 4-6b(3-8); 4, 5-C very strongly developed, usually 3, 4b(2-4); 7-C very strongly developed, usually double (1-3b); 8-C moderately to strongly developed, single; 9-C moderately to strongly developed, usually double or single (1-3b). *Trumpet.* Largely dark brown, gradually widening from base. *Abdomen.* Hair 2-II slightly thickened, mesad of 5-II; 2-III, IV fine; 1-III usually 4-6b; 5-IV usually 3b(2, 3); 5-V usually double (single, double); 5-VI usually single.

LARVA. (Fig. 3) *Head.* Integument largely tan to brown; hair 13-C moderately developed, usually 3-5b. *Antenna.* Short. *Abdomen.* Hair 6-I, II 4, 5b(3-5), with branches coarse to near apex and barbed only in basal portion; 1-III moderately long, single; 1-V long, single; 1-VI shorter than 4-VI; segment VI without sclerotized plate; siphon index usually 3.8-6.6; hair 1-S located 0.44-0.53 from base of siphon and usually 8-11b(6-13).

TYPE DATA. *Orthopodomyia madrensis* Baisas, holotype male with associated larval and pupal skins (TH1B-4) lost; type locality: Llavac, Laguna, Luzon (Sunico), PHILIPPINES.

DISTRIBUTION. Specimens examined: PHILIPPINES, *Luzon*, 22 males, 15 females, 25 pupae, 43 larvae, 19 rearings. Records from literature: PHILIPPINES, *Luzon* (Baisas 1946, Delfinado 1966, Zavortink 1968).

TAXONOMIC DISCUSSION. *O. madrensis* and *lanyuensis*, a species only recently described by Lien, are presently considered to be very closely related. The two are distinguished from each other only in the adult stage and are easily separated from all other species by having the subspiracular scale patch forked or angled and a single bristle on the prealar knob. *O. madrensis* is distinguished from *lanyuensis* by lacking a large white ring over the joint between hind tarsomeres 1 and 2. The male terminalia of both species are unusual in having all the apical setae of the basal mesal lobe more or less equally developed and strong. Pupae of *madrensis* and *lanyuensis* have no unique characters; they are separated from the other species by the combination of a long, single or double hair 5-VI and the trumpet broadening gradually from the base. The larvae of both species have abdominal hair 6-I, II peculiarly developed; each branch is stout nearly to its apex and barbed only near its base. This character alone sets them apart from all other *Orthopodomyia* larvae.

O. madrensis is not distinct from the other members of the *albipes* group, including *lanyuensis*, in ornamentation of the proboscis, base of the costa, or abdominal sterna, as thought by Baisas (1946: 41), Knight & Mattingly (1950: 6, 19), and Lien (1968: 6). The light scaling of the proboscis is frequently white rather than yellow and is subject to the same variation in extent as in the other species. The basal portion of the costa varies from completely dark scaled through distinct light basal, prehumeral and humeral patches to completely light scaled. Only abdominal sterna II and III are light scaled. As mentioned above, the number of white hind tarsomeres is variable in this species.

O. madrensis is apparently endemic to the island of *Luzon* in the Philippines.

BIOLOGY. This species breeds in rot holes in trees and treeferns; it is frequently associated with *anopheloides* in those habitats. Nothing is known of the habits of the adults.

ORTHOPODOMYIA LANYUENSIS LIEN

Orthopodomyia lanyuensis Lien 1968, Trop. Med. 10: 4 (♂*, ♀, P*, L*).

FEMALE. *Head*. Dorsolateral scales yellow; labial light scales cream-colored, band near middle, preapical spot weakly complete ventrally; palpus 0.44 length of proboscis, light scales white to yellow, in 2 patches beyond the base. *Thorax*. *Pra* with 1 bristle; pleural scales largely pure white; *ssp* scale patch well developed, a moderately long forked row. *Legs*. Fore and mid tarsomeres 2 and 3 light at both ends; hind tarsomere 1 with broad apical white ring, hind tarsomeres 2 and 3 conspicuously white ringed at both ends, hind tarsomere 4 all white. *Wing*. Vein Sc without presectoral light patch; 1A dark at base. *Abdomen*. Light scales white to yellowish; distal terga with additional light scales in basal bands; sternum II largely light scaled, III-VIII dark scaled with light basal band and basolateral patch which becomes smaller on distal segments.

MALE. *Head*. Proboscis with additional light scales in large preapical patch; palpus 0.85 length of proboscis. *Abdomen*. Terga with conspicuous basal bands. *Terminalia*. (Probably indistinguishable from *madrensis*.) Tergum VIII lobe with apex rounded and serrate; basimere with strong sinuous bristles distad of basal mesal lobe; basal mesal lobe with 8 or 9 more or less equally developed stout bristles; aedeagus weakly sclerotized, more or less irregularly oval in dorsal aspect, with a pair of slightly separated ventral teeth about 0.58-0.60 distance from base, and without a conspicuous projection between or below ventral parameres.

PUPA and LARVA. Apparently indistinguishable from *madrensis*.

TYPE DATA. *Orthopodomyia lanyuensis* Lien, holotype male with associated larval and pupal skins (78400.6) in Taiwan Provincial Malaria Research Institute; type locality: south of Hongtou, *Lanyu* (Chen), TAIWAN.

DISTRIBUTION. Specimens examined: TAIWAN, *Lanyu*, 1 male, 1 female, 2 pupae, 2 larvae, 2 rearings. Records from the literature: TAIWAN, *Lanyu* (Lien 1968).

TAXONOMIC DISCUSSION. *O. lanyuensis*, only recently described by Lien, is very similar to, and perhaps conspecific with, *madrensis*. The 2 are distinguishable only as adults, and then only by characters which are known to be extremely variable in *Orthopodomyia* species of the *albipes* group. The ways by which adults, male terminalia, pupae, and larvae of *lanyuensis* and *madrensis* are separated from the other species in Southeast Asia are found in the taxonomic discussion of *madrensis*. *O. lanyuensis* differs from *madrensis* by having a large white ring over the joint between hind tarsomeres 1 and 2. Since *lanyuensis* differs from *madrensis* by having a different type of leg banding, rather than just in the number of white hind tarsomeres, I am considering it to be a distinct species.

The pupae of *lanyuensis* which I have seen have a slightly greater number of branches in several hairs, including hair 5-VI which is double,[3] than any specimens of *madrensis*. I believe these differences, rather than being specific, are the result of hairiness in these individual pupae. Hairy larval forms are unknown.

O. lanyuensis is presently known only from *Lanyu*, a small island east of the southern end of Taiwan. *O. madrensis* occurs about 250 miles further south on *Luzon*.

BIOLOGY. The immature stages are found in tree-holes. Habits of the adults are unknown.

ORTHOPODOMYIA SIAMENSIS ZAVORTINK

(Figures 5, 9)

Orthopodomyia siamensis Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 126 (♂*, ♀, P*, L*).

FEMALE. *Head*. Dorsolateral scales brown anteriorly, white or yellow posteriorly; labial light scales cream-colored, band distad of middle; palpus 0.42 length of proboscis, light scales white, in 2 patches beyond the base. *Thorax*. *Pra* bristles absent; pleural scales largely white to cream-colored or yellow-tinged; *ssp* scale patch well developed, a simple short to moderately long row. *Legs*. Fore and mid tarsomeres 2 and 3 usually light scaled at both ends; hind tarsomere 1 white scaled at apex, hind tarsomere 2 with at most a very narrow white ring at base, broadly white ringed at apex, hind tarsomere 3 entirely white or less commonly with dark patch or ring distad of middle, hind tarsomere 4 entirely white. *Wing*. Vein Sc without presectoral light patch; 1A usually dark at base. *Abdomen*. Light scales white or white and yellow; additional light scales sometimes in basal bands on distal terga; sterna II-VIII dark scaled with basolateral light patch which becomes smaller on distal segments.

MALE. *Head*. Proboscis with additional light scales in dorsal and ventral preapical patches or a broad preapical band which extends further basally on ventral surface; palpus 0.82 length of proboscis. *Abdomen*. As in female. *Terminalia*. (Fig. 5) Tergum VIII lobe with apex rounded or emarginate and with or without teeth; basimere without strong specialized bristles distad of basal mesal lobe; basal mesal lobe with 4 or 5 stout bristles and 1 or 2 finer ones; aedeagus strongly sclerotized, shape in dorsal aspect variable, but never pyriform and always broadest in apical half, with a pair of nearly contiguous ventral teeth about 0.50-0.55 distance from base, and without a conspicuous projection between or below ventral parameres.

PUPA. (Fig. 9) *Cephalothorax*. Hairs 1, 2-C strongly developed, usually 6, 7b(5-8); 3-C strongly developed, usually 7-9b(4-10); 4, 5-C strongly developed, usually 5, 6b(3-8); 7-C strongly developed, double; 8-C strongly developed, usually 6, 7b(3-8); 9-C strongly developed, 3-5b. *Trumpet*. Largely light brown, nearly cylindrical. *Abdomen*. Hair 2-II-IV thickened, 2-II laterad of 5-II; 1-III usually 5, 6b(5-7); 5-IV double; 5-V, VI single.

LARVA. (Fig. 5) *Head*. Integument largely tan to light brown; hair 13-C moderately strong, usually 8, 9b(8-11). *Antenna*. Moderately long.

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[3] In one paratype in SEAMP collection hair 5-VI is single on one side, double on the other (B. de M.).

Abdomen. Hair 6-I, II 6, 7b with branches tapering to a fine apex and barbed from near base to near apex; 1-III long, single; 1-V very long, double; 1-VI shorter than 4-VI; segment VI with dorsal sclerotized plate; siphon index usually 6.4-7.8 (6.4-10.1); hair 1-S located 0.41-0.49 from base of siphon and usually 6-8b(5-8).

TYPE DATA. *Orthopodomyia siamensis* Zavortink, holotype male with associated larval and pupal skins (TG 102-30) in U.S. National Museum; type locality: Muang, *Trang*. THAILAND.

DISTRIBUTION. Specimens examined: THAILAND, *Nakhon Si Thammarat, Narathiwat, Phangnga, Ranong, Trang*, 14 males, 8 females, 20 pupae, 58 larvae, 21 rearings. Records from the literature: THAILAND, *Narathiwat, Trang* (Zavortink 1968).

TAXONOMIC DISCUSSION. The adult of this species differs from *madrensis* and *lanyuensis*, the other Southeast Asian members of the *flavicosta* subgroup, by not having a forked or angled subspiracular scale patch or a bristle on the prealar knob. It is, however, apparently indistinguishable from *andamanensis* and many specimens of *anopheloides*, Southeast Asian species of the *anopheloides* subgroup. The male terminalia are differentiated from those of all other species by the shape of the aedeagus. The pupa has hair 2-II-IV thickened and thorn-like. In the larva the branches of hair 6-I, II are stout, yet taper to a fine apex and are barbed throughout. Abdominal segment VI of the mature larva bears a dorsal sclerotized plate; while this plate is commonly found in *Orthopodomyia* larvae of other groups, *siamensis* is the only species in the *albipes* group to have it developed.

Hind tarsomere 3 of the adult is entirely white scaled or has a dark patch or ring beyond the middle. Ornamentation of the base of the costal vein is almost as variable in this species as in *madrensis*. Hairy forms of the larva and pupa are not yet known.

O. siamensis is a relictual species restricted, as far as is known, to peninsular Thailand. Despite the extreme similarity with members of the *anopheloides* subgroup in the adult stage, the species seems to be quite removed from all others.

BIOLOGY. The immature stages have been collected in rot holes in trees, stumps, roots and in bamboo stumps. When found in the latter habitat, they may be associated with *albipes*. All known adults are reared and nothing is known about their behavior.

WILSONI SUBGROUP

PUPA. *Trumpet.* Largely dark brown, cylindrical. *Abdomen.* Hair 1-II moderately developed, moderately long, dendritic or with 1 or more stalks from which 18-34 fine branches arise; 5-V, VI long, usually extending to near alveolus of hair 4 of second following segment; 5-VI usually double (1-3b).

LARVA. *Thorax.* Hair 1-M, T 1-5b, moderately long to long, subequal in length to or much longer than 3-M and 2-T. *Abdomen.* Hair 6-I, II with branches finer than 6-III, tapering to fine apex and barbed from near base to near apex; posterior comb scales narrow at apex and with a single long, strong spine.

TAXONOMIC DISCUSSION. The monotypic *wilsoni* subgroup, known only from the Malay Peninsula, is well differentiated from the other subgroups in all stages. The immature stages are normally found in bamboo internodes.

ORTHOPODOMYIA WILSONI MACDONALD

(Figures 1b, c, g, 6, 9)

Orthopodomyia wilsoni Macdonald 1958, Proc. R. ent. Soc. Lond. (B) 27: 121 (♂*, ♀, P*, L*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 130 (♂*, ♀, P*, L*).

FEMALE. (Figs. 1b, c, g) *Head.* Dorsolateral scales brown anteriorly, yellowish posteriorly; labial light scales cream-colored, band about 0.75 distance from base; palpus 0.42 length of proboscis, light scales white, in 2 patches beyond the base. *Thorax. Pra* bristles absent; pleural scales largely cream-colored to yellow; *ssp* scale patch weakly developed, a simple usually short row. *Legs.* Fore and mid tarsomeres 2 and 3 entirely dark scaled or light scaled only at base; hind tarsomere 1 light or dark scaled at apex, hind tarsomere 2 conspicuously white ringed at both ends, hind tarsomere 3 usually like 2, but sometimes entirely white scaled, hind tarsomere 4 all white. *Wing.* Vein Sc without presectoral light patch; 1A dark at base. *Abdomen.* Light scales white or more frequently yellow or golden; additional light scales usually in large to very large basal middorsal patch on tergum II or terga II and III, and sometimes scattered basally or in narrow basal band on remaining terga; sterna II-VII dark scaled with basolateral light patch which becomes smaller on distal segments.

MALE. *Head.* Proboscis with additional light scales in preapical dorsal patch or oblique band; palpus 0.84 length of proboscis. *Abdomen.* Terga more frequently and broadly banded and subdorsal median light patches larger. *Terminalia.* (Fig. 6) Tergum VIII lobe with apex truncate or emarginate and serrate; basimere without strong, elongate specialized bristles distad of basal mesal lobe; basal mesal lobe with 4 stout bristles and 1 finer; aedeagus moderately sclerotized, pyriform in dorsal aspect, with a pair of separated ventral teeth near apex, and without a conspicuous projection between or below ventral parameres.

PUPA. (Fig. 9) *Cephalothorax.* Hairs 1-5-C moderately developed, 1-3 usually single or double (1-3b), hair 4 usually single (1-4b), hair 5 usually single or double (1-3b); 7-C very strongly developed, usually double (2, 3b); 8, 9-C moderately developed, usually single (single, double). *Abdomen.* Hair 2-II-IV fine, 2-II mesad of 5-II; 1-III usually 5, 6b(4-7); 5-IV usually 3, 4b; 5-V usually 2, 3b.

LARVA. (Fig. 6) *Head.* Integument largely straw-colored to tan; hair 13-C moderately strong, usually with 6, 7b(5-8). *Antenna.* Moderately long. *Abdomen.* Hair 6-I 7, 8b, 6-II usually 5-7b(5-8); 1-III moderately long, usually 2, 3b(1-3); 1-V very long, single; 1-VI equal to or longer than 4-VI; segment VI without sclerotized plate; siphon index usually 7.0-12.0; hair 1-S located 0.30-0.37 from base of siphon and usually 8-10b(6-10).

TYPE DATA. *Orthopodomyia wilsoni* Macdonald, holotype male with associated larval and pupal skins (0348/4) in British Museum; type locality: Ulu Gombak Forest Reserve, *Selangor* (Macdonald), MALAYSIA.

DISTRIBUTION. Specimens examined: MALAYSIA, *Selangor*, 10 males, 7 females, 14 pupae, 14 larvae, 14 rearings. THAILAND, *Nakhon Si Thammarat, Phangnga, Ranong*, 2 males, 2 females, 3 pupae, 21 larvae, 3 rearings. Records from the literature: MALAYSIA, *Selangor* (Macdonald 1958). THAILAND (Zavortink 1968).

TAXONOMIC DISCUSSION. *O. wilsoni* is one of the most distinctive of the Southeast Asian species. The adult has a poorly developed subspiracular scale patch and an unusually large basal light patch on abdominal tergum II or terga II and III. In addition, the abdominal light scaling is more golden or yellow in *wilsoni* than in any other species. The adult is also distinct from all others except *lanyuensis* in banding of the hind tarsomeres. The terminalia of the male differ from those of *albipes*, the only other Southeast Asian species with a distinctly pyriform aedeagus, by lacking strong, elongate specialized bristles on the basimere distad of the basal mesal lobe. The pupa has a dark cylindrical trumpet and cephalothoracic setae 1-6, 8, 9 relatively weakly developed, short and few branched. The shape of the larval comb scales is unlike that of any other species. The larva also differs from all others except *siamensis* by having a long thin siphon.

Most adults of *wilsoni* have conspicuous, subequal white bands at both ends of hind tarsomeres 2 and 3. I have seen a single reared specimen from the Isthmus of Kra which has hind tarsomere 3 entirely white scaled on both legs. The form of larval hairs 1-M, T, I-IV and 13-T, II-V is quite variable; these hairs may be long and relatively few branched to short and relatively many branched. Hairy forms are unknown for the pupa.

O. wilsoni is apparently a relictual species; it has no close relatives, but its affinities probably lie with *albipes*.

BIOLOGY. The immature stages occur in cracked or punctured bamboo internodes. There is one reared record of larvae having been collected in the concave top of the fungus *Polystictus xanthopus*. Although Macdonald (1958) did not recover this species from the same internodes as *albipes* in Malaysia, the two species are frequently associated in collections from peninsular Thailand. Habits of the adults are largely unknown, but a male has been collected resting on vegetation in a forest. Resting adults of both *anopheloides* and *andamanensis* were also taken at the same time and place.

ALBIPES SUBGROUP

PUPA. *Trumpet*. Largely brown to dark brown, broad, attaining maximum width in basal 0.33. *Abdomen*. Hair 1-II moderately developed, short, usually with a central stalk from which 19-35 very fine dendritic or forked branches arise, sometimes without stalk and with as few as 2 simple branches; 5-V, VI long, extending to alveolus of hair 4 of second following segment; 5-VI usually double (2-5b).

LARVA. *Thorax*. Hair 1-M, T 1-4b, usually long, much exceeding 3-M and 2-T. *Abdomen*. Hair 6-I, II with branches finer than 6-III, tapering to fine apex and barbed from near base to near apex; posterior comb scales narrow at apex and with a single strong but relatively short spine.

TAXONOMIC DISCUSSION. The *albipes* subgroup consists of a single species found from eastern India to northern Borneo. The subgroup is quite well marked in all stages. Bamboo internodes are the preferred breeding sites.

ORTHOPODOMYIA ALBIPES LEICESTER

(Figures 1d, 2, 4, 10)

Orthopodomyia albipes Leicester 1904, *In* Theobald, Entomologist 37:237 (♂, ♀); Barraud 1934, Fauna Brit. India, Diptera 5: 102 (♂, ♀, L); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 16 (♂*, ♀, P*, L*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 133 (♂*, ♀, P*, L*).

FEMALE. (Figs. 1d, 2) *Head*. Dorsolateral scales brown anteriorly, white posteriorly; labial light scales white, band at about middle; palpus 0.58 length of proboscis, light scales white, in 3 patches beyond the base. *Thorax*. *Pra* bristles absent; pleural scales largely white, sometimes cream-colored; *ssp* scale patch well developed, a simple moderately long row. *Legs*. Fore and mid tarsomeres 2 and 3 usually light scaled at base only; hind tarsomere

1 dark scaled at apex, hind tarsomere 2 usually with more extensive white scaling at base than at apex (at least on outer surface), hind tarsomere 3 entirely white or rarely with dark patch basad of middle, hind tarsomere 4 entirely white. *Wing.* Vein Sc often with presectoral light patch; 1A white scaled at base. *Abdomen.* Light scales white or rarely some yellow; terga with additional light scales sometimes scattered basally or in basal bands; sternum II mostly light scaled, III-VII dark scaled with light scales in basolateral patch which becomes smaller on distal segments, in midventral apical patch on segments II or III-V or VI, and sometimes in narrow basal band.

MALE. *Head.* Proboscis with additional light scales in preapical band which extends further basally along ventral surface; palpus 0.75 length of proboscis. *Abdomen.* As for female. *Terminalia.* (Fig. 4) Tergum VIII lobe with apex rounded or truncate and serrate; basimere with moderately to strongly developed elongate curved or sinuous bristles distad of basal mesal lobe; basal mesal lobe with 4 or 5 stout bristles and 1 or 2 finer ones; aedeagus moderately sclerotized, pyriform in dorsal aspect, with a pair of separated ventral teeth near apex and without a conspicuous projection between or below ventral parameres.

PUPA. (Fig. 10) *Cephalothorax.* Hair 1-C moderately developed, usually 2-4b(2-5); 2-C strongly developed, usually 2,3b(1-3); 3-C very strongly developed, usually 4-6b(4-9); 4-C strongly developed, usually 3,4b(2-4); 5-C very strongly developed, usually 4,5b(3-6); 7-C very strongly developed, usually 3,4b(3-5); 8,9-C moderately developed, 8 usually single or double, 9 usually single. *Abdomen.* Hair 2-II-IV fine, 2-II mesad of 5-II; 1-III usually 6-8b(4-8); 5-IV usually 3-5b; 5-V usually 3b(2-4).

LARVA. (Fig. 4) *Head.* Integument largely straw-colored; hair 13-C moderately developed, usually 4-6b. *Antenna.* Moderately long. *Abdomen.* Hair 6-I,II 5-7b; 1-III long, usually 2,3b(1-4); 1-V very long, usually single (single, double); 1-VI equal to or longer than 4-VI; segment VI without sclerotized plate; siphon index usually 4.0-6.0(3.6-7.5); hair 1-S located 0.32-0.40 from base of siphon and usually 9-11b(6-14).

TYPE DATA. *Orthopodomyia albipes* Leicester, lectotype male with terminalia slide in British Museum; type locality: Kuala Lumpur, *Selangor*, MALAYSIA.

DISTRIBUTION. Specimens examined: INDIA, *Bihar*, 1 male, 1 female. MALAYSIA, *Kedah, Kelantan, Pahang, Perak, Selangor*, 246 males, 294 females, 266 pupae, 384 larvae, 265 rearings. EAST MALAYSIA, *Sabah, Sarawak*, 2 males, 3 females. SINGAPORE, 1 larva. THAILAND, *Chiang Mai, Kanchanaburi, Lampang, Nakhon Ratchasima, Nakhon Si Thammarat, Narathiwat, Phangnga, Ranong, Surat Thani, Tak*, 87 males, 66 females, 147 pupae, 372 larvae, 142 rearings. Records from the literature: INDIA, Darjeeling District (Barraud 1934). MALAYSIA, *Perak* (Edwards 1928), *Sabah* (Zavortink 1968), *Sarawak* (Barraud 1934), *Selangor* (Leicester 1904, Macdonald 1958). THAILAND, *Kanchanaburi, Ranong* (Zavortink 1968). VIET NAM (Borel 1930).

TAXONOMIC DISCUSSION. *O. albipes*, like the other bamboo internode-breeding species, *wilsoni*, is also one of the most differentiated in Southeast Asia. The adult is distinctive in having hind tarsomere 2 usually more extensively light scaled basally than apically and in possessing a midventral apical light patch on abdominal sterna II or III to V or VI. Segment 4 of the palpus of the female is elongated in *albipes*. In all but a very few specimens, the added length separates the light scales at the apex of the segment from those at the base, so that the palpus has 3 light patches beyond the base instead of the 2 found in all other species. The male terminalia are characterized by the combination of a pyriform aedeagus and strong, elongate specialized bristles on the basimere distad of the basal mesal lobe. The pupa is easily separated from the other species by the shape of the trumpet. The larva differs from other species in shape of the comb scales and, to a lesser extent, in shape of the siphon.

I have seen specimens of *albipes* from West Malaysia and Thailand which have a conspicuous white ring at both ends of hind tarsomere 2. In other respects, including larval and pupal characters, these individuals are typical *albipes*. Hind tarsomere 3, normally entirely white, sometimes has a dark patch basad of the middle. The distimere of the male terminalia frequently bears 2 claws. Larval hairs 1-M, T, III, IV and 13-T, II-V are quite variable in length and number of branches. Hairy forms of the pupa are unknown.

O. albipes is one of the more widely distributed Southeast Asian species. Although it has no close relatives, it is probably derived from the same phyllad as *wilsoni*.

BIOLOGY. This species breeds in cracked or perforated bamboo internodes and, less frequently, bamboo stumps. It is sometimes associated with *wilsoni* in bamboo internodes and has been taken with *siamensis* in bamboo stumps. The immatures are encountered far more frequently than those of the other Southeast Asian species. Females are known to bite man (Macdonald 1958: 124).

ANOPHELOIDES SUBGROUP

PUPA. *Trumpet*. Largely brown to dark brown, broadening gradually from base. *Abdomen*. Hair 1-II moderately to strongly developed, moderately long to long, and with 8-35 mostly simple branches, some much finer than others, arising at base; 5-V, VI short, extending to alveolus of hair 4 of first following segment, in non-hairy forms, but long, extending to alveolus of hair 4 of second following segment, in hairy forms; 5-VI usually 3-7b(2-8).

LARVA. *Thorax*. Hair 1-M, T 1-4b, long to very long, much surpassing 3-M and 2-T. *Abdomen*. Hair 6-I, II with branches finer than 6-III, tapering to a fine apex and barbed from near base to near apex; posterior comb scales expanded at apex and with fan-like fringe of several elongate spines.

DISTRIBUTION. Species of this subgroup are found from India, southern China, and southern Japan, south to Ceylon, *Java*, and northern *Queensland*.

TAXONOMIC DISCUSSION. The *anopheloides* subgroup consists of the 3 species *andamanensis*, *anopheloides*, and *papuensis*. Only the first 2 of these occur in the Southeast Asian area.

O. andamanensis and *anopheloides* are very similar to each other in all stages and often cannot be separated. The male terminalia and immature stages of the pair are well differentiated from the other species in the Southeast Asian area, but the adults are frequently indistinguishable from those of *siamensis*, a species in the *flavicosta* subgroup.

The *anopheloides* subgroup is undoubtedly the most recent in the *albipes* group. The species are poorly marked and widespread.

BIOLOGY. The preimaginal stages of species in this subgroup are commonly found in tree-holes, bamboo stumps, and artificial containers. Adults have been collected resting on tree trunks and forest vegetation. Females of *andamanensis* apparently bite man.

ORTHOPODOMYIA ANDAMANENSIS BARRAUD

(Figures 1f, 8, 10)

Orthopodomyia anopheloides var. *andamanensis* Barraud 1934, Fauna Brit. India, Diptera 5: 102 (♂, ♀).

Orthopodomyia andamanensis Barraud: Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 15 (♂*, ♀, P*, L*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 141 (♂*, ♀, P*, L*).

FEMALE. (Fig. 1f) *Head*. Dorsolateral scales brown anteriorly, white posteriorly; labial light scales usually white, band at or distad of middle or sometimes absent, preapical patch sometimes either absent or completed ventrally, and sometimes with additional light scales scattered near base; palpus 0.43 length of proboscis, light scales white, in 2 patches beyond the base. *Thorax*. *Pra* bristles absent; pleural scales largely white or cream-colored; *ssp* scale patch well developed, a simple moderately long row. *Legs*. Fore tarsomeres 2 and 3 entirely dark scaled or light scaled at base or at both ends, mid tarsomeres 2 and 3 light scaled at both ends; hind tarsomere 1 usually white scaled at apex, hind tarsomere 2 with at most a narrow basal white ring and with a narrow to moderately broad white ring at apex, hind tarsomere 3 entirely white or rarely with subbasal dark patch or ring, hind tarsomere 4 all white. *Wing*. Vein Sc without presectoral light patch; 1A sometimes white scaled at base. *Abdomen*. Light scales white or cream-colored, rarely yellowish; sometimes terga with additional light scales scattered basally or in basal bands; sterna II-VII dark scaled with basolateral light patch which becomes smaller on distal segments.

MALE. *Head*. Proboscis with additional light scales in a moderately broad to broad preapical band which extends farther basally along ventral surface; palpus 0.80 length of proboscis. *Abdomen*. Terga and sterna sometimes with light basal bands. *Terminalia*. (Fig. 8) Tergum VIII lobe emarginate or truncate, serrate; basimere without strong specialized bristles distad of basal mesal lobe; basal mesal lobe with 4 or 5 stout bristles and 1-3 finer ones; aedeagus weakly sclerotized, approximately fusiform in dorsal aspect, without ventral teeth, but with a basal projection extending conspicuously ventrad below ventral parameres.

PUPA. (Fig. 10) The hairs in the hairy form have more branches (in italics in the following description) and are generally more strongly developed than in the non-hairy form. *Cephalothorax*. Hair 1-C moderately developed, usually 2, 3b, *up to 5b;* 2, 3-C moderately developed, usually 3-5b(2-6), *up to 10b;* 4-C moderately to strongly developed, usually 2-4b, *up to 8b;* 5-C strongly to very strongly developed, 2, 3b, *up to 6b*, 7-C very strongly developed, 2, 3b, *up to 6b;* 8, 9-C moderately to strongly developed, usually 2, 3b(2-5), *up to 8b*. *Abdomen*. Hair 1-II moderately developed, usually 16-25b, *up to 35b*, 2-II-IV fine, 2-II mesad of 5-II; 1-III usually 12-14b(10-17); 5-IV 5, 6b, *up to 8b*; 5-V usually 4, 5b(4-6), *up to 7b;* 5-VI usually 6, 7b(4-8).

LARVA. (Fig. 8) *Head*. Integument brown to dark brown; 13-C moderately developed, 4-6b(4-7). *Antenna*. Short. *Abdomen*. Hair 6-I usually 9, 10b(7-10), 6-II usually 9-11b(7-12); 1-III, V very long, single; 1-VI shorter than 4-VI; segment VI without sclerotized plate; siphon index usually 4.0-5.6; hair 1-S located 0.37-0.50 from base of siphon and usually 11, 12b(10-14).

TYPE DATA. *Orthopodomyia anopheloides* var. *andamanensis* Barraud, lectotype male with terminalia slide in British Museum; type locality: ANDAMAN ISLANDS (Covell).

DISTRIBUTION. Specimens examined: ANDAMAN ISLANDS, 1 male, 1 female. INDONESIA, *Java*, 6 males, 10 females, 1 pupa; *Kalimantan*, 2 males, 1 female, 1 pupa, 1 larva, 1 rearing; *Sumatra*, 5 males, 7 females, 1 pupa, 1 larva. MALAYSIA, *Perak*, *Selangor*, 5 males, 8 females, 8 pupae, 8 larvae, 8 rearings. PHILIPPINES, *Palawan*, 1 male, 1 female, 2 pupae, 2 larvae, 2 rearings. SINGAPORE, 2 males, 1 female, 1 pupa, 1 larva. THAILAND, *Chanthaburi*, *Chiang Mai*, *Chiang Rai*, *Khon Kaen*, *Lampang*, *Nakhon Nayok*, *Nakhon Ratchasima*, *Ranong*, *Tak*, *Trang*, 35 males, 15 females, 7 pupae, 15 larvae, 6 rearings. VIET NAM, 1 male, 1 female. Records from the literature: ANDAMAN ISLANDS (Barraud 1934). INDIA, *Darjeeling* District (Barraud 1934). INDONESIA, *Celebes* (Knight & Mattingly 1950), *Java*, *Kalimantan* (Bonne-Wepster 1954), *Sumatra* (Brug & Bonne-Wepster 1947). MALAYSIA, *Perak* (as *albipes*, Leicester 1908), *Selangor* (Macdonald 1958). PHILIPPINES, *Palawan* (Knight & Mattingly 1950).

SINGAPORE (Barraud 1934). THAILAND, *Chiang Mai, Chiang Rai, Khon Kaen, Nakhon Nayok, Nakhon Ratchasima* (Zavortink 1968), *Lampang* (Thurman 1959). VIET NAM (Zavortink 1968).

TAXONOMIC DISCUSSION. The adult of *andamanensis* is apparently indistinguishable from that of *siamensis.* It differs from the majority of those of *anopheloides* by having hind tarsomeres 3 and 4 entirely white scaled. From those rare specimens of *anopheloides* with hind tarsomeres 3 and 4 entirely white scaled, it sometimes differs by having a narrower white ring at the apex of hind tarsomere 2. The aedeagus of the male terminalia of both *andamanensis* and *anopheloides* is quite different from that of the other species. It lacks ventral teeth but has a basal projection between or below the ventral parameres. In *andamanensis* this basal projection is usually directed more ventrally than in *anopheloides.* Non-hairy pupae of *andamanensis* and *anopheloides* differ from other Southeast Asian species by having hair 5-VI short and multiple. The pupa of *andamanensis* is separated from that of *anopheloides* by having a greater number of branches in hairs 1-III and 9-C. Larvae of the 2 species have characteristically shaped posterior comb scales, long thoracic hair 1-M, T, and branches of abdominal hair 6-I, II finer than hair 6-III. The larva of *andamanensis* usually has a greater number of branches in hair 6-I, II than *anopheloides.*

I have seen 3 male specimens from Thailand that have a dark ring in the basal portion of hind tarsomere 3; they agree with *andamanensis* in all other characters and are probably that species. Hairy forms are known for the pupa only.

O. andamanensis and *anopheloides* are very similar in all stages, are sympatric over a broad area and are found in the same breeding sites. It is possible that further study will show them to be only forms of a single species.

O. andamanensis occurs from east India to *Java, Celebes* and *Palawan.* I have not seen the material upon which the *Celebes* record is based. It is possible that the species there is the closely related *papuensis* rather than *andamanensis.*

BIOLOGY. The immature stages of *andamanensis* have been taken from tree-holes, bamboo stumps, and artificial containers; they are often associated with those of *anopheloides.* Females of the *Celebes* population are known to bite man (Knight & Mattingly 1960: 16). Adults are sometimes taken resting in the forest; such collections frequently contain *anopheloides* also.

ORTHOPODOMYIA ANOPHELOIDES (GILES)

(Figures 1e, 7, 11, 12)

Mansonia anopheloides Giles 1903, *In* Wyville Thomson, J. trop. Med. 6: 315 (♂, ♀*, L).

Orthopodomyia albipes var. *nigritarsis* Leicester 1908, Cul. Malaya :177 (♂, ♀); Edwards 1913, Bull. ent. Res. 4: 239 (synonymy).

Orthopodomyia maculata Theobald 1910, Rec. Indian Mus. 4: 29 (♂); Edwards 1913, Bull. ent. Res. 4:239 (synonymy); Barraud 1934, Fauna Brit. India, Diptera 5: 101 (A, L; as variety of *anopheloides*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 9 (♂*, P, L; as subspecies of *anopheloides*); Thurman 1959, Univ. Md. Agric. Exp. Sta. Bull. Pacif. Sci. Congr. 9:55 (as variety of *anopheloides*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 146 (synonymy).

Orthopodomyia maculipes Theobald 1910, Mon. Cul. 5:470 (♀*); Barraud, 1934, Fauna Brit. India, Diptera 5: 101 (A, L; as variety of *anopheloides*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 10 (♂*, ♀, P*, L; elevated to specific rank); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 146 (synonymy).

Orthopodomyia manganus Baisas 1946, Mon. Bull. Bur. Hlth. Philipp., Manila 22: 35 (♂*, ♀, P*, L*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 7 (synonymy).
Orthopodomyia (Orthopodomyia) nipponica LaCasse & Yamaguti 1948, Mosq. Fauna Japan and Korea 2: 264 (♂*, ♀*, P*, L*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 7 (synonymy).
Orthopodomyia (Orthopodomyia) lemmonae Thurman 1959, Univ. Md. Agric. Exp. Sta. Bull. A-100: 58 (L*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 147 (synonymy).
Orthopodomyia anopheloides (Giles): Edwards 1913, Bull. ent. Res. 4: 239 (taxonomy); Barraud 1927, Indian J. med. Res. 14: 527 (♂*, ♀); Barraud 1932, Indian J. med. Res. 19: 1014 (P*, L*); Barraud 1934, Fauna Brit. India, Diptera 5: 98 (♂, ♀*, P*, L*); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 7 (♂*, ♀, P*, L); Delfinado 1966, Mem. Amer. ent. Inst. 7: 66 (♂*, ♀, P*, L*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2):146 (♂*, ♀*, P*, L*).
Orthopodomyia mcgregori of Knight & Chamberlain 1948, Proc. helm. Soc. Wash. 15: 10 (P*; misidentification); Knight & Mattingly 1950, Proc. ent. Soc. Wash. 52: 13 (♂, P, L; misidentification).

FEMALE. (Fig. 1e) *Head*. Dorsolateral scales brown anteriorly, white posteriorly; labial light scales usually white, band at or distad of middle or sometimes absent, preapical patch sometimes either absent or completed ventrally, and sometimes with additional light scales scattered near base; palpus 0.48 length of proboscis, light scales white, in 2 patches beyond the base. *Thorax*. *Pra* bristles absent; pleural scales largely white or cream-colored, rarely yellow-tinged; *ssp* scale patch well developed, a simple moderately long row. *Legs*. Fore and mid tarsomeres 2 and 3 usually light scaled at both ends; hind tarsomere 1 usually white scaled at apex, sometimes with broad white ring, hind tarsomere 2 dark or light scaled basally and with a moderately broad to very broad apical white ring, hind tarsomeres 3 and 4 rarely all white, more commonly 3 or 3 and 4 with dark patch or ring distad of middle. *Wing*. Vein Sc without presectoral light patch; 1A sometimes white scaled at base. *Abdomen*. Light scales white or cream-colored, rarely yellowish; sometimes terga with additional light scales scattered basally or in basal band; sterna II-VII dark scaled with light scales in basolateral patch which becomes smaller on distal segments and sometimes in basal band.

MALE. *Head*. Proboscis with additional light scales in preapical dorsal patch or narrow to broad band which extends further basally along ventral surface; palpus 0.78 length of proboscis. *Abdomen*. Terga and sterna more frequently and extensively banded than in female. *Terminalia*. (Fig. 7) Tergum VIII lobe emarginate or truncate and usually serrate; basimere usually without strong specialized bristles distad of basal mesal lobe; basal mesal lobe with 4-6 stout bristles and 1-3 finer ones; aedeagus weakly to moderately sclerotized, approximately fusiform in dorsal aspect, without ventral teeth, but with a basal projection extending conspicuously cephalad between ventral parameres.

PUPA. (Fig. 11) As in *andamanensis* the hairs in the hairy form have more branches (in italics in the following description) and are generally more strongly developed than in the non-hairy form. *Cephalothorax*. Hair 1-C moderately developed, 2-3b, *up to 4b;* 2-C moderately developed, 1-3b, *up to 7b;* 3-C moderately developed, 3-5b, *up to 10b*; 4-C moderately to very strongly developed, 2, 3b, *up to 6b;* 5-C very strongly developed, 2-3b, *up to 6b;* 7-C very strongly developed, usually double, *up to 6b;* 8, 9-C moderately to strongly developed, usually single (single, double), *1-3b*. *Abdomen*. Hair 1-II moderately developed, usually 12-19b (8-23), *up to 34b;* 2-II fine and mesad of 5-II; 2-III, IV fine; 1-III usually 5-7b(3-11); 5-IV 3, 4b, up to 8b; 5-V usually 3-4b(2-4), *up to 7b;* 5-VI usually 3-5b(2-6).

LARVA. (Figs. 7, 12) *Head.* Integument largely brown to dark brown; hair 13-C moderately developed, 4-6b(4-7). *Antenna.* Short. *Abdomen.* Hair 6-I usually 5-8b, 6-II usually 4-8b; 1-III, V very long and single in non-hairy form, long and double in hairy form; 1-VI shorter than 4-VI in non-hairy form, equal to or longer than 4-VI in hairy form, segment VI without sclerotized plate; siphon index usually 3.5-4.8(3.2-6.4); hair 1-S located 0.36-0.50 from base of siphon and usually 10-12b(9-13).

TYPE DATA. *Mansonia anopheloides* Giles, lectotype male with terminalia slide in British Museum; type locality: Dehra Dun, *Uttar Pradesh*, INDIA. *Orthopodomyia albipes* var. *nigritarsis* Leicester, lectotype female (76) in the British Museum; type locality: Pangkor Laut, *Perak* (Daniels), MALAYSIA. *Orthopodomyia maculata* Theobald, holotype male in Indian Museum; type locality: Maddathorai, *Travancore* (Annandale), INDIA. *Orthopodomyia maculipes* Theobald, lectotype female in British Museum; type locality: ANDAMAN ISLANDS (Lowis and White). *Orthopodomyia manganus* Baisas, holotype male with associated larval and pupal skins (THIII-5) lost; type locality: Llavac, Laguna, *Luzon* (Sunico), PHILIPPINES. *Orthopodomyia (Orthopodomyia) nipponica* LaCasse & Yamaguti, lectotype female with associated pupal skin in U.S. National Museum; type locality: Kyoto, *Honshu*, JAPAN. *Orthopodomyia (Orthopodomyia) lemmonae* Thurman, holotype larva (M398-1) in U.S. National Museum; type locality: Doi Chom Cheng of Doi Sutep Range, *Chiang Mai* (Thurman), THAILAND.

DISTRIBUTION. Specimens examined: ANDAMAN ISLANDS, 4 females. CEYLON, 4 males, 8 females. CHINA, *Chekiang*, 1 male, 1 female. INDIA, *Assam, Himachal Pradesh, Mysore, Uttar Pradesh*, 5 males, 7 females, 5 pupae, 19 larvae, 8 rearing. INDONESIA, *Java*, 1 male, 1 female, 2 pupae, 5 larvae; *Sumatra*, 4 males, 1 female, 2 pupae. JAPAN, *Honshu*, 13 males, 5 females, 2 pupae, 22 larvae, 2 rearings. MALAYSIA, *Perak*, *Selangor*, 13 males, 11 females, 19 pupae, 20 larvae, 19 rearings. EAST MALAYSIA, *Sabah*, 9 males, 8 females, 13 pupae, 13 larvae, 14 rearings. NEPAL, 1 larva. PAKISTAN, *East Pakistan*, 1 larva. PHILIPPINES, *Leyte*, *Luzon, Mindoro, Negros, Palawan*, 29 males, 25 females, 23 pupae, 56 larvae, 25 rearings. RYUKYU ISLANDS, *Iriomote Island, Ishigaki Island*, *Okinawa*, 30 males, 35 females, 28 pupae, 49 larvae, 28 rearings. SINGAPORE, 3 males, 2 females, 1 pupa, 7 larvae. TAIWAN, 5 males, 11 females, 11 larvae. THAILAND, *Chanthaburi, Chiang Mai, Kanchanaburi, Khon Kaen, Nakhon Nayok, Nakhon Ratchasima, Nakhon Si Thammarat, Phangnga, Prachuap Khiri Khan, Ranong, Surat Thani, Tak, Trang*, 61 males, 58 females, 52 pupae, 156 larvae, 49 rearings. VIET NAM, 5 males, 3 females, 3 pupae, 12 larvae, 3 rearings. Records from the literature: ANDAMAN ISLANDS (as *maculipes*, Theobald 1910b). CEYLON (as *maculata*, Theobald 1910b). CHINA, *Chekiang* (Wu 1936), *Hainan* (as *maculata*, Chu 1957), *Hunan* (Chang 1957), *Yunnan* (Chow 1949). INDIA, *Assam, Eastern Himalayas, North Bengal, South Bombay, Western Himalayas* (Barraud 1927), *Malabar, North Kanara* (Barraud 1932), *Travancore* (as *maculata*, Theobald 1910a), *United Provinces* (Giles 1903). INDONESIA, *Java* (as *maculata*, Barraud 1934), *Kalimantan* (as *maculipes*, Haga 1924), *Sumatra* (as *maculipes*, Brug & Edwards 1931). JAPAN, *Honshu* (as *nipponica*, LaCasse & Yamaguti 1948). MALAYSIA, *Perak* (as *nigritarsis*, Leicester 1908), *Sabah* (Zavortink 1968), *Selangor* (partly as *andamanensis* and *maculipes*, Macdonald 1958). NEPAL, PAKISTAN, *East Pakistan* (Zavortink 1968). PHILIPPINES, *Leyte*, *Negros, Mindoro* (Zavortink 1968), *Luzon* (as *manganus*, Baisas 1946), *Palawan* (as *mcgregori*, Knight & Chamberlain 1948 and as *maculipes*, Knight & Mattingly 1950). RYUKYU ISLANDS, *Iriomote, Ishigaki* (Bohart 1959), *Okinawa* (Gentry 1957). SINGAPORE (as *maculipes*, Edwards 1926). TAIWAN (Chow 1950). THAILAND, *Chanthaburi, Khon Kaen, Nakhon Nayok, Nakhon Ratchasima, Trang* (Zavortink 1968), *Chiang Mai* (partly as *lemmonae* and *maculata*, Thurman 1959), *Nakhon Si Thammarat* (as *maculipes*, Edwards 1928).

TAXONOMIC DISCUSSION. *O. anopheloides* and *andamanensis* are a pair of very similar species. The characters which separate them from the other Southeast Asian species are discussed under *andamanensis*. The adult of *anopheloides* is told from that of *andamanensis* by the usual presence of a dark patch or ring distad of the middle of hind tarsomere 3 or hind tarsomeres 3 and 4 and by the usually broader apical white ring on hind tarsomere 2. Male terminalia of *anopheloides* usually have the basal projection of the aedeagus directed more cephalad than in *andamanensis*. The pupa of *anopheloides* differs from that of *andamanensis* by having fewer branches in hairs 1-III and 9-C. The larva of *anopheloides* is distinguished from that of *andamanensis* by having fewer branches in hair 6-I, II.

O. anopheloides is the most variable and widespread of the Southeast Asian species of *Orthopodomyia*. As a result, it has several synonyms. Leicester was apparently unaware of Giles' earlier description when he proposed *nigritarsis* in 1908. *O. maculata* Theobald,1910a and *maculipes* Theobald, 1910b were based on specimens with different types of leg banding. *O. manganus* Baisas,1946 and *nipponica* LaCasse & Yamaguti,1948 were considered to be distinct from *anopheloides* largely on the basis of markings of the proboscis. *O. lemmonae* Thurman,1959 was based on young fourth instar larvae of the hairy form. Large series of anopheloides with associated larval and pupal skins are now available from many parts of the range of the species; study of these series has indicated that only one variable species is involved.

While most adults of *anopheloides* have a dark patch or ring on hind tarsomeres 3 and 4, a few have a patch or ring on only hind tarsomere 3, and even fewer have hind tarsomeres 3 and 4 entirely white scaled. The chaetotaxy of both the larva and pupa of this species is very variable; hairy forms, individuals in which many of the setae are elongate, thickened and more highly branched, are known for both stages.

O. anopheloides is the dominant species of *Orthopodomyia* in the Oriental region. It is found throughout nearly the entire Southeast Asian region.

BIOLOGY. The immature stages of *anopheloides* have been found in tree-holes, bamboo stumps, artificial containers and rock-holes. Adults have been found resting on tree trunks and in vegetation. The aquatic stages may occur with those of *andamanensis* and *madrensis* and adults may rest in the same areas as those of *wilsoni* and *andamanensis*.

HYBRIDS

ANOPHELOIDES X ALBIPES

(Figure 12)

I have seen 4 males with associated larval and pupal skins from northern Thailand, *Chiang Rai*, that I think are hybrids between *anopheloides* and *albipes*. The adults resemble *albipes*, but differ from that species and all other *Orthopodomyia* by having a patch of scales on each side of the clypeus. The larvae and pupae are also similar to *albipes*, but have some less conspicuous features of *anopheloides*. The aedeagus of the male terminalia (Fig. 12) is more or less intermediate between that of *anopheloides* and *albipes*.

NOMEN DUBIUM

ORTHOPODOMYIA MCGREGORI (BANKS)

Kerteszia mcgregori Banks 1909, Philipp. J. Sci. 4: 548 (♂); Edwards 1932, *In* Wytsman, Genera Insect., fasc. 194: 108 (reduced to synonymy with *albipes*); Baisas 1946, Mon. Bull. Bur. Hlth. Philipp., Manila 22: 34, 35 (suggested leaving status uncertain until topotypic material was available); Knight & Chamberlain 1948, Proc. helm. Soc. Wash. 15: 10 (resurrected from synonymy with *albipes*); Zavortink 1968, Contr. Amer. ent. Inst. 3(2): 154 (changed to status of *nomen dubium*).

TYPE DATA. *Kerteszia mcgregori* Banks, holotype male destroyed; type locality: *Basilan Island* (Mcgregor), PHILIPPINES.

TAXONOMIC DISCUSSION. I am following Baisas (1946: 34, 35) in considering *mcgregori* to be a *nomen dubium*. Although Banks' description of *mcgregori* is unusually detailed for descriptions of that time, it remains uncertain to what taxon the name applies. However, the species is not *albipes*, as thought by Edwards (1932: 108). The *mcgregori* of Knight & Chamberlain (1948: 10) and Knight & Mattingly (1950: 13) is *anopheloides*.

ACKNOWLEDGEMENTS

I am grateful to Dr. Botha de Meillon, Responsible Investigator, Southeast Asia Mosquito Project, Dr. Alan Stone, Agricultural Research Service, U.S. Department of Agriculture and Dr. John N. Belkin, Department of Zoology, University of California at Los Angeles, for their counsel in the preparation of this paper. I thank Dr. Wallace A. Steffan, Bernice P. Bishop Museum, Dr. Peter F. Mattingly, British Museum (Natural History), Dr. William W. Macdonald, Liverpool School of Tropical Medicine, Dr. J. C. Lien, Taiwan Malaria Research Institute, and Dr. Richard M. Bohart, University of California at Davis, for loans of specimens. The illustrations were prepared by Mrs. Elaine Hodges, Mr. L. M. Druckenbrod and illustrators of the 406th General Medical Laboratory, Japan. The manuscript was typed for offset reproduction by Miss Helle Starcke.

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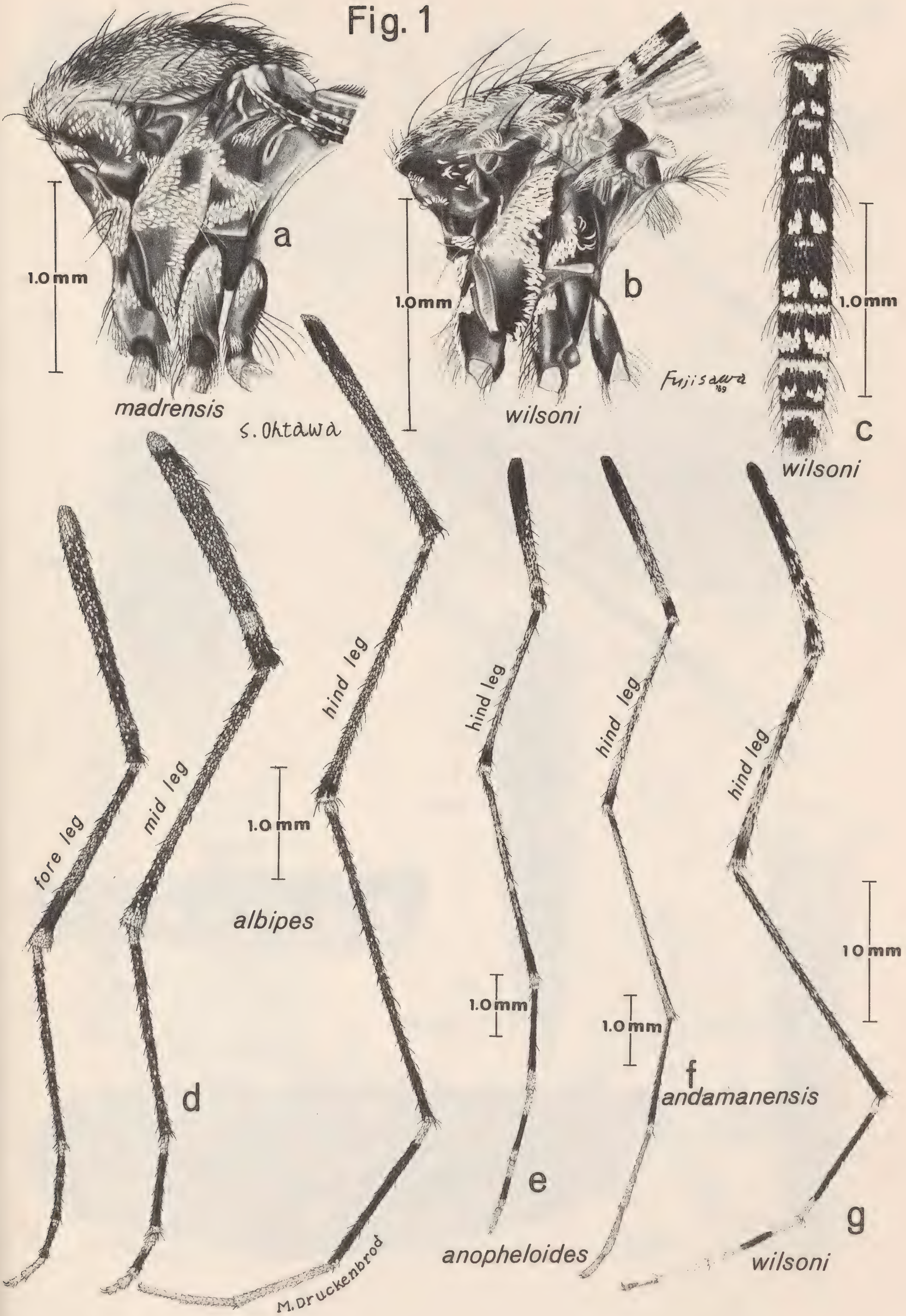
Fig. 1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S. Ohtawa
b
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wilsoni
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c
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mid leg
hind leg
1.0 mm
albipes
d
M. Druckenbrod
hind leg
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anopheloides
hind leg
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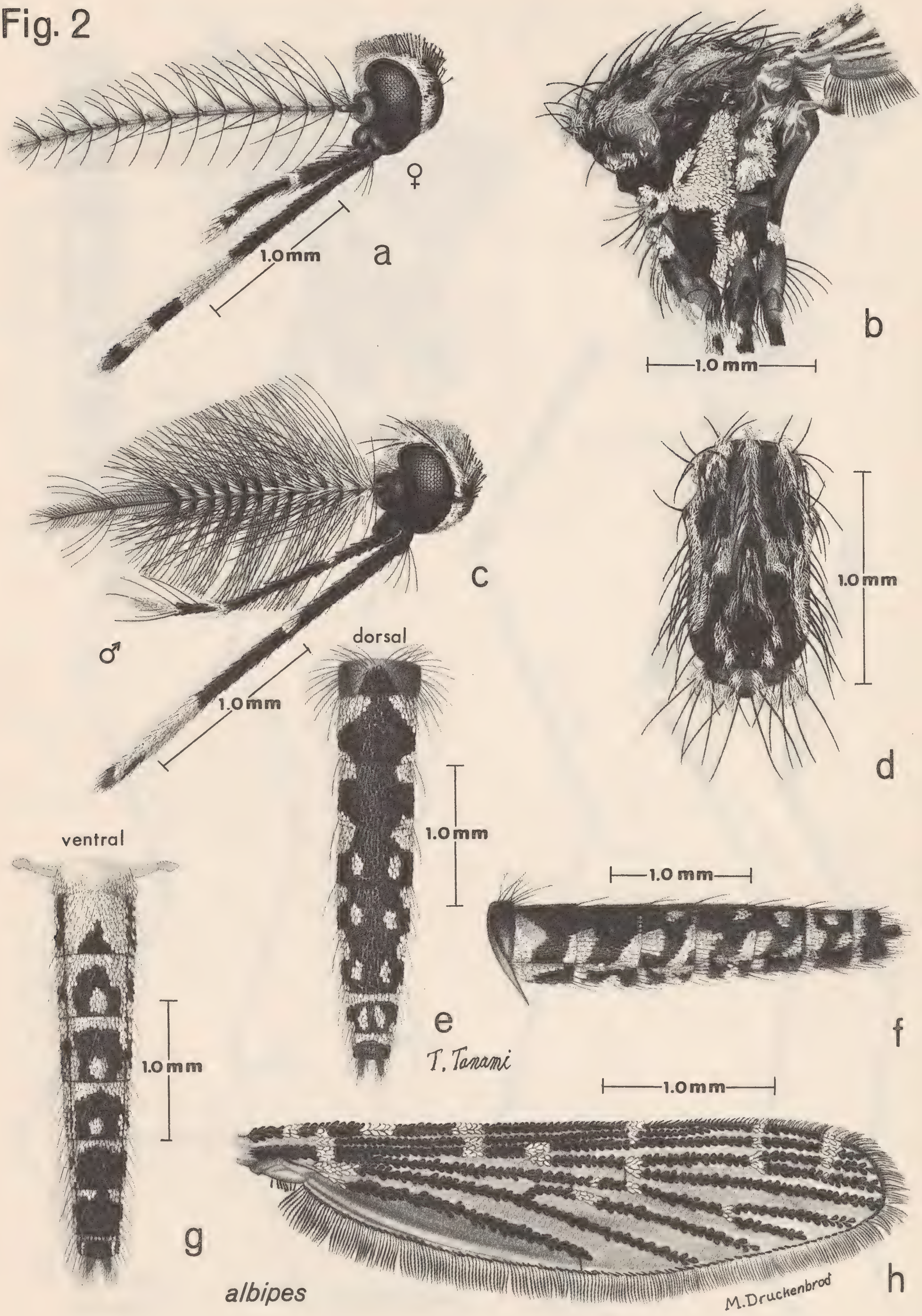
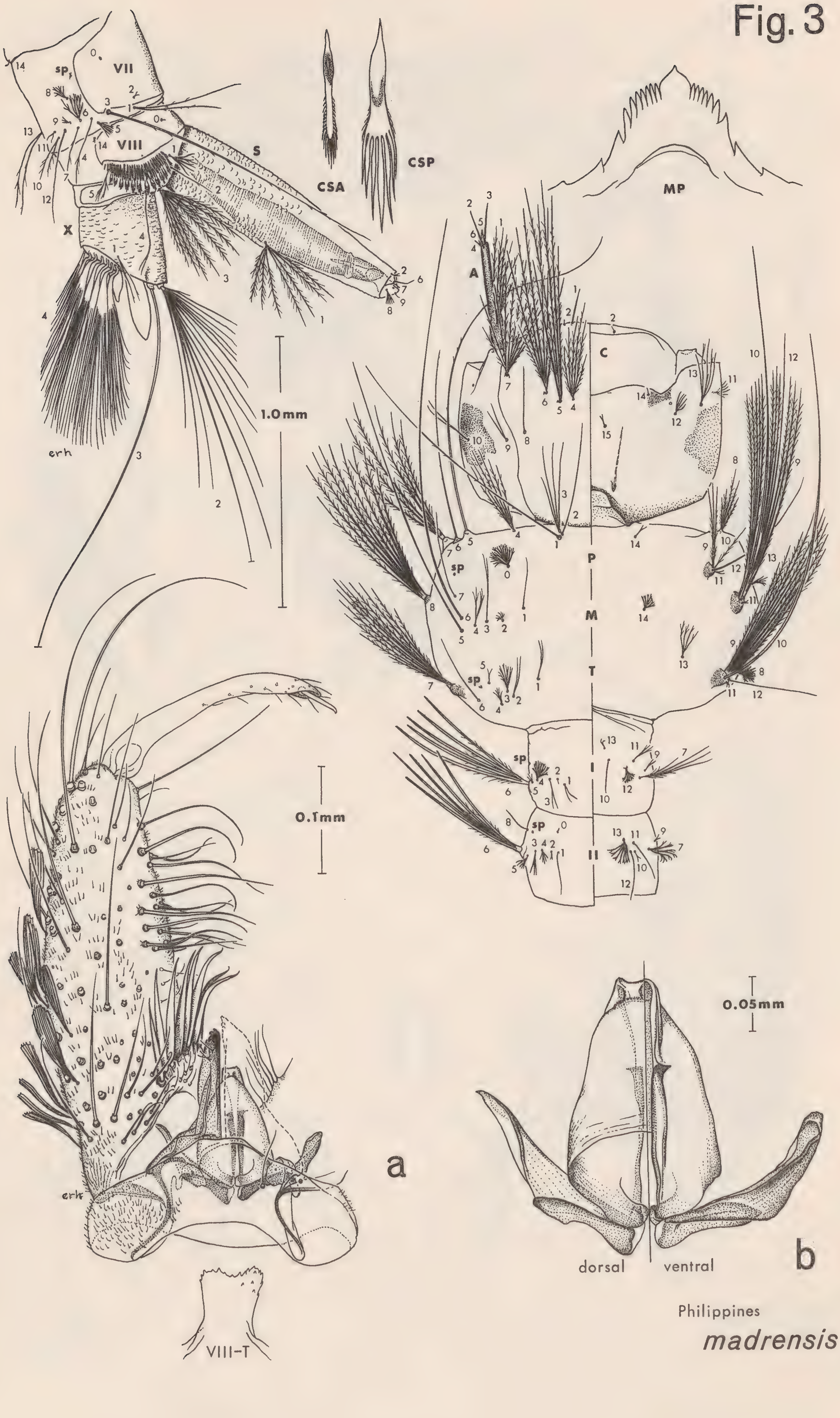
f
andamanensis
hind leg
1.0 mm
g
wilsoni

Fig. 2



albipes

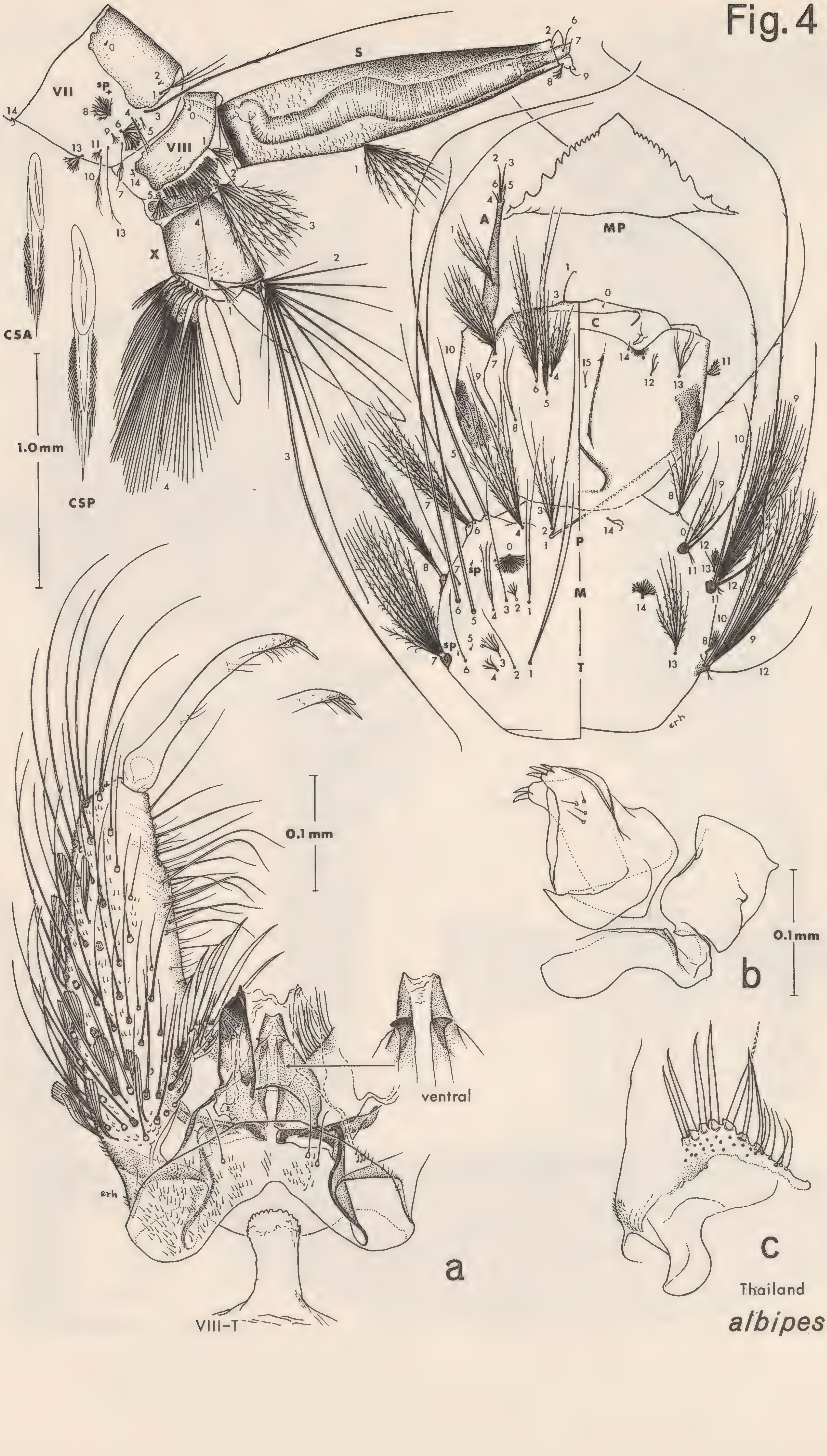
Fig. 3



Philippines

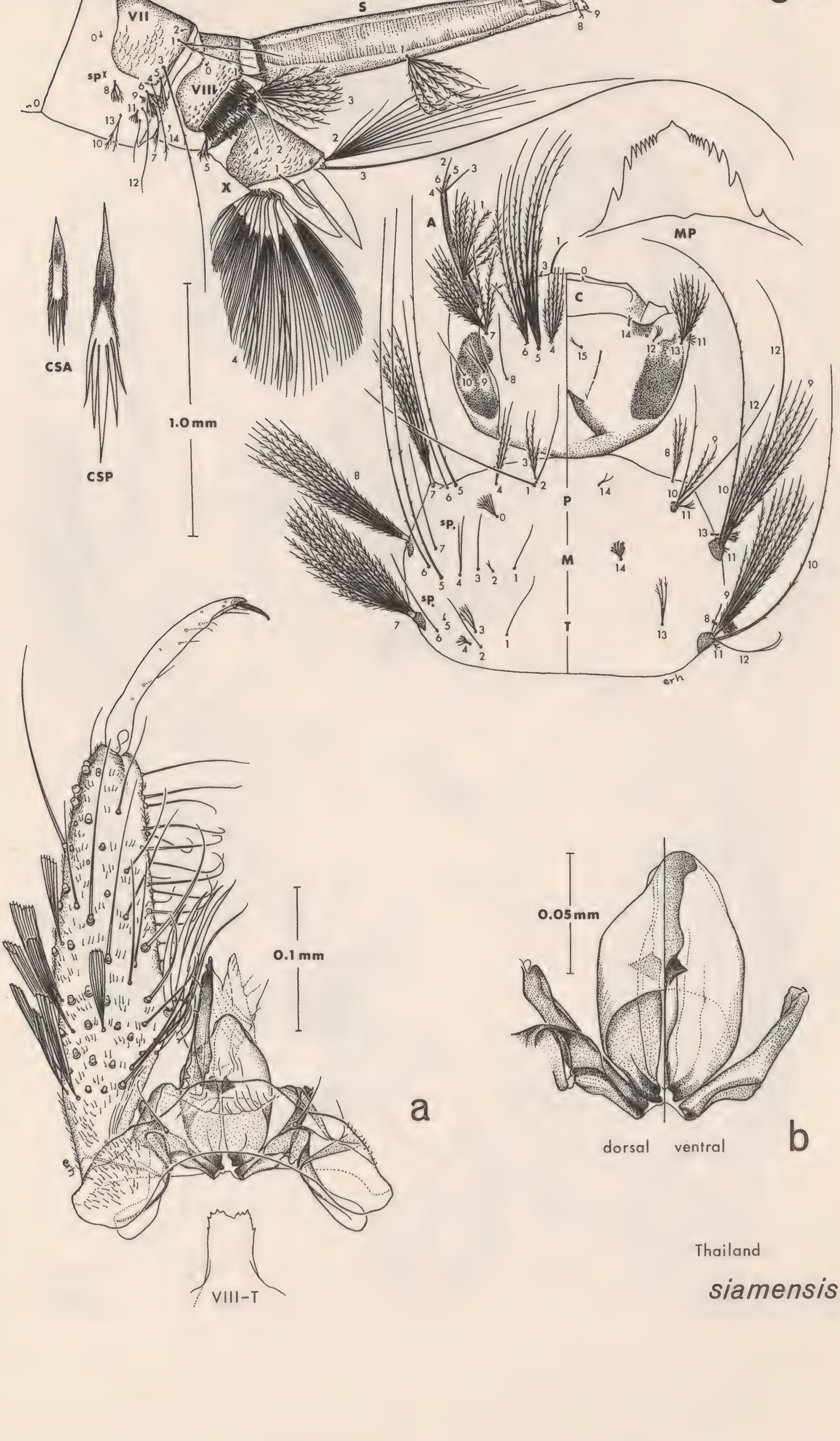
madrensis

Fig. 4



Thailand
albipes

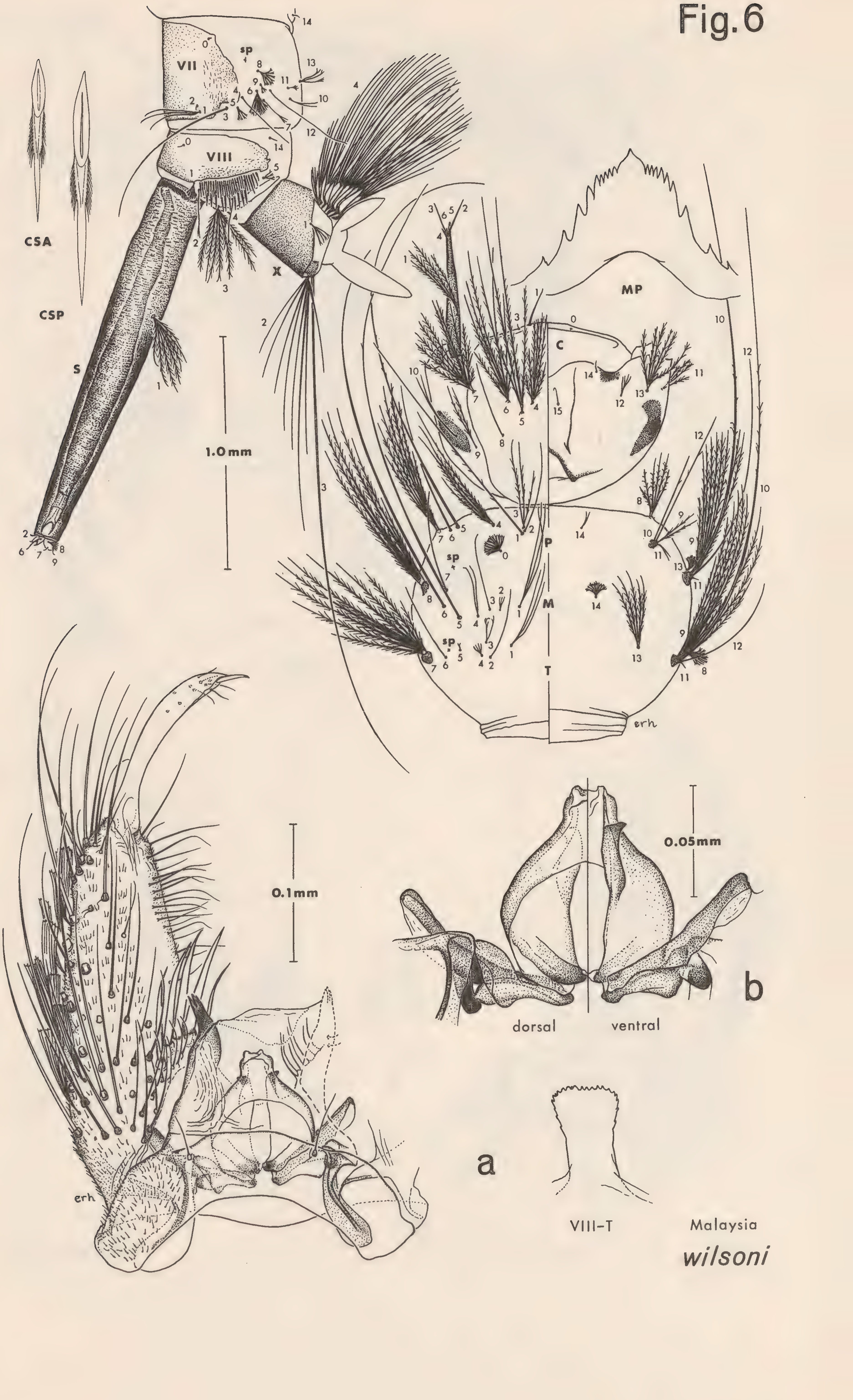
Fig. 5



Thailand

siamensis

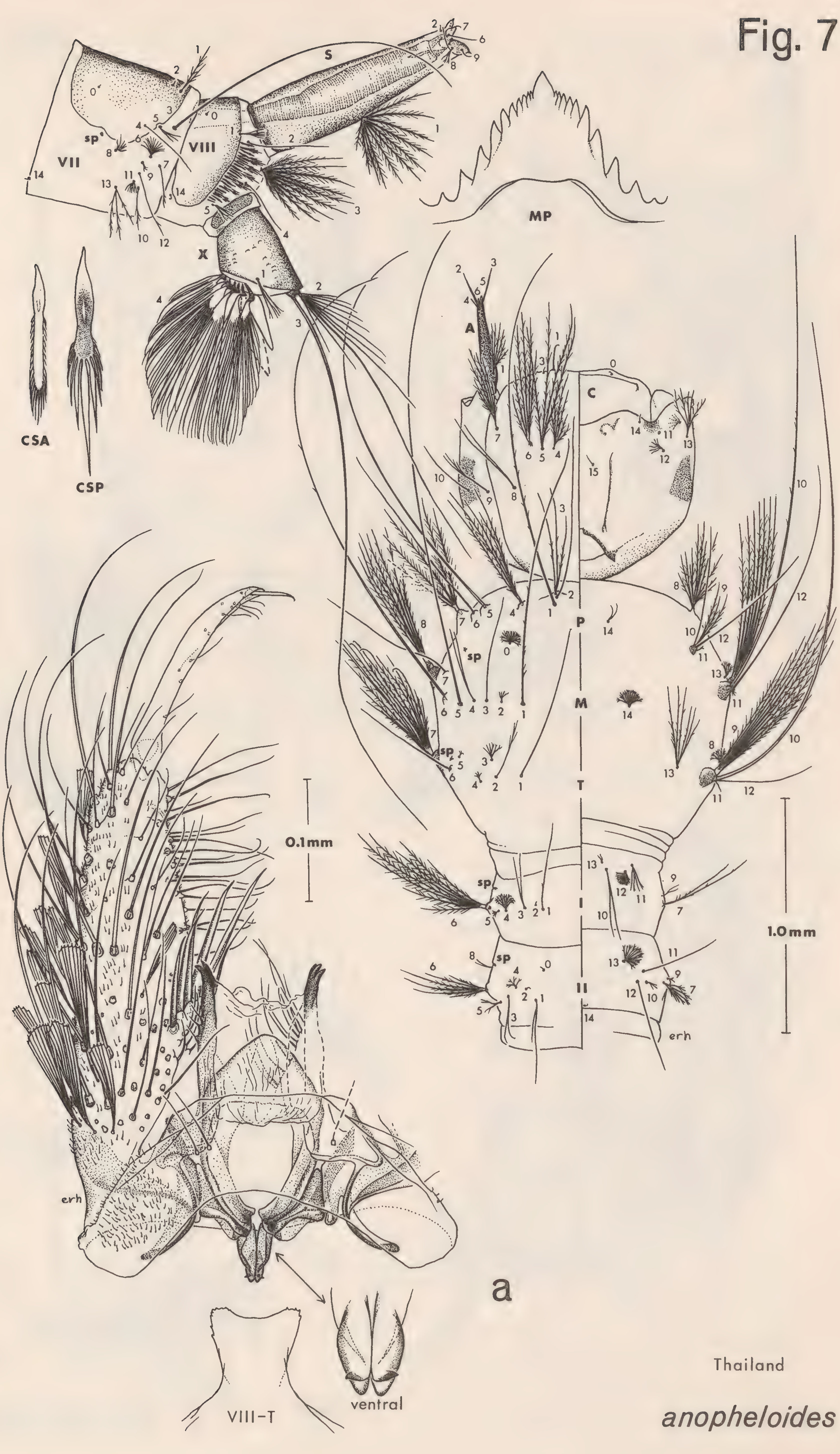
Fig.6



Malaysia

wilsoni

Fig. 7



Thailand

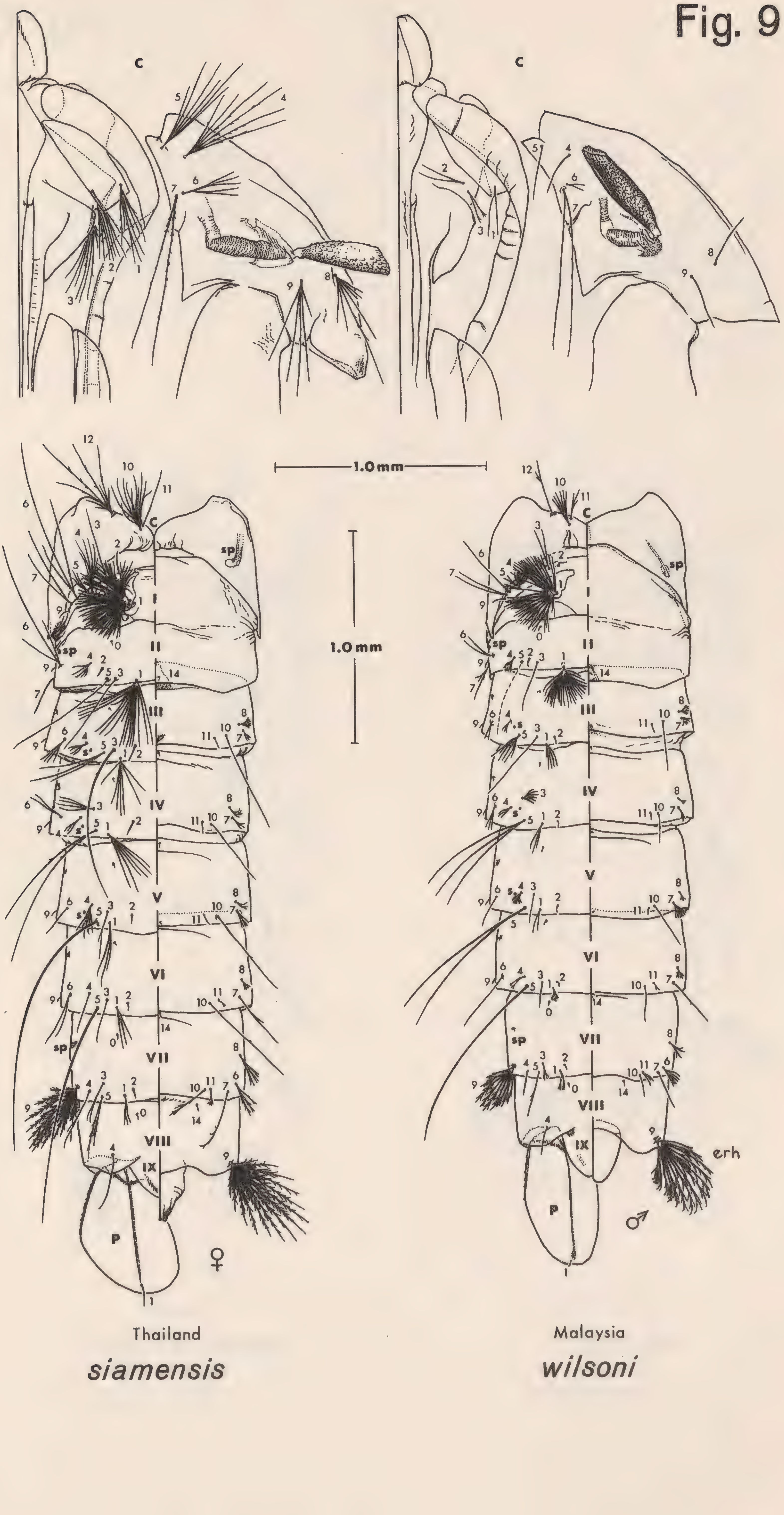
anopheloides

Fig. 8

Thailand

andamanensis

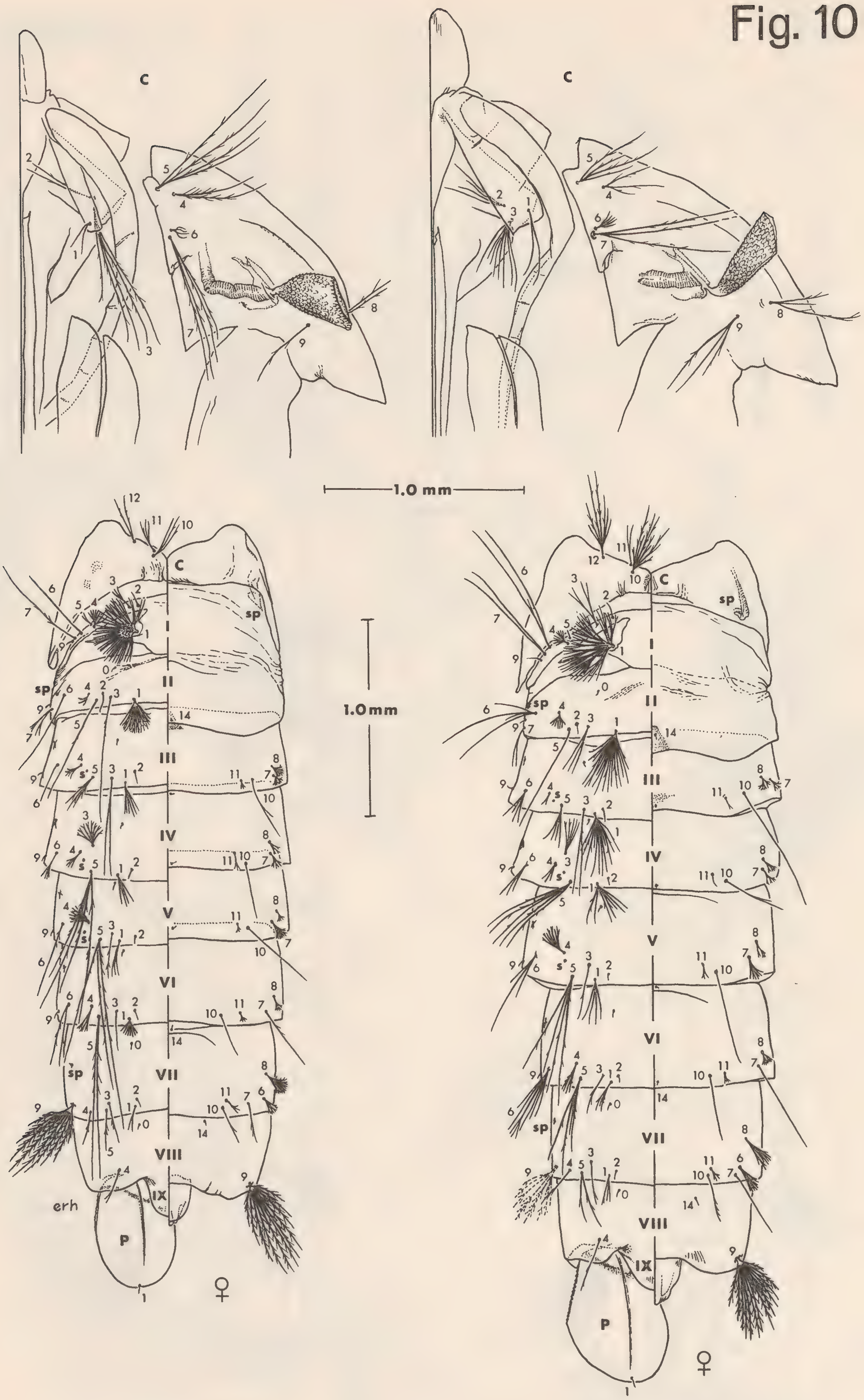
Fig. 9



Thailand
siamensis

Malaysia
wilsoni

Fig. 10



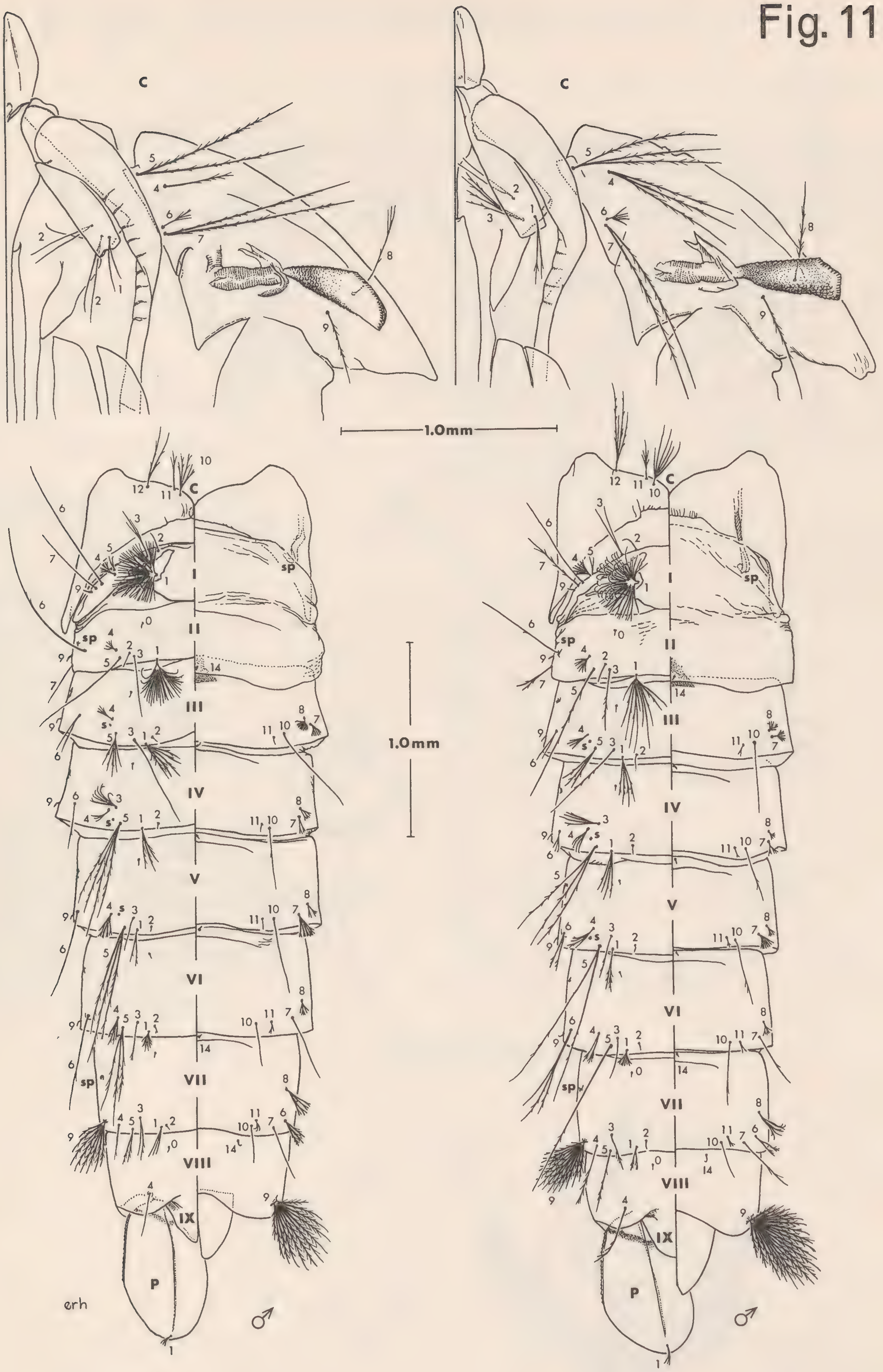
Thailand

albipes

Phillippines

andamanensis

Fig. 11



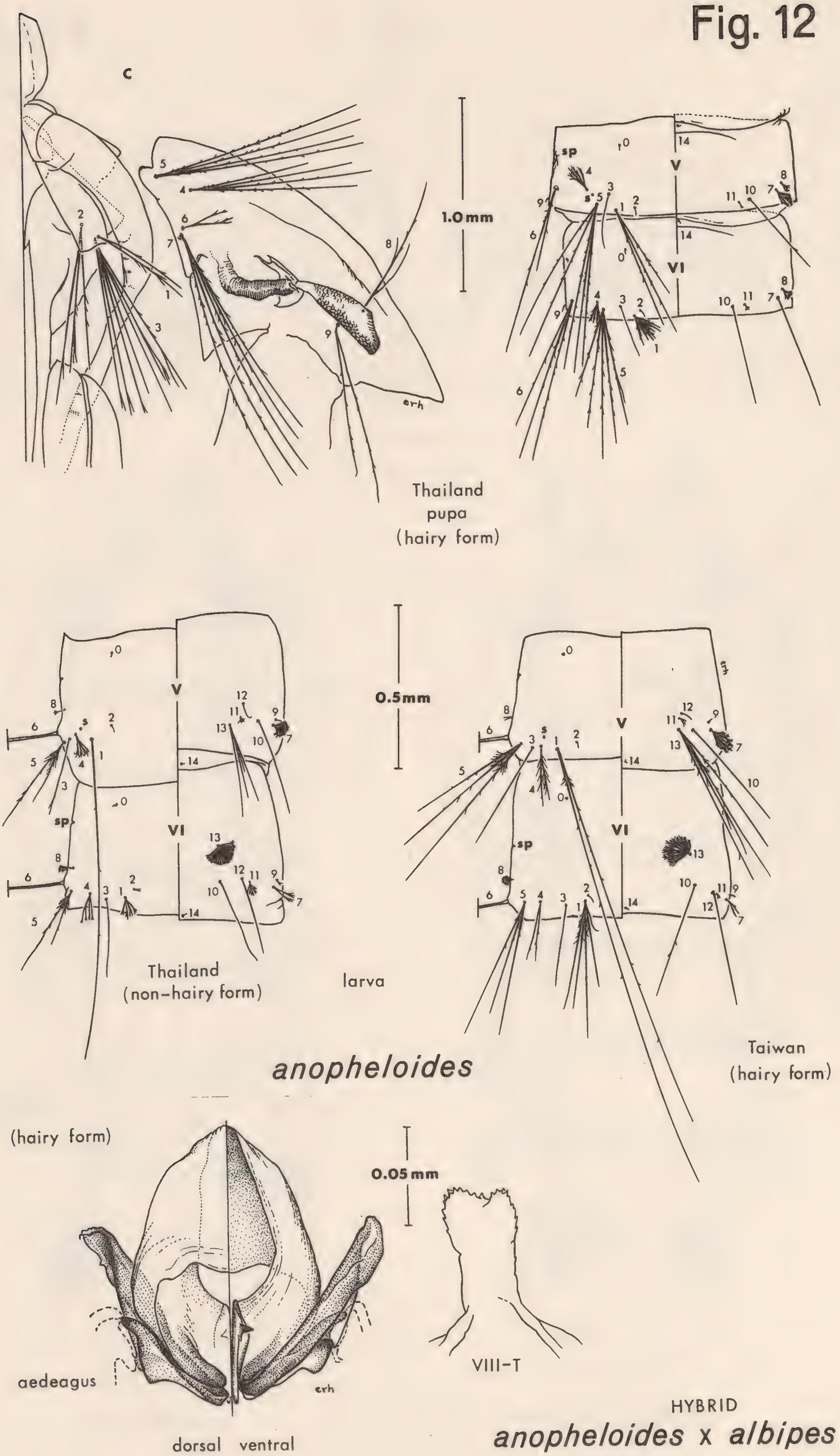
Thailand

anopheloides

Philippines

madrensis

Fig. 12


c
1.0 mm
sp
V
VI
14
erh
Thailand
pupa
(hairy form)
0.5 mm
V
VI
sp
Thailand
(non-hairy form)
larva
Taiwan
(hairy form)
anopheloides
(hairy form)
0.05 mm
aedeagus
dorsal ventral
VIII-T
HYBRID
anopheloides x albipes

INDEX

Names of valid taxa included in the present study are in roman type. Synonyms, valid extralimital species, misidentifications and *nomina dubia* are in italic type. Italic numerals are used for the principal text reference, roman numerals for secondary text references, and roman numerals in parentheses for figures.

albipes Leicester 3, 4, 5, 6, 10, *12,* 13, 14, 19, 20 (1, 2, 4, 10)
albipes group 1, 3, 6, 8
albipes subgroup 3, *12*
andamanensis Barraud 3, 4, 5, 6, 10, 12, *14,* 16, 17, 19 (1, 8, 10)
anopheloides (Giles) 3, 4, 5, 6, 8, 10, 12, 14, *16,* 17, 18, 19, 20 (1, 7, 11, 12)
anopheloides subgroup 3, 6, 10, *14*
anopheloides subgroup of
    Knight & Mattingly 1
anopheloides x albipes *19* (12)
flavicosta Barraud *3, 6*
flavicosta subgroup *3, 6,* 14
flavithorax Barraud *3, 6*
lanyuensis Lien 3, 4, 5, 6, 7, *8,* 9, 10, 11
lemmonae Thurman *17, 18, 19*
maculata Theobald *16, 18, 19*
maculipes Theobald *16, 18, 19*
madrensis Baisas 3, 4, 5, *6,* 7, 8, 9, 10, 19 (1, 3, 11)
manganus Baisas *17, 18, 19*
mcgregori (Banks) nomen dubium *20*
mcgregori of authors *17*
nigritarsis Leicester *16, 18, 19*
nipponica LaCasse & Yamaguti *17, 18, 19*
papuensis Zavortink 3, *14, 16*
siamensis Zavortink 3, 4, 5, 6, *9,* 10, 14, 16 (5, 9)
wilsoni Macdonald 3, 4, 5, 6, *11,* 12, 13, 14, 19 (1, 6, 9)
wilsoni subgroup 3, *10*

CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. X.

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THE GENUS *CULISETA* FELT IN SOUTHEAST ASIA[1]

By

N. V. Dobrotworsky[2]

INTRODUCTION

The genus *Culiseta* was erected by Felt (1904) for a mosquito he had previously described under the name *Culex absobrinus* at the same time he erected *Culicella* for *Culex dyari* Coquillett. Until recently mosquitoes of Felt's genera have been known under the generic name of *Theobaldia*. This had been proposed by Neveu-Lemaire (1902) for *Culex annulatus* Schrank, a species subsequently placed by Blanchard (1905) in another new genus *Theobaldinella*. A related genus *Pseudotheobaldia* was described by Theobald (1907) for *niveitaeniata*. However, Stone et al. (1959) pointed out that Fischer (1885) had already used the generic name *Theobaldia* and that the next available name was *Culiseta* Felt (1904). The name *Culicella* has been retained as a subgenus but the others have become synonyms. Edwards (1921) in a revision of the mosquitoes of the Palaearctic region divided the genus into three subgenera *Theobaldia*, *Culicella* and *Allotheobaldia*. These were defined mainly on larval structure. Edwards expressed the opinion that *Leptosomatomyia fraseri* Edwards should probably be included in this genus and in 1930 he introduced for it the subgeneric name *Theomyia*. Later *Culex melanurus* Coquillett was also transferred to the genus with the subgeneric name *Climacura* Howard, Dyar & Knab (1915). These five subgenera were listed in the Genera Insectorum (Edwards 1932), and with two new ones, *Austrotheobaldia* (1954) and *Neotheobaldia* (1958) introduced by Dobrotworsky for Australian species make up a total of seven recognized by Stone et al. (1959). Edward's assessment of the importance of larval characters for the recognition of subgenera has been widely accepted. Maslov (1964), however, believes that more attention should be paid to adult structure. With this approach, he has limited the genus *Culiseta* to include only the four subgenera *Culiseta*, *Culicella*, *Climacura* and *Neotheobaldia*; the remaining three, *Allotheobaldia*, *Austrotheobaldia* and *Theomyia* he regards as full genera.

In my opinion Maslov's treatment of the genus is not justified. No doubt there are different degrees of relationships between the various subgenera and some are clearly more specialized than others but there are advantages in employing larger generic concepts. As Edwards (1932) has pointed out, this means that "the wider relationships of the species are more clearly indicated" and that "limits can more readily be assigned to the genera than in the case of more numerous and smaller groups."

In this review I shall follow Belkin (1962) and treat the tribe Culisetini (Stone 1957) as monotypic with the single genus *Culiseta*. The genus contains mosquitoes with generalised characters which place them amongst the nearest living representatives of the primitive stock, or stocks, of the Culicinae (Edwards 1932; Belkin 1962; Marks 1968). It includes seven subgenera, which are based mainly on larval characters, 35 species and seven subspecies.

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[1] This work was supported by Research Contract No. DA-49-193-MS-2672 from the U.S. Army Medical Research and Development Command, Office of the Surgeon General, Washington, D.C.

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GENUS *CULISETA* FELT

Theobaldia Neveu-Lemaire 1902, C.R. Soc. Biol., Paris 54: 1331 (non Fischer 1885). Orthotype: *Culex annulatus* Schrank.

Culiseta Felt 1904, Bull. N.Y. St. Mus., no. 79: 391c. Orthotype: *Culex absobrinus* Felt.

Theobaldinella Blanchard 1905, Les Moustiques :390. Diatype: *Culex annulatus* Schrank.

Pseudotheobaldia Theobald 1907, Mon. Cul. 4: 271. Haplotype: *niveitaeniata* Theobald.

FEMALE. Medium sized to large. *Head.* Eyes almost touching; vertex clothed mainly with narrow, curved decumbent and upright forked scales; lateral scales broad, flat; antenna shorter than proboscis; palpus always short, 5-segmented; segment 5 short or minute; proboscis moderately long, not swollen at apex. *Thorax.* Anterior pronotum small, widely separated, usually with bristles and scales; posterior pronotum with several bristles and sometimes with scales; scutum clothed with narrow scales; acrostichal and dorsocentral bristles numerous but not very long; scutellum usually with narrow scales, rarely with broad; pleural scales varied in shape and distribution; spiracular bristles present, usually numerous and pale in colour; in some species these reduced in number to a few or a single one. *Legs.* Bristles well developed on femora and tibiae; tarsi all dark, banded, or pale apically; claws of all legs small, subequal, simple; pulvillae absent. *Wing.* Frequently with dark pattern of scales; wing membrane with distinct microtrichia; cell R_2 longer than vein R_{2+3}; vein 1A somewhat sinuous; base of Sc ventrally with patch of hairs and sometimes with a few scales as well (except *fraseri* which have no hairs ventrally on base of Sc); alula and squama with marginal row of hairlike scales or bristles. *Abdomen.* Terga, except tergum I, and sterna almost completely scaled; tergum I always with numerous long bristles; abdomen blunt tipped, segment VII not retractile; cercus and post-genital plate short and broad; three large, equal spermathecae.

MALE. In general, similar to female. *Head.* Antenna strongly plumose; palpus variable in length, usually as long as proboscis (about a half length of proboscis in *fraseri* and two-thirds of it in *longiareolata);* last two segments of palpus sometimes turned upwards or more or less swollen. *Terminalia.* Apical margin of tergum VII with (in *longiareolata*) or without stout spines; lobes of tergum IX with several setae; basimere usually rather long, more or less conical; basal mesal lobe present; subapical lobe usually absent; distimere simple, usually with single, simple or bifid terminal appendage, *longiareolata* alone has two terminal appendages; phallosome simple; aedeagus conical, rarely with small teeth at top and only in *marchettei* with prominent teeth; paraproct strongly sclerotized with one or more teeth; claspette absent.

PUPA. *Cephalothorax.* Hairs 8-C and 9-C caudad of trumpet; respiratory trumpet short with large opening. *Abdomen.* Hair 1-I a well developed, dendritic. *Paddle.* Usually more or less finely serrate and with one or two hairs at tip of midrib, in *fraseri* these hairs are absent.

LARVA. *Head.* Usually wider than long; antenna varied in length; shaft spiculate; hair 1-A varied in position, always well developed and branched; mouth brushes numerous, all filamentous or inner serrated distally; mentum broad, triangular with numerous teeth; hairs 5-7-C well developed, 5-C frequently single. *Thorax.* Hairs 1-3-P and 9-12-P, M, T on large common tubercles; all other large hairs on more or less distinct separate basal tubercles or plates. *Abdomen.* Hairs 6-I-VI of similar length; hair 7-I long, markedly different from 7-II-VI; 2-VIII and 4-VIII usually single or 2-branched; 1, 3, 5-VIII usually multibranched; comb scales in triangular patch or a single row, no sclerotized plate; siphon varied in length; acus present; pecten usually of strong teeth (only in subgenus *Neotheobaldia* pecten teeth in form of hairs); hair 1-S at base of siphon (only in subgenus *Austrotheobaldia* 1-S half-way along siphon); accessory hairs 1a-S present or absent; valves small; saddle almost always complete (only in subgenus *Allotheobaldia* saddle incomplete); 3-X usually single; ventral brush of 5 or more pairs of branched hairs on grid and frequently 1-7 precratal hairs; anal papillae usually narrow, pointed.

EGGS. In most species eggs rounded at one end and tapered at the other (in some species both ends pointed); some species have eggs with short transparent stem; eggs laid usually in raft on water surface or singly on ground above water level.

DISTRIBUTION. The subgenus *Culiseta* is confined to the Holarctic, *Culicella* occurs in the Holarctic and Australian regions and *Neotheobaldia* is restricted to Australia. Of the three monotypic subgenera, *Theomyia* is restricted to the tropics of Africa, Austrotheobaldia is found in eastern Australia and Tasmania, while *Allotheobaldia* is distributed across the southern part of the Palaearctic from the Azores to Central Asia through the Ethiopian region into India and Pakistan.

The subgenus *Climacura* has a remarkable distribution; one species occurs in the eastern and central parts of the United States, one in West Malaysia, one in eastern Australia and two in New Zealand. As Marks (1968) has pointed out, the distribution pattern of *Culiseta* is a relict one, but there is no unanimity of opinion about the place of origin of the genus.

Maslov (1967) has postulated a northern origin which is centered in "Bering Land" where, during the end of the Mesozoic and early Tertiary, the climate was temperate. From this centre protoculisetines dispersed to the southwest and to the east and southeast across the tropics to Australia. However, Maslov's basic assumption that the subgenus *Culiseta* is the most primitive one does not seem to be justified. Surtees (1959) who made an extensive study of the structural and functional adaptations of the mouthparts of mosquito larvae concluded that filter feeding is primitive. This method is found in the members of the genus *Culiseta,* but not in the subgenus *Culiseta*. Here the larvae are browsers, and their mouth brushes are modified and adapted for scraping particles from submerged surfaces and on this basis the subgenus cannot be regarded as primitive. Marks (1968) has argued that the least specialised of the Australian representatives of the *Culicella* group are more primitive than the northern ones. On this basis and on Brundin's (1966) conclusion about an austral centre of origin of the family Chironomidae, Marks has postulated a southern centre of origin for *Culiseta*. However, Darlington (1970) has convincingly shown that the idea that primitive groups mark places of origin is erroneous. Further, it may be doubted whether a parallel can be drawn between chironomids and culicids. Brundin believes that the chironomids "originated in cool running waters;" their present distribution is markedly amphitropical (Brundin 1967). Culicid larvae which, in contrast to chironomids, are air-breathers, mostly favour still water and the greatest number of present day genera and species are tropical.

Belkin (1962) believes that intercontinental areas of the Old and New World, particularly those in the tropics, have been the places of origin and evolution of new types of mosquitoes. On the available evidence, it seems likely that *Culiseta* evolved in the tropics (Dobrotworsky 1965) and subsequently spread to the northern and southern temperate regions, being progressively displaced by later evolving elements.

There is no doubt that mosquitoes from tropical groups have dispersed to southern Australia and Tasmania and become adapted to cold climatic conditions. Anopheline mosquitoes, for example, entered Australia from the north, probably during the Pleistocene (Mackerras 1950), but *A. stigmaticus* Skuse now breeds in cold water (12^{o}-13^{o} C) in mountainous areas. Again, although species of *Aedes* of the subgenus *Finlaya* belong to the northern element of the Australian fauna (Mackerras 1950), *rubrithorax* (Macquart) is able

SPECIES OF *CULISETA* AND THE ARBOVIRUSES

Species	Virus	Incrimination A	B	C	Country	Reference
melanura	EEE	+		+	USA	Chamberlain et al. 1951, 1954; Holden et al. 1954; Hayes et al. 1962
melanura	Hart Park	+			USA	Whitney 1964
melanura	WEE	+			USA	Kissling et al. 1955; Hayes et al. 1961
inornata	WEE	+		+	USA & Canada	Hammon et al. 1945; Spalatin et al. 1963; Hammon & Reeves 1943a
inornata	SLE			+		Hammon & Reeves 1943b
inornata	Cache Valley	+			USA	Holden & Hess 1959
inornata	Jamestown Canyon	+			USA	Lamotte 1968
inornata	Jerry Slough	+			USA	Reeves 1968
incidens	WEE			+	USA	Hammon & Reeves 1943a
incidens	SLE			+	USA	Hammon & Reeves 1943b
tonnoiri	Whataroa	+			New Zealand	Ross et al. 1963
longiareolata	West Nile		+		Egypt	Hurlbut 1956
annulata	Tahyna	+			USSR	Danielova et al. 1970

A. By recovery from wild caught specimens.
B. By demonstrating multiplication of virus in mosquito.
C. By experimental transmission in laboratory.

to complete its development through to the adult stage at temperatures as low as 10^{o}C. The present pattern of distribution of *Culiseta* is entirely consistent with a tropical origin.

BIOLOGY. Some species are restricted to treeless plains, others to forests or mountains, but a fair number do not show preference to a certain type of country. The majority of species breed in ground pools, bogs, ponds, marshes, edges of streams, rarely in treeholes. Some of the Australian species breed underground in the burrows of land crayfishes (*Engaeus* spp.). Only one species, *fraseri* is restricted to treeholes. A few breed under domestic conditions in artificial containers. In the northern areas, most species overwinter as hibernating adults, but some species do so as well in the larval stage; in the southern areas breeding may be almost continuous during the winter. Australian species overwinter mostly in the larval stage; New Zealand species both as adults and larvae. Biting activity in most species begins after sunset, but some are active during the day. Several species attack man as well as domestic animals. In nature they feed on wild mammals but some feed on birds and may prefer avian hosts.

MEDICAL IMPORTANCE. Several species of *Culiseta* have been found to be naturally infected with arthropod-borne viruses (arboviruses). The table shows that members of the genus are deeply involved in this field and suggests that they certainly deserve further examination in this respect. The species have mostly been incriminated through the isolation of viruses from wild caught specimens but wherever transmission has been attempted it appears to have been successful. It is of further interest to note that *melanura* was considered to be the primary vector during the great epidemic and epizootic of eastern equine encephalomyelitis which occurred in New Jersey, USA in 1959. Blanchard (1905) suggested that *longiareolata* might be involved in the transmission of the bacillus of Malta fever. Maslov (1967) reports the successful laboratory infection of *bergrothi* with the microfilariae of *Dirofilaria immitis* in the Amur region of the USSR.

KEYS TO THE WORLD SUBGENERA OF *CULISETA*

MALES AND FEMALES

1.	No hairs at base of subcosta on underside of wing; male palpus barely half as long as proboscis and with only a few long bristles at its tip	*Theomyia*
	Hairs present at base of subcosta on underside of wing; male palpus as least two-thirds the length of proboscis	2
2(1).	Postspiracular area with a few fine scales	*Austrotheobaldia*
	Postspiracular area bare or with a few hairs	3
3(2).	Tibia lined with white; male palpus shorter than proboscis; tergum IX with a pair of long processes	*Allotheobaldia*
	Tibia not lined with white; male palpus at least as long as proboscis	4
4(3).	Base of subcosta on underside of wing with scanty hairs and not more than 5 spiracular bristles.	5
	Spiracular bristles and hairs on underside of wing numerous	6

5(4). Anterior pronotum without scales or with very long hairlike scales; posterior pronotum with bristles and fine hairlike scales . . . . *Climacura*
Australia only . . *Culicella*
Anterior and posterior pronotum with pale curved scales and bristles . . . . *Neotheobaldia*
Australia only . . *Culicella*

6(4). Cross-veins approximated, usually *m-cu* in line with *r-m* but sometimes *m-cu* is well before *r-m*; last segment of male palpus more or less swollen, not turned upwards; basimere of male terminalia with subapical lobe or patch of hairs in its place. . . . . *Culiseta*
Cross-vein *m-cu* always well before *r-m;* last segment of male palpus may be more or less swollen; if not, often turned upwards; basimere of male terminalia without subapical lobe . . . . not Australia . . . *Culicella*

FOURTH STAGE LARVAE

1. Siphon with hair 1-S halfway along siphon. . . . . *Austrotheobaldia*
Siphon with hair 1-S at base 2

2(1). Siphon with pair of basal hairs only 3
Siphon with hairs 1a-S along ventral side of siphon in addition to basal pair . . . . *Climacura*

3(2). Pecten of spine-like scales 4
Pecten of hair-like scales only . . . . *Neotheobaldia*

4(3). Siphon long and slender; index 6-8 5
Siphon short; index 2.5 - 3.5 6

5(4). Antenna long; hair 1-A well beyond middle . . . . *Culicella*
Antenna short; hair 1-A near middle; siphon heavily sclerotized, almost black; spines of pecten bifid from base . . . . *Theomyia*

6(4). Siphon with pecten of spines only; saddle small not forming complete ring . . . . *Allotheobaldia*
Siphon with row of hairs beyond pecten; saddle forming complete ring . . . . *Culiseta*

SUBGENUS *CULISETA* FELT

Culiseta Felt 1904, Bull. N.Y. St. Mus. no. 79: 391c. Orthotype: *Culex absobrinus* Felt.

FEMALE. *Head.* Palpus with segment 5 sometimes distinctly white. *Thorax.* Anterior pronotum with bristles and a few scales; posterior pronotum with posterior bristles and with broad scales or some narrow ones; spiracular bristles usually more than 7 in number, a few scales may also be present at base of these; scutellum usually with narrow scales but *niveitaeniata* has broad scales. *Legs.* Tarsi all dark or with white basal bands. *Wing.*

Wings often spotted; base of Sc ventrally with large patch of hairs; cross-veins usually approximated. *Abdomen.* Tergum I with patch of scales and long bristles; remaining terga with more or less distinct basal pale bands.

MALE. In general similar to female. *Head.* Palpus about as long as proboscis or longer than it; usually with very long bristles; last segment more or less swollen but not turned upwards. *Terminalia.* Lobes of tergum IX usually with long setae; basimere with basal mesal lobe relatively small, conical, bearing numerous setae on sides and a few apical spines; subapical lobe usually more or less distinct or in place of it there is a patch of hairs; distimere with single, usually bifid terminal appendage; 2 plates of aedeagus usually separate, strongly sclerotized.

PUPA. Tip of midrib of paddle with single hair.

LARVA. *Head.* Head relatively not very large; antenna short or of moderate length; hair 1-A near middle, relatively short; hairs 2-6A usually short and on tip of antenna; some of mouth brushes serrated distally. *Abdomen.* Comb scales in triangular patch; siphon relatively short with index 2.5-3.5; pecten of strong teeth, with a row of hairs beyond; saddle forming complete ring; hair 2-X multibranched; ventral brush 4-X usually with a few tufts piercing saddle.

EGG. Eggs laid in rafts on water surface.

CULISETA (CULISETA) NIVEITAENIATA (THEOBALD)

(Figures 1, 2, 3, 4)

Pseudotheobaldia niveitaeniata Theobald 1907, Mon. Cul. 4: 272 (♂*).
Theobaldia niveitaeniata (Theobald), Barraud 1924, Indian J. med. Res. 12: 141; 1934, Faun. Brit. India, Diptera 5: 91 (♂*, ♀, L*); Edwards 1932, in Gen. Insect., Fasc. 194: 104; Stackelberg 1937, Faune de l'URSS, Ins., Dipt. 3(4); Qutubbudin 1952, Proc. R. ent. Soc. Lond. 21: 39 (L).
Theobaldia kanayamensis Yamada of Liu & Feng (*nec* Yamada) 1956, Acta ent. sinica 6(3): 335. Synonymized by Maslov (1964, 1967).
Culiseta (Culiseta) niveitaeniata (Theobald), Stone, Knight & Starcke 1959, Synop. Cat. Mosq. World 6: 219; Maslov 1964, Rev. d'Ent. de l'URSS 43(1): 206; 1967, Opred. Faune SSSR 93: 145 (♂*, ♀, L*).
Theobaldia (Theobaldia) sinensis Meng & Wu 1962, Acta ent. sinica 11(4): 383 (♂*, L*). Synonymized by Maslov (1964, 1967).
Culiseta (Culiseta) lishanensis Lien 1968, Trop. Med. 10(1): 6 (♂*, ♀*, P*, L*). New synonymy.

FEMALE. *Head.* (Figs. 1, 2) Vertex with pale decumbent scales; upright forked scales mostly dark; lateral scales flat, broad, pale; palpus dark brown, about 1/4 length of proboscis; some pale scales dorsally on segment 3; segment 5 small, but distinct, nude, pale; pedicel with broad white scales mesially. *Thorax.* (Figs. 1, 2) Anterior pronotum with broad pale scales; posterior pronotum with relatively narrow white scales dorsally and broad white scales on lower part; scutum clothed with narrow, curved golden scales; small patch of narrow white scales in front of wing root; scutellum with broad creamy-white scales; 6-8 spiracular bristles and sometimes 2-4 scales at base of bristles; pleural bristles pale, scales broad, white. *Legs.* (Fig. 2) Dark brown; coxa and trochanter with patch of broad pale scales; posterior surface of femur of fore and mid leg pale from base almost to tip; anteriorly fore femur with subapical white spot, hind femur white except for a subapical black ring and a dark line along dorsal side and a white kneespot and an apical tibial ring on all legs; tarsi dark, first tarsomere slightly paler ventrally at base in some specimens; tarsal claws as in Figure 1. *Wing.* (Fig. 1) Wing membrane with darker patches in regions of cross-veins and base of fork cells; veins with narrow dark scales; cross-veins *r-m* and *m-cu* closely approximated. *Abdomen.* (Figs. 1, 2) Terga brownish-black; tergum I with patch of white scales medially; II-VII with whitish basal bands, which on terga IV and V narrows in middle; bands broken in middle on terga VI and VII.

MALE. In general similar to female. *Head.* (Fig. 2) Palpus dark brown, paler at joints, about as long as proboscis; segments 3 and 4 with long bristles, segment 5 widened and spatulate with a few strong, rather short bristles at tip; tarsal claws as in Figure 1. *Terminalia.* (Fig. 3) Tergum VIII without short stout spines on apical margin; each lobe of tergum IX with 8-13 setae; basimere narrow, about 3 times as long as broad at base and without scales; basal mesal lobe conical, relatively small, with 2 strong bristles, sometimes bent almost at right angles, and about 20 small fine setae; subapical lobe prominent with about 8 bristles, 4-7 of these stronger and with bent tip; distimere about half as long as basimere, terminal appendage relatively short, bifid; aedeagus simple with narrow pointed tip, sclerotized on ventral side; paraproct with 1 long and 3-4 short teeth apically and 3-4 cercal hairs.

PUPA. (Fig. 3). *Cephalothorax.* Respiratory trumpets about 2 1/2 times as long as pinna. Hair 8-C single; 9-C single or 2-branched. *Abdomen.* Hairs 1, 5-IV-VII single; 5-IV-VI very long, on VII shorter and weaker; 1-IV-V as long as 5, shorter and weaker on VI, VII; 6-I-VI single. *Paddle.* Oval, with posterior margin spiculated; hair 1-P single or with 2 branches.

LARVA. (Fig. 4) *Head.* Antenna short, about 1/2 length of head, with sparse, minute spiculation; hair 1-A inserted about at middle of shaft, with 4-6 slightly plumose branches, about 1/3-1/2 as long as shaft; hair 4-C small, fine, with 2-4 simple branches; 5-7-C plumose, 5-C 6-7b, 6-C with 3 unequal branches, median longest and strongest, 7-C 8-12b, 8-C single, 9-C 2-5b, 10-C with forked tip; median mouth brush hairs serrated distally; mentum with 12-13 lateral teeth on each side. *Thorax.* Prothoracic hairs more or less plumose; pleural groups of hairs well developed; hairs 1-3-P arising from a sclerotized plate, 1-P long, 3-5b, 2-P single, long, 3-P shorter than 2-P, 6-9b, 4-P 6-10b, 5, 6-P single, 7-P 5-9b, 8-P 4-5b, 9-P 4-7b, 10, 12-P single, long, 11-P very short, multibranched; 5-7-M single, long, 8-M 6-10b, plumose, on sclerotized plate; 7-T 13-15b, plumose, 9-T plumose, 8-12b, 13-T 4b. *Abdomen.* Hair 6-I, II 4-6b, 6-III-IV 2b; I-VIII 3b, 2, 4-VIII single; 3-VIII 7-12b, plumose, 5-VIII 4b; comb of about 40 scales; siphon index about 3.0, hair 1-S inserted at base 5-10b, plumose; pecten with 12-20 spines followed by an even row of 12-15 hairs extending to near apex of siphon; anal segment completely ringed by saddle; hair 1-X 2-4b, 2-X 7-8b; 3-X 1, 2b; ventral brush consisting of 15 tufts 1-3 of which precratal, 1 may be inserted in the saddle; anal papillae slender, tapering, more than twice as long as saddle

EGG. Unknown.

TYPE DATA. *Pseudotheobaldia niveitaeniata* Theobald 2 male cotypes in the British Museum. Type locality: Dehra Dun, *United Provinces*, INDIA. *Culiseta lishanensis* Lien, holotype male and allotype female with associated larval and pupal skins; paratypes 3 males and 6 females in Provincial Malaria Research Institute, Taipeh, Taiwan; 1 male and 1 female in USNM. Type locality: Lishan, *Taichung Hsien*, TAIWAN.

DISTRIBUTION. Specimens examined: INDIA, *Punjab*, Kasauli 3 males, 4 females; *Almora*, Kausani 1 female, 4 rearings. TAIWAN 6 males, 5 females, 6 rearings. Records from literature: INDIA, Punjab, Dehra Dun, Murree, Theog on Hindustan-Tibet road 2.439 m; *Uttar Pradesh*, Naini Tal, Muktesar. TIBET, Yatung, near Sikkim border 3.658 m. (Barraud 1934). CHINA, North East, Central and South (Maslov 1967).

TAXONOMIC DISCUSSION. In China, this species was misidentified by Liu & Feng (1956) as *Theobaldia kanayamensis* Yamada. Later it was described as a new species, *Theobaldia sinensis*, by Meng & Wu (1962) but Maslov (1964, 1967) has pointed out that there are no consistent differences between their species and *niveitaeniata*, which is more variable than Meng &

Wu realized. Lien (1968) described *lishanensis* from Taiwan as very closely related to *niveitaeniata* but distinct from it. I have examined the paratypes and also specimens collected at Alishan, Taiwan, and have found that there are no significant differences between them and *niveitaeniata* from India. It should be noted that Lien's description and drawings (his Figure 1E) of the terminalia of *lishanensis* are inaccurate; the terminalia does not differ from that of *niveitaeniata*. On these grounds I have relegated *lishanensis* to the synonymy.

BIOLOGY. The larvae are found in mountainous areas at an elevation of 1600 m. to 3658 m. They live in clear or polluted water in a wide variety of habitats such as ground and rock pools, pits, ditches, seepages, shallow wells and artificial containers. The larvae were usually present during the cooler part of the year from November to May and generally disappear during the rest of the year. According to Meng & Wu (1962) the larvae can survive in frozen pools. The adults I have seen, were collected in March and April. In China *niveitaeniata* bites cattle, water buffalo and man (Meng & Wu 1962).

SUBGENUS *CLIMACURA* HOWARD, DYAR & KNAB

Climacura Howard, Dyar & Knab 1915, Mosq. N. and C. Amer. 3: 452.
Orthotype: *Culex melanurus* Coquillett.

FEMALE. *Head*. Palpus with segment 5 small, round or elongate. *Thorax*. Anterior pronotum with bristles only; posterior pronotum with posterior bristles and very narrow scales; 1-7 spiracular bristles; scutellum with narrow scales. *Legs*. Tarsi all dark or with distinct basal bands on hind legs. *Wing*. Wing with or without spots; base of Sc with reduced number of ventral hairs; cross-vein *m-cu* well before *r-m*. *Abdomen*. Tergum I with setae only; terga II-VIII usually dark scaled; in *marchettei* terga V-VIII have basal pale bands.

MALE. In general similar to female. *Head*. Palpus as long as proboscis or longer, last segment slender. *Terminalia*. Lobes of tergum IX with long setae; basimere with relatively small conical basal mesal lobe bearing bristles, mostly medium to small but also a few strong ones; subapical lobe absent; distimere with single terminal appendage; aedeagus usually simple and weakly sclerotized except in *marchettei* where it has strongly sclerotized lateral walls and 3-4 prominent apical teeth.

PUPA. Tip of midrib of paddle with 2 hairs.

LARVA. *Head*. Head very large; antenna long and slender; hair 1-A, a large tuft well beyond middle of antenna; 2-A and 3-A very long and usually slightly removed from tip of antenna. *Abdomen*. Comb scales in a single row; siphon long, index 4.0-7.5; basal hair 1-S small, single or with 2-5 branches; ventral hairs 1a-S extending nearly to end of siphon; saddle forming complete ring; hair 2-X multibranched; precratal tufts of ventral brush 4-X, if present, small.

EGG. Eggs laid in rafts on water surface.

CULISETA (CLIMACURA) MARCHETTEI GARCIA, JEFFERY & RUDNICK

(Figures 5, 6, 7, 8)

Culiseta marchettei Garcia, Jeffery & Rudnick 1969, J. med. Ent. 6(3): 252 (♂*, ♀, L*, P*); 1968, Med. J. Malaya 23(1): 29.

FEMALE. *Head*. (Figs. 5, 6) Vertex with decumbent pale scales; upright forked scales blackish; lateral scales broad, pale; palpus about 1/5 length of proboscis, brown; without scales. *Thorax.* Anterior pronotum without scales; posterior pronotum with fine black hair-like scales; 3-4 spiracular bristles; scutum and scutellum with narrow dark scales; pleuron with a few scales. *Legs*. (Fig. 6) Dark scaled; mid legs with pale scaling on posterior surface of femur and with lighter scales along tibia and at base of tarsomeres 1-3; hind femur with pale scaled posterior surface; tibia with pale scaled apex, tarsomeres 1-4 with basal pale bands, tarsomere 5 mostly white scaled; tarsal claws as in Figure 5. *Wing.* (Fig. 5) Membrane of wing clear; scales on veins uniformly dark; cross-veins without scales. *Abdomen.* Tergum I without scales, II-VII brown scaled, III and IV with lateral basal patches of white scales, V-VII with white basal bands, VIII mostly pale scaled; sterna mostly pale scaled.

MALE. In general similar to female. *Head.* (Figs. 5, 6) Palpus longer than proboscis, dark scaled with some pale scaling laterally on segments 2 and 3; distal part of segment 3 and segments 4 and 5 with long hairs; segment 5 slender. *Legs.* Tarsal claws as in Figure 5. *Terminalia.* (Fig. 7) Tergum VIII with some short, stout bristles at apical margin; each lobe of tergum IX with 2-4 setae; basimere long and conical, without scales; basal mesal lobe conical with 1-2 strong and some medium and small bristles; distimere simple, about half as long as basimere, terminal appendage broad, blunt, spoon-shaped; aedeagus more or less cylindrical, with lateral walls strongly sclerotized and with 3-4 prominent teeth; paraproct with 3-4 strong teeth apically and 3-4 cercal setae.

PUPA. (Fig. 7) *Cephalothorax.* Respiratory trumpets short with opening almost to base. Hair 8-C single; 9-C 2-3b. *Abdomen.* Hair 1-III strong, 5-6b; 1-IV strong, 3-4b; 5-IV, V strong, 4-5b; 6-I-IV single or 2b, 6-V 2b, 6-VI 4b, 6-VII 3-4b. *Paddle.* Oval; posterior margin with minute spicules; hair 1-P 2-3b; accessory hair single, short.

LARVA. (Fig. 8) *Head.* Head broader than long; antenna long, only slightly shorter than the length of head, with sparse minute spiculation; hair 1-A inserted on distal 1/7 of shaft with 20-25 plumose branches, more than 1/2 length of shaft; hair 4-C small, fine, 2b, 5-C about as long as 4-C about 10b, 6-C long, single, 7-C 5-9b, 8-C about 7b, 9-C minute about 8b, 10-C single, 11-C 4-6b, 13-C well developed 5-7b; all mouth brush hairs filiform; mentum with 7 teeth on each side. *Thorax.* Hairs 1-3-P arising from sclerotized base, 1, 2-P long, single, 3-P 3b, 4-P 5-9b, 5, 6-P single, 7-P 5-6b plumose, 8-P 4-6b plumose, 9, 10, 12-P single; 5, 6, 7-M single, 8-M about 6b plumose, 9-M about 10b plumose; 7-T 6-10b plumose, 9-T 7b plumose. *Abdomen.* Hairs 6-I, II 4-6b plumose, 6-III-VI 3-5b; 1-VIII 9-12b, 3-VIII 8-10b, 5-VIII 12-16b, 2, 4-VIII single; comb with a single row of 13-20 spindle shaped, finely fringed scales; siphon index 4.0-5.7, black on apical quarter; pecten with 9-11 spines; hair 1-S inserted at base, small, 3-5b, 1a-S in single row of 13-18 hairs (usually 6b) distal to pecten; abal segment completely ringed by saddle; hair 1-X small 5-7b, 2-X 3-4b, 3-X 2b; ventral brush consisting of 16-18 tufts, 1 or 2 precratal; gills narrow, more than twice as long as saddle, with constriction near base.

EGG. Elongate-oval, grey with posterior end narrower and darker; deposited in raspberry-shaped clusters of up to 149 eggs.

TYPE DATA. Holotype male, allotype female and paratypes: 4 males and 2 females with associated larval and pupal skins in U.S. National Museum. Type locality: Tanjong Rabok, Kuala Langat Forest Reserve, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: WEST MALAYSIA, *Selangor*, Tanjong Rabok, Kuala Langat Forest Reserve 1 paratype male and 1 paratype female, 3 larval and 3 pupal skins, 8 whole larvae. Records from literature: *Selangor*, Batang Berjuntai; *Pahang*, highway to Pekan, 32 km. from Kuantan (Garcia et al. 1968).

TAXONOMIC DISCUSSION. The species of the subgenus *Climacura* from North America, Australia and New Zealand show a great degree of similarity in the larval stages and in the terminalia of the male. In all these species the aedeagus has a simple structure and weak sclerotization. However, *marchettei* shows some specializations in the larva and the male genitalia. The siphon in *marchettei* is more heavily pigmented apically and the aedeagus is more sclerotized with prominent teeth apically.

BIOLOGY. Only adults have been collected, all of them in fresh-water peat-swamp forests. Although no larvae have been found in nature they have been successfully reared, from eggs, in the laboratory. Adults were obtained when larvae were reared in covered pans in an air-conditioned room at a temperature of 20-25°C. (Garcia et al. 1968, 1969). It is probable that like some Australian species of *Culiseta*, *marchettei* breeds in subterranean waters.

Adults have been recorded from traps baited with pig-tail monkey and chicken. However, freshly engorged mosquitoes were recovered only from the chicken-baited traps. Presumably this species prefers avian hosts.

ACKNOWLEDGEMENTS

I am grateful to Drs. Alan Stone and Botha de Meillon for the loan of type material now in the U.S. National Museum and for many helpful suggestions during the preparation of this paper; to Dr. F. H. Drummond, Department of Zoology, University of Melbourne for assistance in the preparation of the manuscript. The loan of collections of *niveitaeniata* from India by Dr. P. F. Mattingly, Department of Entomology, British Museum (Natural History) and *lishanensis* from Taiwan by Capt. R. H. Watten, Department of U. S. Naval Medical Research Unit No. 2 is acknowledged with sincere appreciation. The illustrations prepared by Miss T. L. Ford of the Southeast Asia Mosquito Project and artists of the U.S. Army 406th General Medical Laboratory, Tokyo, were also much appreciated.

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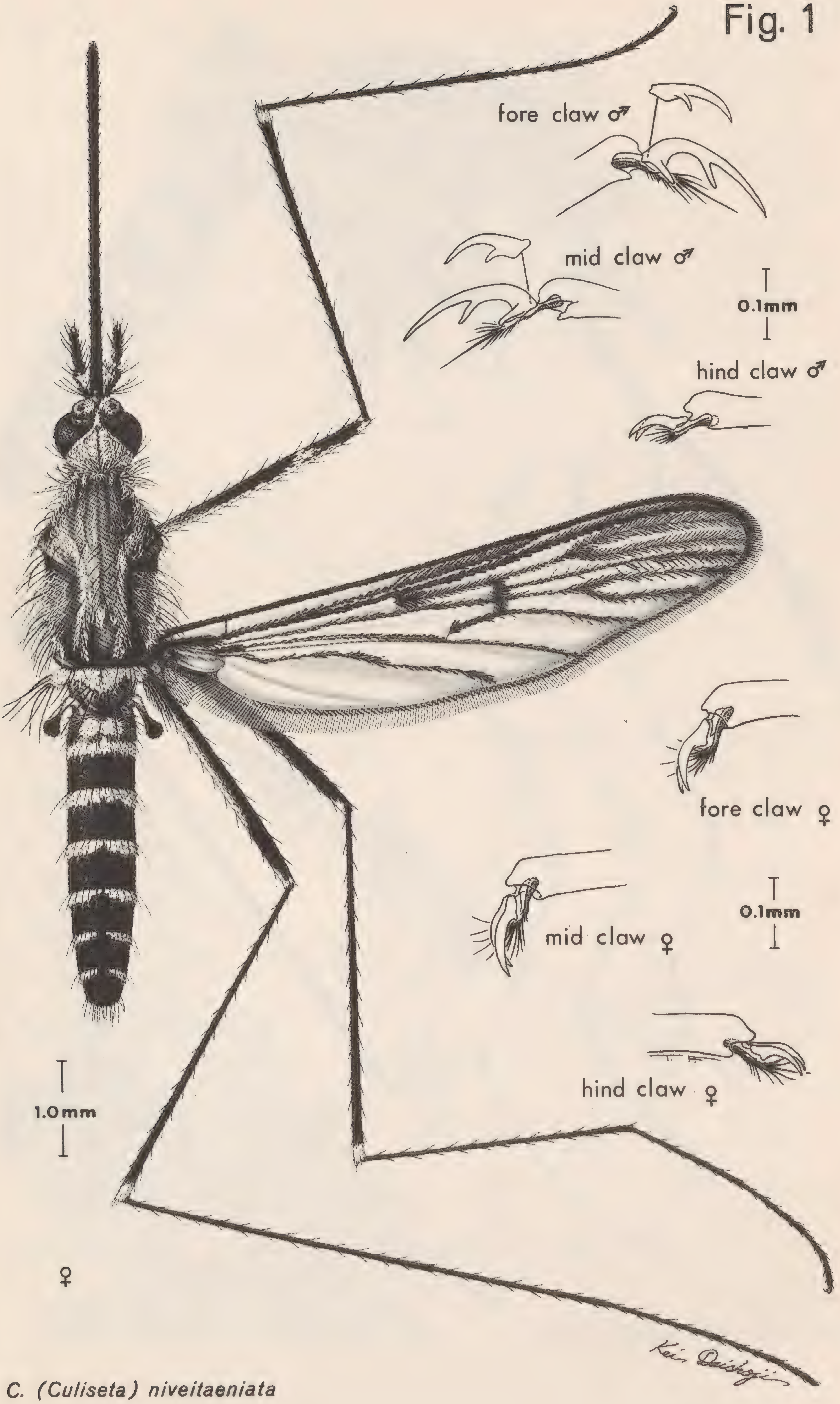
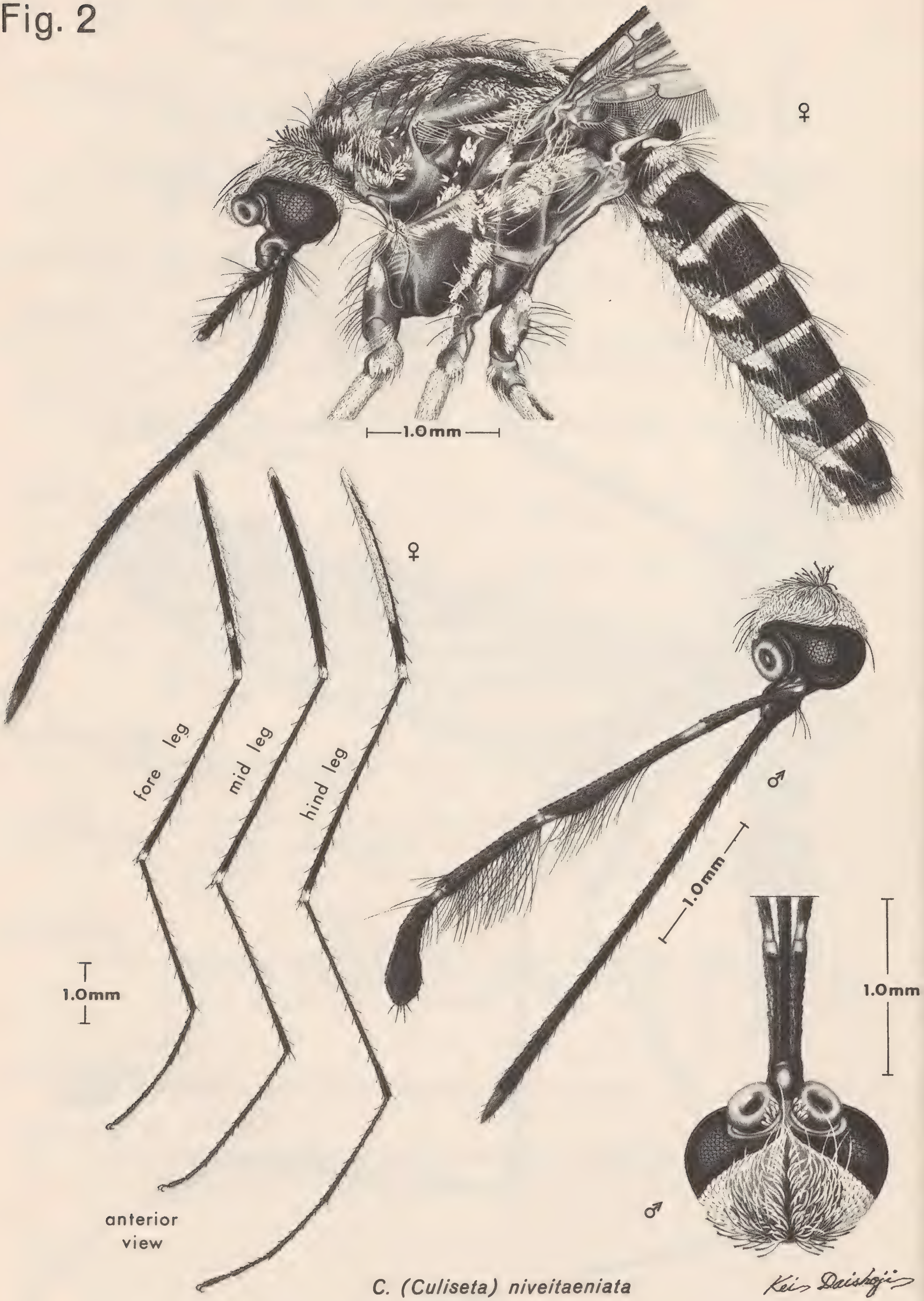
Fig. 1



C. (Culiseta) niveitaeniata

Fig. 2



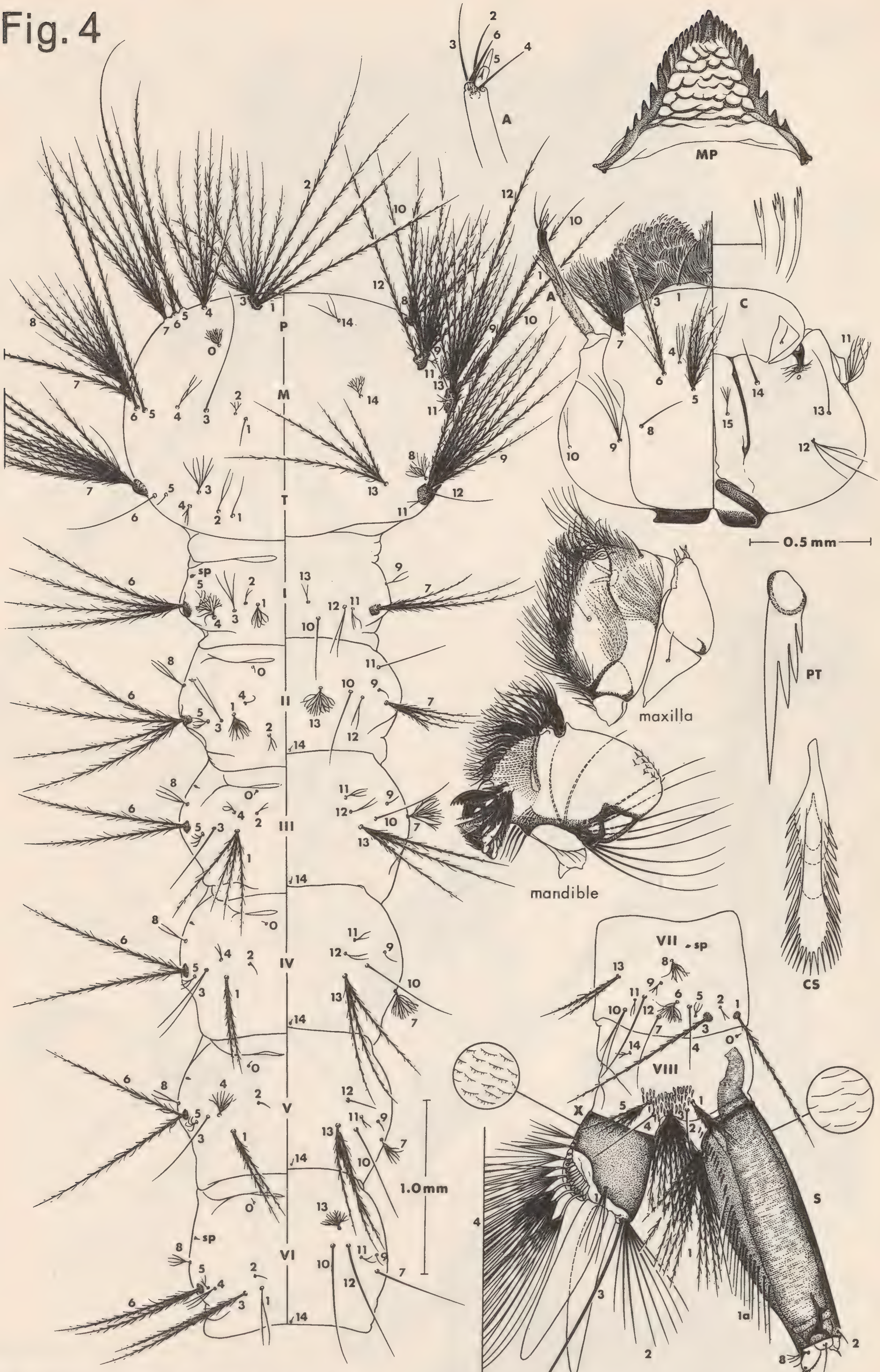
C. (Culiseta) niveitaeniata

Kei Daishoji

Fig. 3

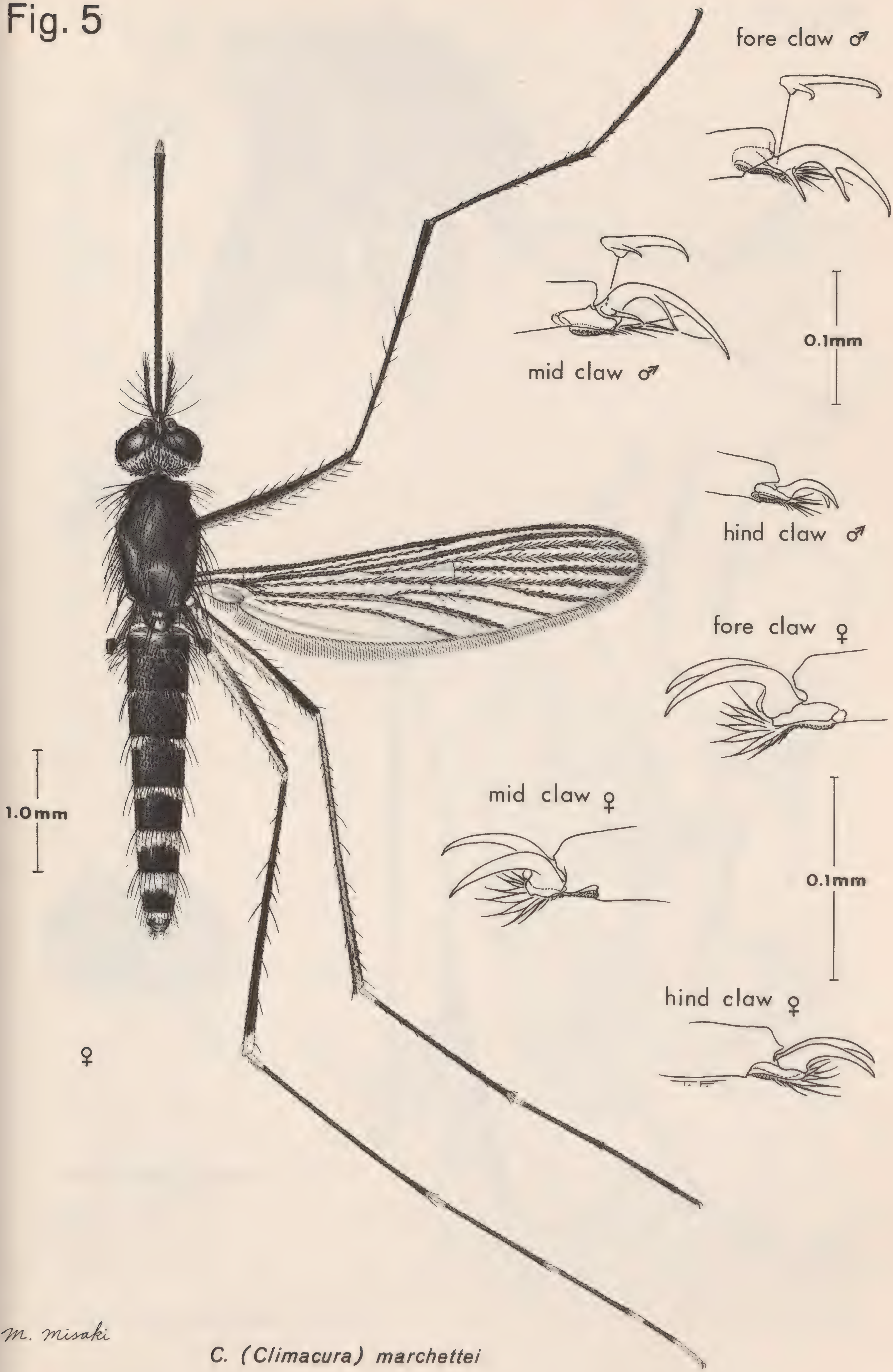
C. (Culiseta) niveitaeniata

Fig. 4



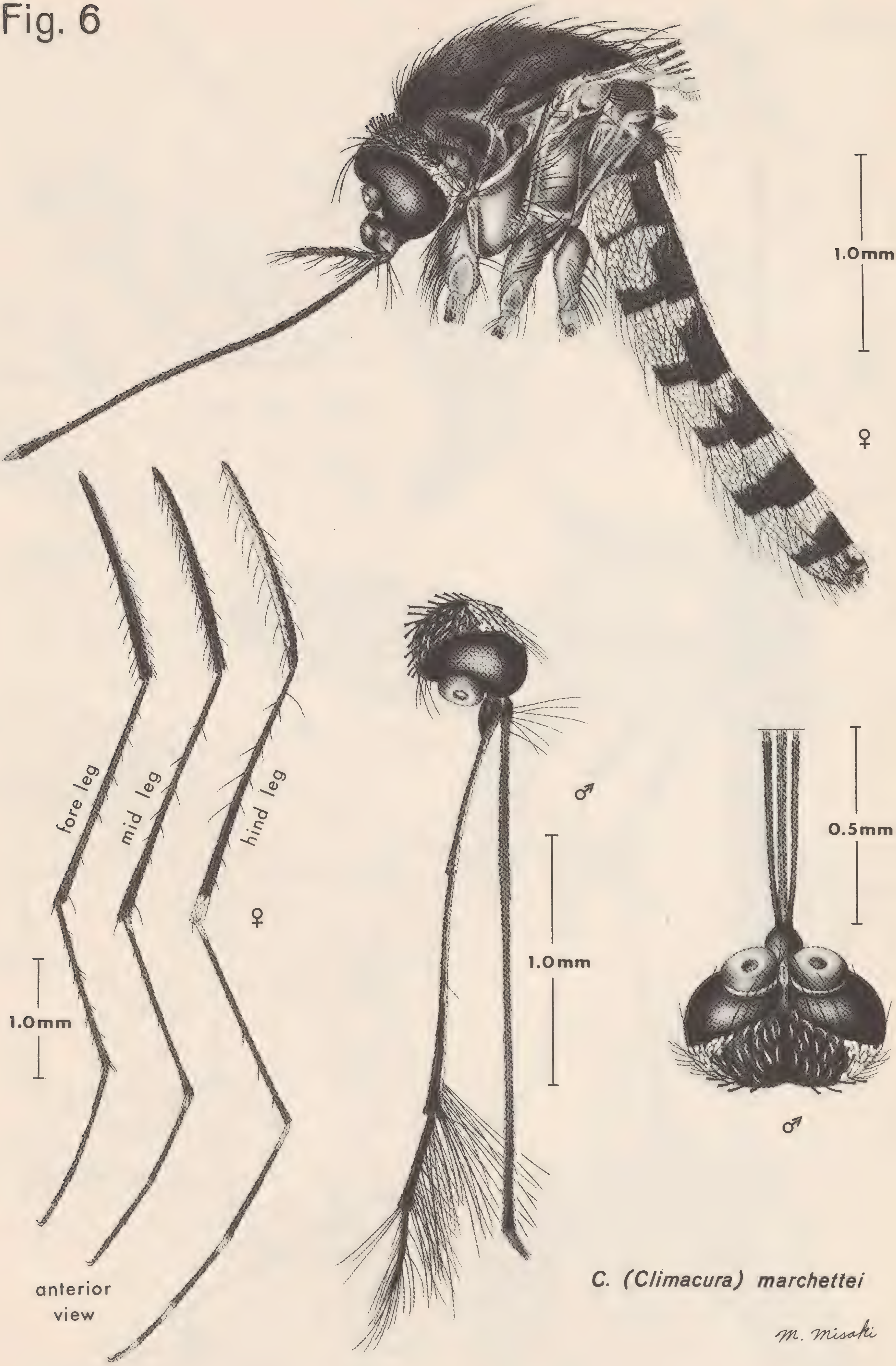
C. (Culiseta) niveitaeniata

Fig. 5



C. (Climacura) marchettei

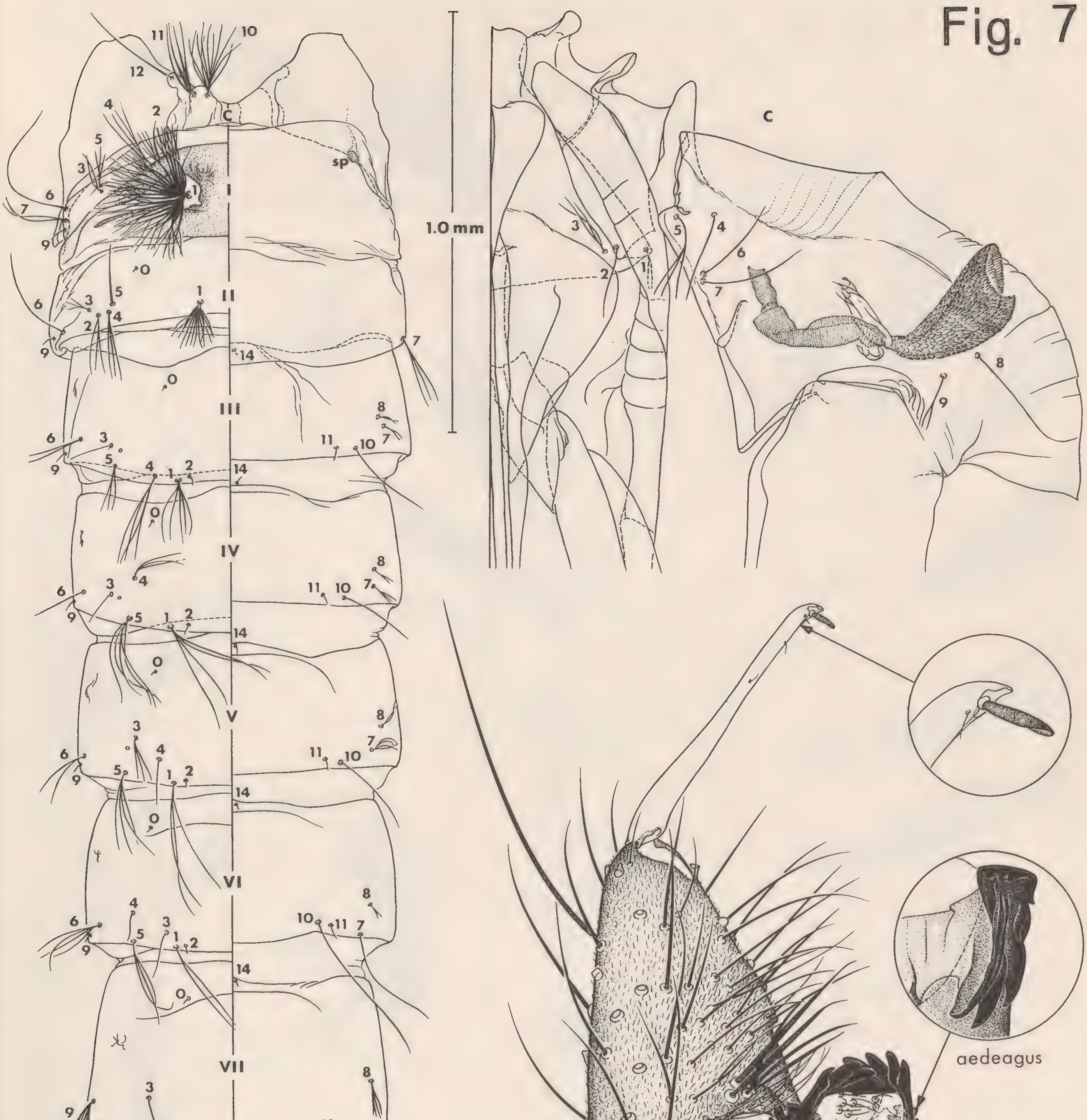
Fig. 6



C. (Climacura) marchettei

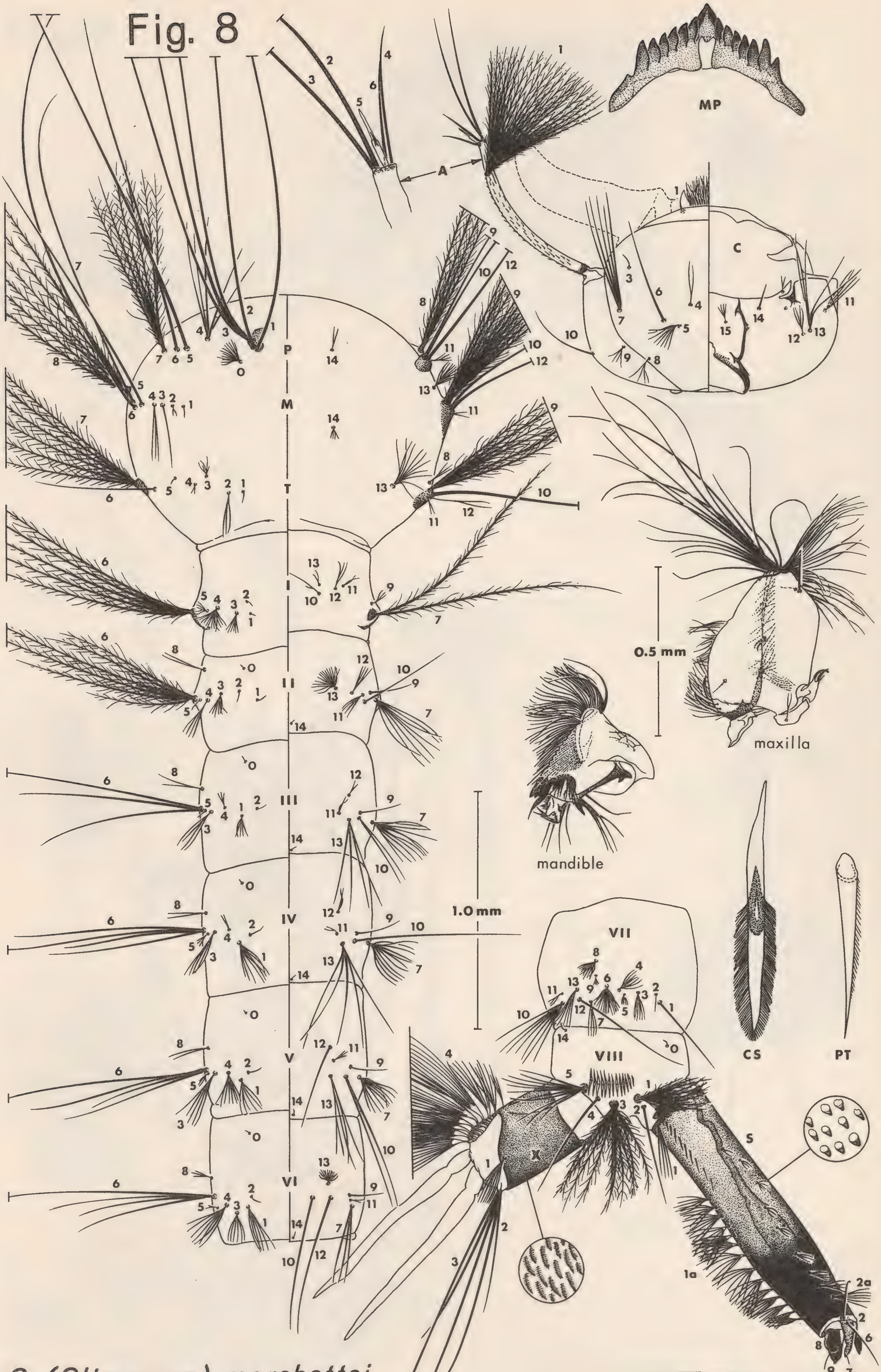
M. Misaki

Fig. 7



C. (Climacura) marchettei

Fig. 8



C. (Climacura) marchettei

T. FORD

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Valid names are printed in roman type, synonyms are italicized. Italicized page numbers are those which begin the primary treatment of that species. Numbers in parenthesis refer to the figures illustrating some portion of that species.

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CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. XI.

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ABSTRACT

A reclassification of *Neoculex* proposed here is based on the comparative morphology of the male terminalia as well as on other correlated external characters of the adults. In this scheme, three subgenera: *Neoculex*, *Maillotia* and *Eumelanomyia* instead of two, *Neoculex* and *Mochthogenes*, as proposed by Edwards (1932), are recognized. The subgenera *Maillotia* and *Eumelanomyia* are resurrected from synonymy with *Neoculex* and *Mochthogenes* which Edwards (1930) treated as a full subgenus is suppressed by synonymizing it with *Eumelanomyia*. The species *tricuspis* Edwards 1930 is transferred to *Culiciomyia* and *sumatranus* Brug 1931 and *caeruleus* King & Hoogstraal 1947 to *Lophoceraomyia*.

Over 80 species previously assigned to *Neoculex* and *Mochthogenes* in the synoptic catalog of Stone et al. (1959) and Stone (1961, 1963, 1967, and 1970) are placed in various species groups of the three subgenera. Keys to the subgenera, groups and subgroups are provided and each category is briefly defined with regard to systematics and zoogeography.

A PROPOSED RECLASSIFICATION OF *NEOCULEX* DYAR BASED PRINCIPALLY ON THE MALE TERMINALIA[1]

By

Sunthorn Sirivanakarn[2]

INTRODUCTION AND HISTORY OF PREVIOUS CLASSIFICATIONS

The subgenus *Neoculex* Dyar 1905 in the broad sense of Edwards (1932, 1941) has remained perhaps one of the most poorly understood subgenera of *Culex*. The subgenus, as defined by Edwards, with the material at his disposal, is a heterogeneous array of several distinct lineages of 70 or more species known at the present time. These species are mostly restricted to certain zoogeographical regions. The one exception is *territans* (Walker, 1856) from North America which is also known to occur in some European countries. Records of species from different areas are as follows: 33 from the Ethiopian region, 8 from the Mediterranean subregion, 9 from the Oriental region, 9 from the Australasian region (Australia and New Guinea), 5 from the South Pacific and 6 from the Nearctic region.

No attempt has yet been made to revise *Neoculex* on a world basis, but there have been a good number of taxonomic papers dealing with local species in several regional works (see references below). Edwards' subgeneric interpretation and his internal classification have been largely followed by a few critical comments. Mattingly & Marks (1955) and Belkin (1962) pointed out the weaknesses regarding the relationships between Edwards' species groups, but these were limited to brief statements. A critical examination of Edwards' scheme is made here to set a stage for the further development of a phylogenetic classification. The main purpose of the present attempt is to lay out certain basic and significant features not used by Edwards in his interpretation of *Neoculex*. The basis of this discussion includes the study of his work and the re-examination of almost all species which he used in devising his scheme.

Edwards' interpretation of *Neoculex* was based on many superficial characters which greatly overlap with those of other subgenera, particularly *Mochthogenes*, *Lophoceraomyia*, *Culiciomyia* and to some extent even with those of other *Culex* subgenera. He apparently defined all species involved on the basis of the simple phallosome of the male terminalia which he did not describe in detail. This has resulted in some incorrect subgeneric assignments of certain species to the subgenus. Edwards' description of the male phallosome is brief and also appears to conceal a number of significant features with regard to its varied shape and the relative position of the tergal bridge which connects the two lateral plates. This point will be considered and illustrated below in my interpretation of various species groups. It suffices to mention that the shape of the phallosome is quite constant in certain lineages and appears to be strongly differentiated. The other characters which appear to be more or less consistently correlated with the differences in shape of the phallosome, but were not considered by Edwards are: texture of the spicules of the

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[1] This work was supported by Research Contract No. DA-49-193-MD-2672 from the U.S. Army Medical Research and Development Command, Office of the Surgeon General, Washington, D.C. 20314.

[2] Southeast Asia Mosquito Project, Department of Entomology, Smithsonian Institution, Washington, D.C. 20560.

proctiger crown, number of rodlike setae in the proximal division of the subapical lobe and the presence or absence of scale patches on the pleura. A brief summary of Edwards' scheme is as follows:

In grouping species in the subgenus *Neoculex*, Edwards (1932) suppressed 3 genera of Theobald (1907, 1910) including *Maillotia*, *Eumelanomyia* and *Protomelanoconion* by reducing them to synonymy with the genus *Neoculex* Dyar (1905). The genus *Neoculex*, as originally conceived by Dyar, was based on *C. territans* (Walker 1856) from North America, a form which shows a great deal of superficial resemblance to some members of the *pipiens* group of subgenus *Culex*. In clarifying his classification, Edwards separated 3 groups in the subgenus, namely: group A. *Neoculex s. str.* or *apicalis* group, group B. *Eumelanomyia* or *albiventris* group and group C. *Protomelanoconion* or *uniformis* group. These groups are distinguished by the relative length of male palpi, texture of decumbent scales on vertex and presence or absence of apical bands on abdominal terga. Later, in his work on the Ethiopian species, he (1941) split group A. into 3 groups by incorporating features of the female buccopharyngeal armature, color pattern of pleural integument and certain conspicuous ornamentation. This subdivision resulted in: group A. *pulchrithorax*, group B. *Neoculex s. str.* and group C. *rima* group. The original groups B. and C. became groups D. and E. The first and second treatments are essentially similar in outline and scope and in 1947, King & Hoogstraal followed this scheme by recognizing another additional group F. *pedicellus* from New Guinea. A critical study of Edwards' system indicates that he lumped a number of unrelated forms in *Neoculex s. str.* group and his group characters largely overlapped and remained confused. The relationships between these groups are not at all clear and the entire treatment appears to suffer from the lack of uniformity in most parts. A broader examination of his system reveals the difficulties he experienced in ranking certain species groups. This is quite obvious from his treatment of *Mochthogenes* as a subgenus separated from the *Protomelanoconion* or *uniformis* group of *Neoculex* based on the relative length of the male palpi which are as short as in the female of all *Mochthogenes* species but are longer in the *Protomelanoconion* species. Although such treatment is convenient in practice since species of *Mochthogenes* share these characters, the relationship with *Protomelanoconion* on the basis of the male terminalia and many other characters do not seem to warrant its separation. The two groups, as recently pointed out by Bram (1969), are also so similar in the larval stage to be treated in the same subgenus.

In my current study of *Neoculex* in Southeast Asia and other adjacent areas, the difficulty presented by Edwards' classification are illustrated by the following examples. Four species, namely *tenuipalpis* Barraud 1924, *hayashii* Yamada 1917, *hackeri* Edwards 1923 and *kiriensis* Klein & Sirivanakarn 1969, all with extremely similar male terminalia and several external characters, but with palpi of different lengths, will, according to Edwards, have to be placed in either *Neoculex* or *Mochthogenes*. Similarly *tricuspis* Edwards 1930, at present in *Neoculex*, should in fact be reassigned to *Culiciomyia*; *sumatranus* Brug 1931 and *caeruleus* King & Hoogstraal 1947 on the other hand rightly belong to *Lophoceraomyia*.

In developing the following scheme of reclassification, I have been fortunate in having the opportunity to re-examine several authenticated specimens, including the types and identified specimens of species used by Edwards in his revision of the world fauna, by Mattingly (1953) in his work on the Mediterranean species and other type specimens from several areas, at the British Museum. In addition, while undertaking the revision of the Indomalayan species at Southeast Asia Mosquito Project, I have also seen specimens of the North American species and others from several areas in the reference collections of the United States National Museum.

The history of the classification of *Neoculex* and *Mochthogenes* is summarized in table I below.

TABLE I. HISTORY OF THE CLASSIFICATION OF *NEOCULEX* AND *MOCHTHOGENES*

EDWARDS (1932)	EDWARDS (1941) KING & HOOGSTRAAL (1947)	PRESENT CLASSIFICATION
Subgenus *Neoculex*	Subgenus *Neoculex*	Subgenus *Neoculex*
A. *Neoculex s.* str. or *apicalis* group	A. *Pulchrithorax* group	1. *territans* group
B. *Eumelanomyia* or *albiventris* group	B. *Neoculex s. str.* or *apicalis* group	2. *pseudomelanoconia* group
C. *Protomelanoconion* or *uniformis* group	C. *Rima* group	3. *crassistylus* group
	D. *Eumelanomyia* or *albiventris* group	Subgenus *Maillotia*
		1. *pulchrithorax* group
	E. *Protomelanoconion* or *uniformis* group	2. *hortensis* group
Subgenus *Mochthogenes*	F. *Pedicellus* group (King & Hoogstraal 1947)	3. *seyrigi* group
		Subgenus *Eumelanomyia*
	Subgenus *Mochthogenes*	1. *eumelanomyia* group
		2. *rubinotus-rima* group (subgroups: *rubinotus*, *rima*)
		3. *protomelanoconion* group
		4. *mochthogenes* group (subgroups: *hinglungensis*, *uncinatus*, *inconspicuosus*, *malayi*, *castrensis*, *femineus*, *otachati*, *tenuipalpis*)

A CONSIDERATION OF THE PROPOSED RECLASSIFICATION

The adults of all species, previously assigned to *Neoculex* and *Mochthogenes* and to be considered at present are generally distinguished from other *Culex* subgenera as follows: From *Lophoceraomyia* by the absence of scale tufts on the male antennal flagellum; from *Culiciomyia* by the absence of a row of lanceolate scales on the ventral surface of segment 3 of the male palpus; from *Acalleomyia* by the narrow scutellar scales; from *Barraudius* and *Lasiosiphon* by having tarsomere 1 of the hind tarsus about as long as the tibia and by the absence of scales on the basimere of the male terminalia; from *Culex* and *Lutzia* by the absence of basal sternal processes on the proctiger of the male terminalia ; and from all New World subgenera including *Melanoconion, Aedinus, Isostomyia, Carrollia, Mochlostyrax, Microculex,*and *Micraedes* by the absence of a basal hook on the lateral plate of the male phallosome.

Taxonomic Characters. As indicated earlier in the introduction, basis to the present interpretation of various species groups and their reclassification is the comparative morphology of the phallosome and other correlated characters in the proctiger crown and subapical lobe of the male terminalia. The shape of the phallosome is not only of taxonomic significance in this interpretation, but also provides, in addition to other conspicuous characters, a clear-cut separation of all species involved from other closely related subgenera of *Culex*. It appears that there are at least 3 basic types of male phallosome present among species of *Neoculex* as interpreted by Edwards. These are: Type I tubular, elongate with the axis of the two lateral plates more or less parallel and with the tergal bridge located above the middle or near the apex of the lateral plate; Type II more or less globular or subspherical with tergal bridge as in I or at the middle of the lateral plate; Type III slightly modified from type II in being oval with tergal bridge at or slightly below the midpoint of the lateral plate. In the proctiger crown, there are two kinds of spicules; one of these is flat and blunt, the other fine and pointed. In certain lineages, the crown may consist of flat or fine spicules only, or a mixture of both. In the subapical lobe, there is a great deal of variation in the development of parts and the number of specialized setae, however, the features which appear to be correlated with different types of phallosome are the presence of 2 or 3 rodlike setae in the proximal division and the presence or absence of a leaflet (foliform seta) in the distal division.

In the external morphology, a number of conspicuous characters which are of practical value in separating species groups at various levels are: (1) presence or absence of pleural scaling, (2) color and texture of scutal scales, (3) relative length of male palpus and (4) presence or absence of pale abdominal banding. These and a few other features may be correlated with the terminalia to a certain extent and have been considered here in developing key and group characters.

The female buccopharyngeal armature and the immature stages may also prove to be useful in developing this classification but because of insufficient material, no attempt has been made here to incorporate them with the present scheme.

Systematics. In the present interpretation, I believe it would be much sounder, considering both the comparative male terminalia and, to some extent, zoogeography to recognize at least 3 principal subgeneric categories among 80 or more species known at the present time. In the general outline presented below, I recognize *Neoculex, Maillotia* and *Eumelanomyia* as distinct subgenera based on differences in the shape of the male phallosome as discussed above. The subgenera *Maillotia* and *Eumelanomyia* are resurrected from synonymy under *Neoculex* and the subgenus *Mochthogenes* is downgraded to a species group of *Eumelanomyia*.

These three subgenera are further subdivided into groups and subgroups wherever it is appropriate to accomodate all species presently listed in

Neoculex and *Mochthogenes* in Stone et al. (1959) and Stone (1961, 1963, 1967 and 1970), except *caeruleus* King & Hoogstraal 1947; *sumatranus* Brug 1931 and tricuspis Edwards 1930. The first two of these I am transferring to *Lophoceraomyia* and *tricuspis* to *Culiciomyia*. The assignment of some species to groups below the subgeneric level has been based only on the published descriptions and may need future realignment in order to indicate a more accurate affinity.

OUTLINE OF THE PROPOSED SCHEME OF RECLASSIFICATION

Subgenus I. *NEOCULEX* Dyar 1905.

(1). territans group with *territans* (Walker 1856); *apicalis* Adam 1903; *boharti* Brookman & Reeves 1950; *reevesi* Wirth 1948; *arizonensis* Bohart 1950; *derivator* Dyar & Knab 1906; *deserticola* Kirkpatrick 1924; *judaicus* Edwards 1926; *impudicus* Ficalbi 1889; *rubensis* Sasa & Takahashi 1948 and *martinii* Medschid 1930.

(2). *pseudomelanoconia* group with *pseudomelanoconia* (Theobald 1907); *postspiraculosus* Lee 1944; *chaetoventralis* (Theobald 1910); *douglasi* Dobrotworsky 1956; *latus* Dobrotworsky 1956; *fergusoni* (Taylor 1914); *cheesmanae* Mattingly & Marks 1955; *dumbletoni* Belkin 1962; *gaufini* Belkin 1962 and *millironi* Belkin 1962.

(3). *crassistylus* group with *crassistylus* Brug 1934; *pedicellus* King & Hoogstraal 1947 and *leonardi* Belkin 1962.

Subgenus II. *MAILLOTIA* (Theobald 1907).

(1). *pulchrithorax* group with *pulchrithorax* Edwards 1914.

(2). *hortensis* group with *hortensis* Ficalbi 1889; *arbieeni* Salem 1938 and *quettensis* Mattingly 1955.

(3). *seyrigi* group with *seyrigi* Edwards 1941; *peringueyi* Edwards 1924; *salisburensis* Theobald 1901 and *avianus* de Meillon 1943.

Subgenus III. *EUMELANOMYIA* (Theobald 1909).

(1). *eumelanomyia* group with *albiventris* Edwards 1922; *andersianus* Edwards 1941; *acrostichalis* Edwards 1941; *vinckei* Hamon, Holstein & Rivola 1961(1962); *kanyamwerima* Someren 1951; *kilara* Someren 1951; *garioui* Bailly-Choumara & Rickenbach 1966.

(2). *rubinotus-rima* group

(a). *rubinotus* subgroup with *rubinotus* Theobald 1901; *kingianus* Edwards 1927; *andreanus* Edwards 1927; *pseudoandreanus* Bailly-Choumara 1965 and *simplicicornis* Edwards 1930.

(b). *rima* subgroup with *rima* Theobald 1901; *subrima* Edwards 1941; *galliardi* Edwards 1941; *calabarensis* Edwards 1941; *wigglesworthi* Edwards 1941; *insignis* (Carter 1911); *sunyaniensis* Edwards 1941; *albertianus* Edwards 1941; *wansoni* Worlfs 1945; *adami* Hamon & Mouchet 1955; *laplantei* Hamon, Adam & Mouchet 1955;

amaniensis Someren & Hamon 1964 and *chauveti* Brunhes & Rambelo 1968.

(3). *protomelanoconion* group with *brevipalpis* (Giles 1902); *stellatus* Someren 1947 and *horridus* Edwards 1922.

(4). *mochthogenes* group

(a). *hinglungensis* subgroup with *hinglungensis* Chu 1957; *culionicus* Delfinado 1966; *tricontus* Delfinado 1966 and *cataractarum* Edwards 1923.

(b). *uncinatus* subgroup with *uncinatus* Delfinado 1966.

(c). *inconspicuosus* subgroup with *inconspicuosus* (Theobald 1908); *simpliciforceps* Edwards 1935; *castor* de Meillon & Lavoipierre 1944; *hamoni* Brunhes et al. 1967; *mijanae* Brunhes et al. 1967 and *orstom* Brunhes et al. 1967; perhaps also *bokorensis* Klein & Sirivanakarn 1969.

(d). *malayi* subgroup with *malayi* (Leicester 1908); *laureli* Baisas 1935 and *yeageri* Baisas 1935.

(e). *castrensis* subgroup with *castrensis* Edwards 1922; *foliatus* Brug 1932; *latifoliatus* Delfinado 1966; chiyutoi Baisas 1935 and *shrivastavii* Wattal, Kalra & Krishnan 1966.

(f). *femineus* subgroup with *femineus* Edwards 1926.

(g). *otachati* subgroup with *otachati* Klein & Sirivanakarn 1969.

(h). tenuipalpis subgroup with tenuipalpis Barraud 1924; hayashii Yamada 1917; hackeri Edwards 1923; pluvialis Barraud 1924; kiriensis Klein & Sirivanakarn 1969; selai Klein & Sirivanakarn 1969; campilunati Carter & Wijesundara 1948; and perhaps also *okinawae* Bohart 1953; *lini* Lien 1968; *khazani* Edwards 1922; and *iphis* Barraud 1924.

KEY TO THE SUBGENERA

1. Phallosome elongate, more or less uniformly cylindrical, H-shaped in tergal view with tergal bridge above the midpoint or near apex of lateral plate; proctiger with crown of flat and blunt spicules; pleuron usually with broad scale patches on propleuron, upper corner and lower border of sternopleuron, anterior upper mesepimeron and occasionally also on postspiracular area . . . Subgenus *NEOCULEX*

Phallosome short, stout, oval or subspherical in shape with tergal bridge at or below the midpoint of lateral plates; proctiger with crown of flat and blunt spicules or fine pointed spines; pleural scaling present as above or absent 2

2(1). Proctiger with crown of flat and blunt spicules entirely or with some coarse pointed spines in addition; pleural scaling present; scutal scales usually pale or sand-colored . . . . . Subgenus *MAILLOTIA*

Proctiger usually with a crown of fine pointed spines only, or sometimes with a few coarse ones in addition; pleural scaling entirely absent; scutal scales predominantly dark brown . . . . Subgenus *EUMELANOMYIA*

Subgenus I. *NEOCULEX* Dyar

1905 *Neoculex* Dyar, Proc. ent. Soc. Wash. 7:45; Type species *Culex territans* Walker 1856, original designation.

1932 *Culex (Neoculex)* in part of Edwards, Gen. Insect. Dipt. Fam. Culicidae, Fasc. 194:193-195.

Culex (Neoculex) in part of Edwards (1941: 249-270); King & Hoogstraal (1947: 65-69); Mattingly & Marks (1955: 166-175); Dobrotworsky (1956: 105-114); Belkin (1963: 238-247); and Dobrotworsky (1965: 193-202).

Subgeneric Characters. As diagnosed in the key to subgenera, with the following additional features. Medium to large sized species, wing length over 3.0 mm. *Head.* Male palpi as long as or longer than proboscis; antenna strongly plumose. *Thorax.* Scutal scales usually predominantly pale, sometimes with striking pattern of coloration or entirely dark; pleuron usually with extensive broad scale patches on propleuron, upper corner and posterior lower border of sternopleuron and anterior upper mesepimeron, sometimes also on postspiracular area and prealar area; rarely absent entirely. *Abdomen.* Terga with or without apical or basal bands, sometimes with apicolateral pale spots. *Male Terminalia.* (Fig. 1) Phallosome elongate, tubelike, H-shaped in tergal view or slightly modified, tergal bridge usually near to or almost at the apex of lateral plate, rarely at the middle, a few denticles present or absent; proctiger with crown of flat and blunt spicules only or also with a few coarse pointed spines in addition; subapical lobe always with 2 long rodlike setae in the proximal division; distal division with only narrow flattened setae, broad leaflets absent.

Systematics. Species which are strictly or provisionally placed within this subgenus are generally similar in the configuration of the phallosome, proctiger and features of the subapical lobe as described above. They may be well divided into 3 groups on the basis of slight differences in phallosome structure, presence or absence of pleural scaling as in the following key.

KEY TO THE GROUPS OF SUBGENUS *NEOCULEX*

1. Phallosome uniformly tubular in shape with tergal bridge between the midpoint and apex of lateral plates; pleural scaling always present; abdominal terga with apical pale bands; scutal scales sand-colored . . . . *territans* group

Phallosome broad in apical half, narrow in basal half; tergal bridge nearly at or below the apex of lateral plates; pleural scaling present or absent; abdominal terga with apical or basal pale bands, apicolateral spots or sometimes entirely dark; scutal scales usually entirely dark or sometimes partly golden brown 2

2(1). Tergal bridge nearly at the apex of lateral plates; distimere usually slender, sickle shaped; proximal and distal divisions of subapical lobe usually clearly separated but not elongated; pleural scaling usually present . . . . *pseudomelanoconia* group

Tergal bridge at or just above the midpoint of lateral plates; distimere modified from above; proximal and distal divisions of subapical lobe elongated into stemlike lobes; pleural scaling entirely absent or sometimes only a few scales present on sternopleuron . . . . *crassistylus* group

TERRITANS GROUP

This group includes 6 species from the Nearctic (mainly North America); *territans* (also known in Europe), *apicalis*, *boharti*, *reevesi*, *arizonensis* and *derivator*; 1 species from northern Palearctic of the Oriental region: *rubensis* and 4 species from the Mediterranean, namely *deserticola*, *judaicus*, *impudicus* and *martinii*. The group can be easily recognized by the predominantly pale or sand-colored scutal scales, presence of broad scale patches on 3 or 4 areas of pleura and presence of apical banding on abdominal terga, as indicated in the key.

PSEUDOMELANOCONIA GROUP

This group contains 6 species from Australia: pseudomelanoconia, *chaetoventralis*, *douglasi*, *fergusoni*, *latus* and *postspiraculosus* and 4 species from the South Pacific: *cheesmanae*, *dumbletoni*, *gaufini* and *millironi*. The extent of the pleural scaling is variable, but the shape of the phallosome and the characteristic crown of the proctiger are very constant in nearly all species involved. According to Dobrotworsky (1956: 105) the members of this group could be well divided into two subgroups, one involving *fergusoni* and *latus* with apical abdominal banding or apicolateral abdominal spots and presence of pleural scaling, the other involving *douglasi* and *pseudomelanoconia* with basal abdominal banding and reduced pleural scaling.

CRASSISTYLUS GROUP

Two members of this group: *crassistylus* and *pedicellus* are known from New Guinea and the other one, *leonardi*, is from the South Pacific. They are strikingly differentiated from the other two groups in the almost complete absence of pleural scaling, modified shape of distimere, development of parts of the subapical lobe and in having striations on the upper tergal surface of the lateral plate of the phallosome. They are probably derived from members in the pseudomelanoconia group.

Subgenus II. *MAILLOTIA* (Theobald)

1907 *Maillotia* Theobald, Mon. Cul. 4:274; Haplotype: *pilifera* (presently known as *hortensis*).
Culex (Neoculex) in part of Edwards (1932: 193); Edwards (1941: 249); Mattingly (1955: 376-389).

Subgeneric Characters. As given in the key to the subgenera with the following additional description. Very similar in general external features to the *territans* group of subgenus *Neoculex*, but pleural scaling is more extensive, sometimes scale patch also present on prosternum and scutal scales rather coarse. *Male Terminalia*. (Fig. 2) Phallosome short, broad, oval, subspherical or cup-shaped from tergal view, tergal bridge at or just above the midpoint of lateral plates, denticles not developed or sometimes only a few ones present on apex; proctiger heavily sclerotized with a relatively large crown of flat and blunt spicules arranged in comblike fashion or sometimes mixed with coarse pointed spines in the form of a tuft; proximal division of subapical lobe with 2 or sometimes 3 rodlike setae, distal division with few short narrow setae or none; distimere more or less modified.

Systematics. This is perhaps the most primitive of the three subgenera. It is rather heterogeneous consisting of species which are perhaps better placed with either *Neoculex* or *Eumelanomyia*. However, as they show the type of phallosome, and other features, somewhat intermediate between the other two subgenera, I think it is probably better to consider them as belonging to a subgenus of their own. As they are either exclusively Ethiopian or Mediterranean, it seems better to treat them this way.

KEY TO THE GROUPS OF SUBGENUS MAILLOTIA

1.	Head, scutum and pleuron with a pattern of silvery white scale lines contrasting sharply with dark scaled background; apex of proctiger of male terminalia with a heavily sclerotized plate bearing a small crown of coarse spicules	*pulchrithorax* group
	Head, scutum and pleuron without above ornamentation; apex of proctiger of male terminalia without heavily sclerotized plate, but with crown of flat and blunt spicules or of coarse pointed spines	2
2(1).	Proximal part of subapical lobe with 2 rodlike setae; lateral plate of phallosome without denticles	*hortensis* group
	Proximal part of subapical lobe with 3 rodlike setae; apex of lateral plate of phallosome with some denticles	*seyrigi* group

PULCHRITHORAX GROUP

This group, as keyed above, corresponds to Edwards' group A (1941: 249) with only one species, namely, the Ethiopian *C. pulchrithorax*. Its outstanding ornamentation on the dorsum of head, scutum, pronotum and upper pleura is very distinctive as described and illustrated by Edwards (1941: 254). The female buccopharyngeal armature is, however, rather similar to species in the *seyrigi* group.

HORTENSIS GROUP

This group contains 3 or perhaps more species from the Mediterranean. Their external characters are more or less similar to the territans group of *Neoculex*, but with propleural scale patch extended to prosternum in some species. At present, 3 forms, namely *hortensis*, *arbieeni* and *quettensis* are grouped together here. They appear to show the characters of the subgenus better than the other two groups.

SEYRIGI GROUP

I tentatively place 4 forms, namely *seyrigi*, *peringueyi*, *salisburensis* and *avianus*, all from the Ethiopian region, in this group, based on the characters given in the key. They are similar to members of the *hortensis* group in external features, but the male phallosome and other features of the male terminalia resemble members in the subgenus *Eumelanomyia*.

Subgenus III. *EUMELANOMYIA* Theobald

1909 *Eumelanomyia* Theobald, Mon. Cul. 5:240; Haplotype: *inconspicuosus* (presently known as *albiventris*).

1910 *Protomelanoconion* Theobald, Mon. Cul. 5:462; Haplotype: *fusca* (presently known as *horridus*).

1930 *Culex (Mochthogenes)* Edwards, Bull. ent. Res. 21:306; Type: *C. malaya* Leicester 1908.

Culex (Neoculex) in part of Edwards (1932: 193-195); Edwards (1951: 249-269); Barraud (1934: 347-352); Bohart & Ingram (1946); Bohart (1953:187); Delfinado (1966: 124-128); Bram (1967: 23-32).

Culex (Mochthogenes) of Edwards (1932:195; 1941:277-279); Barraud (1934:352-359); Baisas (1935:175-177); Delfinado (1966:128-135); Bram (1967:33-42).

Subgeneric Characters. As indicated in the key to subgenera, with the following additional description. Small to medium sized, wing length usually not more than 3.0 mm., dark brown to black species. *Head.* Male palpus from 0.2 to longer than the length of proboscis; antennal flagellomeres 1-10 usually with a single whorl of long hairs each, sometimes also with a much smaller whorl of short but conspicuous hairs in addition (Fig. 3). *Thorax.* Scutal scales narrow and usually entirely dark, rarely pale; pleural scaling absent or only a few scales present on upper corner of sternopleuron. *Abdomen.* Terga entirely dark or with apical bands, apicolateral pale spots, rarely with basal bands. *Male Terminalia.* (Fig. 3) Phallosome small, generally broad, oval or subspherical in shape; tergal bridge at or below the midpoint of lateral plates; usually with several denticles over the upper tergal surface, rarely bare; proctiger with small dark crown of fine spinelike spicules, some coarse ones present or absent; proximal division of subapical lobe always with 3 rodlike setae; distal division usually with at least a broad leaflet; distimere slender, sickle-shaped or else modified.

Systematics. Members of this subgenus can be easily distinguished from the other two subgenera by smaller size, dark scaled scutum and the absence of scale patches on the pleura. The phallosome is variable among different species but all are remarkably constant with regard to shape and position of tergal bridge and do not appear to overlap in these characters with species in *Neoculex*. The fine texture of the spicules of the proctiger crown and the presence of 3 rodlike setae in the proximal division of the subapical lobe are also characteristics of this subgenus.

This subgenus contains the majority of species from the Ethiopian region and the Indomalayan part of the Oriental region. The number of species involved is the largest of the 3 subgenera recognized here. They are divided into 4 major groups as follows:

KEY TO THE GROUPS OF SUBGENUS *EUMELANOMYIA*

1.	Male palpus as long as or longer than proboscis; flagellomeres 1 to 10 of male antenna each with a single large whorl of long hairs	2
	Male palpus from 0.2 to 0.75 the length of proboscis; flagellomeres 1 to 10 of male antenna each with a smaller whorl in addition to a large normal whorl (Fig. 3)[3]	3
2(1).	Decumbent scales in center of vertex broad; acrostichal bristles absent; tergal bridge of phallosome present or absent	*eumelanomyia* group
	Decumbent scales in center of vertex narrow; acrostichal bristles present; tergal bridge of phallosome present	*rubinotus-rima* group
3(1).	Male palpus about 0.75 the length of proboscis; acrostichal bristles absent; lower anterior mesepimeral bristle absent . . .	*protomelanoconion* group
	Male palpus usually about 0.2 the length of proboscis, sometimes longer to about 0.75; acrostichal bristles present; lower anterior mesepimeral bristle usually present	*mochthogenes* group

EUMELANOMYIA GROUP

This group corresponds to Edwards' group B (1932) and group D. (1941) or *albiventris* group. Five species, all from the Ethiopian region are placed here: *albiventris*, *andersianus*, *vinckei*, *acrostichalis* and *kanyamwerima* and perhaps also *kilara* and *garioui*. The group is characterized as in the key and may be further subdivided into two subgroups on the basis of presence or absence of a tergal bridge of the phallosome. Certain members of this group appear to show affinity to the subgenus *Culiciomyia*.

RUBINOTUS-RIMA GROUP

This group corresponds to the *rima* group or group C and *Neoculex s. str.* group, in part, of Edwards (1941). It could be subdivided into 2 subgroups: 1) *rubinotus* subgroup with *rubinotus*, *kingianus*, *andreanus*, *pseudoandreanus* from the Ethiopian region and *simplicicornis* from the Indomalayan

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[3] As illustrated, the term "normal whorl" as used here refers to the large tuft of 10 to over 20 long hairs arising from a series of tubercles encircling the middle part of each flagellomere, whereas the term "small or minor whorl" refers to a much smaller tuft with 4-8 short hairs arising near the junction of the flagellar segments.

area (Borneo) by having abdominal terga entirely dark and by having the pleural integument uniformly dark brown; and 2) *rima* subgroup with *rima*, *subrima*, *galliardi*, *calabarensis*, *wigglesworthi*, *insignis*, *albertianus*, *wansoni* and perhaps also *sunyaniensis* and others as listed by having apical band or apicolateral spots on abdominal terga and by having a pattern of dark and pale areas on the pleura. The members in the *rubinotus* subgroup show strong affinity to the subgenus *Lophoceraomyia* on the basis of several characters indicating that the latter subgenus is probably derived from them.

PROTOMELANOCONION GROUP

This group includes *brevipalpis*, a dominant form from several areas in the Oriental region, horridus from the Ethiopian region and *stellatus* from Seychelles. It is closely related to the *mochthogenes* group, but with longer male palpi and differing in other constant features as indicated in the key.

MOCHTHOGENES GROUP

This group is dominant in the Indomalayan areas and other southern parts of the Oriental region in which it is represented by many distinct lineages (see list above). It is perhaps represented by a single lineage (*inconspicuosus* subgroup) in the Ethiopian region. In the South Pacific, it is represented by a single species (*femineus*). I recognize 8 subgroups in this group. They are separated as follows:

KEY TO THE SUBGROUPS OF GROUP *MOCHTHOGENES*

1. Decumbent scales in the center of vertex entirely or predominantly broad along anterior ocular line 2
Decumbent scales in the center of vertex entirely narrow 5

2(1). Distimere of male terminalia simple, sickle shaped 3
Distimere of male terminalia strongly modified from above 4

3(2). Lateral plate of phallosome without large internal process; minor flagellar whorls of short hairs of male antenna present . . . *hinglungensis* subgroup
Lateral plate of phallosome with a large internal process; minor flagellar whorls of short hairs of male antenna absent. . . . . . *uncinatus* subgroup

4(2). Distimere sharply angled at the middle of dorsal curvature, its basal half thick, distal half narrow and tapered to a curved spine . . . . *inconspicuosus* subgroup
Distimere divided into a short dorsal and a long ventral arm . . . . *malayi* subgroup

5(1). Male antennal flagellar whorls with rather weak and relatively few hairs; size minute or very small, wing length usually not exceeding 3.0 mm. 6
Male antennal flagellar whorls with strong and numerous hairs; size relatively large, wing length usually 3.0 mm. or more 7

6(5). Abdominal terga entirely dark; phallosome of male terminalia short and oval in shape; basimere small, slender and conical in shape . . . . *castrensis* subgroup
Abdominal terga with basal pale bands; phallosome of male terminalia tubular in shape; basimere swollen and broadly oval in shape . . . . *femineus* subgroup

7(5) Male phallosome heavily sclerotized and dark, lateral plate rodlike and pointed with some heavy lateral teeth . . . . *otachati* subgroup
Male phallosome weakly sclerotized and pale yellow or brown, lateral plate oval or subspherical in shape; teeth confined to inner tergal surface . . . . *tenuipalpis* subgroup

As indicated in the above key, the *mochthogenes* group is rather complex as it contains several lineages, most of which can be easily recognized by the short male palpus more or less similar to the female. Only the *tenuipalpis* subgroup, as far as known, consists of some members with male palpi longer than those of the females. These are *tenuipalpis*, *hayashii* and *okinawae* which Edwards (1932:194-195) and Bohart (1953:187) placed with the *protomelanoconion* group of *Neoculex s. lat.* The *femineus* subgroup is also rather anomalous in male terminalia but since it shows several characters common to most *mochthogenes* members, I place it here for the present.

Culex gamma Seguy (1924, Encycl. ent., :47) was described from larva only and cannot definitely be placed with any subgenus according to the present scheme.

ACKNOWLEDGEMENTS

I wish to thank Dr. Botha de Meillon, Project Leader, Southeast Asia Mosquito Project, Smithsonian Institution and Dr. Alan Stone, Agriculture Research Service, U.S. Department of Agriculture for their many helpful suggestions in improving the manuscript. I also wish to thank Dr. Stone for the loan of specimens from the United States National Museum and several papers on *Neoculex* in his private file for study and consultation. I am indebted to Dr. P. F. Mattingly for his courtesy extended to me while studying the specimens at the British Museum. Dr. John N. Belkin, Department of Zoology, University of California, Los Angeles, kindly read the manuscript and I wish to thank him for his comments and advice. I thank Mr. Vichai Malikul for his assistance with the illustrations.

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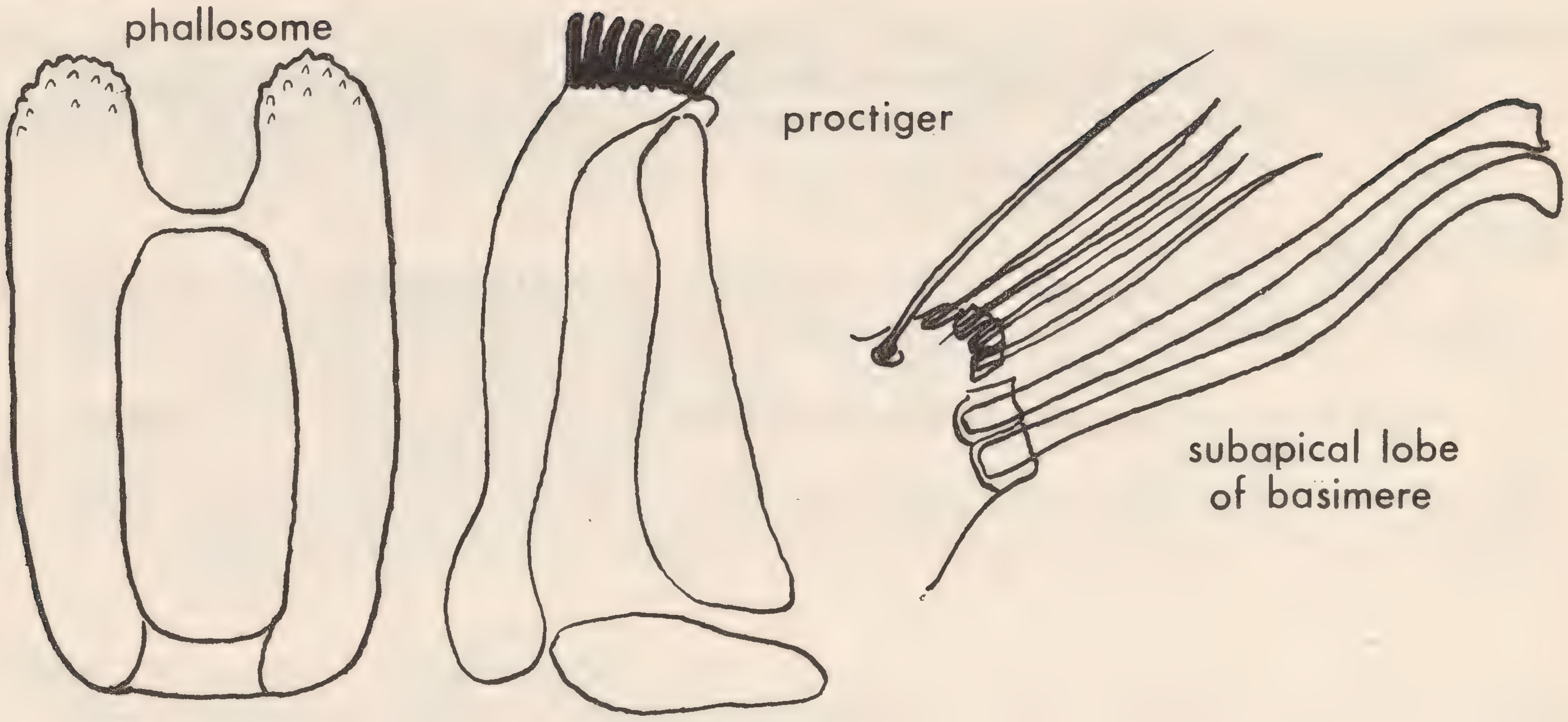
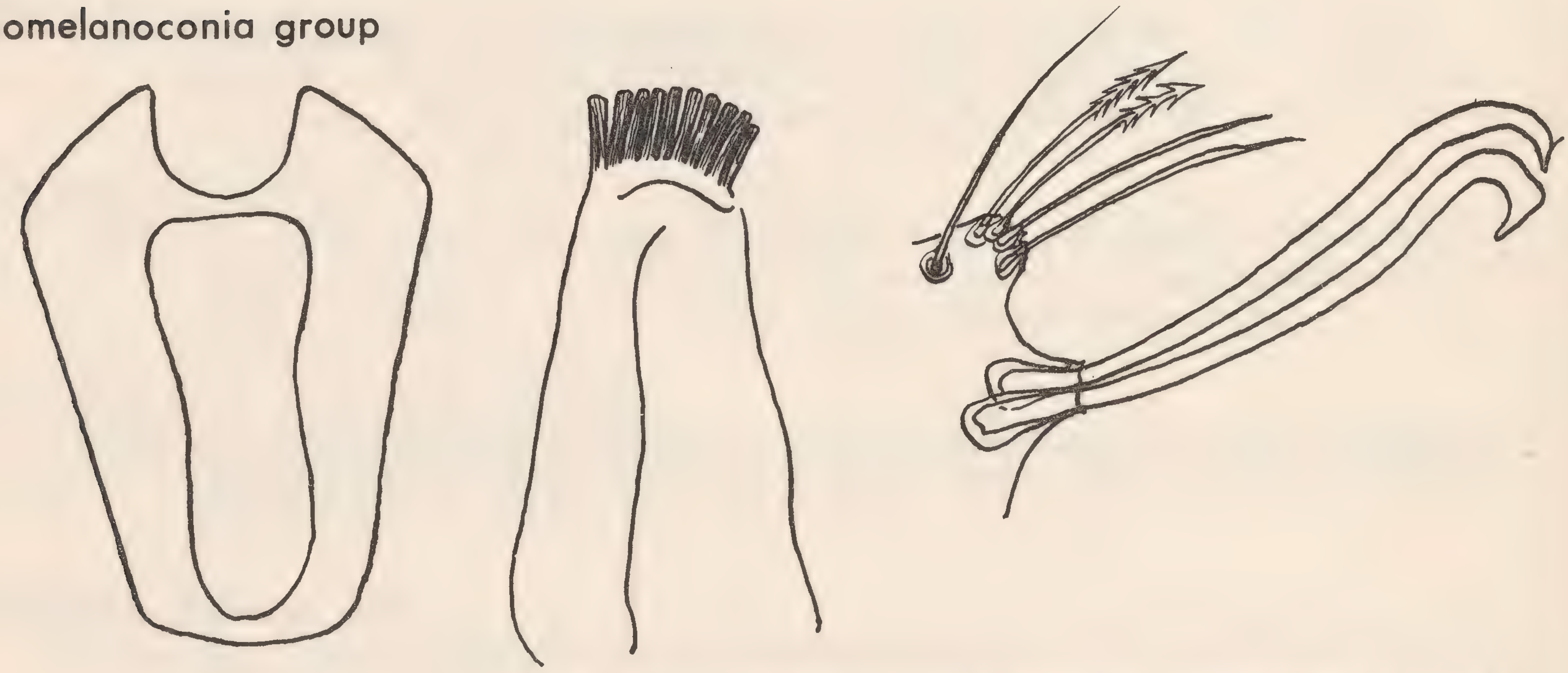
Fig.1

Territans group



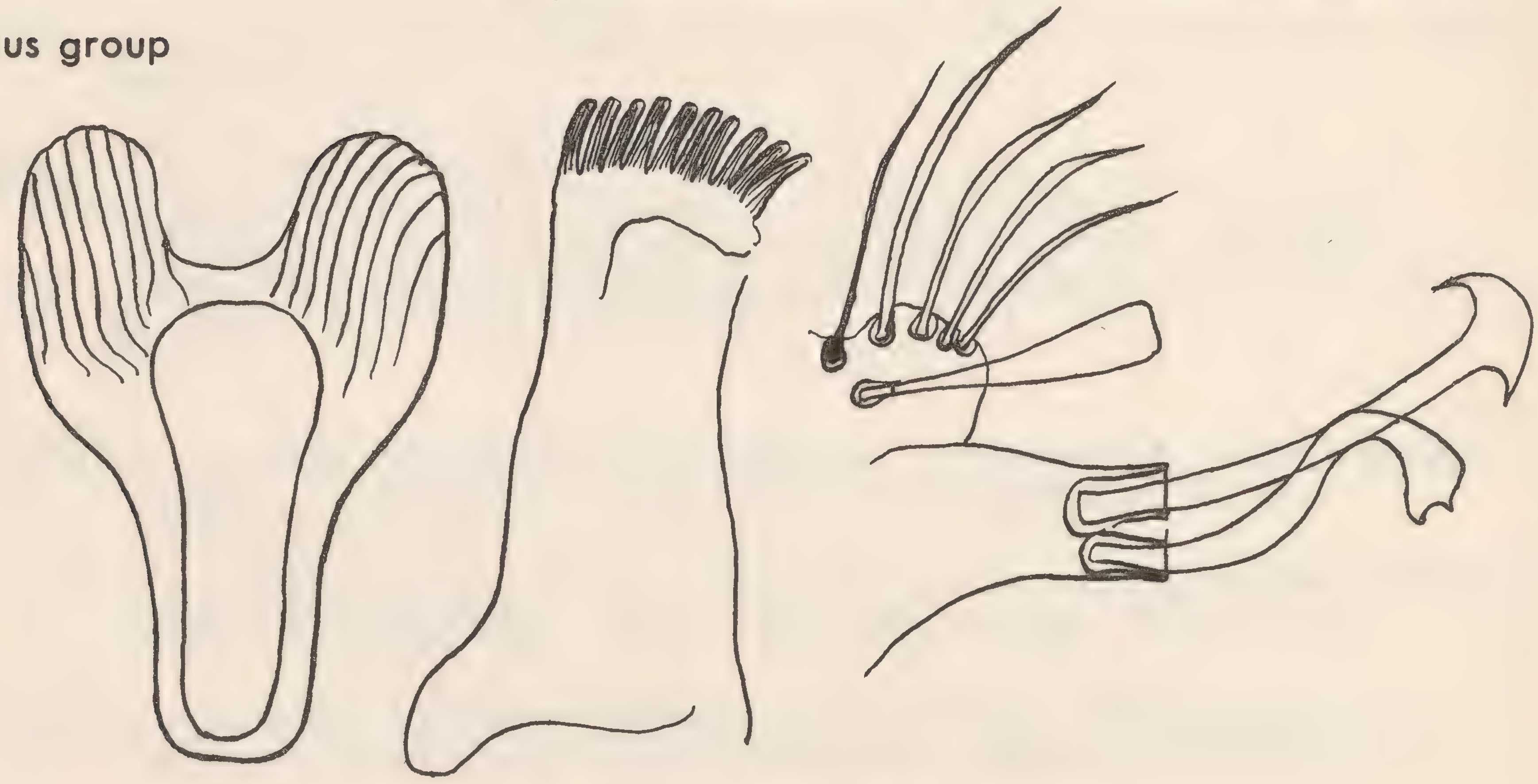
C.territans

Pseudomelanoconia group



C.pseudomelanoconia (after Dobrotworsky 1965)

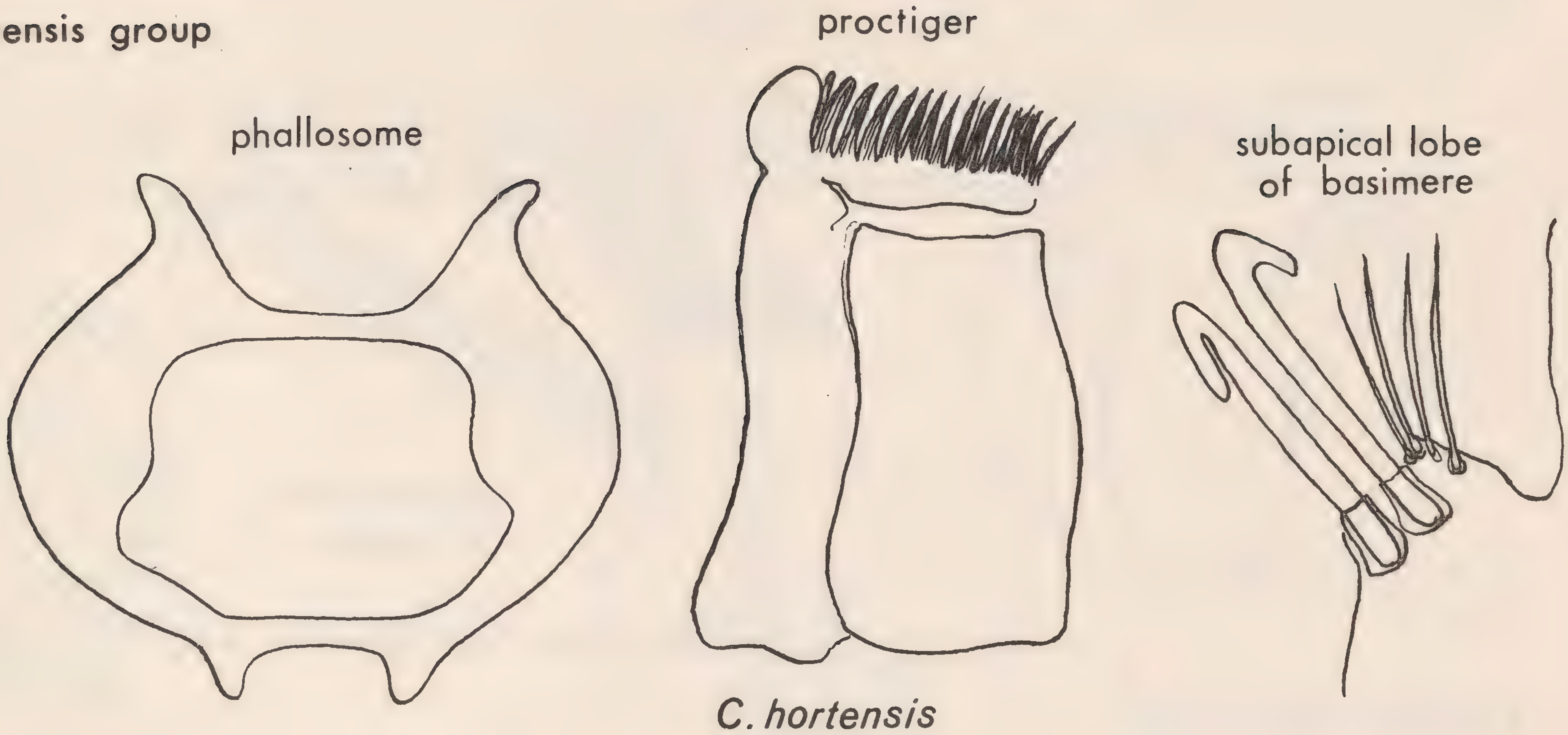
Crassistylus group



C.leonardi (after Belkin 1962)

Fig. 2

Hortensis group



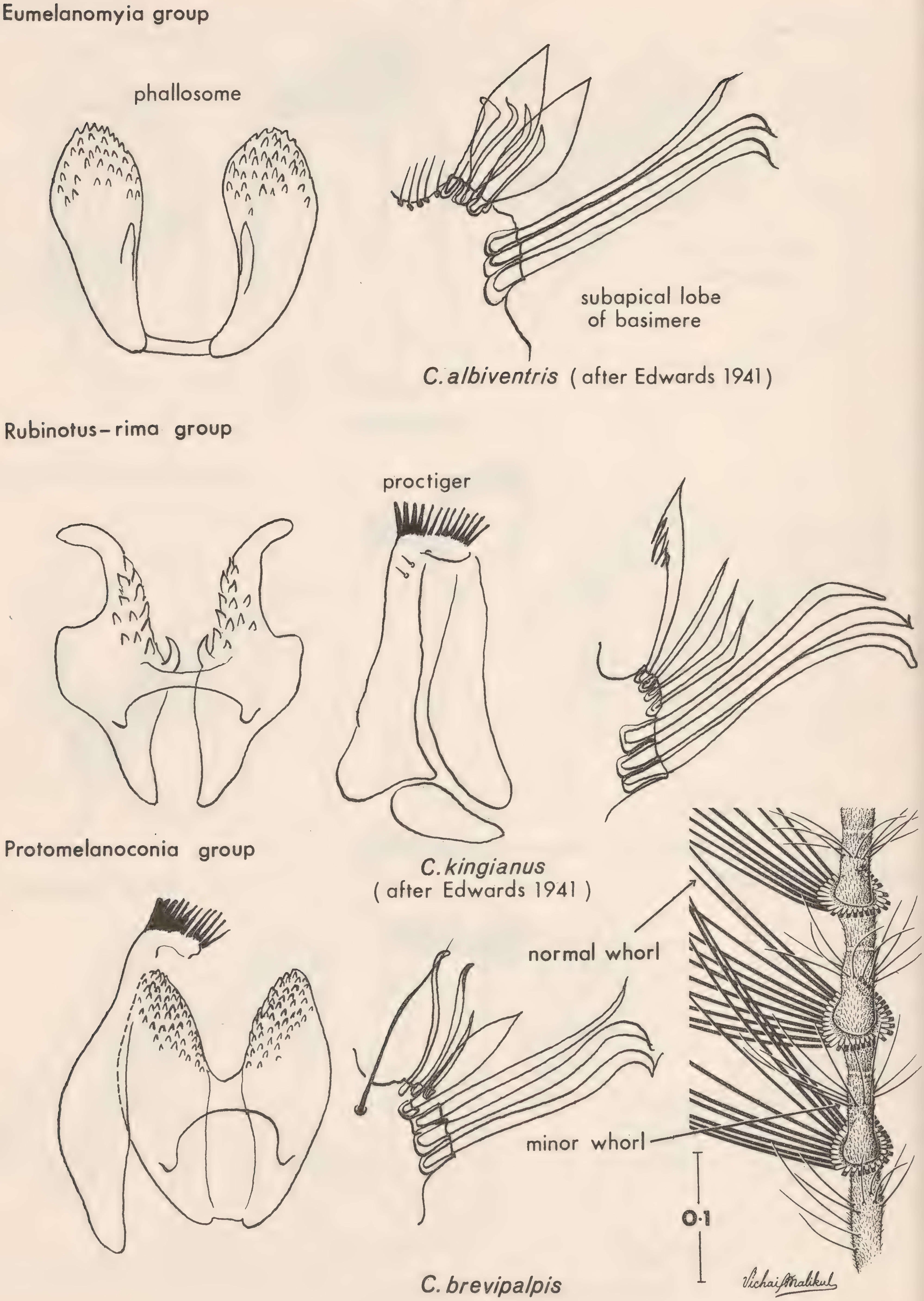
C. hortensis

C. arbieeni

Pulchrithorax group

C. pulchrithorax (after Edwards 1941)

Fig. 3


Eumelanomyia group
phallosome
subapical lobe of basimere
C. albiventris (after Edwards 1941)
Rubinotus–rima group
proctiger
Protomelanoconia group
C. kingianus
(after Edwards 1941)
normal whorl
minor whorl
0·1
C. brevipalpis
Vichai Malikul

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ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES (DIPTERA, CULICIDAE)

By
Peter F. Mattingly

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ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES (DIPTERA, CULICIDAE)

By
Peter F. Mattingly

CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. XII.

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ILLUSTRATED KEYS TO THE GENERA OF MOSQUITOES[1]

By

Peter F. Mattingly[2]

INTRODUCTION

The suprageneric and generic classification adopted here follow closely the Synoptic Catalog of the Mosquitoes of the World (Stone et al., 1959) and the various supplements (Stone, 1961, 1963, 1967, 1970). Changes in generic nomenclature arising from the publication of the Catalog include the substitution of *Mansonia* for *Taeniorhynchus* and *Culiseta* for *Theobaldia*, bringing New and Old World practice into line, the substitution of *Toxorhynchites* for *Megarhinus* and *Malaya* for *Harpagomyia*, the suppression of the diaeresis in *Aëdes*, *Aëdeomyia* (formerly *Aëdomyia*) and *Paraëdes* (Christophers, 1960b) and the inclusion of the last named as a subgenus of *Aedes* (Mattingly, 1958). The only new generic name to appear since the publication of the Catalog is *Galindomyia* (Stone & Barreto, 1969). *Mimomyia*, previously treated as a subgenus of *Ficalbia*, is here treated, in combination with subgenera *Etorleptiomyia* and *Ravenalites*, as a separate genus. Ronderos & Bachmann (1963a) proposed to treat *Mansonia* and *Coquillettidia* as separate genera and they have been followed by Stone (1967, 1970) and others. I cannot accept this and they are here retained in the single genus *Mansonia*.

It will be seen that the treatment adopted here, as always with mosquitoes since the early days, is conservative. Inevitably, therefore, difficulties arise in connection with occasional aberrant species. In order to avoid split, or unduly prolix, couplets I have preferred, in nearly every case, to deal with these in the Notes to the Keys. The latter are consequently to be regarded as very much a part of the keys themselves and should be constantly borne in mind. A bibliography of key works is included for the benefit of those who may wish to carry out identification at the subgeneric or species level.

DISEASE RELATIONS AND BIONOMICS

Disease Relations

Setting aside mechanical transmission and phoresy, mosquitoes serve as vectors of three groups of human pathogens. These are Haemosporidia (four species of human malaria parasite and an occasional simian malaria parasite, all belonging to the genus *Plasmodium*), two or more species of Filarioidea belonging to the genera *Brugia* and *Wuchereria*, and the arboviruses, of

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[1] This work was supported by Research Contract No. DA-49-193-MD-2672 from the U. S. Army Medical Research and Development Command, Office of the Surgeon General.

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which more than 40 have been recovered from man and another 40 are believed to infect man on the evidence of antibody surveys. The diseases to which these give rise are discussed as ecological systems by Mattingly (1969). Monographs or reviews dealing with particular groups of diseases include Edeson & Wilson (1964), Garnham (1966), Reeves (1965), Russell et al. (1963), Taylor (1967), Berge et al. (1970) and Ward & Scanlon (1970). For epidemiology and epidemiological sampling methods see Detinova (1968), Muirhead-Thomson (1968) and Pampana (1969). For control methods see Busvine (1966).

Human malaria is transmitted exclusively by *Anopheles* spp. Vectors include *An. labranchiae* Falleroni, *sacharovi* Favre, *sergentii* (Theobald), *superpictus* Grassi and *pharoensis* Theobald in parts of the Mediterranean area, *An. funestus* Giles, *moucheti* Evans, *nili* (Theobald) and members of the *gambiae* Giles complex in the Ethiopian Region, *An. stephensi* Liston, *fluviatilis* James and *pulcherrimus* Theobald in western Asia, *An. culicifacies* Giles in India and Ceylon, *An. maculatus* Theobald, *sundaicus* (Rodenwaldt) and members of the *An. barbirostris* Van der Wulp, *hyrcanus* (Pallas), *umbrosus* (Theobald), *leucosphyrus* Dönitz, *minimus* Theobald and *annularis* Van der Wulp groups in southern Asia, members of the *An. punctulatus* complex in Melanesia and *An. pseudopunctipennis* Theobald, *bellator* Dyar & Knab, *cruzii* Dyar & Knab, *darlingi* Root, *aquasalis* Curry, *albimanus* Wiedemann, *albitarsis* Lynch Arribalzaga and *nuneztovari* Gabaldon in Central and South America. Other species may be locally important and in general a list such as the above can present only a very crude picture since the importance of a particular vector in a given area will vary with the prevailing ecological conditions (see, e.g. Reid in Ward & Scanlon, 1970). Complicating factors include the development of insecticide resistance among a number of important vectors (World Health Organization, 1970) and the habit of some others of feeding and resting outside houses where they fail to make contact with the insecticide. (For behavioral aspects see Mattingly, 1962b). Vectors of wuchererian filariasis include several of the major malaria vectors and, in addition, the highly domestic *Culex pipiens fatigans* Wiedemann throughout the tropics except in the Pacific area where the nocturnal periodicity of the parasite is suppressed and day-biting vectors, particularly *Aedes (Stegomyia) polynesiensis* Marks, take over. Vectors of brugian filariasis include *Anopheles* and *Mansonia* spp. (See Wharton, 1962, Edeson & Wilson, 1964, Reid, 1968).

Viruses known or believed to infect man have been recovered from more than 150 species of mosquitoes belonging to 14 different genera (*Aedeomyia, Aedes, Anopheles, Culex, Culiseta, Deinocerites, Eretmapodites, Haemagogus, Limatus, Mansonia, Psorophora, Sabethes, Trichoprosopon, Wyeomyia).*

Bionomics

The egg stage, though of cardinal ecological importance, has been somewhat neglected. The nearest to a general review will be found in Mattingly (Riv. Parassit., in press). Oviposition sites (or larval breeding places) may be roughly classified as follows:

A. Running water habitats (stream edges, mainly anophelines).
B. Still water habitats.
    1. Ground water habitats
        a. Permanent (anophelines and culicines other than *Aedes* and aedine genera).
        b. Temporary (especially *Aedes*).
        c. Specialized (crab holes, rock holes, wells, soak aways) (various culicines, a few anophelines in wells).
    2. Container habitats (artifacts, tree holes, cut, split or bored bamboos, leaf axils, plant pitchers, flower petals, bracts, spathes, fallen leaves or rachids, fruits and husks, snail shells, cup fungi etc.) (*Toxorhynchites*, *Anopheles* subgenus *Kerteszia*, sabethine genera, some aedine genera, some subgenera of *Aedes*,

individual species and species groups of *Anopheles* and various culicine genera).

Larval bionomics are reviewed in the various taxonomic monographs listed on p. 37, notably Hopkins (1952), and by Laird (1956). Since the introduction of residual insecticides a quarter of a century ago adult bionomics have received increasing attention. Coverage in taxonomic monographs is not always adequate. Exceptions are Gillies & de Meillon (1968) and Reid (1968). Among general reviews Bates (1949) and Muirhead-Thomson (1951) are classics, the former recently republished. Horsfall (1955) is a compilation useful mainly for references to earlier literature. Marshall (1938) has enjoyed great popularity as an elementary introduction and has also been recently republished. Natvig (1948) contains much information regarding northern species. Clements (1963) covers a much wider spectrum than the title might suggest. Mattingly (Riv. Parassit., in press) summarizes a wide range of topics and has an extensive and up-to-date bibliography. Publications on bionomics of individual vectors include Christophers (1960a), Jachowski (1954) and de Meillon et al. (1967). Wharton (1962) covers various aspects of Old World *Mansonia* spp. Literature on Neotropical species is scattered. Galindo et al. (1950) and Trapido & Galindo (1957) will serve as an introduction.

The role of diel rhythms in cyclical behavior has received much attention but there is no general review. Mattingly (Trans. 13th internat. Congr. Ent., in press) reviews some ecological implications. Haddow (1955) discusses techniques for recording and analyzing biting cycles. More fundamental work has been concerned chiefly with the oviposition cycle. Gillett (1962) is a key paper for the modus operandi of the internal 'clock'. More recently this type of study has been extended to the diel activity rhythm (Taylor & Jones, 1969).

Interest in mosquito genetics stemmed mainly from the development of insecticide resistance but many other aspects of mosquito biology are now involved. The field as a whole is well covered by Wright & Pal (1967).

GEOGRAPHICAL DISTRIBUTION

Outline distributions are given in the Synoptic Catalog. For further details see the various regional monographs listed below. Mattingly (1962a) discusses mosquito zoogeography in general. For zoogeography of the Pacific area see Belkin (1962, 1968).

FAMILY CULICIDAE

KEYS TO THE GENERA

I. FEMALES

1. Proboscis long, strongly attenuated and recurved with prominent setulae confined to base; posterior edge of wing emarginated just beyond tip of vein Cu2 (Fig. 1) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 1. *Toxorhynchites splendens* (Wiedemann), a. female head, b. male head, c. wing.

Proboscis and wing otherwise 2

2. Abdomen with sterna (and usually also terga) wholly or largely devoid of scales (Subfamily Anophelinae) 3

Abdominal terga and sterna with dense, uniform covering of scales (Subfamily Culicinae) 5

3. Veins Cu1 and M, distad of the cross vein, wavy (Fig. 2); all wing scales dark; Moluccas, Melanesia and northern Australia only . . . . *Bironella* Theobald

Fig. 2. *Bironella hollandi* Taylor, wing.

These veins very rarely wavy; if so then wing with conspicuous pattern of light and dark scales[1]* 4

4. Scutellum trilobed with bristles in 3 distinct groups (Fig. 3a); posterior pronotal bristles present (Fig. 4); New World tropics only . . . . *Chagasia* Cruz

Fig. 3. Thorax in dorsal view, a. *Chagasia fajardoi* (Lutz); b. *Anopheles balabacensis* Baisas; c. *Wyeomyia aporonoma* Dyar & Knab; d. *Trichoprosopon digitatum* (Rondani). *apn* anterior pronotum, *p* postnotum, *s* scutum, *sc* scutellum.

Fig. 4. Generalized mosquito thorax in lateral view showing setae used in the keys. *1 me* lower mesepimeral, *pa* prealar, *ppn* posterior pronotal, *psp* postspiracular, *sp* spiracular.

Scutellum smoothly rounded with bristles more or less evenly distributed (Fig. 3b); posterior pronotal bristles absent . . . . *Anopheles* Meigen

5. Tip of proboscis swollen, upturned and hairy (Fig. 5); Old World tropics only . . . . *Malaya* Leicester[2,3,5]

Fig. 5. *Malaya genurostris* Leicester, female head.

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* Superscript, here and elsewhere, refers to "Notes on the Keys" p. 29.

Proboscis sometimes with tip swollen,
otherwise unmodified 6

6. Scutum with double median longitudinal stripe
of broad, flat, usually white or silvery, scales;
spiracular bristles present, postspiraculars
absent (see Fig. 4); Southeast Asia and New
Guinea only . . . . *Topomyia* Leicester[2,3,5]
Without this combination of characters 7

7. Squama and postnotum bare; vein 1A reaching
wing margin at most very slightly beyond
base of fork of vein Cu (Fig. 6a) 8

Fig. 6. *Hodgesia malayi* Leicester, a. wing,
b. outstanding scales from outer half of wing
field. *al* alula, *c* costa, *sc* subcosta, *sq*
squama, *st* stem vein.

Squama fringed at least in part (Fig. 14a, b, d)
or postnotum with bristles (Fig. 3c, d) or vein
1A reaching wing margin well beyond the base
of fork of vein Cu (Fig. 13) or with any combination of these characters 10

8. Outstanding scales on outer half of wing field with
emarginated tips (Fig. 6b); Old World tropics
only . . . . *Hodgesia* Theobald[2]
Wing scales otherwise; distribution various 9

9. Pleuron with conspicuous vertical stripe of broad,
silvery scales extending from the prealar area
to mid coxa (Fig. 7); wing membrane with microtrichia visible under magnification of about 50x;
Southeast Asia only . . . . *Zeugnomyia* Leicester[2]

Fig. 7. Thorax in side view, *Zeugnomyia
gracilis* Leicester.

Pleural ornamentation otherwise; microtrichia
minute, visible only under high mangification
. . . . *Uranotaenia* Lynch Arribalzaga[2]

10. Spiracular area with scales or one or more bristles
(Fig. 4) 11
Spiracular area bare 18

11. At most 1 or 2 prealar bristles present (see Fig. 4);
stem vein and base of subcosta without bristles
(see Fig. 6a); Oriental and Australasian Regions
and far eastern Palaearctic only . . . . . . *Tripteroides* Giles[5,6]
Prealar bristles more numerous; stem vein, at
least, with bristles or genera confined to New
World 12

12. Postspiracular bristles absent; abdomen blunt tipped;
prealar bristles relatively numerous; bristles
present dorsally on stem vein and, usually, also

ventrally at base of subcosta; Nearctic Region and Old World only . . . . *Culiseta* Felt[4]

Without this combination of characters; New World species only 13

13\. Postspiracular bristles present; postnotum bare; abdomen pointed at tip . . . . *Psorophora* Robineau-Desvoidy

Postspiracular bristles absent; postnotum usually with a tuft of setulae (Fig. 3c, d); abdomen blunt tipped 14

14\. Spiracular area with broad scales only, without bristles; proboscis shorter than fore femur; scutal scales with gold and purple metallic reflections; pleura with abundant golden and silvery scales; hind tarsus with only 1 claw . . . . *Limatus* Theobald

Spiracular area with 1 or more small bristles (Fig. 4); proboscis and thoracic ornamentation various; hind tarsus with 2 claws as usual 15

15\. Antenna at most about half the length of the proboscis, usually less; proboscis long and slender, at least one-sixth as long again as fore femur (as in Fig. 16c); scutum covered with broad, flat scales; scutellum with silvery scales at least on part of mid lobe; one or more tarsi nearly always with white markings on one side at least. . . . . *Phoniomyia* Theobald[7]

Without this combination of characters 16

16\. Scutum covered with flat, metallic scales with bright iridescent reflection; prealar bristles absent (see Fig. 4); anterior pronotal lobes large, almost touching in mid line; one or more tarsi often with conspicuous "paddles" of erect scales (Fig. 8a) . . . . *Sabethes* Robineau-Desvoidy[8]

Fig. 8. a. mid leg, *Sabethes belisarioi* Neiva; b, c. base of wing, b. *Wyeomyia moerbista* (Dyar & Knab); c. *Trichoprosopon pallidiventer* (Lutz).

Without this combination of characters; tarsi never with "paddles" 17

17\. Anterior pronotal lobes large and closely approximated (Fig. 3c); squama bare or with 1-3 bristles or hairlike scales arising from the upper portion near the alula (Fig. 8b); clypeus sometimes with scales, never with setulae . . . *Wyeomyia* Theobald

Pronotal lobes smaller, well separated (Fig. 3d) or squama with bristles more numerous or arising from lower portion (Fig. 8c) or clypeus with conspicuous setulae or with any combination of these characters. . . *Trichoprosopon* Theobald

18. Antenna short, thick, tapering, basal flagellomere with a prominent scale tuft; mid and hind femora with large tufts of sub-erect scales at apex (Fig. 9a, c) . . . . *Aedeomyia* Theobald

Fig. 9. *Aedeomyia catasticta* Knab, a. female antenna, b. male antenna, c. hind femur.

Antenna and femora otherwise 19

19. Antenna with flagellomeres short and thick and verticillary hairs unusually short; vertex and occiput with numerous short hairs (Fig. 10a, b); New Zealand only. . . . . *Opifex* Hutton

Fig. 10. Head of *Opifex fuscus* Hutton, a. female, b. male.

Head quite otherwise 20

20. Postnotum with a small patch of setulae (as in Fig. 3c, d) or scutum covered with flat scales with bright metallic reflection, usually both; southern and eastern Asia only. . . . . *Heizmannia* Ludlow[9]

Postnotum without setulae or distribution otherwise 21

21. Scutum covered with broad, flat scales with bright metallic reflection; anterior pronotal lobes unusually large; New World tropics and subtropics only. . . . . *Haemagogus* Williston

Scutal ornamentation otherwise; anterior pronotal lobes not unusually large 22

22. Antenna unusually long, exceeding the proboscis by about the length of the last 4 flagellomeres or more; first flagellomere greatly elongated, 3 or more times as long as the terminal flagellomere (Fig. 11a); proboscis not noticeably swollen apically; New World only . . . . . . *Deinocerites* Theobald

Fig. 11. Antenna, palp and proboscis, *Deinocerites cancer* Theobald, a. female, b. male; *Galindomyia leei* Stone & Barreto, c. female, d. male; *Ficalbia minima* Theobald, e. female.

Without this combination of characters 23

23. Antenna longer than proboscis with all flagellomeres markedly elongated, apical flagellomere at least half as long as the basal one (Fig. 11c); proboscis distinctly swollen apically; scutum without conspicuous ornamentation; postspiracular bristles absent; tarsi unbanded; New World tropics only. . . . . *Galindomyia* Stone & Barreto[10]

Without this combination of characters 24

24. First fore and mid tarsomere distinctly longer than the other 4 together; fourth tarsomere shorter than fifth, only a little longer than broad (Fig. 15b); (postspiracular bristles absent; all claws simple) . . . . . . *Orthopodomyia* Theobald
Proportions of these tarsomeres otherwise 25

25. Postspiracular bristles present or fore tarsal claws toothed or both 26
Postspiracular bristles absent; all tarsal claws simple 30

26. Paratergite broad and bare; postnotum usually with a group of setulae (as in Fig. 3c, d); back of head, pleura and posterolateral corners of abdominal terga with broad, silvery scales; tropical Africa only. . . . . . *Eretmapodites* Theobald
Without this combination of characters 27

27. Decumbent scales of vertex broad, flat; postspiracular and lower mesepimeral bristles present and proboscis curved and laterally compressed (Fig. 12a) or postspiraculars absent and palpus half length of proboscis or more; southern Asia, Japan and Melanesia only . . . *Armigeres* Theobald[11]

Fig. 12. *Armigeres (Armigeres) subalbatus* (Coquillett); antenna, palp and proboscis, a. female, b. male.

Proboscis otherwise; postspiracular bristles present 28

28. Upper surface of wing with all or most scales very broad, many often asymmetrical (Fig. 13); all tarsal claws simple; decumbent scales of vertex narrow . . . . *Mansonia* Blanchard (part)[12]

Fig. 13. *Mansonia (Mansonioides) uniformis* (Theobald); wing.

Without this combination of characters 29

29. Squama bare or with at most 6 short hairs (Fig. 14a); alula with broad scales; posterior pronotum without scales; pleural scales restricted to 4 small white spots; those on sternopleuron and mesepimeron sometimes fused; hind tarsomeres II-IV with conspicuous white basal bands; Southeast Asia only . . . . *Udaya* Thurman

Fig. 14. Base of wing, a. *Udaya lucaris* Macdonald & Mattingly; b. *Mimomyia (Etorleptiomyia) luzonensis* (Ludlow); c. *Mimomyia (Ravenalites) deguzmanae* (Mattingly); d. *Mansonia (Coquillettidia) crassipes* (Van der Wulp).

Without this combination of characters . . . . *Aedes* Meigen[13]

30. Small or very small species; alula with fringe of narrow scales; antenna with first flagellomere at least twice as long as fifth, usually longer; palpus less than one-fifth length of proboscis; scutellum with narrow scales only; wing with anterior fork cell less than twice as long as its stem; Old World tropics only . . . . *Ficalbia* Theobald[14]
Without this combination of characters 31

31. Alula bare or with flat, decumbent scales (Fig. 14b, c); Old World tropics only . . *Mimomyia* Theobald[14, 15]
Alula with narrow fringe scales (Fig. 14d) 32

32. Hind tarsal claws very small and inconspicuous; all tarsi with well developed pulvilli (Fig. 15a) . . . . *Culex* Linnaeus

Fig. 15. a. *Culex* sp., apex of hind tarsus; b. *Orthopodomyia anopheloides* (Giles), mid tarsus.

Hind tarsal claws not unusually small; pulvilli absent . . . . *Mansonia* Blanchard (part)[16]

II. MALES[17]

1. Proboscis long, strongly attenuated and recurved with prominent setulae confined to base; posterior edge of wing emarginated just beyond tip of vein Cu2; palps of the same order of length as the proboscis (Fig. 1b, c) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]
Proboscis and wing otherwise; palps various 2

2. Abdominal sterna wholly or largely bare; scutellum evenly rounded, not trilobed (Fig. 3b); fore tarsus with a single claw only 3
Without this combination of characters 4

3. Veins Cu1 and M, distad of the cross vein, wavy (Fig. 2); all wing scales dark; palps various; Moluccas, Melanesia and northern Australia only . . . . *Bironella* Theobald
These veins wavy only in a few species with brightly ornamented wing[1]; palps at least three-quarters of the length of the proboscis, usually longer . . . . *Anopheles* Meigen

4. Abdomen devoid of scales; fore tarsi with paired claws; New World only . . . . *Chagasia* Cruz
Abdomen densely scaly. 5

5.	Proboscis strongly modified, as in the female (Fig. 5); Old World tropics only	*Malaya* Leicester[2,3,5]
	Proboscis otherwise	6
6.	Scutum with double median stripe of broad, flat scales; spiracular bristles present; postspiraculars absent; palps minute, as in female; Southeast Asia and New Guinea only	*Topomyia* Leicester[2,3,5]
	Without this combination of characters	7
7.	Squama bare; vein 1A reaching wing margin at most very slightly beyond base of fork of vein Cu (Fig. 6a); palps minute, as in female	8
	Squama fringed, at least in part (Fig. 14a-c), or vein 1A reaching wing margin well beyond this or both; palps various	10
8.	Outstanding scales on distal half of wing emarginated at tips (Fig. 6b); antenna as in female, non-plumose and with all flagellomeres, including the last 2, subequal	*Hodgesia* Theobald[2]
	Wing scales otherwise; antennae various	9
9.	Pleuron with conspicuous vertical stripe of broad, silvery scales (Fig. 7); 1 fore and 1 mid claw toothed	*Zeugnomyia* Leicester[2]
	Pleuron otherwise; fore and usually also mid claws both simple	*Uranotaenia* Lynch Arribalzaga[2,18]
10.	Spiracular area with scales or 1 or more bristles (Fig. 4)	11
	Spiracular area bare	18
11.	Prealar bristles numerous (Fig. 4); postspiracular bristles absent; bristles present dorsally on stem vein and usually also ventrally at base of subcosta (see Fig. 6); palps at most slightly shorter than proboscis; Nearctic Region and Old World only	*Culiseta* Felt[4]
	Without this combination of characters and distribution	12
12.	Old World only	*Tripteroides* Giles[5,6]
	New World only	13
13.	Postspiracular bristles present; postnotum bare; palps longer than proboscis	*Psorophora* Robineau-Desvoidy
	Postspiracular bristles absent; postnotum normally with a tuft of setulae (Fig. 3c, d); palps often only a quarter of the length of the proboscis or less	14

14. Proboscis shorter than antenna, and with a conspicuous scale tuft at tip (Fig. 16a), or with an abrupt flexure beyond half way (Fig. 16b); palps minute as in female; scutal scales with gold and purple metallic reflection . . . . *Limatus* Theobald

Fig. 16. Male antenna, palp and proboscis. a. *Limatus asulleptus* (Theobald); b. *Limatus durhamii* Theobald; c. *Phoniomyia davisi* Lane & Cerqueira; d. *Trichoprosopon perturbans* (Williston).

Proboscis otherwise; palps and scutal ornamentation various 15

15. Palps about a quarter of the length of the proboscis or less; antenna at most about half the length of the proboscis, usually less; proboscis long and slender, at least about one-sixth as long again as fore femur (Fig. 16c); scutum covered with broad, flat, often metallic scales; scutellum with silvery scales on part of mid lobe at least; one or more tarsi nearly always with white markings . . . . *Phoniomyia* Theobald[19]
Without this combination of characters 16

16. Palps less than a quarter of the length of the proboscis; scutum with broad scales with bright, iridescent, metallic reflection; one or more pairs of legs often with conspicuous "paddles" (as in Fig. 8a); prealar bristles absent (see Fig. 4); anterior pronotal lobes very large, almost touching in mid line . . . . *Sabethes* Robineau-Desvoidy[20]
Without this combination of characters; legs never with "paddles" 17

17. Palps usually more than half the length of the proboscis; if not then either scutum with narrow scales or proboscis long and slender and antenna much more than half the length of the proboscis with the 2 terminal flagellomeres greatly elongated (Fig. 16d). . . . . *Trichoprosopon* Theobald[21]
Palps at most about a quarter of the length of the proboscis, usually less; scutum covered with broad, flat scales; antennae various but never with the 2 terminal flagellomeres greatly elongated . . . . . . *Wyeomyia* Theobald[19, 20]

18. Antenna with the 2 terminal flagellomeres markedly thickened (Fig. 9b); hind femur with a large apical scale tuft (Fig. 9c); palps very short, as in female. . . . . *Aedeomyia* Theobald
Antenna and hind femur otherwise; palps various 19

19. Antenna with flagellomeres 2-4 each with a stout dorsal spine; back of head with numerous short hairs; palps with apex clavate (Fig. 10b); New Zealand only . . . . *Opifex* Hutton
Antenna, palps and back of head quite otherwise 20

20. Palps at most about one-fifth of the length of the proboscis; scutum covered with broad, flat scales with bright, metallic reflection or postnotum with a group of setulae (as in Fig. 3c, d) or both; antenna usually with verticillary hairs short as in female (Fig. 17a); southern and eastern Asia only. . . . . *Heizmannia* Ludlow[22]

Fig. 17. a. *Heizmannia scintillans* Ludlow, male antenna, palp and proboscis; b. *Galindomyia leei* Stone & Barreto, male fore tarsal claws.

Without this combination of characters 21

21. Antenna with basal flagellomere (and sometimes also some succeeding flagellomeres) greatly elongated, at least 3 times as long as the terminal flagellomere; verticillary hairs short as in female; proboscis not noticeably swollen apically (Fig. 11b); New World only . . . . *Deinocerites* Theobald
Antenna otherwise 22

22. Palps very short as in female; antennal flagellum with verticillary hairs short and scanty; apical flagellomere at least half as long as the basal one; proboscis distinctly swollen apically (Fig. 11d); inner claw of fore tarsus with 2-5 teeth arising from the convex surface (Fig. 17b); other claws all simple; New World tropics only . . . . *Galindomyia* Stone & Barreto[10, 23]
Without this combination of characters 23

23. Scutum covered with bright, metallic, iridescent scales; anterior pronotal lobes unusually large (see Fig. 3); palps at most two-thirds of the length of the proboscis, often much less; New World tropics and subtropics only . . . . *Haemagogus* Williston
Without this combination of characters 24

24. Postspiracular bristle or bristles present 25
Postspiracular area without bristles 29

25. Paratergite broad and bare; postnotum usually with a group of setulae (as in Fig. 3c, d); back of head, pleura and posterolateral corners of abdominal terga with conspicuous patches of broad, silvery scales; tropical Africa only . . . . *Eretmapodites* Theobald
Without this combination of characters 26

26. Decumbent scales of vertex broad, flat; postspiracular and lower mesepimeral bristles present; acrostichals and dorsocentrals absent; proboscis curved and laterally compressed (Fig. 12b); southern Asia, Japan and Melanesia only . . . . *Armigeres* Theobald (part)[11]
Without this combination of characters 27

27. Upper surface of wing with all or most scales very broad, many often asymmetrical (Fig. 13); species confined to New World or if occurring in Old World then with apical segment of palp greatly reduced (Fig. 18a) . . . . *Mansonia* Blanchard (part)[24]

Fig. 18. Male palps and proboscis, a. *Mansonia (Mansonioides) uniformis* (Theobald); b. *Ficalbia minima* Theobald; c. *Mansonia (Coquillettidia) crassipes* (Van der Wulp).

Wing seldom with scales of this type and then only in Old World species; the latter with apical and subapical segments of palps either both well developed or both greatly reduced 28

28. Palps long, slender, almost hairless, the 2 terminal joints together more than half the length of the shaft; squama bare or at most with 6 short hairs; alula with broad scales; posterior pronotum without scales; hind tarsomeres II-IV with conspicuous white basal bands; Southeast Asia only . . . . *Udaya* Thurman
Without this combination of characters . . . . *Aedes* Meigen[25]

29. Alula bare or with flat, decumbent scales (Fig. 14b, c); Old World tropics only . . *Mimomyia* Theobald[14, 15]
Alula with narrow fringe scales (Fig. 14d) 30

30. Proboscis greatly swollen on distal third or more (Fig. 18b); Old World tropics only . . . . *Ficalbia* Theobald[14]
Proboscis at most slightly swollen apically 31

31. Pulvilli present (best seen on hind legs); hind tarsal claws unusually small (as in Fig. 15b); palps various, in some cases very much shorter than proboscis . . . . *Culex* Linnaeus
Pulvilli absent; hind claws not unusually small; palps always at least as long or almost as long as proboscis 32

32. Palps longer than proboscis, the terminal segment not much shorter than the subterminal; subterminal segment and tip of shaft with numerous long hairs (Fig. 18c) . . . . *Mansonia* Blanchard (part)[26]
Palps otherwise 33

33. Palps with the last 2 segments not greatly reduced (Fig. 19b); southern Asia only . . . . *Armigeres* Theobald (part)[27]

Fig. 19. Male palps and proboscis, a. Culex *postspiraculosus* Lee; b. *Armigeres (Leicesteria) dentatus* Barraud; c. *Orthopodomyia anopheloides* (Giles).

Palps with the apical segment (and sometimes also the subapical) greatly reduced (Fig. 19c) . . . . *Orthopodomyia* Theobald[28]

III. PUPAE

The pupa of genus *Galindomyia* is undescribed.

Fig. 20. Generalized mosquito pupa. *as* Apical paddle seta, *fh* Float hair, *p* Paddle, *tr* Trumpet.

1. Segment X with a conspicuous branched hair; seta 9 on segment VIII greatly reduced; paddles without apical seta (Fig. 21a) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 21. Terminal segments of pupa. a. *Toxorhynchites splendens* (Wiedemann), b. *Anopheles balabacensis* Baisas, c. *Chagasia bathana* (Dyar).

Segment X without setae; seta 9-VIII and paddle various 2

2. Paddles nearly always with an accessory seta arising anterior to and in line with the apical seta (Fig. 21b, c); if not then seta 9 on segments IV-VII in the form of a short, stout, dark spine arising from the extreme posterior corner of the segment (as in Fig. 21b) and trumpets short, flared and split nearly to base (Subfamily Anophelinae)[29] 3
Paddles with accessory seta absent or, if present, arising level with and laterad of the apical seta; seta 9 usually and trumpets almost always otherwise (Subfamily Culicinae) 4

3. Seta 2-III-VII a short, stout, dark spine (Fig. 21c); New World tropics only . . . . *Chagasia* Cruz
Seta 2 on these segments otherwise . . . . *Anopheles* Meigen
Bironella Theobald

4. Trumpets modified for insertion into subaqueous plant tissues (Fig. 22a, b); float hair suppressed . . . . *Mansonia* Blanchard[30]

Fig. 22. Pupal trumpets. a. *Mansonia (Mansonioides) uniformis* (Theobald), b. *Mansonia (Coquillettidia) microannulata* (Theobald), c. *Hodgesia malayi* Leicester, d. *Topomyia spathulirostris* Edwards, e. *Topomyia tipuliformis* Leicester, f. *Tripteroides lorengaui* Peters, g. *Tripteroides fuscipleura* Lee.

Trumpets otherwise or float hair well developed or both 5

5. Trumpets with a hinged tragus (Fig. 22c) . . . . . *Hodgesia* Theobald
Trumpets otherwise 6

6. Paddles small, usually more or less pointed, without apical seta (Fig. 23) (Tribe Sabethini) 7

Fig. 23. Sabethine pupal paddles. a. *Topomyia decorabilis* Leicester, b. *Topomyia barbus* Baisas, c. *Tripteroides stonei* Belkin, d. *Limatus durhamii* Theobald, e. *Phoniomyia pallidoventer* Theobald, f. *Trichoprosopon magnum* (Theobald).

Paddles otherwise, nearly always with apical seta[31] 14

7. Old World only 8
New World only 10

8. Trumpets subcylindrical with inner and outer walls widely separated (Fig. 22d, e) 9
Trumpets subconical or with inner and outer walls closely apposed or both (Fig. 22f, g) . . . . *Tripteroides* Giles[32]

9. Seta 6-VII relatively well developed, arising well cephalad of seta 9-VII (Fig. 24a) . . . . *Malaya* Leicester

Fig. 24. Segment VII of pupal abdomen. a. *Malaya genurostris* Leicester, b. *Topomyia spathulirostris* Edwards.

Seta 6-VII usually less well developed and arising close to and laterad of seta 9-VII (Fig. 24b) . . . . *Topomyia* Leicester[33]

10. Paddles short and broad, much shorter than seta 9-VIII, with edges sometimes serrated but tips entirely bare; posterior border of segment VIII deeply excavated; trumpets narrow, cylindrical or subconical (Figs. 23d, 25a) . . . . *Limatus* Theobald

Fig. 25. Sabethine pupal trumpets. a. *Limatus durhamii* Theobald, b. *Phoniomyia edwardsi* Lane & Cerqueira, c. *Trichoprosopon soaresi* Lane & Cerqueira, d. *Sabethes soperi* Lane & Cerqueira, e. *Trichoprosopon magnum* (Theobald), f. *Wyeomyia circumcincta* Dyar & Knab.

Without this combination of characters 11

11. Trumpets slender, tubular, narrowing basally, not or only slightly expanded at apex (Fig. 25b); paddles broad with apex pointed and usually spiculate (Fig. 23e) . . . . *Phoniomyia* Theobald[34]

Trumpets broader, usually conical or beaker-shaped with basal portion expanded and inner lining well separated (Fig. 25c, d) 12

12. Either with long, delicate fringe on both borders of paddle (Fig. 26a) or with genital sac sunk in a deep embrasure (Fig. 26b) . . . . *Wyeomyia* Theobald (part)[35]

Fig. 26. Posterior segments of pupal abdomen. a. *Wyeomyia felicia* (Dyar & Nunez Tovar), b. *Wyeomyia codiocampa* Dyar & Knab, c. *Sabethes purpureus* (Theobald), d. *Trichoprosopon soaresi* Lane & Cerqueira.

Paddles without such a fringe; posterior border of segment VIII with at most a shallow excavation (Fig. 26c, d) 13

13. Seta 5-VI longer, usually much longer, than segment VII; seta 9-VI variously developed but always conspicuous (Fig. 26c) . . . . *Sabethes* Robineau-Desvoidy[36]
Wyeomyia Theobald (part)[35]

Seta 5-VI less strongly developed, often shorter than segment VII; seta 9-VI very small and inconspicuous (Fig. 26d) . . . . *Trichoprosopon* Theobald[36]
Wyeomyia Theobald (part)[35]

14. Paddles smooth on both borders with apex convex; apical paddle seta at least two-thirds as long as paddle; seta 9-VIII long, single, simple (Fig. 27a); New World only . . . . *Deinocerites* Theobald

Fig. 27. Pupal abdomen. a. *Deinocerites mcdonaldi* Belkin & Hogue, b. *Aedeomyia catasticta* Knab, c. *Opifex fuscus* Hutton.

Without this combination of characters 15

15. Paddle smooth on both borders, deeply cleft at apex; apical seta at least half as long as paddle; seta 5-IV-VI with long, frayed median branch and short lateral branches (Fig. 27b). . . . . *Aedeomyia* Theobald
Paddles and seta 5-IV-VI otherwise 16

16. Seta 9-VII very short, single, simple as on anterior segments (Fig. 27c); New Zealand only . . . . *Opifex* Hutton
Seta 9-VII more strongly developed than on anterior segments or distribution otherwise or both. 17

17. Trumpets at least about 10 times as long as their breadth at half way, usually more; paddles narrow or very narrow, not or only very slightly inflated on inner aspect; fringe, usually of irregular spicules, on both borders; apical seta minute or absent (Fig. 28); Old World tropics only . . . . *Mimomyia* Theobald[14,15,37]

Fig. 28. Pupal trumpets and paddles. Genus *Mimomyia*. a. *M. perplexens* (Edwards), b. *M. hybrida* (Leicester), c. *M. chamberlaini* Ludlow, d. *M. (Etorleptiomyia) luzonensis* (Ludlow), e. *M. (Ravenalites) deguzmanae* (Mattingly).

Without this combination of characters 18

18. Paddles with long, delicate fringe on both borders; float hair arising unusually near mid line, tending to point forward in mounted specimens; seta 1-II long, stout, single or bifid; seta 5-III-VII in each case longer than the following segment (Fig. 29); Southeast Asia only . . . . *Zeugnomyia* Leicester

Fig. 29. Pupal abdomen. *Zeugnomyia lawtoni* Baisas.

Without this combination of characters 19

19. Paddles with inner half deeply excavated towards base, usually much broader than outer half; segment IX usually with a pair of small setulae; paddles fringed or toothed on both borders, usually extensively so (Fig. 30) . . . . *Uranotaenia* Lynch Arribalzaga[38]

Fig. 30. Terminal segments of pupa. Genus *Uranotaenia*. a. *U. mendiolai* Baisas, b. *U. ascidiicola* De Meijere, c. *U. modesta* Martini.

Without this combination of characters 20

20. Paddles small, with long, delicate fringe on both borders; apical paddle seta long and stout; seta 8-C much longer and stouter than 9-C (Fig. 31a, b); tropical Africa only . . . . *Eretmapodites* Theobald[39]

Fig. 31. Terminal segments and cephalothorax of pupa. a. *Eretmapodites inornatus* Newstead, b. *Eretmapodites dracaenae* Edwards, c. *Aedes (Stegomyia) ruwenzori* Haddow & Van Someren.

Without this combination of characters and distribution 21

21. Paddles with long, delicate fringe on both borders; seta 6-VI very strongly developed, longer and much stouter than 5-VI (nearly always spinose or multibranched, often subplumose); seta 9-VI a minute, colourless setula (Fig. 32a, b); southern Asia, China, Japan and Melanesia only . . . *Armigeres* Theobald[40]

Fig. 32. Terminal segments of pupa. a. *Armigeres subalbatus* (Coquillett), b. *Armigeres malayi* (Theobald), c. *Heizmannia achaetae* (Leicester).

Paddles without such a fringe or segment VI otherwise; distribution various 22

22. Paddles with long, delicate fringe on both borders; mid rib of paddle very poorly developed, barely visible, if at all, even towards base; Southeast Asia only (Fig. 33a) . . . . *Udaya* Thurman

Fig. 33. Terminal segments of pupa. a. *Udaya argyrurus* (Edwards), b. *Aedes (Stegomyia) meronephada* (Dyar & Shannon), c. *Aedes (Stegomyia) annandalei* (Theobald), d. *Heizmannia scintillans* Ludlow.

Paddles various, if with long fringe then mid rib always strongly developed, conspicuous (Fig. 33b-d) 23

23. Paddles with long, delicate fringe on both borders, oval, usually more or less pointed, never indented at tip; seta 9-VI minute, colourless (Fig. 33d) or if not then either seta 5-II long, stout, dark

(Fig. 34a) or seta 5 on all segments very short (Fig. 34b); southern Asia only. . . . . *Heizmannia* Ludlow[41]

Fig. 34. Pupal abdomen. Genus *Heizmannia*. a. *H. complex* (Theobald), b. *H. aureochaeta* (Leicester).

Without this combination of characters 24

Fig. 35. Terminal segments of pupa. a. *Aedes (Lorrainea) fumidus* (Edwards), b. *Ae. (Diceromyia) franciscoi* Mattingly, c. *Ae. (Diceromyia) periskelatus* (Giles).

Fig. 36. Pupal abdomen. *Aedes* subgenus *Stegomyia*. a. *Ae. albopictus* (Skuse), b. *Ae. desmotes* (Giles).

24. Trumpets at least 7 times as long as their breadth at half way, the pinna occupying at least half the length, meatus entirely tracheoid or almost so; seta 9-VIII very feebly developed; paddle edge strongly serrated on outer half, inner half smooth (Fig. 37); Old World tropics only. . . . . *Ficalbia* Theobald[14]

Fig. 37. Pupal trumpet and terminal segments. Genus *Ficalbia*. a. *F. circumtestacea* (Theobald), b. *F. malfeyti* (Newstead).

Without this combination of characters 25

25. Paddles more or less rectangular with thickened basal portion of outer edge sometimes spiculate but whole border otherwise smooth, hyaline; accessory paddle seta absent; apical paddle seta very short; seta 9-VII-VIII long, stout, plumose, on VIII about half the length of the paddle or more (Fig. 38) . . . . *Orthopodomyia* Theobald[42]

Fig. 38. Pupal cephalothorax and terminal segments. Genus *Orthopodomyia*. a. *O. flavicosta* Barraud, b. *O. wilsoni* Macdonald.

Without this combination of characters 26

26. Trumpets with tubular portion occupying most of the length and with rudimentary basal tracheation at most; seta 9-VIII arising from the posterolateral corner of the segment, not, or only very slightly, displaced anteriorly; either with posterior corner of abdominal segment IV toothed or with prominent ventral lobes on posterior border of segment VIII, partly covering the bases of the paddles, or with accessory paddle seta present (Fig. 39); New World only. *Psorophora* Robineau-Desvoidy[43]

Fig. 39. Pupa. Genus *Psorophora*. a. Cephalothorax and abdomen, *Ps. ciliata* (Fabricius), b. Segment IV of abdomen, *Ps. ferox* (Humboldt), c. Segments I-II, *Ps. infinis* (Dyar & Knab)[43]

Without this combination of characters 27

27. Seta 8-C arising anterior or at most slightly posterior to base of trumpet, very much anterior to 9-C; trumpet nearly always with rudimentary basal tracheation at most; seta 9-VIII rarely arising cephalad of the posterior border of the segment (Fig. 40) 28

Fig. 40. Pupal cephalothorax and abdomen. a. *Haemagogus spegazzinii* Brethes, b. *Haemagogus capricornii* Lutz, c. *Aedes aegypti* (Linnaeus).

Seta 8-C arising level with or posterior to the base of the trumpet, more nearly level with 9-C; trumpets frequently with extensive subbasal tracheation; position of seta 9-VIII various (Fig. 41) 29

Fig. 41. Pupal cephalothorax and abdomen. a. *Culex pipiens* Linnaeus, b. *C. antillummagnorum* Dyar, c. *Culiseta longiareolata* (Macquart).

28. Setae 8-C and 9-C poorly developed; setae 5-II and 5-III very feebly developed, not or barely reaching onto the following segment; either with seta 5-VII as long as or longer than the following segment or with mid rib of paddle deeply pigmented and seta 5-IV-VI shorter than the following segment; seta 9-III-VI minute; seta 9-VIII with 4 or more branches, about half the length of the paddle or more (Fig. 40a, b); New World tropics and subtropics only . . *Haemagogus* Williston[44]

Without this combination of characters or distribution otherwise . . . . *Aedes* Meigen[45]

29. Trumpets with well developed subbasal tracheation or seta 9-VIII arising well cephalad of the posterior border of the segment, usually both (Fig. 41a, b, 42a-c). . . . . *Culex* Linnaeus[45]

Fig. 42. Pupal cephalothorax. a. *Culex davisi* Kumm, b. *Culex bamborum* Rozeboom & Komp, c. *Culex pseudomelanoconia* Theobald, d. *Aedes aurantius* (Theobald), e. *Aedes longirostris* (Leicester), f. *Aedes gilli* Barraud.

Trumpets with rudimentary basal tracheation at most; seta 9-VIII always arising from the posterior border of the segment (Fig. 41c) . . . . *Culiseta* Felt[4,46]

IV. FOURTH STAGE LARVAE

The larva of genus *Galindomyia* is undescribed.

1. Respiratory siphon absent; seta 1 usually palmate on most abdominal segments (Fig. 43) (Subfamily Anophelinae) 2

Fig. 43. Terminal segments of anopheline larvae. a. *Chagasia bathana* (Dyar), b. *Anopheles balabacensis* Baisas.

Siphon present; seta 1 never palmate 4

2. Anterior flap of spiracular apparatus produced into a long, spinelike process, ventral valves with fringe of fine hairs; palmate hairs characteristically shaped (Fig. 43a); New World tropics only *Chagasia* Cruz

Spiracular apparatus and palmate hairs otherwise 3

3. Inner clypeal setae close together; seta 1 of mesothorax palmate (Fig. 44); northern Australia, Melanesia and Moluccas only . . . . *Bironella* Theobald

Fig. 44. Larval head and thorax. *Bironella hollandi* Taylor. *icl* Inner clypeal setae.

Without this combination of characters and distribution . . . . *Anopheles* Meigen

4. Mouthbrushes with about 10 flattened, nonpectinate blades; antenna with setae 2-A and 3-A arising basad of seta 1-A; comb and pecten absent (Fig. 45) (Subfamily Toxorhynchitinae) . . . . *Toxorhynchites* Theobald[5]

Fig. 45. Larval head and terminal segments. *Toxorhynchites splendens* (Wiedemann).

Mouthbrushes with numerous hairs; antenna with setae 2-A and 3-A distad of 1-A; comb almost always present; pecten present or absent (Subfamily Culicinae) 5

5. Ventral brush with at most 2 pairs of setae, usually only 1, (Fig. 46); New World only[47] 6

Fig. 46. Terminal segments of New World sabethine larvae. a. *Sabethes purpureus* (Theobald), b. *Phoniomyia fuscipes* (Edwards). *vbr* Ventral brush, *lcs* Lower caudal seta.

Ventral brush with 3 pairs of setae or more or species confined to Old World 10

6. Setae of ventral brush as long, or almost as long, as lower caudal setae; siphon relatively slender, at least about 3.5 times as long as saddle; comb teeth in a single row or with at most 3 or 4 detached (Fig. 46a) . . . . *Sabethes* Robineau-Desvoidy
Wyeomyia Theobald (part)[48]

Setae of ventral brush much shorter than lower caudal setae or siphon short and stout or comb teeth in at least 2 complete rows or with any combination of these 7

7. Siphon long, slender, strongly tapering, about 5 times as long as its breadth at base or more, with numerous long, unbranched setae dorsally and ventrally; comb teeth in 2 or more rows (Fig. 46b) . . . *Phoniomyia* Theobald
Wyeomyia Theobald (part)[49]

Siphon otherwise or comb teeth in a single, regular row (sometimes arising from a sclerotized plate) or both 8

8. Siphon short, stout, at most about 3 times as long as its breadth at base with several branched setae dorsally and ventrally; head setae 4-C, 5-C and 6-C single; maxillary "horns" not developed; comb with about 4-7 teeth in a single row, not arising from a sclerotized plate (Fig. 47) . . . . *Limatus* Theobald

Fig. 47. Larval head and terminal segments. *Limatus durhamii* Theobald. *mx* Maxilla.

Without this combination of characters; maxillary "horns" present in some species (Fig. 48) 9

Fig. 48. Larval head and terminal segments. *Trichoprosopon frontosum* (Theobald). *mx* Maxilla.

9. Mandible greatly enlarged (Fig. 49a) or maxilla with a large "horn" (Fig. 48); siphon with a dense midventral row of setae extending for almost the whole length (Fig. 48) or setae of ventral brush at least 3 times as long as saddle . . . . *Trichoprosopon* Theobald

Fig. 49. Larval head and terminal segments. a. *Trichoprosopon digitatum* (Rondani), b. *Wyeomyia confusa* (Lutz). *md* Mandible, *mx* Maxilla.

Mandibles never thus; maxilla seldom with conspicuous "horn", if so then ventral brush or siphon otherwise . . . . . . *Wyeomyia* Theobald (part)[50]

10. Ventral brush with a single pair of setae (1 or 2 small, supplementary hairs present in occasional individuals); antenna short, without articulated apical segment; siphon with 2 or (usually) more subdorsal setae as well as various ventral or subventral setae (Fig. 50). 11

Fig. 50. Larval head, prothorax and terminal segments. a. *Malaya genurostris* Leicester, b. *Topomyia gracilis* Leicester.

Without this combination of characters[51] 13

11. Prothoracic setae 5 and 6 large fan-shaped tufts arising from a common tubercle; comb usually a patch of teeth in 2 or more rows (Fig. 50); seta 6 of mesothorax and seta 7 of metathorax never stout spines; tropical Africa, southern Asia and Melanesia only 12

Fig. 51. Larval head and terminal segments. a. *Mimomyia (Ravenalites) deguzmanae* (Mattingly), b. *Culex (Acallyntrum) belkini* Stone & Penn.

Prothoracic setae otherwise; seta 6 of mesothorax and/or seta 7 of metathorax often a stout spine; comb teeth in a single row, sometimes arising from a sclerotized plate, occasionally absent or reduced to a single tooth (Fig. 52), or distribution otherwise . . . . *Tripteroides* Giles[52,53]

Fig. 52. Head, thorax and terminal segments of larva. Genus *Tripteroides*. a. *T. powelli* (Ludlow), b. *T. stonei* Belkin.

12. Either abdominal segments IV-VI (at least) with 1 or more pairs of stellate setae with numerous short, stiff branches (Fig. 50b, 53a) or maxillae with conspicuous "horns" (Fig. 53b) or siphon at least 6 times as long as saddle (Fig. 53c); southern and eastern Asia and Melanesia only . . . . *Topomyia* Leicester[53]

Fig. 53. Genus *Topomyia*. a. Segment V of larval abdomen. *T. tenuis* Edwards, b. Larval head., *T. decorabilis* Leicester, c. Terminal segments of larva. *T. spathulirostris* Edwards. *mx* Maxilla.

Setae of this kind never present; maxillae never with "horns"; siphon at most about 4 times as long as saddle (Fig. 50a); Old World tropics from Africa to eastern Asia and Melanesia . . . . *Malaya* Leicester

13. Siphon modified for piercing plant tissues, with sclerotized saw-toothed process at tip (Fig. 54a) . . . . *Mansonia* Blanchard

Fig. 54. Terminal segments of larva. a. *Mansonia uniformis* (Theobald), b. *Mimomyia hybrida* (Leicester).

Siphon not so modified or, if so, without any saw-toothed process (Fig. 54b) 54 14

14. Antenna broad, flattened; some thoracic setae enormously long, others stellate; tip of siphon with paired hooks and branched setae (Fig. 55) . . . . *Aedeomyia* Theobald

Fig. 55. Larval head, thorax and terminal segments. *Aedeomyia catasticta* Knab.

Antenna, thoracic setae and siphon otherwise 15

15. Siphon with a single pair of subventral setae; metathoracic setae 9-12 very short, unbranched (Fig. 56); New Zealand only . . . . *Opifex* Hutton

Fig. 56. Larval thorax and terminal segments. *Opifex fuscus* Hutton.

Without this combination of characters or distribution otherwise 16

16. Siphon with a single pair of subventral setae arising at not more than one-fifth of the distance from base to apex; comb a single row of at most 20 teeth; siphon less than twice as long as saddle (Fig. 57); Old World tropics only 17

Fig. 57. Larval head and terminal segments. a. *Hodgesia malayi* Leicester, b. *Ficalbia minima* (Theobald).

Without this combination of characters or distribution otherwise 55 18

17. Head seta 5 arising almost directly behind 6 which is single; head seta 4 nearly as long as 5; pecten with at least 3 teeth, usually more (Fig. 57a) . . . . *Hodgesia* Theobald

Head setae otherwise; pecten with at most 2 teeth (Fig. 57b) . . . . *Ficalbia* Theobald[56]

18. Distal portion of antenna freely articulated (Fig. 58); siphon with a single pair of subventral setae; pecten with at most 4 teeth on either side, often fewer; ventral brush with 2-4 pairs of setae, 1 or 2 supernumerary setae occasionally present in addition; Old World tropics only . . . . *Mimomyia* Theobald[14,15,54]

Fig. 58. Larval head. Genus *Mimomyia*. a. *M. (Mimomyia) chamberlaini* Ludlow, b. *M. (M.) plumosa* (Theobald), c. *M. (Ravenalites) deguzmanae* (Mattingly).

Antenna never thus; siphon often otherwise; ventral brush with at least 3 pairs of setae, often with 5 or more pairs 19

19. Pecten absent; siphon very short and broad with a single pair of subventral setae arising beyond half way; antennal seta minute (Fig. 59a); southern Asia, Japan and Melanesia only . . . . *Armigeres* Theobald[57]

Fig. 59. Larval head and terminal segments. a. *Armigeres subalbatus* (Coquillett), b. *Orthopodomyia wilsoni* Macdonald.

Without this combination of characters and distribution 20

20. Pecten absent; antennal seta arising on basal half, with 4 or more branches; head setae 5 and 6 long and branched; siphon at least about 2.5 times as long as its breadth at base, often much longer, with a single pair of subventral setae; ventral brush with 6 pairs of setae or more (Fig. 59b) . . . . *Orthopodomyia* Theobald[57]

Without this combination of characters 21

21. Head with a pair of conspicuous lateral pouches; siphon with a pair of large subventral setae and 2 pairs of smaller setae distal to this, 1 subdorsal, the other subventral; saddle poorly developed; a small accessory sclerotized plate usually present basad of the ventral brush (Fig. 60a); New World only . . . . *Deinocerites* Theobald

Fig. 60. Larval head and terminal segments. a. *Deinocerites cancer* Theobald, b. *Culiseta longiareolata* (Macquart), c. *Culiseta littleri* (Taylor).

Without this combination of characters 22

22. Siphon with a single pair of subventral setae arising at not less than a quarter of the distance from base to apex, usually more; (a pair of minute subdorsal setae also usually present near tip) (Figs. 62-65)[58] 23

Siphon with subventral setae more numerous or (in 1 or 2 neotropical species) entirely absent or if with a single pair of such setae then these arising at about one-fifth of the distance from base to apex or less (Figs. 60b, 69a) 30

23. Maxillary suture absent or incomplete, not reaching posterior tentorial pit (Fig. 61a); head seta 5 or 6 or both often flattened, barbed, spinelike; comb often arising from a large sclerotized plate (Fig. 62a) . . . . *Uranotaenia* Lynch Arribalzaga[57, 59]

Fig. 61. Larval head in ventral view. a. *Uranotaenia sapphirina* (Osten-Sacken), b. *Aedes aegypti* (Linnaeus). *m* Mentum, *ms* Maxillary suture, *ptp* Posterior tentorial pit.

Fig. 62. Larval head and terminal segments. a. *Uranotaenia sapphirina*, b. *Aedes (Stegomyia) annandalei* (Theobald).

Maxillary suture well developed, extending from the level of the mentum to the posterior tentorial pit (Fig. 61b); head setae 5 and 6 sometimes single and barbed but never spinelike; comb plate, if present, smaller (Fig. 62b) 24

24. Antennal seta and head setae 4-7 small, delicate, inconspicuous; comb teeth never in a regular row; siphon at most about 3.5 times as long as its breadth at base, usually much shorter; pecten with at most 7 teeth, usually fewer (sometimes absent); ventral brush with 4 (rarely 5) pairs of stout, strongly plumose setae, some of them usually single (Fig. 63a); Ethiopian Region only . . . . *Eretmapodites* Theobald[60]

Fig. 63. Larval head and terminal segments. a. *Eretmapodites chrysogaster* Graham, b. *Aedes aegypti* (Linnaeus), c. Segment V of larval abdomen, *E. chrysogaster*.

Without this combination of characters and distribution 25

25. Comb with at most 10 teeth, in a single row; head seta 5 single, 4 and 6 shorter than 5 with 2 or more delicate branches, 7 single and much longer than any of these (Fig. 64); Southeast Asia only . . . . *Udaya* Thurman

Fig. 64. Larval head and terminal segments. Genus *Udaya*. a. *U. argyrurus* (Edwards), b. *U. lucaris* Macdonald & Mattingly.

Comb various; head setae otherwise; distribution various 26

26. Comb teeth in a single row; saddle incomplete with strongly developed spines along the distal edge; head seta 7 slender, delicate, single or bifid, 5 and 6 long, single, somewhat stouter than 7 but not conspicuously thickened (Fig. 65a); Southeast Asia only . . . . *Zeugnomyia* Leicester[61]

Fig. 65. Larval head and terminal segments. a. *Zeugnomyia aguilari* Baisas & Feliciano, b. *Heizmannia scintillans* Ludlow.

Without this combination of characters and distribution 27

27. Head seta 4 large and conspicuous, 6 markedly anterior to 5 and 7, 7 with at least 5 branches, usually more; stellate setae absent; thoracic integument devoid of spicules; comb teeth never fused at base or arising from a sclerotized plate; pecten teeth with secondary denticles, if any, confined to base; saddle incomplete (Fig. 65b); southern and eastern Asia only . . . . *Heizmannia* Ludlow[62]

Without this combination of characters and distribution 28

Fig. 66. a. Larval head. *Aedes (Christophersiomyia) gombakensis* Mattingly, b. Larval head and thorax. *Aedes (Finlaya) poecilus* (Theobald).

28. Comb teeth in a single, regular row; anal segment completely ringed by saddle, the latter pierced in the mid line by the proximal setae of the ventral brush which form a midventral row extending almost to the base of the anal segment (Fig. 67a, b); New World only . . . . *Psorophora* Robineau-Desvoidy[63]

Fig. 67. Larval head and terminal segments. a. *Psorophora howardii* Coquillett, b. *Psorophora signipennis* (Coquillett), c. *Aedes diantaeus* Howard, Dyar & Knab, d. *Aedes atlanticus* Dyar & Knab.

Without this combination of characters and distribution 29

29. Antenna short, smooth or almost so; antennal seta very small, single or bifid, rarely trifid; head setae 5 and 6 slender, single or bifid, 6 markedly anterior to 7; saddle incomplete; ventral brush arising from a sclerotized boss (Fig. 68a); New World tropics and subtropics only . . . . *Haemagogus* Williston[64]
Aedes Meigen (part)

Fig. 68. Larval head and terminal segments. a. *Haemagogus capricornii* Lutz, b. *Aedes serratus* (Theobald).

Without this combination of characters and distribution . . . . *Aedes* Meigen (part)[64]

30. Siphon with a single pair of subventral setae arising near base (with or without a midventral row of setae beyond this) (Figs. 60b, 69a) . . . . *Culiseta* Felt[55,58]

Fig. 69. Terminal segments of larva. a. *Culiseta melanura* (Coquillett), b. *Culex pipiens* Linnaeus, c. *Culex modestus* Ficalbi.

Siphon with subventral setae usually well removed from mid line (Fig. 69b), occasionally forming a midventral row (Fig. 69c) but never with a separate pair arising near base . . . . *Culex* Linnaeus[55]

NOTES ON THE KEYS

1. Outside the genus *Bironella* this condition is found only in certain members of the *Anopheles leucosphyrus* Dönitz complex.

2. Genera *Malaya*, *Hodgesia*, *Uranotaenia*, *Zeugnomyia* and, in part, *Topomyia* are characterized by the fact that vein 1A turns down abruptly to reach the wing margin before or at most very slightly beyond the base of the fork of vein Cu (Fig. 6a). This is a very distinctive character shared only by *Aedes* subgenus *Cancraedes* and the males of a few *Culex*. In some *Limatus* spp. there is a tendency for the tip of vein 1A to turn down abruptly but this seems always to take place well beyond the base of the fork of vein Cu. In *Zeugnomyia* the tip of vein 1A turns down abruptly but sometimes reaches the wing margin slightly beyond the base of the fork of vein Cu. Doubtful specimens are easily recognized by the vertical silvery stripe extending from the prealar area down to the mid coxa (Fig. 7).

3. *Topomyia* and some species of the closely related genus *Malaya* (formerly *Harpagomyia)* are very similarly ornamented, having a conspicuous median longitudinal white or silvery stripe on the scutum (occasionally brownish in *Topomyia*). They can, however, always be distinguished with ease by the proboscis. This is strongly swollen towards the tip in some *Topomyia* but never shows the extensive modifications, associated with feeding on the regurgitations of ants, which are found in *Malaya*.

4. Formerly called *Theobaldia* by workers in the Old World.

5. *Tripteroides*, *Malaya* and *Topomyia*, together with the New World genera in couplets 14-17, form the tribe Sabethini of the subfamily Culicinae. The other subfamilies of Culicidae are the Anophelinae *(Anopheles*, *Bironella*, *Chagasia)* and the Toxorhynchitinae with the single genus *Toxorhynchites* *(Megarhinus* of earlier authors).

6. It has been proposed to place the New Zealand species *T. argyropus* (Walker) in a monotypic genus *Maorigoeldia* but this is retained here as a subgenus of *Tripteroides*.

7. One species of *Phoniomyia* has the tarsi entirely dark in a proportion of individuals. The very short antenna, of the order of a third of the length of the proboscis, distinguishes it from other New World sabethines with comparable proboscis. Some *Trichoprosopon* or a few *Wyeomyia* spp. with unusually long proboscis might be confused but these can be recognized by the entirely dark scutellum or tarsi or both. A few *Trichoprosopon* spp. with white tarsal markings have a peacock blue, rather than silvery, scale patch on the mid lobe of the scutellum.

8. A few *Trichoprosopon* spp. have scutal scales with dull, bluish lustre but they are never brightly iridescent. A few *Wyeomyia* spp. with bright metallic scutal scaling might run down here but these are distinguished by the presence of prealar bristles.

9. Two species lacking postnotal bristles have been placed in a separate genus, *Mattinglyia*. I prefer to treat this as a subgenus of *Heizmannia* and am describing an annectant species elsewhere.

10. Known only from a single species with undescribed early stages and uncertain affinities.

11. *Armigeres* differs markedly from *Mansonia* in the broad scaled vertex and from *Udaya* in the heavily scaled pleuron. *Aedes* is distinguished, except from *Armigeres* s. str., by the presence of postspiracular bristles. *Aedes* subgenus *Alanstonea* resembles *Armigeres* s. str. closely in general facies but differs in having no lower mesepimeral bristle. All other *Aedes* lack the curved proboscis. Another character distinguishing many *Aedes* is the presence of acrostichal or dorsocentral bristles.

12. Some authors recognize *Mansonia* and *Coquillettidia* as distinct genera, each with two subgenera. I prefer to include all four subgenera in the genus *Mansonia*. Apart from a single species, all the subgenera, except *Coquillettidia*, run to the present couplet. *Coquillettidia* and one species of subgenus *Rhynchotaenia* run to couplet 32.

13. *Culex postspiraculosus* Lee, from Australia, would also run down here. It is the only known *Culex* in which postspiracular bristles occur otherwise than as an occasional aberration. It is recognizable as a *Culex* by the well developed pulvilli. (See Fig. 15a). One species of *Aedes*, formerly placed in a separate genus, *Ayurakitia*, lacks postspiracular bristles but runs down correctly, via couplet 25, to the present couplet since it has toothed fore and mid tarsal claws and palps less than a quarter of the length of the proboscis. (See also note 27)

14. The genus *Ficalbia* is currently held to include four subgenera. In my view, however, the nominotypical subgenus differs too widely from the others for this treatment to be acceptable. I prefer, therefore, to treat *Ficalbia* s. str. as a separate genus, referring the other three subgenera to genus *Mimomyia*. Diagnostic characters are given in the keys.

15. One species extends beyond the tropics in the extreme eastern part of its range, as far north as Okinawa. Two others extend some distance south of the tropics in Queensland.

16. Subgenus *Coquillettidia* and one species of subgenus *Rhynchotaenia* lacking postspiracular bristles. (See note 12). One species of *Armigeres*, with simple claws, would also run down here but this can be immediately recognized by the flat scaled vertex, palps more than half as long as proboscis and the curved proboscis (as in Fig. 12).

17. Based on external characters only.

18. Males of *Aedes* subgenus *Cancraedes*, from southern Asia, would also run down here. They differ from *Uranotaenia* in having postspiracular bristles and 2 or more lower mesepimerals. (One or none in *Uranotaenia*).

19. A few species of *Wyeomyia*, with unusually long proboscis, might run down here but all of these have either the scutellum or the tarsi entirely dark scaled or both. One species of *Phoniomyia* has the tarsi entirely dark in a porportion of individuals but this is recognizable from any *Wyeomyia* with a comparable proboscis by the very short antenna (not more than about one third of the length of the proboscis).

20. One or two species of *Wyeomyia* with bright metallic scutal scaling might run down here but these can be recognized by the presence of prealar bristles.

21. The very long male palps will separate most *Trichoprosopon* spp. from other New World sabethines. Some of the few *Trichoprosopon* spp. with

short male palps have narrow scutal scales which are completely diagnostic. The others have the two terminal antennal flagellomeres greatly elongated, together about 10 times as long as the antepenultimate flagellomere or more (Fig. 16d). No *Trichoprosopon* spp. have bright, metallic scutal scaling though a few have scutal scales with dull bluish reflection.

22. See note 9. Males of subgenus *Mattinglyia* differ from those of the nominotypical subgenus in having quite strongly plumose antennae and in lacking postnotal setae.

23. Some *Haemagogus* have short male palps and reduced flagellar setae but their antenna in no way resembles that of *Galindomyia*. It is subplumose with all flagellomeres, except the last, very short.

24. All except subgenus *Coquillettidia* and one species of subgenus *Rhynchotaenia*. (See notes 16 and 27).

25. The Australian *Culex postspiraculosus* would run down here. (See note 13). It can be recognized by the long, upturned, tapering palps (Fig. 19a).

26. Subgenus *Coquillettidia* only. (See note 24).

27. Subgenus *Leicesteria* only. Individuals of *Mansonia (Rhynchotaenia) arribalzagai* Theobald lacking postspiracular bristles would also run down here but this species and subgenus are found only in the New World tropics. *Aedes (Kompia) purpureipes* Aitken, which is almost unique among *Aedes* in lacking postspiracular bristles, would also run down here but this species is found only in the United States and Mexico.

28. *Aedes* subgenus *Ayurakitia* would run down here. (See note 13). It includes only one species and is known only from Thailand. It differs from *Orthopodomyia* in many details of ornamentation, among them the restriction of the pleural scaling to four small silvery spots.

29. In some *Bironella* spp. the accessory paddle seta is absent or arises level with the apical paddle seta. These can at once be recognized as anopheline by the character of seta 9 and the trumpets. Among non-anopheline genera only *Aedeomyia* (Fig. 27b) has seta 9 approximately as in *Anopheles*. One species of *Uranotaenia* has a trumpet of anopheline type, but this is recognizable by the other characters given.

30. Some *Mimomyia* have a rather similar trumpet but, apart from the African *M. perplexens*, these have the float hair well developed. *M. perplexens* has the trumpet modified in quite a different way from any *Mansonia* sp. (Fig. 28a). Pupae of subgenus *Coquillettidia*, and apparently also *Rhynchotaenia*, have the tips of the trumpets equipped with backwardly directed barbs which prevent them being withdrawn. The tips break off short when the pupa rises to the surface at the time of emergence. They are consequently seldom seen in cast skins.

31. Absent only in some *Mimomyia* with a highly characteristic type of paddle.

32. Complete separation of *Tripteroides* pupae from those of other Old World sabethines is not at present possible but almost all can be recognized by the combination of characters given in the key.

33. All but two of the known *Topomyia* pupae have seta 6-VII as in Fig. 24b. Both the others have it as in *Malaya* but differ from that genus in having all or most of the paddle surface spiculate (Fig. 23a).

34. *Trichoprosopon magnum* (Fig. 25e) has longer trumpets than are usual in the genus but differs from all known *Phoniomyia* in having them strongly expanded at the tip and from known *Limatus* spp. in the large paddles and relatively shallow excavation of the posterior border of segment VIII (Fig. 23f). *Wyeomyia circumcincta* would key here with *Phoniomyia* but has the trumpets much longer than any known in that genus (Fig. 25f).

35. Pupae of *Wyeomyia* cannot be entirely separated from those of *Sabethes* or *Trichoprosopon* on currently available material and descriptions.

36. Some *Sabethes* spp. have seta 9-VI more strongly developed, others less strongly developed, than in the figure but it is always more conspicuous than in any known *Trichoprosopon*. All those *Sabethes* spp. with feebly developed seta 9-VI which are known to me have seta 5-VI more strongly developed than in any known *Trichoprosopon* except perhaps *Tr. magnum* with its distinctive trumpet (Fig. 25e and see note 34).

37. Subgenera *Etorleptiomyia* and *Ravenalites* of genus *Mimomyia* have highly distinctive pupae unlikely to be confused with any others (Fig. 28d, e). The resemblance of some pupae of subgenus *Mimomyia* to those of *Mansonia* has already been mentioned (note 30). A few *Uranotaenia* resemble *Mimomyia* superficially in the shape of the paddle and the long trumpets but can be recognized by the excavation of the basal part of the inner half of the paddle and the presence of paired setulae on abdominal segment IX (Fig. 30a). The African *M. splendens* Theobald is unique in having a fringe of long, hairlike spicules on both borders of the paddle but it should run down correctly.

38. The characteristic paddle shape is usually conspicuous, least so in one or two aberrant species resembling the Sabethini but differing from these in the presence of an apical paddle seta (Fig. 30b). A few *Aedes (Lorrainea)* and *Armigeres* s. str. have a similar type of paddle but with a delicate fringe on both borders which is very rare in *Uranotaenia* (Figs. 32a, b, 35a). The few *Uranotaenia* with such a fringe can be recognized from both the above genera by the reduction of seta 9-VIII and the paddle seta (Fig. 30c). One or two *Haemagogus* spp. have a somewhat similar paddle but are easily recognized by the combination of characters given in couplet 27. Paired setulae are present on abdominal segment IX in most *Uranotaenia* (Fig. 30a) but absent in a few atypical ones (Fig. 30b, c).

39. The only species which might be confused are a few members of the *Aedes (Stegomyia) africanus* group (Fig. 31c) but these have the paddle fringe and apical seta less strongly developed and differ in various other characters among them the cephalothoracic setae as indicated in the key.

40. *Armigeres malayi* (Fig. 32b) has seta 6-VI less strongly developed than in other species but still much better developed than 5-VI. One species of *Heizmannia* (Fig. 32c) would run here but this differs from *Arm. malayi* in the much more strongly developed seta 9-VIII and from other *Armigeres* in having seta 6-VI much less strongly developed.

41. *Aedes (Lorrainea)* spp. have a similar paddle fringe but are recognizable by the characteristic paddle shape (Fig. 35a and see note 38). *Ae.*

(Diceromyia) spp. differ in the indented tip of the paddle (Fig. 35b) except for *Ae. periskelatus* which has the apical paddle seta longer and stouter than in *Heizmannia* (Fig. 35c) as do some *Stegomyia* (Fig. 36a). A few other *Stegomyia* present difficulties but can be recognized by having seta 5 on most segments intermediate in type (Fig. 36b), less reduced than in *H. aureochaeta* (Fig. 34b), more so than in other *Heizmannia* (Figs. 33d, 34a).

42. Some *Aedes*, particularly *Ae. (Finlaya)* spp., have a similar paddle but differ either in the much longer apical paddle seta or in the reduction of seta 9-VII-VIII or both. The relative position of setae 8-C and 9-C also furnishes an absolute distinction from *Aedes*. (See Fig. 40c).

43. Subgenera *Psorophora* and *Janthinosoma* are distinguished from other genera by the lobed posterior border of segment VIII and/or the toothed posterolateral corner of segment IV. Most species of subgenus *Grabhamia* are distinguished, except from *Culex* and one species of *Culiseta* by the presence of an accessory paddle seta. *Culex* are readily distinguishable by the tracheated trumpet or anterior displacement of seta 9-VIII, usually both. The only New World *Culiseta* with an accessory paddle seta, *C. melanura*, is distinguished by having the trumpet cleft nearly to base, i.e. with very short tubular portion. *Aedes atropalpus* is said sometimes to have an accessory paddle seta but this species can be recognized by the short, broad paddle, almost as broad as, or broader than, long with apex flattened and more or less indented. In *Grabhamia* the paddle is distinctly longer than broad or has a rounded or pointed apex, usually both. One species of *Grabhamia* from the Caribbean area lacks the accessory paddle seta and would run to *Aedes* in couplet 28. It can be recognized by having seta 2-II well inside 3-II and seta 5-II almost directly anterior to 3-II (Fig. 39c).

44. The only *Haemagogus* sp. known to me which might not run down here is *H. chalcospilans*. It is recognizable from any known *Aedes* or *Psorophora* by the combination of very short setae 5-II and 5-III, setae 5-IV and 5-V only a little longer than the following segments, seta 9-III-VI minute, seta 9-VII with several branches, 9-VIII about half the length of the paddle, paddle with apex pointed and short, branched apical paddle seta. A number of *Aedes* otherwise resembling *Haemagogus* have seta 5 on one or more abdominal segments as long as the two following segments together. In *Haemagogus* seta 5 is never more than a little longer than the following segment. *Aedes aegypti* is at once distinguished by the well developed seta 9-III-VI (Fig. 40c).

45. The relative position of setae 8-C and 9-C appears to be almost completely diagnostic as between *Aedes* and *Culex*. In the former, however, seta 8-C occasionally arises somewhat posterior to the trumpet (Fig. 40c) while in the latter it arises further forward in some species than in others. In comparing pupal skins, therefore, the specimens must be carefully oriented. A few small New World *Culex* apparently have these setae as in *Aedes* but these have trumpets with subbasal tracheation of a kind unknown in the New World aedine genera (Fig. 41b). In the great majority of *Culex* seta 9-VIII arises well cephalad of the posterior border of the segment (Fig. 41a). The few species known to me in which this is not so have slender trumpets with extensive tracheation of a kind almost unknown in *Aedes* (Fig. 42a-c). They are all small or very small species. The few *Aedes* with comparable tracheation are all Old World species and are either large or very large species or have seta 8-C much further forward than in any Old World *Culex* (Fig. 42d, e). In contrast to this seta 9-III

rarely arises cephalad of the posterior border of the segment in *Aedes*. All the species in which it is known to do so have trumpets with poorly developed basal tracheation and seta 8-C arising well forward (Fig. 42f). (See also note 43).

46. The relative position of setae 8-C and 9-C appears to be absolutely diagnostic as between *Aedes* and *Culiseta* (Figs. 40c, 41c). In the latter seta 8-C always arises far back. Additional partial characters are the abnormally long seta 1-IV-VI in most *Culiseta* (but not the tropical African species) and the presence of an accessory paddle seta in about half the known species. These characters should not, however, be needed for diagnosis.

47. Two species of *Sabethes* have a pair of small, supernumerary setae in addition to the single pair of well developed setae by which the ventral brush is represented in all other known sabethines.

48. Most *Wyeomyia* spp. have the setae of the ventral brush short (often stellate). In some they are longer, though still much shorter than the lower caudal seta. All but about 3 of the remaining species can be recognized by the arrangement of the comb teeth as indicated in the key. Some *Sabethes* spp. have a pair of dorsal, chitinous hooks on abdominal segment VII. These are unknown in any other New World genus.

49. A few *Trichoprosopon* spp. have the siphon moderately long, slender, tapering with several short subdorsal setae. In these, however, the ventral setae form a long row of branched tufts quite unlike anything found in *Phoniomyia*. Two or three *Wyeomyia* spp. would run down here and are best separated at the species level.

50. None of the few species of *Wyeomyia* with the siphon as in Fig. 48 has a conspicuous maxillary horn. Two species which might run down to the first half of the present couplet are *W. confusa* (Fig. 49b) and *W. occulta*. The former, however, has an enormously elongated maxilla, quite unlike that of any other species in either genus, while the latter differs from any known *Trichoprosopon* lacking a mid-ventral row of setae on the siphon in having a comb of numerous scales in a patch three rows deep. An additional character serving to distinguish most, though not quite all, species of *Trichoprosopon* with the siphon otherwise than in Fig. 48 is the very small number of comb teeth (5 or less; not less than 10 in *Wyeomyia* spp. with maxillary horn).

51. Two African *Culex* spp. lack the ventral brush entirely. In *Mimomyia* subgenus *Ravenalites* it comprises two pairs of setae only. Some members of this subgenus have a superficial resemblance to *Tripteroides* but they can be recognized at once by the articulated terminal joint of the antenna and the presence of only one pair of subventral setae on the siphon (Fig. 51a). In *Culex (Acallyntrum)* spp. from Melanesia the ventral brush is represented by a single pair of setae. Larvae of these species differ from those of the sabethine genera in lacking dorsal or subdorsal setae on the siphon (Fig. 51b). In addition the larvae of the sabethine genera almost always have the antenna and antennal seta much reduced while in many the thorax and abdomen are covered with large stellate setae (Fig. 52a), a condition not met with in *Acallyntrum* .

52. Some *Topomyia* have the comb reduced to a single row or almost so. These, however, can at once be separated from *Tripteroides*, as can all other *Topomyia* and *Malaya*, by the large fan-shaped setae 5 and 6 on the

prothorax (Fig. 50). A few *Topomyia* spp. have well developed stellate setae on the thorax and/or abdomen but these are never so strongly developed as in many *Tripteroides* (Figs. 50b, 52a). The modified mesothoracic seta 6 and/or metathoracic seta 7 (Fig. 52a), when present as they are in the majority of species, are completely diagnostic of *Tripteroides*. *T. (Maorigoeldia) argyropus* is unique in the genus in having a comb with numerous scales in a patch but this species is confined to New Zealand.

53. Two of the three known species of *Topomyia* with strongly developed maxillary horns lack stellate setae on the abdomen. They are, however, readily distinguished from *Malaya* in which, so far as is known, maxillary horns never occur. Horns of this kind are found in various Australasian *Tripteroides* but not in either of the known Australasian *Topomyia* (one undescribed). One species of *Topomyia (T. spathulirostris)* lacks maxillary horns and has the stellate setae poorly developed. It can, however, be easily recognized by the siphon which is much longer than in any *Malaya* (Fig. 53c).

54. A few African, Southeast Asian and Melanesian *Mimomyia* have a piercing siphon (Fig. 54b) but this is much less elaborately modified than in *Mansonia* and there should be no danger of confusion.

55. Most *Culiseta* have a pair of subventral setae arising at or near the base of the siphon and are without other siphonal setae, but only three of them are found in the tropics. Two of these are recognizable by the fact that the comb teeth are arranged in a patch (Fig. 60b) and the third by the presence of a midventral row of setae on the siphon.

56. An additional character is the presence in most *Hodgesia* larvae of several long, very delicate setae on the anal segment anterior to the barred area of the ventral brush (Fig. 57a). These are easily broken off, however, and when this happens their bases are virtually impossible to detect. One or two short, delicate setae anterior to the ventral brush are also sometimes seen in *Ficalbia*.

57. The only culicine genera consistently lacking a pecten are *Armigeres* and *Orthopodomyia*. Among the other genera remaining to be keyed this condition is found in whole or in part in two species of *Culex*, two of *Uranotaenia* and half dozen *Eretmapodites*. The latter are confined to the Ethiopian Region where *Armigeres* is absent and *Orthopodomyia* very rare. They differ from *Orthopodomyia* in many characters including the reduced antennal seta, head setae and ventral brush (Fig. 63a). Of the two *Culex* spp. *C. moucheti* lacks the ventral brush entirely while *C. dispectus* has 4 pairs of subventral tufts on the siphon. The two *Uranotaenia* spp. both occur outside the known geographical range of *Armigeres* and *Orthopodomyia*. One (*U. browni* from the Seychelles) has the siphon densely covered with long spicules. The other (*U. colocasiae* from Fiji) has the ventral brush much as in *Eretmapodites*.

58. One species of *Culiseta*, known only from southern Australia, would run down here instead of to the second half of the couplet. It is easily recognized from any other species with which it might be confused by the long siphon, complete saddle and long head setae 5 and 6 and antennae (Fig. 60c).

59. New World *Uranotaenia* larvae are recognizable also by the more or less thickened, barbed, spinelike head setae 5 and 6, very large comb plate and apically fringed pecten scales. Many of the Old World species

also exhibit some or all of these characters but some do not and for these the only absolutely diagnostic character is the absence or extreme reduction of the maxillary suture (Fig. 61a).

60. The only species likely to be confused are some *Aedes* subgenus *Stegomyia*. These are easily recognized by the long, slender, non-plumose setae of the ventral brush (Fig. 63b). Most of them also differ in having the comb teeth in a single row and in the more numerous pecten teeth. A character which is completely diagnostic for *Eretmapodites*, when present, is the occurrence of rugose, sclerotized bosses at the bases of the principal lateral abdominal setae (Fig. 63c).

61. Among the remaining Southeast Asian genera with a single pair of subventral setae on the siphon *Heizmannia* is distinguished by the much more strongly developed head seta 7 (and usually also 5) and less strongly spiculate saddle edge (Fig. 65b). Many *Aedes* differ in having head seta 7 (at least) more strongly developed or the comb teeth in more than one row. Those which do not differ in either of these characters, e.g. most *Stegomyia* are distinguished by having the saddle edge finely spiculate at most while some also differ in having the comb teeth arising from a sclerotized plate. One Southeast Asian *Finlaya* (*Aedes harperi* from the Philippines) seems from the published description to be distinguishable only at the species level.

62. Larvae of this genus closely resemble those of some *Aedes*. They often have a characteristic head seta 6 with two unequal branches (Fig. 65b). This, when present, is absolutely diagnostic except from *Aedes* subgenus *Christophersiomyia*, easily recognized by the much smaller head seta 4 (Fig. 66a) and one or two *Aedes (Finlaya)* spp. differing in other characters given in the key. *Ae. (Christophersiomyia)* spp., like many other *Aedes*, are also distinguished by the fact that head seta 6 arises only very slightly, if at all, anterior to 7. *Aedes* spp. resembling *Heizmannia* in the well developed head seta 4 and the position of head seta 6, e.g. many *Ae. (Stegomyia)* spp., can be recognized by the feebly developed head seta 7 (Fig. 62b). Other characters serving to separate a few doubtful species are the presence of stellate setae on thorax and abdomen (Fig. 66b) or the possession of a spiculated thoracic and abdominal integument.

63. Larvae of subgenus *Psorophora* s. str. have the mouthbrushes modified for predation (Fig. 67a) and are unlikely to be mistaken for anything else. Those of the other subgenera show some resemblances to *Aedes*. However, most New World *Aedes* have the comb teeth in two or more rows while those which do not either have the saddle incomplete (Fig. 67c) or the ventral brush confined to that part of the anal segment which is not ringed by the saddle (Fig. 67d). None of them have the comb arising from a sclerotized plate as in many *Psorophora* (Fig. 67b). Some *Haemagogus* have the comb arising from a small sclerotized plate but these all have the saddle incomplete and lack the anterior extension of the ventral brush. They are also distinguished by the much reduced antenna (Fig. 68a).

64. Most New World *Aedes* are distinguishable from *Haemagogus* either by the longer or more strongly spiculate antenna, position and branching of the head setae, complete saddle or absence of lateral sclerotizations from the barred area at the base of the ventral brush (Fig. 68b) or by a combination of these. There remain a number of *Aedes*, particularly in the subgenera *Finlaya* and *Howardina*, which are best separated at the species level.

BIBLIOGRAPHY

As a source of references to the taxonomic literature the Synoptic Catalog (Stone et al., 1959) and supplements (Stone, 1961-70) are indispensable. They can be kept up to date with the aid of one of the monthly bibliographies. The Bulletin Analytique d'Entomologie Medicale et Veterinaire, published by the Office de la Recherche Scientifique et Technique Outre-mer at Bondy, Seine-et-Oise, is the best. As a general introduction to the fauna of the various regions, and a source of further references, the following are recommended.

Palaearctic Region

Gutsevitch et al. (1970), Guy (1959), Kramar (1958), La Casse & Yamaguti (1950), Mattingly & Knight (1956), Mihalyi (1963), Mohrig (1969), Natvig (1948), Rioux (1958), Senevet & Andarelli (1959), University of Maryland (1963).

Ethiopian Region

Edwards (1941), Gillies & de Meillon (1968), Grjebine (1966), Haddow et al. (1951), Hamon (1963), Hopkins (1952), Leeson (1958), Mattingly (1952, 1953), Mattingly & Brown (1955), Mattingly & Lips (1953), Muspratt (1955, 1956), Ovazza et al. (1956), Van Someren et al. (1955).

Oriental Region

Barraud (1934), Bonne-Wepster (1954), Borel (1930), Bram (1967a), Christophers (1933), Delfinado (1966), Lien (1968), Macdonald (1957, 1960), Mattingly (1965), Reid (1968), Reuben (1969), Thurman (1959), Tyson (1970), Wharton (1962).

Australian Region (including Micronesia)

Belkin (1962, 1968), Bohart (1956), Dobrotworsky (1965), Huang (1968a, b), Marks (1954), O'Gower (1958), Ramalingam & Belkin (1965), Sirivanakarn (1968), Steffan (1966, 1968), Van den Assem & Bonne-Wepster (1964).

Nearctic Region

Barr (1958), Beckel (1954), Carpenter (1968), Carpenter & La Casse (1955), Darsie (1951), Gjullin et al. (1961), King et al. (1960), Ross & Horsfall (1965), Smith (1969), Steward & McWade (1961), Vockeroth (1954), Zavortink (1970).

Neotropical Region

Belkin et al. (1970), Belkin & Hogue (1959), Berlin (1969a, b), Bram (1967b), Correa & Ramalho (1956), Cova-Garcia (1961), Cova-Garcia et al. (1966), Foote (1954), Forrattini (1962, 1965a, b), Galindo et al. (1954), Garcia & Ronderos (1962), Guedes et al. (1965), Lane (1953), Ronderos & Bachmann (1963b), Schick (1970).

General

Certain of the above overlap two or more adjacent regions, notably Mattingly & Knight, 1956 (Palaearctic, Oriental and Ethiopian), University of Maryland, 1963 (Palaearctic and Oriental), Bonne-Wepster, 1954 (Oriental and Australian), Belkin & Hogue, 1959; Bram, 1967b; Foote, 1954; Galindo et al., 1954; Zavortink, 1970 (Neotropical and Nearctic). Recent taxonomic works with World coverage are Maslov (1967) and Zavortink (1968). Foote & Cook (1959) is useful as a general survey of vector species.

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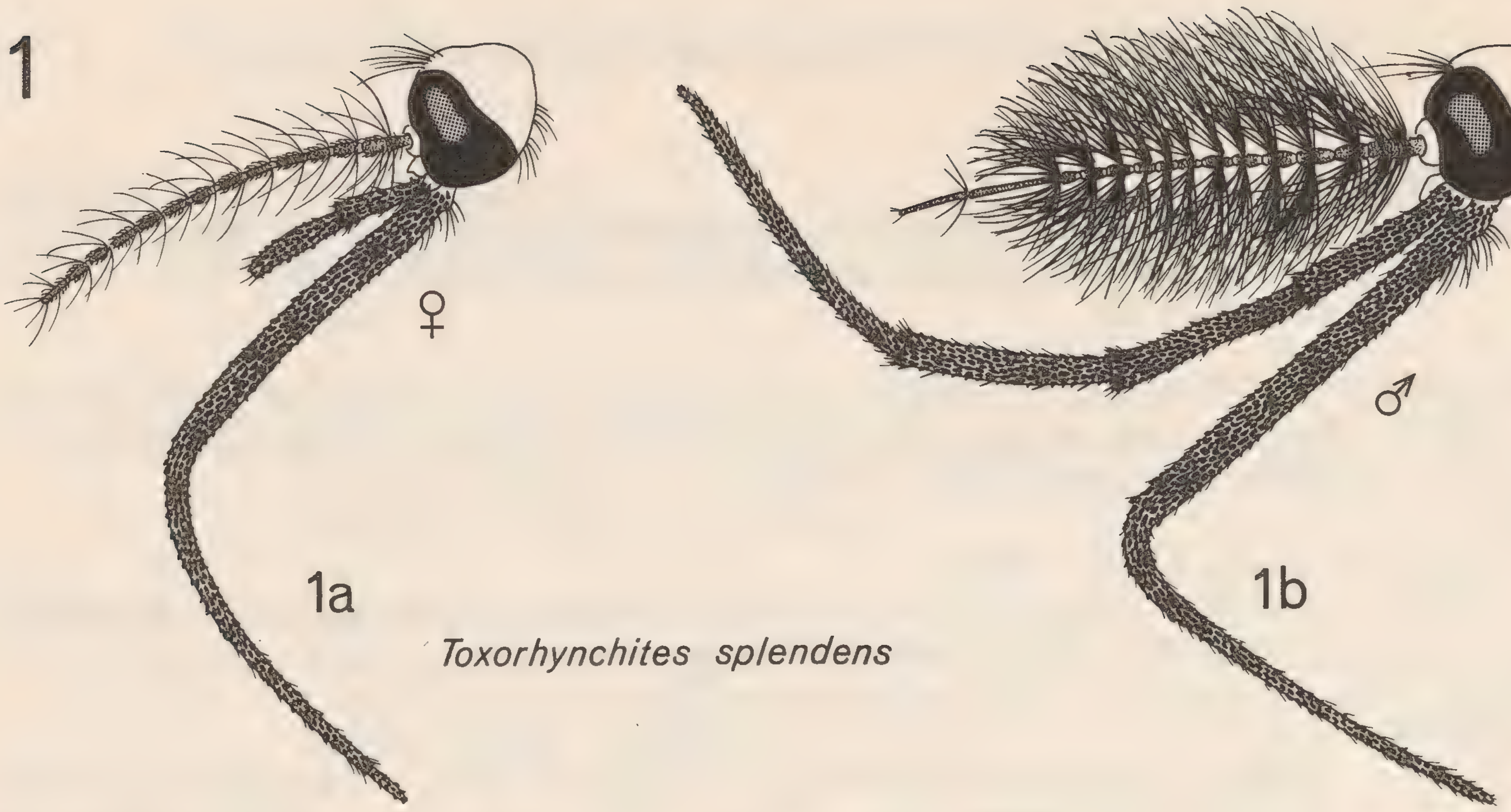
ACKNOWLEDGEMENTS

I am indebted to Dr. Botha de Meillon and the staff of the Southeast Asia Mosquito Project, and to Dr. Alan Stone, for much kindness and hospitality in Washington and for checking the keys and making many helpful criticisms and suggestions. All mistakes are my own.

Pl. 1



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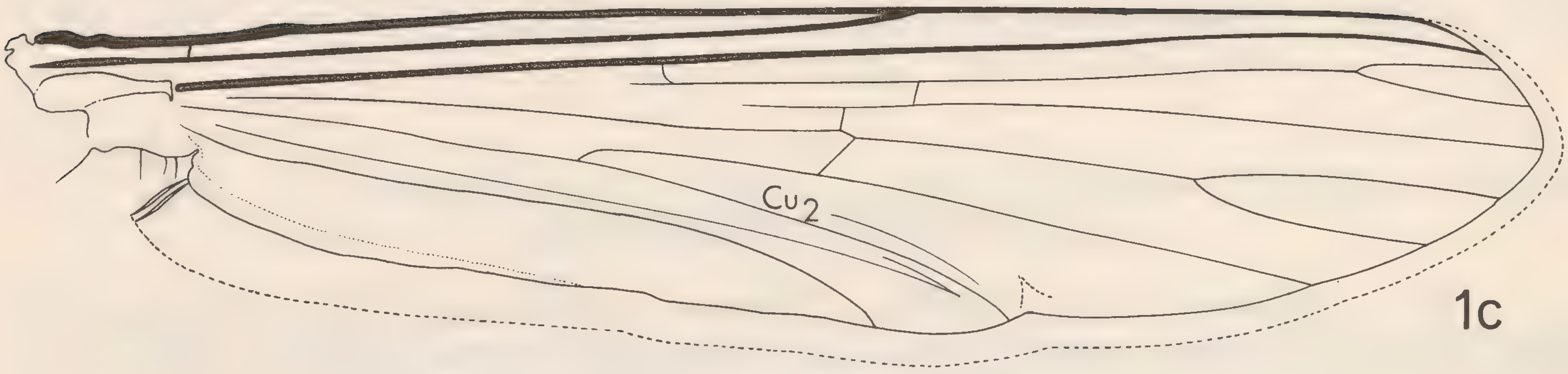

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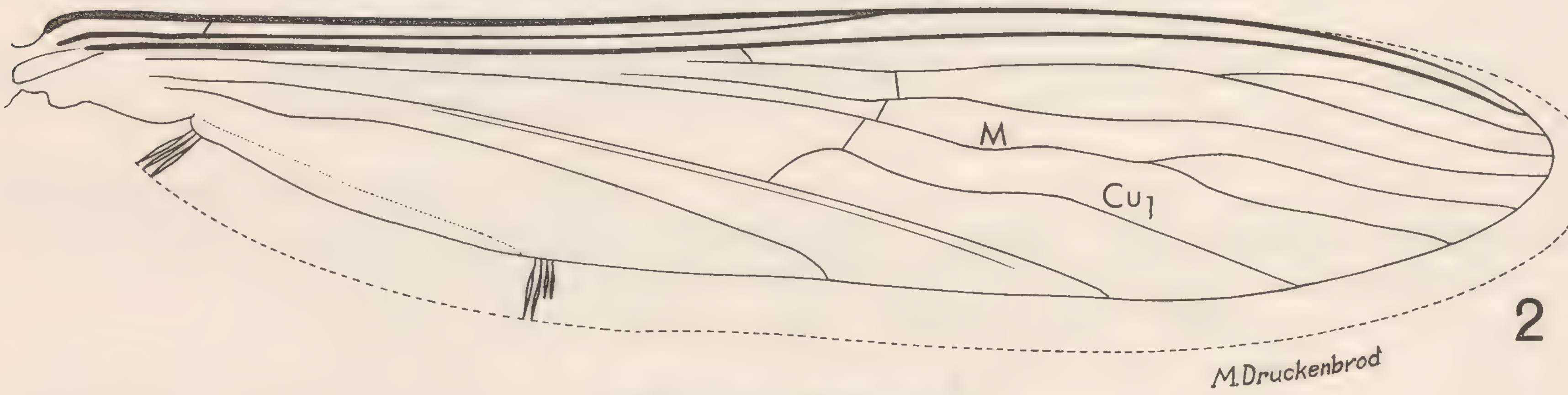

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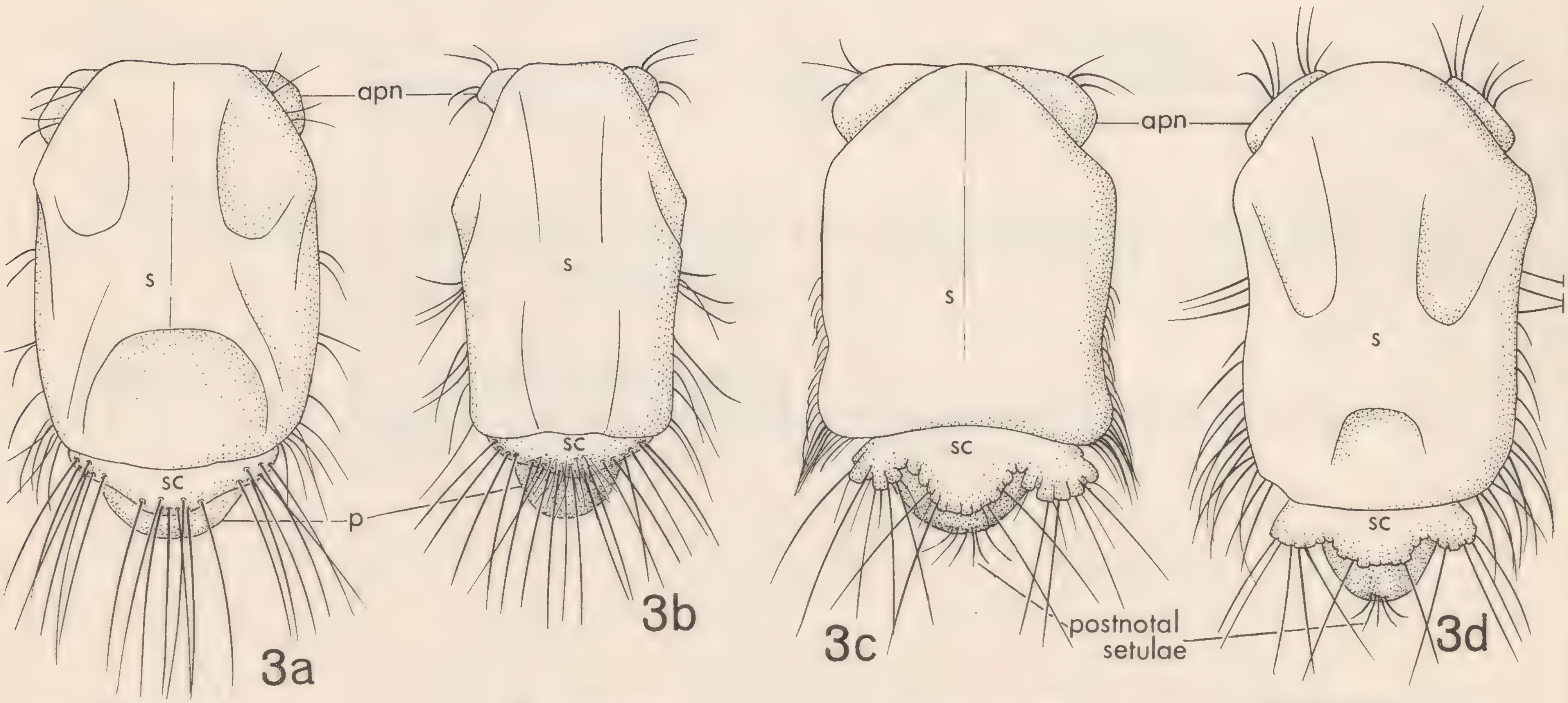


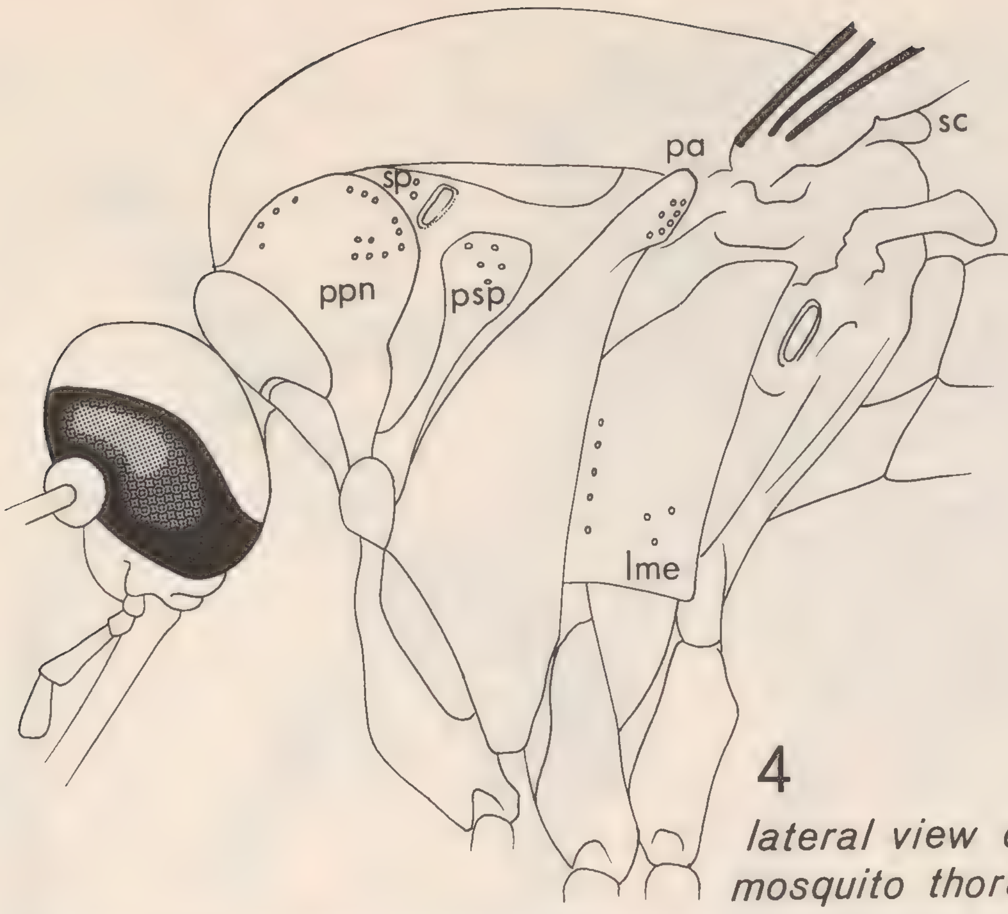
Chagasia fajardoi

Anopheles balabacensis

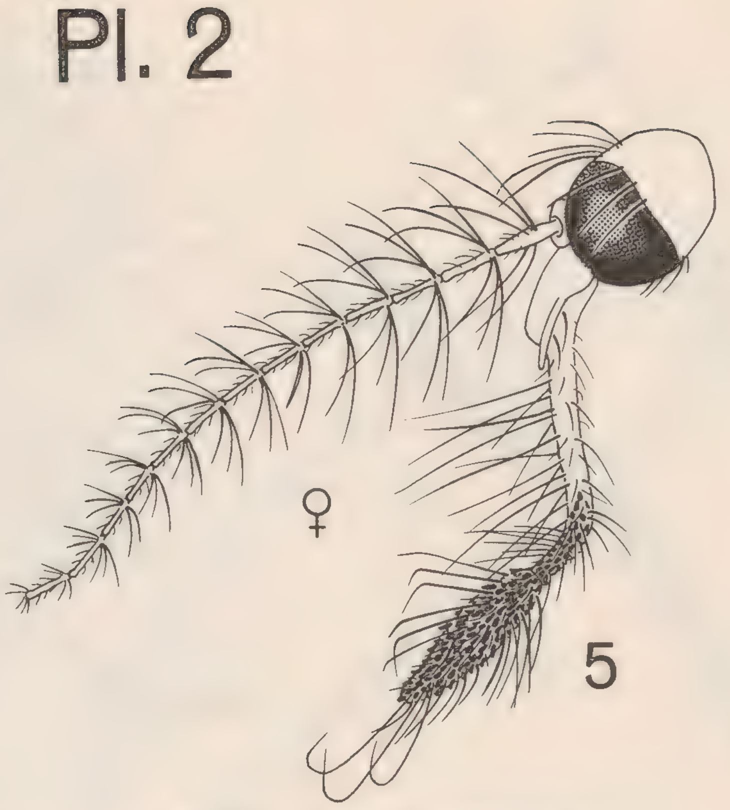
Wyeomyia aporonoma

Trichoprosopon digitatum

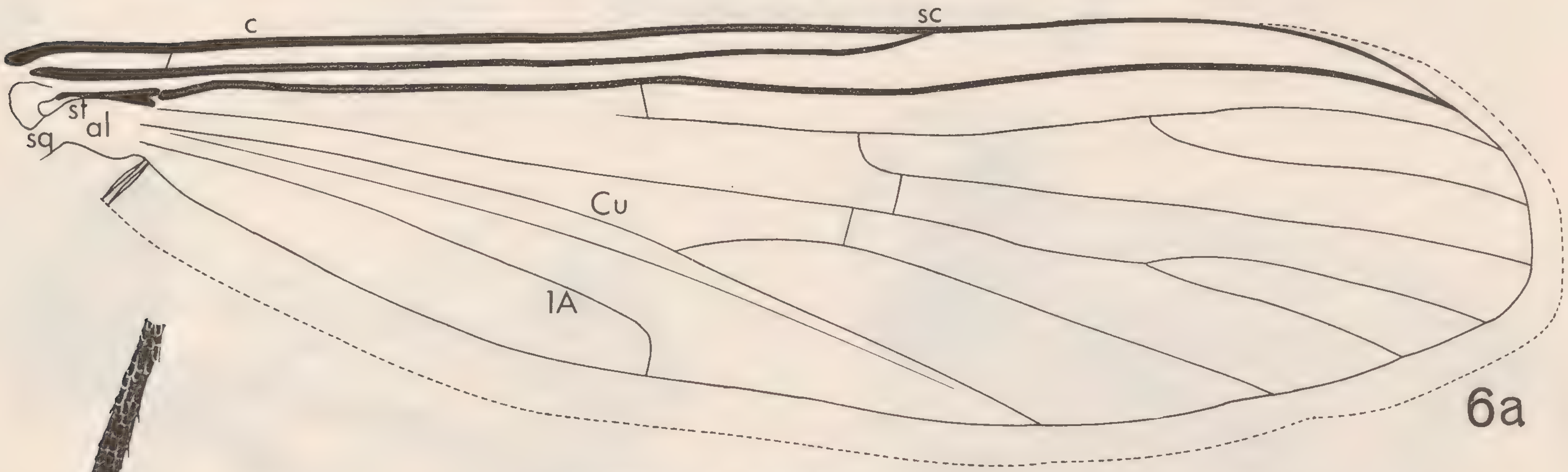
Pl. 2



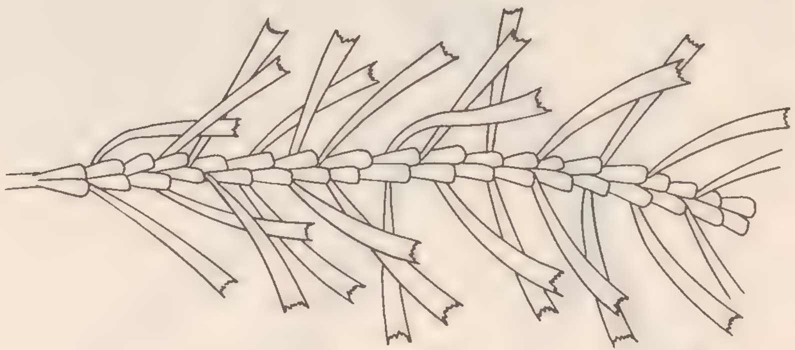
4
lateral view of mosquito thorax



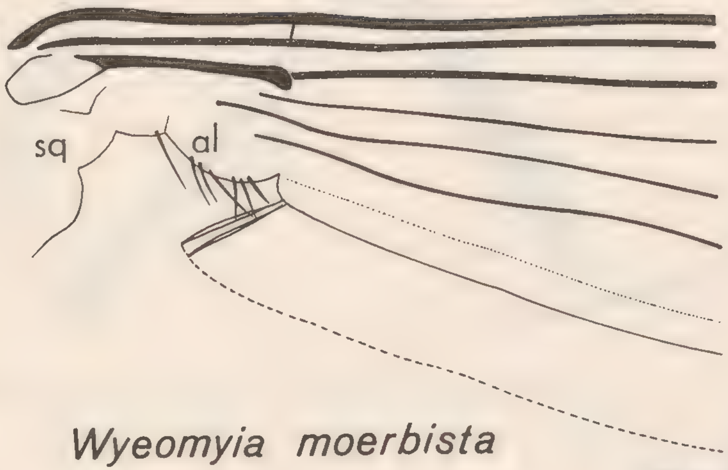
5
Malaya genurostris



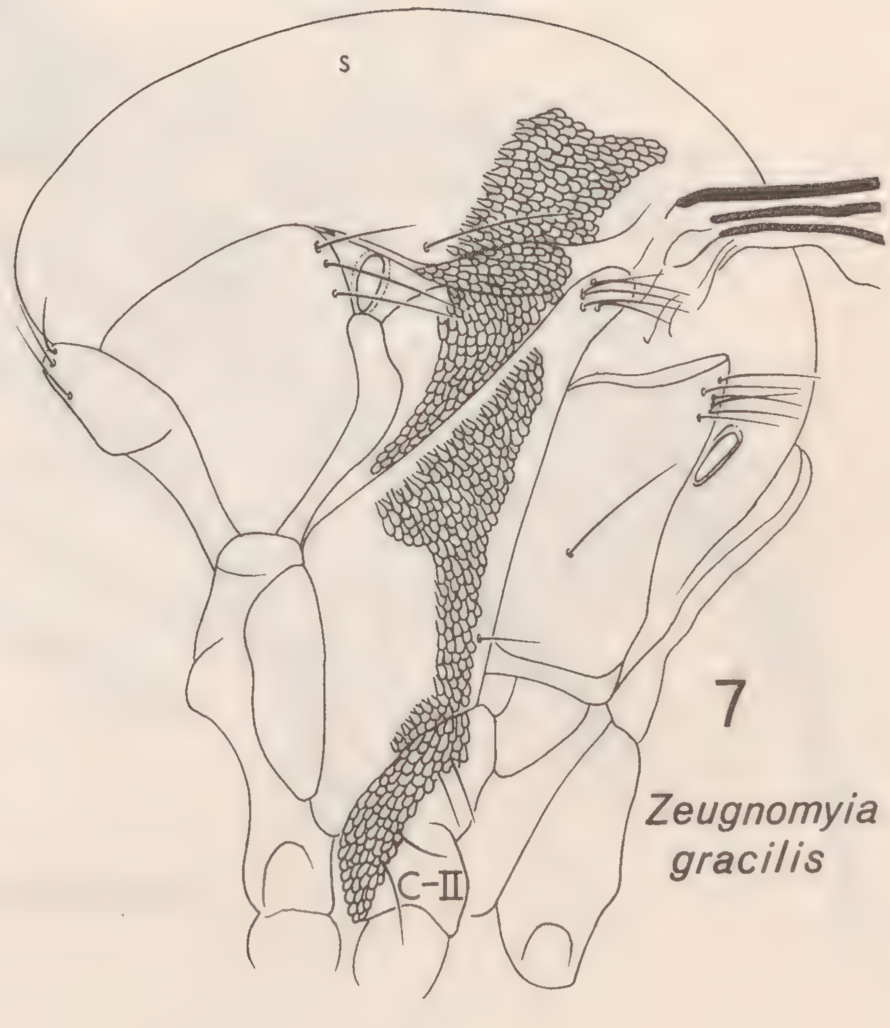
6a
Hodgesia malayi



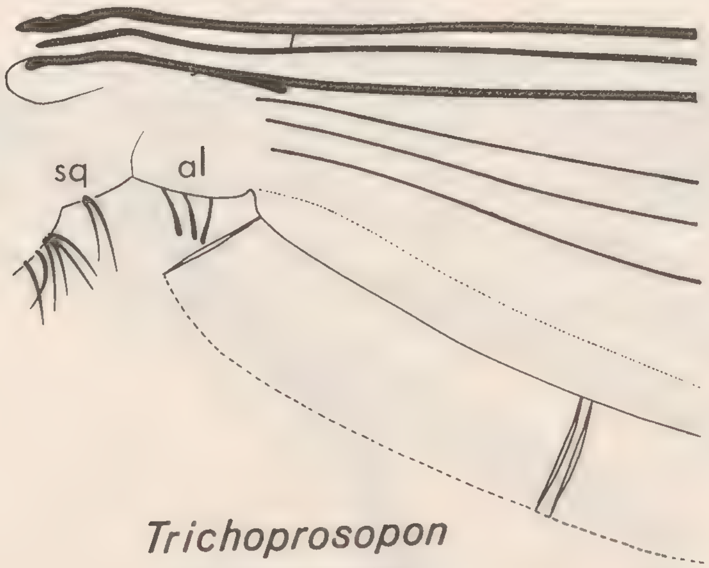
Hodgesia malayi 6b



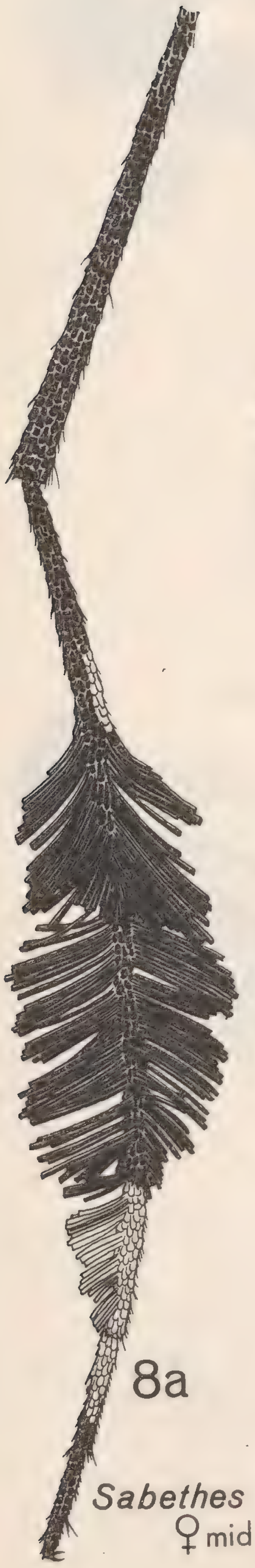
Wyeomyia moerbista
8b



7
Zeugnomyia gracilis



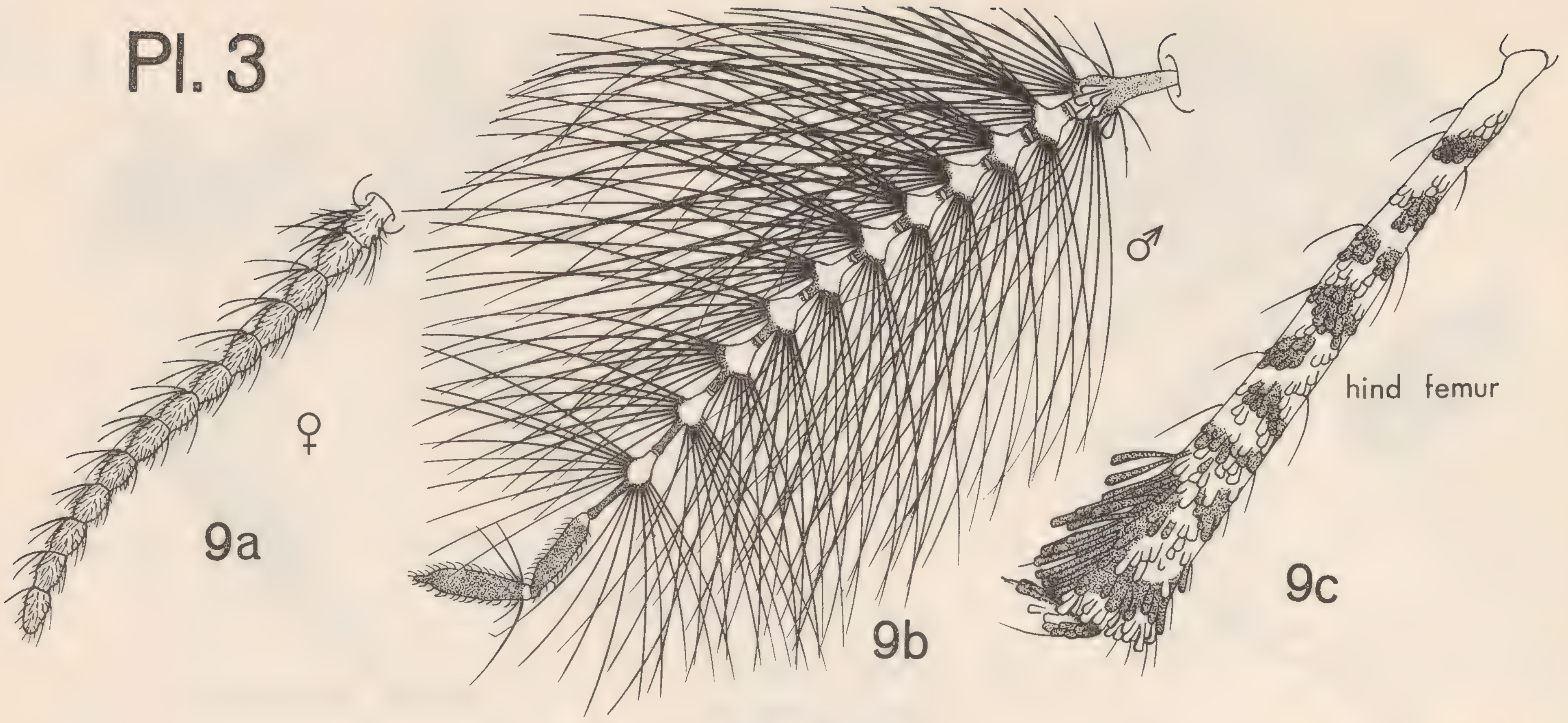
Trichoprosopon pallidiventer
8c



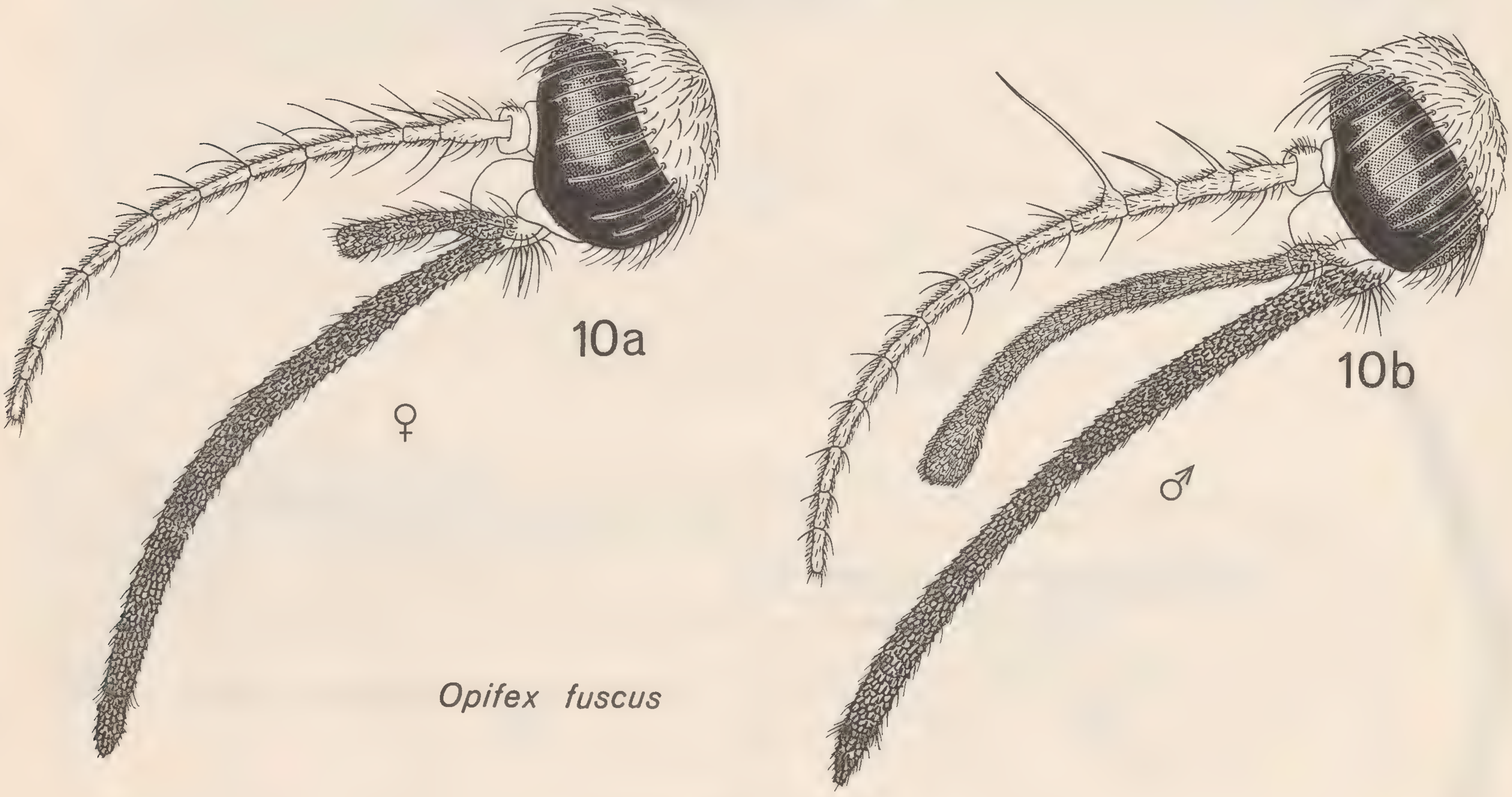
8a
Sabethes belisarioi
♀ mid leg

M. Druckenbrod

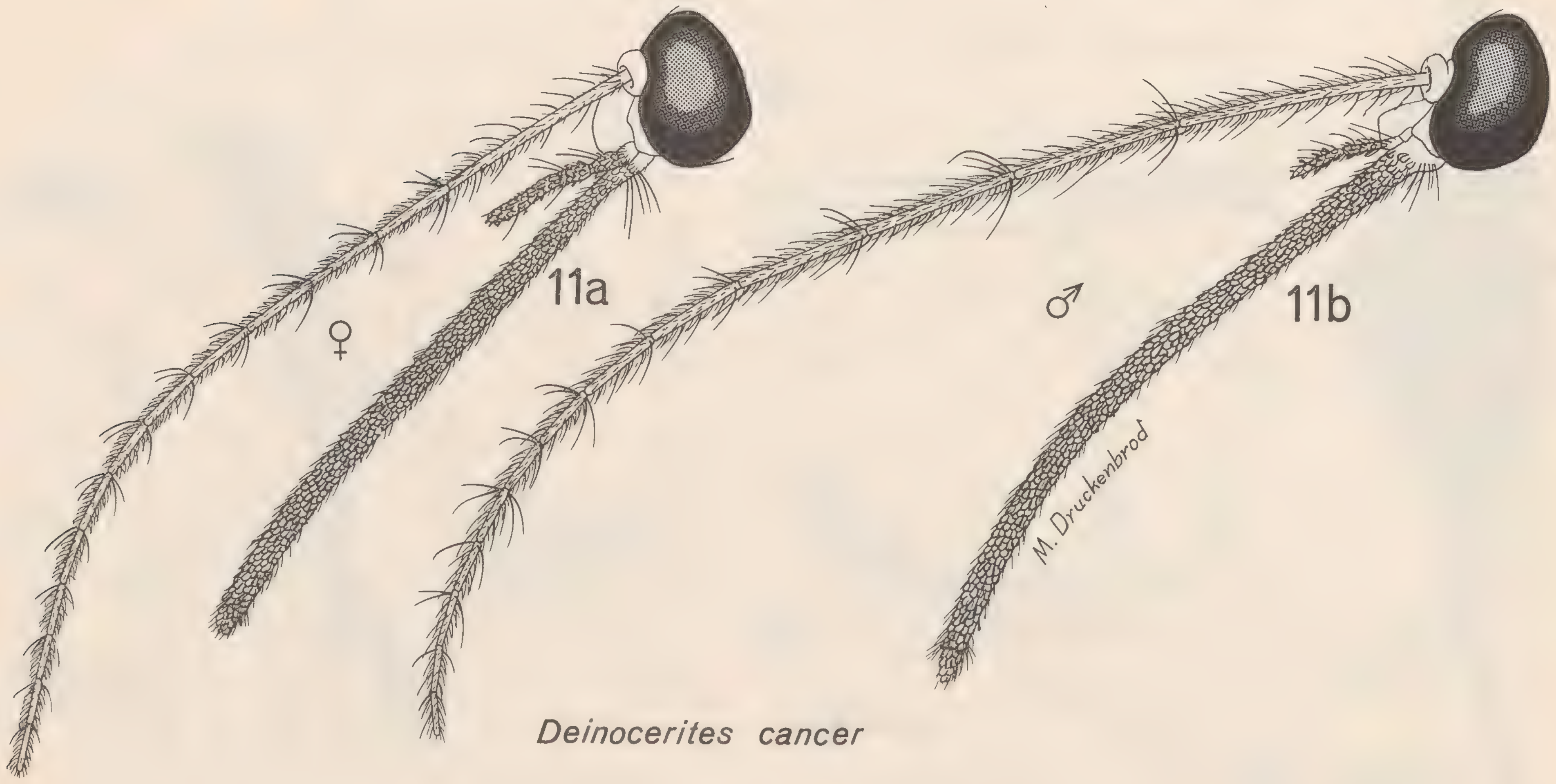
Pl. 3



Aedeomyia catasticta

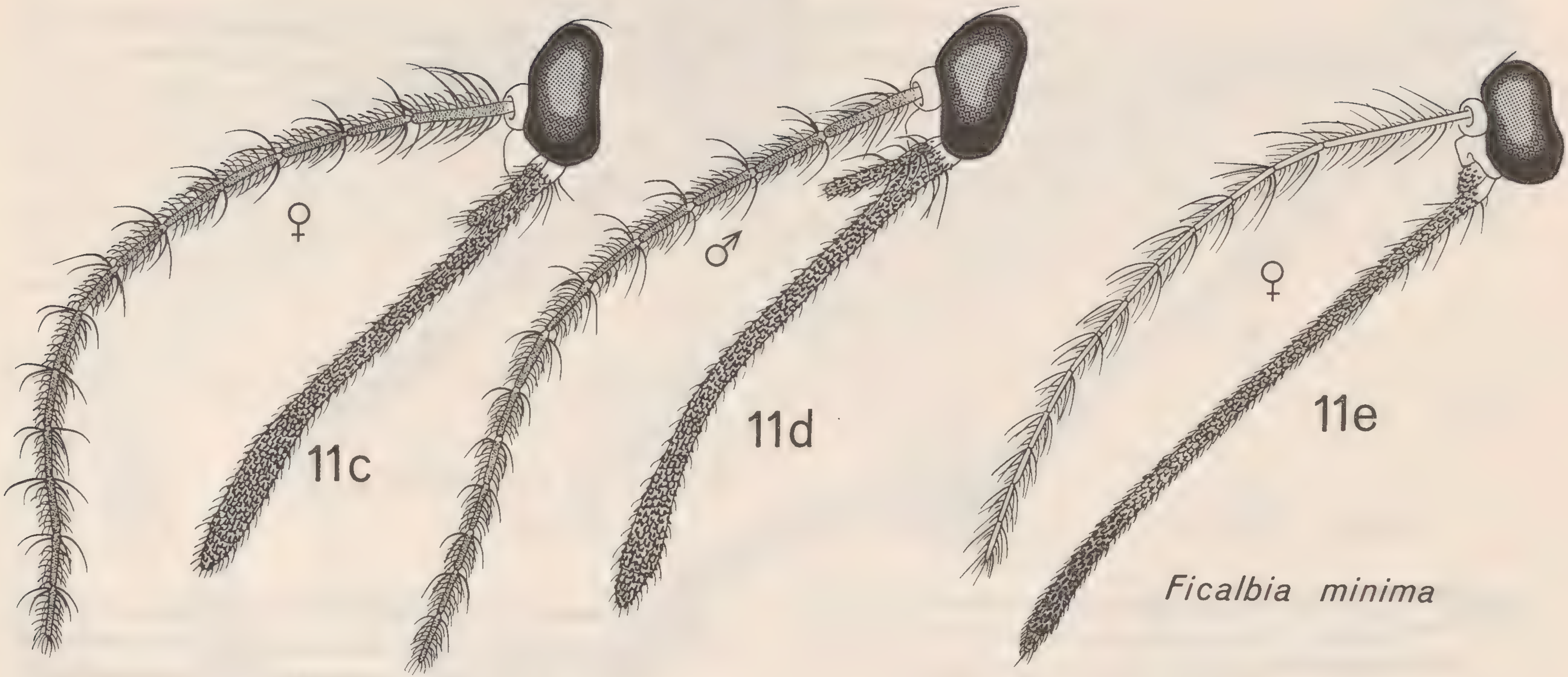


Opifex fuscus



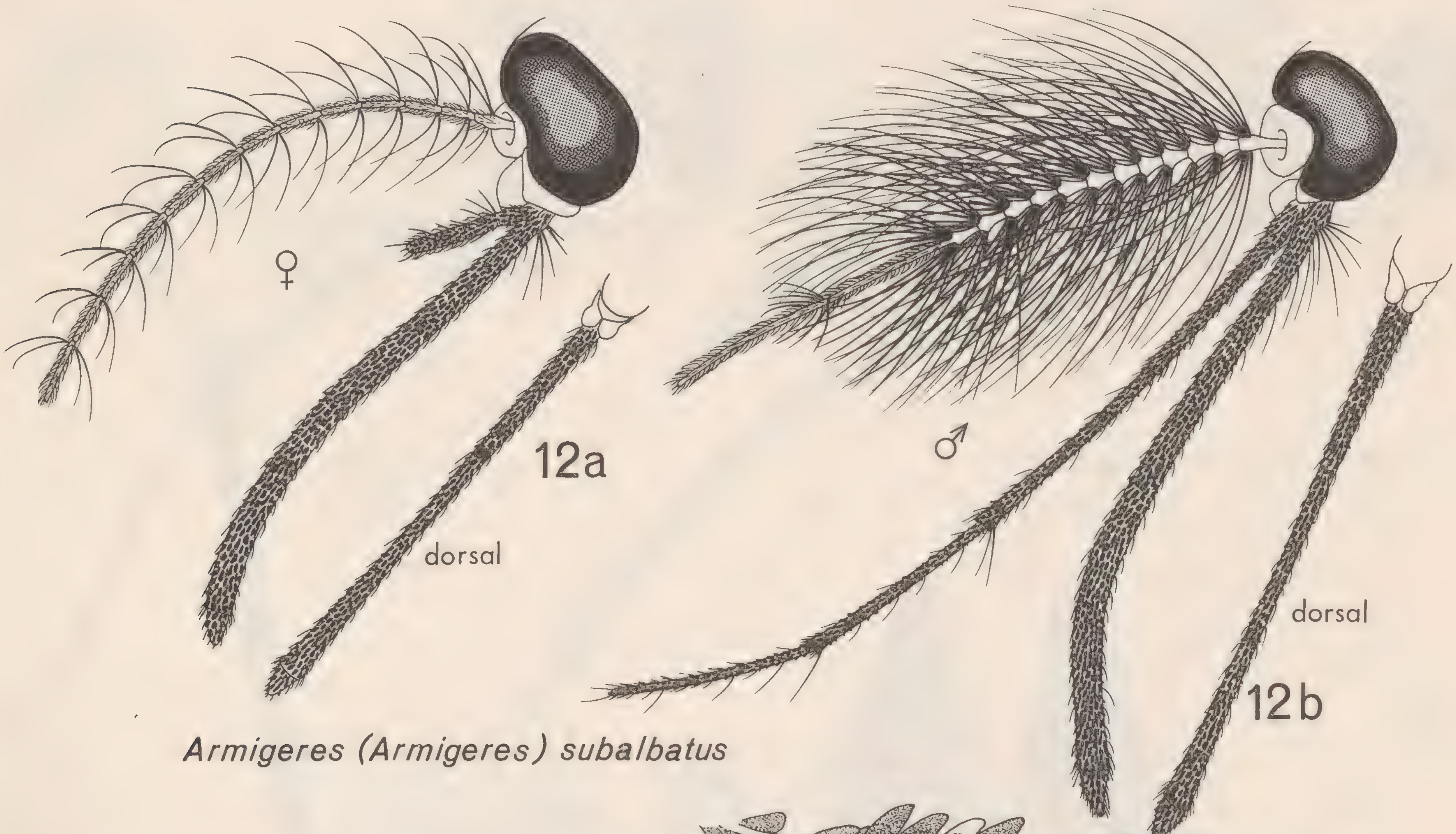
Deinocerites cancer

Pl. 4

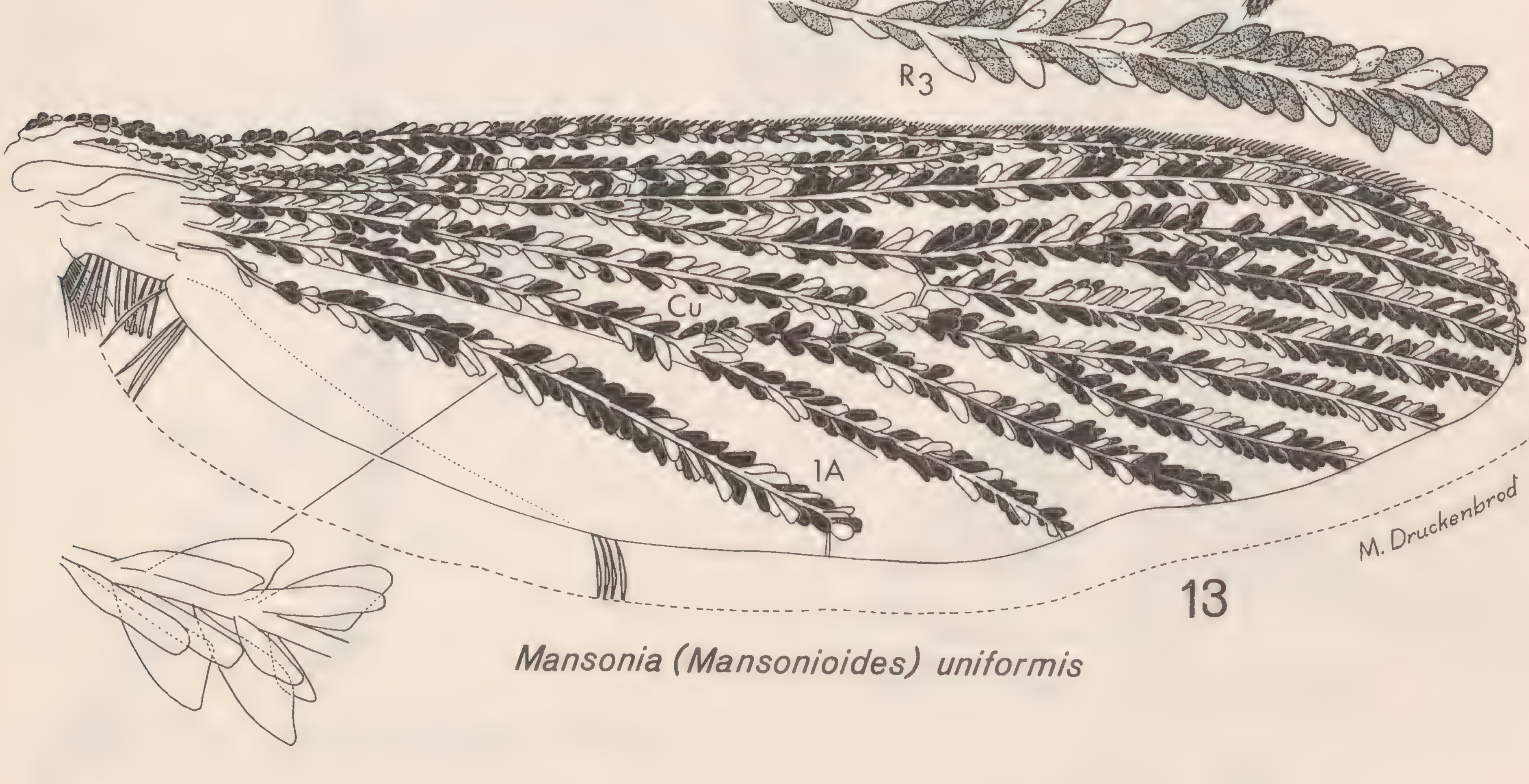


Ficalbia minima

Galindomyia leei

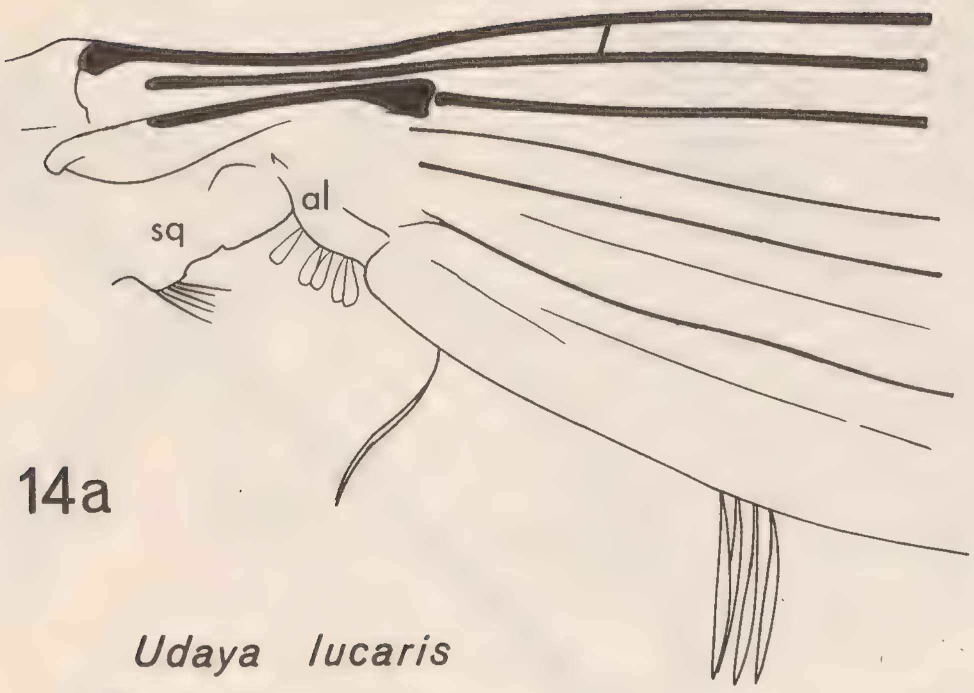


Armigeres (Armigeres) subalbatus



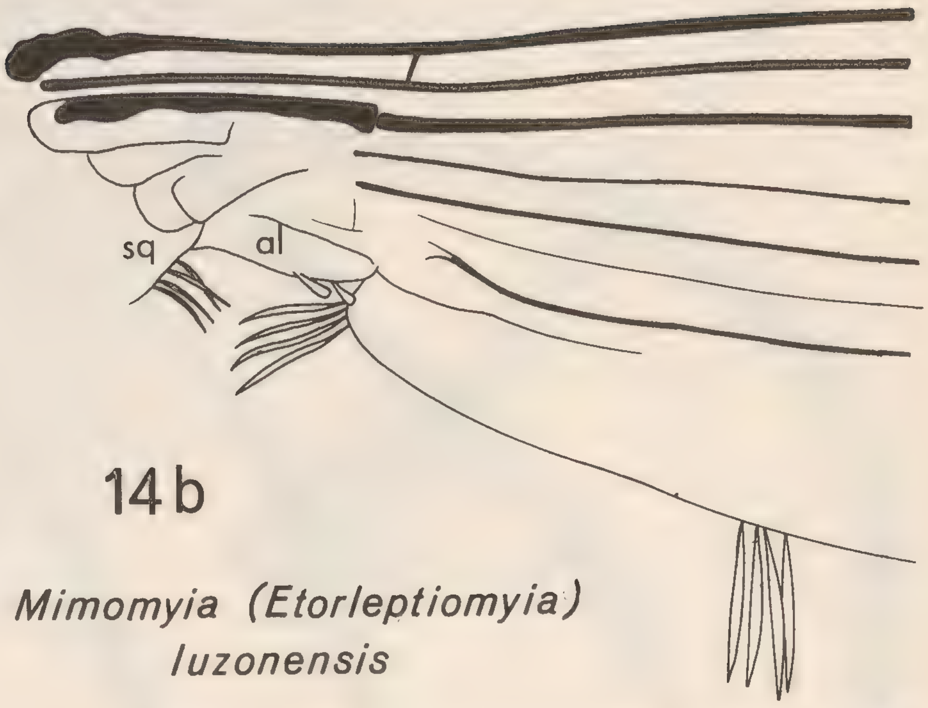
Mansonia (Mansonioides) uniformis

Pl. 5



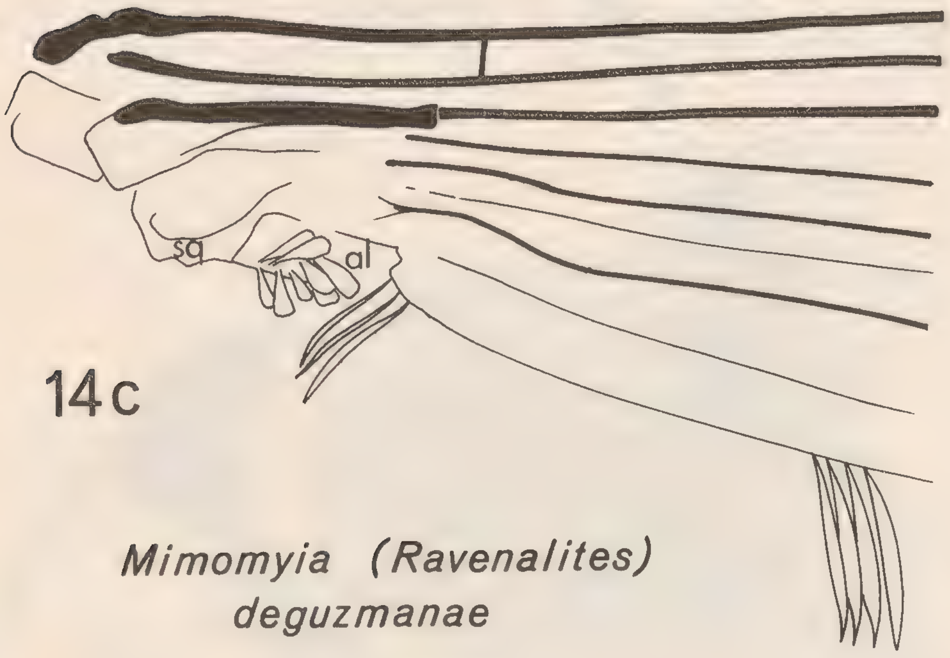
14a

Udaya lucaris



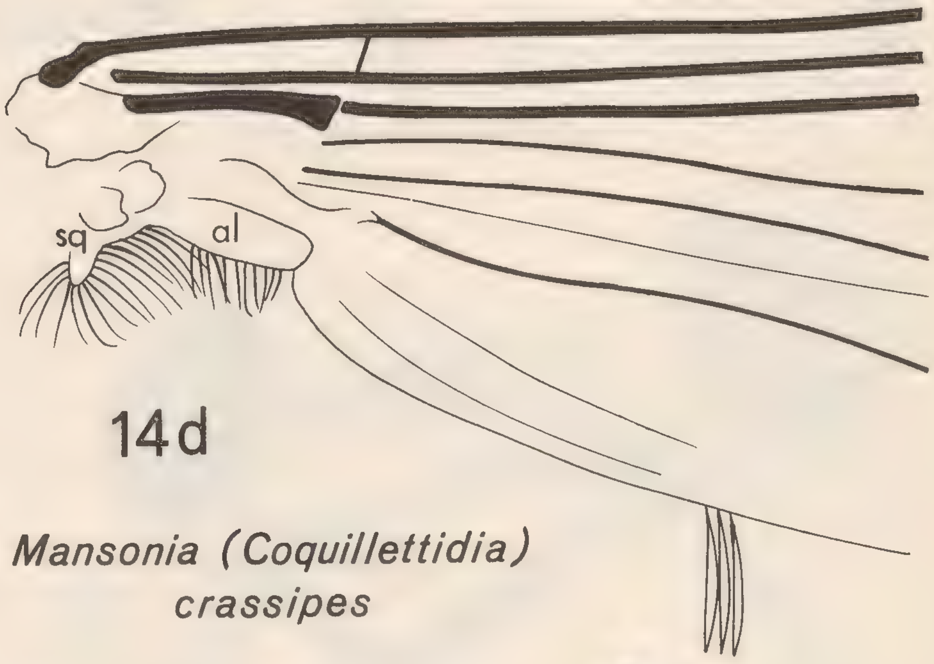
14b

Mimomyia (Etorleptiomyia) luzonensis



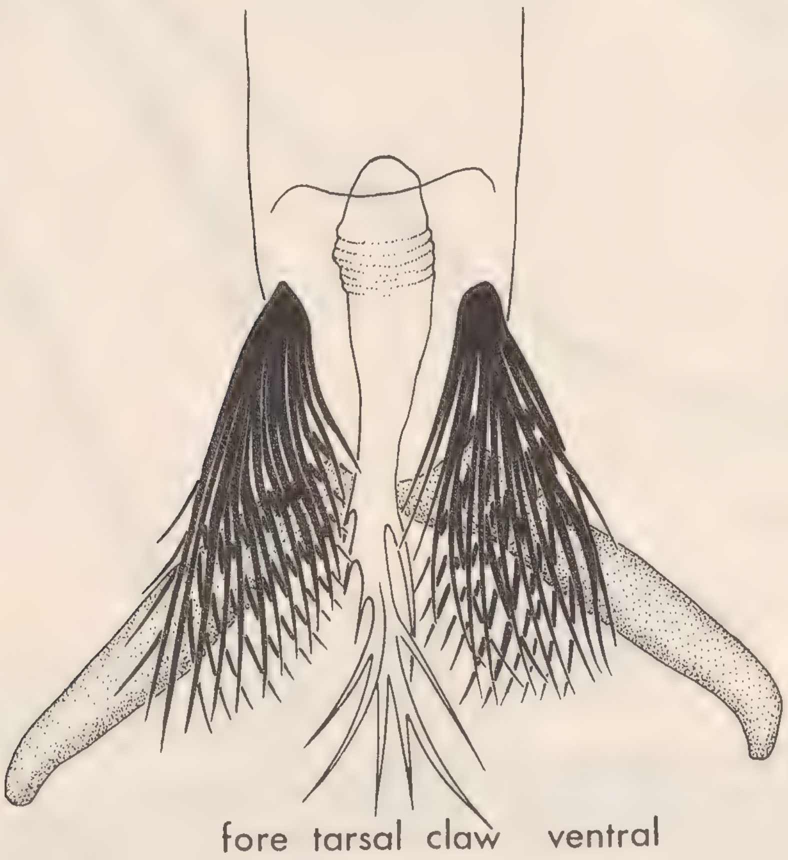
14c

Mimomyia (Ravenalites) deguzmanae

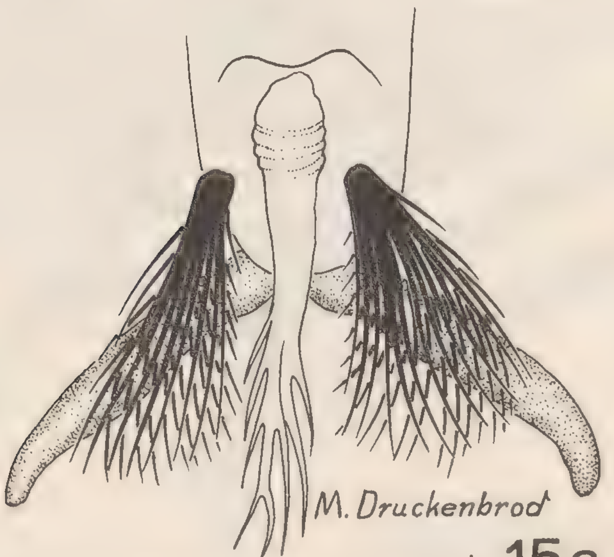


14d

Mansonia (Coquillettidia) crassipes



fore tarsal claw ventral



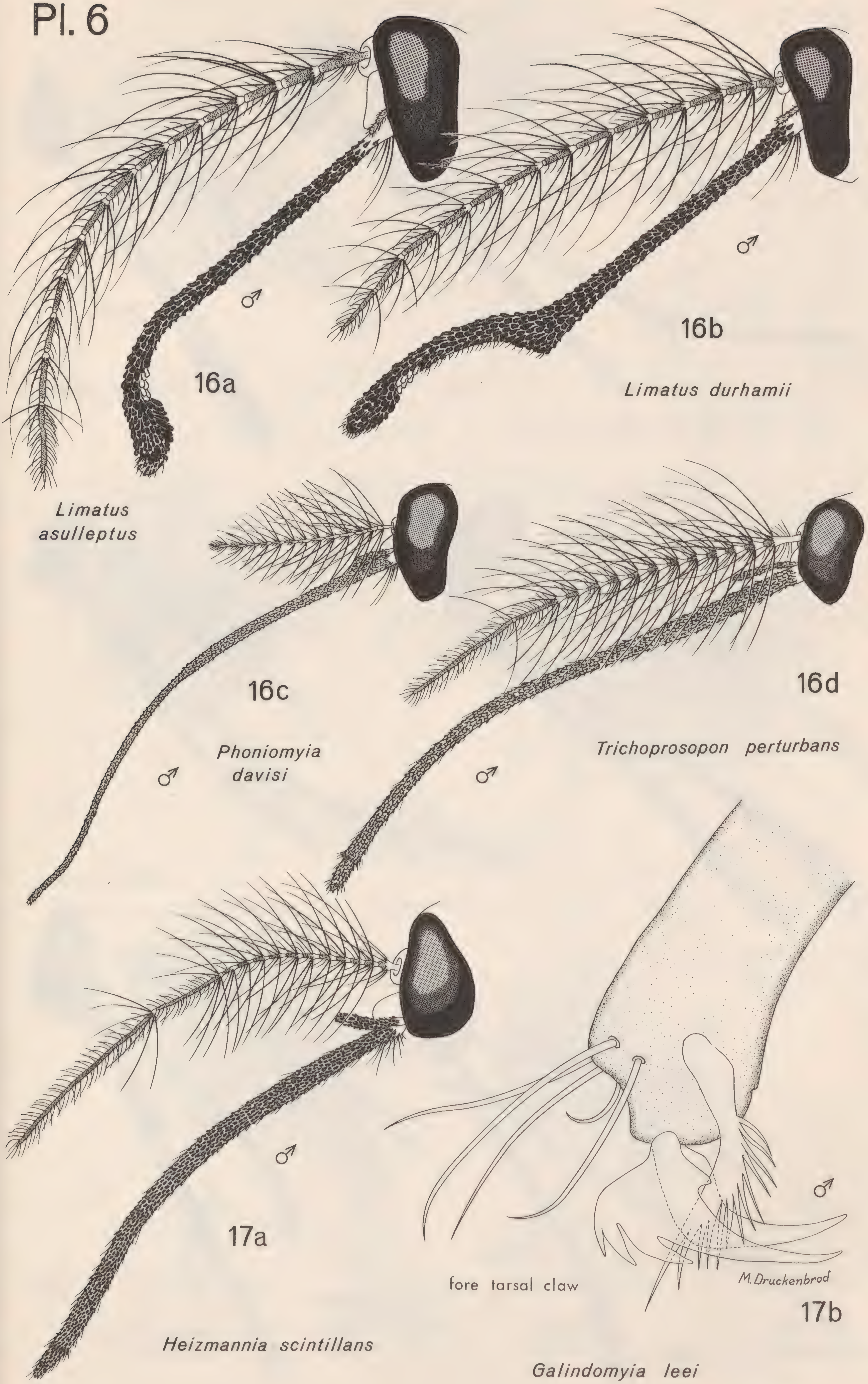
hind tarsal claw ventral 15a

Culex sp.

15b

Orthopodomyia anopheloides

Pl. 6



16a
Limatus asulleptus

16b
Limatus durhamii

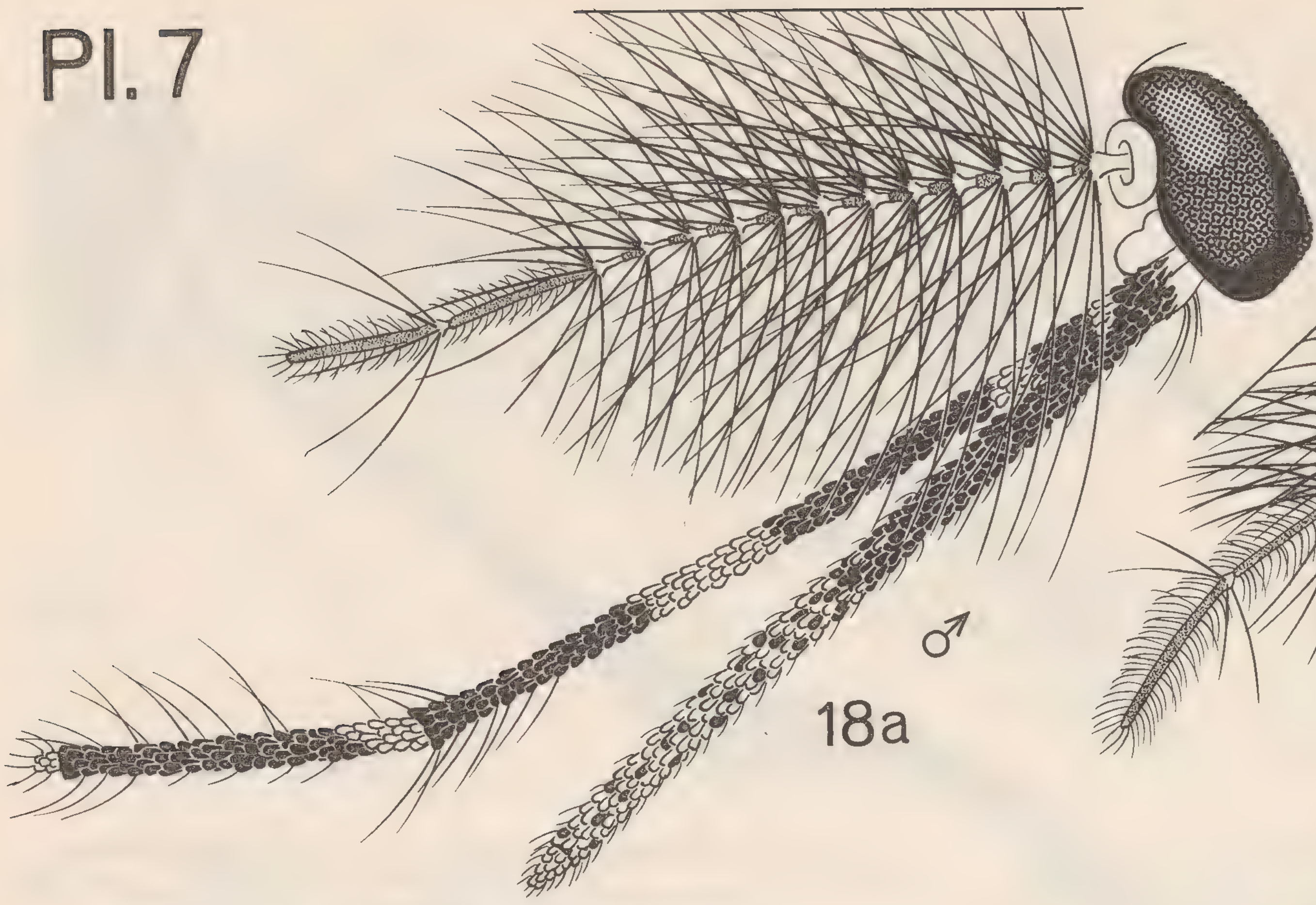
16c
Phoniomyia davisi

16d
Trichoprosopon perturbans

17a
Heizmannia scintillans

17b
Galindomyia leei

Pl. 7

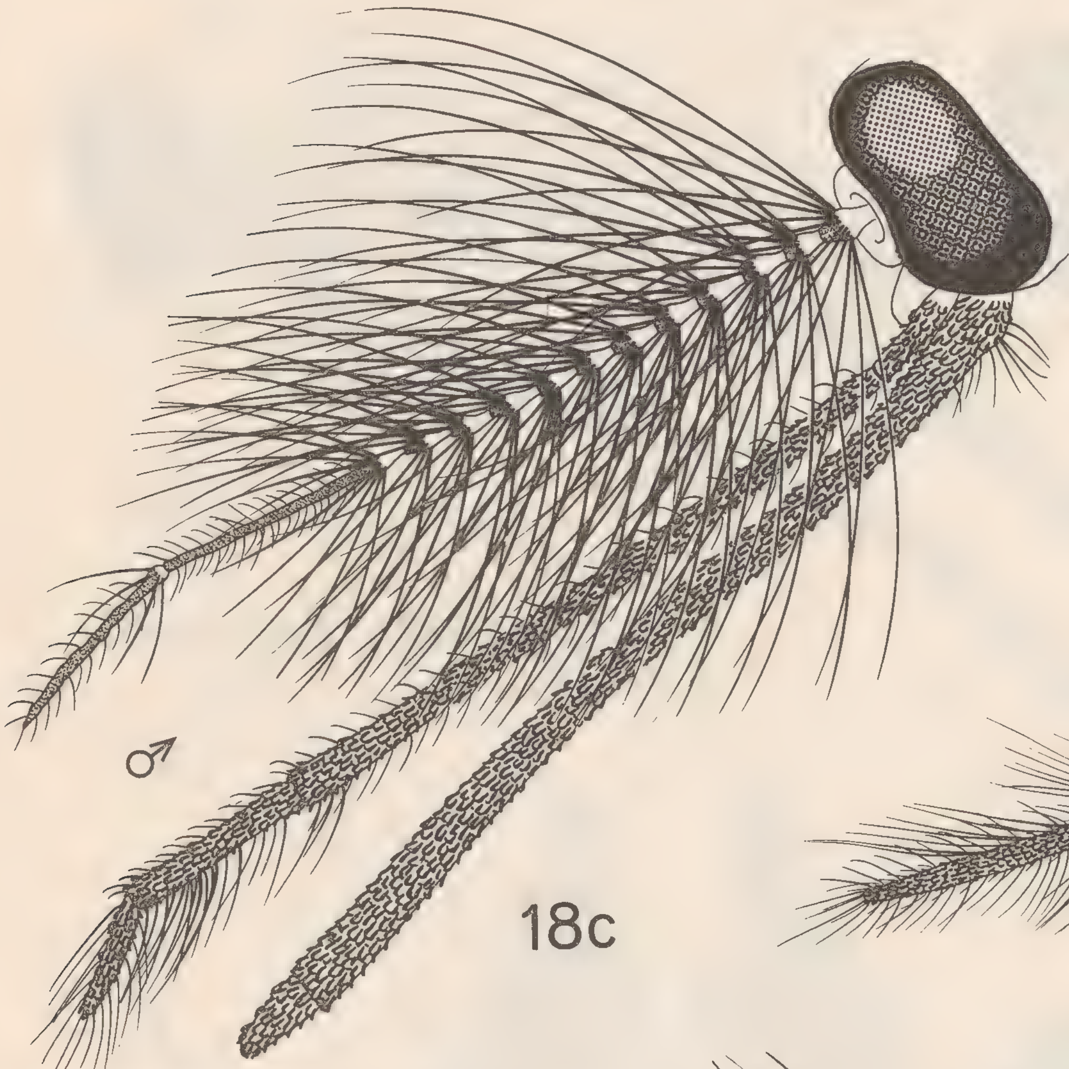


18a

Mansonia (Mansonioides) uniformis

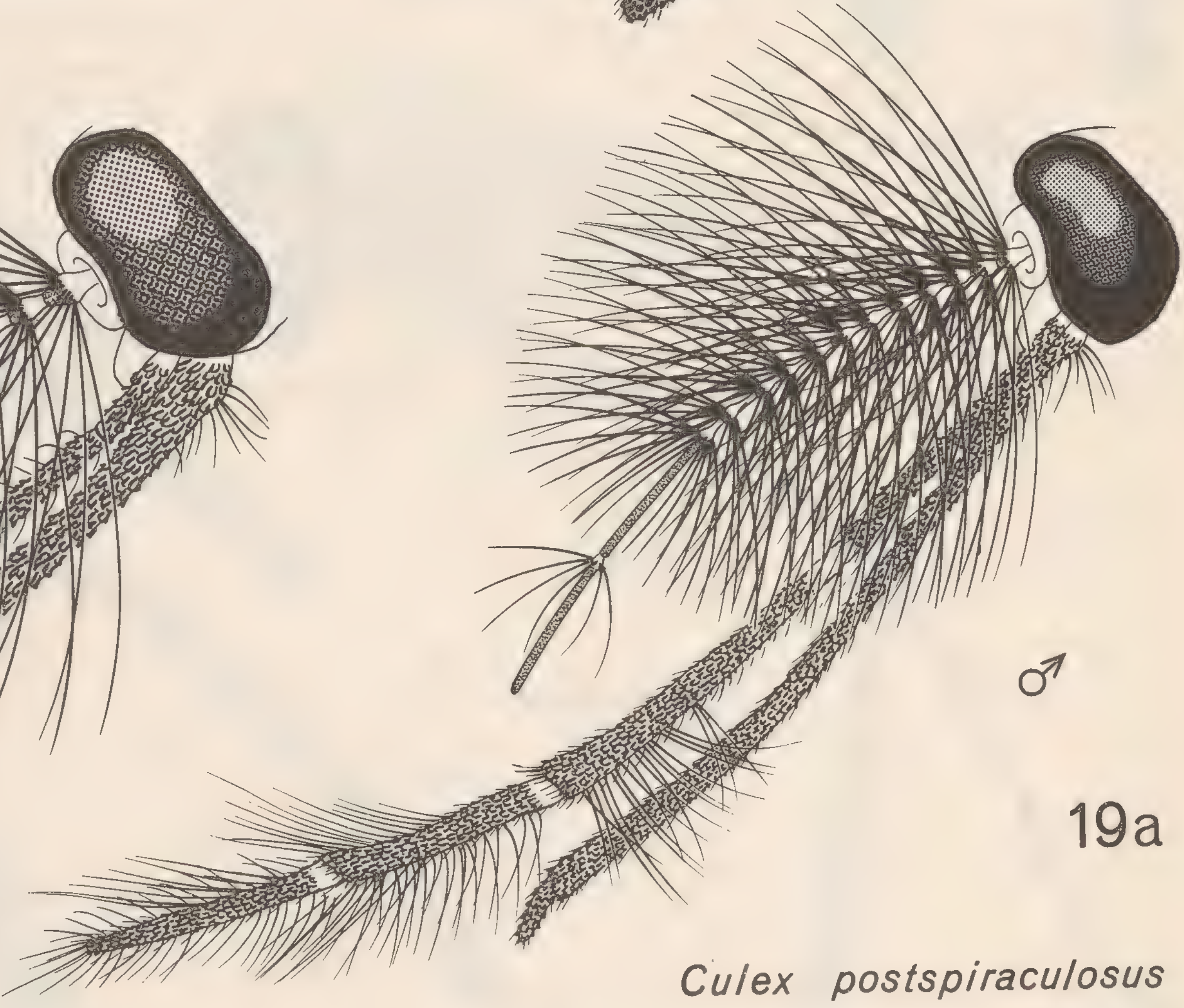
18b

Ficalbia minima



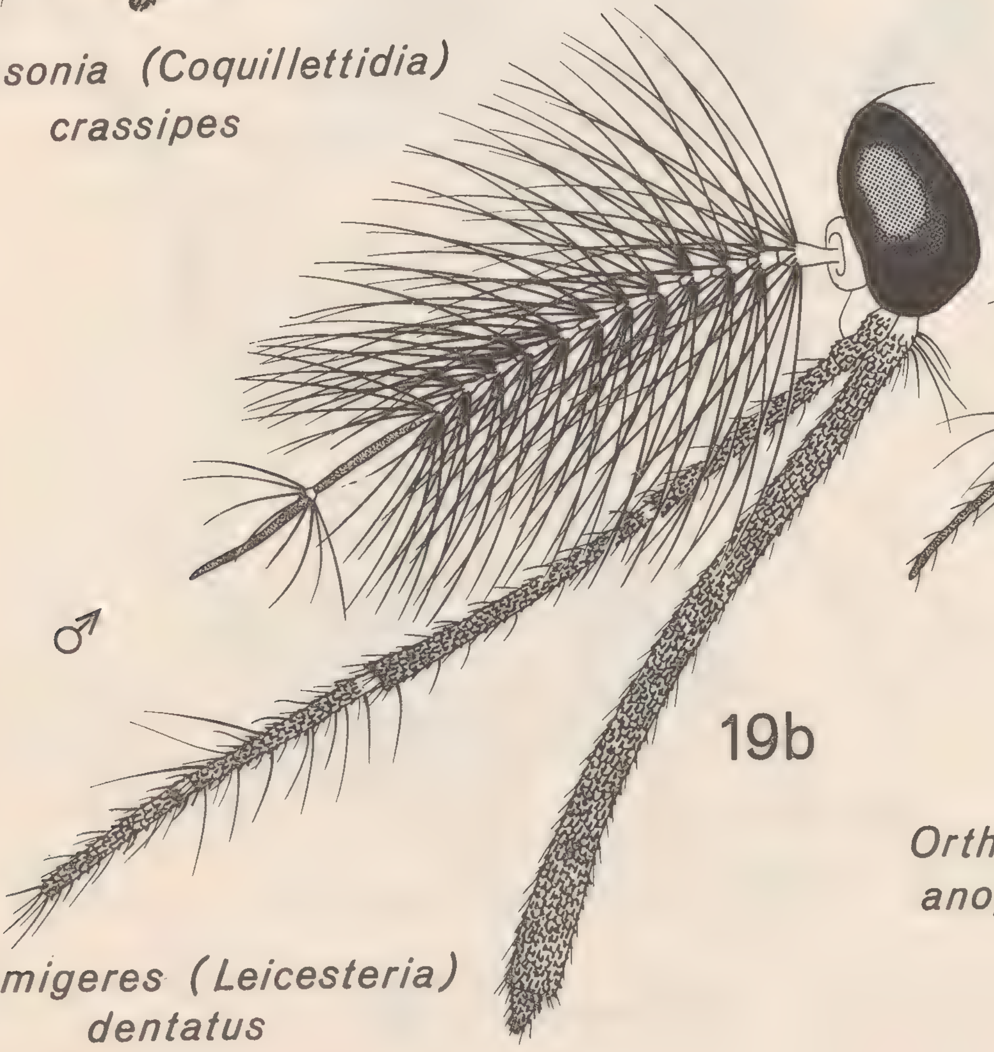
18c

Mansonia (Coquillettidia) crassipes



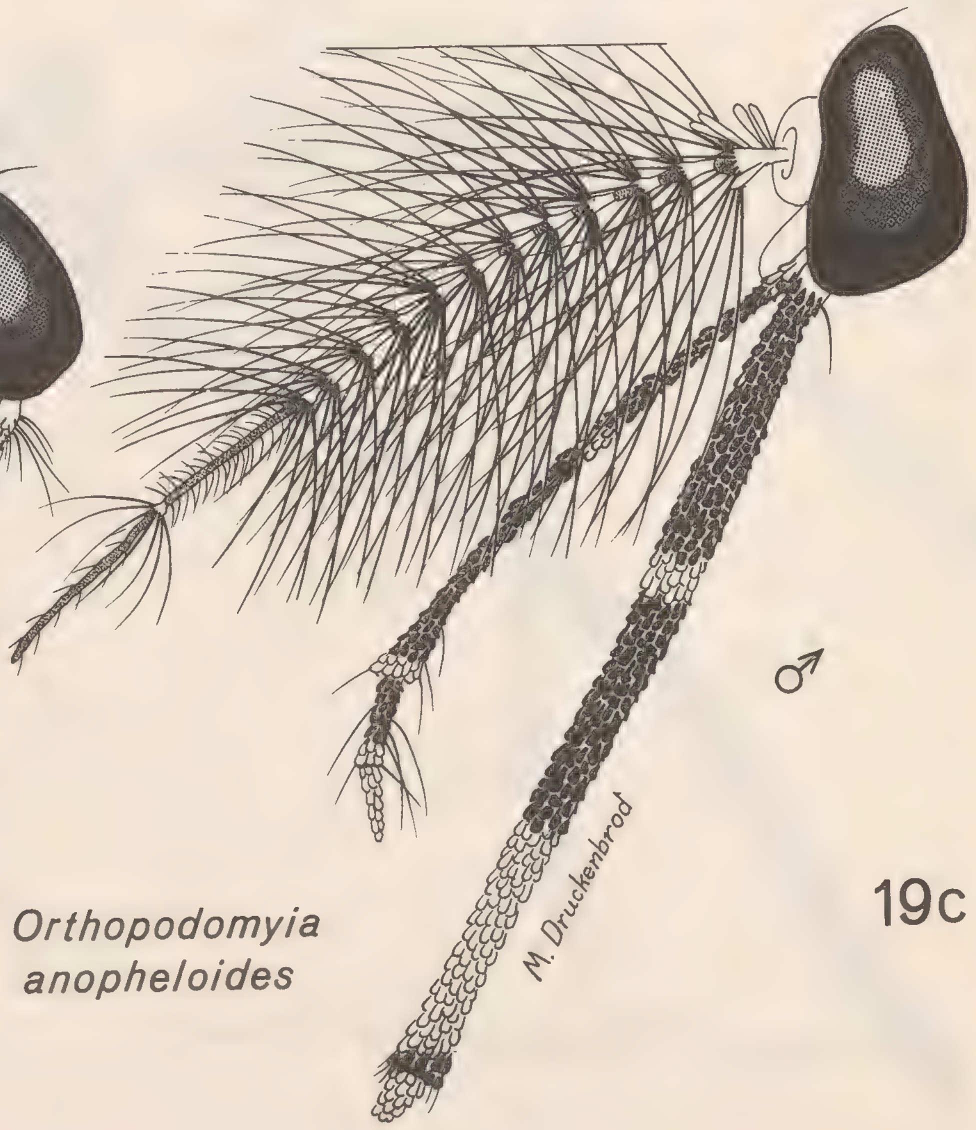
19a

Culex postspiraculosus



19b

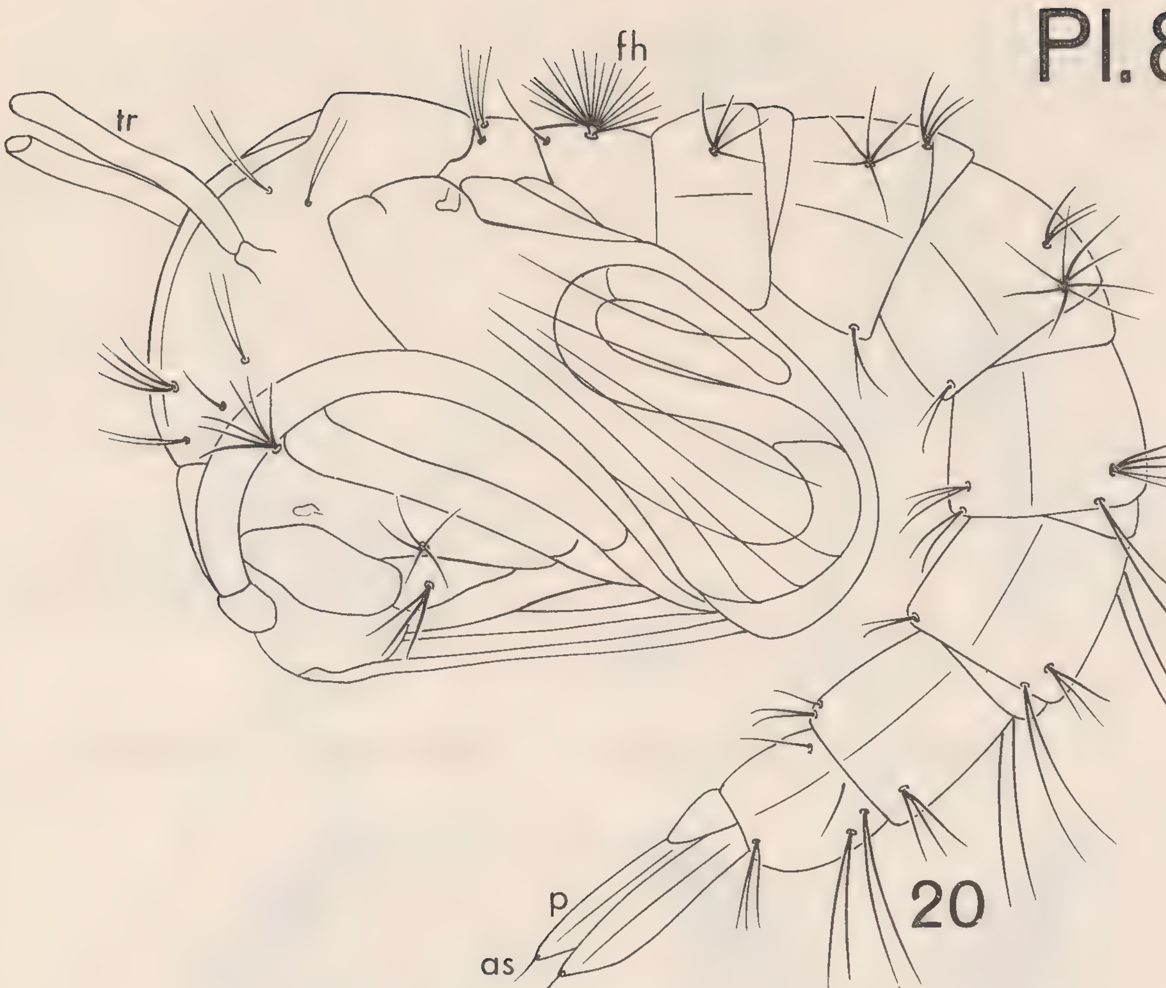
Armigeres (Leicesteria) dentatus



19c

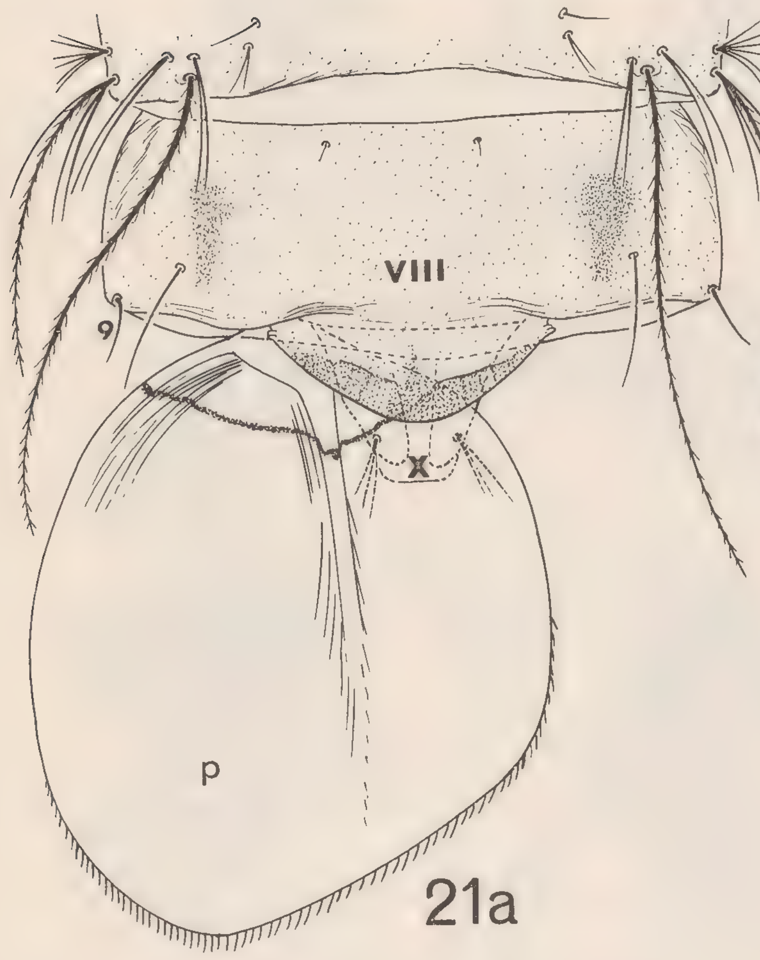
Orthopodomyia anopheloides

Pl. 8



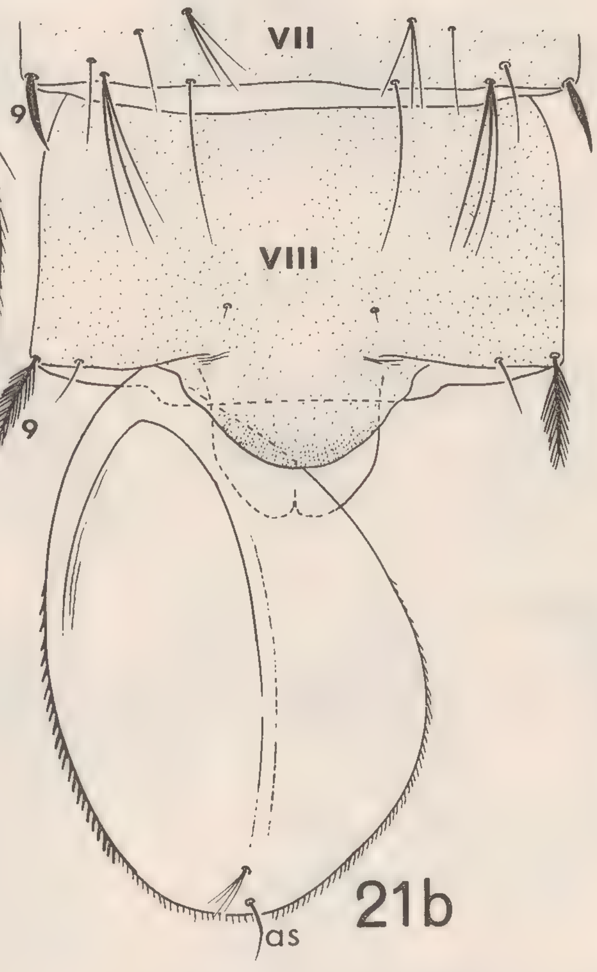
20

Generalized mosquito pupa



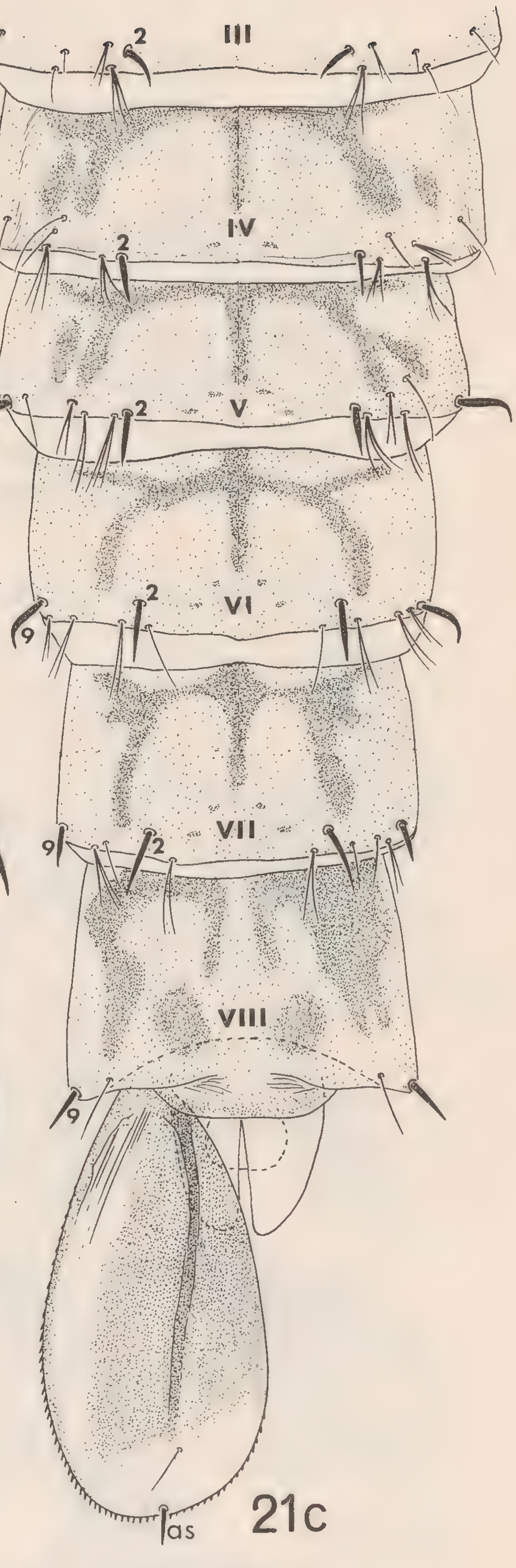
21a

Toxorhynchites splendens



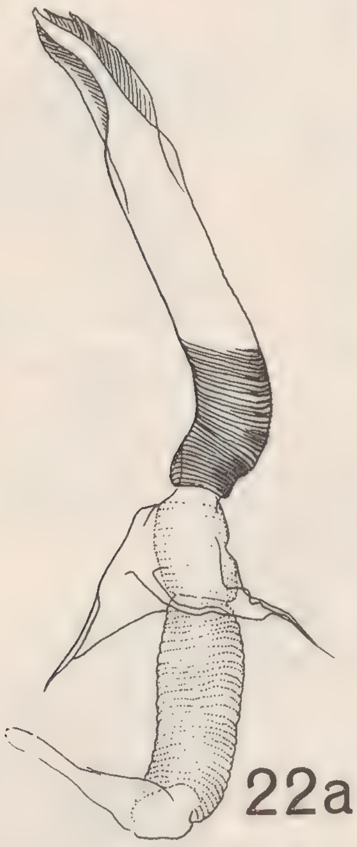
21b

Anopheles balabacensis



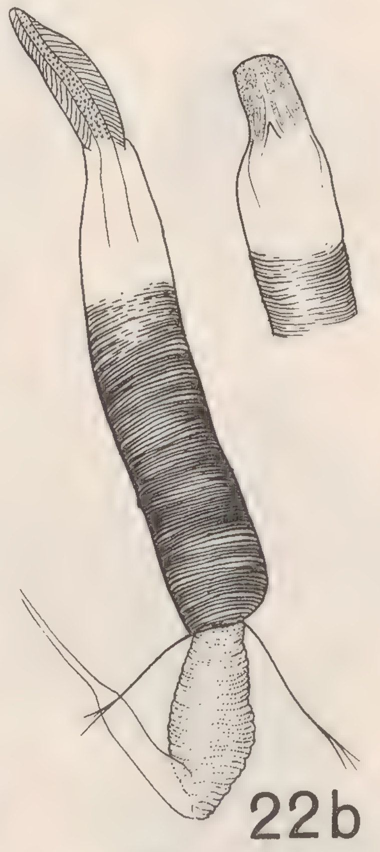
21c

Chagasia bathana



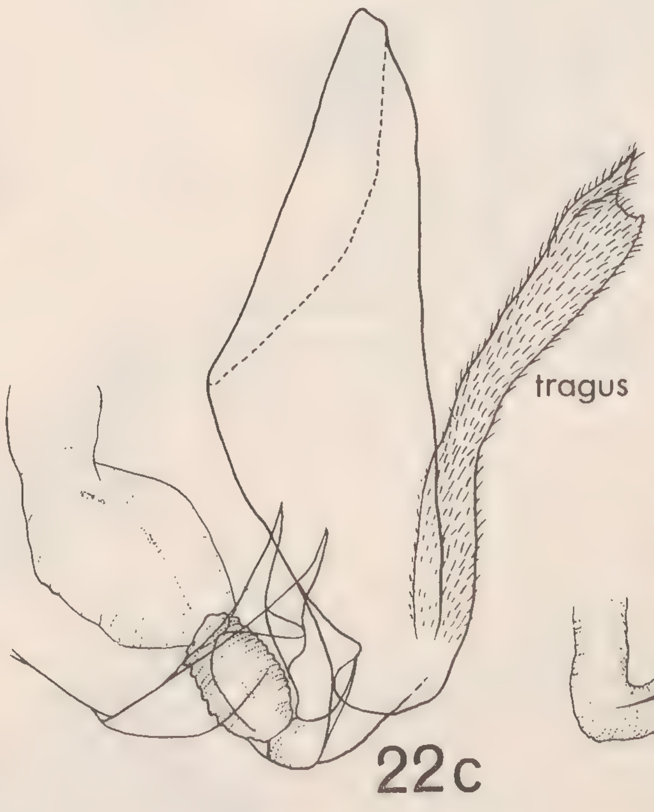
22a

Mansonia (Mansonioides) uniformis



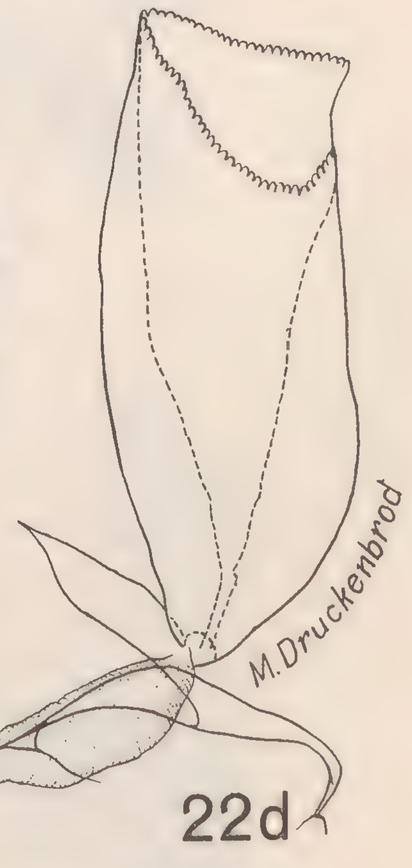
22b

Mansonia (Coquillettidia) microannulata



22c

Hodgesia malayi



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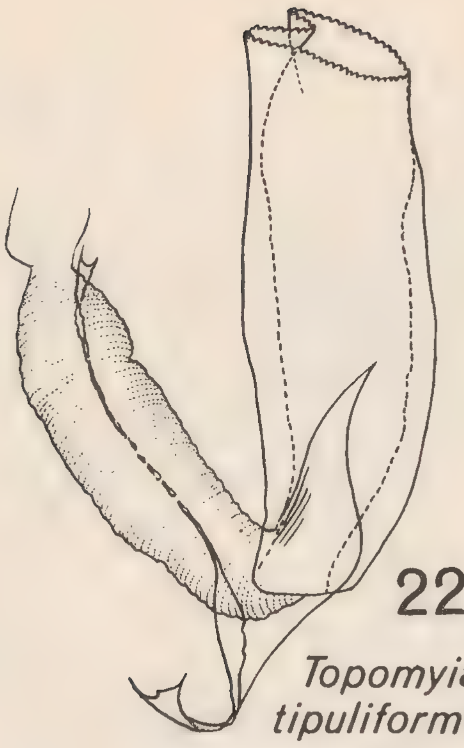
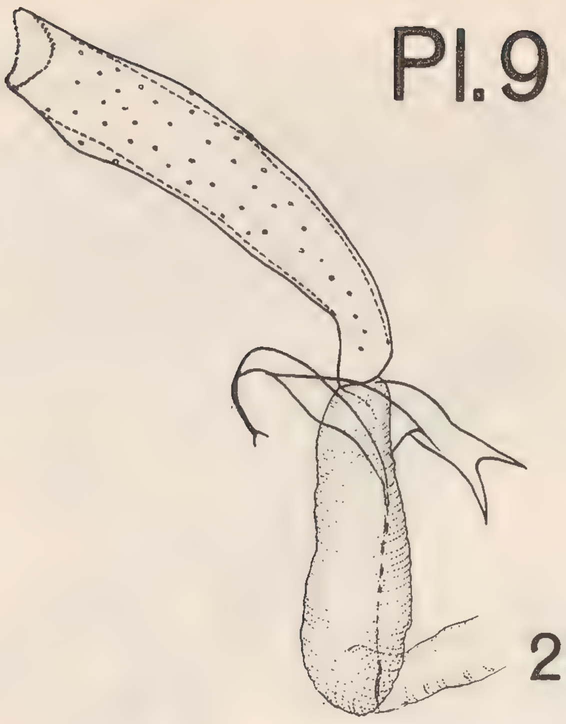
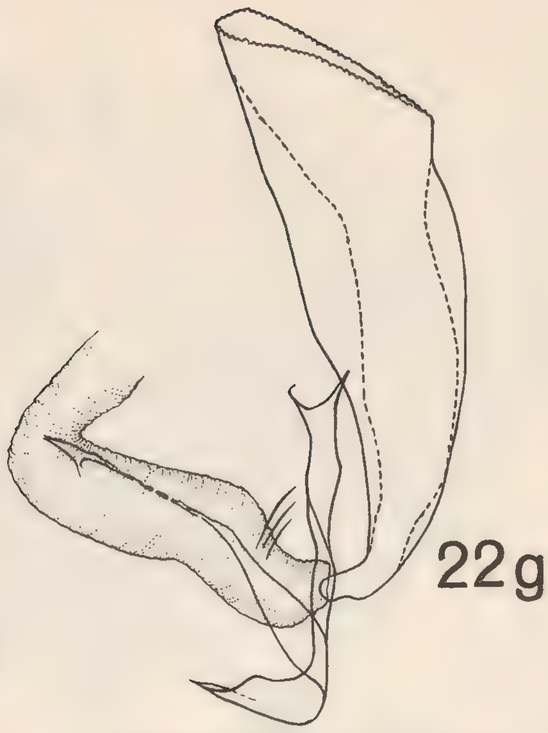
22d

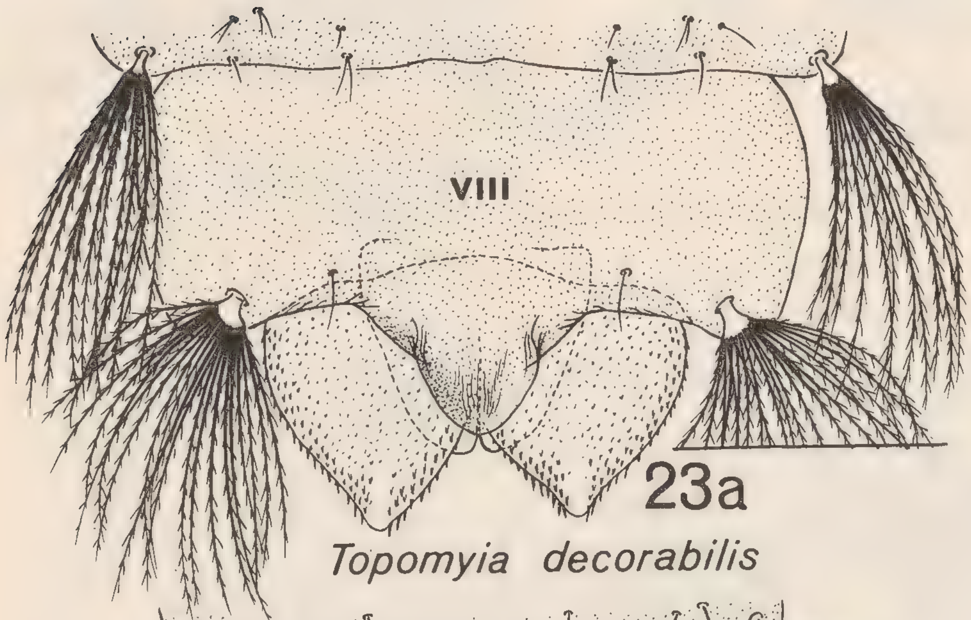
Topomyia spathulirostris

Pl. 9

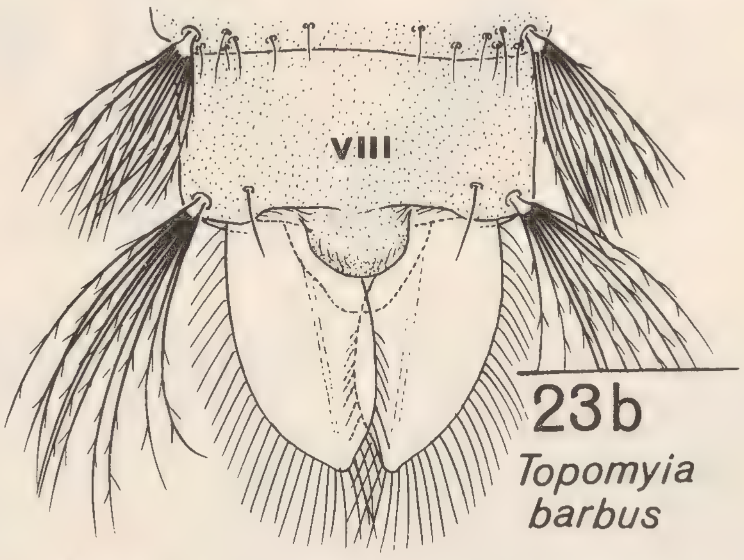

22e
Topomyia tipuliformis


22f
Tripteroides lorengaui

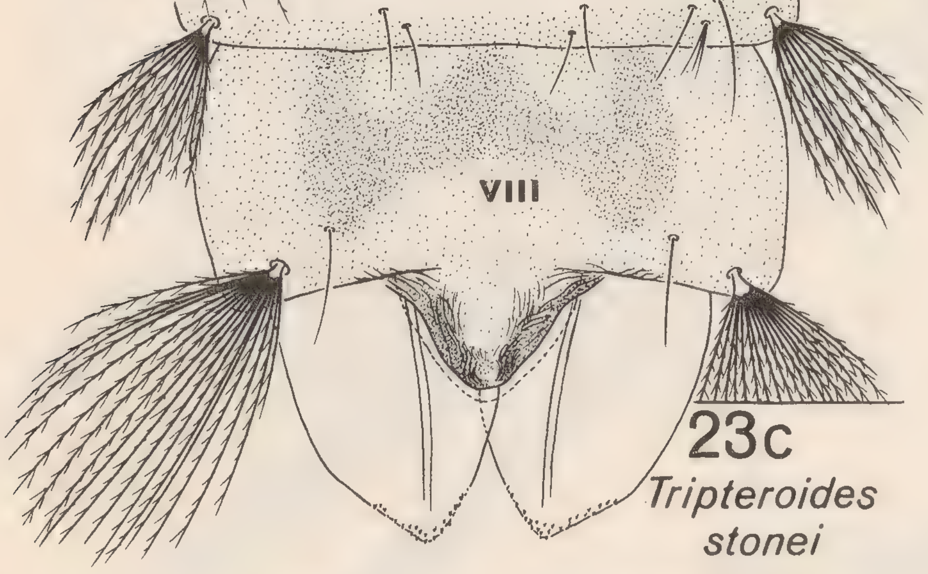

22g
Tripteroides fuscipleura



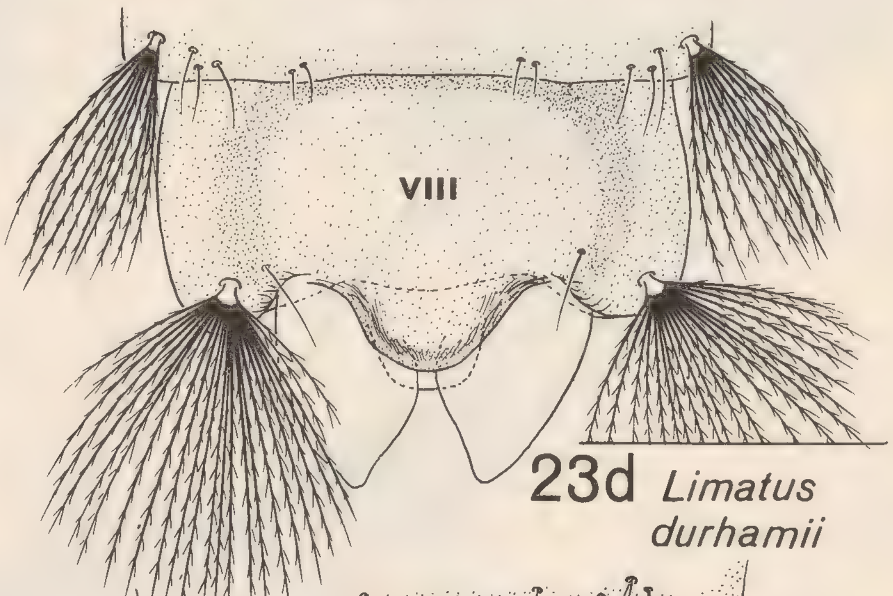
23a
Topomyia decorabilis



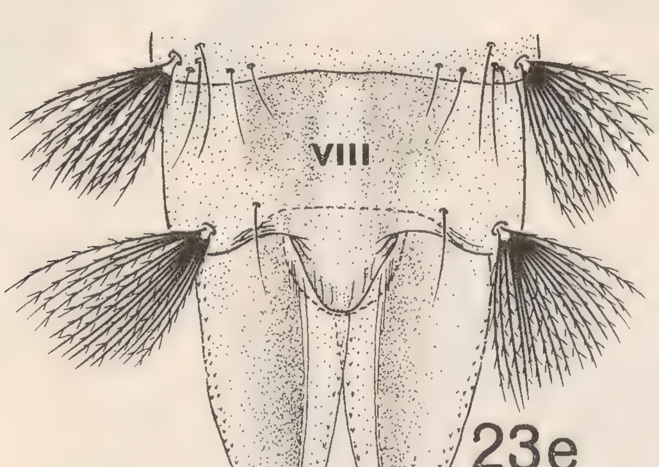
23b
Topomyia barbus



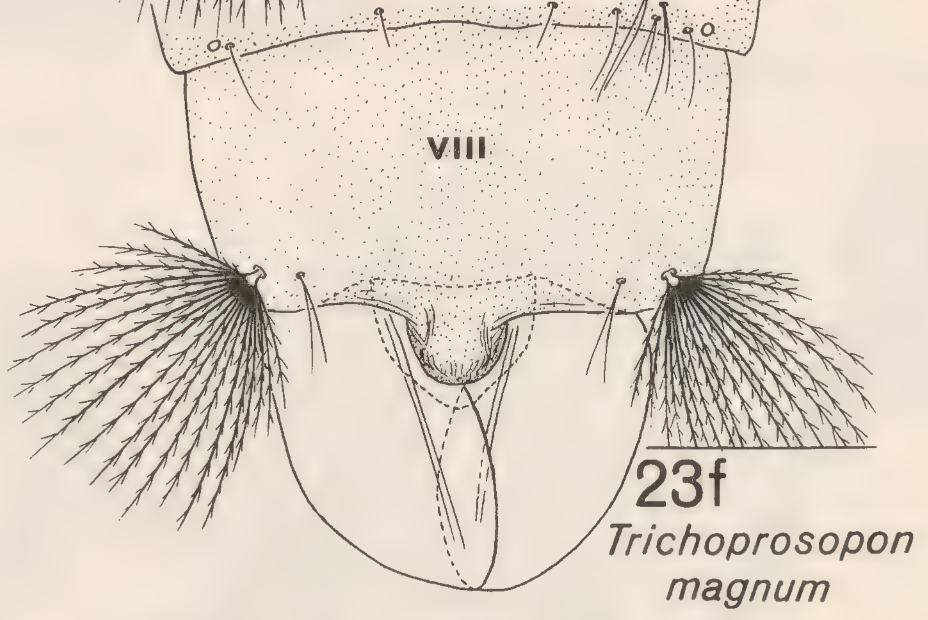
23c
Tripteroides stonei



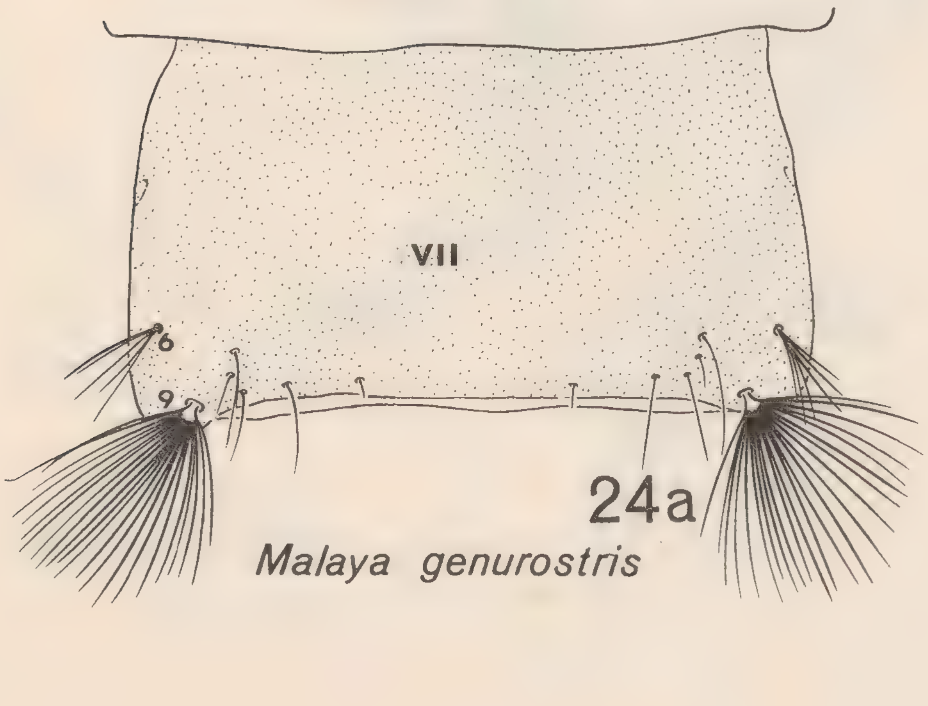
23d
Limatus durhamii



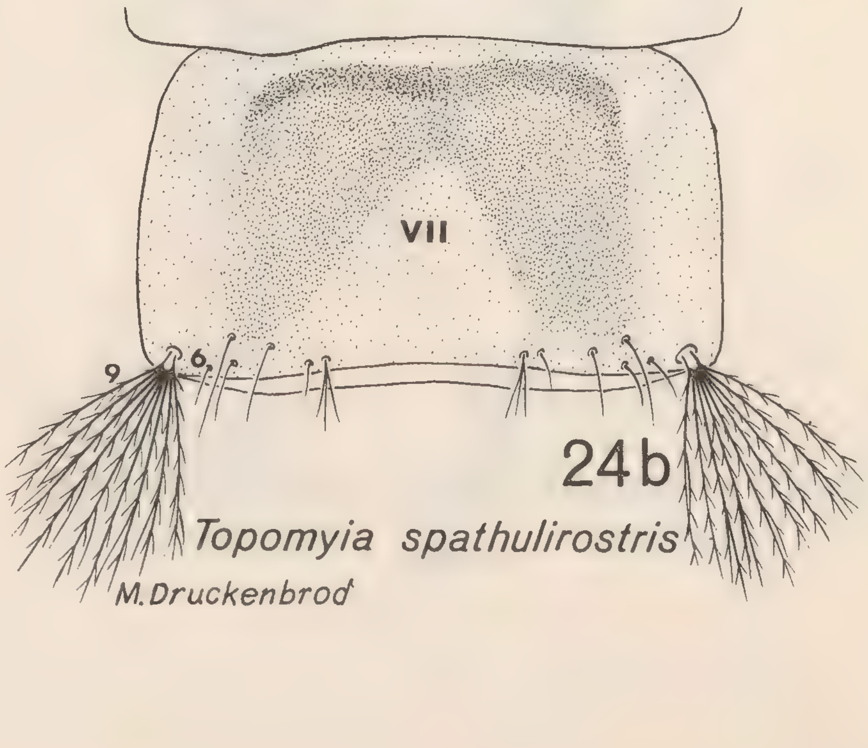
23e
Phoniomyia pallidoventer



23f
Trichoprosopon magnum



24a
Malaya genurostris



24b
Topomyia spathulirostris

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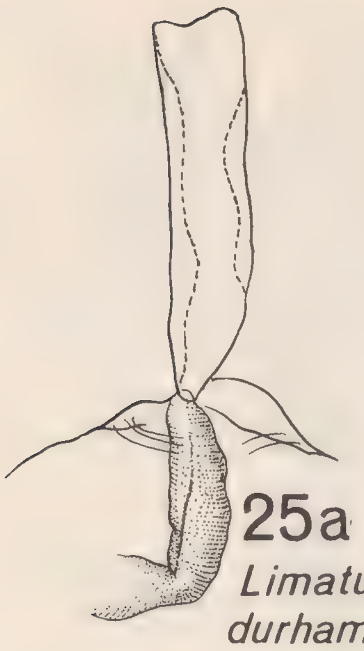
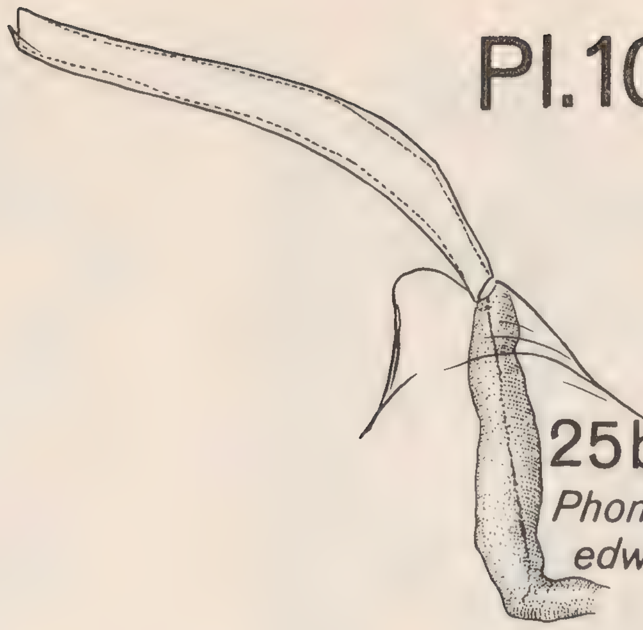
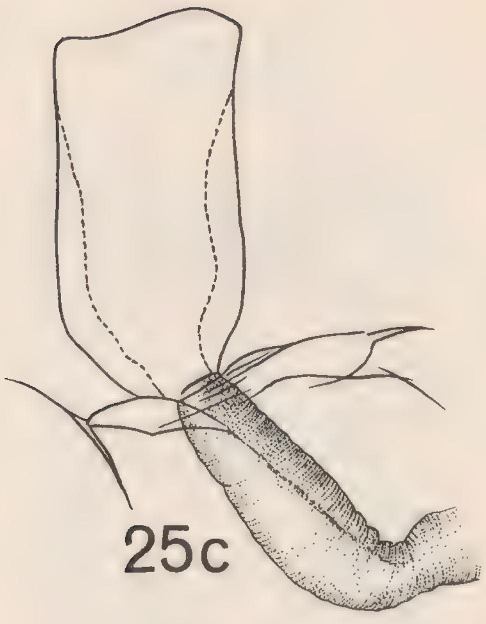
Pl.10



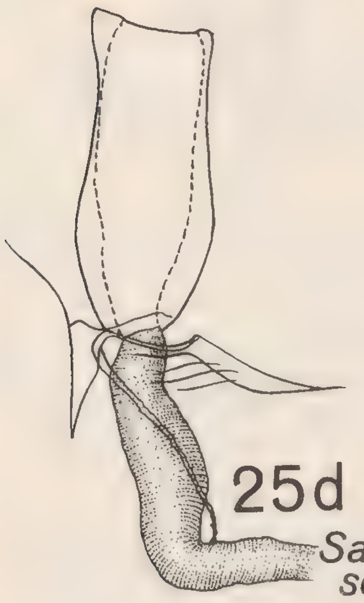
25a *Limatus durhamii*



25b *Phoniomyia edwardsi*

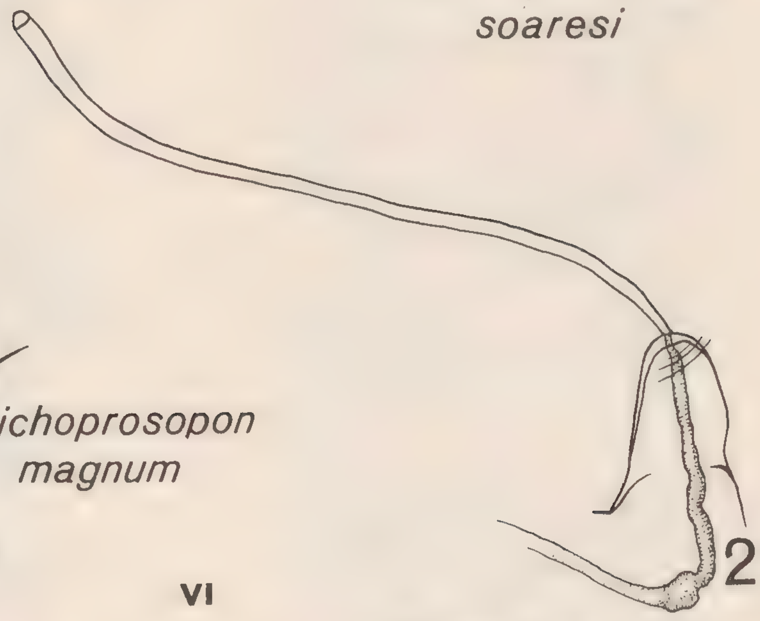


25c *Trichoprosopon soaresi*

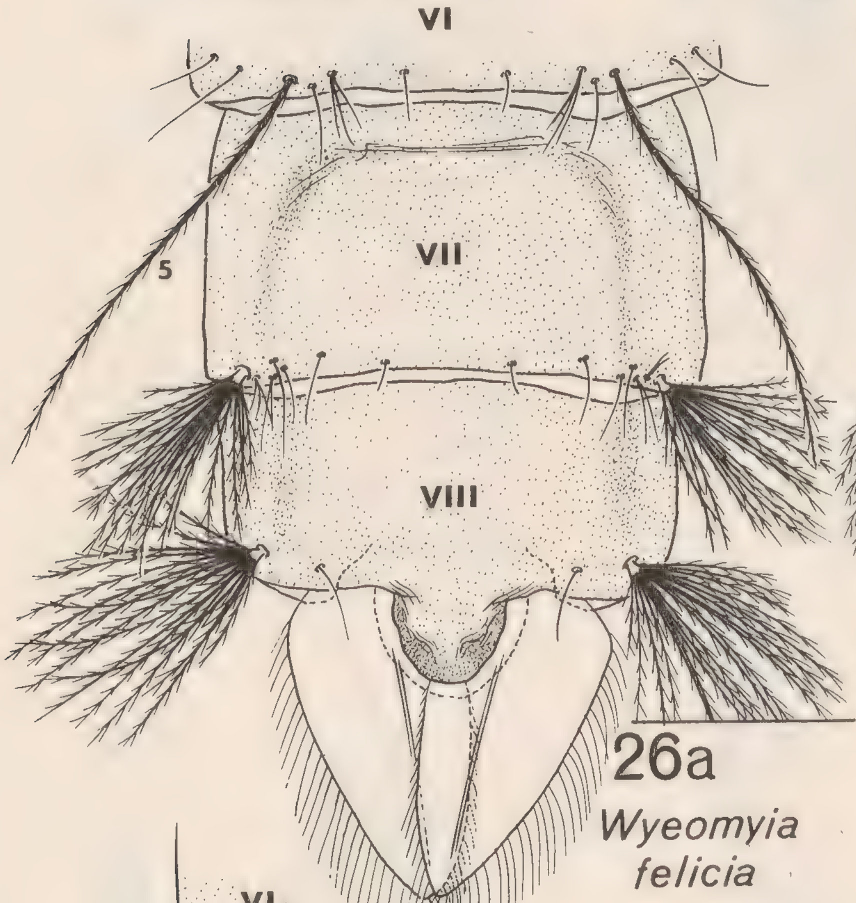


25d *Sabethes soperi*

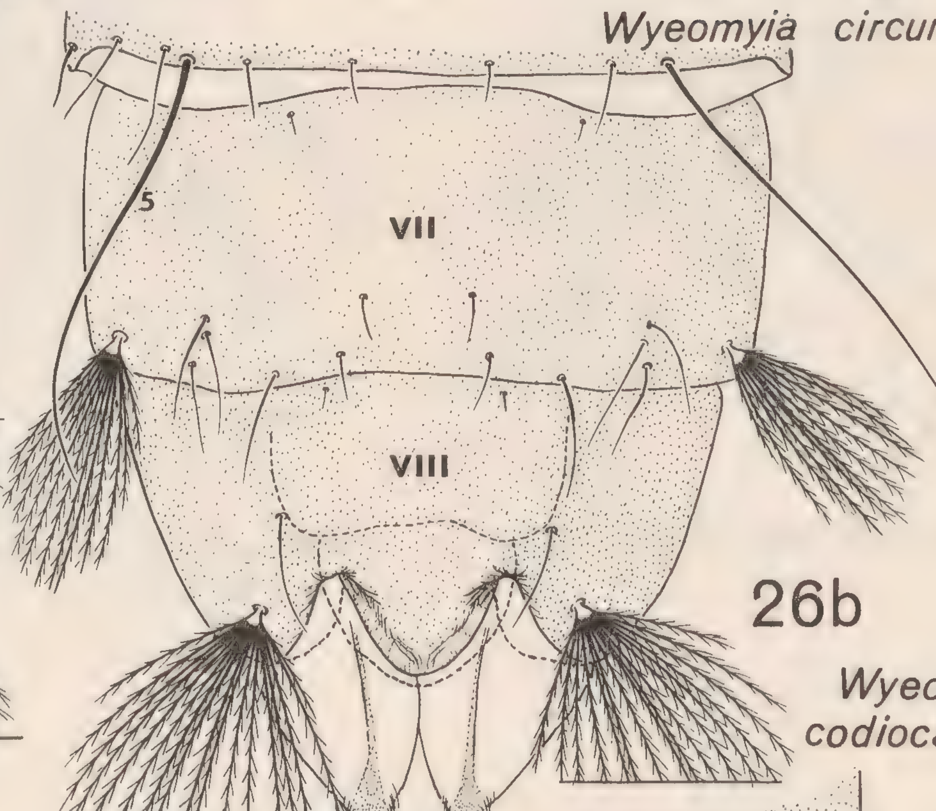
Trichoprosopon magnum 25e



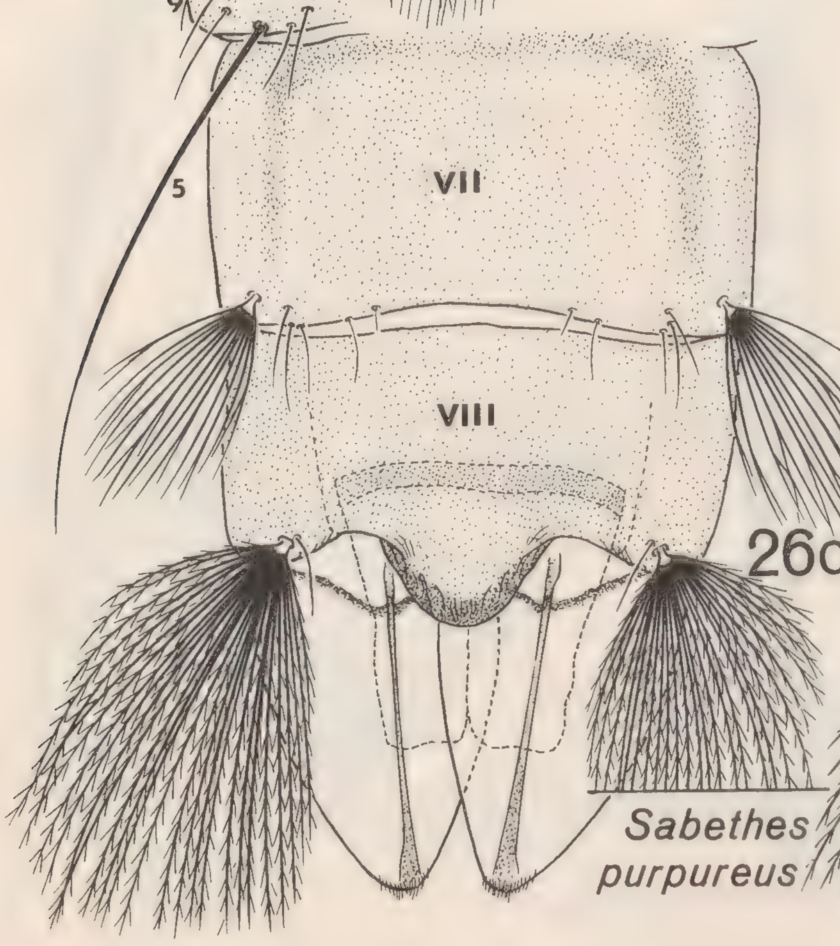
25f *Wyeomyia circumcincta*



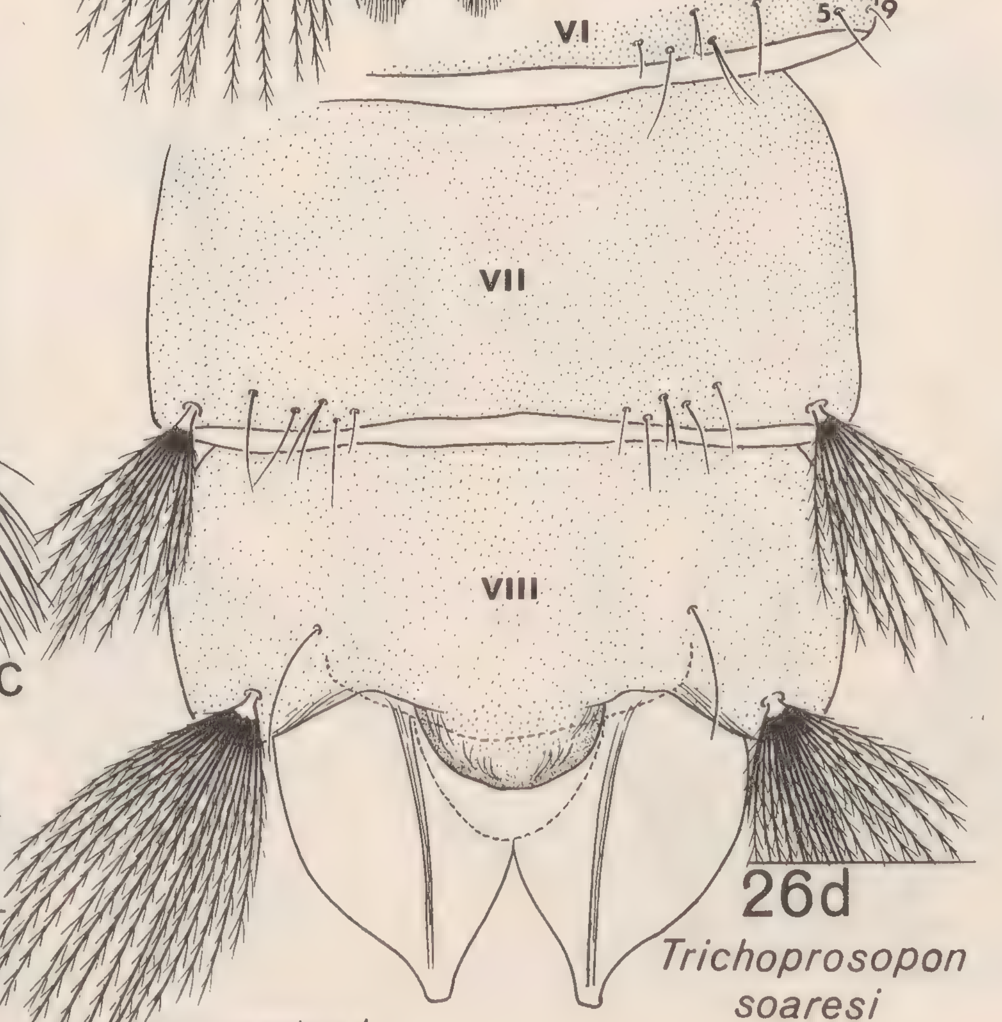
26a *Wyeomyia felicia*



26b *Wyeomyia codiocampa*



26c *Sabethes purpureus*



26d *Trichoprosopon soaresi*

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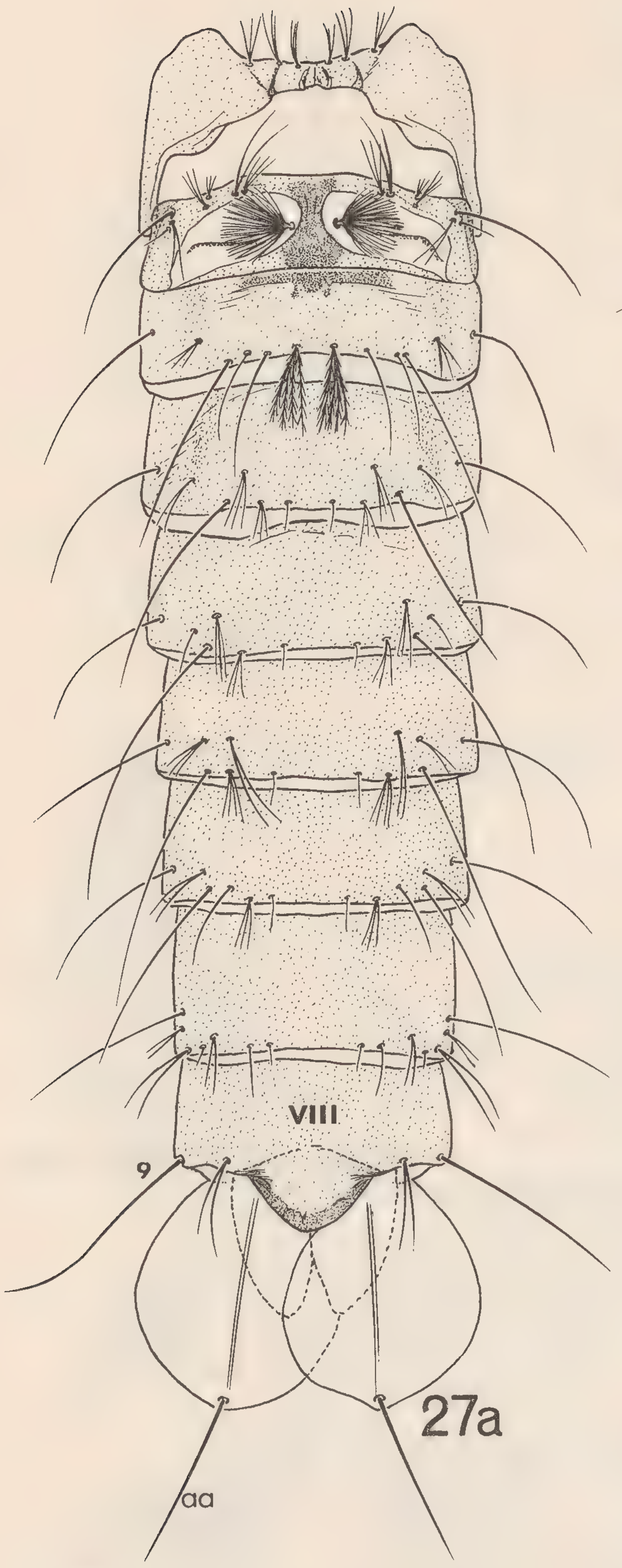
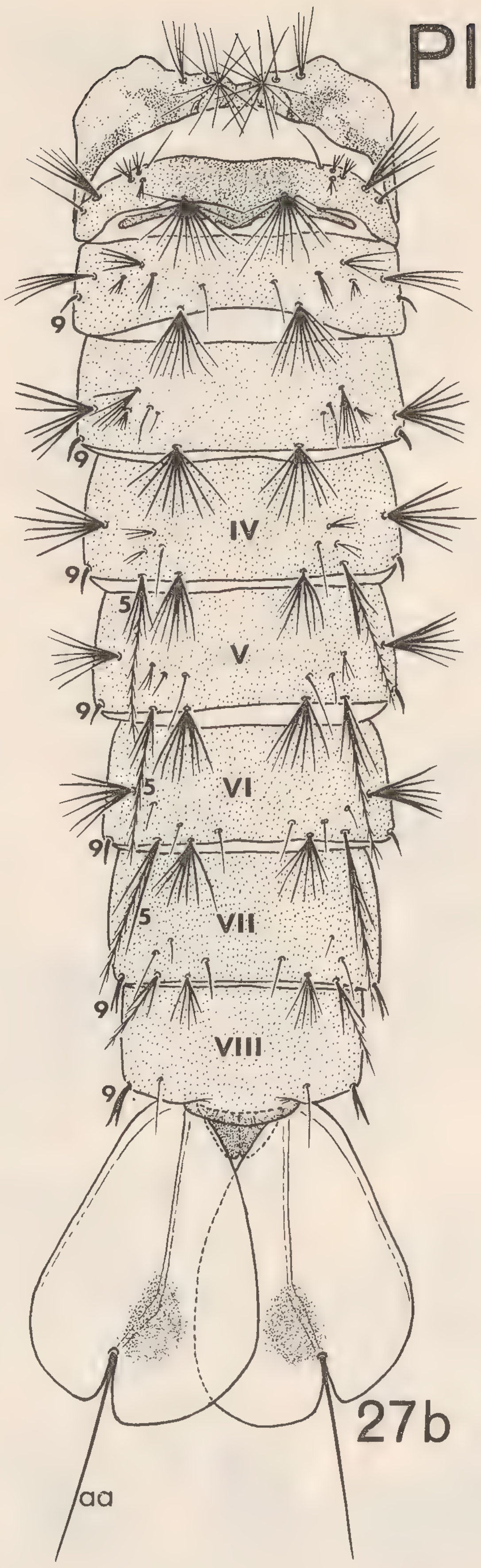
Pl.11



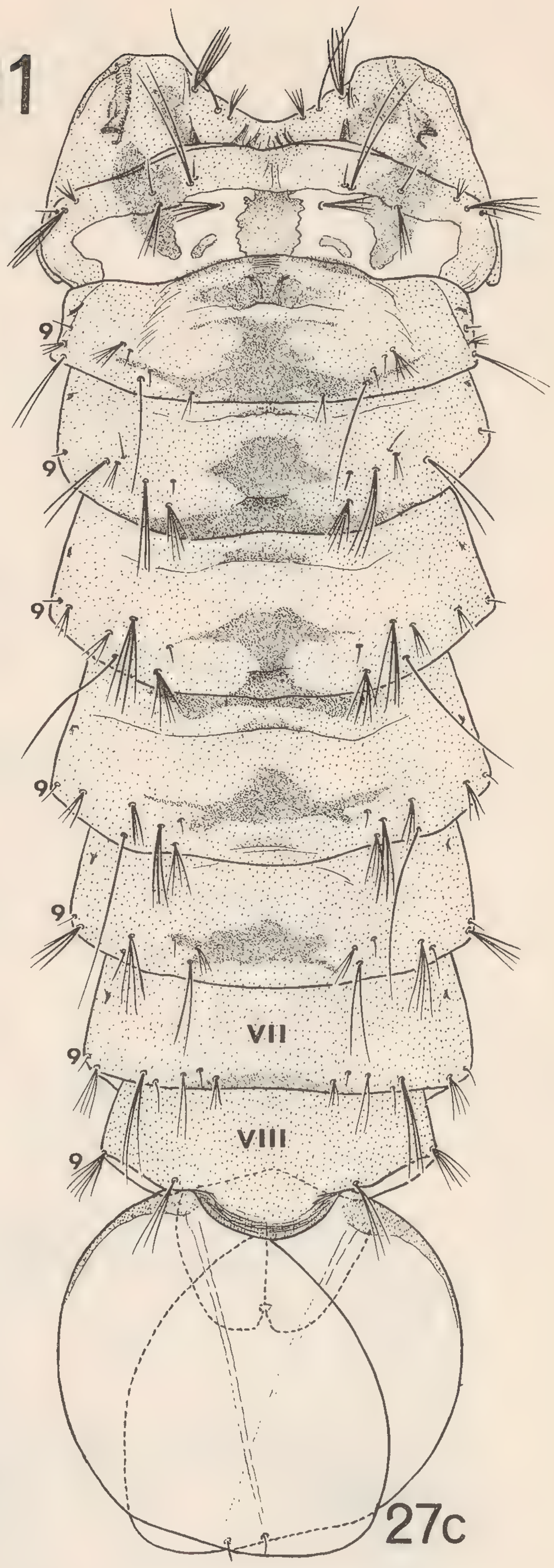
27a

Deinocerites mcdonaldi



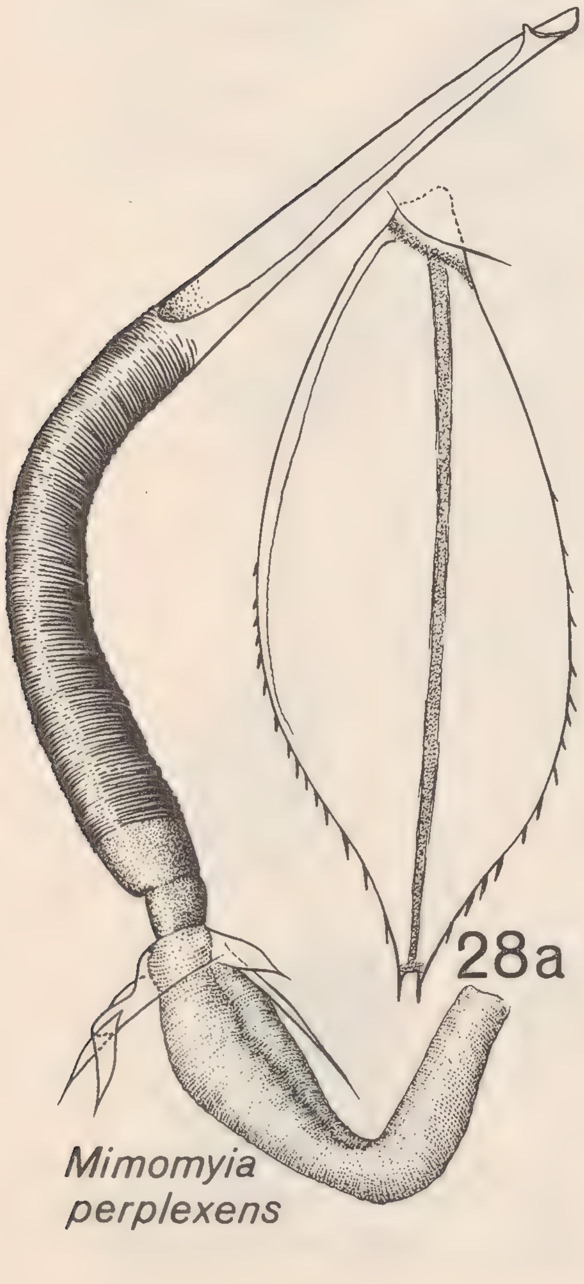
27b

Aedeomyia catasticta



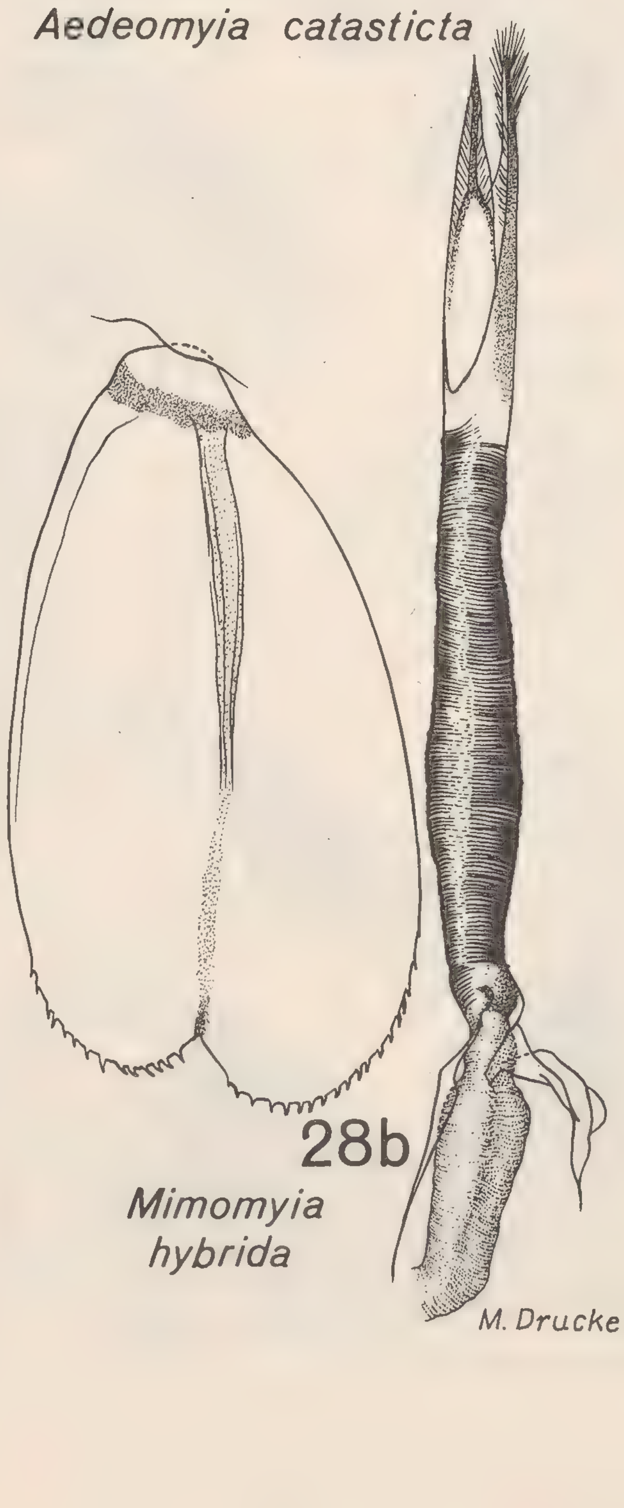
27c

Opifex fuscus



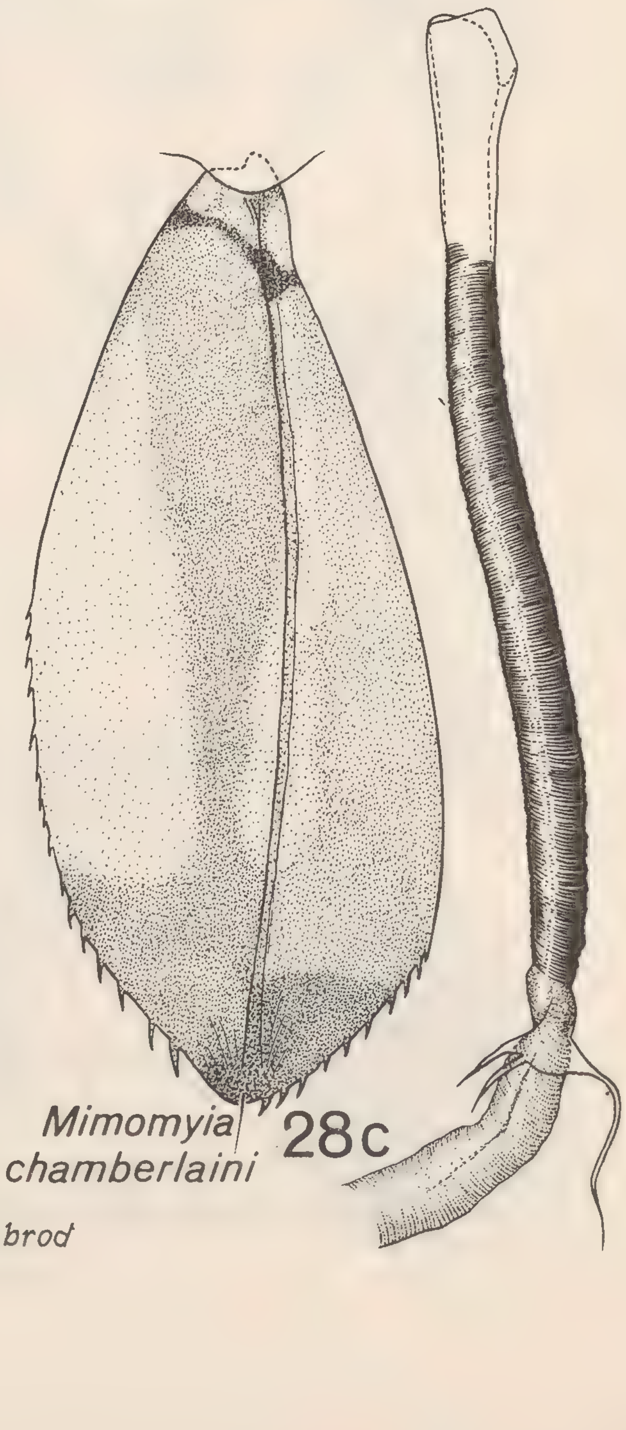
28a

Mimomyia perplexens



28b

Mimomyia hybrida



28c

Mimomyia chamberlaini

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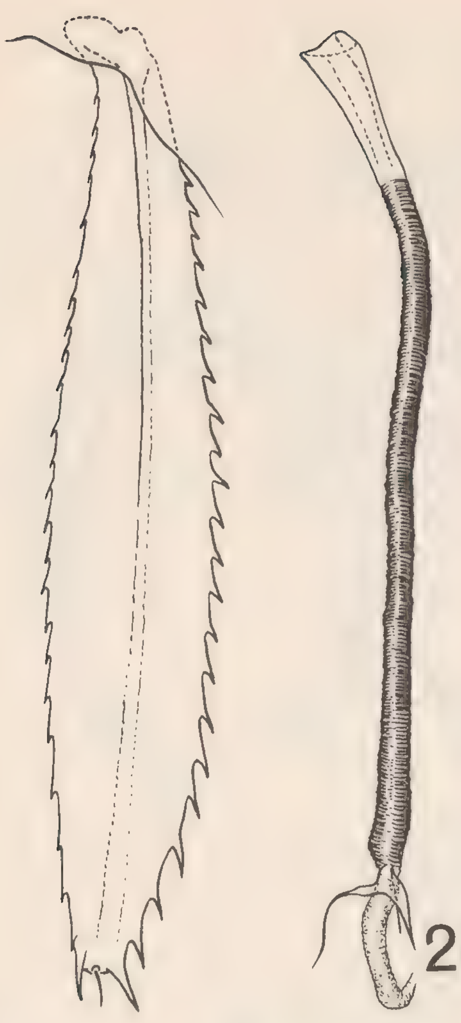
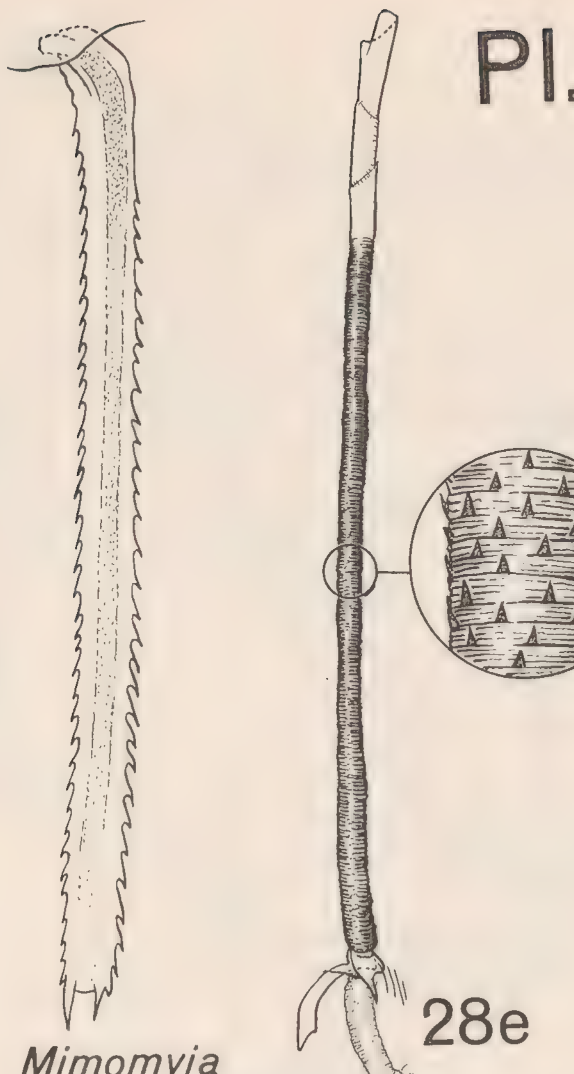
Pl.12



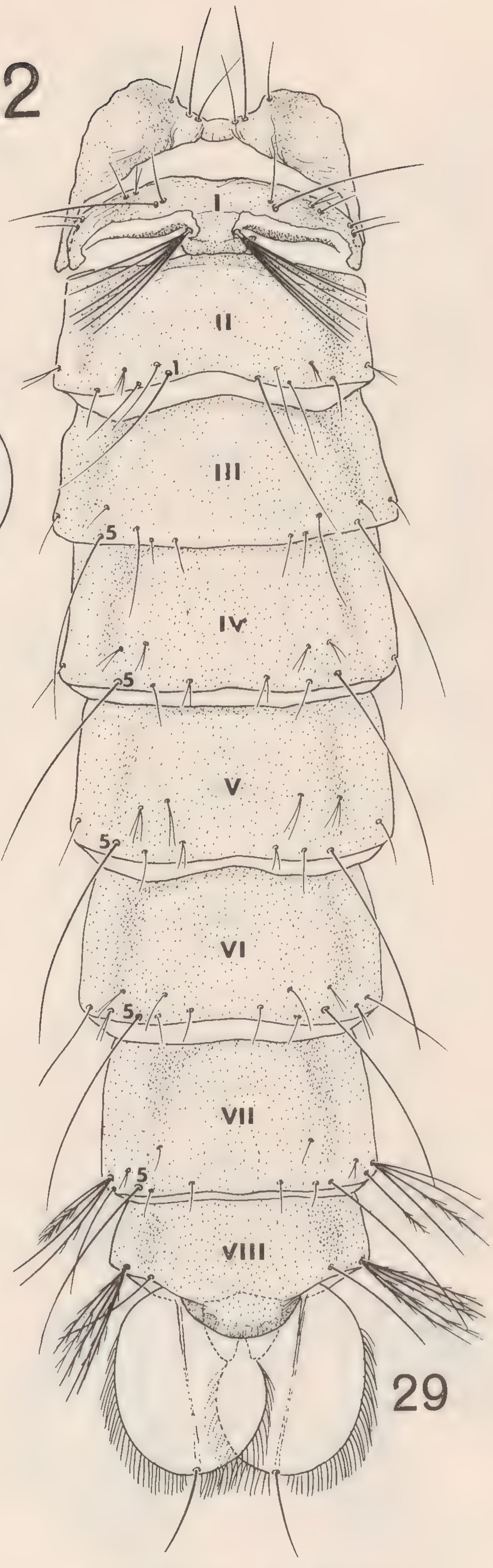
28d

Mimomyia (Etorleptiomyia) luzonensis



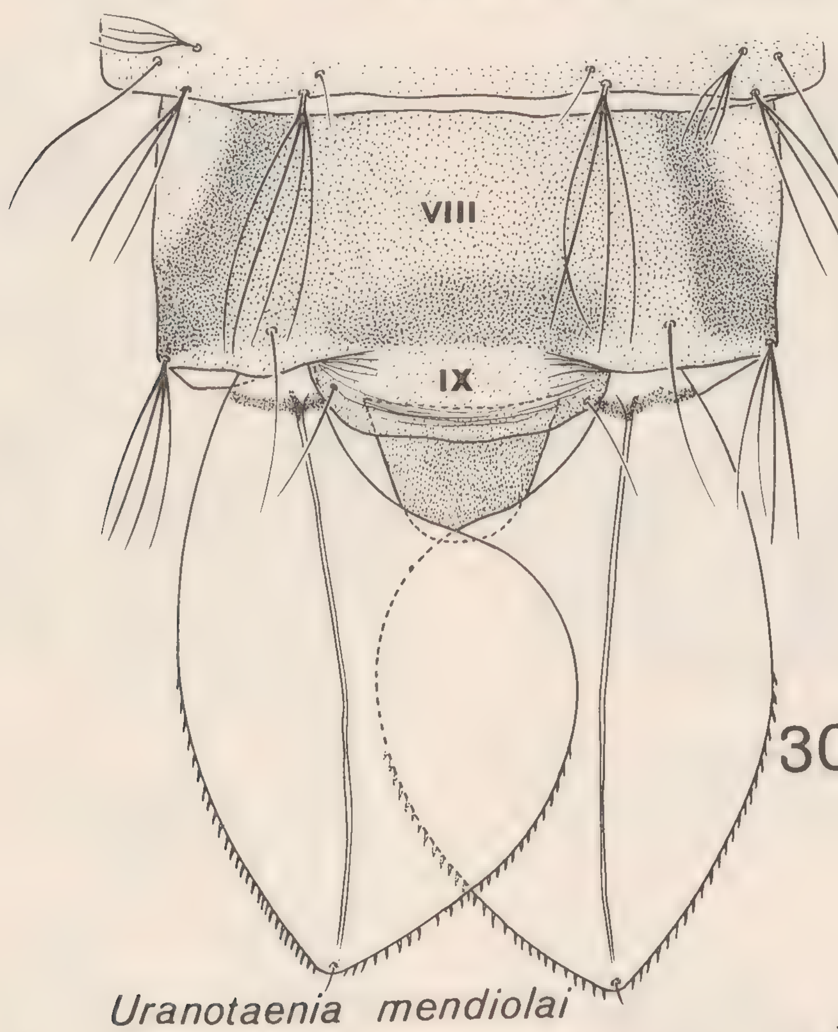
28e

Mimomyia (Ravenalites) deguzmanae



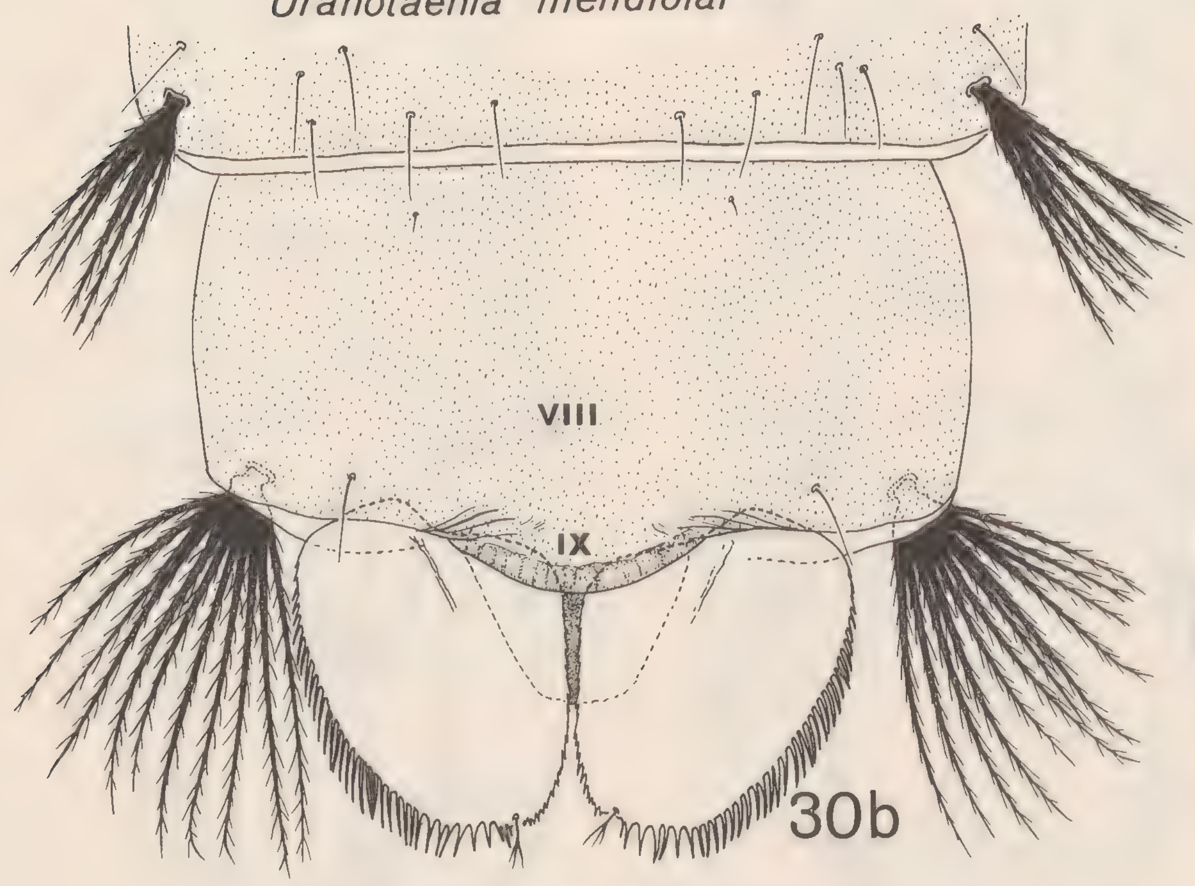
29

Zeugnomyia lawtoni



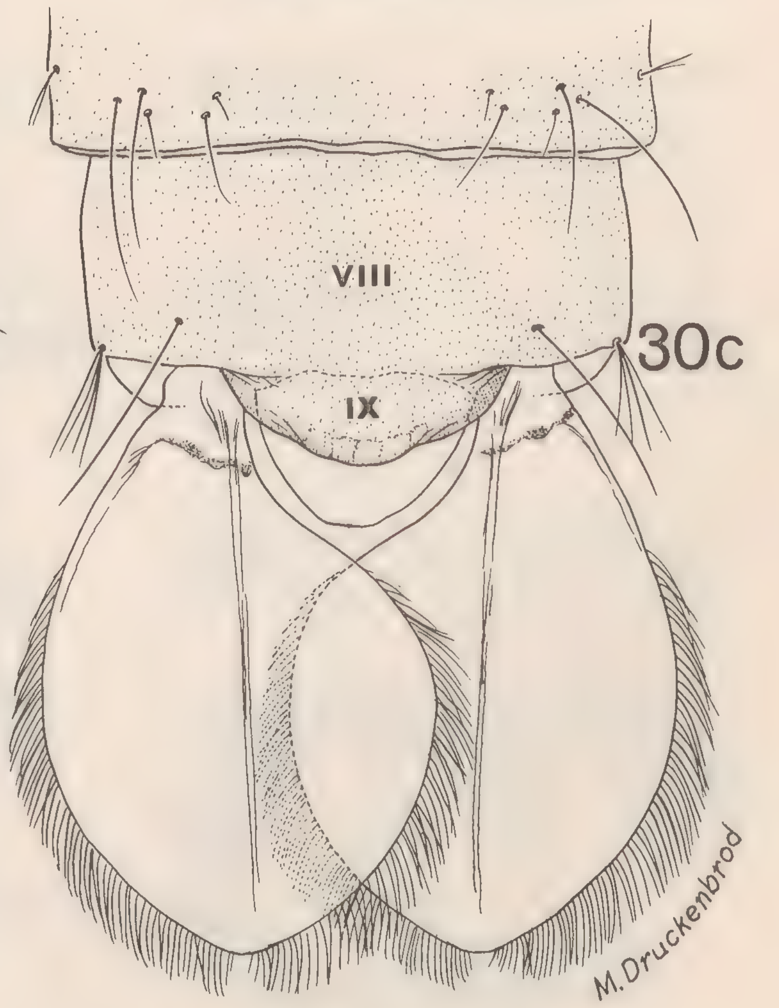
30a

Uranotaenia mendiolai



30b

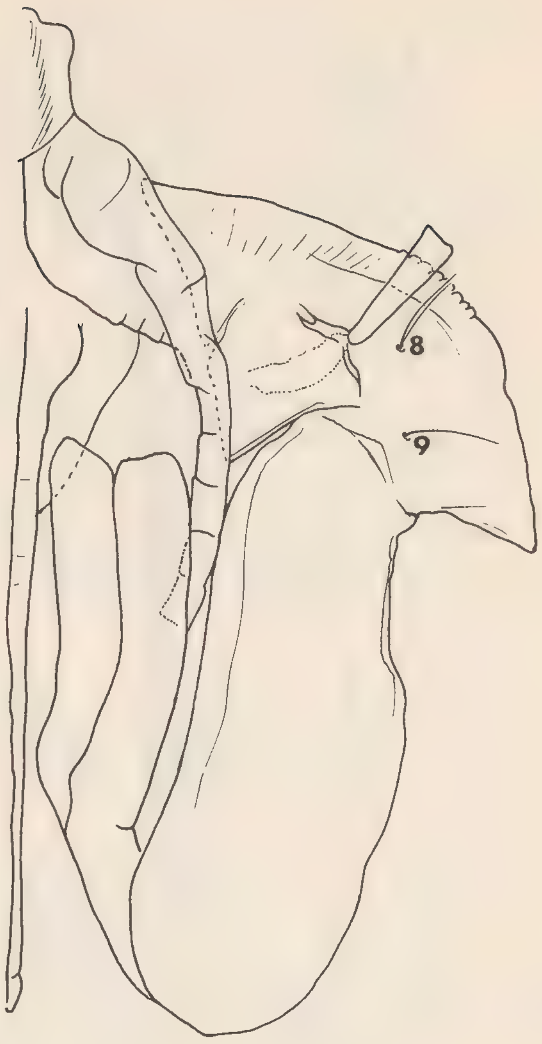
Uranotaenia ascidiicola

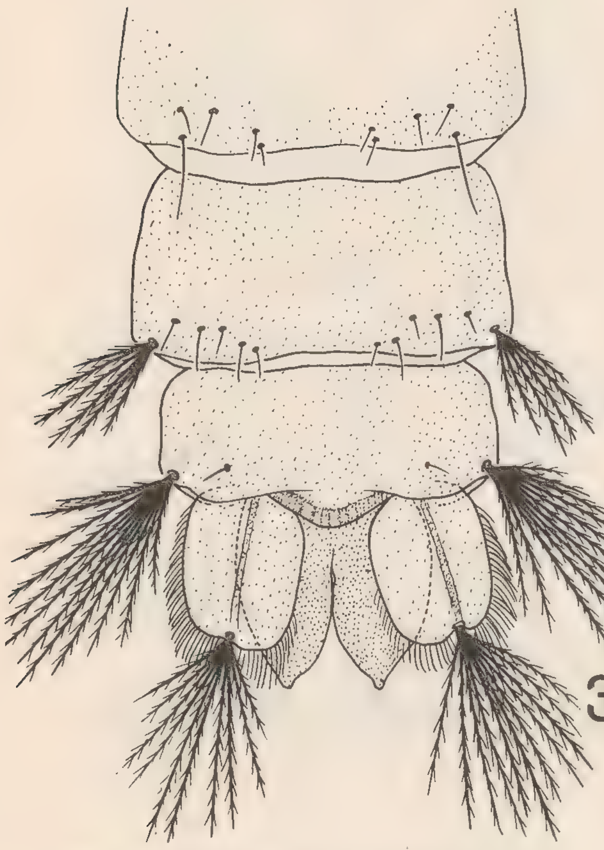


30c

Uranotaenia modesta

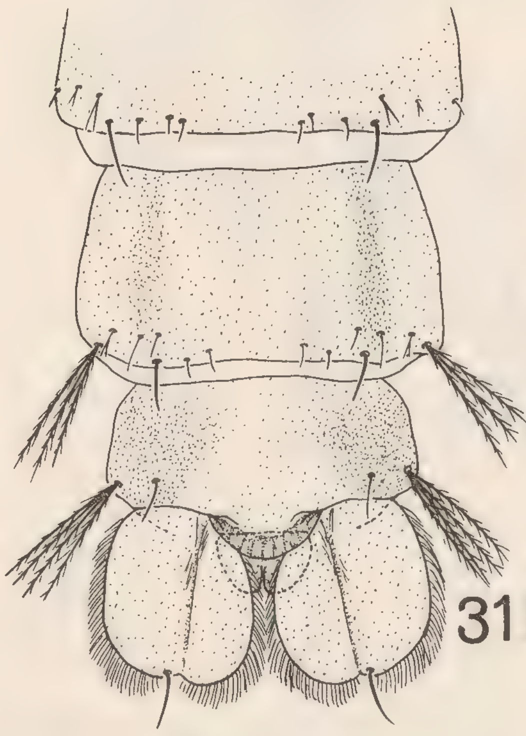
Pl.13





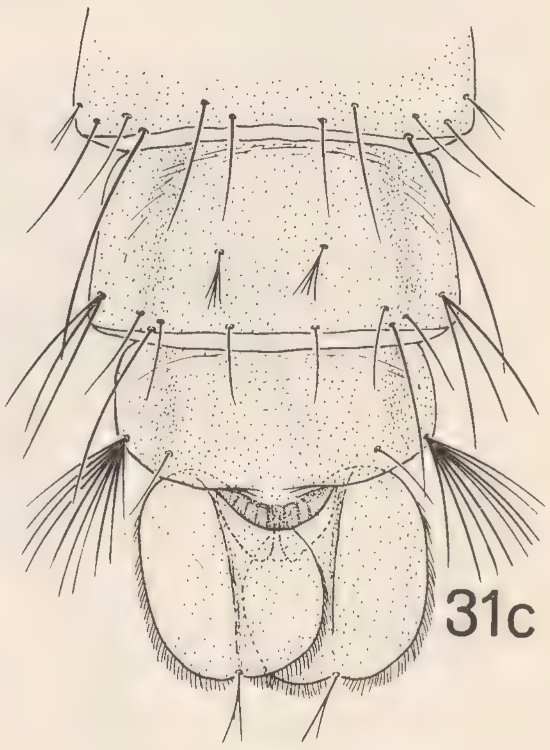
31a

Eretmapodites inornatus



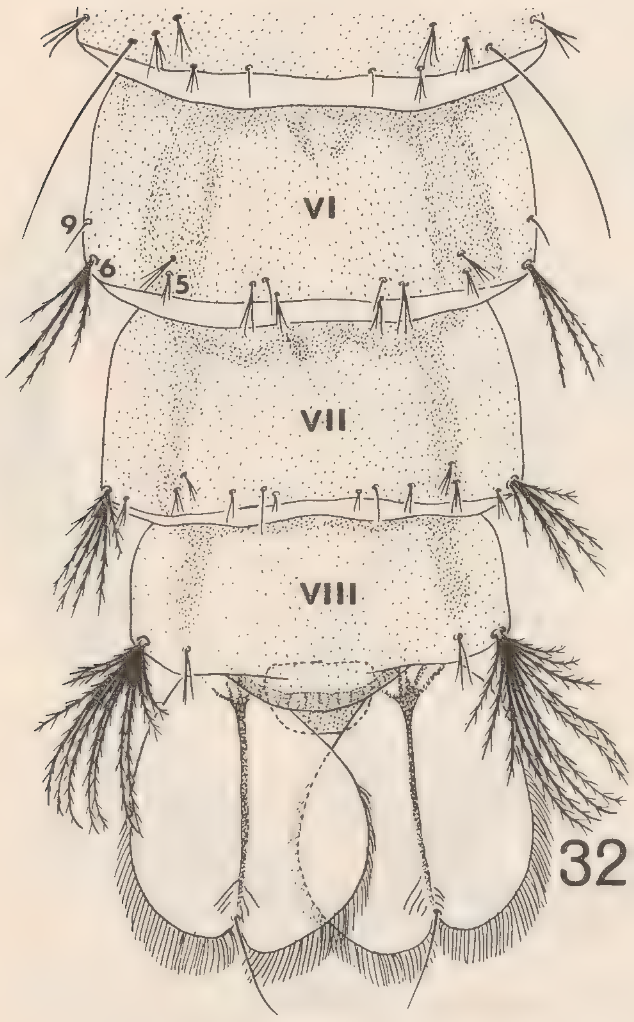
31b

Eretmapodites dracaenae



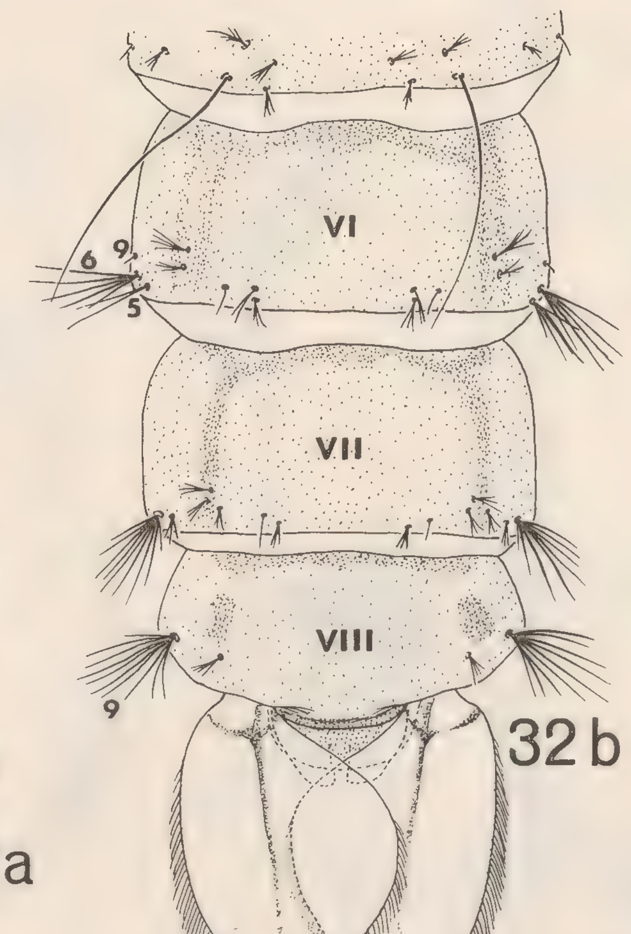
31c

Aedes (Stegomyia) ruwenzori



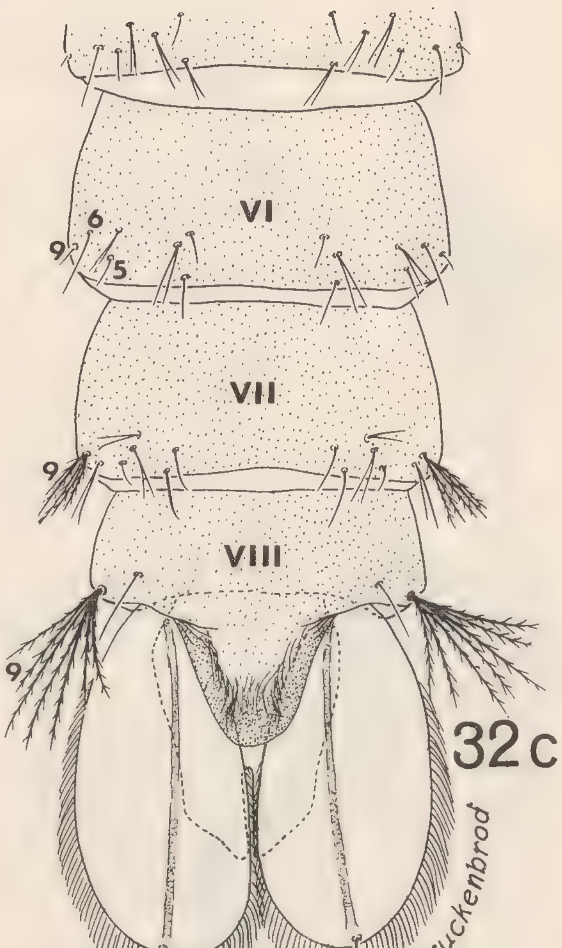
32a

Armigeres subalbatus



32 b

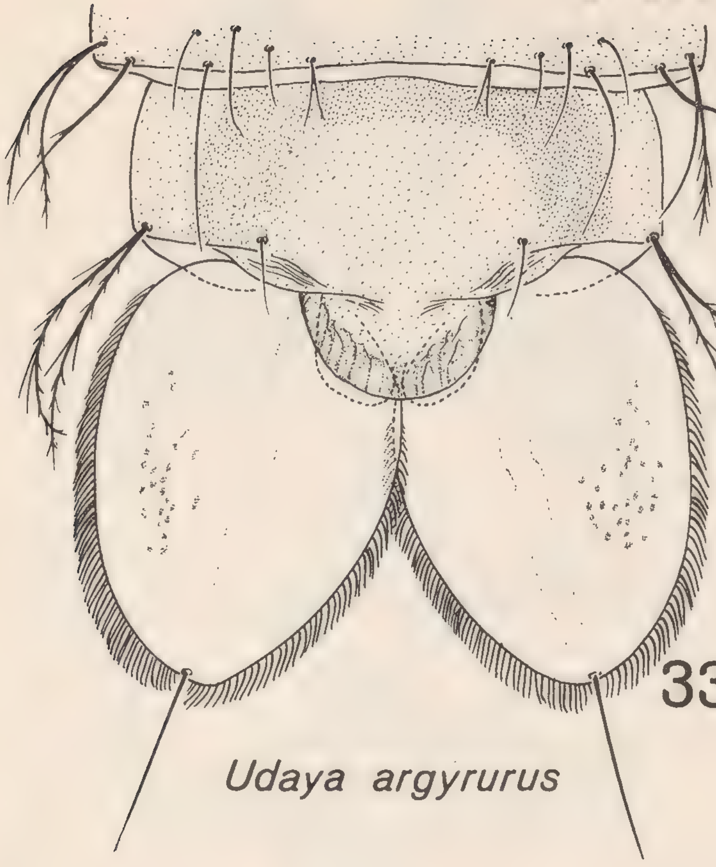
Armigeres malayi



32 c

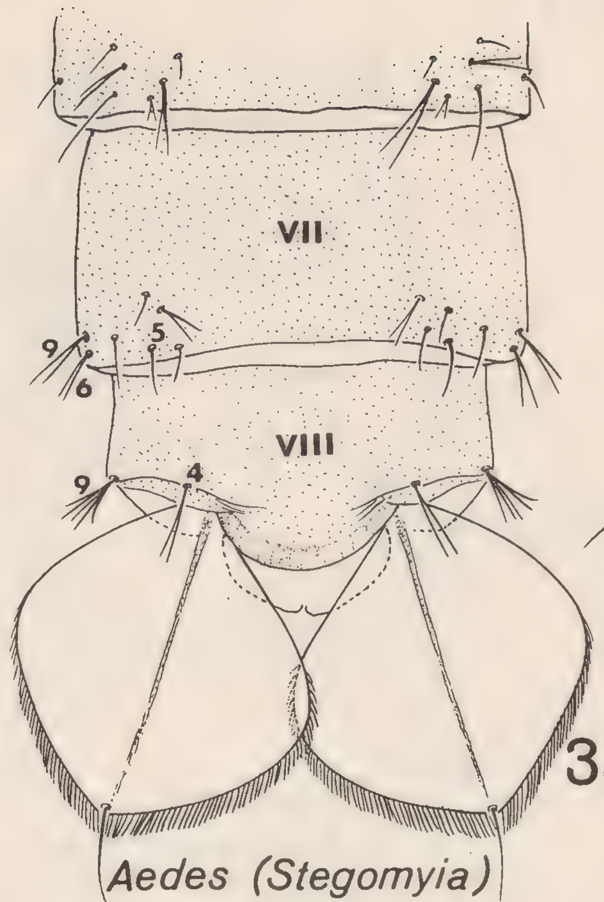
Heizmannia achaetae

Pl.14



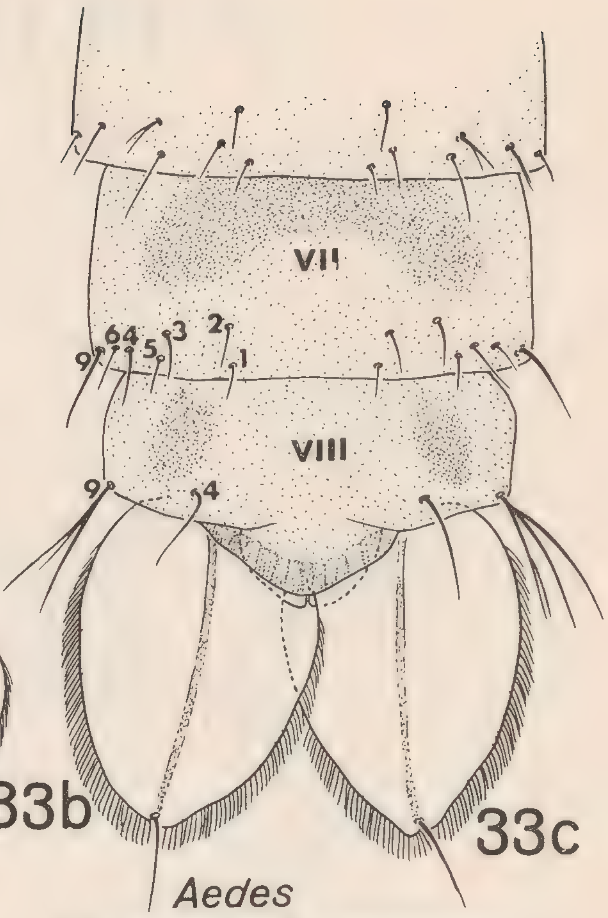
33a

Udaya argyrurus



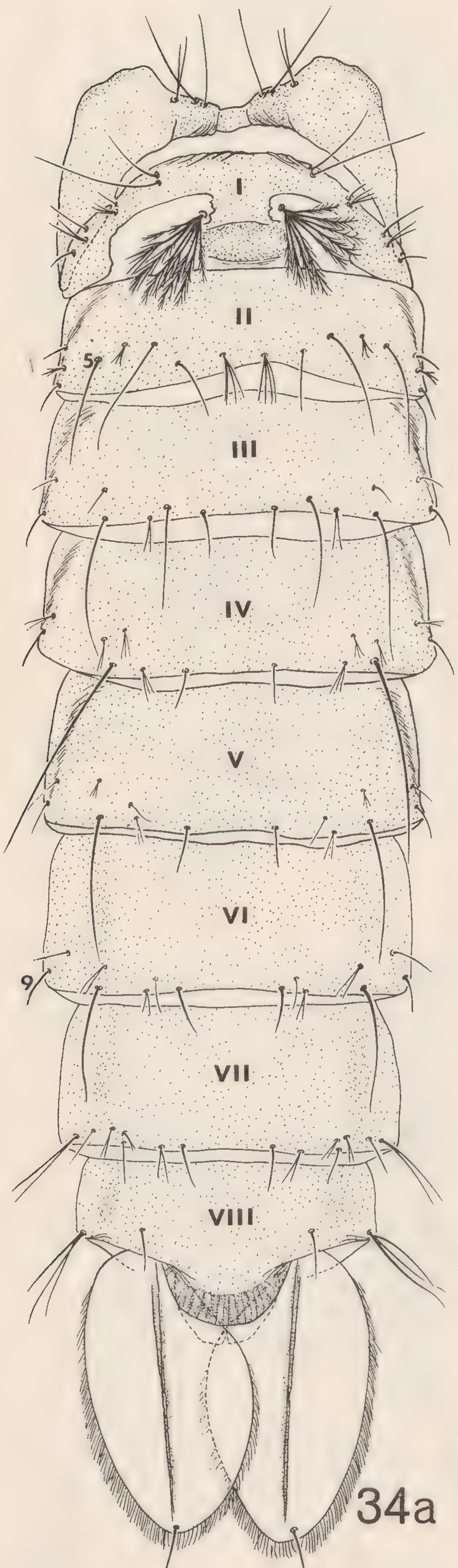
33b

Aedes (Stegomyia) meronephada



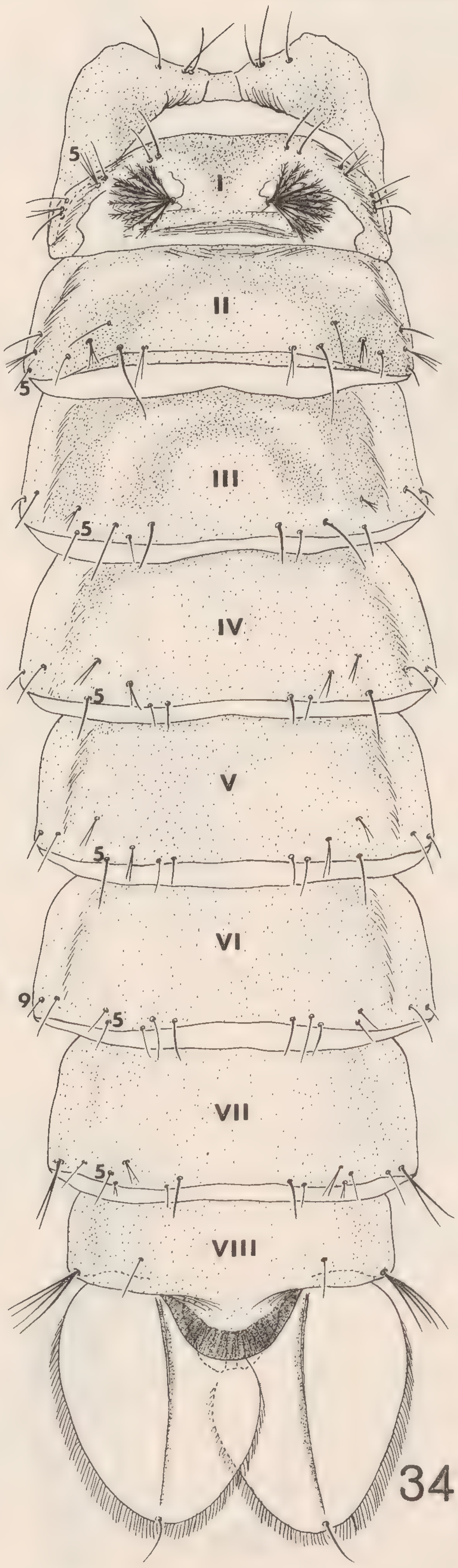
33c

Aedes (Stegomyia) annandalei



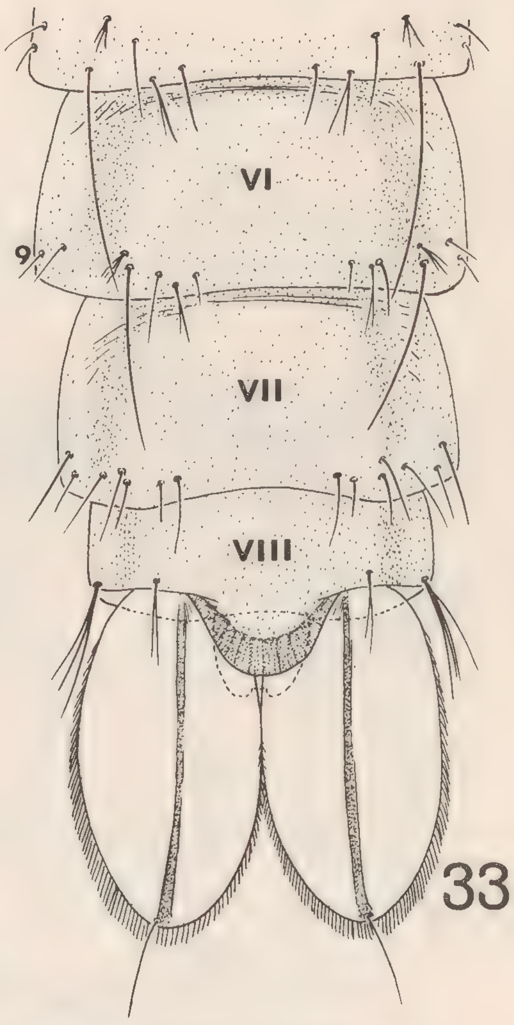
34a

Heizmannia complex



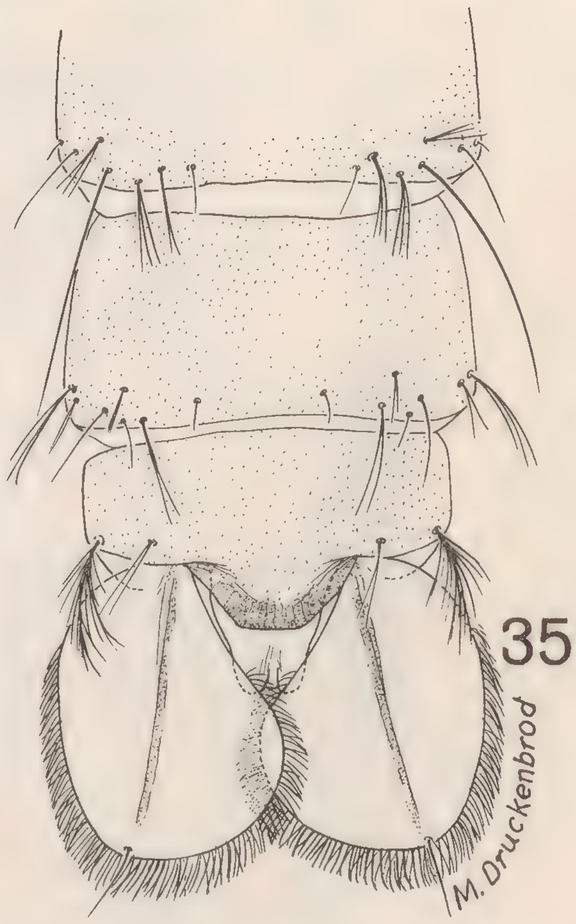
34b

Heizmannia aureochaeta



33d

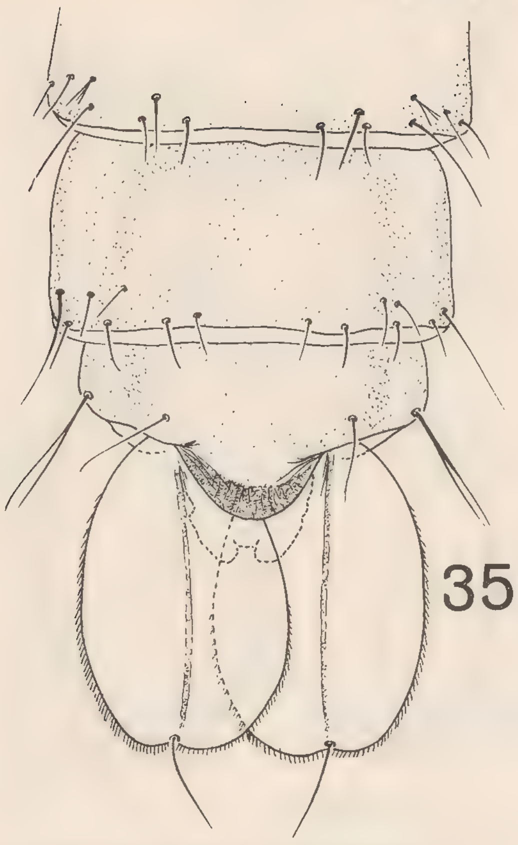
Heizmannia scintillans



35a

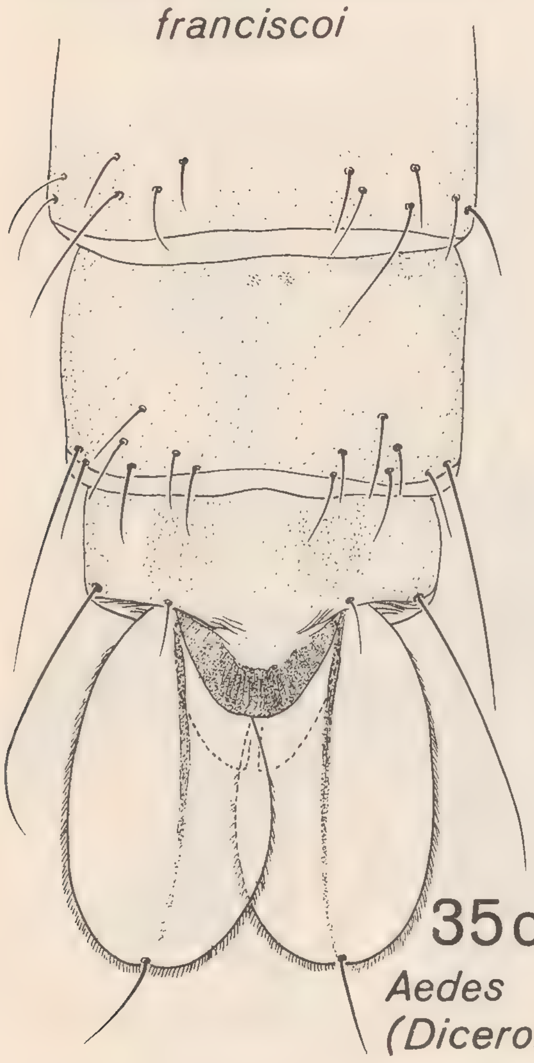
Aedes (Lorrainea) fumidus

Pl. 15



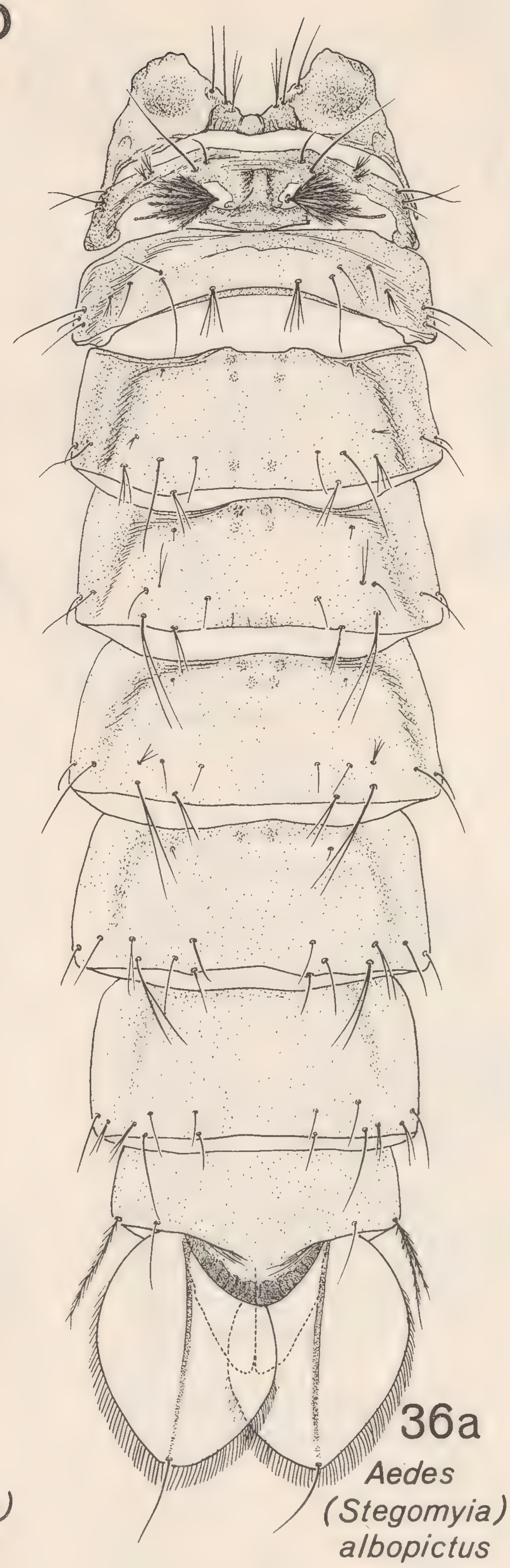
35b

Aedes (Diceromyia) franciscoi



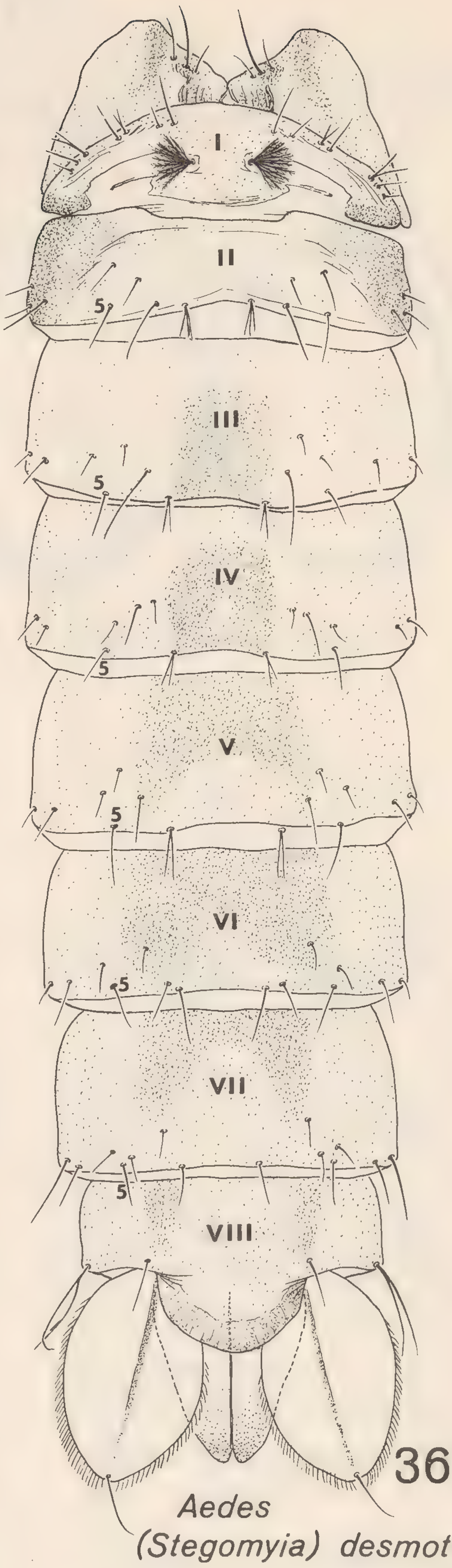
35c

Aedes (Diceromyia) periskelatus



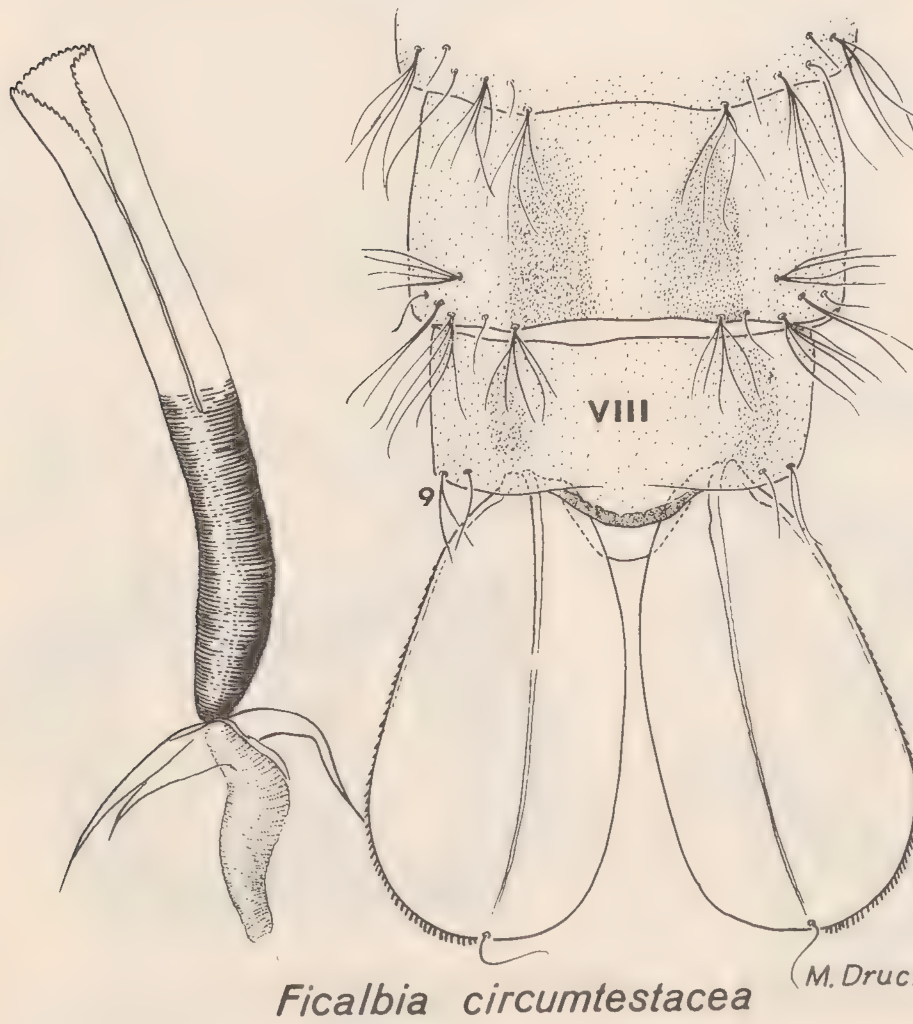
36a

Aedes (Stegomyia) albopictus



36b

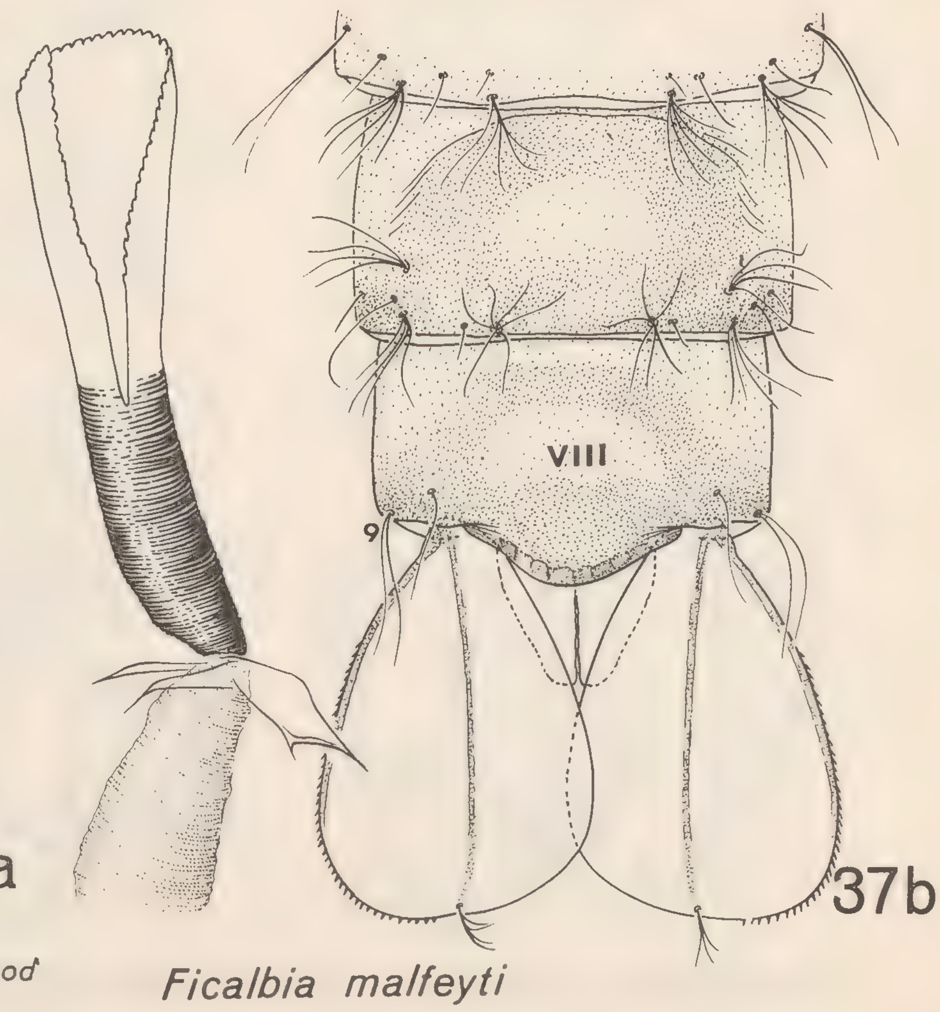
Aedes (Stegomyia) desmotes



37a

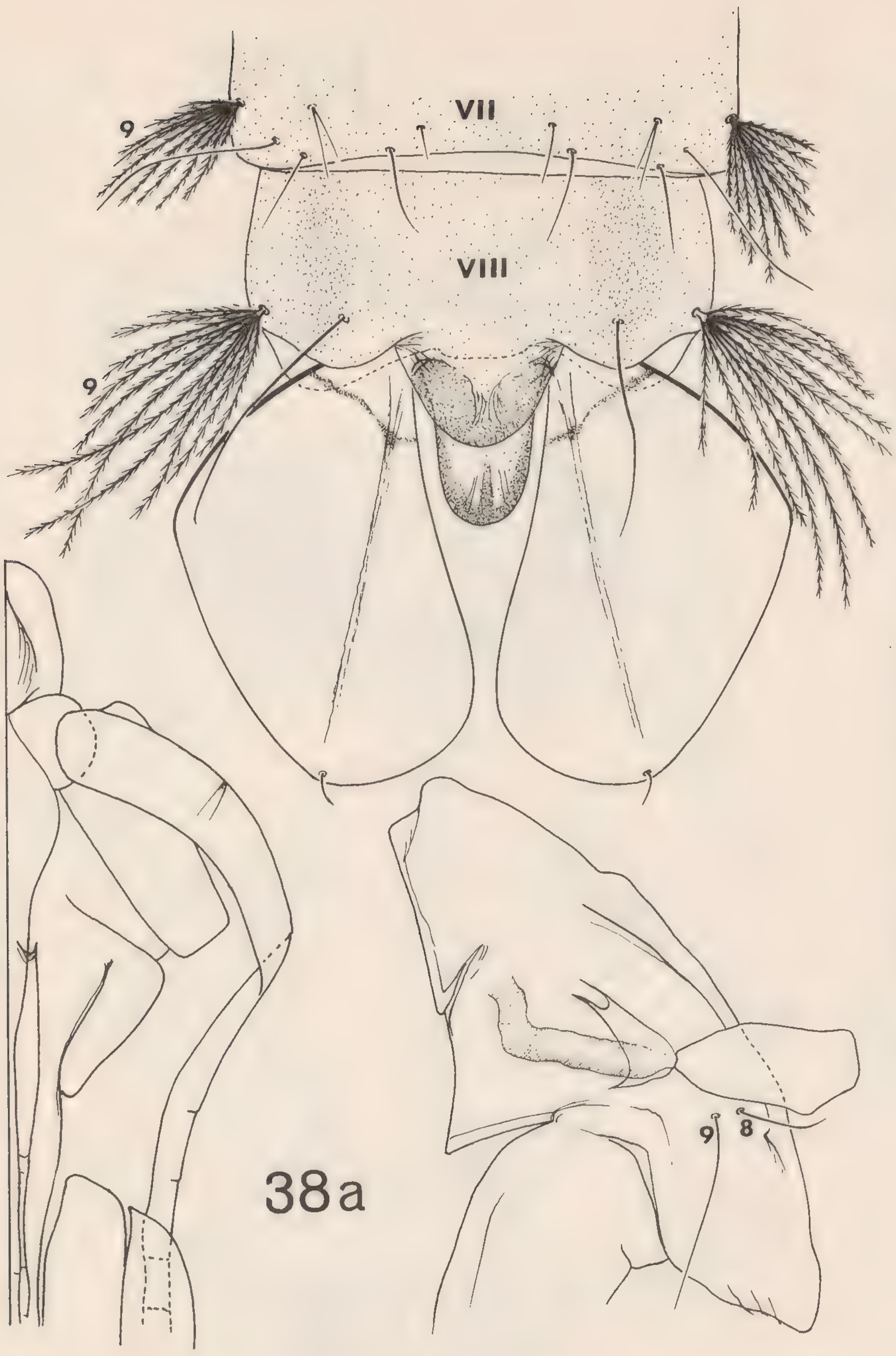
Ficalbia circumtestacea

M. Druckenbrod



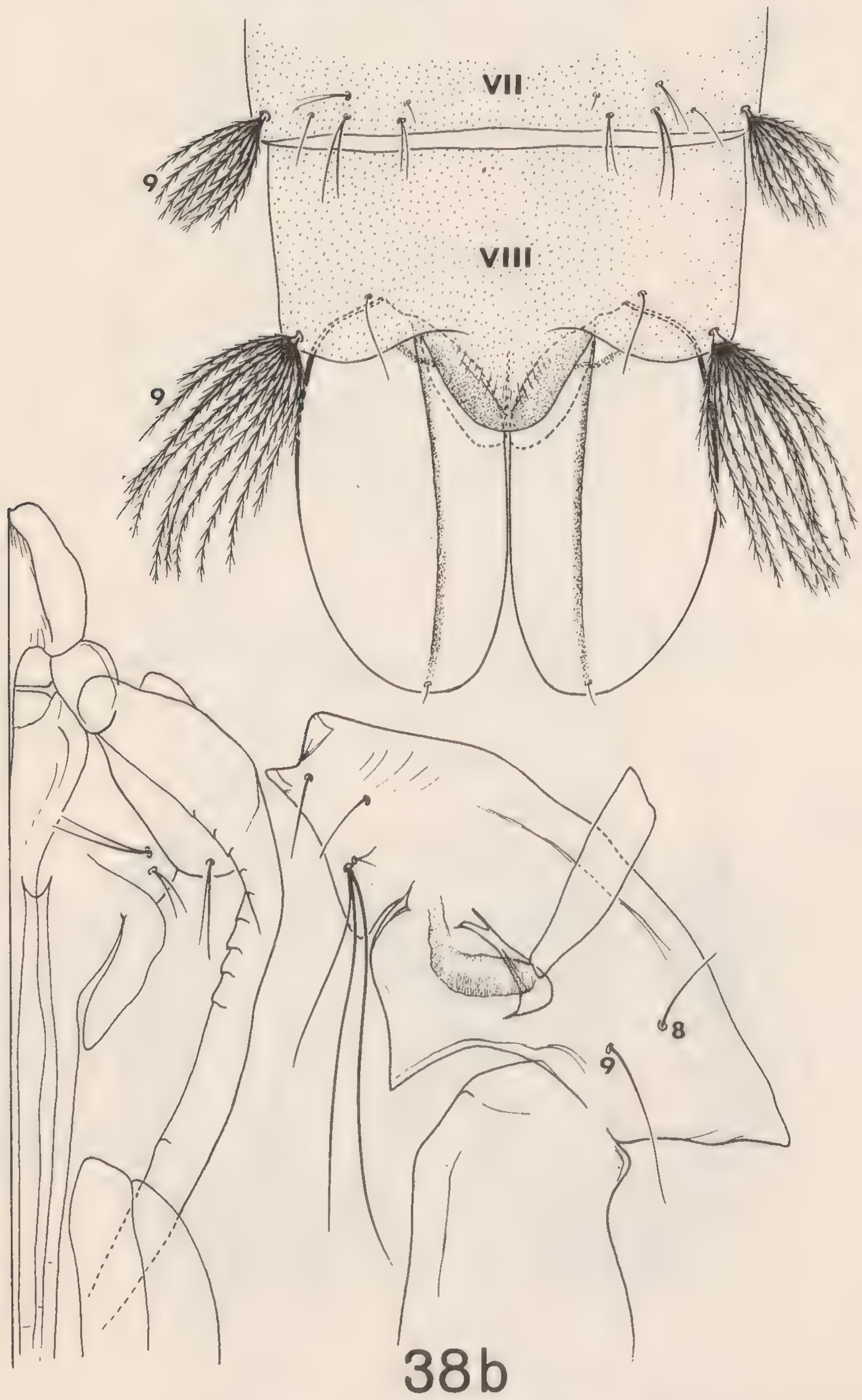
37b

Ficalbia malfeyti



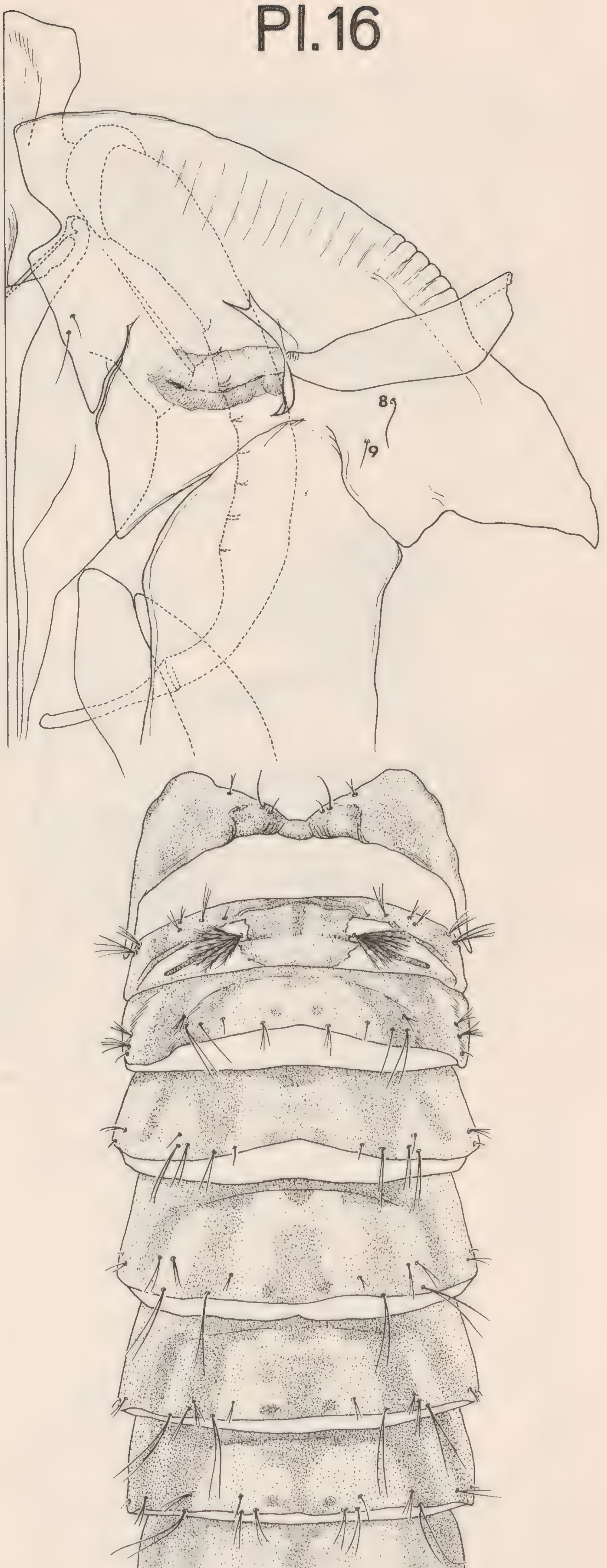
38a

Orthopodomyia flavicosta



38b

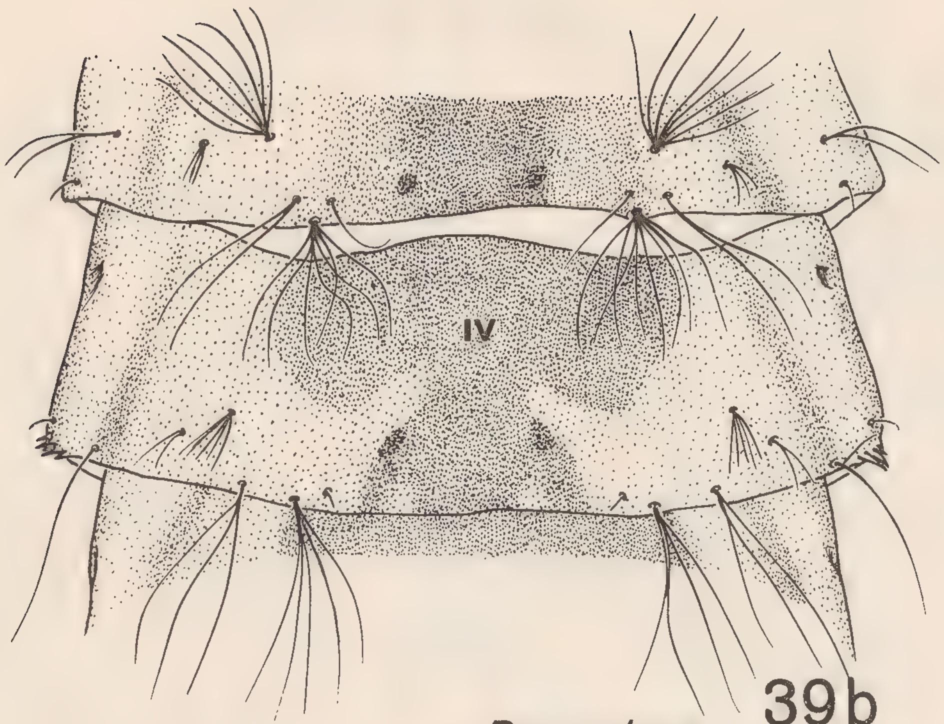
Orthopodomyia wilsoni



39a

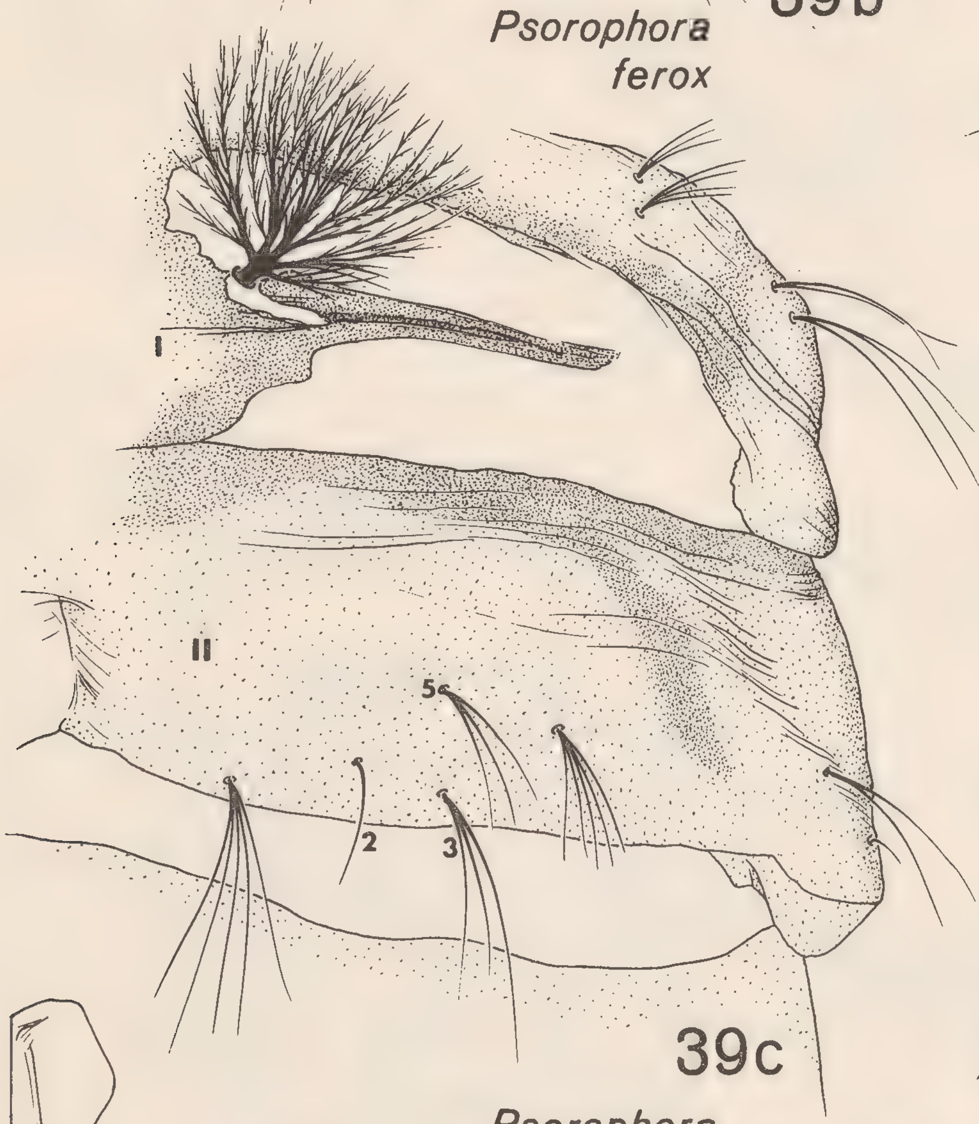
Psorophora ciliata

Pl.17



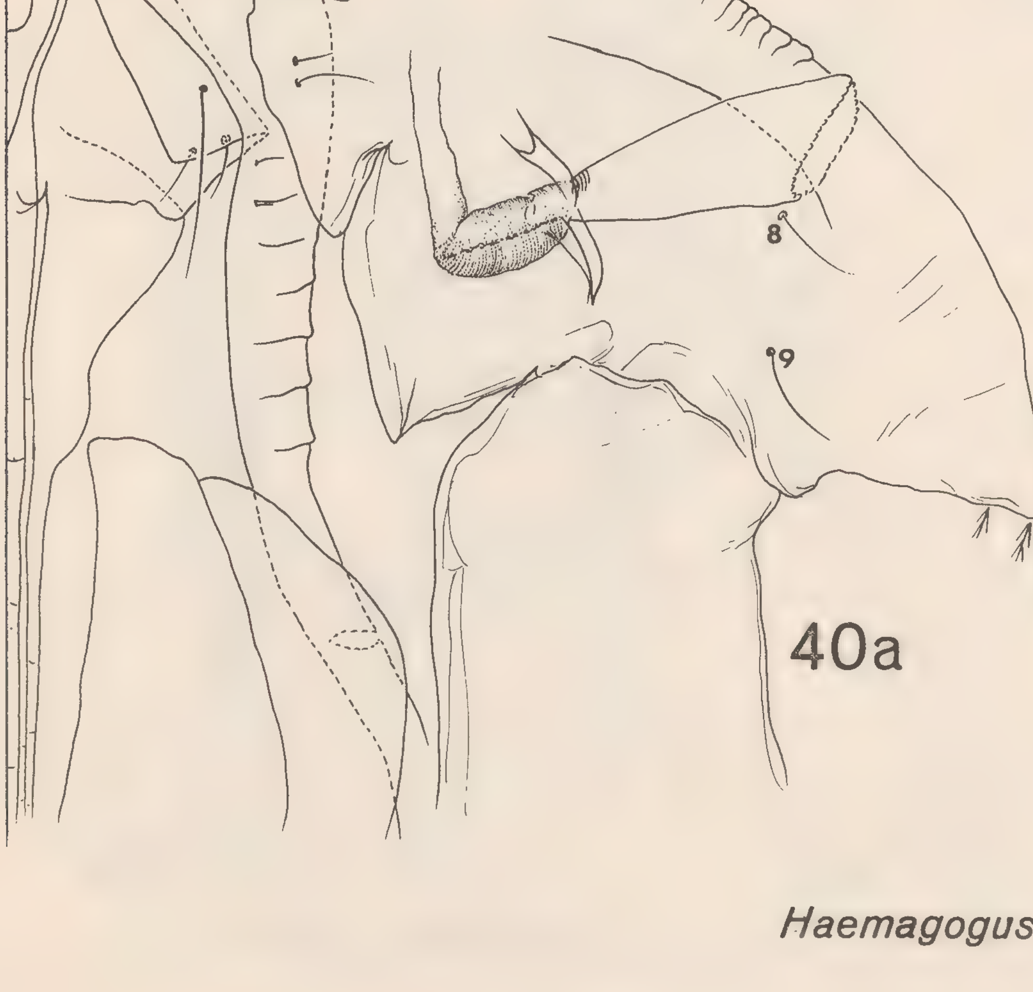
39b

Psorophora ferox

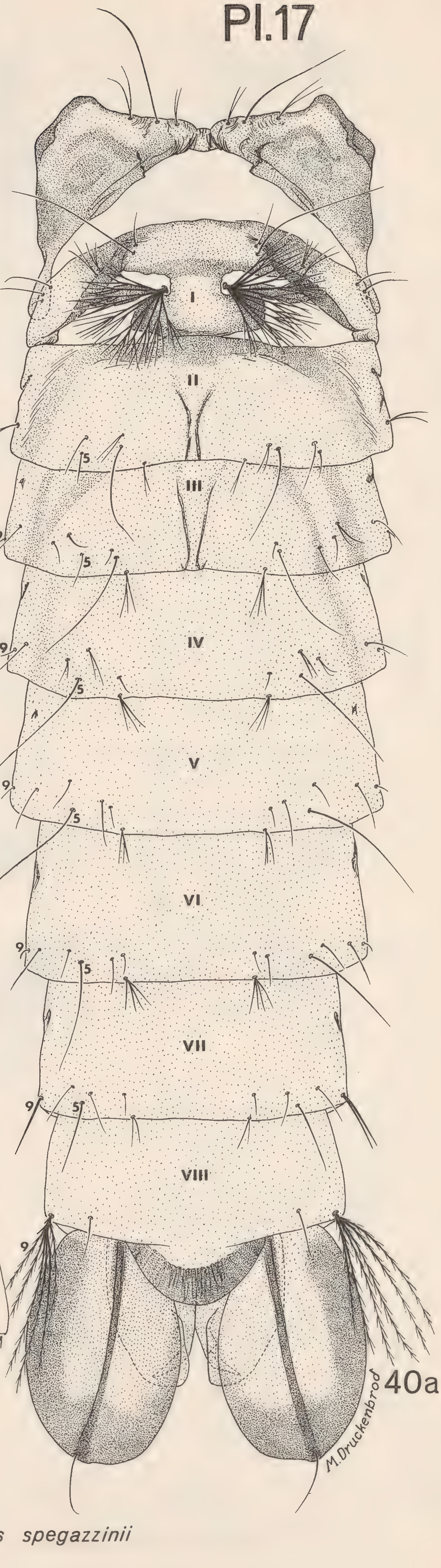


39c

Psorophora infinis



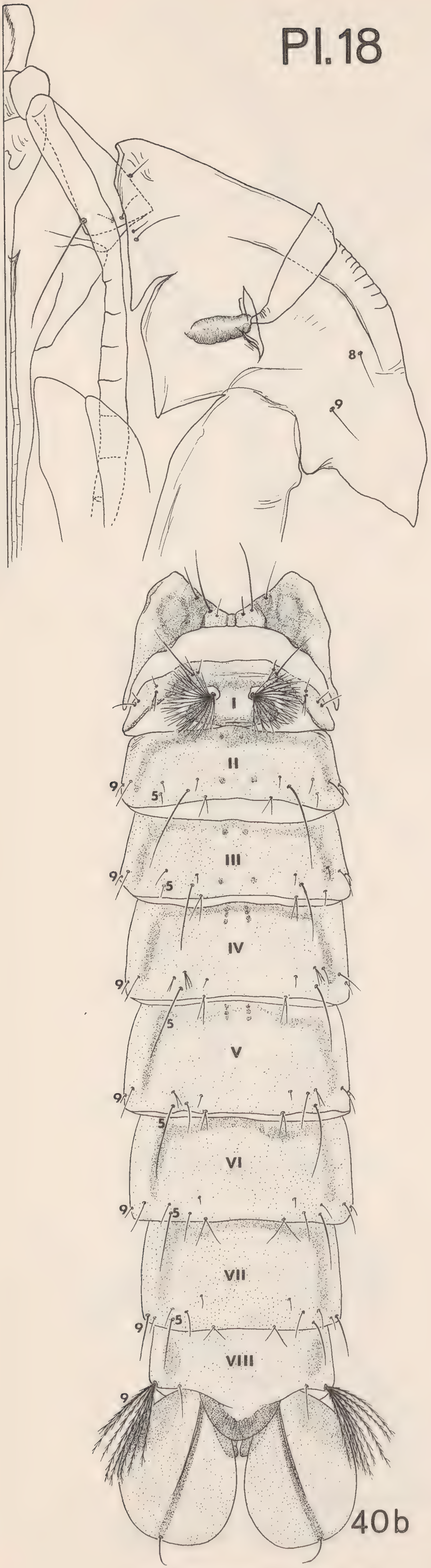
40a



40a

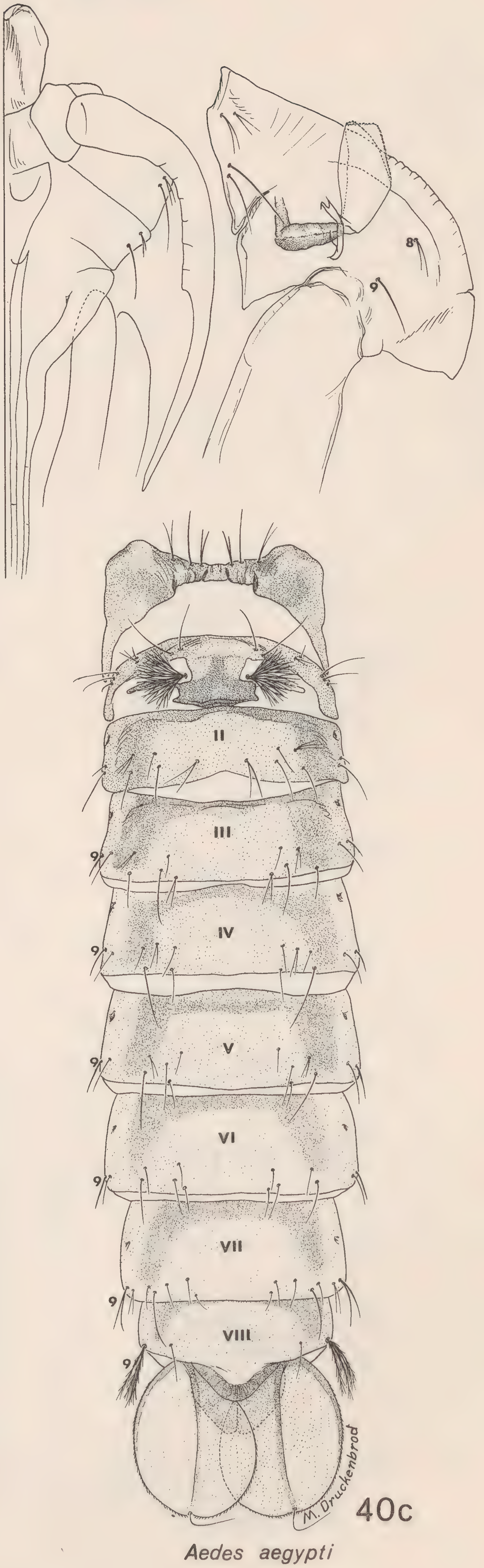
Haemagogus spegazzinii

Pl. 18



40b

Haemagogus capricornii



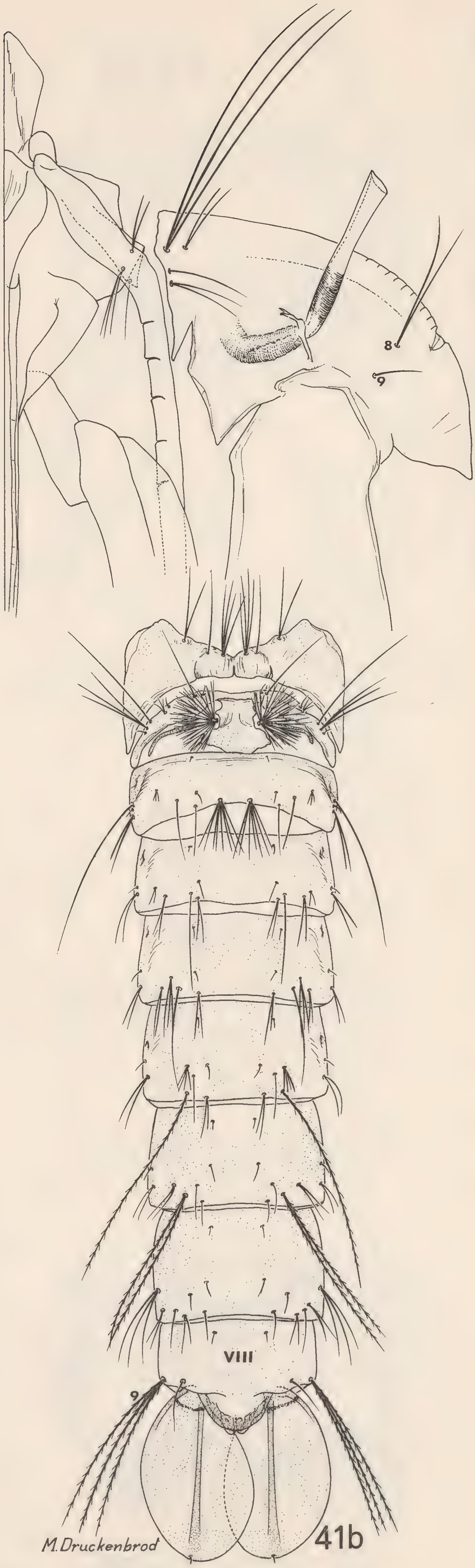
40c

Aedes aegypti

Pl. 19

41a

Culex pipiens

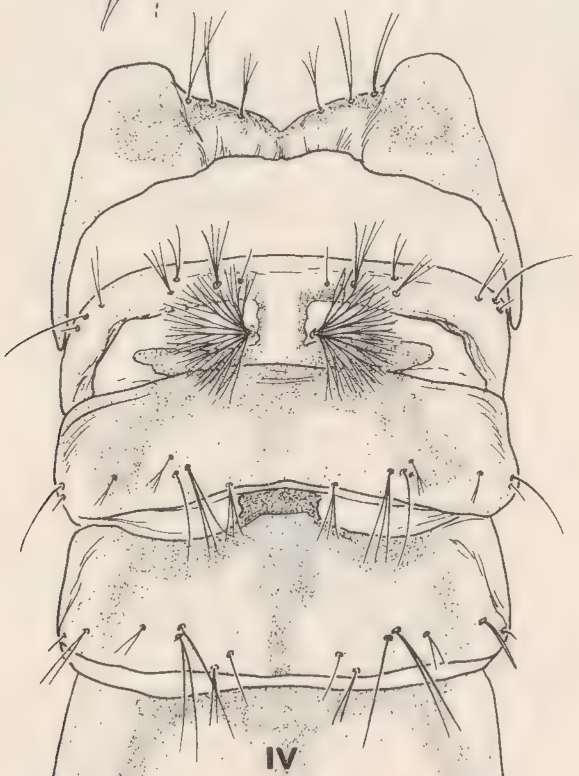


M. Druckenbrod

41b

Culex antillummagnorum

Pl. 20



41c

Culiseta longiareolata

42a

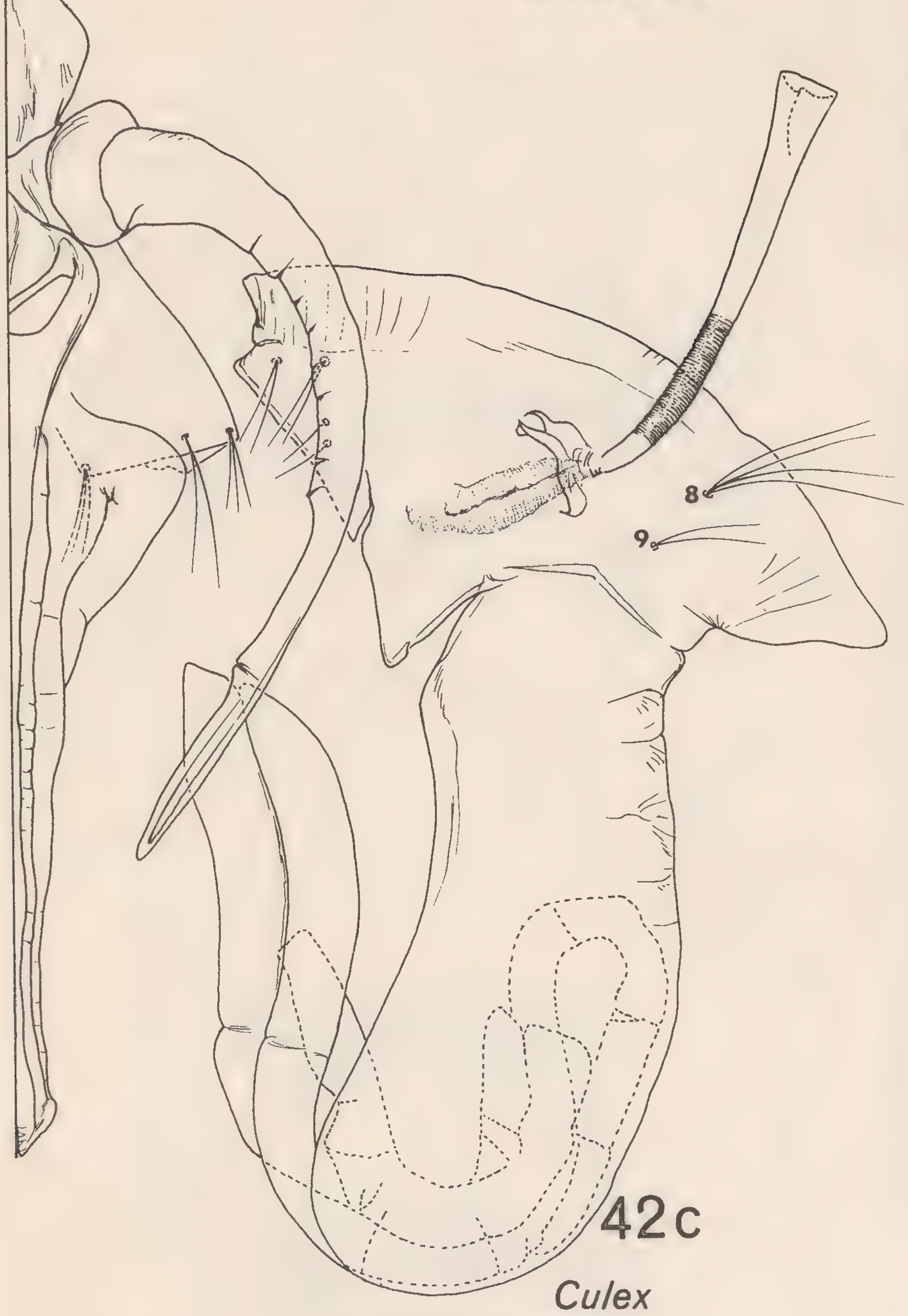
Culex davisi

42b

M. Druckenbrod

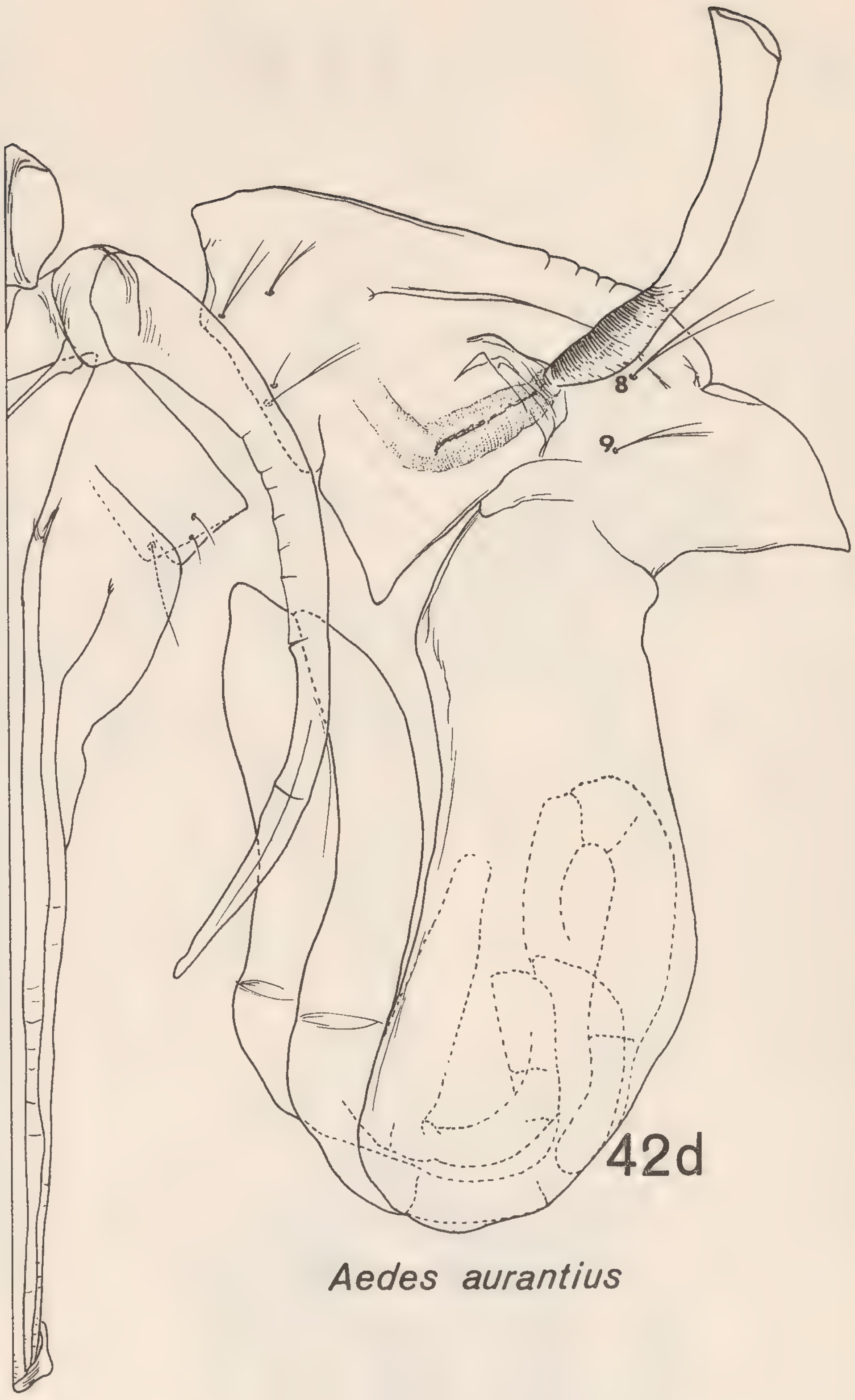
Culex bamborum

Pl. 21



42c

Culex pseudomelanoconia

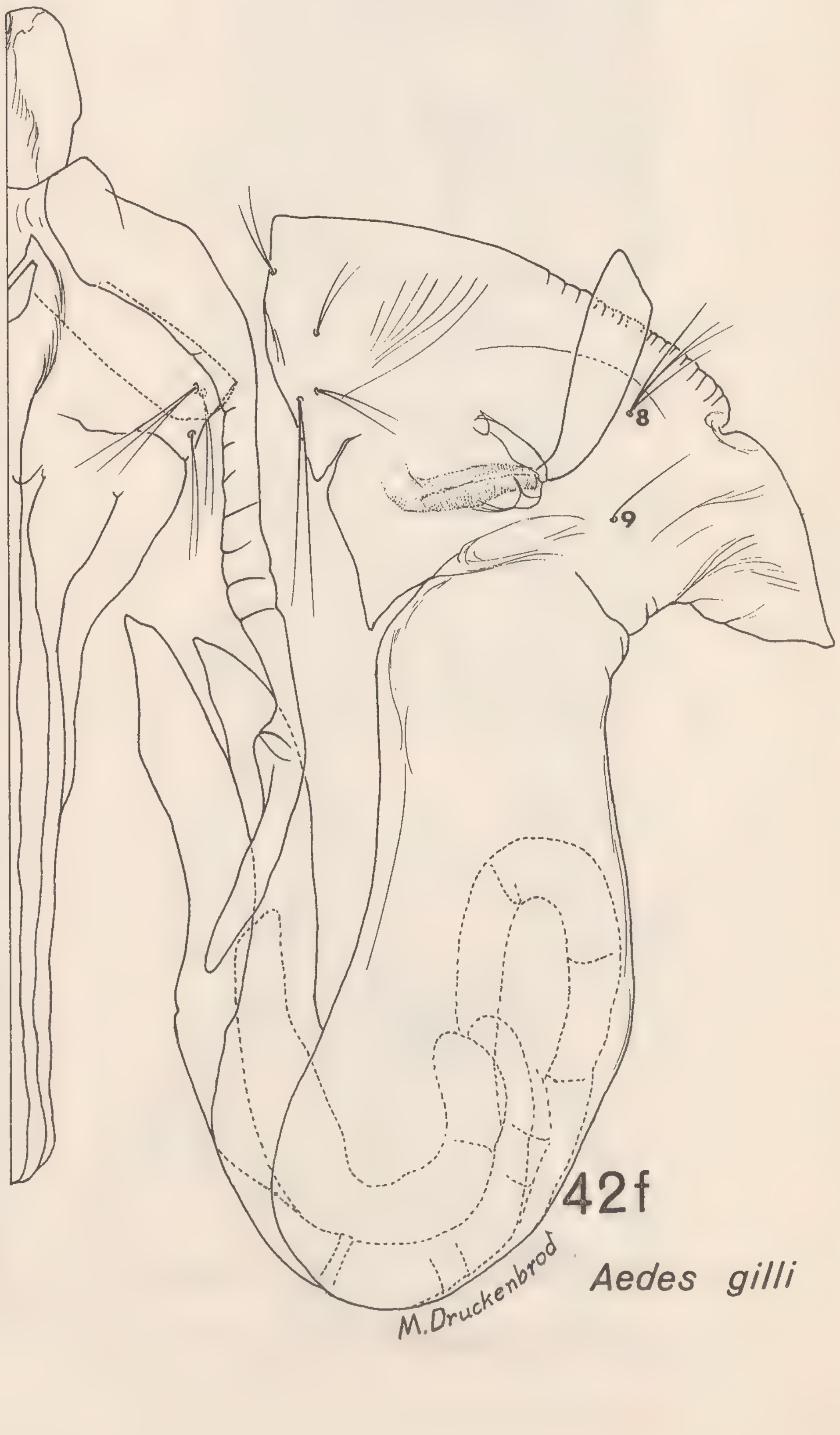


42d

Aedes aurantius

42e

Aedes longirostris

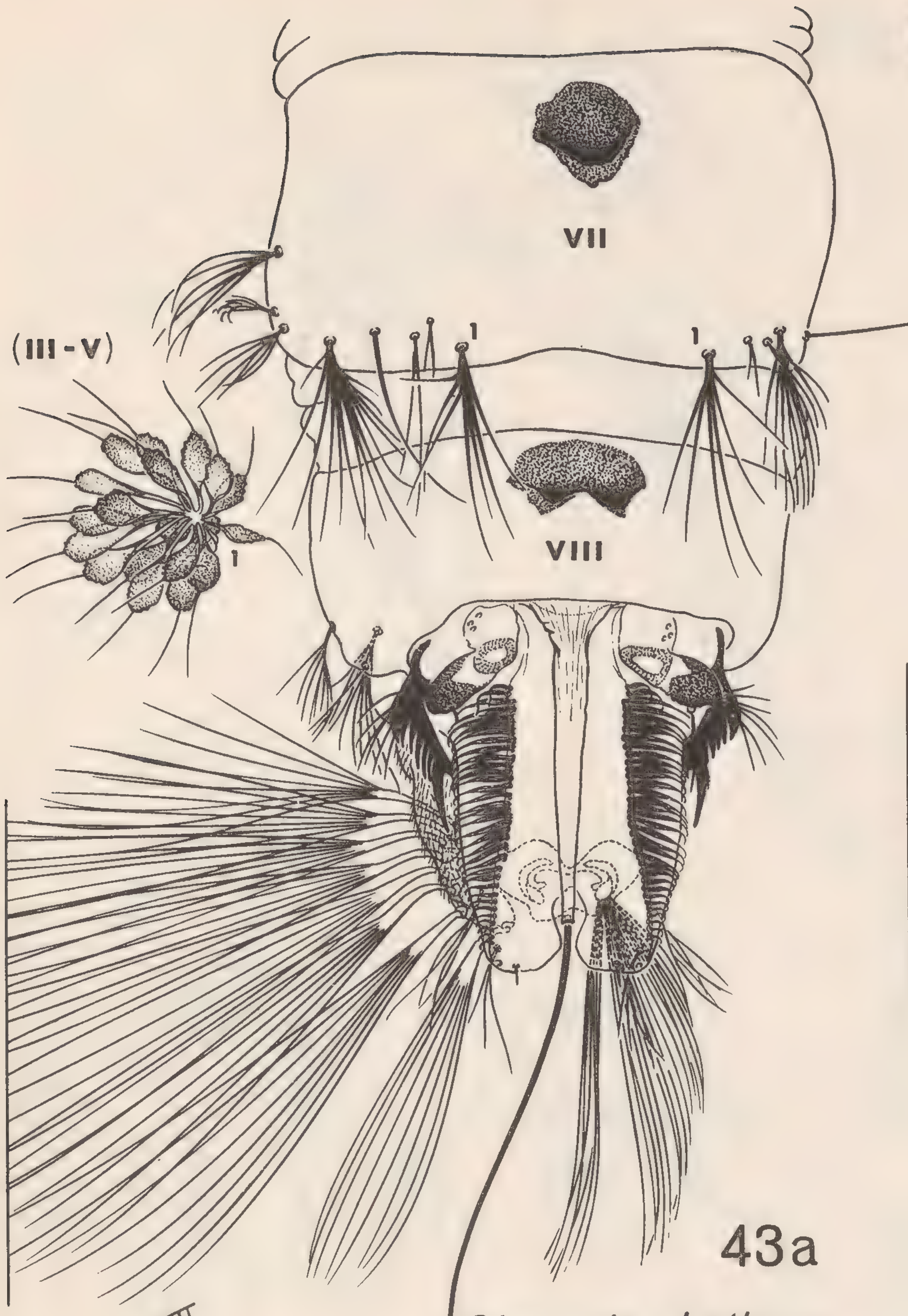


M.Druckenbrod

42f

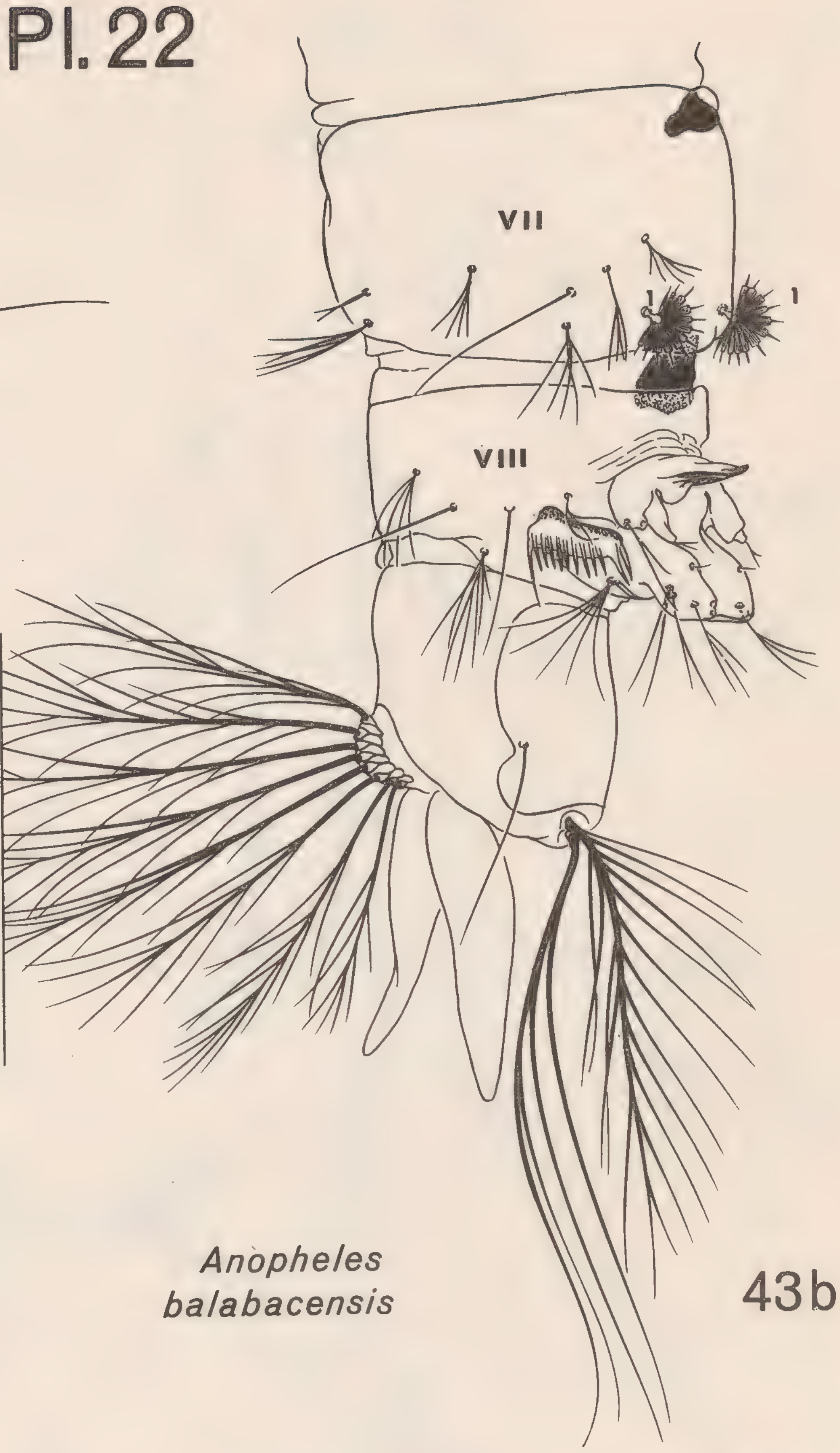
Aedes gilli

Pl. 22



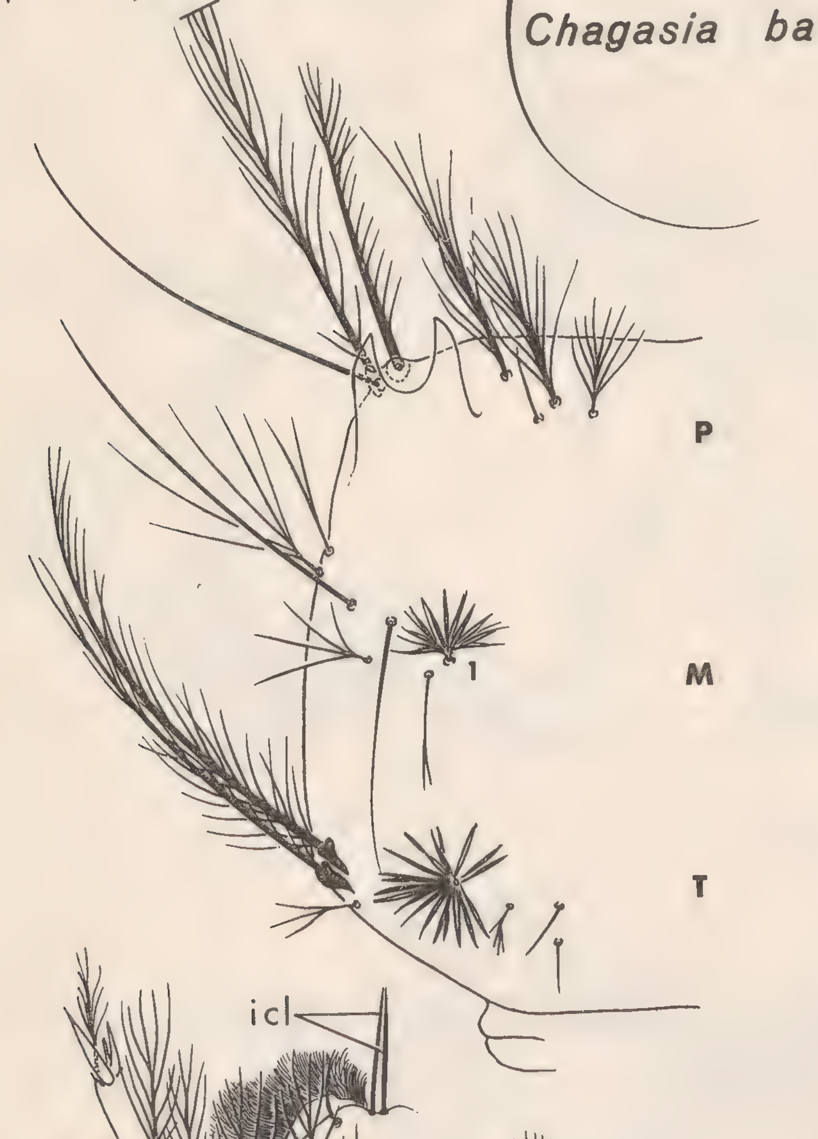
43a

Chagasia bathana



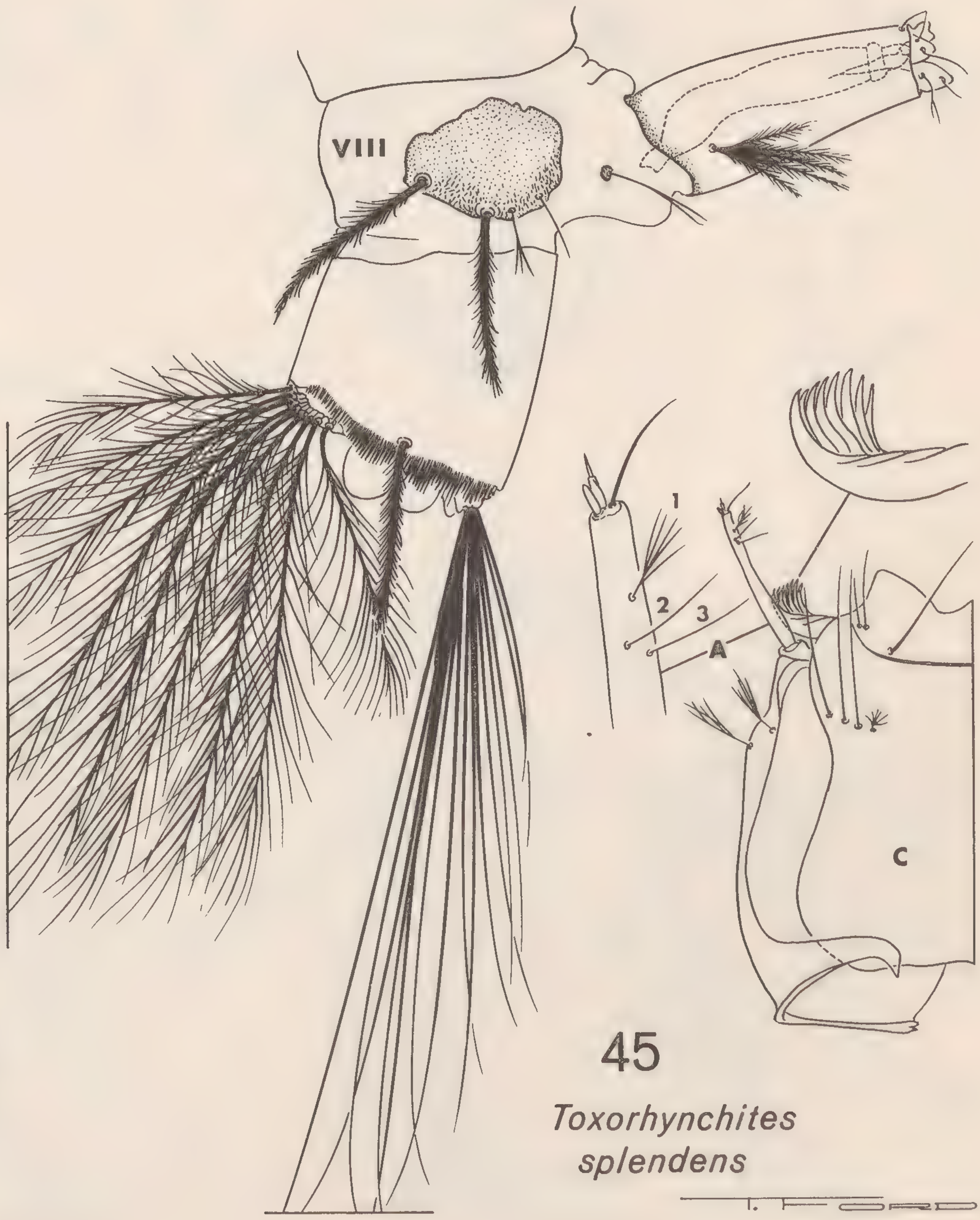
Anopheles balabacensis

43b



44

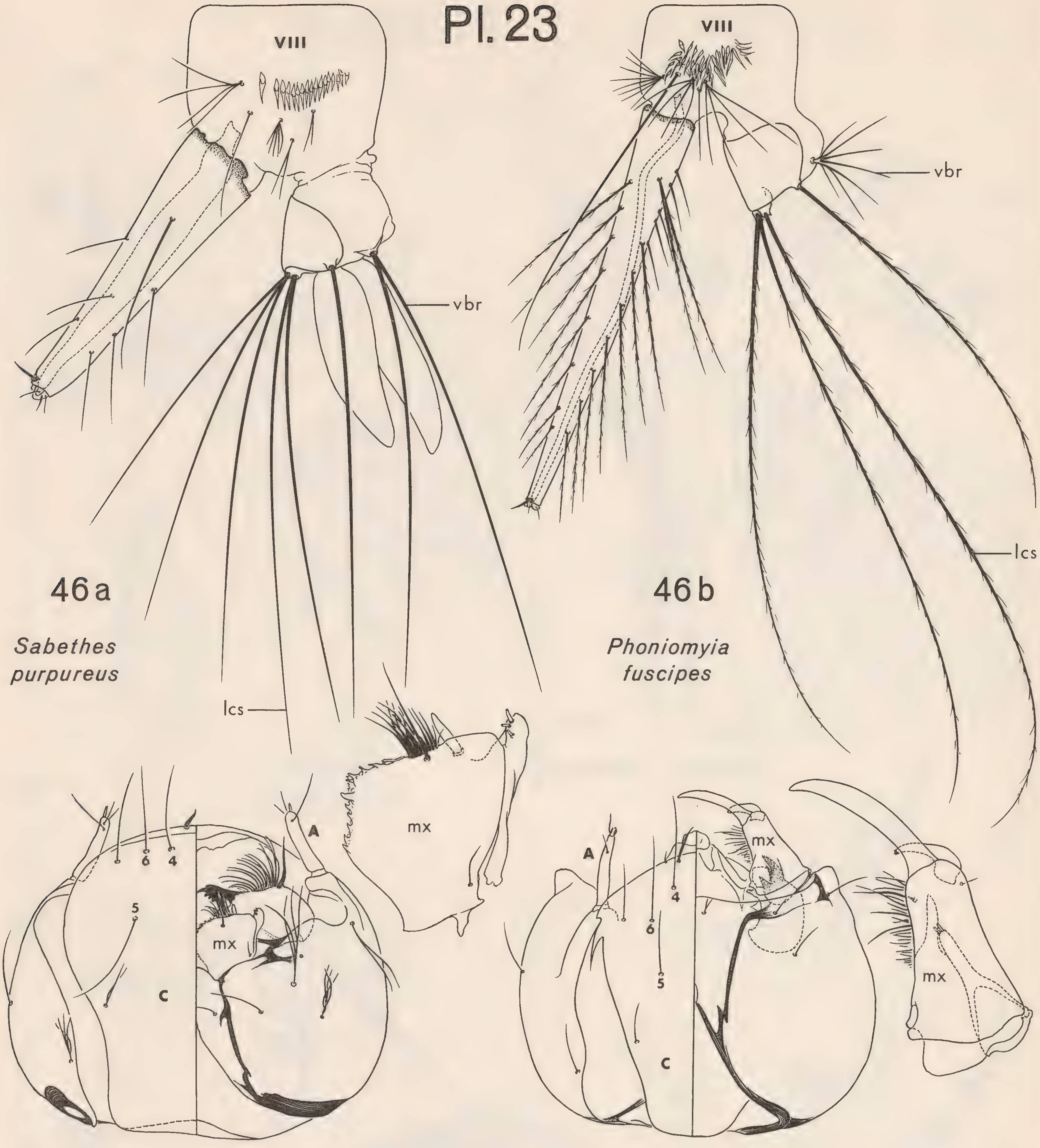
Bironella hollandi



45

Toxorhynchites splendens

Pl. 23

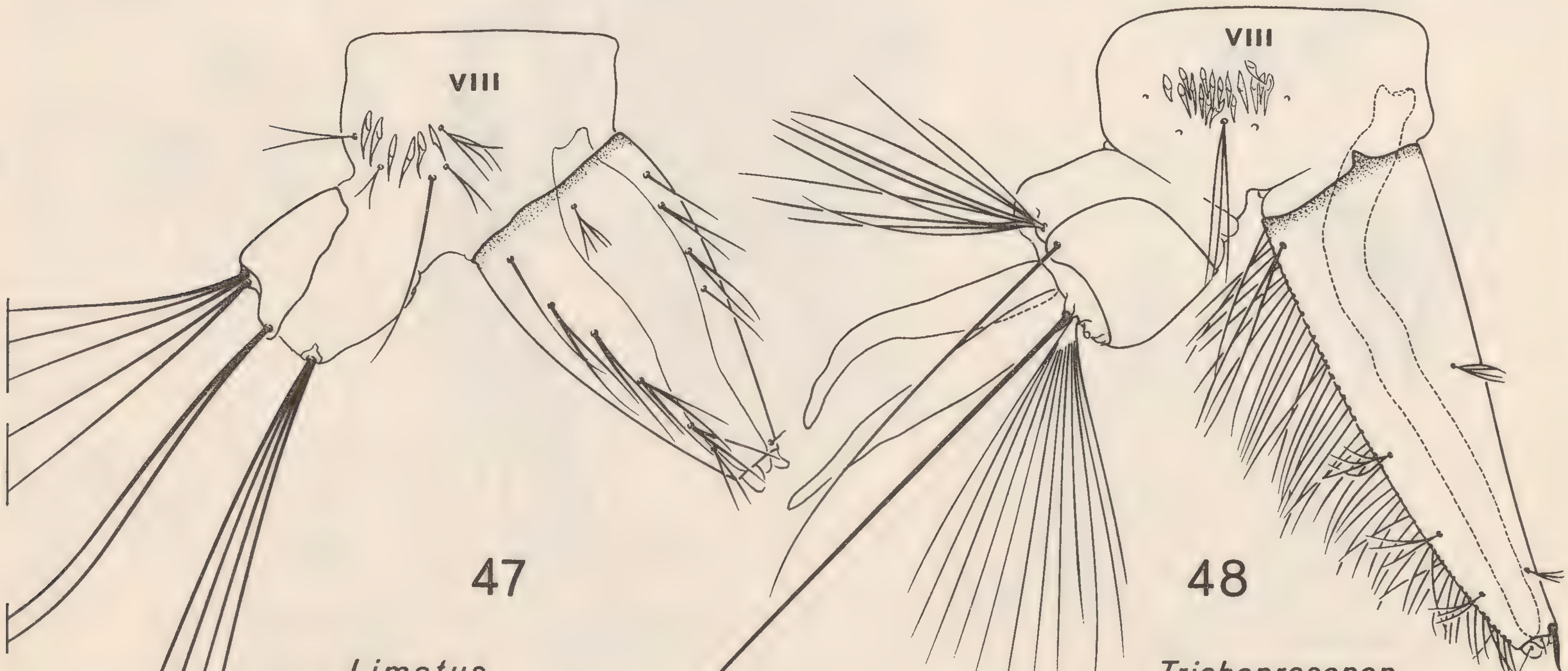


46a

Sabethes purpureus

46b

Phoniomyia fuscipes



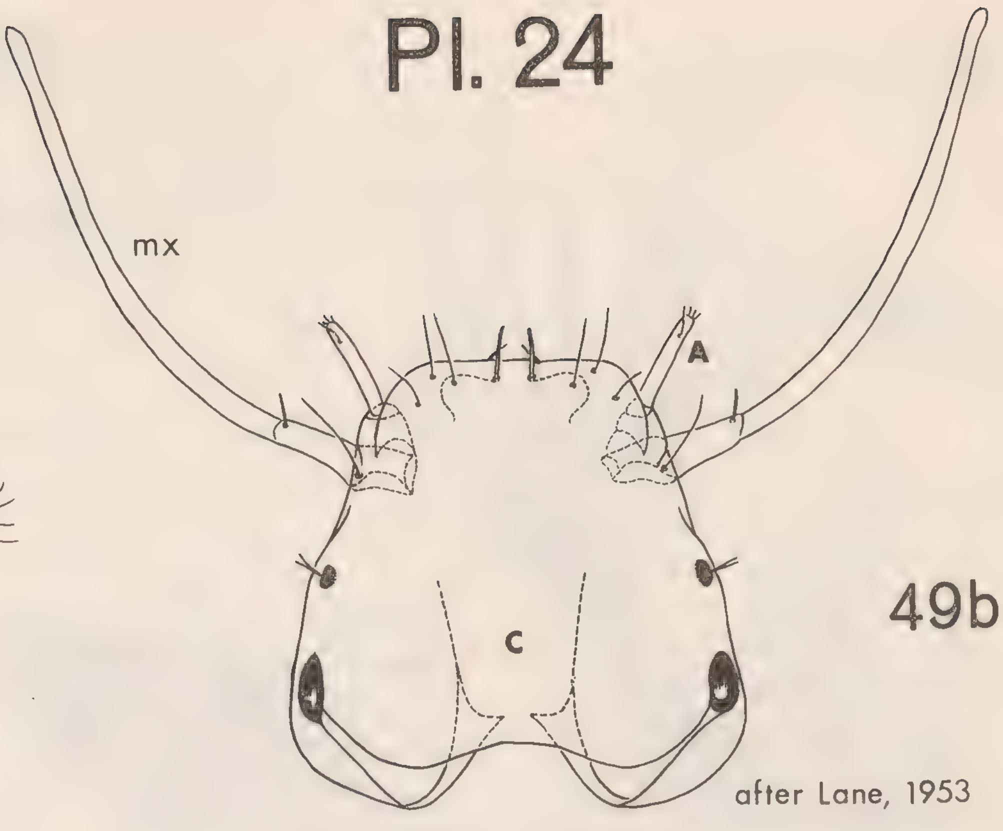
47

Limatus durhamii

48

Trichoprosopon frontosum

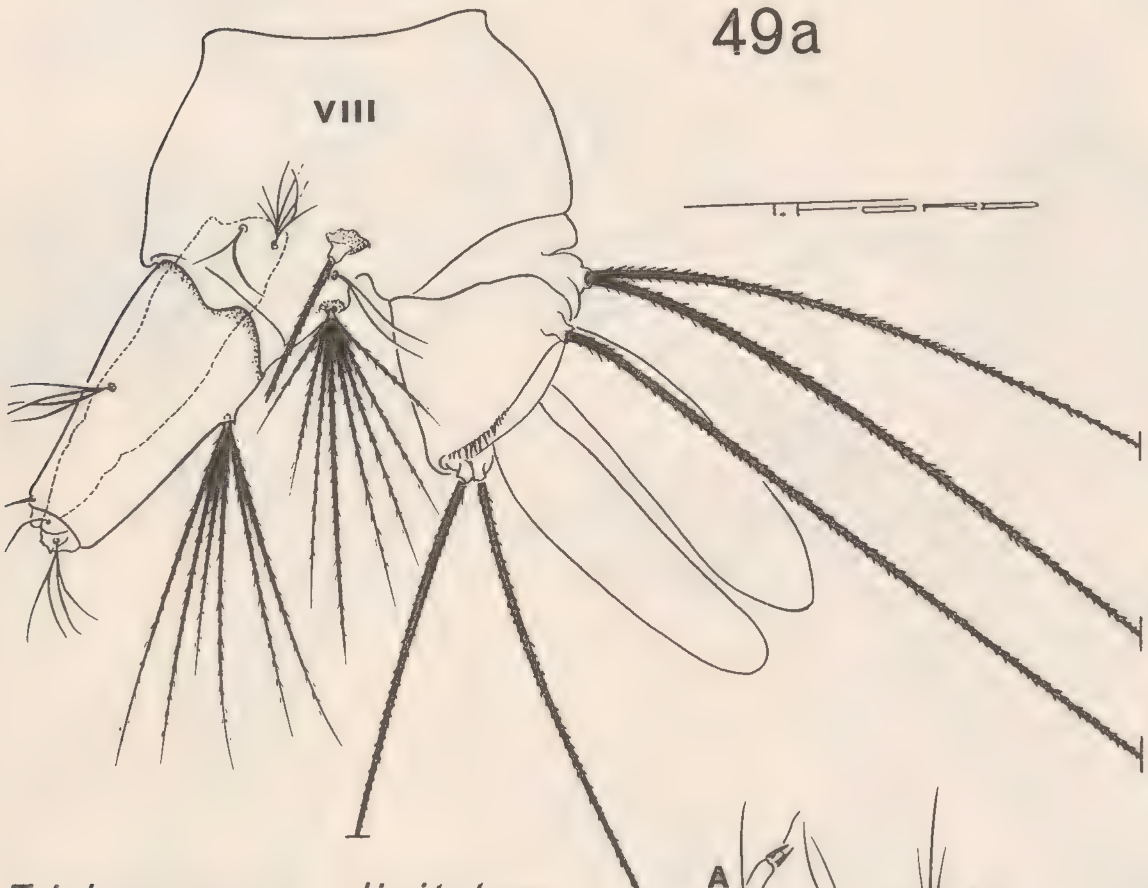
Pl. 24

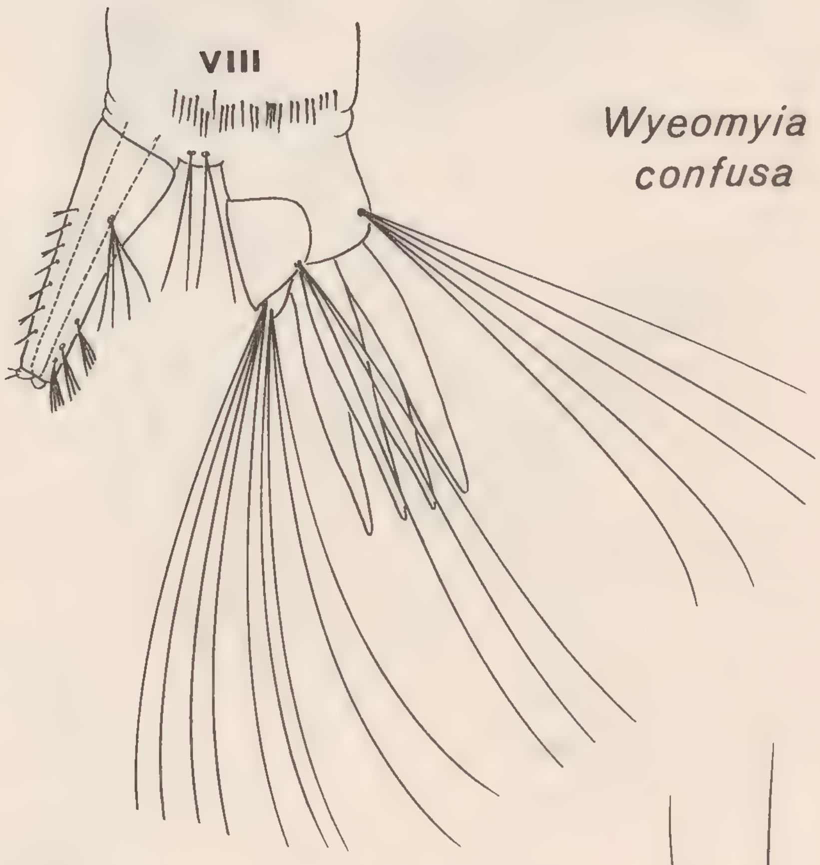


49b

after Lane, 1953

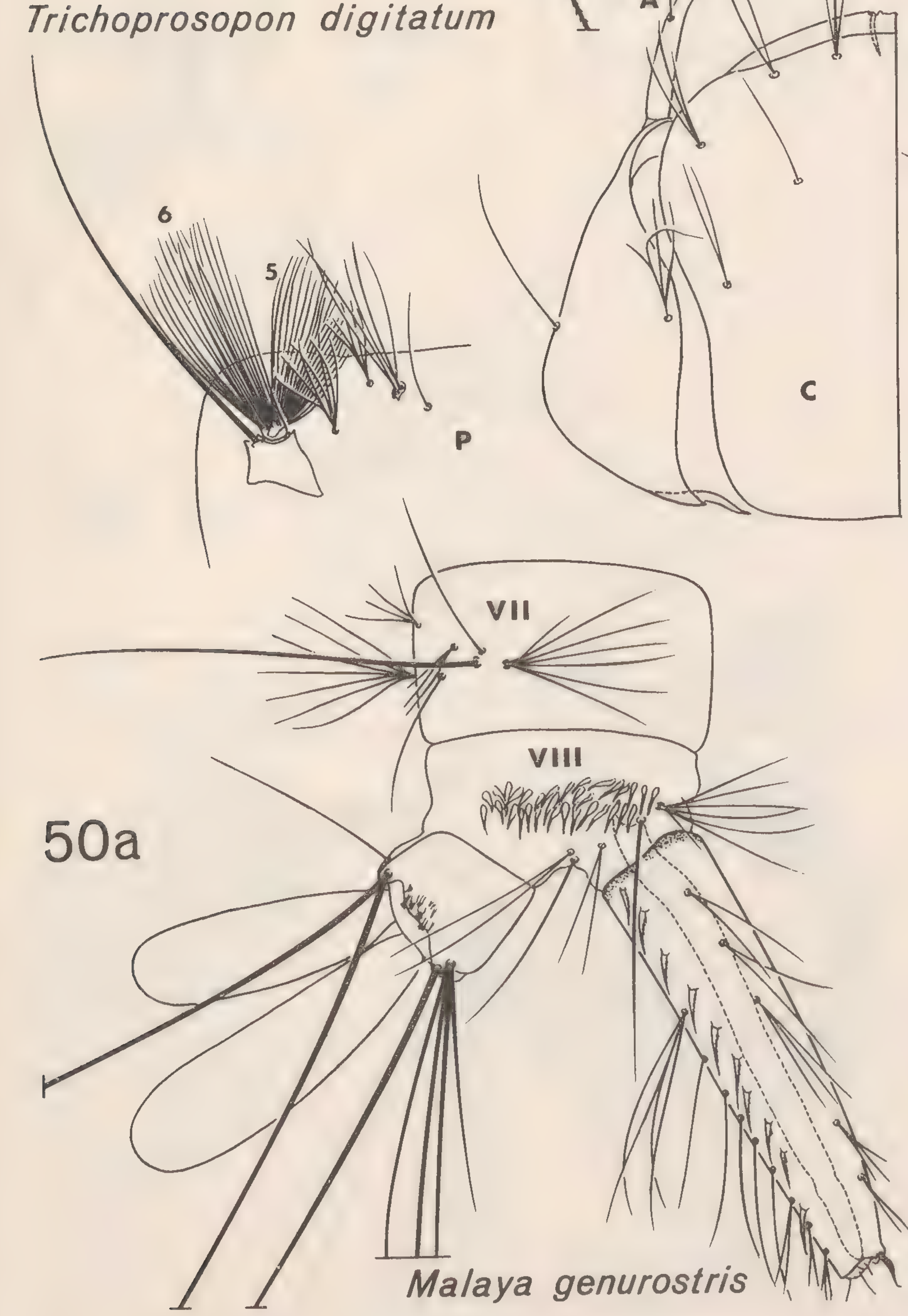
49a





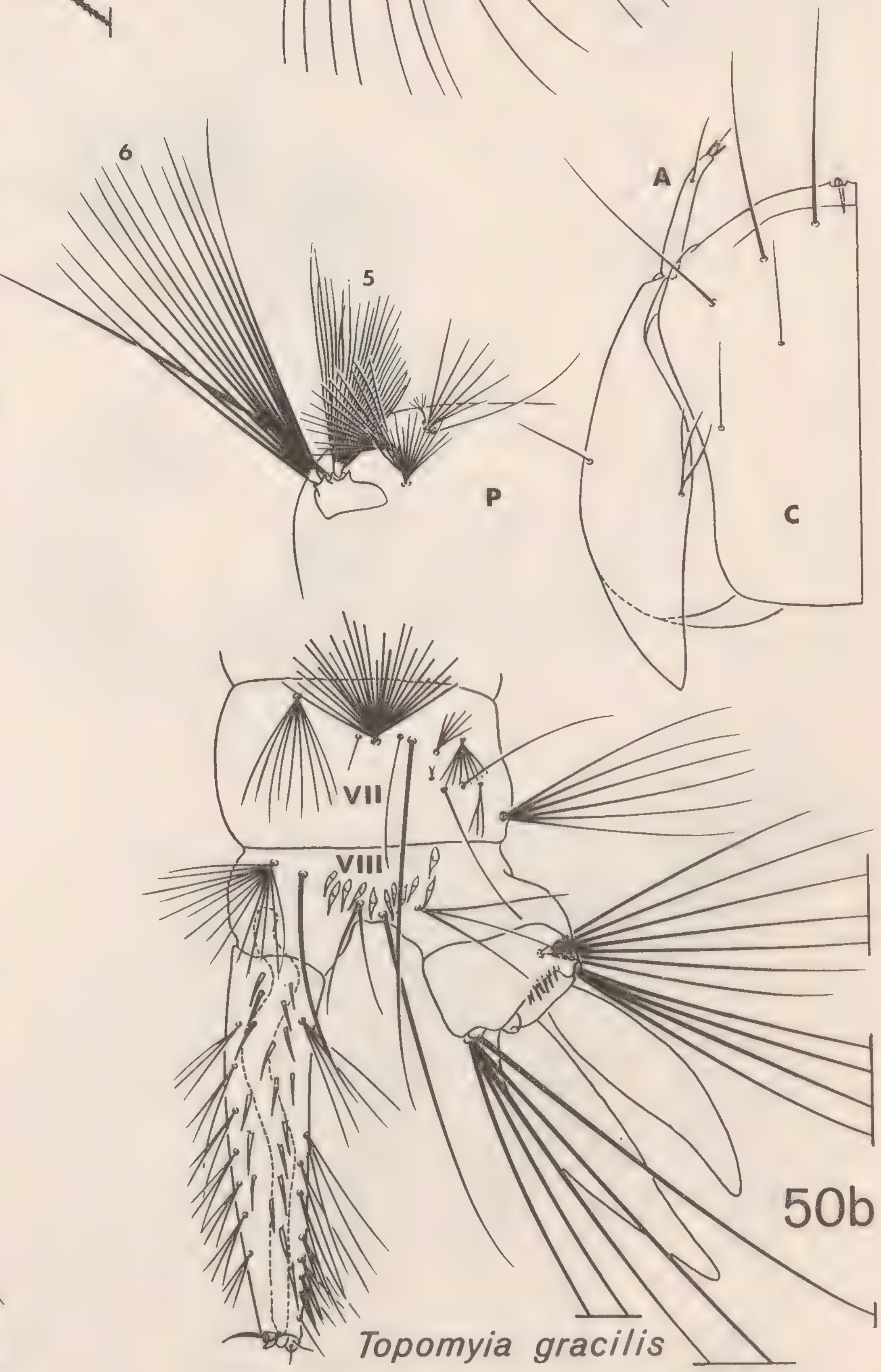
Wyeomyia confusa

Trichoprosopon digitatum



50a

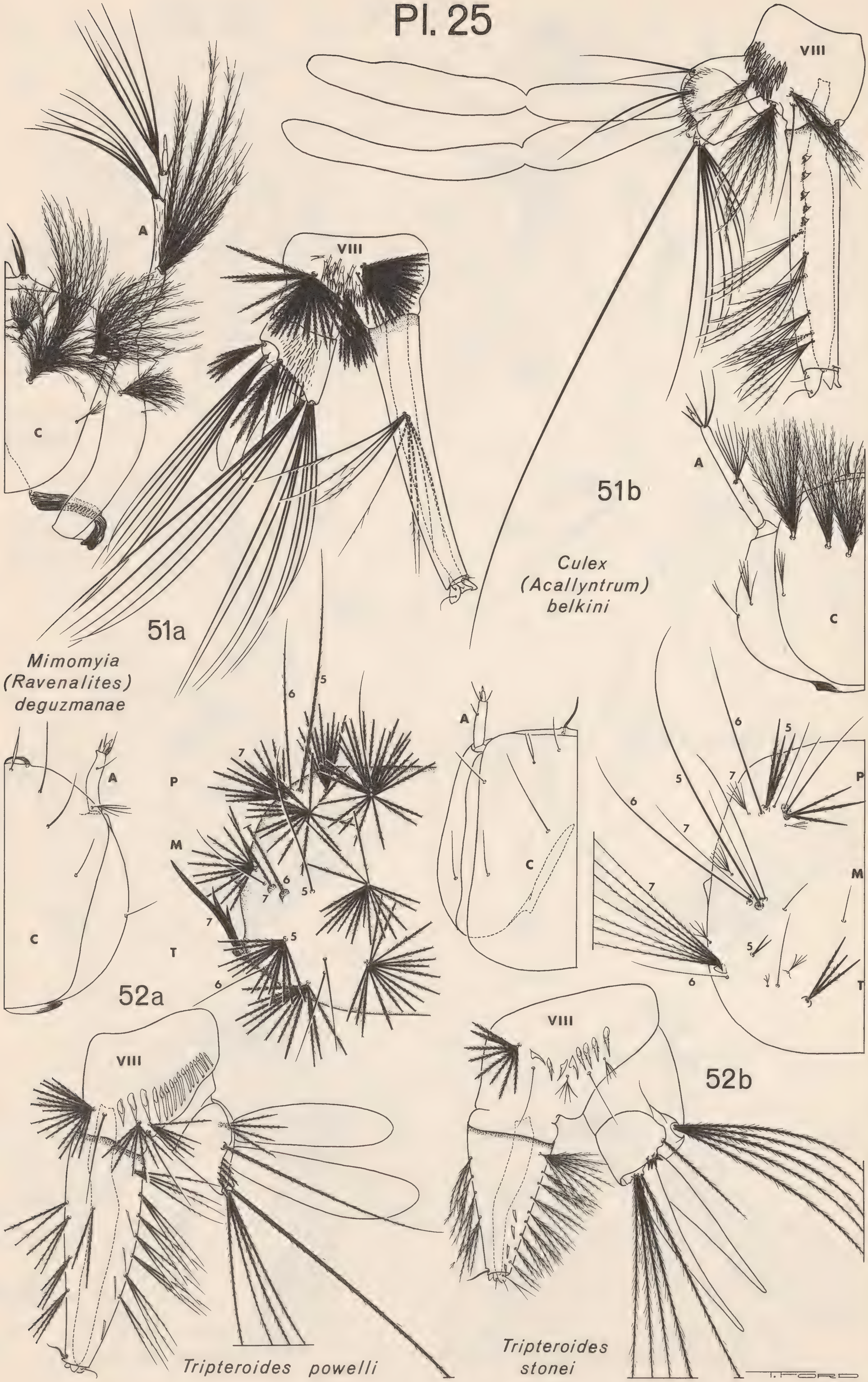
Malaya genurostris



50b

Topomyia gracilis

Pl. 25



51a

Mimomyia (Ravenalites) deguzmanae

51b

Culex (Acallyntrum) belkini

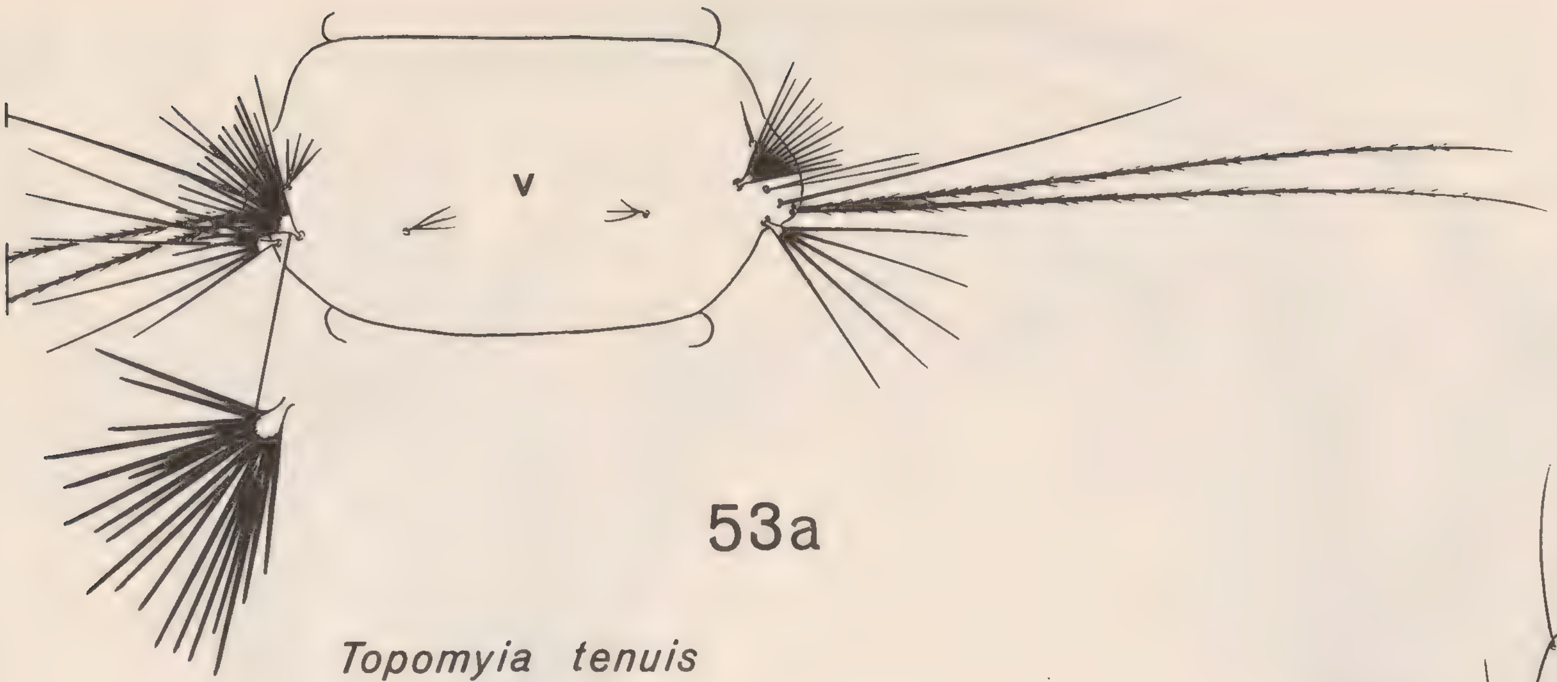
52a

Tripteroides powelli

52b

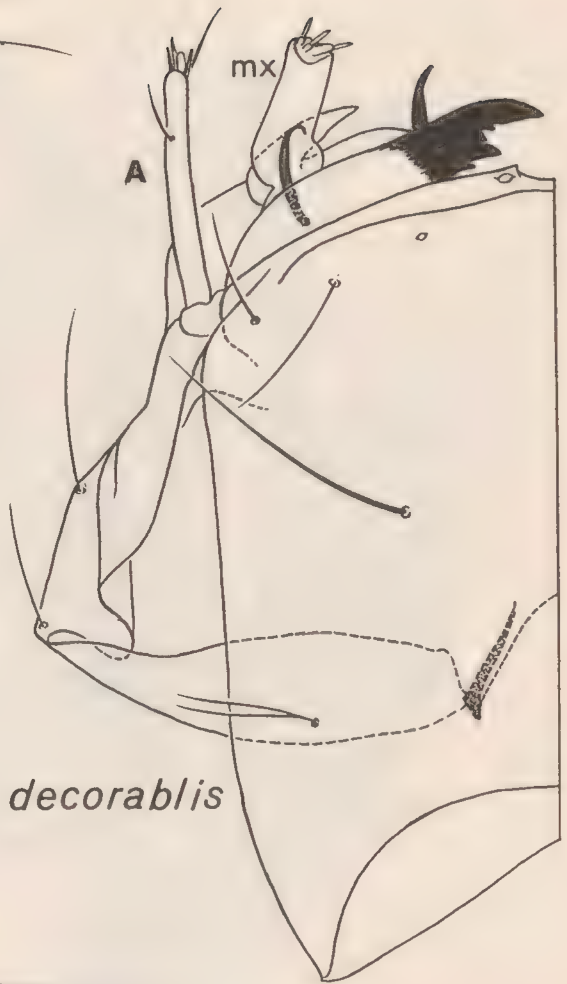
Tripteroides stonei

Pl. 26



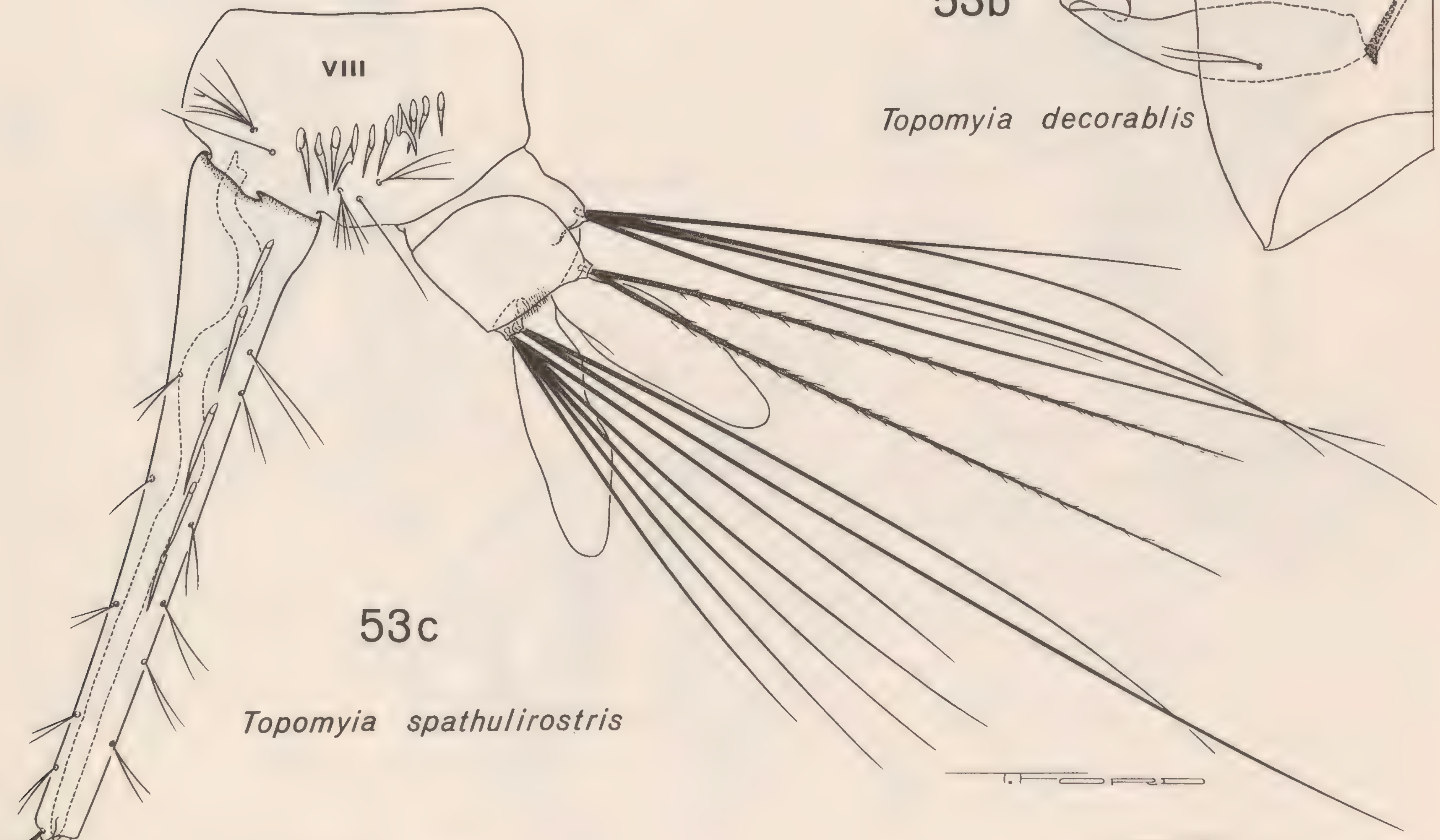
53a

Topomyia tenuis



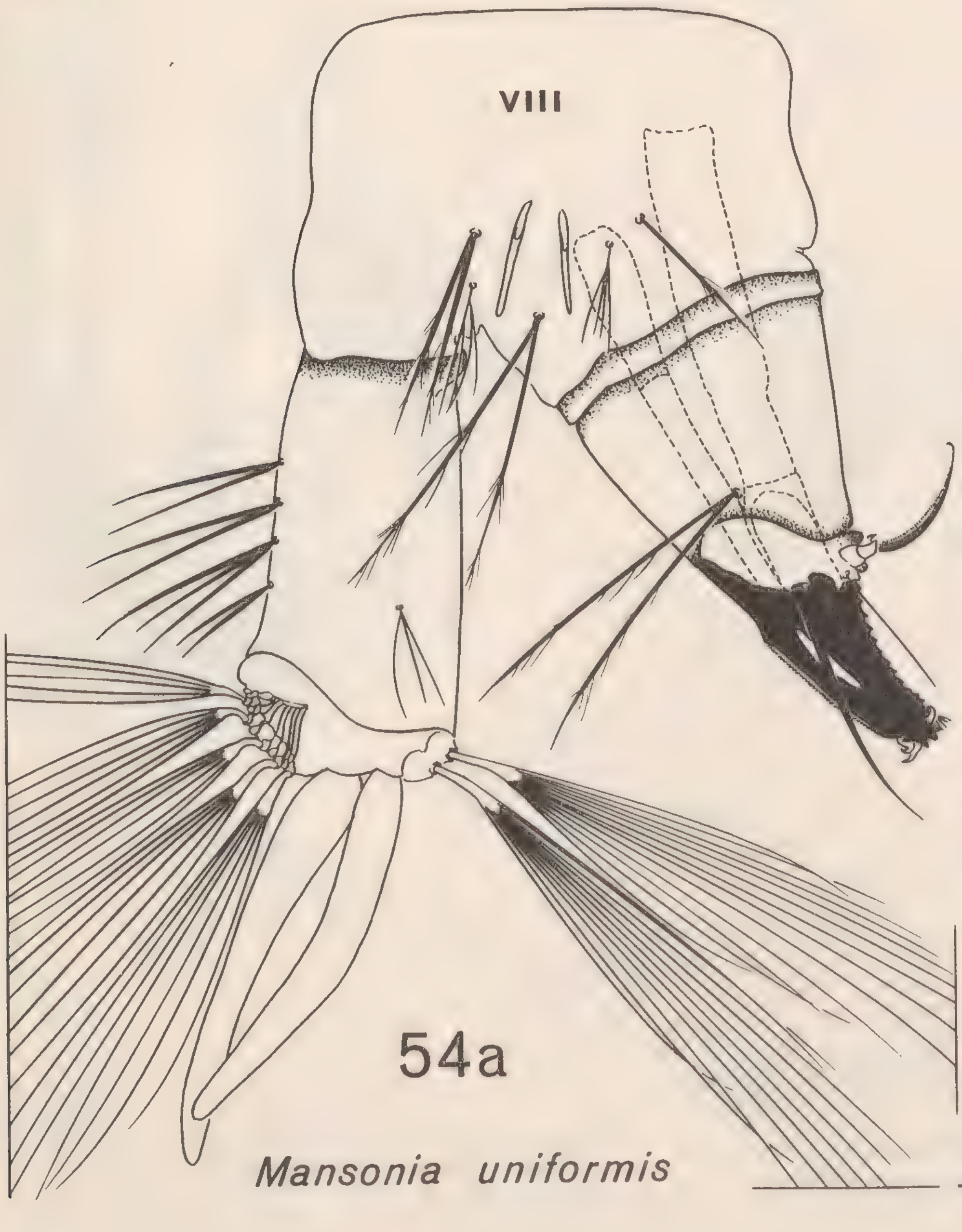
53b

Topomyia decorablis



53c

Topomyia spathulirostris



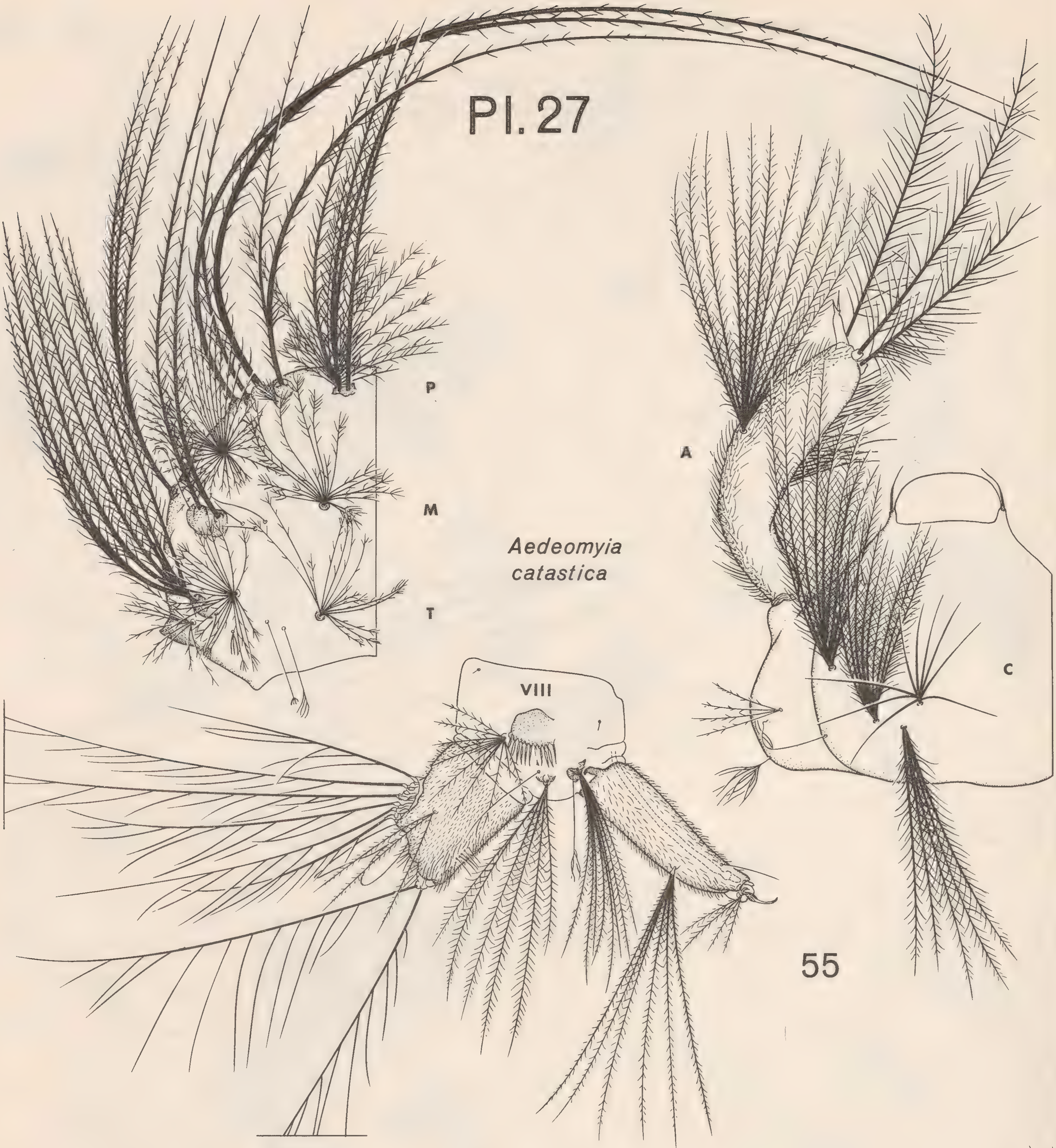
54a

Mansonia uniformis

54b

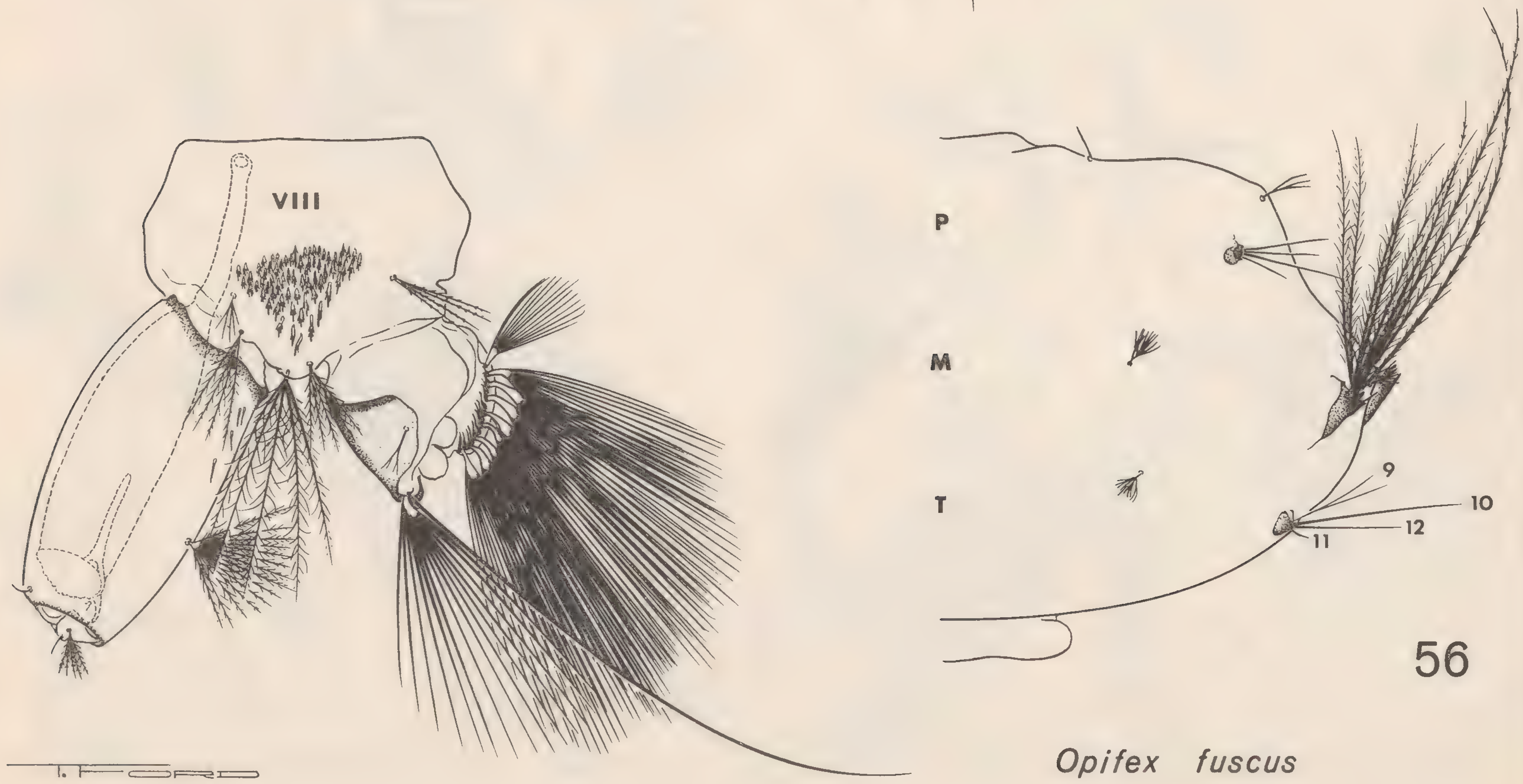
Mimomyia hybrida

Pl. 27



Aedeomyia catastica

55



56

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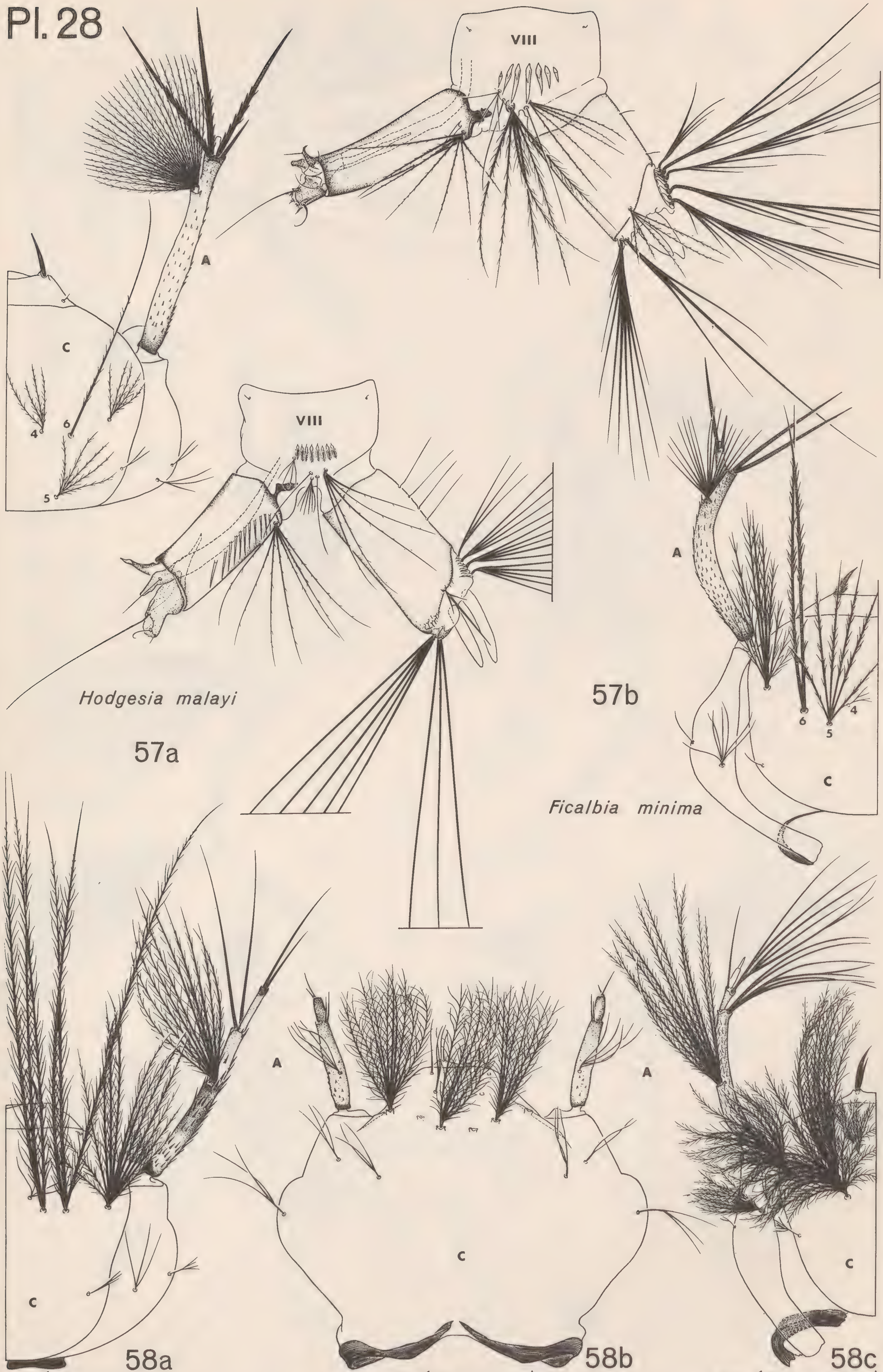
Opifex fuscus

Pl. 28



Hodgesia malayi

57a

57b

Ficalbia minima

58a

M. (Mimomyia) chamberlaini

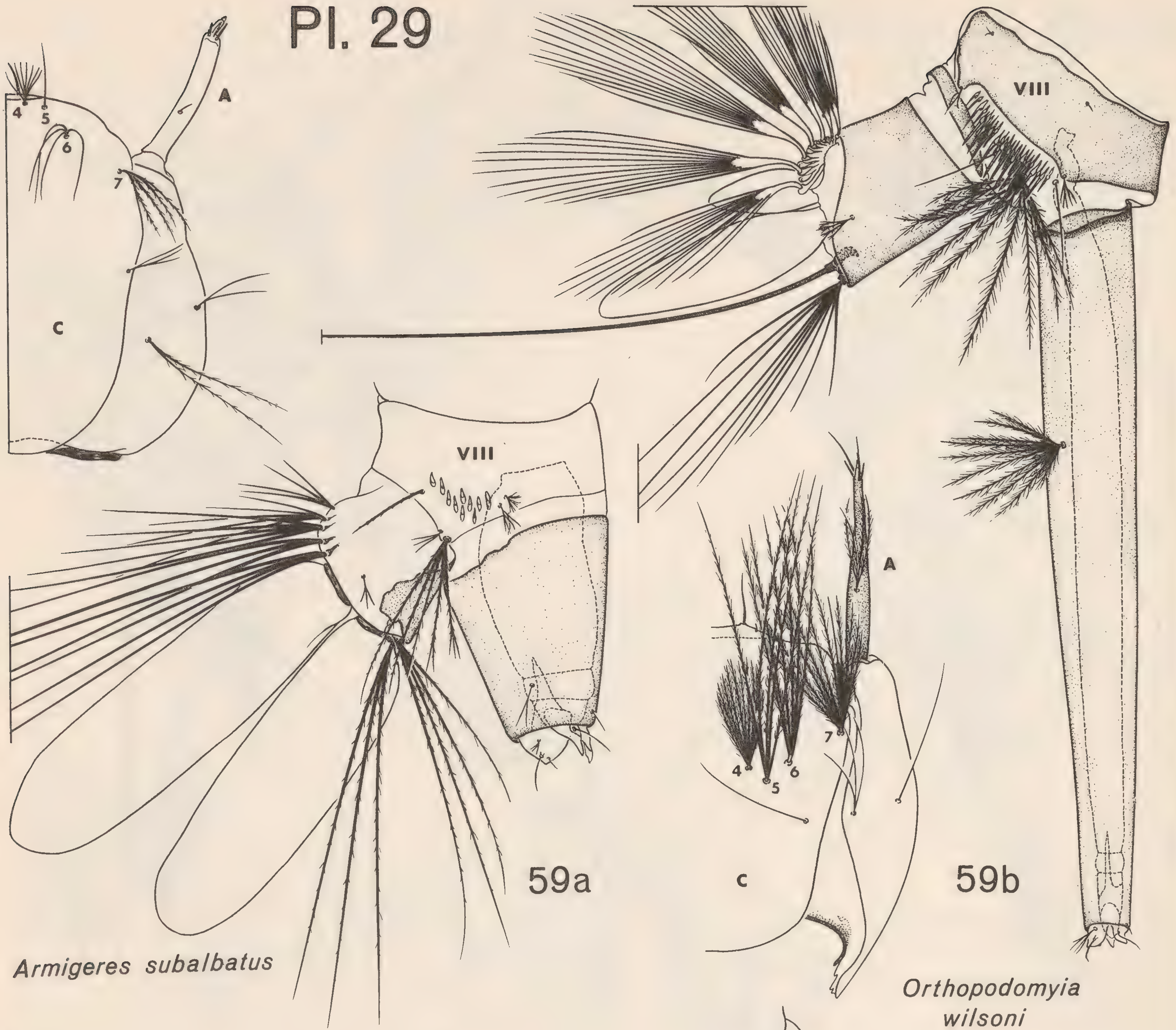
58b

M. (Mimomyia) plumosa

58c

M. (Ravenalites) deguzmanae

Pl. 29

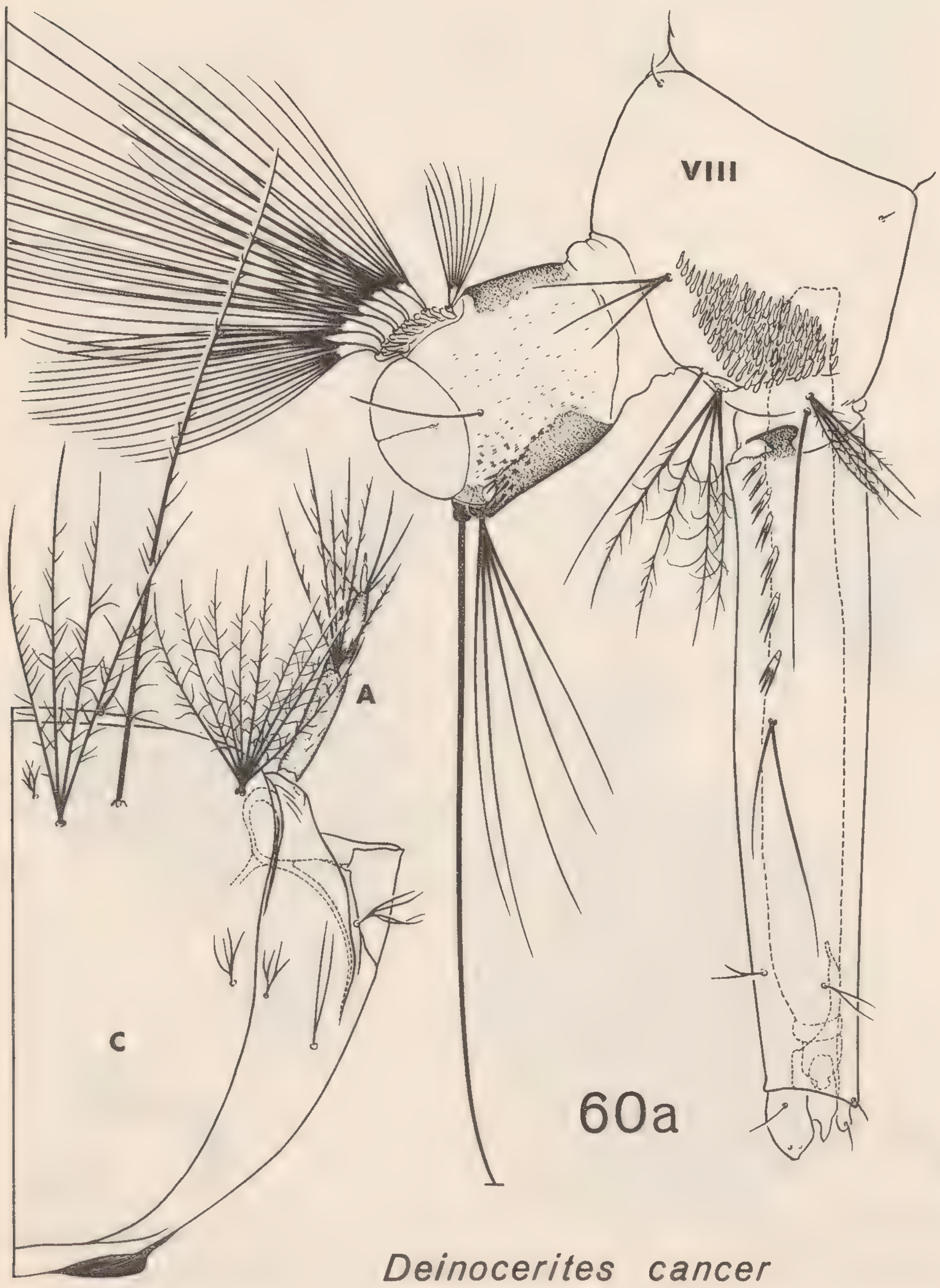


59a

Armigeres subalbatus

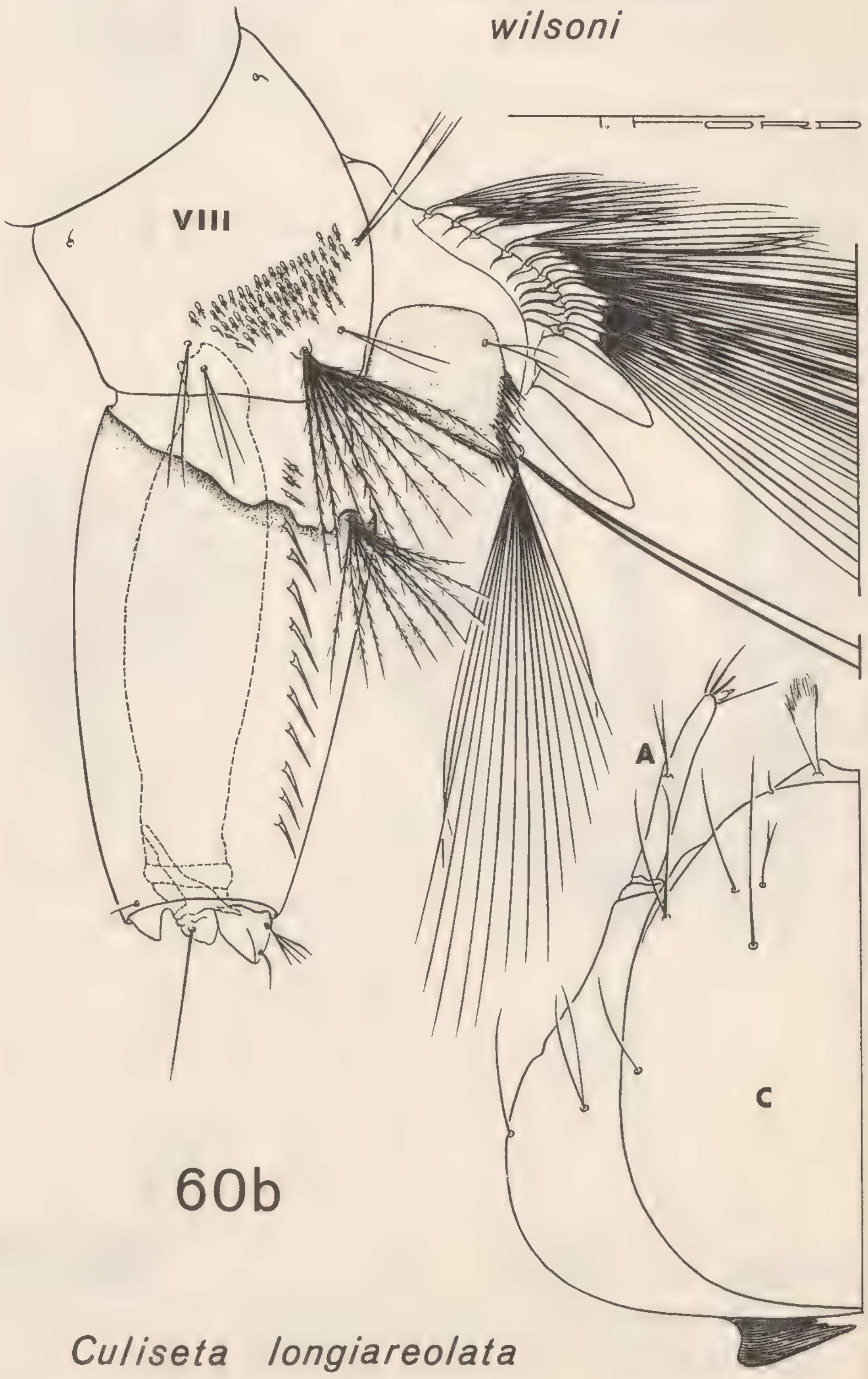
59b

Orthopodomyia wilsoni



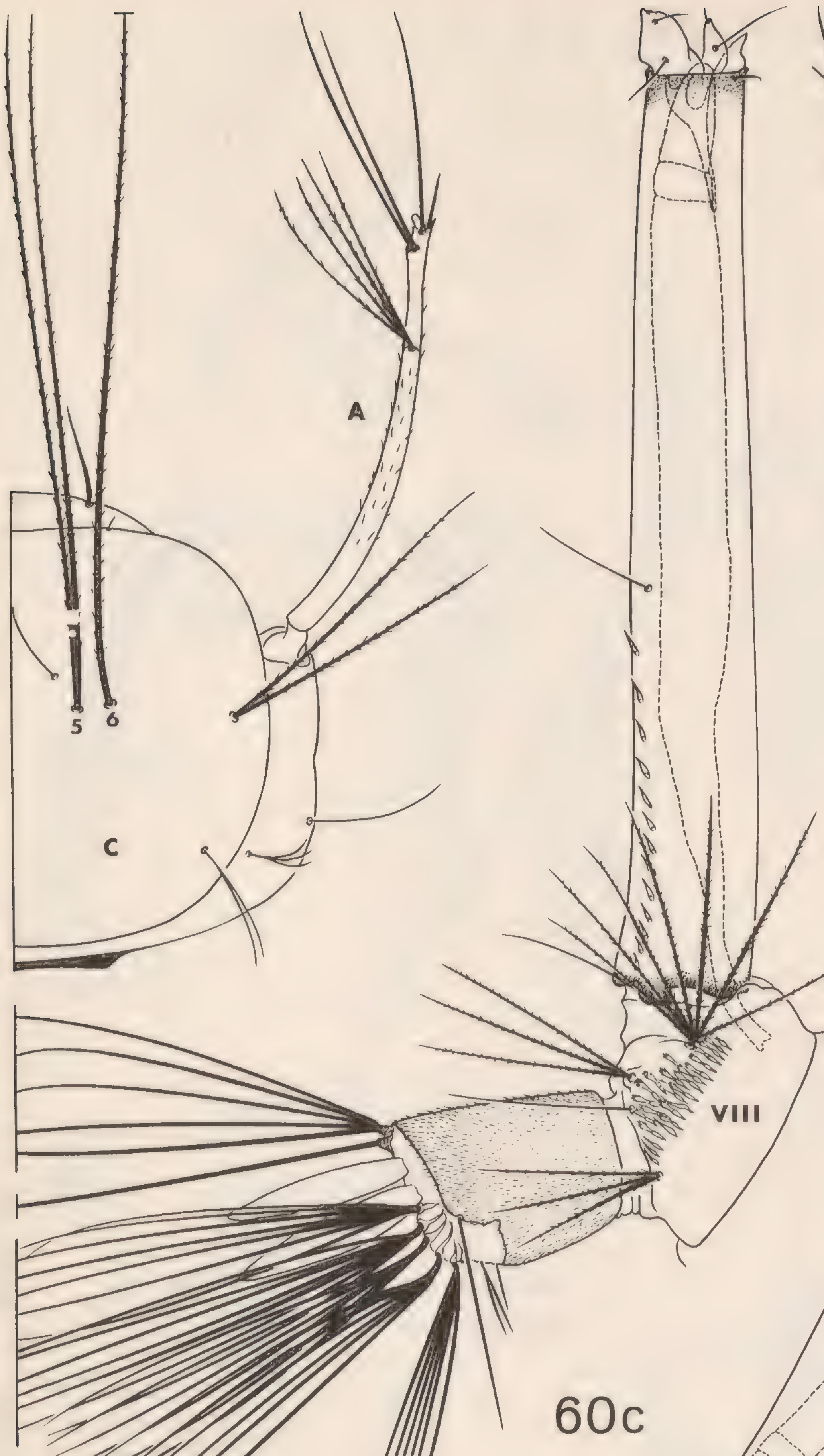
60a

Deinocerites cancer



60b

Culiseta longiareolata

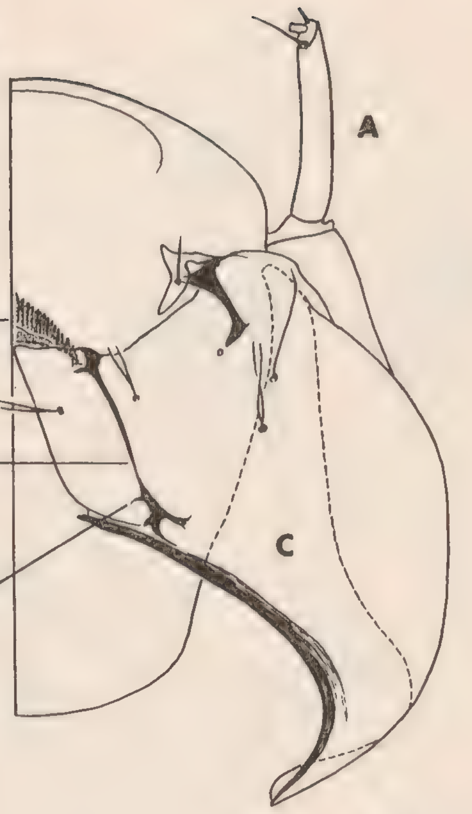


60c

Culiseta littleri

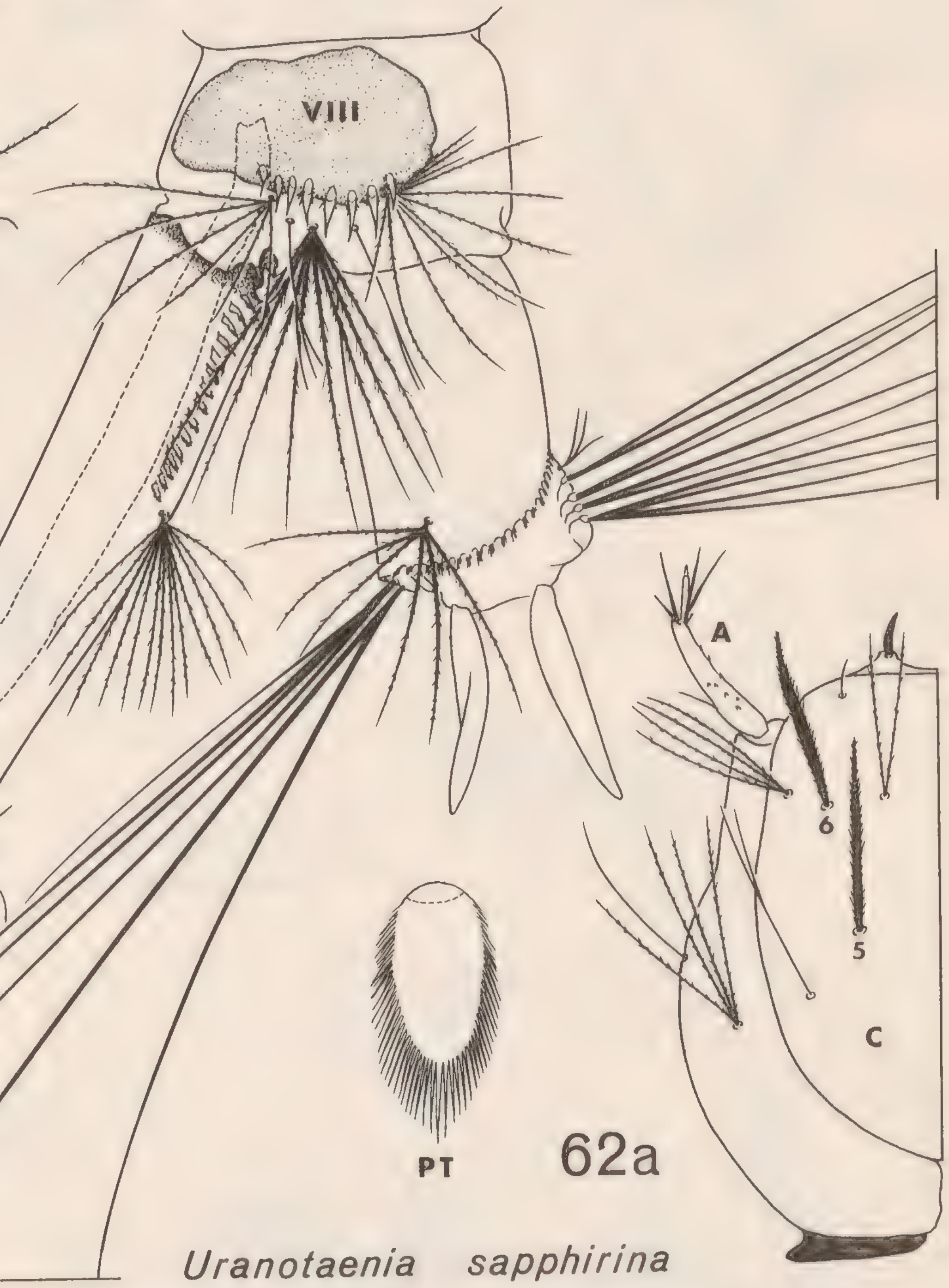
61a

Uranotaenia sapphirina



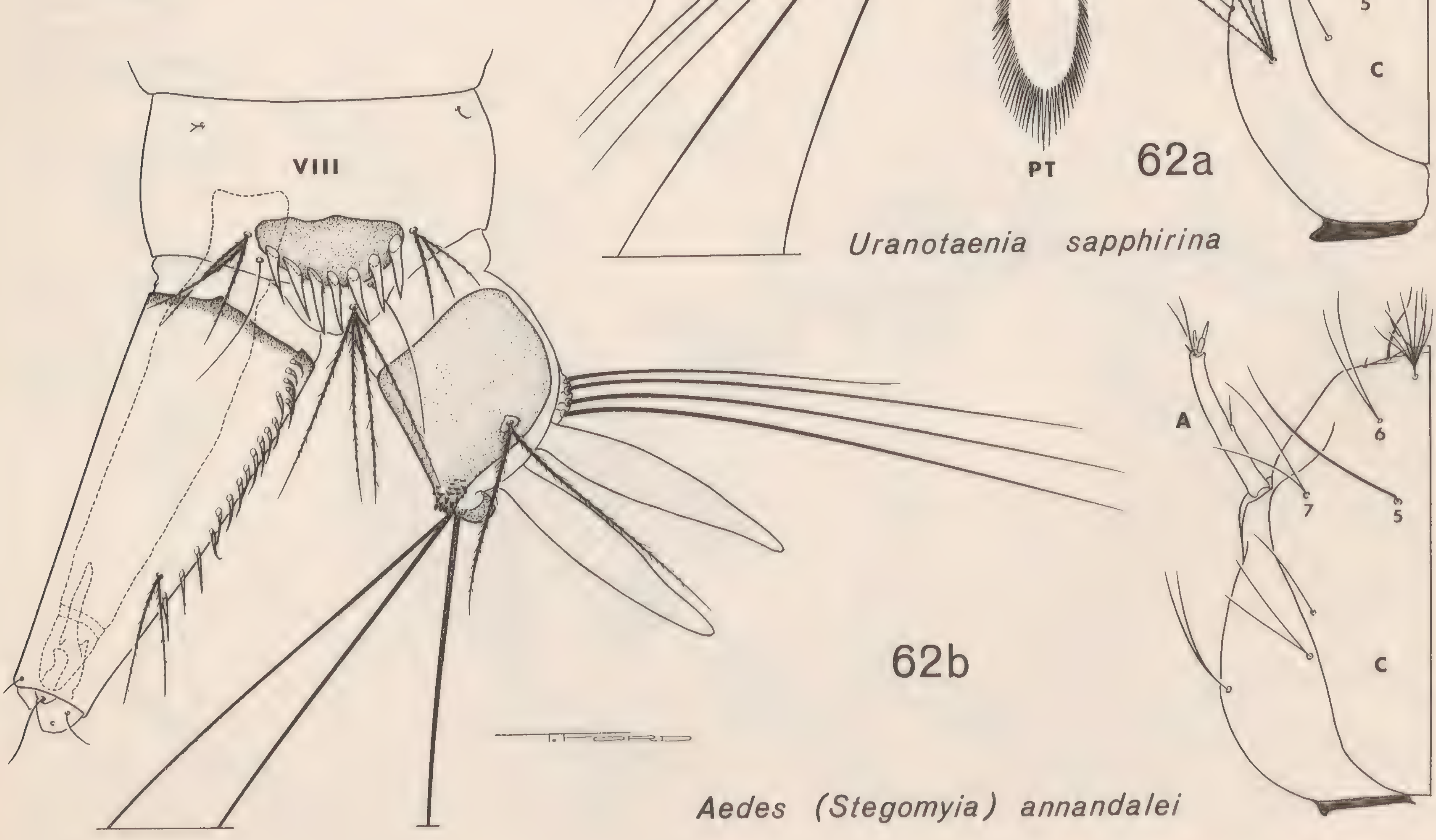
61b

Aedes aegypti



62a

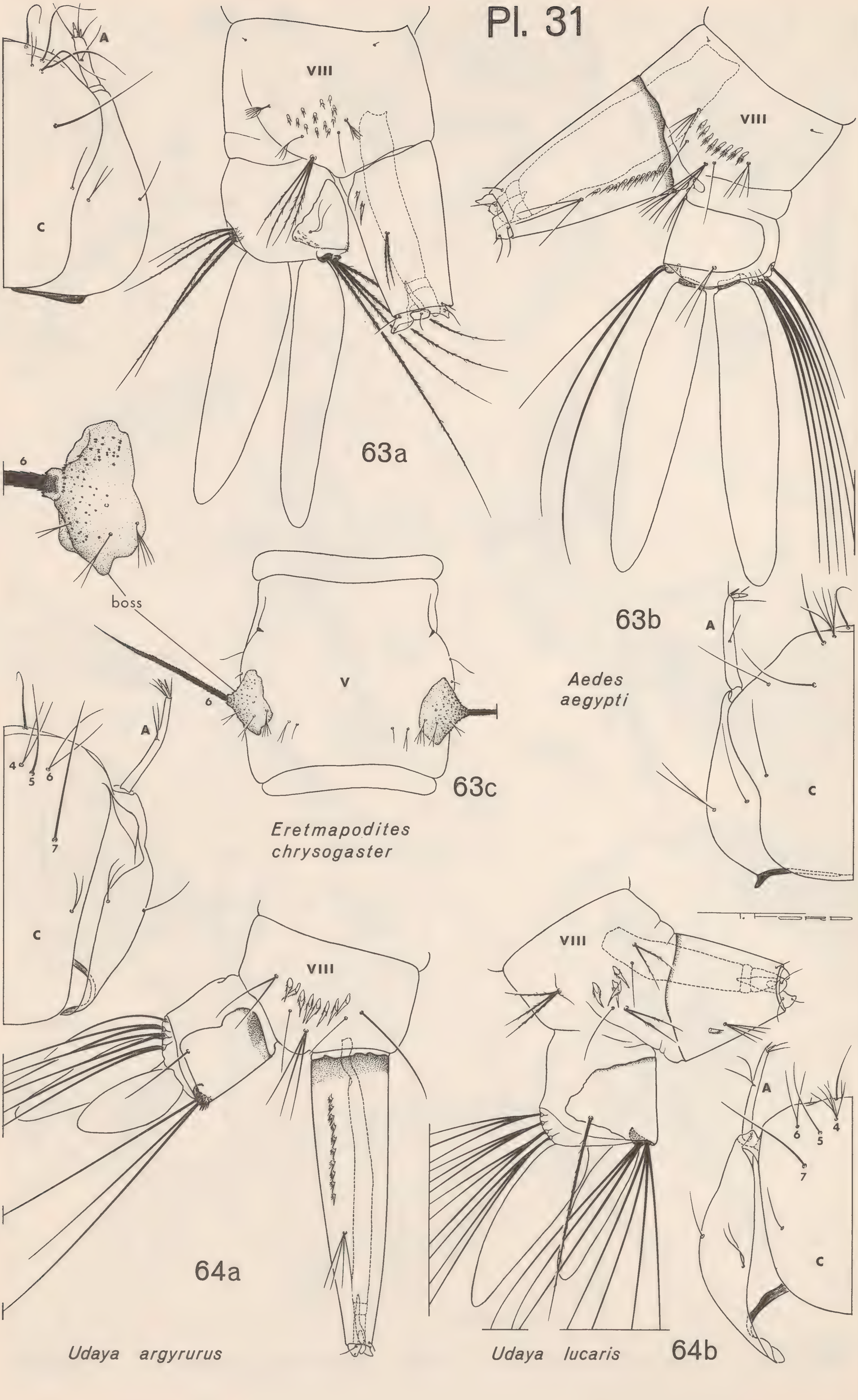
Uranotaenia sapphirina



62b

Aedes (Stegomyia) annandalei

Pl. 31



63a

63b

Aedes aegypti

63c

Eretmapodites chrysogaster

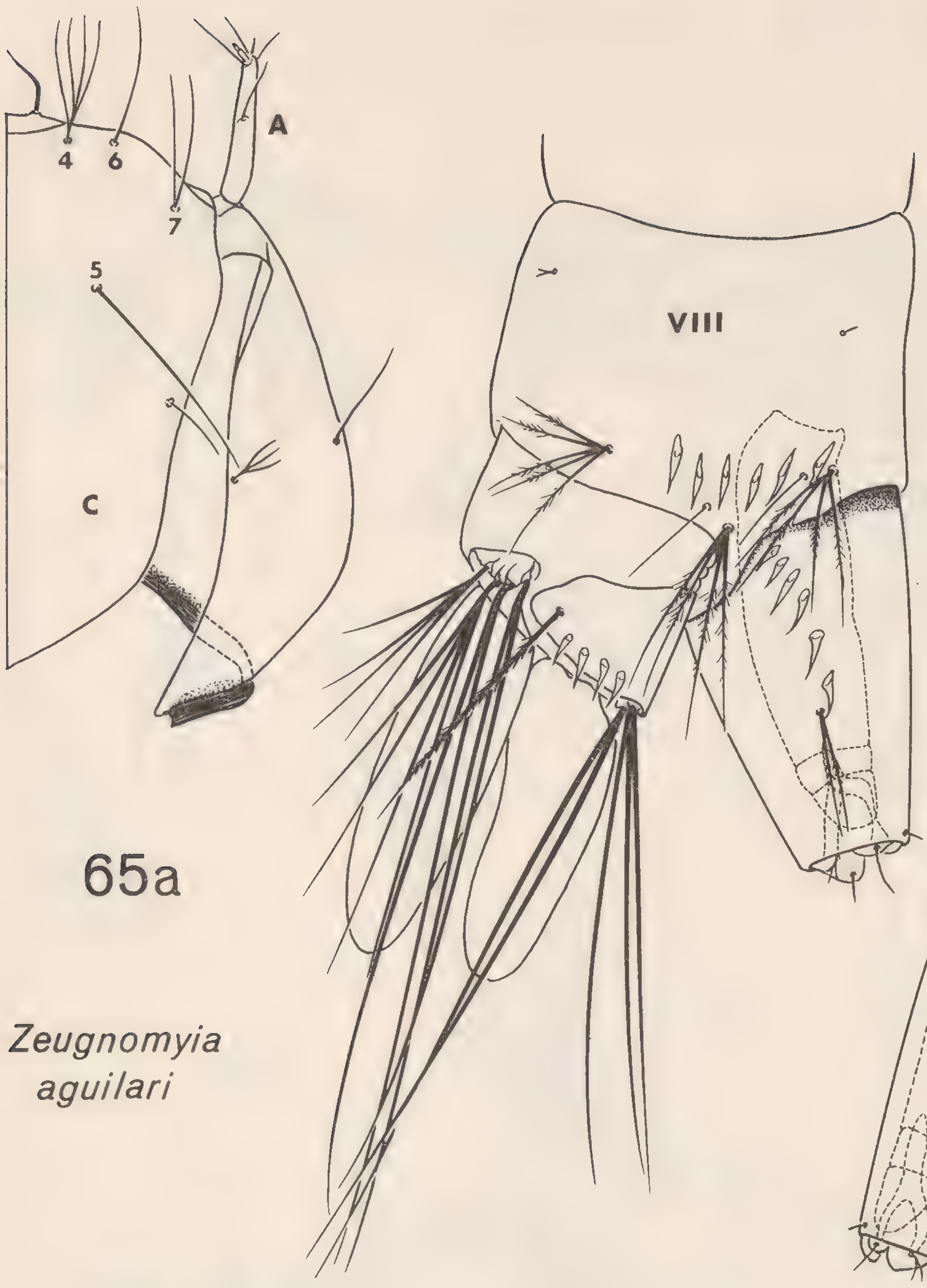
64a

Udaya argyrurus

Udaya lucaris

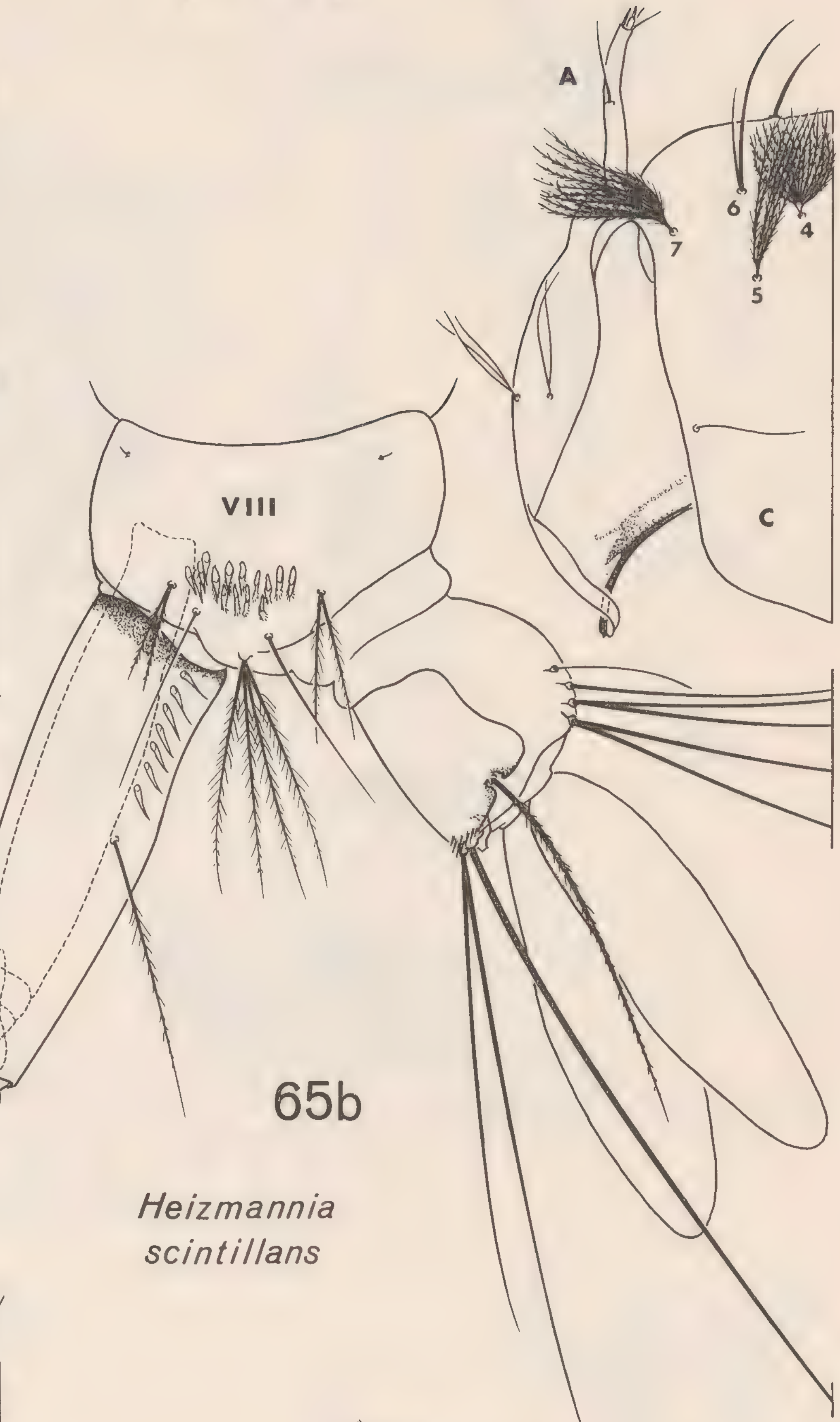
64b

Pl. 32



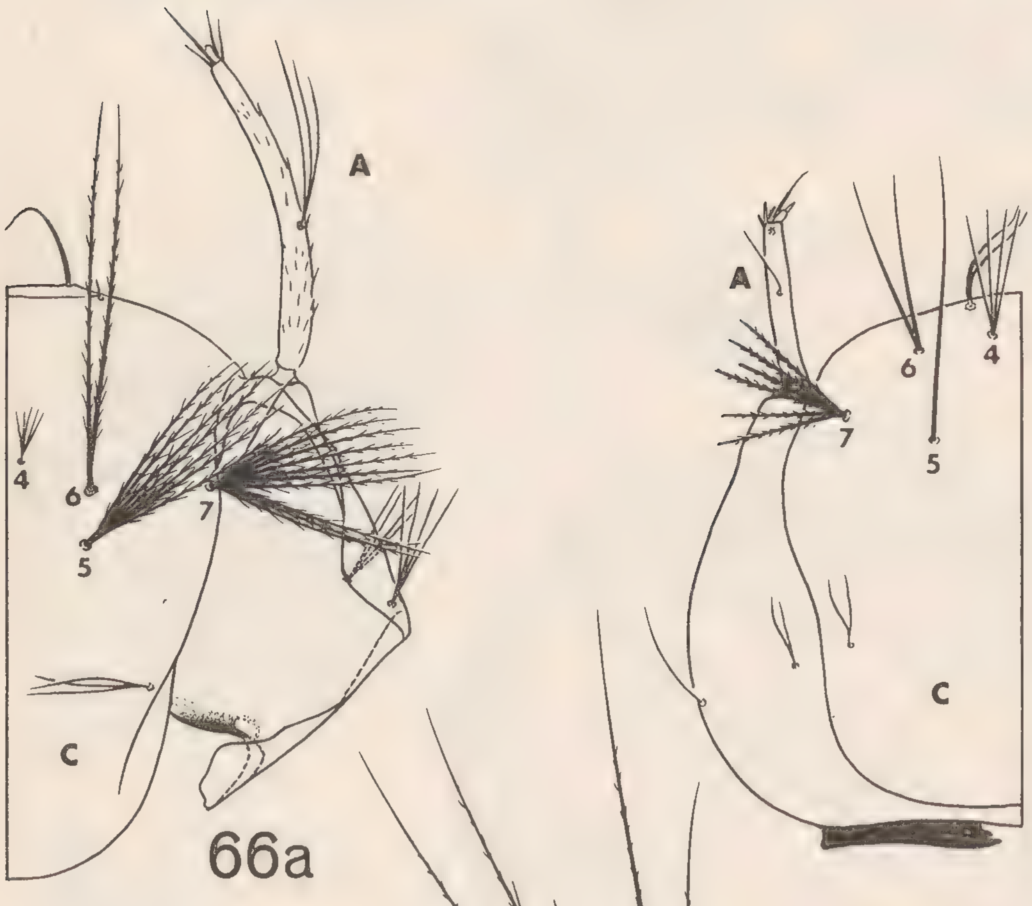
65a

Zeugnomyia aguilari



65b

Heizmannia scintillans



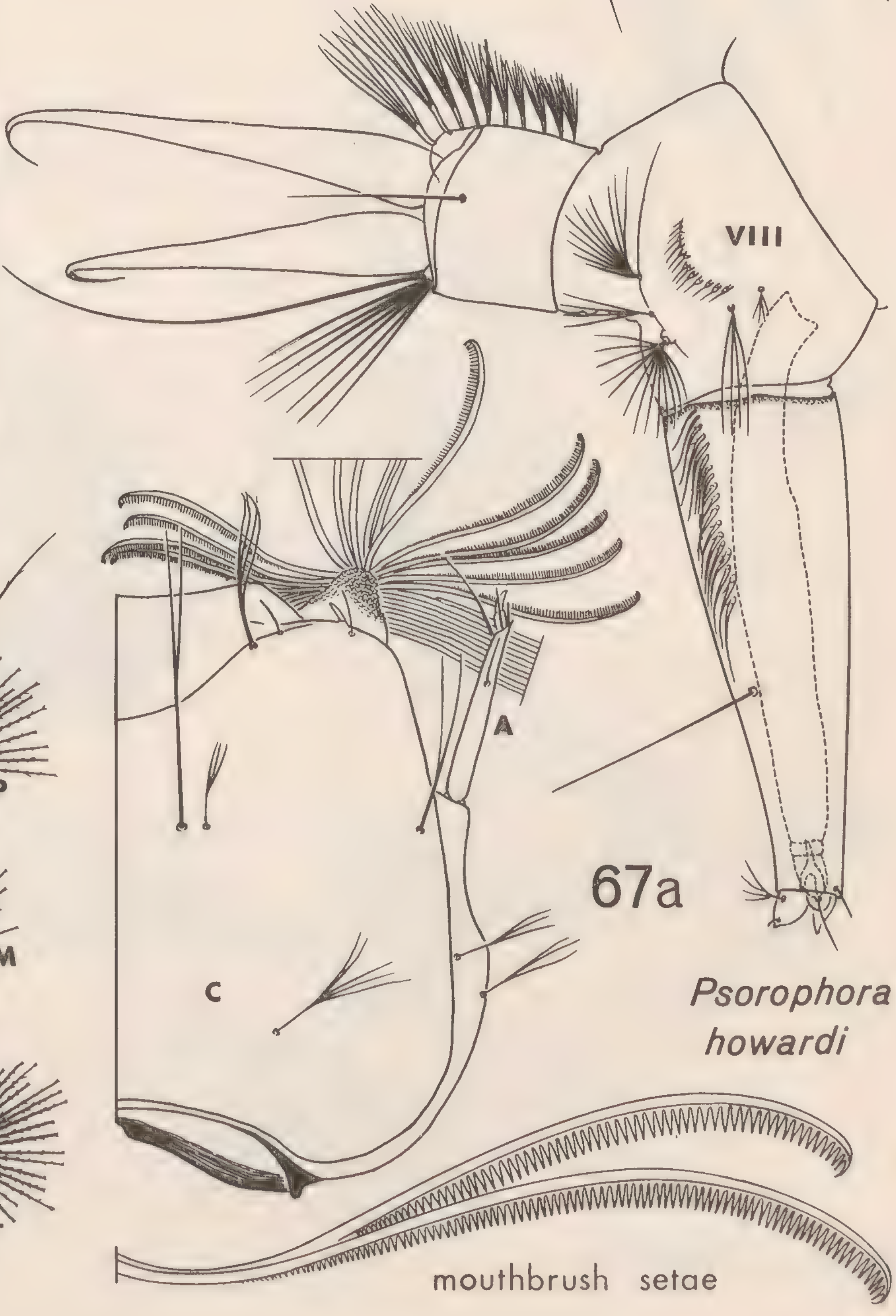
66a

Aedes (Christophersiomyia) gombakensis

66b

Aedes (Finlaya) poecilus

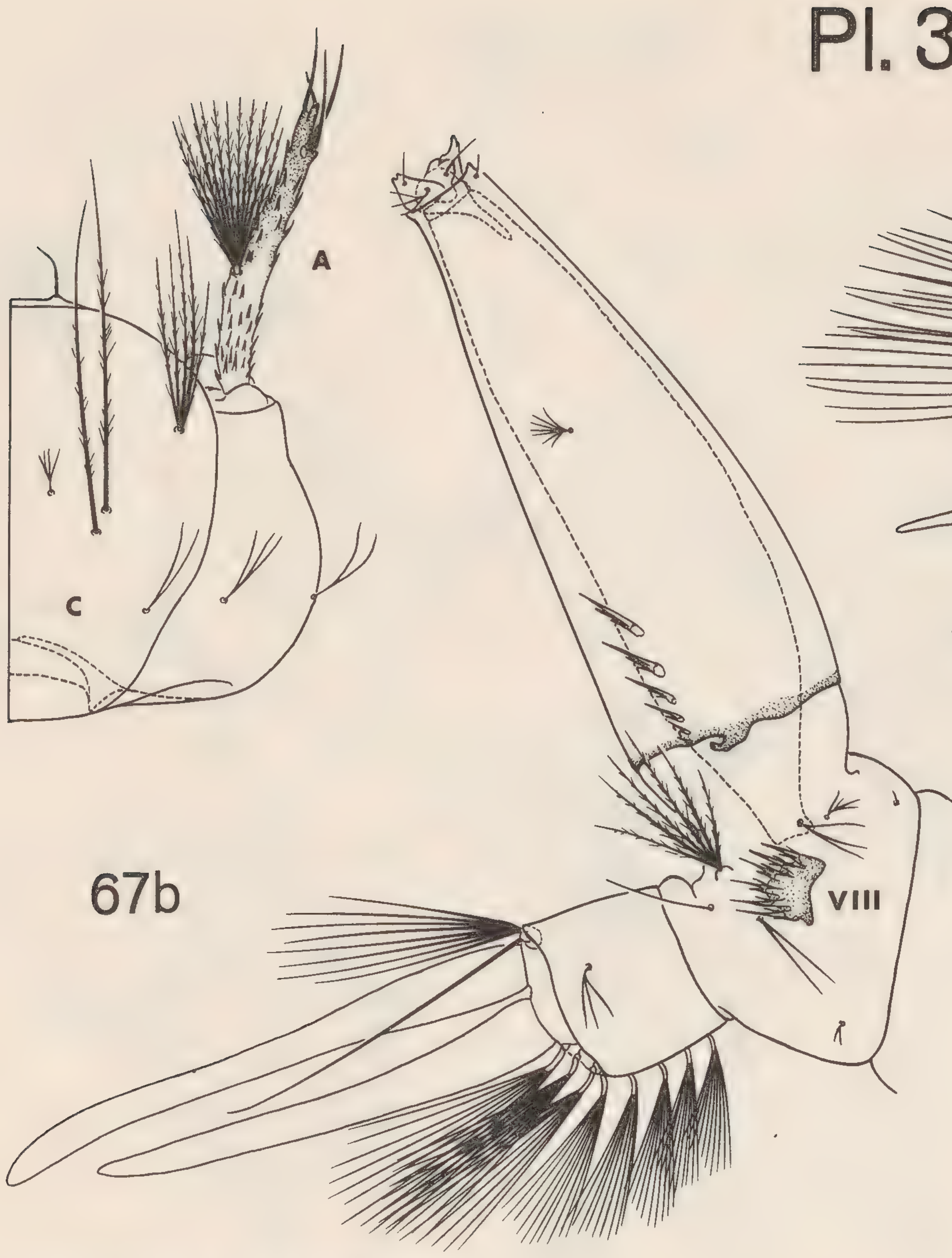
T. FORD



67a

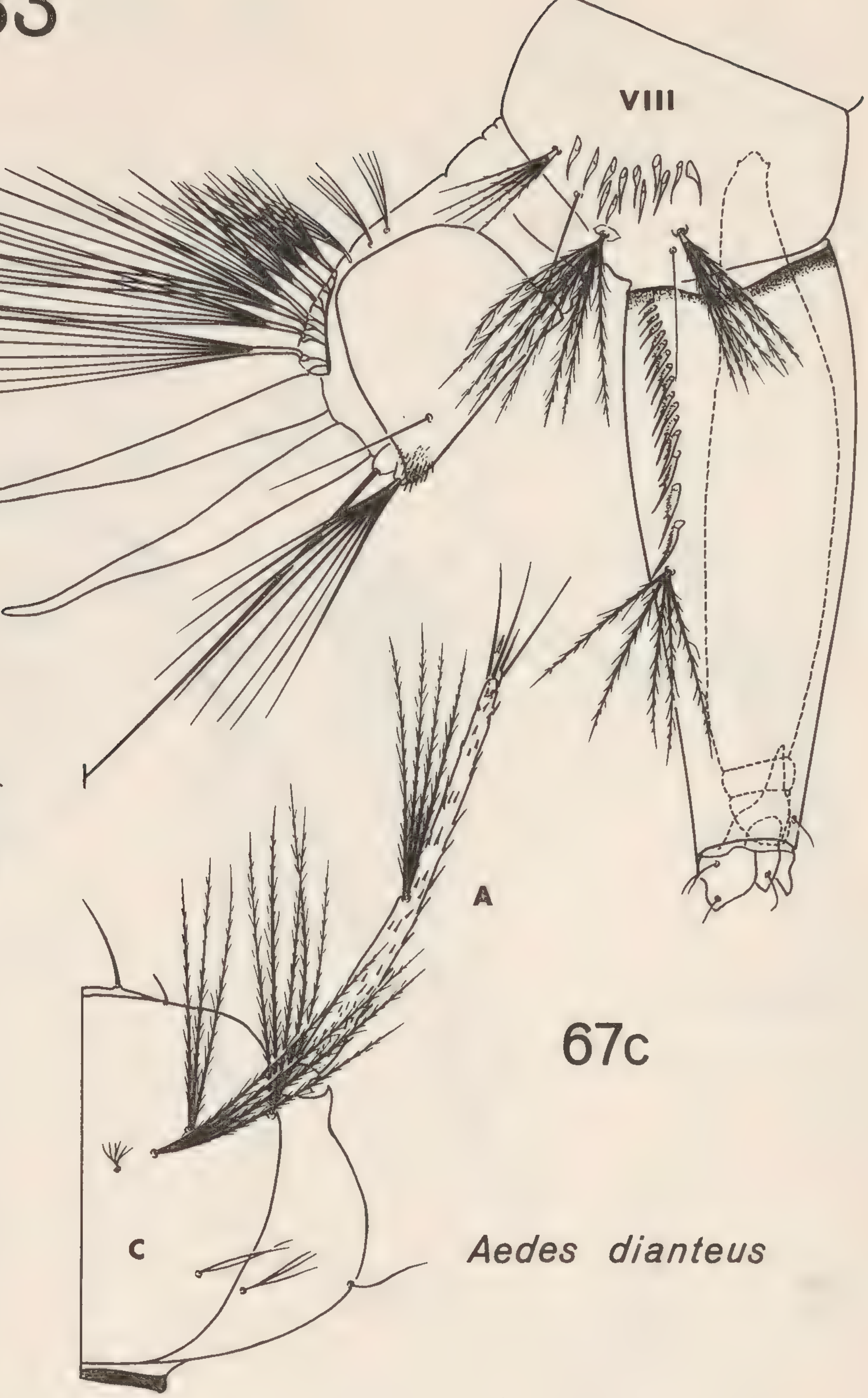
Psorophora howardi

Pl. 33



67b

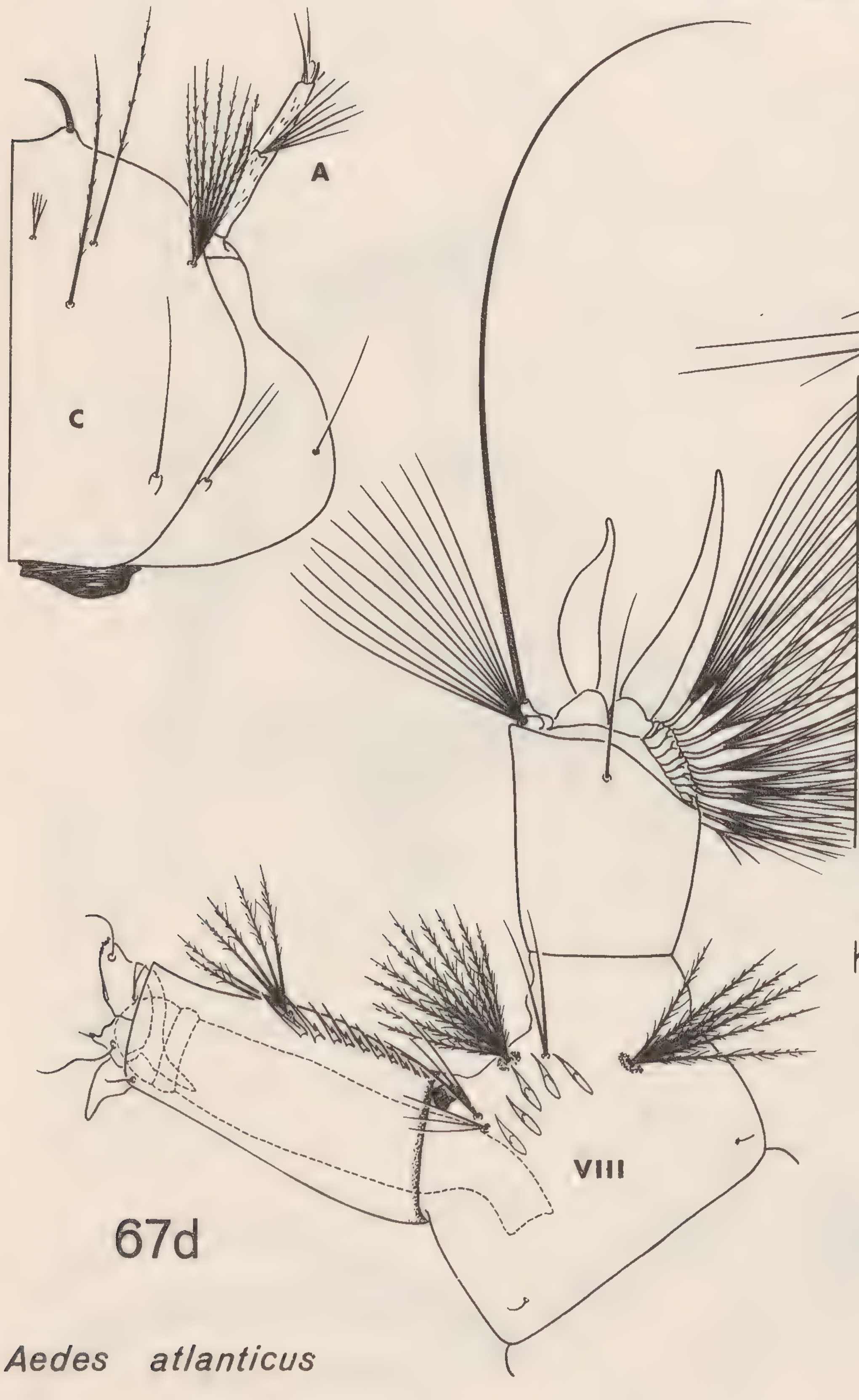
Psorophora signipennis



67c

Aedes dianteus

T. FORD



67d

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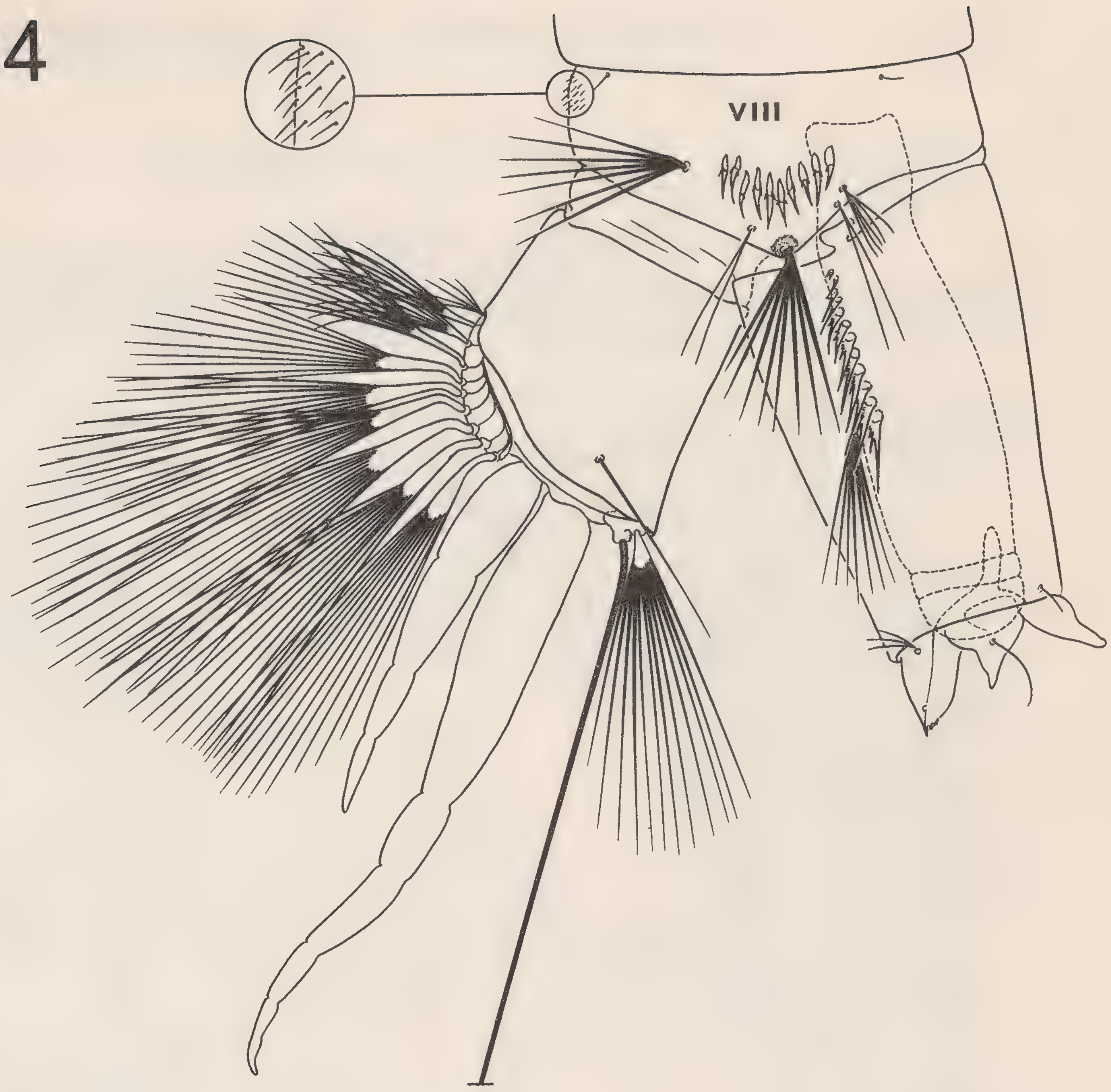
68a

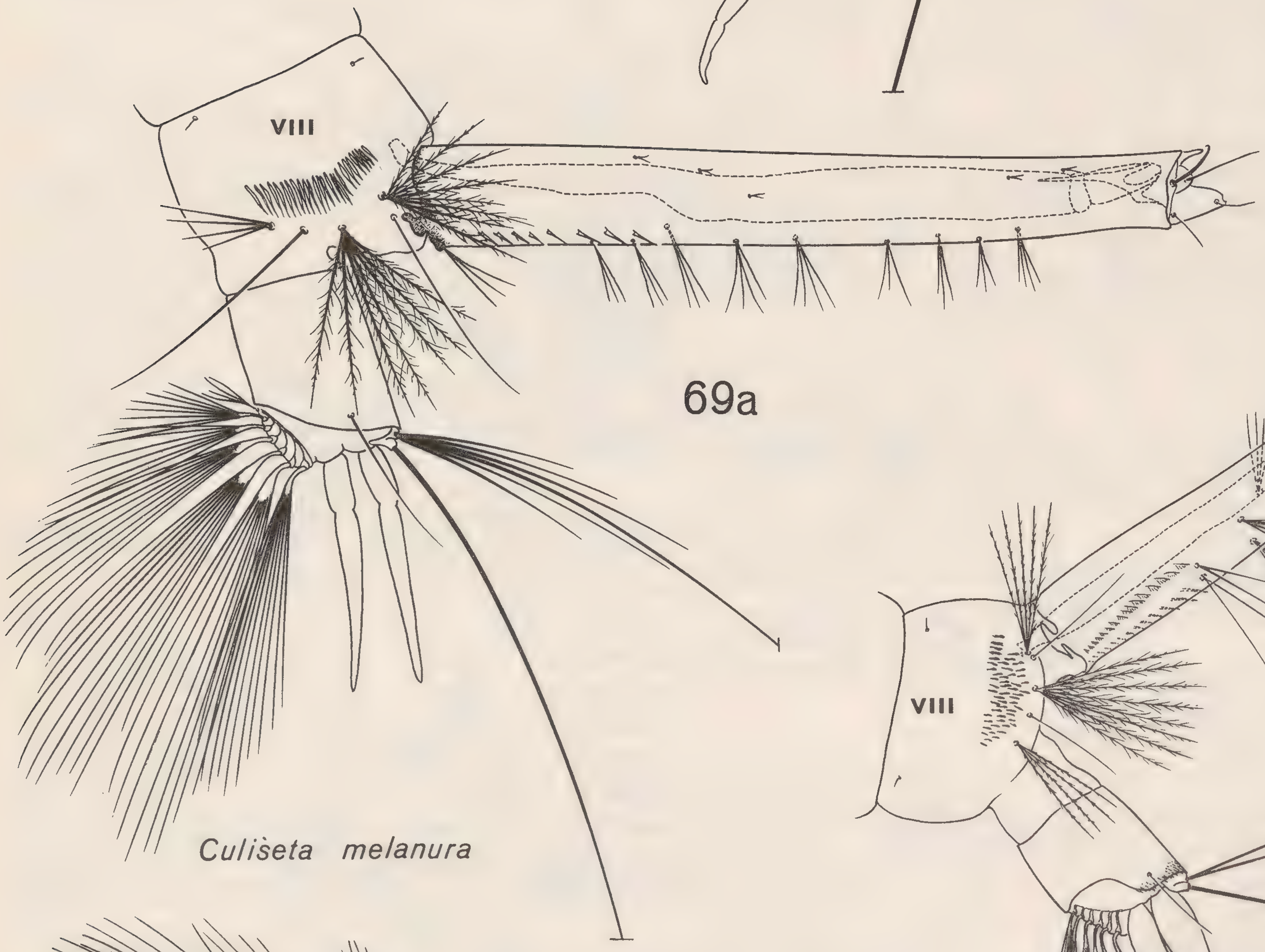
Haemogogus capricornii

Pl. 34



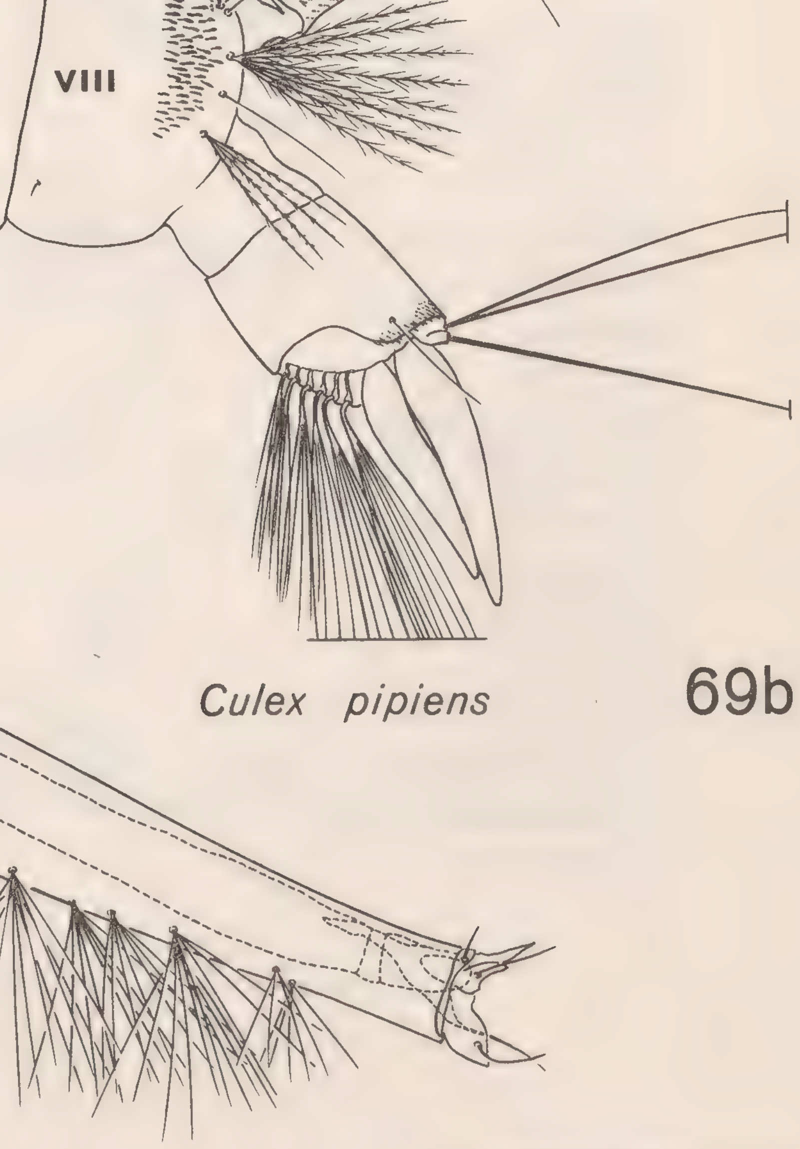
68b

Aedes serratus



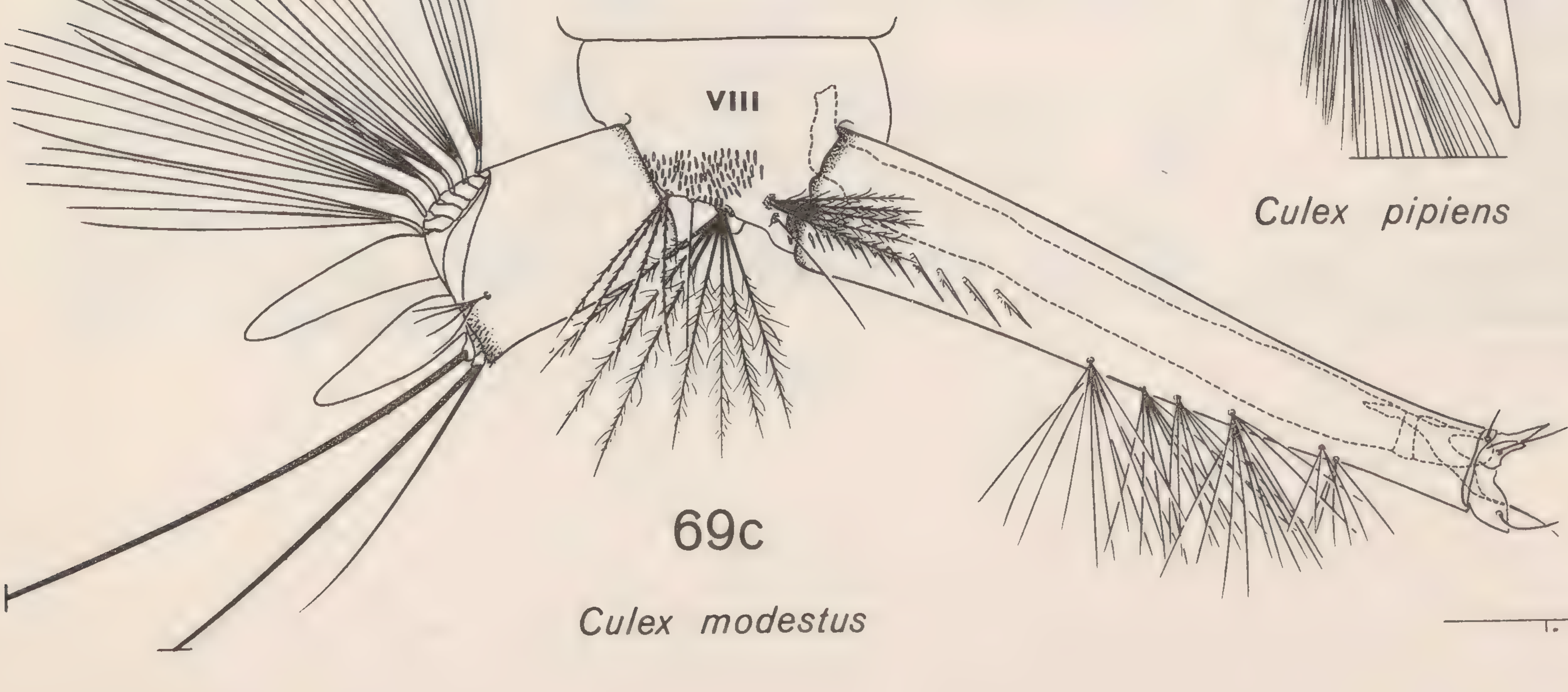
69a

Culiseta melanura



Culex pipiens

69b



69c

Culex modestus

T. FORD

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Volume 7 Number 5, 1971

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By John N. Belkin, Robert X. Schick, and
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MOSQUITO STUDIES (Diptera, Culicidae)

XXV. MOSQUITOES ORIGINALLY DESCRIBED FROM BRAZIL[1]

By

John N. Belkin, Robert X. Schick and Sandra J. Heinemann[2]

This is the fifth in a series of papers providing information on the source and location of the original type material of mosquitoes described from the Americas (Belkin, Schick and Heinemann, 1965, 1966, 1968; Peters, 1968). A sixth paper, with corrections and additions up to the end of 1970 for the entire series, is in preparation. In addition to the species originally described from Brazil, the present paper includes all the species originally described from South America without indication of the country of origin; the type localities of all of these are here restricted to localities in Brazil. We are greatly indebted to the following individuals for assistance to one of us (JNB) in locating type material in various institutions and for other courtesies: T.H.G. Aitken, R.R. Correa, L.M. Deane, J.P. Duret, O.P. Forattini, H. de Souza Lopes, B. Lutz, S. de Oliveira, E.X. Rabello, L.E. Rozeboom, A. Stone and L.P. Travassos. We also thank Claire M. Price for the painstaking preparation of the copy for lithoprinting.

For explanation of the arrangement and method of presentation in the sections on **Nominal Taxa** and **Localities**, the first paper of the series should be consulted (Belkin, Schick and Heinemann, 1965). The nominal taxa described up to the end of 1969 are included. For the subfamily (family, auct.) Culicinae the listing follows the taxonomic order and interpretation of the world catalog as modified by the supplements (Stone, Knight & Starcke, 1959; Stone, 1961, 1963, 1967, 1970); a few additional changes in synonymy are indicated. The subfamilies (families, auct.) Chaoborinae and Dixinae follow, with the taxonomic interpretation adopted by Stone (1966a, 1966b). For the localities, we have used as standard the gazetteer of Brazil prepared by U.S. Board on Geographic Names (1963), except for the elimination of all diacritic marks, accents and so on.

Lectotype designations are made here for the first time for several species without previously designated holotype or lectotype; for the procedure followed see Belkin (1968:2). We have also designated **restricted type localities** for the majority of species without originally specified locality. In case the locality given was Rio de Janeiro, Para or Bahia we have interpreted it to mean the city of Rio de Janeiro

[1] Contribution from project "Mosquitoes of Middle America" supported by U.S. Public Health Service Research Grant AI-04379 and U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478.

[2] Department of Zoology, University of California, Los Angeles, California 90024.

(Guanabara), Belem (Para) and Salvador (Bahia) respectively. For species described from Brazil or South America without specified locality, we have been guided in designating a locality by the source of other species described by the author in question as well as by the known distribution of the species as currently interpreted. In complex cases, an explanation is given in the section on **Authors**.

The section on **Authors** provides an index to the nominal species described by every author and the location of the type material of these species. Discussions of special problems relevant to the determination of the type material and type localities are also given.

In the section on **Depositories** is an alphabetical list of institutions abbreviated as in the world catalog (Stone, Knight and Starcke, 1959); a few institutions have been added. This section provides an index to the type material contained in each institution and, in a few instances, discussions of special problems.

The section on **References Cited** provides full bibliographic entries for all literature citations given in the text. The citations of periodicals conform to the rules of entry in "Anglo-American Cataloging Rules; North American Text" (Amer. Libr. Ass., 1967) and the abbreviations follow the "Revised and Enlarged Word-Abbreviation List for American National Standard for Periodical Title Abbreviations" (Nat. Clearinghouse Period. Title Word Abbreviations, 1966).

In the **Index to Scientific Names**, the number in parentheses following a specific name refers to the number assigned to that name in the section on **Nominal Taxa**; all other references are to page numbers.

NOMINAL TAXA

1. ***Chagasia fajardi*** (Lutz, 1904). Type: Female(s), Sao Paulo (Sao Paulo) (LU, not in IOC). Bionomics: [Larvae in mats of aquatic vegetation along margins of swift streams].

2.* ***Chagasia neivae* Cruz, 1906 [= *fajardi*]. Type: Female(s), Juiz de Fora (Minas Gerais), C. Chagas (LU). Bionomics: [As for *1. fajardi*].

3. ***Chagasia maculata*** Peryassu, 1921 [= *fajardi*]. Type: Adult(s), in forest near park in Cambuquira (Minas Gerais) (LU). Bionomics: [As for *1. fajardi*].

4. ***Chagasia stigmopteryx*** Martini, 1932 [= *fajardi*]. Type: Holotype female, Butantan, Sao Paulo (Sao Paulo), 28 Mar 1920, R. Fischer (DEI). Bionomics: [As for *1. fajardi*].

5. ***Chagasia rozeboomi*** Causey, Deane & Deane, 1944. Type: Egg(s), Ceara; Type LOCALITY here restricted to vicinity of Sao Benedito (NE). Bionomics: [Larvae probably in vegetation along margins of streams].

6. ***Anopheles (Stethomyia) lineatus*** (Lutz, 1905) [= *nimbus*]. Type: Holotype male, probably near Sao Paulo (Sao Paulo) (possibly IOC, tubes 433,434,1066). Bionomics: [Larvae probably in mats of algae along margins of shaded swift streams].

7. ***Anopheles (S.) lewisi*** Shannon, 1931; ***thomasi*** Shannon, 1933, new name. Type: Holotype male, Rio Cururipe, near Salvador (Bahia) (USNM; see Stone and Knight, 1956b:278). Bionomics: [Larvae in forest springs and streams].

8. ***Anopheles (A.) anchietai*** Correa & Ramalho, 1968. Type: Holotype male (15856) with genitalia slide (3114) and slide of larval and pupal skins (3115), Cangaiba, Sao Paulo (Sao Paulo) (FH). Bionomics: [Larvae probably in permanent or semipermanent shaded ground waters].

9. ***Anopheles (A.) bustamentei*** Galvao, 1955. Type: Holotype female (10909, 4112), Ribeirao Pequeno, municipio de Laguna (Santa Catarina), 13 June 1950, J. Bento (FH). Bionomics: [Larvae probably in permanent or semipermanent ground waters]. Females on animal bait.

10. ***Anopheles (A.) geometricus*** Correa, 1944 [= var. of *eiseni*]. Type: Males larvae, pupae, eggs, Guaruja, Ilha de Santo Amaro (Sao Paulo) (NE). Bionomics: [Larvae probably in shaded waters with vegetation and organic matter].

11. ***Anopheles (A.) evandroi*** Lima, 1937. Type: Holotype female (3040) with slide of wing (3285), Sao Bento, Baixada Fluminense (Rio de Janeiro), Feb 1935, Evandro Chagas (IOC). Bionomics: [Larvae probably in permanent or semipermanent shaded ground waters].

12. ***Anopheles (A.) fluminensis*** Root, 1927. Type: Holotype male, Itaperuna (Rio de Janeiro), 17 June 1925, F.M. Root (USNM). Bionomics: Larvae along edges of a small brook.

13. ***Anopheles (A.) intermedius*** (Peryassu, 1908). Type: Females, Rio de Janeiro (Guanabara) and Xerem (Rio de Janeiro), July (possibly in IOC, slide (3295) of wing, 3045). Bionomics: [Larvae in shaded ground waters with dense vegetation; forest ponds or pools].

14.* ***Anopheles (A.) maculipes* (Theobald, 1903). Type: Holotype female, Sao Paulo (Sao Paulo), A. Lutz (BM). Bionomics: [Larvae probably in permanent or semipermanent shaded ground waters].

15. ***Anopheles (A.) mattogrossensis*** Lutz & Neiva, 1911. Type: Holotype female (3530), Lagoa de Manicore (Mandicore) [?Mandiore] (Mato Grosso), Aug 1908, J.C. Diogo (IOC). Bionomics: [Larvae in marshes, drainage ditches and small rainwater pools in open country; lagoons in forests].

16. ***Anopheles (A.) amazonicus*** Christophers, 1923 [= *mattogrossensis*]. Type: Holotype female, River Amazon, June 1915, A.A. Clark; TYPE LOCALITY here restricted to Manaus (Amazonas) (BM). Bionomics: [As for *15. mattogrossensis*].

17.* ***Anopheles (A.) mediopunctatus* (Theobald, 1903). Type: Holotype male, Sao Paulo (Sao Paulo), A. Lutz (BM). Bionomics: [Larvae in sunlit, shallow freshwater pools with abundant vegetation; in forest ponds and pools].

18. ***Anopheles (A.) rockefelleri*** (Peryassu, 1923) [= *mediopunctatus*]. Type: Female(s), Brazil without locality specified, Mar and Apr; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (LU). Bionomics: [As for *17. mediopunctatus*].

19.* ***Anopheles (A.) limai* Fonseca & Ramos, 1939; ***costalimai*** Coutinho, 1944, new name [= *mediopunctatus*]. Type: Holotype male (SPM33) with slides of wing (3) and male genitalia (2), Sao Vicente (Sao Paulo), Aug 1939 (FH). Bionomics: [As for *17. mediopunctatus*].

20. ***Anopheles (A.) costai*** Fonseca & Ramos, 1939 [= *mediopunctatus*]. Type: Holotype male (SPM21) with slide of genitalia (1), Sao Vicente (Sao Paulo), June 1934 (FH). Bionomics: [As for *17. mediopunctatus*].

21. ***Anopheles (A.) minor*** Lima, 1929. Type: Syntypes 1 male and 1 female (tube 281 not 291) with slides of wings (673,890), Estrella [Imbarie] (Rio de Janeiro), 14 Jan 1929 (IOC). Bionomics: [Larvae in ground waters with slow current].

22.* ***Anopheles (A.) lutzi* (Cruz, 1907); ***peryassui*** Dyar & Knab, 1908, new name. Type: Adult(s), shores of Rio Bicudo (Minas Gerais), June, C. Chagas (?IOC, 1 slide with 2 wings). Bionomics: [Large bodies of sunlit clear water with abundant emergent vegetation and some algae; partially shaded streams].

23. ***Anopheles (A.) alagoanii*** Peryassu, 1925 [= *peryassui*]. Type: Males and females, Mutange and Bom Parto, suburbs of Maceio, on shores of Lagoa Manguaba (Alagoas), June-Sept (LU). Bionomics: Larvae in partially shaded ditches and swamps. Adults fly rapidly and silently.

24. ***Anopheles (A.) celidopus*** Dyar & Shannon, 1925 [= *peryassui*]. Type: Holotype female, Carmo, Rio Branco (Roraima), 1 Sept 1924, J. Bequaert (USNM, 27747). Bionomics: [As for *22. lutzi*].

25. ***Anopheles (A.) pseudomaculipes*** (Peryassu, 1908). Type: Adult(s), Xerem (Rio de Janeiro), July and Aug (?IOC, vial 280, slide 672, without data). Bionomics: [Larvae probably in permanent or semipermanent ground water].

26. ***Anopheles (A.) rachoui*** Galvao, 1952. Type: LECTOTYPE by present designation, female (1002) with 1 wing and 1 leg missing, Acude Sao Bento, municipio Santo Amaro (Bahia), 19 Mar 1947, C. Azumbuja (FH, 10080). Bionomics: Larvae in swamp.

27. ***Anopheles (A.) shannoni*** Davis, 1931. Type: Holotype female, Belem (Para), Apr 1930, D.J. Crawford and N.C. Davis (USNM). Bionomics: [Larvae in forest ponds and pools]. Adults on horse bait and alighting to feed in woods.

28.* ***Anopheles (A.) tibiamaculatus* (Neiva, 1906). Type: Female(s), Oliveira (Minas Gerais), May, C. Chagas (LU; not in IOC). Bionomics: [Larvae in rainpool without vegetation (Davis, 1944), in road ruts and pools on margins of streams in forest with cold water and without vegetation].

29. ***Anopheles (Nyssorhynchus) allopha*** (Peryassu, 1921) [= *albitarsis*]. Type: Syntypes males and females, coastal lowlands in Rio de Janeiro (Guanabara) and state of Rio de Janeiro (Museu Nac Rio de Janeiro). Bionomics: Larvae in swamps and bromeliads (?).

30. ***Anopheles (N.) limai*** Galvao & Lane, 1937 [= *albitarsis*]. Type: Eggs, adult(s), Pinheiros and Butantan, Sao Paulo (Sao Paulo) (NE; only slides of stomachs in FMSP). Bionomics: Larvae in depressions; grassy sunlit rain pools; generally with clear water but sometimes muddy; by Rio Pinheiros.

31. ***Anopheles (N.) marajoara*** Galvao & Damasceno, 1942 [= *albitarsis*]. Type: Males, females, larvae, Ilha do Marajo (Para); TYPE LOCALITY here restricted to vicinity of Cachoeira do Arari (FMSP 958). Bionomics: [As for *30. limai*].

32. ***Anopheles (N.) imperfectus*** Correa & Ramos, 1943 [= *albitarsis*]. Type: Holotype female (22), Vera Cruz (Sao Paulo), G.R. Ramalho (FH). Bionomics: [As for *30. limai*]. Taken biting horse.

33. ***Anopheles (N.) domesticus*** Galvao & Damasceno, 1944 [= ssp. of *albitarsis*]. Type: Males, females, eggs, Cachoeira [?do Arari], Ilha do Marajo (Para) (LU). Bionomics: [Larvae in borrow pits, brick pits, ditches, swamps, ponds, springs, streams].

34. ***Anopheles (N.) antunesi*** Galvao & Amaral, 1940. Type: Holotype female (370) with slide (235) of larval skin, Emilio Ribas, Campos do Jordao (Sao Paulo), elev. ca 1570 m (FMSP). Bionomics: Larvae in shaded clear water with sparse vegetation, in rockholes along river (Rio Capivari), in small drainage pools of fountain (Fonte Simao) and in shaded pools of small streams. Adults taken at night biting horse.

35. ***Anopheles (N.) emilianus*** Komp, 1941 [= *aquasalis*]. Type: Holotype male, northern outskirts of Belem (Para), 14 Apr 1941, W.H.W. Komp (USNM). Bionomics: Larvae in grassy pool. Holotype bred from larva.

36. ***Anopheles (N.) guarujaensis*** Ramos, 1942 [= *aquasalis*]. Type: Adults, larvae, eggs, Guaruja (Sao Paulo), Mar 1939 (LU). Bionomics: [Larvae in brackish or fresh water in tidal areas]. Adults in house.

37. *Anopheles (N.) argyritarsis Robineau-Desvoidy, 1827. Type: Female(s), unspecified locality in Brazil; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE). Bionomics: [Larvae in partly shaded or sunlit ground pools, usually small].

38. *Anopheles (N.) sawyeri* Causey, Deane, Deane & Sampaio, 1943 [= ssp. of *argyritarsis*]. Type: Holotype female, plateau of Serra da Ibiapaba, near Sao Benedito (Ceara) (USNM). Bionomics: [Larvae in mountain forest pools (Deane, Causey and Deane, 1946:45)]. Holotype bred from egg laid by female captured on horse bait.

39. *Anopheles (N.) braziliensis* (Chagas, 1907). Type: Syntypes 6 females, margins of Rio das Velhas (Minas Gerais), 11 July 1907; TYPE LOCALITY here restricted to vicinity of Lassance, see Root, 1926:704 (IOC). Bionomics: [Larvae in sunlit clear water with abundant emergent vegetation and algae].

40. *Anopheles (N.) pessoai* Galvao & Lane, 1937 [= *braziliensis*]. Type: Holotype female (82,25), left bank of Rio Pinheiros, Pinheiros, Sao Paulo (Sao Paulo), G.R. Ramalho (FMSP). Bionomics: Larvae in small, shallow, sunlit pools with abundant grass and algae. Holotype bred from larva.

41. *Anopheles (N.) darlingi* Root, 1926. Type: Lectotype male, Caxiribu, near Porto das Caixas (Rio de Janeiro), 12 Mar 1925 (USNM; designation by Stone, 1943:30). Bionomics: Larvae in patches of *Ceratophyllum* in small side bays and along edges of small river and canal with rather rapid current.

42. *Anopheles (N.) paulistensis* Galvao, Lane & Correa, 1937 [= *darlingi*]. Type: Adults, eggs, Novo Oriente, 3 km from Lussanvira, near Pereira Barreto (Sao Paulo), Apr-May, 1937 (LU). Bionomics: [As for *41. darlingi*].

43. *Anopheles (N.) strodei* Root, 1926 [= *evansae*]. Type: Lectotype male (64), a few miles from Agua Limpa Station, near Juiz de Fora (Minas Gerais), 27 Mar 1925 (USNM; designation by Stone and Knight, 1956b:280). Bionomics: Larvae in small marshy expansions of mountain streams, side pools of a river and in small pools, marshes and seepage areas with abundant vegetation.

44. *Anopheles (N.) ramosi* Unti, 1940 [= var. of *evansae*]. Type: Larvae, Lorena (Sao Paulo), Mar 1940 (NE). Bionomics: Larvae in shade in extensive swamps with vegetation, principally "Aguape" and "Vassoura do brejo".

45. *Anopheles (N.) arthuri* Unti, 1941 [= var. of *evansae*]. Type: Eggs, valley of Rio Paraiba [do Sul] (Sao Paulo), elev. ca 500 m (NE). Bionomics: [As in *43. strodei*].

46. *Anopheles (N.) artigasi* Unti, 1941 [= *evansae* var. *arthuri*]. Type: Eggs, valley of Rio Paraiba [do Sul] (Sao Paulo), elev. ca 500 m (NE). Bionomics: [As for *43. strodei*].

47. *Anopheles (N.) albertoi* Unti, 1941 [= var. of *evansae*]. Type: Eggs, valley of Rio Paraiba [do Sul] (Sao Paulo), elev. ca 500 m (NE). Bionomics: [As for *43. strodei*].

48. *Anopheles (N.) galvaoi* Causey, Deane & Deane, 1943. Type: LECTOTYPE female (R426) by present designation, marked *capanemai* in register, Rio Branco (Acre), O.R. Causey (FMSP, 694). Bionomics: [Larvae in small pools with algae and grass and in swamps]. Adults reared from eggs.

49. *Anopheles (N.) lanei* Galvao & Amaral, 1938. Type: Holotype female (86-1, 220), Emilio Ribas, near Campos do Jordao (Sao Paulo), elev. ca 1570 m, Feb-Mar, 1938 (FMSP). Bionomics: Larvae in clear permanent waters. Adults strongly zoophilic.

50. *Anopheles (N.) lutzii* Cruz, 1901. Type: Syntypes 3 females (1965) in tube

993 and slide (2111) of wing, Lagoa Rodrigo de Freitas, Rio de Janeiro (Guanabara) (IOC). Bionomics: [Larvae in swamps].

51. **Anopheles (N.) niger* (Theobald, 1907) [= *lutzii*]. Type: Lectotype female, Cantareira (Sao Paulo), 9 Nov 1904, A. Lutz (BM; designation by Belkin, 1968:10). Bionomics: [As for *50. lutzii*].

*52. **Anopheles (N.) guarani*** Shannon, 1928 [= *lutzii*]. Type: Holotype female, Iguacu (Parana), 5 Oct 1927, R.C. and E.M. Shannon (USNM). Bionomics: [As for *50. lutzii*].

*53. **Anopheles (N.) nigritarsis*** (Chagas, 1907). Type: Female(s), [Oliveira (Minas Gerais)] (from Peryassu, 1908:60) (LU). Bionomics: [Larvae probably in swamps or forest pools].

*54. **Anopheles (N.) noroestensis*** Galvao & Lane, 1937. Type: LECTOTYPE by present designation, male genitalia slide (2177;10293), adult apparently lost, (possible syntype FMSP, 343), Novo Oriente [Pereira Barreto], near Lussanvira (Sao Paulo) (FH). Bionomics: [Larvae in sunlit or partially shaded pools].

*55. **Anopheles (N.) ayrozai*** Unti, 1940 [= *noroestensis*]. Type: Female(s), larva(e), eggs, Guaratingueta (Sao Paulo), Nov 1939-Aug 1940 (NE; not in FH or SPM). Bionomics: Larvae in sunlit, clear water, shallow pools; wells and ditches with slightly colored or muddy water.

*56. **Anopheles (N.) goeldii*** Rozeboom & Gabaldon, 1941 [= *nuneztovari*]. Type: Holotype male, Boa Vista, Rio Tapajos (Para), C.H.T. Townsend (USNM). Bionomics: [Larvae in muddy pools and small lagoons, sunlit or partially shaded].

*57. **Anopheles (N.) dunhami*** Causey, 1945 [= *nuneztovari*]. Type: Holotype male with genitalia slide, Tefe (Amazonas) (USNM). Bionomics: [As for *56. goeldii*].

*58. **Anopheles (N.) oswaldoi*** (Peryassu, 1922). Type: Syntypes males and females, Vale do Rio Doce (Espirito Santo) and Baixada Fluminense (Rio de Janeiro), Mar and Apr (Museu Nac Rio de Janeiro). Bionomics: [Larvae in shaded fresh water in swamps, pools or stagnant streams].

*59. **Anopheles (N.) metcalfi*** Galvao & Lane, 1937 [= *oswaldoi*]. Type: LECTOTYPE by present designation, male (96) with genitalia on slide (710210-1), Porto das Caixas (Rio de Janeiro), 29 May 1925, F.M. Root; 1 of several specimens identified as *tarsimaculatus* by Root (1926:711), on which Galvao and Lane based their *metcalfi* (USNM). Bionomics: Larvae in thick vegetation or flotage of quiet pools, ponds, marshes, lagoons, side-bays or edges of rivers.

*60. **Anopheles (N.) konderi*** Galvao & Damasceno, 1942 [= *oswaldoi*]. Type: Male(s), larva(e), pupa(e), Coari (Amazonas) (LU, no material in FMSP, 651; apparently lost). Bionomics: [As for *58. oswaldoi*].

*61. **Anopheles (N.) parvus*** (Chagas, 1907). Type: Male(s) and female(s), [Oliveira (Minas Gerais) (Galvao, 1941:537)] (?IOC,1966; female (tube 994) and slide (2112) of wing, both without data). Bionomics: [Larvae in small, shaded forest pools].

*62. **Anopheles (N.) rondoni*** (Neiva & Pinto, 1922). Type: LECTOTYPE by present designation, large wing mounted on slide (403) together with wing of type of *cuyabensis*, marked Matto Grosso, C. Pinto, remainder of adult apparently lost; TYPE LOCALITY restricted here to Ladario (Mato Grosso) on Rio Paraguai (IOC). Bionomics: [Larvae in small areas of clear water in ditches and marshes among aquatic vegetation].

*63. **Anopheles (N.) triannulatus*** (Neiva & Pinto, 1922). Type: Holotype female, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso) (LU; not in IOC). Bionomics: [Larvae in vegetation in freshwater pools, lakes and river margins].

64. ***Anopheles (N.) cuyabensis*** (Neiva & Pinto, 1923) [= *triannulatus*]. Type: LECTOTYPE by present designation, small wing mounted on slide (403) together with wing of type of *rondoni*, marked Matto Grosso, C. Pinto, remainder of adult apparently lost; type locality, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso) (IOC). Bionomics: [As for *63. triannulatus*].

65. ***Anopheles (N.) chagasi*** Galvao, 1941 [= *triannulatus*]. Type: Females and eggs, Chaves (Para), Itacoatiara and Manaus (Amazonas); TYPE LOCALITY here restricted to Manaus (LU). Bionomics: [As for *63. triannulatus*].

66. ***Anopheles (Kerteszia) lutzii*** Theobald, 1901; **cruzii** Dyar & Knab, 1908, **adolphoi** Neiva, 1908, new names. Type: Lectotype female, Rio de Janeiro (Guanabara), 4 July 1899, A. Lutz (BM, designation by Belkin, 1968:10). Bionomics: [Larvae in bromeliads].

67. ***Anopheles (K.) montemor*** Correa, 1950 [= *cruzii*]. Type: Holotype male (102) with slides of genitalia (15,G8D1) and larval and pupal skins (15,G8D1), Caraguatatuba (Sao Paulo), G.R. Ramalho and J. Germano (FH). Bionomics: [Larvae in bromeliads].

68. ***Anopheles (K.) laneanus*** Correa & Cerqueira, 1944 [= ssp. of *cruzii*]. Type: Holotype male (383.H.13) with genitalia slide (640), Campos do Jordao (Sao Paulo), elev. 1600 m, J. Lane and F. Lane (FH;2226 in tube 2227). Bionomics: [Larvae in bromeliads].

69.* ***Anopheles (Lophopodomyia) gilesi* (Peryassu, 1908). Type: Holotype male, Rio das Velhas (Minas Gerais), June; TYPE LOCALITY here restricted to vicinity of Lassance (LU). Bionomics: [Larvae in shaded, cool, clear water in mountain forest streams].

70. ***Anopheles (L.) pseudotibiamaculatus*** Galvao & Barretto, 1941. Type: Holotype female (380,438), Casa Grande, municipio Mogi das Cruzes (Sao Paulo), 5 Sept 1940, M. Pereira Barretto (FMSP). Bionomics: [Larvae in shaded streams and pools].

71. ***Toxorhynchites (Ankylorhynchus) catharinensis*** (Lima, Guitton & Ferreira, 1962). Type: Holotype female (5553) with slide (4869) of associated pupal skin, Brusque (Santa Catarina), R. Rachou (IOC). Bionomics: [Larvae in bromeliads].

72. ***Toxorhynchites (A.) purpureus*** (Theobald, 1901). Type: Lectotype female, Amazon, 1861, H.W. Bates; TYPE LOCALITY here restricted to Manaus (Amazonas) (BM; designation by Belkin, 1968:34). Bionomics: [Larvae in bromeliads].

73. ***Toxorhynchites (A.) trichopygus*** (Wiedemann, 1828). Type: Syntypes 3 males, Brazil, locality not specified, Freireiss; TYPE LOCALITY here restricted to Salvador (Bahia) (SNG; see Belkin, 1968:34). Bionomics: [Larvae in bromeliads].

74. ***Toxorhynchites (A.) neglectus*** (Lutz, 1904) [= *trichopygus*]. Type: Holotype female, near Sao Paulo (Sao Paulo) (NE). Bionomics: Bred from larva in bromeliad.

75. ***Toxorhynchites (Lynchiella) bambusicola*** (Lutz & Neiva, 1913). Type: Syntypes males and females, Petropolis (Rio de Janeiro), elev. 800-900 m, J.G. Foetterle et al (IOC). Bionomics: Larvae in bamboo internodes (taquaracu [*Guadia* sp.]).

76. ***Toxorhynchites (L.) horei*** (Gordon & Evans, 1922) [*identity uncertain*]. Type: Lectotype male (463) with genitalia on 2 slides, Macapa, near Manaus (Amazonas), 21 Dec 1921, R.M. Gordon (BM; designation by Belkin, 1968:33). Bionomics: Larvae in axils of "bananeira brava" [*Heliconia* sp.].

77. ***Toxorhynchites (L.) mariae*** (Bourroul, 1904). Type: Female(s), larva(e), Ilha de Itaparica (Bahia) (NE). Bionomics: Larvae in bromeliads.

78. ***Toxorhynchites (L.) pusillus*** (Lima, 1931). Type: Syntypes 1 male (541), 1 female (526) with slides of associated larval skins (1102,1121) and pupal skins (1116,1135), Alto da Boa Vista, Tijuca, Rio de Janeiro (Guanabara), Apr 1930, C.A. Campos Seabra (IOC). Bionomics: Larvae in bamboo internodes.

79. ***Toxorhynchites (L.) solstitialis*** (Lutz, 1904). Type: LECTOTYPE by present designation, female marked as type by Theobald (data in Belkin, 1968:34), Sao Paulo (Sao Paulo), 7 Oct 1903 (BM). Bionomics: Larvae in bromeliads, principally "*Aechmea tinctoria*".

80. ***Toxorhynchites (L.) chrysocephalus*** (Theobald, 1907) [= *solstitialis*]. Type: Holotype male, Sao Paulo (Sao Paulo), 17 Aug 1903, A. Lutz (BM). Bionomics: [As for *79. solstitialis*].

81. ***Toxorhynchites (L.) ferox*** (Wiedemann, 1828); **wiedemanni** Dyar & Knab, 1906, new name. Type: Syntypes several males, Brazil, without specified locality; TYPE LOCALITY here restricted to Salvador (Bahia) (SNG and NMW; see Belkin, 1968:33). Bionomics: [Larvae probably in treeholes or bamboo].

82. ***Toxorhynchites (L.) posticatus*** (Lutz & Neiva, 1913) [?= *wiedemanni*]. Type: Syntypes 2 females (549,550) and possibly 1 male (540), Petropolis (Rio de Janeiro) (IOC). Bionomics: Larvae in bromeliads.

83. ***Toxorhynchites (L.) violaceus*** (Wiedemann, 1820). Type: Lectotype male, Bahia [Salvador (Bahia)] (NMW; designation by Belkin, 1968:34). Bionomics: [Larvae in bromeliads].

84. ***Toxorhynchites (L.) ambiguus*** (Dyar & Knab, 1906) [*identity uncertain*]. Type: Holotype male, Brazil, locality not specified, coll. Winthem; TYPE LOCALITY here restricted to Salvador (Bahia) (LU; originally in Winthem Collection in Hamburg, possibly now in NMW; see Belkin, 1968:32). Bionomics: [Larvae probably in treeholes, bamboo or bromeliads].

85. ***Toxorhynchites (L.) fluminensis*** (Peryassu, 1908) [*identity uncertain*]. Type: Described from unspecified number of males, females and larvae, Rio de Janeiro (Guanabara) (possibly IOC, male (tube 535), with genitalia slide (1128), Rua Conde de Bonfim, Rio de Janeiro, 16 Apr 1907, C. Chagas leg.). Bionomics: Larvae in bromeliads.

86. ***Trichoprosopon (T.) compressum*** Lutz, 1905. Type: Syntypes males and females, states of Sao Paulo and Rio de Janeiro; following material in box 13 possibly part of type series: 1 female (2653), Sao Paulo; 1 male without genitalia (2651), 1 female (2652), Petropolis; 1 female (2654), 1 adult (2655), without data; 2 male genitalia slides (1313,1314), "da coll. do Dr. Lutz" (IOC). Bionomics: Larvae in bamboo.

87. ***Trichoprosopon (T.) digitatum*** (Rondani, 1848). Type: Female(s), Brazil locality not specified; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (LU; see Belkin, 1968:35). Bionomics: [Larvae in cacao pods, coconut husks and fallen palm spathes].

88. ***Trichoprosopon (T.) splendens*** Lutz, 1904 [= *digitatum*]. Type: Adult(s), Manaus (Amazonas) (NE). Bionomics: [As for *87. digitatum*].

89. ***Trichoprosopon (T.) townsendi*** Stone, 1944 [= var. of *digitatum*]. Type: Holotype male (56740), Boa Vista, Rio Tapajos (Para), 20-22 July, C.H.T. Townsend (USNM). Bionomics: [Probably as for *87. digitatum*].

90. ***Trichoprosopon (T.) obscurum*** Lane & Cerqueira, 1942. Type: Holotype male, Mangaratiba (Rio de Janeiro), Apr-Oct 1938 (IOC). Bionomics: [Larvae probably in bamboo].

91.* ***Trichoprosopon (T.) pallidiventer* (Lutz, 1904). Type: LECTOTYPE by present designation, male dissected on slide, marked *Holoconops pallidiventer* Lutz by

Theobald, Sao Paulo (Sao Paulo), A. Lutz (BM; see Belkin, 1968:36-37). Bionomics: [Larvae in bamboo internodes].

*92. **Trichoprosopon (T.) soaresi*** Lane & Cerqueira, 1942. Type: Holotype male, Sao Joao de Petropolis (Espirito Santo) (IOC). Bionomics: [Larvae in bamboo internodes].

93. **Trichoprosopon (Limamyia) brevipes* (Lima, 1931). Type: LECTOTYPE by present designation, male (tube 462) with genitalia on slide (1029) and larval and pupal skins on slides, apparently mixed with those of female, Laranjeiras, Rio de Janeiro (Guanabara), Jan 1930, J.F. Ladeiras (IOC). Bionomics: Larvae in bamboo internode.

94. **Trichoprosopon (Shannoniana)* **fluviatile** (Theobald, 1903). Type: Holotype female, marked by Theobald *Heleconops longipalpis* Lutz, Sao Paulo (Sao Paulo), A. Lutz (BM; see Belkin, 1968:35-36). Bionomics: [Larvae in bored internodes of bamboo or "taquarucu" (*Chusquea gaudichaudii*)].

*95. **Trichoprosopon (S.) longipalpis*** (Lutz, 1905) [= *fluviatile*]. Type: Syntypes male(s) and female(s), [Sao Paulo (Sao Paulo)] (IOC, possibly male (2635) with genitalia slide, 1315). Bionomics: [As for *94. fluviatile*].

*96. **Trichoprosopon (Isostomyia) luederwaldti*** (Lane, 1936). Type: Holotype female (439), Fazenda Jose Euphrasio, Avare (Sao Paulo), 21 Mar 1936, J. Lane and F. de Andrade (FH,426 not 428). Bionomics: [Larvae probably in leaf axils of Araceae or leaf axils and flower bracts of Musaceae].

*97. **Trichoprosopon (Ctenogoeldia) walcotti*** Lane & Cerqueira, 1942. Type: Holotype female, Caravelas (Bahia), Jan 1931, N.C. Davis (IOC). Bionomics: [Larvae probably in leaf axils or flower bracts of Marantaceae or Musaceae].

*98. **Trichoprosopon (Runchomyia) castroi*** Lane & Cerqueira, 1942. Type: Holotype male, Teresopolis (Rio de Janeiro), Mar-May, 1938 (IOC). Bionomics: [Larvae probably in bromeliads or leaf axils and flower bracts of other water holding plants]

*99. **Trichoprosopon (R.) cerqueirai*** Stone, 1944. Type: Holotype male (57190), Rio de Janeiro (Guanabara), Feb 1940, L. Whitman (USNM). Bionomics: [Larvae in bromeliads].

*100. **Trichoprosopon (R.) edwardsianum*** Lane & Cerqueira, 1942. Type: Holotype female, Belterra, Santarem (Para), Sept 1938 (IOC). Bionomics: [Larvae in crown of palms, *Mauritia* sp.].

*101. **Trichoprosopon (R.) humboldti*** Lane & Cerqueira, 1942. Type: Holotype male, Paineiras, Rio de Janeiro (Guanabara), Aug 1939 (IOC). Bionomics: [Larvae probably in bromeliads or leaf axils and flower bracts of other water holding plants].

*102. **Trichoprosopon (R.) trichopus*** (Dyar, 1919) [= *longipes*]. Type: Holotype female (21996), Tefe (Amazonas), June 1906, Ducke (USNM). Bionomics: [Larvae in leaf axils of *Montrichardia arborescens* (Araceae), Kumm and Novis, 1938:512].

103. **Trichoprosopon (R.) lunatum* (Theobald, 1901). Type: Lectotype female, Maua, Rio de Janeiro (Guanabara), 22 July 1899, C. Moreira (BM; designation by Belkin, 1968:36). Bionomics: [Larvae in leaf axils of Musaceae and Araceae].

*104. **Trichoprosopon (R.) reversum*** Lane & Cerqueira, 1942. Type: Holotype male, Mage (Rio de Janeiro), July 1940 (IOC). Bionomics: Larva in bromeliad.

*105. **Trichoprosopon (R.) simile*** Lane & Cerqueira, 1942. Type: Holotype male, Campos do Jordao (Sao Paulo), Dec 1935 or Jan 1936, F. Lane (IOC). Bionomics: [Larvae probably in bromeliads or leaf axils and flower bracts of other water holding plants].

*106. **Trichoprosopon (R.) theobaldi*** Lane & Cerqueira, 1942. Type: Holotype male, Mage (Rio de Janeiro), June 1940 (IOC). Bionomics: [Larvae in bromeliads in Trinidad (Lane, 1945:133)].

*107. **Wyeomyia (W.) arthrostigma*** (Lutz, 1905). Type: LECTOTYPE by present designation, only remaining specimen, female without locality label but with handwritten label, "Proveniente de larva de taqueras, (larva os predador e desenhada)" [Sao Paulo (Sao Paulo), Peryassu, 1908:75] (IOC). Bionomics: Larvae in bamboo.

*108. **Wyeomyia (W.) downsi*** Lane, 1945. Type: Holotype female (608), Mirassol (Sao Paulo), Jan 1936, Andrade and Antenor (FH,4043). Bionomics: [Larvae probably in leaf axils or flower bracts of plants or in bamboo].

*109. **Wyeomyia (W.) leucotarsis*** Lane, 1936 [= var. of *hosautos*]. Type: Syntype females, Boa Esperanca and Pocinho (Mato Grosso), 19 Aug-6 Sept (LU; not in FH). Bionomics: [Larvae in cut bamboo]. Females attracted to humans in forest in daytime.

*110. **Wyeomyia (W.) limai*** Lane & Cerqueira, 1942. Type: Holotype male, Londrina (Parana), Sept 1936, Jan or Feb 1937 (IOC). Bionomics: [Larvae probably in bamboo].

*111. **Wyeomyia (W.) lutzi*** (Lima, 1930). Type: Syntypes, several males and females, with larval and pupal skins and genitalia slides, Alto da Boa Vista, Tijuca, Rio de Janeiro (Guanabara), 28 Feb, 20 Apr 1930, C.A. Campos Seabra (IOC; tubes 472,513,514; slides 1058,1066,1084,1096-1101,1103,1104,1118,1119,1171-1176). Bionomics: Larvae in bamboo internodes.

*112. **Wyeomyia (W.) medioalbipes*** Lutz, 1904. Type: LECTOTYPE by present designation, male with attached genitalia mount, rest of abdomen glued on another attached mount with red type label, [garden of Hospital de Santa Isabel], Bahia [Salvador] (Bahia) (BM; see Belkin, 1968:40-41). Bionomics: Reared from larvae collected in bromeliads.

*113. **Wyeomyia (W.) oblita*** (Lutz, 1904). Type: Syntypes male and female (tube 1544), with genitalia on slides (4599,4600), [Pacaembu], Sao Paulo (Sao Paulo), 11 Oct 1904, [A. Lutz] (IOC); female (BM; see Belkin, 1968:41). Bionomics: Males reared from larvae in "tabuas" (*Typha*), Lutz, 1905:271.

*114. **Wyeomyia (W.) pintoi*** (Lima, 1930) [?= *oblita*]. Type: Holotype female (618), Mendes (Rio de Janeiro), fazenda of Dr. Olympio da Fonseca (IOC). Bionomics: Larvae in bamboo internodes.

*115. **Wyeomyia (W.) sabethea*** Lane & Cerqueira, 1942. Type: Holotype male, Teresopolis (Rio de Janeiro), Apr 1938 (IOC). Bionomics: [Larvae probably in bamboo internodes].

*116. **Wyeomyia (W.) serrata*** (Lutz, 1905). Type: LECTOTYPE by present designation, male, marked as 1 of 2 "cotypes" by Costa Lima, with genitalia slides (1167 and 1168) and possibly slide of leg (1169) and wing (1170), R. Frio, Pindamonhangaba, Sao Paulo (Sao Paulo), 9-12 Feb 1905, A. Lutz (IOC). Bionomics: [Larvae probably in bamboo].

***117. Wyeomyia (Cruzmyia) dyari** Lane & Cerqueira, 1942. Type: Lectotype male (1363) with slides of genitalia (355) and midtarsus (356), Petropolis (Rio de Janeiro), May 1938, R.C. Shannon (FH; designation by Lane and Cerqueira, 1958a). Bionomics: Larvae in bromeliads.

*118. **Wyeomyia (C.) kummi*** Lane & Cerqueira, 1942. Type: Holotype female, Curralinho (Para), Jan, Feb 1936, H.W. Kumm (IOC). Bionomics: [Larvae probably in bromeliads].

*119. **Wyeomyia (C.) mattinglyi*** Lane, 1953. Type: Female(s), state of Bahia; TYPE LOCALITY here restricted to vicinity of Salvador (LU; not in IOC or FH). Bionomics: [Larvae probably in bromeliads].

***120. Wyeomyia (Menolepis) leucostigma** Lutz, 1904. Type: Adult(s), Sao Paulo (Sao Paulo) (NE). Bionomics: Larvae in "tabuas" (*Typha*).

*121. ***Wyeomyia (Antunesmyia) rooti*** Lane & Cerqueira, 1942; ***alani*** Lane & Cerqueira, 1957, new name. Type: Holotype male, Rio de Janeiro (Guanabara), Oct 1940 (IOC). Bionomics: [Larvae probably in bamboo].

122. ***Wyeomyia (Dendromyia) airosai*** Lane & Cerqueira, 1942. Type: Holotype male, Santa Teresa (Espirito Santo), May 1940 (IOC). Bionomics: [Larvae probably in bromeliads].

123. ***Wyeomyia (D.) bourrouli*** (Lutz, 1905). Type: Male(s) and female(s), Estacao de Itaici (Sao Paulo) (NE). Bionomics: Larvae in bromeliads.

124. ***Wyeomyia (D.) cesari*** Del Ponte & Cerqueira, 1938. Type: Holotype female (2209), Cuiaba (Mato Grosso), Mar 1935, G. Cesar (IOC). Bionomics: [Larvae probably in leaf axils].

*125. ***Wyeomyia (D.) confusa*** (Lutz, 1905). Type: Syntype females, woods near Sao Paulo (Sao Paulo) (NE). Bionomics: [Larvae probably in leaf axils or flower bracts of Araceae, Marantaceae and Musaceae, and possibly bromeliads].

126. ***Wyeomyia (D.) finlayi*** Lane & Cerqueira, 1942. Type: Holotype male, Xerem (Rio de Janeiro), June 1940 (IOC). Bionomics: [Larvae probably in bromeliads].

127. ***Wyeomyia (D.) howardi*** Lane & Cerqueira, 1942. Type: Holotype male, Muriqueira [Gois Calmon] (Bahia), May 1929, R.C. Shannon (IOC). Bionomics: [Larvae probably in bromeliads].

128. ***Wyeomyia (D.) kerri*** Del Ponte & Cerqueira, 1938. Type: Holotype female (2210), Cuiaba (Mato Grosso), Feb-July 1935, G. Cesar (IOC). Bionomics: larvae in "palma de assaizeiro" (*Garapa guyanensis* Hubl.).

129. ***Wyeomyia (D.) knabi*** Lane & Cerqueira, 1942. Type: Holotype male, Cachoeira (Rio de Janeiro), May 1938 (IOC). Bionomics: [Larvae probably in leaf axils].

*130. ***Wyeomyia (D.) luteoventralis*** Theobald, 1901. Type: Lectotype female, [Belem] (Para), H.E. Durham (BM; designation by Belkin, 1968:40). Bionomics: [Larvae probably in bromeliads].

131. ***Wyeomyia (D.) melanoides*** (Root, 1928) [= *melanocephala*]. Type: Lectotype male (90-2) with genitalia slide and associated pupal skin, Mage (Rio de Janeiro), 26 May 1925 (USNM,44165; designation by Stone and Knight, 1957b:124). Bionomics: [Larvae probably in leaf axils of Araceae, Musaceae or Typhaceae].

132. ***Wyeomyia (D.) mystes*** Dyar, 1924. Type: Lectotype male with genitalia slide (36.VII.28b), Rio de Janeiro (Guanabara), Aug 1922, F.L. Soper (USNM; designation by Stone and Knight, 1957b:124). Bionomics: [Larvae in leaf axils, of aroids (Dyar, 1928:72) or bromeliads (Shannon, 1931:6)].

133. ***Wyeomyia (D.) negrensis*** Gordon & Evans, 1922. Type: Lectotype male (10-5/643) with 2 slides of genitalia, Macapa, near Manaus (Amazonas), 20 Dec 1921, R.M. Gordon (BM; designation by Belkin, 1968:41). Bionomics: Larvae in "bananeira brava" (*Heliconia* sp.).

134. ***Wyeomyia (D.) personata*** (Lutz, 1904). Type: LECTOTYPE by present designation, male with attached genitalia mount, marked "Type selected by J. Lane", Cantareira (Sao Paulo) (BM; see Belkin, 1968:41). Bionomics: Larvae in "taquaras" (bamboo).

135. ***Wyeomyia (D.) brucei*** Del Ponte & Cerqueira, 1938 [= *personata*]. Type: Holotype female (2211), Cuiaba (Mato Grosso), Feb-June 1935, G. Cesar (LU; in IOC only "allotype" of Lane and Cerqueira (1942:599) present). Bionomics: [Larvae in bamboo internodes (Lane and Cerqueira, loc. cit.)].

136. ***Wyeomyia (D.) rooti*** (Del Ponte, 1939). Type: LECTOTYPE by present designation, female, same specimen as the holotype of *delpontei* Lane & Cerqueira, 1942, Cuiaba (Mato Grosso), Feb 1935 (IOC; for explanation see Del Ponte in authors section). Bionomics: [Larvae probably in uncut internodes of bamboo].

137. ***Wyeomyia (D.) delpontei*** Lane & Cerqueira, 1942 [= *rooti*]. Type: Holotype female, Cuiaba (Mato Grosso), Feb 1935 (IOC). Bionomics: [Larvae probably in uncut internodes of bamboo].

138. ***Wyeomyia (D.) shannoni*** Lane & Cerqueira, 1942. Type: Holotype male, Mangaratiba (Rio de Janeiro), Apr 1938 (IOC). Bionomics: [Larvae probably in leaf axils or flower bracts of Musaceae and Araceae, or possibly in bromeliads or palms].

139. ***Wyeomyia (D.) subcomplosa*** (Del Ponte, 1939) [*identity uncertain*]. Type: Syntype females, Cuiaba (Mato Grosso), Feb-Mar 1935, G. Cesar; Rio Canaticu, Curralinho (Para), Jan 1936, H.W. Kumm; Bahia [Salvador (Bahia)], 1930, R.C. Shannon and N.C. Davis; Sergipe, 1929, R.C. Shannon and N.C. Davis; Para [Belem (Para)], Apr 1930, R.C. Shannon and N.C. Davis (LU, possibly FH, IOC or USNM; for explanation see Del Ponte in authors section). Bionomics: [Pupa in water in "inaja" palm (*Maximiliana regia*)].

140. ***Wyeomyia (D.) tarsata*** Lane & Cerqueira, 1942. Type: Holotype male, Anapolis (Goias), Sept 1936, Veiga and O. Verano (IOC). Bionomics: Larvae in treehole ("jenipapeiro", *Genipa americana*) in association with *Aedes fulvithorax*.

141. ***Wyeomyia (D.) undulata*** Del Ponte & Cerqueira, 1938. Type: Holotype female (2213), Cuiaba (Mato Grosso) Feb 1935, G. Cesar (IOC). Bionomics: [Larvae probably in leaf axils or in bamboo].

142. ***Phoniomyia antunesi*** (Lane & Guimaraes, 1937). Type: Syntypes males, females and larvae, Campos do Jordao (Sao Paulo), Dec 1935-Jan 1936, F. Lane (FH; lectotype not designated). Bionomics: [Larvae in bromeliads].

143. ***Phoniomyia bonnei*** Lane & Cerqueira, 1942. Type: Holotype male, Rio de Janeiro (Guanabara) (IOC not FH; in latter a male (FH,1362, slide 354) from Iguacu (Rio de Janeiro), labelled holotype of "*rockefelleri*" and *bonnei* is a paratype). Bionomics: [Larvae in bromeliads].

144. ***Phoniomyia davisi*** Lane & Cerqueira, 1942. Type: Holotype male, Mangaratiba (Rio de Janeiro), July 1938, R.C. Shannon (IOC not FH; in latter male (1515) with genitalia intact, from same locality, May 1938, marked holotype is a paratype). Bionomics: [Larvae in bromeliads].

145. ***Phoniomyia diabolica*** Lane & Forattini, 1952. Type: Holotype male (9110) with attached mounts of genitalia and larval and pupal skins, Serra do Diabo, rio Cuiaba, municipio Venceslau (Sao Paulo), 25 Apr 1951, O.P. Forattini (FH). Bionomics: Larvae in epiphytic bromeliads.

146. ***Phoniomyia edwardsi*** Lane & Cerqueira, 1942. Type: LECTOTYPE by present designation, male (95.x) with genitalia on slide (95 x/y. Mercedes) together with pupal skin, Porto das Caixas (Rio de Janeiro), 29 May 1925, F.M. Root; 1 of several specimens identified as *quasilongirostris* by Dyar (1928:54); Lane and Cerqueira's (1942:638, footnote) reference to a single specimen of this series as a holotype is incorrect; the present specimen is probably the one from which the figure of the genitalia in Dyar (1928:fig. 37) was drawn; the larva described and figured by Dyar (1928: fig. 37) is incorrectly associated and belongs to *Weomyia (C.) dyari*, see Lane and Cerqueira, 1942:581 (USNM). Bionomics: Larvae in bromeliads.

147. ***Phoniomyia flabellata*** Lane & Cerqueira, 1942. Type: Holotype male, Muriqueira [Gois Calmon] (Bahia), 1929 (IOC). Bionomics: [Larvae probably in bromeliads].

148. ***Phoniomyia galvaoi*** Correa & Ramalho, 1956. Type: Holotype male (804-4) with slide (2298, not labelled) of genitalia and larval and pupal skins, Parada 24 de Outubro, municipio Guaruja (Sao Paulo) (FH,10886). Bionomics: [Larvae in bromeliads].

149. ***Phoniomyia incaudata*** (Root, 1928). Type: Lectotype male (66) with genitalia slide, Rio de Janeiro (Guanabara), 12 Apr 1925, F.M. Root (USNM,44163; designation by Stone and Knight, 1957b:117). Bionomics: Larvae in bromeliads.

150.* ***Phoniomyia longirostris* (Theobald, 1901). Type: Lectotype female, Rio de Janeiro (Guanabara), 4 July 1899, A. Lutz (BM; designation by Belkin, 1968:24). Bionomics: [Larvae in bromeliads].

151. ***Phoniomyia lopesi*** Correa & Ramalho, 1956. Type: Holotype male (6.14) with slide (2300, not labelled) of genitalia and larval and pupal skins, Parada 24 de Outubro, municipio Guaruja (Sao Paulo), 14 Jan 1953 (FH,10888). Bionomics: Larvae in bromeliads.

152. ***Phoniomyia pallidoventer*** Theobald, 1907. Type: Holotype male (10) with genitalia on slide, Rio de Janeiro (Guanabara), F. Fajardo (BM; see Belkin, 1968: 24). Bionomics: [Larvae in bromeliads].

153. ***Phoniomyia palmata*** Lane & Cerqueira, 1942. Type: Holotype male, Rio de Janeiro (Guanabara) (IOC). Bionomics: Larvae in bromeliads.

154. ***Phoniomyia pilicauda*** (Root, 1928). Type: Lectotype male (95.2) with genitalia slide and associated larval and pupal skins, Porto das Caixas (Rio de Janeiro), 29 May 1925, F.M. Root (USNM,44164; designation by Stone and Knight, 1957b: 117). Bionomics: Larvae in bromeliads.

155. ***Phoniomyia quasilongirostris*** Theobald, 1907. Type: Lectotype female (7), Mana [Maua], Rio de Janeiro (Guanabara), F. Fajardo (BM; designation by Belkin, 1968:24). Bionomics: [Larvae in bromeliads].

156. ***Phoniomyia neivai*** Lane & Cerqueira, 1942 [= *quasilongirostris*]. Type: Holotype female, Londrina (Parana) (IOC; in FH (1373) female (11566) from same locality, Nov 1936, also marked holotype). Bionomics: [Larvae in bromeliads].

157. ***Phoniomyia theobaldi*** Lane & Cerqueira, 1942. Type: Holotype male, Rio de Janeiro (Guanabara), May 1937 (IOC; in FH (1434) male (SFA1) with genitalia slide, same locality, June 1937, also labelled holotype). Bionomics: [Larvae in bromeliads].

158.* ***Phoniomyia tripartita* (Bonne-Wepster & Bonne, 1921). Type: Holotype male, represented by fig. 2 in Dyar (1919), Sao Paulo (Sao Paulo) (NE, see Belkin, 1968:24). Bionomics: [Larvae probably in bromeliads].

159.* ***Limatus durhamii* Theobald, 1901. Type: Lectotype female, Para [Belem] (Para), H.E. Durham (BM; designation by Belkin, 1968:23). Bionomics: [Larvae in treeholes, bamboo, cacao pods, fruit rinds, fallen leaves and artificial containers].

160.* ***Limatus curvirostris* (Laveran, 1902) [= *durhamii*]. Type: Male(s) and female(s), neighborhood of Rio de Janeiro (Guanabara), elev. 300-500 m (NE; see Belkin, 1968:22). Bionomics: [As for *159. durhamii*].

161. ***Limatus paraensis*** (Theobald, 1903) [= *durhamii*]. Type: Holotype female, Para [Belem] (Para), H.E. Durham (BM). Bionomics: [As for *159. durhamii*].

162. ***Limatus flavisetosus*** Castro, 1935. Type: Holotype, presumably male, Serra do Cubatao (Sao Paulo) (LU; not in IOC). Bionomics: Larvae in treeholes.

163. ***Sabethes (S.) albiprivus*** Theobald, 1903. Type: Lectotype female, Sao Paulo (Sao Paulo), 28 Nov, A. Lutz (BM; designation by Belkin, 1968:30). Bionomics: [Larvae probably in treeholes, bamboo or possibly leaf axils].

164. ***Sabethes (S.) albiprivatus*** Lutz, 1904 [= *albiprivus*]. Type: LECTOTYPE by present designation, female, Sao Paulo (Sao Paulo), 28 Nov, A. Lutz, same as lectotype of *163. albiprivus* (BM; see Belkin, 1968:30). Bionomics: [As for *163. albiprivus*].

165. ***Sabethes (S.) amazonicus*** Gordon & Evans, 1922. Type: Holotype female, ca 300 yds in forest, Macapa, near Manaus (Amazonas), 22 Dec 1921, R.M. Gordon (BM). Bionomics: [Larvae probably in treeholes, bamboo or possibly leaf axils].

166. ***Sabethes (S.) longfieldae*** Edwards, 1928 [= *amazonicus*]. Type: Holotype female, Melguierra [?], Ribeirao Amolar, headwaters of Rio Paraguai, south of Diamantino (Mato Grosso), elev. ca 2000 ft, 24 May 1927, C. Longfield (BM). Bionomics: [As for *165. amazonicus*].

167. ***Sabethes (S.) batesi*** Lane & Cerqueira, 1942. Type: Holotype male, Tingua (Rio de Janeiro), July 1940, J. Lane (IOC). Bionomics: [Larvae probably in treeholes, bamboo or possibly leaf axils].

168. ***Sabethes (S.) belisarioi*** Neiva, 1908. Type: Syntypes 2 females, Bicudos (Minas Gerais), Feb, B. Penna (LU; not in IOC). Bionomics: [Larvae in bromeliads and occasionally in water on cut trees].

169. ***Sabethes (S.) argyronotum*** Edwards, 1928 [= *belisarioi*]. Type: Lectotype female, Melguierra [?], Ribeirao Amolar, headwaters of Rio Paraguai, south of Diamantino (Mato Grosso), elev. ca 2000 ft, 26 May 1927, C. Longfield (BM; designation by Belkin, 1968:30). Bionomics: [As for *168. belisarioi*].

170. ***Sabethes (S.) nitidus*** Theobald, 1901 [distinct from *bipartipes*]. Type: Lectotype male, Para [Belem] (Para), H.E. Durham (BM; designation by Belkin, 1968:31). Bionomics: [Larvae probably in treeholes, bamboo or leaf axils].

171.* ***Sabethes (S.) locuples* Robineau-Desvoidy, 1827 [= *cyaneus*]. Type: Female(s), Brazil, locality not specified; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE). Bionomics: [Larvae probably in bamboo or treeholes].

172. ***Sabethes (S.) remipes*** (Wiedemann, 1828) [= *cyaneus*]. Type: Holotype female, Brazil, without specified locality; TYPE LOCALITY here restricted to Salvador (Bahia) (ZMC; see Belkin, 1968:32). Bionomics: [As for *171. locuples*].

173. ***Sabethes (S.) forattinii*** Cerqueira, 1961. Type: Holotype male (2018) with genitalia slide (399), Manaus, km 23 on route 17 to Caracarai (Amazonas), 16 Oct 1959, C. Elias (FH,15017, slide 2963). Bionomics: [Larvae probably in bamboo, treeholes or possibly leaf axils].

174. ***Sabethes (S.) lanei*** Cerqueira, 1961. Type: Holotype male (2015) with genitalia slide (465), Manaus, km 23 on route 17 to Caracarai (Amazonas), 14 Oct 1959, C. Elias (FH,15113, slide 2969). Bionomics: [Larvae probably in bamboo, treeholes or possibly leaf axils].

175. ***Sabethes (S.) lutzii*** Theobald, 1903 [*nomen dubium*]. Type: Holotype possibly represented by slide (1278) of wing, marked "da coll. de Dr. Lutz/XI-930/ C.L."; type locality, Manaus (Amazonas) (?IOC). Bionomics: [Larvae probably in treeholes, bamboo or possibly leaf axils].

176. ***Sabethes (S.) purpureus*** (Theobald, 1907). Type: Lectotype female with right wing on slide, Rio de Janeiro (Guanabara), E.A. Goeldi (BM; designation by Belkin, 1968:31). Bionomics: [Larvae in treeholes].

177. ***Sabethes (S.) purpureus*** Peryassu, 1908; ***remipusculus*** Dyar, 1924, new name [= *purpureus* Theobald, 1907]. Type: LECTOTYPE by present designation, only remaining specimen, broken (135), head and thorax on 1 pin, leg on point on another pin, wing on slide (1092), Juiz de Fora (Minas Gerais), 28 Oct 1907, A. Neiva (IOC,505). Bionomics: [As for *176. purpureus* Theobald, 1907].

178. ***Sabethes (S.) quasicyaneus*** Peryassu, 1922. Type: Female(s), Mato do Utinga, suburb of Belem (Para) (LU). Bionomics: [Larvae probably in treeholes, bamboo or possibly leaf axils].

179. ***Sabethes (S.) shannoni*** Cerqueira, 1961. Type: Holotype male (2062-43) with slide (2965) of associated larval and pupal skins (456), Igarape do Leao, Manaus (Amazonas), 8 Jan 1960, C. Elias and E. Viera (FH,15109). Bionomics: Larvae in epiphytic bromeliads, "bananeira brava" (*Heliconia sylvestris*) and tree trunk cut at about 1 m from ground.

180. ***Sabethes (S.) spixi*** Cerqueira, 1961. Type: Holotype male (2013) with genitalia slide (393,2962), Manaus, km 23 on route 17 to Caracarai (Amazonas), Oct 1959, C. Elias (FH,15106). Bionomics: [Larvae probably in bamboo, treeholes or possibly leaf axils].

181. ***Sabethes (Sabethoides) confusus*** (Theobald, 1903) [= *chloropterus*]. Type: Lectotype female (female "type" of *nitidus*), Para [Belem] (Para), H.E. Durham (BM; designation by Mattingly, 1958:105; see Belkin 1968:30). Bionomics: [Larvae in treeholes].

182. ***Sabethes (Sabethoides) glaucodaemon*** (Dyar & Shannon, 1925). Type: Holotype female, near San Alberto [?], Rio Branco (Roraima), 28 Aug 1924, J. Bequaert (USNM,27744). Bionomics: [Larvae in treeholes or bamboo; possibly in leaf axils of *Montrichardia* as stated by Lane and Cerqueira, 1942:674].

183. ***Sabethes (Sabethoides) tridentatus*** Cerqueira, 1961. Type: Holotype male (1403.3) with associated larval and pupal skins (62) on slide (2968); slide (422) of male genitalia missing, Igarape da Bolivia, Manaus (Amazonas), May 1956, C. Elias et al (FH,15112). Bionomics: Larvae in treeholes in forest.

184. ***Sabethes (Sabethinus) aurescens*** (Lutz, 1905). Type: LECTOTYPE by present designation, the specimen identified as the holotype of *aurescens* Theobald, 1907 by Belkin (1968:30); the latter name is here eliminated (see discussion under Theobald in section on authors below); Cantareira (Sao Paulo), 16 Apr 1905, A. Lutz (BM). Bionomics: [Larvae in bamboo internodes].

185. ***Sabethes (Sabethinus) fabricii*** Lane & Cerqueira, 1942. Type: Holotype male, Tingua (Rio de Janeiro), Jan 1941 (IOC). Bionomics: [Larvae probably in bamboo internodes or treeholes, possibly in leaf axils].

186. ***Sabethes (Sabethinus) lutzianus*** Lane & Cerqueira, 1942 [?= *identicus*]. Type: Holotype male, locality not specified (Rio de Janeiro); TYPE LOCALITY here restricted to Tingua (IOC). Bionomics: [Larvae probably in bamboo internodes].

187. ***Sabethes (Sabethinus) intermedius*** (Lutz, 1904). Type: LECTOTYPE by present designation, female marked as lectotype by John Lane, [near Sao Paulo] (Sao Paulo) (BM; see Belkin, 1968:31). Bionomics: [Larvae in bamboo internodes].

188. ***Sabethes (Sabethinus) albiprivatus*** (Theobald, 1907); ***melanonymphe*** Dyar, 1924, new name. Type: Lectotype male with thorax and 5 legs on pin, abdomen and genitalia on 1 slide, head and left wing on another, Cantareira (Sao Paulo), 16 Apr 1905, A. Lutz (BM; designation by Belkin, 1968:29). Bionomics: [Larvae in bamboo internodes].

189. ***Sabethes (Sabethinus) soperi*** Lane & Cerqueira, 1942. Type: Holotype male, Piraja (Bahia), Mar 1930, R.C. Shannon (IOC). Bionomics: [Larvae probably in bamboo internodes or treeholes; possibly in leaf axils].

190. ***Sabethes (Sabethinus) whitmani*** Lane & Cerqueira, 1942. Type: Holotype male, Sao Joao de Petropolis, Santa Teresa (Espirito Santo), May 1940 (IOC). Bionomics: [Larvae probably in bamboo internodes or treeholes; possibly in leaf axils].

191. ***Coquillettidia (Rhynchotaenia) albicosta*** (Peryassu, 1908). Type: LECTOTYPE by present designation, only remaining specimen, female, Xerem (Rio de Janeiro), 28 Oct 1907 (IOC). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

192. ***Coquillettidia (R.) albifera*** (Prado, 1931). Type: Holotype female, marshes near Rio Pinheiros, Butantan, Sao Paulo (Sao Paulo), 23 Apr 1931, Franca (IB, 1040; antigo 72). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

193. ***Coquillettidia (R.) arribalzagae*** (Theobald, 1903). Type: Lectotype female, Para [Belem] (Para), H.E. Durham (BM; designation by Belkin, 1968: 11). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

194. ***Coquillettidia (R.) chrysonotum*** (Peryassu, 1922). Type: Syntypes males and females, Vale do Rio Doce (Espirito Santo) and Baixada Fluminense (Rio de Janeiro), Mar-Apr (Museu Nac Rio de Janeiro and IOC, tubes 431 and 432). Bionomics: [Larvae attached to roots of grassy vegetation in permanent or semipermanent ground waters].

195. ***Coquillettidia (R.) hermanoi*** (Lane & Coutinho, 1940). Type: Holotype female (1010), Acampamento dos Morros Azues (Mato Grosso), 6 Sept 1937, A. Bueno de Oliveira (FH,1630; tube 1461). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

196. ***Coquillettidia (R.) juxtamansonia*** (Chagas, 1907). Type: LECTOTYPE by present designation, female (tube 428), wing on slide (1001), Juiz de Fora (Minas Gerais), Oct 1906, A. Neiva (IOC). Bionomics: [Larvae attached to roots of grassy vegetation in permanent or semipermanent ground waters].

197. ***Coquillettidia (R.) hypocindyna*** (Dyar, 1918) [= *juxtamansonia*]. Type: Holotype female, [Sao Paulo] (Sao Paulo), A. Lutz (USNM,21720). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

198. ***Coquillettidia (R.) lynchi*** (Shannon, 1931). Type: Holotype male, Para [Belem] (Para), N.C. Davis (USNM). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

199. ***Coquillettidia (R.) neivai*** (Lane & Coutinho, 1940) [distinct from *nigricans*, see Belkin, Heinemann and Page, 1970:103]. Type: Holotype male (1137) with genitalia on slide (453), marked "*Mansonia chrysa*" and *Taeniorhynchus nigricans* (pinned specimen only), Juquia (Sao Paulo), 16 Jan 1939, J. Lane (FH,1676). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent and semipermanent ground waters].

200. ***Coquillettidia (R.) shannoni*** (Lane & Antunes, 1937). Type: Holotype female, Cuiaba (Mato Grosso), Sept 1934, J. Lane (FH,809). Bionomics: [Larvae probably attached to roots of grassy vegetation in permanent or semipermanent ground waters].

201. ***Mansonia (M.) amazonensis*** (Theobald, 1901). Type: Holotype female, S.S. Faraday, between Gurupa and Monte Alegre (Para), 25 Jan 1896, E.E. Austen; TYPE LOCALITY here restricted to vicinity of Gurupa (BM). Bionomics: [Larvae attached to vegetation in permanent or semipermanent ground waters].

*202. **Mansonia (M.) cerqueirai*** (Barreto & Coutinho, 1944). Type: Holotype male, Maracaju (Mato Grosso) (LU). Bionomics: [Larvae probably attached to vegetation in permanent or semipermanent ground waters].

*203. **Mansonia (M.) chagasi*** (Lima, 1935). Type: Holotype male, Bicudos (Minas Gerais), 11 Feb 1908, C. Chagas (IOC, 1956). Bionomics: [Larvae probably attached to vegetation in permanent or semipermanent ground waters].

*204. **Mansonia (M.) indubitans*** Dyar & Shannon, 1925. Type: Holotype female, Belem (Para) 19 Sept 1924, J. Bequaert (USNM,27746). Bionomics: [Larvae attached to vegetation (*Pistia*) in permanent or semipermanent ground waters].

*205. **Mansonia (M.) pessoai*** (Barreto & Coutinho, 1944). Type: Holotype male with genitalia on slide (512), marked paratype, Curitiba (Parana), G. Ramalho (FH,1822). Bionomics: [Larvae probably attached to vegetation in permanent or semipermanent ground waters].

*206. **Mansonia (M.) pseudotitillans*** (Theobald, 1901). Type: Lectotype female, S.S. F[araday], Breves (Para), 25 Jan 1896, E.E. Austen (BM; designation by Belkin, 1968:23). Bionomics: [Larvae probably attached to vegetation in permanent or semipermanent ground waters].

207. **Mansonia (M.) titillans* (Walker, 1848). Type: Holotype female, Brazil, without specified locality; TYPE LOCALITY here restricted to vicinity of Belem (Para) (BM; see Belkin, 1968:23). Bionomics: [Larvae attached to *Pistia* and floating grass].

*208. **Mansonia (M.) wilsoni*** (Barretto & Coutinho, 1944). Type: Holotype male, Sao Paulo (Sao Paulo) (LU, not in FMSP). Bionomics: [Larvae probably attached to vegetation in permanent and semipermanent ground waters].

*209. **Uranotaenia albitarsis*** Gordon & Evans, 1922 [= *calosomata*]. Type: Lectotype male (15/463) with genitalia slide, sawmill near Macapa (near Manaus) (Amazonas), 20 Jan 1922, R.M. Gordon (BM; designation by Belkin, 1968:37). Bionomics: Larvae in old iron "bath".

*210. **Uranotaenia davisi*** Lane, 1943. Type: Holotype male (436) with genitalia on slide (897), Salvador (Bahia), P.C.A. Antunes (FH,3557). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*211. **Uranotaenia ditaenionota*** Prado, 1931. Type: Holotype female, woods of Butantan, Sao Paulo (Sao Paulo), 15 July 1931, D. Yered (IB, 1131; antigo 175). Bionomics: [Larvae in pools of dirty water and in a small stream (Lane, 1943:160)].

*212. **Uranotaenia burkii*** Lane, 1936 [= *ditaenionota*]. Type: Holotype male (232A) with genitalia slide (32) and larval skin slide (31), [Coronel] Ponce (Mato Grosso), 24-26 July 1934 (FH,367). Bionomics: Larvae in a shaded pool with dirty water and in a small stream pool.

*213. **Uranotaenia geometrica*** Theobald, 1901. Type: Lectotype female, Cubatao (Sao Paulo), A. Lutz (BM; designation by Belkin, 1968:37). Bionomics: [Larvae in ground and rock pools with algae].

*214. **Uranotaenia mathesoni*** Lane, 1943. Type: Holotype male (1112) with genitalia on slide (895), Juquia (Sao Paulo), Nov 1938, J. Lane (FH,3554). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*215. **Uranotaenia noctivaga*** Neiva & Pinto, 1922 [= *nataliae*]. Type: Holotype female, Gavea, Rio de Janeiro (Guanabara) (LU; not found in IOC). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*216. **Uranotaenia argenteopennis*** Peryassu, 1923 [= *nataliae*]. Type: Syntype male(s) and female(s), [vicinity of Rio de Janeiro] (Guanabara) and Baixada Fluminense (Rio de Janeiro) (LU). Bionomics: Larvae in association with anophelines [in permanent and semipermanent ground waters].

217. ***Uranotaenia pallidoventer*** Theobald, 1903. Type: Holotype female, Para [Belem] (Para), H.E. Durham (BM). Bionomics: [Larvae in ground pools].

218. ***Orthopodomyia albicosta*** (Lutz, 1904). Type: LECTOTYPE by present designation, female (2663), marked S. Paulo; type locality, Serra da Cantareira (Sao Paulo), Lutz, 1905:69 (IOC; in box 14). Bionomics: Larvae in bamboo.

219.* ***Orthopodomyia longipalpis* (Newstead & Thomas, 1910) [=*fascipes*]. Type: Lectotype female, near Manaus (Amazonas), 23 Aug 1906 (BM; designation by Zavortink, 1968:75). Bionomics: [Larvae in treeholes].

220. ***Orthopodomyia townsendi*** Lima, 1935 [= *fascipes*]. Type: Holotype female, Rio Tapajos, Boa Vista (Para), 11 Oct 1932, C.H.T. Townsend (IOC,582). Bionomics: [Larvae in treeholes].

221. ***Orthopodomyia sampaioi*** Lima, 1935. Type: Lectotype male (1861) with genitalia in capillary tube, Tijuca, Rio de Janeiro (Guanabara), June 1934, P.C. Sampaio (IOC, tube 941; designation by Zavortink, 1968:82). Bionomics: [Larvae in treeholes].

222. ***Psorophora (P.) tibialis*** (Robineau-Desvoidy, 1827) [= *ciliata*]. Type: Male(s) Brazil, locality not specified; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE). Bionomics: [Larvae in rain pools].

223. ***Psorophora (P.) pilipes*** (Macquart, 1834) [?= *ciliata*]. Type: Female(s), locality not specified, Brazil; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE; see Belkin, 1968:28). Bionomics: [Probably as for *222. tibialis*].

224. ***Psorophora (P.) scintillans*** (Walker, 1848) [= *cilipes*]. Type: Lectotype male (45.56) with genitalia intact, Para [Belem] (Para) (BM; designation by Belkin, 1968: 29). Bionomics: [Larvae in rain pools].

225. ***Psorophora (P.) genumaculata*** Cruz, 1907 [= *lineata*]. Type: LECTOTYPE by present designation, male (2582) without head but genitalia intact, Santos (Sao Paulo), Oct 1906, T. Ribeiro Gomes (IOC; box 9). Bionomics: [Larvae in rain pools].

226. ***Psorophora (Janthinosoma) albigenu*** (Peryassu, 1908) [distinct from *varipes*]. Type: Holotype female (3523), Chanaan [Canaan] (Sao Paulo), M. Latif (IOC, tube 1367). Bionomics: [Larvae probably in rain pools in wooded areas].

227. ***Psorophora (J.) amazonica*** Cerqueira, 1960. Type: Holotype male (1443.60) with slide (2960) of larval and pupal skins (342), slide of genitalia (386) missing, Igarape do Taruma, Manaus (Amazonas), 16 June 1956, C. Elias (FH,15104). Bionomics: Larvae in a grassy pool at edge of forest.

228. ***Psorophora (J.) discrucians*** (Walker, 1856). Type: Syntypes male(s) and female(s), described from South America; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (BM; see Belkin, 1968:26). Bionomics: [Larvae probably in rain pools in wooded areas].

229. ***Psorophora (J.) arribalzagae*** (Giles, 1902) [?= *discrucians*]. Type: Holotype female, Sao Paulo (Sao Paulo), A. Lutz (BM; see Belkin, 1968:25). Bionomics: [As for *228. discrucians*].

230. ***Psorophora (J.) forceps*** Cerqueira, 1939. Type: Holotype male, Jacarepagua, Rio de Janeiro (Guanabara) (IOC). Bionomics: [Larvae probably in rain pools in wooded areas].

231. ***Psorophora (J.) lanei*** Shannon & Cerqueira, 1943. Type: Holotype female, Maracaju (Mato Grosso) (LU; not in IOC). Bionomics: [Larvae probably in rain pools in wooded areas].

232. ***Psorophora (J.) lutzii*** (Theobald, 1901). Type: Lectotype female, Parque do Museu [Quinta da Boa Vista], Rio de Janeiro (Guanabara), 5 Nov 1899, C. Moreira (BM; designation by Belkin, 1968:27). Bionomics: [Larvae in rain pools in wooded areas].

233. ***Psorophora (Grabhamia) apicalis*** (Theobald, 1903); ***neoapicalis*** (Theobald, 1910), new name [?= *cingulata*]. Type: Lectotype male, Rio de Janeiro (Guanabara), A. Lutz (BM; designation by Belkin, 1968:25). Bionomics: [Larvae in woodland pools, hoofprints and rarely in artificial containers].

234. ***Psorophora (G.) scutipunctata*** (Lutz & Neiva, 1911) [= *confinnis*]. Type: Syntypes [?], 1 or 2 females (tube 1060) and slide of wing (2347), without data; type locality [Rio] Tiete, immediately above Itapura (Sao Paulo), Jan 1909 (IOC; only 2 syntypes mentioned in original description but 3 in tube, 2 mounted on 1 pin). Bionomics: [Larvae probably in rain pools].

235. ***Psorophora perterrens*** (Walker, 1856) [*nomen dubium*]. Type: Holotype female, described from South America; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE; see Stone, 1957:337-338).

236. ***Aedes (Ochlerotatus) aenigmaticus*** Cerqueira & Costa, 1946. Type: Holotype male, Maracaju (Mato Grosso), Jan-Feb 1938, R.C. Shannon (LU; not in IOC). Bionomics: [Larvae probably in rain pools].

237. ***Aedes (O.) albifasciatus*** (Macquart, 1838). Type: Holotype female, Brazil, locality not specified, 1833, C. Gaudichaud; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (MNHP; see Belkin, 1968:4). Bionomics: [Larvae in temporary ground pools].

238. ***Aedes (O.) crinifer*** (Theobald, 1903). Type: Lectotype female, Sao Paulo (Sao Paulo), A. Lutz (BM; designation by Belkin, 1968:4). Bionomics: [Larvae in grassy rain pools and flooded grassy margins of creeks].

239. ***Aedes (O.) fulvus*** (Wiedemann, 1828). Type: Holotype female, Brazil, locality not specified, Freireiss; TYPE LOCALITY here restricted to Salvador (Bahia) (SNG). Bionomics: [Larvae in forest rain pools].

240. ***Aedes (O.) flavicosta*** (Walker, 1856) [= *fulvus*]. Type: Holotype female, Amazon region; TYPE LOCALITY here restricted to Manaus (Amazonas) (BM). Bionomics: [As for *239. fulvus*].

241. ***Aedes (O.) jacobinae*** Serafim & Davis, 1933. Type: Holotype male apparently lost, only genitalia slide remaining, Rio d'Ouro, in center of Jacobina (Bahia), elev. 450 m, Dec 1931, J. Serafim (USNM; see Stone and Knight, 1956a:220). Bionomics: Larvae in streamside rock pools.

242. ***Aedes (O.) lepidus*** Cerqueira & Paraense, 1945. Type: Holotype male, Belo Horizonte (Minas Gerais), Nov 1943 (LU; not in IOC). Bionomics: [Larvae in artificial containers and rockholes, Cerqueira, 1957].

243. ***Aedes (O.) pennai*** Antunes & Lane, 1938. Type: Holotype male (970) with genitalia on 3 slides (185,186,187), Cabreuva (Sao Paulo), Apr 1937, A.R.R. (FH, 810). Bionomics: Larvae in forest rain pools.

244. ***Aedes (O.) perventor*** Cerqueira & Costa, 1946, Type: Holotype male, Mangaratiba (Rio de Janeiro), Dec 1938, R.C. Shannon (LU; not in IOC). Bionomics: [Larvae in crabholes, material in FH].

245. ***Aedes (O.) rhyacophilus*** Lima, 1933. Type: Syntypes males, females with larval exuviae and pupae, Vale do Canaa (Espirito Santo), 1932, J. Serafim; TYPE LOCALITY here restricted to Sao Joao de Petropolis (LU; not in IOC). Bionomics: Larvae in rockholes.

246. ***Aedes (O.) scapularis*** (Rondani, 1848). Type: Female(s), Brazil, locality not specified; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (LU; see Belkin, 1968:7). Bionomics: [Larvae in grassy rain pools].

247. ***Aedes (O.) serratus*** (Theobald, 1901). Type: Lectotype male with attached genitalia mount, Parque do Museu [Quinta da Boa Vista], Rio de Janeiro (Guanabara), 5 Nov 1899, C. Moreira (BM; designation by Belkin, 1968:7). Bionomics: [Larvae in grassy rain pools].

248. ***Aedes (O.) mathisi*** (Neveu-Lemaire, 1902) [?= *serratus*]. Type: Syntypes 3 females, Cunani (Amapa) [as French Guiana], Jan 1901, Mathis (NE; see Belkin, 1968:6). Bionomics: [As for *247. serratus*].

249. ***Aedes (F.) braziliensis*** Gordon & Evans, 1922. Type: Holotype male (10.1/463), Macapa, near Manaus (Amazonas), 8 Dec 1921, R.M. Gordon (BM). Bionomics: Larvae in hollow tree stump.

250. ***Aedes (Finlaya) fluviatilis*** (Lutz, 1904). Type: LECTOTYPE by present designation, the female holotype of *tripunctatus* (Theobald, 1907), Rio Grande near Franca (Sao Paulo), 23 Sept 1903, A. Lutz (BM; see Belkin, 1968:5). Bionomics: [Larvae in stream bed rockholes].

251. ***Aedes (F.) mediomaculatus*** (Theobald, 1907) [?= *fluviatilis*]. Type: Lectotype male, Para [Belem] (Para), E.A. Goeldi (BM; designation by Belkin, 1968:6). Bionomics: [Probably as for *250. fluviatilis*].

252. ***Aedes (F.) tripunctatus*** (Theobald, 1907) [?= *fluviatilis*]. Type: Holotype female, Rio Grande near Franca (Sao Paulo), 23 Sept 1903, A. Lutz (BM; see Belkin, 1968:8). Bionomics: [Larvae probably as for *250. fluviatilis*].

253.* ***Aedes (F.) leucomelas* (Lutz, 1904); ***leucocelaenus*** Dyar & Shannon, 1924, new name. Type: LECTOTYPE by present designation, female marked by Theobald "Stegomyia silvestris Lutz Type", Franca (Sao Paulo), 23 Sept 1903 (BM; see Belkin, 1968:5-6). Bionomics: [Larvae in treeholes and bamboo internodes].

254. ***Aedes (F.) leucophoebus*** Galindo, Carpenter & Trapido, 1953. Type: Holotype male (1763.2) with slides of genitalia (2204) and associated larval and pupal skins (2205), Feijo (Acre), 4 Aug 1949 (FH,10377). Bionomics: [Larvae in treeholes].

255. ***Aedes (F.) terrens*** (Walker, 1856). Type: Holotype male with attached genitalia mount; described from South America, TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (BM). Bionomics: [Larvae in treeholes].

256.* ***Aedes (F.) oswaldi* (Lutz, 1904) [= *terrens*]. Type: LECTOTYPE by present designation, female marked by Theobald "Stegomyia cruzi Lutz Type"; locality label here reinterpreted as "[F. do] Bonito, S[erra] d[a] Bocaina [Sao Paulo]", type locality of a tabanid described by A. Lutz (see Fairchild, 1961:207); 22 May 1903 (BM; see Belkin, 1968:6). Bionomics: [Larvae in treeholes].

257. ***Aedes (Howardina) aureolineatus*** Berlin, 1969. Type: Holotype female, Piaja (Bahia), May 1931 (USNM). Bionomics: [Larvae probably in treeholes].

258. ***Aedes (H.) fulvithorax*** (Lutz, 1904). Type: Holotype female, Ponte Ipe-Arcado (Goias) (NE). Bionomics: [Larvae in treeholes and bamboo].

259. ***Aedes (Stegomyia) toxorhynchus*** (Macquart, 1838) [= *aegypti*]. Type: Holotype female (10), Brazil, locality not specified, C. Gaudichaud, 1833; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (MNHP;2602/33; see Belkin, 1968:8). Bionomics: [Larvae in artificial containers].

260. ***Aedes (S.) exagitans*** (Walker, 1856) [= *aegypti*]. Type: Holotype female (37), Para [Belem] (Para) (BM). Bionomics: [Larvae in artificial containers].

261. ***Haemagogus (Longipalpifer) tropicalis*** Cerqueira & Antunes, 1938. Type: Holotype male, Curralinho (Para), Jan-May 1936, H.W. Kumm and A. Rabello

(LU; not in IOC). Bionomics: Larvae in treeholes.

262. Haemagogus (Stegoconops) baresi Cerqueira, 1960. Type: Holotype male (1607.3) with pupal slide (316;2961) but genitalia slide (332) missing, Igarape do Taruma, Manaus (Amazonas), 6 Dec 1956, C. Elias (FH,15105). Bionomics: Larvae in treeholes in dark forest.

**263. Haemagogus (S.) capricornii* Lutz, 1904. Type: Neotype female reared from egg, Horto Florestal, Serra da Cantareira (Sao Paulo), Apr 1944 (LU, not in IOC or FH; designation by Cerqueira and Lane, 1945:286). Bionomics: [Larvae in treeholes].

264. Culex (Lutzia) brasiliae (Dyar, 1923) [= *bigoti*]. Type: Lectotype male with genitalia slide (1778), Sao Paulo (Sao Paulo), A. Lutz (USNM; designation by Stone and Knight, 1957a:44). Bionomics: [Larvae in permanent or semipermanent ground waters].

265. Culex (C.) abnormalis Lane, 1936. Type: Holotype male (289) with genitalia on slide (289;184a), Coronel Ponce (Mato Grosso), 17 July-27 Sept 1934 (FH,361). Bionomics: Larvae in turbid water next to a creek and in hoofprints with clean water, in full sun.

266. Culex (C.) acharistus Root, 1927. Type: Lectotype fragmentary male (64-1) with genitalia on slide, Agua Limpa, near Juiz de Fora (Minas Gerais), 27 Mar 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:42). Bionomics: Larvae in marshy expansions of mountain streams and in side pools of a small rapid river.

267. Culex (C.) airozai Lane, 1945. Type: Holotype male with attached genitalia mount, Rio Parauari (Amazonas), Mar 1937, C. Worontzow (FH,4297). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

268. Culex (C.) brami Forattini, Rabello & Lopes, 1967. Type: Holotype male (15844) with genitalia on slide (3109), Boraceia, municipio Salesopolis (Sao Paulo), Nov 1965, E.X. Rabello (FH). Bionomics: Pupae in peridomestic artificial containers.

269. Culex (C.) carcinoxenus Castro, 1932. Type: LECTOTYPE by present designation, male "cotype", with genitalia on slide (4186), Bertioga (Sao Paulo), July 1931, G.M. de Oliveira Castro (IOC; no material in IBSP where "typos" (presumably 1 male and 1 female) were originally deposited without designation of a holotype). Bionomics: Larvae in crabholes (*Cardisoma guanhumi*).

270. Culex (C.) corniger Theobald, 1903. Type: Lectotype male with attached genitalia mount, Para [Belem] (Para), E.A. Goeldi (BM; designation by Belkin, 1968:15). Bionomics: [Larvae in ground pools, stream bed rock pools, treeholes, bamboo, artificial containers and flower bracts].

271. Culex (C.) deanei Correa & Ramalho, 1959. Type: Holotype male (S.2-6) with genitalia and larval and pupal skins (SPM-62) on 1 slide (2576), Campo de Marte, Santana, Sao Paulo (Sao Paulo), R.R. Correa and G.R. Ramalho (FH, 13189). Bionomics: Larvae in ground pools.

272. Culex (C.) bilineatus Theobald, 1903 [?= *dolosus*]. Type: Lectotype male with attached genitalia mount; TYPE LOCALITY here restricted to Sao Paulo (Sao Paulo), A. Lutz (BM; designation by Belkin, 1968:13). Bionomics: [Larvae in permanent or semipermanent ground waters].

273. Culex (C.) foliaceus Lane, 1945. Type: Holotype male (5643) with genitalia on slide (1288), Ares, near Sao Jose de Mipibu (Rio Grande do Norte), Oct 1935 (FH,5926). Bionomics: [Larvae in crabholes, Stone, 1950:239].

274. Culex (C.) forattinii Correa & Ramalho, 1959. Type: Holotype male (197.6) with genitalia on slide (2575), Santa Cruz do Rio Pardo (Sao Paulo), Feb 1952 (FH,13188). Bionomics: Larvae in a cemetery vase.

275. ***Culex (C.) lygrus*** Root, 1927. Type: Lectotype male (115.2) with genitalia slide, Mage (Rio de Janeiro), 21 June 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:53). Bionomics: Larvae in small ditches and pools with abundant vegetation.

276. ***Culex (C.) mauesensis*** Lane, 1945. Type: Holotype male with attached genitalia mount, Maues (Amazonas), Feb 1937, C. Worontzow (FH,4885). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

277. ***Culex (C.) oswaldoi*** Forattini, 1965. Type: Holotype male (12) with genitalia on slide (RB62-290), Macaphyba, Natal (Rio Grande do Norte), 23 July 1943, MacCreary (USNM,67550). Bionomics: Larva in quarry hole.

278. ***Culex (C.) paramaxi*** Duret, 1968. Type: Holotype male (672), Engenheiro Dolabela (Minas Gerais), 6 May 1964 (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

279. ***Culex (C.) aestuans*** Wiedemann, 1828 [= *quinquefasciatus*]. Type: Lectotype male with genitalia slide, Brazil, locality not specified; TYPE LOCALITY here restricted to Salvador (Bahia) (NMW; designation by Stone, 1958:186). Bionomics: [Larvae in artificial containers and polluted ground waters].

280. ***Culex (C.) renatoi*** Lane & Ramalho, 1960. Type: Holotype male (1372-9) with genitalia and larval and pupal skins on slide (2423), Bairro Sao Miguel Paulista, Sao Paulo (Sao Paulo), 5 Jan 1956, F. Rosario (FH,12058). Bionomics: Larvae in terrestrial bromeliads.

281. ***Culex (C.) spinosus*** Lutz, 1905. Type: LECTOTYPE by present designation, male mounted on 2 slides, Brazil, Dr. Lutz; type locality Sao Paulo (Sao Paulo) (BM, see Belkin, 1968:20; no material of original series in IOC). Bionomics: Larvae in leaf axils of *Eriocaulon vaginatum* and *Eryngium alvofolium*.

282. ***Culex (C.) virgultus*** Theobald, 1901(*nomen dubium*). Type: Syntypes 2 males, Parque do Museu [Quinta da Boa Vista], Rio de Janeiro (Guanabara), 5 Nov 1899, C. Moreira (LU; see Belkin, 1968:21). Bionomics: [Larvae in permanent or semipermanent ground pools].

283. ***Culex (Melanoconion) gordoni*** Evans, 1924 [= *albinensis*]. Type: Holotype male (16.1/463) with attached wing mount and 3 genitalia slides, the Bosque, Manaus (Amazonas), 29 Dec 1921, R.M. Gordon (BM). Bionomics: Larvae in a ground pool.

284. ***Culex (Mel.) andricus*** Root, 1927. Type: Holotype male, near Lassance (Minas Gerais), 13 May 1925, F.M. Root (USNM). Bionomics: Larvae in small pond full of vegetation.

285. ***Culex (Mel.) aureonotatus*** Duret & Barreto, 1956. Type: Holotype male, Fazenda Monte Alegre, Ribeirao Preto (Sao Paulo), 27 Dec 1954, M.P. Barreto and J.P. Duret (FMRP). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

286. ***Culex (Mel.) bahiensis*** Duret, 1969. Type: Holotype male (2427), Urucuca (Bahia), Aug 1953, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

287. ***Culex (Mel.) innominatus*** Evans, 1924 [= *bastagarius*]. Type: Lectotype male (D3) with attached genitalia mount, River Amazon, to or from Manaus, 1915, A.A. Clark; TYPE LOCALITY here restricted to Itacoatiara (Amazonas) (BM; designation by Belkin, 1968:16). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

288. ***Culex (Mel.) bequaerti*** Dyar & Shannon, 1925. Type: Holotype male, Sororoca, Rio Branco (Roraima), 1 Sept 1924, J.C. Bequaert (USNM,27745). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

289. ***Culex (Mel.) bifoliolatus*** Duret & Barreto, 1956. Type: Holotype male, Fazenda Monte Alegre, Ribeirao Preto (Sao Paulo), 2 June 1953, M.P. Barreto and J.P. Duret (FMRP). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

290. ***Culex (Mel.) mojuensis*** Duret & Damasceno, 1955 [= *breviculus*]. Type: Holotype male (Br49,E4), Oriboca, Rio Guajara (Para), 23 Aug 1953, R.G. Damasceno and J.P. Duret (Duret). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

291. ***Culex (Mel.) chrysothorax*** (Peryassu, 1908). Type: LECTOTYPE by present designation, male with genitalia slide (2331), Copacabana, Rio de Janeiro (Guanabara), Oct 1907 (IOC,2033). Bionomics: Larvae probably in ground pools only and not found in bromeliads also as stated by Peryassu.

292. ***Culex (Mel.) contei*** Duret, 1968. Type: Holotype male (2226), Sao Miguel do Guama (Para), 9 July 1963, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

293. ***Culex (Mel.) cristovai*** Duret, 1968. Type: Holotype male (1883), Caracarai (Roraima), 7 July 1964 (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

294. ***Culex (Mel.) exedrus*** Root, 1927 [= *dunni*]. Type: Lectotype male (30.1), head missing, Porto das Caixas (Rio de Janeiro), 24 Feb 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:49). Bionomics: Larvae in dense aquatic vegetation in rivers, lagoons and ponds.

295. ***Culex (Mel.) dyius*** Root, 1927. Type: Holotype male genitalia only, adult lost, probably coastal lowlands (Rio de Janeiro), May or June 1925, F.M. Root (USNM). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

296. ***Culex (Mel.) manaosensis*** Evans, 1924 [= *eastor*]. Type: Holotype male, wharf, Manaus (Amazonas), 5 Dec 1923, A.A. Clark (BM). Bionomics: [Larvae probably in swamps].

297. ***Culex (Mel.) ernanii*** Duret, 1968. Type: Holotype male (1730), Boa Vista (Roraima), 4 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

298. ***Culex (Mel.) evansae*** Root, 1927. Type: Lectotype male (34) with genitalia slide (34a), Mage (Rio de Janeiro), 26 Feb 1925, N.C. Davis (USNM; designation by Stone and Knight, 1957a:49). Bionomics: Larvae in small "jungle" pools.

299. ***Culex (Mel.) fasciolatus*** (Lutz, 1904). Type: Syntypes 2 females (Lutz, 1905), wooded mountains near Sao Paulo (Sao Paulo) (possibly in Lutz collection in IOC). Bionomics: Larvae in swamps.

300. ***Culex (Mel.) faurani*** Duret, 1968. Type: Holotype male (1940), near Manaus (Amazonas), 28 June 1963, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

301. ***Culex (Mel.) flochi*** Duret, 1969 [probably not *Melanoconion*]. Type: Holotype male (2283), Rio Moju, Belem (Para), 21 Aug 1953, J.P. Duret and R.G. Damasceno (A). Bionomics: [Larvae probably in bromeliads].

302. ***Culex (Mel.) humilis*** Theobald, 1901. Type: Lectotype male, genitalia apparently lost, Sao Paulo (Sao Paulo), A. Lutz (BM; designation by Belkin, 1968:16). Bionomics: [Larvae in stream bed pools].

*303. **Culex (Mel.) inadmirabilis*** Dyar, 1928. Type: Holotype male, Sao Paulo (Sao Paulo), A. Lutz (USNM,40776). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*304. **Culex (Mel.) indecorabilis*** (Theobald, 1903). Type: Lectotype female, Para [Belem] (Para), H.E. Durham (BM; designation by Belkin, 1968:16). Bionomics: Larvae probably in permanent or semipermanent ground waters].

*305. **Culex (Mel.) cenus*** Root, 1927 [= *intrincatus*]. Type: Lectotype male (115-1) with genitalia slide, Mage (Rio de Janeiro), 21 June 1925 (USNM,40527; designation by Stone and Knight, 1957a:45). Bionomics: Larvae in woodland pools, roadside ditch and side eddies of a river.

*306. **Culex (Mel.) isabelae*** Duret, 1968. Type: Holotype male (1925), Caracarai (Roraima), 3 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*307. **Culex (Mel.) johnnyi*** Duret, 1968. Type: Holotype male (723), Rio Preto, municipio Joao Goulard (Amazonas), 18 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*308. **Culex (Mel.) kerri*** Duret, 1968. Type: Holotype male (1858), Rio Preto, municipio Joao Goulard (Amazonas), 17 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*309. **Culex (Mel.) lugens*** Lutz, 1905. Type: Syntypes male(s) and female(s), 1 of each remaining in collection (2610), Lagoa (Sao Paulo), 3 Feb 1904, A. Lutz (IOC; in box 6). Bionomics: Larvae in swamps.

*310. **Culex (Mel.) nigrescens*** (Theobald, 1907). Type: Holotype male, Santo Amaro, Sao Paulo (Sao Paulo), 1 Nov 1900, A. Lutz (BM). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*311. **Culex (Mel.) clarki*** Evans, 1924 [= *nigrescens*]. Type: Lectotype male (C4) with attached wing mount and genitalia slide, River Amazon (Amazonas), 1915, A.A. Clark; TYPE LOCALITY here restricted to Manaus (Amazonas) (BM; designation by Belkin, 1968:14). Bionomics: [As for *310. nigrescens*].

*312. **Culex (Mel.) nigricorpus*** (Theobald, 1901). Type: Lectotype female, Itacoatiara (Amazonas), 7 Feb 1896, E.E. Austen (BM; designation by Belkin, 1968:18). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

*313. **Culex (Mel.) nigrimacula*** Lane & Whitman, 1943 [probably not *Melanoconion*]. Type: Holotype male, vicinity of Rio de Janeiro (Guanabara), Sept 1940, L. Whitman (LU). Bionomics: Larvae in broad-leaved bromeliads.

*314. **Culex (Mel.) ocellatus*** Theobald, 1903 [probably not *Melanoconion*]. Type: Holotype male, Sao Paulo (Sao Paulo), A. Lutz (BM; see Belkin, 1968:18). Bionomics: Larvae in bromeliads.

*315. **Culex (Mel.) automartus*** Root, 1927 [= *ocellatus*]. Type: Holotype male, Botanical Garden, Rio de Janeiro (Guanabara), 24 May 1925, F.M. Root (USNM). Bionomics: Pupa in bromeliad.

*316. **Culex (Mel.) oedipus*** Root, 1927. Type: Lectotype male (8-1) with genitalia slide, Mage (Rio de Janeiro), 4 Feb 1925, F.M. Root (USNM; designation by Rozeboom and Komp, 1950:94). Bionomics: Larvae in "jungle" pools.

*317. **Culex (Mel.) plectoporpe*** Root, 1927 [= *phlogistus*]. Type: Lectotype male (109-1), Bangu, Rio de Janeiro (Guanabara), 11 June 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:55). Bionomics: Larvae in ditch in small pools full of grass and water weeds.

*318. **Culex (Mel.) putumayensis*** Matheson, 1934. Type: Holotype male with genitalia slide, Amazon River, 7 Aug 1920, J.C. Bradley; TYPE LOCALITY here restricted to Santo Antonio do Ica (Amazonas) (USNM,50353). Bionomics: [Larvae in permanent or semipermanent ground waters].

319. ***Culex (Mel.) rachoui*** Duret, 1968. Type: Holotype male (2258), Paragominas, municipio Capim (Para), 24 June 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

320. ***Culex (Mel.) serratimarge*** Root, 1927. Type: Holotype male, Sant'Anna (Rio de Janeiro), 27 Apr 1925 (USNM). Bionomics: Larvae in a "jungle" pool.

321. ***Culex (Mel.) silvai*** Duret, 1968. Type: Holotype male (85), Caracarai (Roraima), 6 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

322. ***Culex (Mel.) theobaldi*** (Lutz, 1904). Type: LECTOTYPE by present designation, female (next to large pin) on mount with another female, Lagoa (Sao Paulo), 6 Mar 1904, A. Lutz (BM; see Belkin, 1968:20-21). Bionomics: [Larvae in shaded roadside borrow pit].

323. ***Culex (Mel.) chrysothorax*** (Newstead & Thomas, 1910) [= *theobaldi*]. Type: Lectotype female (160), inner Flores swamp, Pensador, near Manaus (Amazonas), 12 July 1906 (BM; designation by Belkin, 1968:14). Bionomics: [As for *322. theobaldi*].

324. ***Culex (Mel.) thomasi*** Evans, 1924. Type: Holotype male (8.1) with attached wing mount and 4 slides of genitalia, Manaus (Amazonas), 1910, H.W. Thomas (BM). Bionomics: Larvae in swamp water from "Amatory" [?].

325. ***Culex (Mel.) trilobulatus*** Duret & Barreto, 1956. Type: Holotype male, Rio Tamandua, Ribeirao Preto (Sao Paulo), Nov 1954, M.P. Barreto and J.P. Duret (FMRP). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

326. ***Culex (Mochlostyrax) megapus*** Root, 1927 [= *alogistus*]. Type: Holotype male destroyed, only genitalia slide remaining, mountains near Angra dos Reis (Rio de Janeiro), Jan 1925, N.C. Davis (USNM). Bionomics: Larva in "jungle" pool.

327. ***Culex (Mochl.) galvaoi*** Duret, 1968. Type: Holotype male (2414), Chere (Rio de Janeiro), 15 July 1953, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

328. ***Culex (Mochl.) innovator*** Evans, 1924. Type: Lectotype male (D4) with attached wing mount and 4 genitalia slides, River Amazon, to or from Manaus, 1915, A.A. Clark; TYPE LOCALITY here restricted to Itacoatiara (Amazonas) (BM; designation by Belkin, 1968:16). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

329. ***Culex (Mochl.) palaciosi*** Duret, 1968. Type: Holotype male (1817), Boa Vista (Roraima), 8-9 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

330. ***Culex (Microculex) albipes*** Lutz, 1904. Type: Holotype female, [Ilha de] Itaparica (Bahia) (NE; no specimens in IOC or BM). Bionomics: Larva in bromeliads.

331. ***Culex (Micr.) aphylactus*** Root, 1927. Type: Lectotype male (79) with only genitalia slide remaining, Serra dos Orgaos, woods near Rio Soberbo at crossing of railroad from Mage to Teresopolis (Rio de Janeiro), 1 May 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:43). Bionomics: Larvae in bromeliads.

332. ***Culex (Micr.) aureus*** Lane & Whitman, 1951. Type: Holotype male, Rio de Janeiro (Guanabara), Aug 1940, L. Whitman (LU). Bionomics: Larvae in fallen epiphytic tank bromeliad.

333. ***Culex (Micr.) carioca*** Lane & Whitman, 1951. Type: Holotype male, Rio de Janeiro (Guanabara), Sept 1940, L. Whitman (LU). Bionomics: Larvae in tank bromeliad.

334. ***Culex (Micr.) trychnus*** Root, 1927 [= *consolator*]. Type: Lectotype male (79-2) with genitalia on slide, Serra dos Orgaos, woods near Rio Soberbo at crossing of railroad between Mage and Teresopolis (Rio de Janeiro), 1 May 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:57). Bionomics: Larvae in bromeliads.

335. ***Culex (Micr.) davisi*** Kumm, 1933. Type: Males, females, larvae, Salvador (Bahia), 1931 (LU). Bionomics: Larvae in bromeliads.

336. ***Culex (Micr.) dubitans*** Lane & Whitman, 1951. Type: Holotype male, Rio de Janeiro (Guanabara), Oct or Dec 1940, L. Whitman (LU). Bionomics: Larvae in tank bromeliad.

337. ***Culex (Micr.) gairus*** Root, 1927. Type: Lectotype male (22c) with slides of male genitalia and associated larval and pupal skins, Botanical Garden, Rio de Janeiro (Guanabara), 15 Feb 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:50). Bionomics: Larvae in bromeliads.

338. ***Culex (Micr.) hedys*** Root, 1927. Type: Holotype male, destroyed except for genitalia slide, Angra dos Reis (Rio de Janeiro), Jan 1925, N.C. Davis (USNM). Bionomics: Larvae in bromeliads.

339. ***Culex (Micr.) imitator*** Theobald, 1903. Type: Holotype male with attached genitalia mount, Sao Paulo (Sao Paulo), A. Lutz (BM). Bionomics: Larvae in bromeliads.

340.* ***Culex (Micr.) argenteoumbrosus* (Theobald, 1907) [= *imitator*]. Type: Lectotype male with genitalia slide, Rio de Janeiro (Guanabara), Apr 1903, E.A. Goeldi (BM; designation by Belkin, 1968:13). Bionomics: [Probably as for *339. imitator*].

341. ***Culex (Micr.) retrosus*** Lane & Whitman, 1951 [= ssp. of *imitator*]. Type: Holotype male, Rio de Janeiro (Guanabara), Sept 1939 or Oct 1940, L. Whitman (LU). Bionomics: Larvae in terrestrial tank bromeliads.

342. ***Culex (Micr.) fuscatus*** Lane & Whitman, 1951 [= ssp. of *inimitabilis*]. Type: Holotype male, Rio de Janeiro (Guanabara), Oct 1940, L. Whitman (LU). Bionomics: Larvae in epiphytic tank bromeliad.

343. ***Culex (Micr.) intermedius*** Lane & Whitman, 1951. Type: Holotype male, Rio de Janeiro (Guanabara), Nov 1940, L. Whitman (LU). Bionomics: Larvae in tank bromeliads.

344. ***Culex (Micr.) lanei*** Coutinho & Forattini, 1962. Type: Holotype male (1B(6)7), with attached genitalia mount and slide of larval and pupal skins (2941, marked cotype), Bertioga, municipio Santos (Sao Paulo), Aug 1961, O.P. Forattini (FH,15062). Bionomics: Larvae in artificial containers placed in a forest.

345. ***Culex (Micr.) microphyllus*** Root, 1927. Type: Lectotype male (92-1) with genitalia on slide, Mage (Rio de Janeiro), 26 May 1925, F.M. Root (USNM; designation by Stone and Knight, 1957a:53). Bionomics: Larvae in bromeliads.

346. ***Culex (Micr.) neglectus*** Lutz, 1904. Type: Lectotype male with genitalia on slide (783;108-34), Serra da Cantareira (Sao Paulo), 12-II-04, A. Lutz (USNM; designation by Lane *in* Lane and Whitman, 1951:364). Bionomics: Larvae in bamboo.

347. ***Culex (Micr.) pleuristriatus*** Theobald, 1903. Type: Lectotype female, Sao Paulo (Sao Paulo), A. Lutz (BM; designation by Belkin, 1968:19). Bionomics: [Larvae in terrestrial tank bromeliads].

348. ***Culex (Micr.) reducens*** Lane & Whitman, 1951. Type: Holotype male, Rio de Janeiro (Guanabara), Sept 1940, L. Whitman (LU). Bionomics: [Larvae probably in bromeliads].

*349. **Culex (Micr.) shopei*** Forattini & Toda, 1966. Type: Holotype male (46U12) with slides of male genitalia (3107) and larval and pupal skins (3107), Utinga, Belem (Para), 4 Mar 1965, A. Toda (FH,15841 and 15842). Bionomics: Larvae in bromeliads.

*350. **Culex (Micr.) worontzowi*** Pessoa & Galvao, 1936. Type: Holotype male (1,Nt5), Tabatinguera (Sao Paulo), C. Worontzow (FMSP). Bionomics: Larvae in bromeliads.

*351. **Culex (Aedinus) accelerans*** Root, 1927. Type: Holotype male, Porto das Caixas (Rio de Janeiro), 15 Apr 1925, F.M. Root (USNM). Bionomics: Larvae in dense vegetation in lagoon connected to river.

352. **Culex (Aed.) amazonensis* (Lutz, 1905). Type: Syntypes males and females, Amazon River below Manaus (Amazonas), Lindenberg (LU; not in IOC). Bionomics: [Larvae in swamps, margins of lakes and permanent pools].

*353. **Culex (Aed.) hildebrandi*** Evans, 1923 [= *amazonensis*]. Type: Holotype male (1/467) with slide of wing and 2 slides of genitalia, River Amazon on S.S. "Hildebrand" on way to Manaus, 1922, A.A. Clark; TYPE LOCALITY here restricted to Itacoatiara (Amazonas) (BM). Bionomics: [Probably as for *352. amazonensis*].

*354. **Culex americanus*** (Neveu-Lemaire, 1902) [*nomen dubium*; possibly = *amazonensis*]. Type: Syntypes 4 females, Cunani (Amapa) [as French Guiana], Jan 1901, Mathis (NE; see Belkin, 1968:12-13). Bionomics: [Probably as for *352. amazonensis*].

*355. **Culex (Aed.) clastrieri*** Casal & Garcia, 1968. Type: Holotype male, Belem (Para), 29 Nov 1959, Eber and Evangelista (Casal). Bionomics: [Larvae probably in swamps].

*356. **Culex (Anoedioporpa) belemensis*** Duret & Damasceno, 1955. Type: Holotype male (Br15,E10), Belem (Para), 19 Aug 1953, R.G. Damasceno and J.P. Duret (Duret). Bionomics: [Larvae probably in treeholes].

*357. **Culex (Anoed.) canaanensis*** Lane & Whitman, 1943. Type: Holotype male, Sao Joao de Petropolis, Vale do Canaa (Espirito Santo), Apr or July, 1940, L. Whitman (LU). Bionomics: [Larvae probably in treeholes].

*358. **Culex (Anoed.) damascenoi*** Duret, 1969. Type: Holotype male (2275), Rio Preto, municipio Joao Goulard (Amazonas), 18 July 1964, J.P. Duret (A). Bionomics: [Larvae probably in treeholes].

*359. **Culex (Anoed.) luteopleurus*** (Theobald, 1903). Type: Holotype female, [Belem] (Para), H.E. Durham (BM). Bionomics: [Larvae probably in treeholes].

*360. **Culex (Anoed.) originator*** Gordon & Evans, 1922. Type: Lectotype male (13.2/463) with genitalia on 2 slides, 0.5 mi in forest, Macapa, near Manaus (Amazonas), 21 Dec 1921, R.M. Gordon (BM; designation by Belkin, 1968:18). Bionomics: Larvae in treehole, "Carapana uba".

*361. **Culex (Carrollia) anduzei*** Cerqueira & Lane, 1944. Type: Holotype male, Rio Maues (Amazonas), Feb 1937, C. Worontzow (FH,4099). Bionomics: [Larvae probably in treeholes, bamboo or plant material on ground].

*362. **Culex (Car.) antunesi*** Lane & Whitman, 1943. Type: Holotype male, Sao Joao de Petropolis, Vale do Canaa (Espirito Santo), Apr or May 1940, L. Whitman (LU). Bionomics: Larvae in bamboo internodes.

363. **Culex (Car.) iridescens* (Lutz, 1905). Type: Neotype male with genitalia on slide (222), Serra da Cantareira (Sao Paulo), Apr 1938, M. Sanches, E. Coimbra and H. Guimaraes (FH,953; contrary to interpretation of Belkin, 1968:16, the neotype designation of Antunes and Ramos, 1939:380-381 is probably correct as the Lutz material in IOC may not be part of type series). Bionomics: Larvae in bamboo.

364. ***Culex (Car.) soperi*** Antunes & Lane, 1937. Type: Holotype male (886), genitalia on 2 slides (99,100), Perus (Sao Paulo), 23 Apr 1937 (FH,721). Bionomics: [Larvae in bamboo internodes].

365. ***Culex (Car.) wilsoni*** Lane & Whitman, 1943. Type: Holotype male, Sao Joao de Petropolis, Vale do Canaa (Espirito Santo), Apr 1940, L. Whitman (LU). Bionomics: Larvae in bamboo internodes.

366. ***Culex pallipes*** Robineau-Desvoidy, 1827 [*nomen dubium*]. Type: Female(s), Brazil, locality not specified; TYPE LOCALITY here restricted to vicinity of Rio de Janeiro (Guanabara) (NE; see Belkin, 1968:19).

367. ***Culex molestus*** Kollar, 1832 [*nomen dubium*]. Type: Male(s) and female(s), Rio de Janeiro (Guanabara) (NE).

368. ***Corethrella confusa*** Lane, 1939 [?= *appendiculata*]. Type: Holotype male (1080) with genitalia on slide (279), Inhumas (Goias), 19 Apr 1935, J. Paternostro (FH). Bionomics: Pupa in treehole.

369. ***Corethrella bromelicola*** Lane, 1939. Type: Holotype female (874) with pupal skin on point and part of larval skin on slide (203), Poco Grande, Juquia (Sao Paulo), Nov 1938, J. Lane (FH). Bionomics: Larva in epiphytic bromeliad.

370. ***Corethrella cardosoi*** Lane, 1942. Type: Holotype male (3297) with attached genitalia mount, Casa Grande (Sao Paulo), Dec 1940 (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

371. ***Corethrella edwardsi*** Lane, 1942. Type: Holotype female (3334), locality not specified (Mato Grosso), July 1939; TYPE LOCALITY here restricted to Salobra (FH,1206). Bionomics: [Larvae probably in ground waters or bromeliads].

372. ***Corethrella flavitibia*** Lane, 1939. Type: Holotype female (1137), Juquia (Sao Paulo), Jan 1939, J. Lane (FH,1067). Bionomics: [Larvae in bromeliads].

373. ***Corethrella fulva*** Lane, 1939. Type: Holotype male (868) with attached genitalia mount, Agua Fria, Perus (Sao Paulo), June 1937, Ramalho and Vieira (FH). Bionomics: Larvae in epiphytic bromeliads.

374. ***Corethrella infuscata*** Lane, 1939. Type: Holotype female (1153), Juquia (Sao Paulo), 20 Jan 1939, J. Lane (FH,1028). Bionomics: [Larvae in bromeliads].

375. ***Corethrella kummi*** Lane, 1942. Type: Holotype female, locality not specified (Bahia), 1931, H.W. Kumm; TYPE LOCALITY restricted to vicinity of Salvador (BM). Bionomics: [Larvae probably in ground waters or bromeliads].

376. ***Corethrella lopesi*** Lane, 1942. Type: Holotype male (3282), Japuiba, Angra dos Reis (Rio de Janeiro), Mar 1940, H. Sousa Lopes and J. Lane (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

377. ***Corethrella pillosa*** Lane, 1939. Type: Holotype male (872) with genitalia on slide (202), Poco Grande, Juquia (Sao Paulo), 12 Dec 1938 (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

378. ***Corethrella selvicola*** Lane, 1939. Type: Holotype male (1146), Juquia (Sao Paulo), 16-20 Jan 1939, J. Lane (FH,1030). Bionomics: [Larvae in running water and epiphytic bromeliads, Lane and Cerqueira, 1958b:562].

379. ***Corethrella striata*** Lane, 1942. Type: Holotype female (3314), Palmeira (Sao Paulo), Mar 1941, J.O. Coutinho (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

380. ***Corethrella tarsata*** Lane, 1942. Type: Holotype male with attached genitalia mount, Camacari (Bahia), 1931, H.W. Kumm (BM). Bionomics: [Larvae probably in bromeliads].

381. ***Corethrella travassosi*** Lane, 1942. Type: Holotype female (1206), Salobra (Mato Grosso), July 1939 (FH,3266). Bionomics: [Larvae probably in bromeliads or ground waters].

382. ***Corethrella vittata*** Lane, 1939. Type: Holotype male (1042) with genitalia slide (268), Juquia (Sao Paulo), 16-19 Jan 1939, J. Lane (FH). Bionomics: [Larvae probably in bromeliads].

383. ***Corethrella whitmani*** Lane, 1942. Type: Holotype female (3311), locality not specified (Espirito Santo), Aug 1940, L. Whitman; TYPE LOCALITY here restricted to Sao Joao de Petropolis (FH). Bionomics: [Larvae in bromeliads].

384. ***Lutzomiops alticola*** (Lane, 1939). Type: Holotype male (378-M-18) with genitalia slide (208), Campos do Jordao (Sao Paulo), elev. 1700 m, 13 Jan 1936, F. Lane (FH,881). Bionomics: [Larvae probably in bromeliads].

385. ***Lutzomiops amazonicus*** (Lane, 1939). Type: Holotype female, Porto Velho, Rio Madeira (Rondonia, as Amazonas), Mar-Apr 1931, R.C. Shannon (USNM). Bionomics: [Larvae probably in bromeliads or ground waters].

386. ***Lutzomiops barrettoi*** (Lane, 1942). Type: Holotype male (461), Casa Grande (Sao Paulo), Sept 1940, M.P. Barretto (FH,3367). Bionomics: [Larvae probably in bromeliads or ground waters].

387. ***Lutzomiops coutinhoi*** (Lane, 1942). Type: Holotype male (3365) with attached genitalia mount, Palmeira (Sao Paulo), Mar 1941, J.O. Coutinho (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

388. ***Lutzomiops niger*** (Lane, 1939) [= *davisi*]. Type: Holotype male (875), only 1 leg left on pin, genitalia (204) on slide together with those of paratype (877), Maracaju (Mato Grosso), May 1937, R.C. Shannon (FH). Bionomics: [Larvae in ground waters].

389. ***Lutzomiops iridescens*** (Lane, 1939). Type: Holotype female (1148), Juquia (Sao Paulo), 19 Jan 1939, J. Lane (FH,1046). Bionomics: [Larvae in running water, Lane and Cerqueira, 1958b:565].

390. ***Lutzomiops juquianus*** (Lane, 1939). Type: Holotype female (873), Poco Grande, Juquia (Sao Paulo), 14 Dec 1938, J. Lane (FH). Bionomics: [Larvae in ground pools].

391. ***Lutzomiops lutzi*** (Lane, 1942). Type: Holotype female (3362), Jaragua (Sao Paulo), Sept 1940, M.P. Barretto (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

392. ***Lutzomiops manaosensis*** Lane & Cerqueira, 1958. Type: Holotype male (406-13) with associated larval and pupal skins on slide, genitalia not located, near Manaus (Amazonas), N.L. Cerqueira (FH,13193). Bionomics: Larvae in swamps and running water.

393. ***Lutzomiops nigrescens*** (Lane, 1942). Type: Holotype female (3363), Mage (Rio de Janeiro), 18 Mar 1940, R.C. Shannon (FH). Bionomics: [Larvae probably in bromeliads or ground waters].

394. ***Sayomyia braziliensis*** (Theobald, 1901). Type: Holotype female, represented by slide of 1 wing and 1 leg, Brazil, locality not specified, A. Lutz; TYPE LOCALITY here restricted to Sao Paulo (Sao Paulo) (BM). Bionomics: [Larvae probably in ponds, lakes or reservoirs].

395. ***Sayomyia antunesi*** (Lane, 1939) [= *braziliensis*]. Type: Holotype male (1150), Juquia (Sao Paulo), Jan 1939, J. Lane (FH,1027). Bionomics: [As for *394. braziliensis*].

396. ***Sayomyia souzai*** (Lane, 1939). Type: Holotype male (1083) with genitalia slide (221), Santarem (Para), June 1931, R.C. Shannon (FH). Bionomics: [Larvae in shallow forest ground pools].

397. ***Edwardsops brevisector*** (Edwards, 1931). Type: Holotype female, "on board S.S. Jerome", Manaus (Amazonas), 24-27 April 1901 (BM). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

398. ***Edwardsops magnificus*** (Lane, 1942). Type: Holotype female (3223), Salobra (Mato Grosso), 31 Jan 1941, F. Lane (FH). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

399.* ***Edwardsops unicolor* (Lane, 1942). Type: Holotype male (1216) with genitalia mount, Salobra, bank of Rio Miranda (Mato Grosso), July 1939 (FH,3203). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

400. ***Dixella chapadensis*** (Lane, 1939). Type: Holotype male (845) with genitalia on slide with another specimen, Portinha, Chapada region (Mato Grosso), 27 Aug, J. Lane (FH). Bionomics: [Larvae probably in permanent or semipermanent ground waters].

401. ***Dixella limai*** (Santos, 1940). Type: Adult(s), larvae, pupae, Uberaba (Minas Gerais) (Univ. Minas Gerais). Bionomics: Larvae in small streams.

402. ***Dixella paulistana*** (Lane, Forattini & Rabello, 1955). Type: Holotype male (8094) with larval and pupal skins on slide, Campo Experimental da Agua Funda, Sao Paulo (Sao Paulo), 5 Nov 1954, E.X. Rabello (FH). Bionomics: Larvae in a rather shallow, sunlit pond with turbid water; in muddy margins with sparse emergent vegetation.

403. ***Dixella torrentia*** (Lane, 1939). Type: Holotype male (847), genitalia intact, Salto do Poco Grande, Juquia (Sao Paulo), 13 Dec 1938, J. Lane (FH). Bionomics: [Larvae probably in stream margins].

404. ***Dixella wygodzinskyi*** (Lane, 1945). Type: LECTOTYPE by present designation, female (5653), marked as holotype by Lane but not so indicated in original publication, Vila Capivari, Campos do Jordao (Sao Paulo), elev. 1700 m, Apr 1935, P. Wygodzinsky (FH). Bionomics: Larvae in epiphytic bromeliads in *Araucaria* forest.

AUTHORS

Amaral, A.D. Franco. See **Galvao** for the 2 species described by Galvao and Amaral.

Antunes, P.C.A. The only Brazilian species described by Antunes were: 2 as senior author with **Lane**, *243. Aedes (O.) pennai* and *364. Culex (Car.) soperi*, whose types are in FH; 1 with **Lane** as senior author, *200. Coquillettidia (R.) shannoni*, whose holotype is also in FH; and 1 with **Cerqueira** as senior author, *261. Haemagogus (L.) tropicalis*, whose location is unknown (LU).

Barretto (also Barreto), M. Pereira. Of the 3 species described by Barretto with **Coutinho** as junior author, all with designated holotypes, we have found only *205. Mansonia (M.) pessoai*, whose holotype is in FH (see section on depositories). The location of the holotypes of the other 2 species: *202. Mansonia (M.) cerqueirai* and *208. Mansonia (M.) wilsoni*, is unknown (LU).

See also **Duret** for 3 species described by Duret and Barretto, and **Galvao** for 1 species described by Ayroza Galvao and Barretto.

Berlin, Olavil George William. The holotype of the only Brazilian species described by Berlin is in USNM: *257. Aedes (H.) aureolineatus.*

Bonne-Wepster, Jean and Cornelis Bonne. The holotype of *158. Phoniomyia tripartita*, the only Brazilian species described by these authors, is non-existent (NE). It is represented by fig. 2 in Dyar (1919); see Belkin, 1968:24.

Bourroul, Celestino. The type material of the only species described by Bourroul is non-existent (NE): *77. Toxorhynchites (L) mariae*. See Belkin (1968:51) for other names attributed to Bourroul in the past.

Carpenter, Stanley J. See **Galindo** for the 1 species from Brazil described by Galindo, Carpenter and Trapido.

Casal, Osvaldo H. The holotype of *355. Culex (Aed.) clastrieri* described by Casal with **Garcia** as junior author is in the private collection of Casal and will presumably be eventually deposited in BA.

Castro, Gustavo M. de Oliveira. We have designated a lectotype, in IOC, for 1 of the 2 species described by Castro: *269. Culex (C.) carcinoxenus*. The location of the holotype of *162. Limatus flavisetosus* is unknown (LU), we did not find it in IOC where it was supposedly deposited.

Causey, Ottis R. The holotype of the 1 Brazilian species described by Causey as sole author is in USNM: *57. Anopheles (N.) dunhami*. Of the 2 species described by **Causey, Deane and Deane**, we have designated a lectotype, in FMP, for: *48. Anopheles (N.) galvaoi*. No material of the other species, based on eggs, *5. Chagasia rozeboomi*, has been located and it is safe to consider that its type is non-existent (NE). We have restricted the type locality of this species to the vicinity of Sao Benedito, the locality in the state of Ceara where other Causey material was collected. The fourth species: *38. Anopheles (N.) sawyeri*, was described by **Causey** with **Deane**, **Deane** and **Sampaio** as junior authors; its holotype is in USNM.

Cerqueira, Nelson L. The holotypes of all 8 Brazilian species described by Cerqueira as sole author are in existence: 1 in IOC, *230. Psorophora (J.) forceps*; and 7 in FH: *173. Sabethes (S.) forattinii; 174. Sabethes (S.) lanei; 179. Sabethes (S.) shannoni; 180. Sabethes (S.) spixi, 183. Sabethes (Sabethoides) tridentatus; 227. Psorophora (J.) amazonica; 262. Haemagogus (S.) baresi.*

The location of the holotype of *261. Haemagogus (L.) tropicalis*, described by **Cerqueira** with **Antunes** as junior author, is unknown (LU); it was not found in IOC or FH.

The location of the holotypes of *236. Aedes (O.) aenigmaticus* and *244. Aedes (O.) perventor*, described by **Cerqueira** with **Costa** as junior author, is unknown (LU); they were not found in IOC or FH.

The holotype of *361. Culex (Car.) anduzei*, described by **Cerqueira** with **Lane** as junior author, is in FH.

The location of the holotype of *242. Aedes (O.) lepidus*, described by **Cerqueira** and **Paraense**, is unknown (LU); it was not found in IOC or FH.

Cerqueira was also the junior author of 1 species with **Correa** (see), 4 species with **Del Ponte** (see), 34 species with **Lane** (see) and 1 species with **Shannon** (see).

Cerqueira's list of Amazonian species (1961) is the most useful source of information on the bionomics and distribution of Brazilian mosquitoes.

Chagas, Carlos. We have designated lectotypes for 2 of the 4 species described by Chagas, both in IOC: *39. Anopheles (N.) braziliensis* (type locality restricted to vicinity of Lassance on the basis of the statement in Root, 1926:704); *196. Coquillettidia (R.) juxtamansonia*. Type material of *61. Anopheles (N.) parvus* may also be in IOC but since the only specimen remaining in the collection bears no data we hesitate to designate it as lectotype; the type locality is stated to be Oliveira (Minas Gerais) by Galvao, 1941:537 and is one of the localities mentioned for this species by Peryassu (1908:60). We have not been able to locate (LU) any original material of *53. Anopheles (N.) nigritarsis* whose type locality we have determined to be Oliveira also on the basis of the citation of this locality in Peryassu (1908:60).

Christophers, S. Rickard. The holotype of the only Brazilian species described by Christophers, *16. Anopheles (A.) amazonicus*, is in BM. We have restricted its original indefinite type locality (River Amazon) to Manaus.

Correa, Renato R. Correa is the sole author of only 2 nominal species: the type material of *10. Anopheles (A.) geometricus* is non-existent (NE); the holotype of *67. Anopheles (K.) montemor*, originally in SPM, is now in FH.

The holotype of the 1 species described by **Correa** and **Cerqueira**, *68. Anopheles (K.) laneanus*, is in FH.

The holotypes of all 5 species described by **Correa** and **Ramalho** are in FH: *8. Anopheles (A.) anchietai; 148. Phoniomyia galvaoi; 151. Phoniomyia lopesi; 271. Culex (C.) deanei; 274. Culex (C.) forattinii.*

The holotype of *32. Anopheles (N.) imperfectus*, described by **Correa** and **Ramos** and originally in SPM, is now in FH.

Correa was also the junior author with **Galvao** and **Lane** of *42. Anopheles (N.) paulistensis*. The location of the type material of this species is not known (LU).

Costa, Almir F. For the 2 species described by Costa with **Cerqueira** as senior author, see under the latter.

Coutinho, Jose Oliveira. The holotype of *344. Culex (Micr.) lanei* described by Coutinho and **Forattini** is in FH. Coutinho also proposed the replacement name *costalimai* for *19. Anopheles (A.) limai* (FH).

See also **Barretto** for 3 species described by Barretto and Coutinho, and **Lane** for 2 species described by Lane and Coutinho.

Cruz, Oswaldo Goncalves. We have designated a lectotype for only 1 of the 4 species described by Oswaldo Cruz (in IOC): *225. Psorophora (P.) genumaculata*. Authentic original material of *50. Anopheles (N.) lutzii* is in the IOC collection but it requires careful study before designation of a lectotype. Also in IOC is a slide with 2 wings labelled *Manguinhosia lutzi*; this may be the only remaining original material of *22. Anopheles (A.) lutzi* but this also requires study. The location of the type material of *2. Chagasia neivae* remains unknown (LU), it was not found in IOC where it should be but Belkin's search was not exhaustive. The localities of the species described by Oswaldo Cruz are given in Peryassu (1908).

Damasceno, Reinaldo G. See **Duret** for 2 species described by Duret and Damasceno, and **Galvao** for 3 species described by Galvao and Damasceno.

Davis, Nelson C. The holotype of the only Brazilian species described by Davis as sole author is in USNM: *27. Anopheles (A.) shannoni*. See also **Serafim** for 1 species described by Serafim with Davis as junior author.

Deane, Leonidas M. and **M.P. Deane**. See **Causey**.

Del Ponte, Eduardo. In the world catalog (Stone, Knight and Starcke, 1959:87), 2 Brazilian species, *136. Wyeomyia (D.) rooti* and *139. Wyeomyia (D.) subcomplosa*, are credited to Del Ponte (1939) as sole author in a table (Del Ponte, 1939:

541) listing coded character states of females without mention of type specimens. Stone, Knight and Starcke (loc. cit.) indicate the state of Goias as the type locality of these nominal species, apparently on the basis of the initial sentence in Del Ponte's paper (1939:535), which however merely states that the preparation of Del Ponte's work was initiated at the time of his study of the mosquitoes of Goias.

There are a number of unfortunate errors in Del Ponte's paper (1939), among them: (1) a reference to a prior non-existent description of *rooti* (p. 536) by Del Ponte and Cerqueira (1938), (2) no reference to *undulata* described by these authors, and (3) a discrepancy in 2 important character states attributed to *kerri* in the table with those appearing in the original description of Del Ponte and Cerqueira (1938:228,229). Fortunately these errors do not affect the availability of *rooti* Del Ponte, 1939. There is no doubt that type material of *rooti* Del Ponte, 1939 was in the hands of Lane and Cerqueira (1942:690) when they described *delpontei* in the belief that the former name had not been proposed (Lane and Cerqueira, 1957). In IOC there is a notation by Costa Lima that the type of *rooti* was loaned to the Rockefeller Foundation, which supported in part the studies of Lane and Cerqueira (1942:473). In spite of Lane and Cerqueira's statement (1957) that they did not describe *delpontei* until material additional to the *rooti* of Del Ponte came to hand, we believe that the specimen which they designated as the holotype of *delpontei* was one of the original specimens of *rooti*. The date and locality of capture of this specimen agree with others mentioned by Del Ponte and Cerqueira (1938) and it was probably collected by Gastao Cesar. Since Del Ponte (1939) did not designate a holotype, we have designated here as lectotype of *136. Wyeomyia (D.) rooti*, Del Ponte, 1939 the same specimen as the holotype of *137. Wyeomyia (D.) delpontei* Lane & Cerqueira, 1942 (IOC). The latter nominal species was synonymized by Lane and Cerqueira (1957) with *rooti* Del Ponte, 1939 when they were informed by Alan Stone of the validity of Del Ponte's description. At the same time Lane and Cerqueira (1957) proposed the name *alani* to replace the preoccupied specific name of *Wyeomyia (A.) rooti* described by them in 1942.

The character states given by Del Ponte for *139. Wyeomyia (D.) subcomplosa* are identical to those indicated for *complosa*. We believe that Del Ponte intended to propose *subcomplosa* for the Brazilian species identified earlier as *complosa* Dyar, 1928 by Del Ponte and Cerqueira (1938:234-235). The latter authors pointed out some differences in the male genitalia of their *complosa* from the description and figure by Dyar (1928:74, fig. 45). Therefore, we consider that all the females listed under *complosa* by Del Ponte and Cerqueira are syntypes of *subcomplosa*. Unfortunately the male of *complosa* of Del Ponte and Cerqueira, with the distinctive genitalia, cannot be included in the type series of *subcomplosa* as this sex is not mentioned in Del Ponte (1939). The location of the female syntypes of *subcomplosa* is unknown (LU) at present but it is very likely that some of these specimens will be found in FH, IOC or USNM. To our knowledge, *subcomplosa* has not been described or recognized as a distinct species since the original mention of the name by Del Ponte (1939). Its taxonomic identity remains uncertain.

The holotypes of 3 of the 4 species described by **Del Ponte** with **Cerqueira** as junior author are in IOC: *124. Wyeomyia (D.) cesari; 128. Wyeomyia (D.) kerri; 141. Wyeomyia (D.) undulata*. We did not find the holotype of *135. Wyeomyia (D.) brucei*; in IOC there is only the "allotype" designated by Lane and Cerqueira (1942: 599); its location is considered unknown (LU) for the present but it may be lost.

Duret, Jose Pedro. The holotypes of all 15 Brazilian species described up to 1970 by Duret as sole author are all in the Duret private collection: *278. Culex (C.) para-*

maxi; 286. Culex (Mel.) bahiensis; 292. Culex (Mel.) contei; 293. Culex (Mel.) cristovai; 297. Culex (Mel.) ernanii; 300. Culex (Mel.) faurani; 301. Culex (Mel.) flochi; 306. Culex (Mel.) isabelae; 307. Culex (Mel.) johnnyi; 308. Culex (Mel.) kerri; 319. Culex (Mel.) rachoui; 321. Culex (Mel.) silvai; 327. Culex (Mochl.) galvaoi; 329. Culex (Mochl.) palaciosi; 358. Culex (Anoed.) damascenoi.

The holotypes of all 3 species described by **Duret** with **Barretto** as junior author are in FMRP: *285. Culex (Mel.) aureonotatus; 289. Culex (Mel.) bifoliolatus; 325. Culex (Mel.) trilobulatus.*

The holotypes of the 2 species described by **Duret** with **Damasceno** as junior author are in the Duret private collection: *290. Culex (Mel.) mojuensis; 356. Culex (Anoed.) belemensis.*

Dyar, Harrison G. The holotypes or lectotypes of all 5 species described from Brazil by Dyar as sole author are in USNM: *102. Trichoprosopon (R.) trichopus; 132. Wyeomyia (D.) mystes; 197. Coquillettidia (R.) hypocindyna; 264. Culex (L.) brasiliae; 303. Culex (Mel.) inadmirabilis.* Dyar also proposed the replacement names *remipusculus* for *177. Sabethes (S.) purpureus* Peryassu, 1908 (IOC) and *melanonymphe* for *188. Sabethes (Sabethinus) albiprivatus* (BM).

The location of the holotype of the 1 Brazilian species described by **Dyar** with **Knab** as junior author is unknown (LU): *84. Toxorhynchites (L.) ambiguus.* This species was never seen by the authors and was based on a single specimen mentioned by Wiedemann (see Belkin, 1968:32). This specimen may possibly be in NMW. Dyar and Knab also proposed the replacement names *peryassui* for *22. Anopheles (A.) lutzi* (?IOC), *cruzii* for *66. Anopheles (K.) lutzii* Theobald, 1901 (BM), and *wiedemanni* for *81. Toxorhynchites (L.) ferox* (Wiedemann, 1828) (SNG and NMW).

The holotypes of all 4 Brazilian species described by **Dyar** with **Shannon** as junior author are in USNM: *24. Anopheles (A.) celidopus; 182. Sabethes (Sabethoides) glaucodaemon; 204. Mansonia (M.) indubitans; 288. Culex (Mel.) bequaerti.* Dyar and Shannon also proposed the replacement name *leucocelaenus* for *253. Aedes (F.) leucomelas* (BM).

Edwards, Frederick W. The 2 holotypes and 1 lectotype of the only 3 Brazilian species described by Edwards are in BM: *166. Sabethes (S.) longfieldae; 169. Sabethes (S.) argyronotum; 397. Edwardsops brevisector.*

Evans, Alwen M. The holotypes or lectotypes of all 7 Brazilian species described by Miss Evans as sole author are in BM: *283. Culex (Mel.) gordoni; 287. Culex (Mel.) innominatus* (type locality here restricted); *296. Culex (Mel.) manaosensis; 311. Culex (Mel.) clarki* (type locality here restricted); *324. Culex (Mel.) thomasi; 328. Culex (Mochl.) innovator* (type locality here restricted); *353. Culex (Aed.) hildebrandi* (type locality here restricted). The restricted type locality for 3 of the species noted above is Itacoatiara when the original description or labels indicated River Amazon to or from Manaus. For the fourth species, *clarki*, which was stated to be collected on the River Amazon, the restriction is to Manaus.

See also **Gordon** for 6 species described by Gordon and Evans.

Ferreira, Orlando. See **Lima** for the 1 species described by Lima, Guitton and Ferreira.

Fonseca, Flavio da. The holotypes of the 2 nominal species described by **Fonseca** and **Ramos** are in FH: *19. Anopheles (A.) limai; 20. Anopheles (A.) costai.*

Forattini, Oswaldo Paulo. The holotype of the 1 Brazilian species credited to

Forattini as sole author is in USNM: *277. Culex (C.) oswaldoi.* The holotypes of the 2 Brazilian species described by Forattini as senior author are in FH: *268. Culex (C.) brami* Forattini, Rabello & Lopes; *349. Culex (Micr.) shopei* Forattini & Toda.

See also **Coutinho** for 1 species described by Coutinho and Forattini; and **Lane** for 1 species described by Lane and Forattini and 1 species described by Lane, Forattini and Rabello.

Gabaldon, Arnoldo. See **Rozeboom** for 1 Brazilian species described by Rozeboom and Gabaldon.

Galindo, Pedro. The holotype of *254. Aedes (F.) leucophoebus*, the only Brazilian species described by **Galindo**, with **Carpenter** and **Trapido** as junior authors, is in FH.

Galvao, A.L. Ayroza. Type material of 2 of the 3 species described by Ayroza Galvao as sole author have been located in FH: the holotype of *9. Anopheles (A.) bustamentei* and the lectotype, here designated, of *26. Anopheles (A.) rachoui.* The location of the type material of *65. Anopheles (N.) chagasi* is unknown (LU); the type locality is here restricted to Manaus, 1 of 3 localities mentioned in the original description.

The holotypes of the 2 species described by **Ayroza Galvao** and **Amaral** are in FMSP (see section on depositories): *34. Anopheles (N.) antunesi* and *49. Anopheles (N.) lanei.*

The holotype of *70. Anopheles (L.) pseudotibiamaculatus* described by **Ayroza Galvao** and **Barretto** is also in FMSP (see section on depositories).

Syntypes of the 3 species described by **Ayroza Galvao** and **Damasceno** were probably originally in FMSP as stated for *60. Anopheles (N.) konderi.* However, Belkin could not locate any original material of this species which is recorded in this collection and it is probably lost. There is some material in this collection of *31. Anopheles (N.) marajoara* that could probably be designated as the lectotype. The type locality of this species is here restricted to the vicinity of Cachoeira do Arari, the site of collection of the following species. No material or record of the third species, *33. Anopheles (N.) domesticus*, was located in FMSP; for the present the location of its type material is unknown (LU).

Of the 4 species described by **Ayroza Galvao** and **Lane**, the holotype of *40. Anopheles (N.) pessoai* was found in FMSP. The only type material of *54. Anopheles (N.) noroestensis* found by Belkin was in FH and possibly FMSP; the lectotype here designated is represented by the male genitalia slide in FH. The type locality of this species is Lussanvira (Galvao and Lane, 1938:176,177) and not Tiete as stated by Stone, Knight and Starcke (1959:33). No type material of *30. Anopheles (N.) limai* was found, only slides of stomachs in FMSP; it is considered non-existent (NE). We have designated a lectotype (USNM) for *59. Anopheles (N.) metcalfi,* which was based on *tarsimaculatus* of Root (1926).

No material of *42. Anopheles (N.) paulistensis* described by **Ayroza Galvao, Lane** and **Correa**, was found by Belkin; the location of the type material remains unknown (LU).

See **Pessoa** for 1 species described by Pessoa and Galvao.

Garcia, Miguel. See **Casal.**

Giles, George M. The holotype of the only species described from Brazil by Giles is in BM: *229. Psorophora (J.) arribalzagae.*

Gordon, Rupert M. The holotypes or lectotypes of all 6 species described from Brazil by **Gordon** with **Evans** as junior author are in BM: *76. Toxorhynchites (L.) horei; 133. Wyeomyia (D.) negrensis; 165. Sabethes (S.) amazonicus; 209. Uranotaenia albitarsis; 249. Aedes (F.) braziliensis; 360. Culex (Anoed.) originator.*

Guimaraes, Lindolpho da Rocha. See **Lane** for the 1 species described by Lane and Guimaraes.

Guitton, Neide. See **Lima** for the 1 species described by Lima, Guitton and Ferreira.

Knab, Frederick. See **Dyar.**

Kollar, Vincenz. The type material of *367. Culex molestus,* a *nomen dubium,* is non-existent (NE).

Komp, William H.W. The holotype of *35. Anopheles (N.) emilianus,* the only species described by Komp from Brazil, is in USNM.

Kumm, Henry W. The location of the type material is unknown (LU) for the only species described from Brazil by Kumm: *335. Culex (Micr.) davisi.*

Lane, John. Holotypes (in 1 case the lectotype) of 41 of the 43 species described from Brazil by Lane as sole author have been located. In USNM is the holotype of *385. Lutzomiops amazonicus* and in BM the holotypes of *375. Corethrella kummi* (type locality restricted) and *380. Corethrella tarsata.* The FH contains the types of 38 species: *96. Trichoprosopon (R.) luederwaldti; 108. Wyeomyia (W.) downsi; 210. Uranotaenia davisi; 212. Uranotaenia burkii; 214. Uranotaenia mathesoni; 265. Culex (C.) abnormalis; 267. Culex (C.) airozai; 273. Culex (C.) foliaceus; 276. Culex (C.) mauesensis; 368. Corethrella confusa; 369. Corethrella bromelicola; 370. Corethrella cardosoi; 371. Corethrella edwardsi* (type locality restricted); *372. Corethrella flavitibia; 373. Corethrella fulva; 374. Corethrella infuscata; 376. Corethrella lopesi; 377. Corethrella pillosa; 378. Corethrella selvicola; 379. Corethrella striata; 381. Corethrella travassosi; 382. Corethrella vittata; 383. Corethrella whitmani* (type locality restricted); *384. Lutzomiops alticola; 386. Lutzomiops barrettoi; 387. Lutzomiops coutinhoi; 388. Lutzomiops niger; 389. Lutzomiops iridescens; 390. Lutzomiops juquianus; 391. Lutzomiops lutzi; 393. Lutzomiops nigrescens; 395. Lutzomiops antunesi; 396. Sayomyia souzai; 398. Edwardsops magnificus; 399. Edwardsops unicolor; 400. Dixella chapadensis; 403. Dixella torrentia; 404. Dixella wygodzinskyi* (lectotype). The location of the type material (holotypes not designated) of the following 2 species is unknown (LU), we did not find any material in FH or IOC: *109. Wyeomyia (W.) leucotarsis* and *119. Wyeomyia (C.) mattinglyi* (type locality restricted).

The holotype of the 1 species described by **Lane** with **Antunes** as junior author is in FH: *200. Coquillettidia (R.) shannoni.*

The holotypes (in 2 cases lectotypes) of all 34 species described by **Lane** with **Cerqueira** as junior author have been located. We have designated a lectotype (USNM) for *146. Phoniomyia edwardsi.* In FH are the types of *117. Wyeomyia (C.) dyari* (lectotype) and *392. Lutzomiops manaosensis.* Holotypes of 31 species are in IOC: *90. Trichoprosopon (T.) obscurum; 92. Trichoprosopon (T.) soaresi; 97. Trichoprosopon (C.) walcotti; 98. Trichoprosopon (R.) castroi; 100. Trichoprosopon (R.) edwardsianum; 101. Trichoprosopon (R.) humboldti; 104. Trichoprosopon (R.) reversum; 105. Trichoprosopon (R.) simile; 106. Trichoprosopon (R.) theobaldi; 110. Wyeomyia (W.) limai; 115. Wyeomyia (W.) sabethea; 118.*

Wyeomyia (C.) kummi; 121. Wyeomyia (A.) rooti (alani, new name*); 122. Wyeomyia (D.) airosai; 126. Wyeomyia (D.) finlayi; 127. Wyeomyia (D.) howardi; 129. Wyeomyia (D.) knabi; 137. Wyeomyia (D.) delpontei; 138. Wyeomyia (D.) shannoni; 140. Wyeomyia (D.) tarsata; 143. Phoniomyia bonnei; 144. Phoniomyia davisi; 147. Phoniomyia flabellata; 153. Phoniomyia palmata; 156. Phoniomyia neivai; 157. Phoniomyia theobaldi; 167. Sabethes (S.) batesi; 185. Sabethes (Sabethinus) fabricii; 186. Sabethes (Sabethinus) lutzianus; 189. Sabethes (Sabethinus) soperi; 190. Sabethes (Sabethinus) whitmani.* There is some confusion regarding the holotypes of *143. Phoniomyia bonnei; 144. Phoniomyia davisi; 156. Phoniomyia neivai* and *157. Phoniomyia theobaldi.* There are specimens of all 4 species labelled as holotypes in both IOC and FH. We consider that in all cases the true holotypes are in IOC and that the specimens in FH were so marked by Lane before he undertook his joint work with Cerqueira and inadvertently the type labels were not removed later.

The holotypes of the 2 species described by **Lane** with **Coutinho** as junior author are in FH: *195. Coquillettidia (R.) hermanoi; 199. Coquillettidia (R.) neivai.*

The holotypes of *145. Phoniomyia diabolica*, described with **Forattini** as junior author, and *402. Dixella paulistana*, described with **Forattini** and **Rabello** as joint authors, are in FH.

Syntypes of *142. Phoniomyia antunesi*, described by **Lane** with **Guimaraes** as junior author, are in FH. We have not designated a lectotype for this species since the type material requires careful study.

The holotype of *280. Culex (C.) renatoi*, described by **Lane** with **Ramalho** as junior author, is in FH.

We did not locate the holotypes of the 11 species described by **Lane** with **Whitman** (LU). They were presumably originally in the Rockefeller Foundation Laboratory at IOC: *313. Culex (Mel) nigrimacula; 332. Culex (Micr.) aureus; 333. Culex (Micr.) carioca; 336. Culex (Micr.) dubitans; 341. Culex (Micr.) retrosus; 342. Culex (Micr.) fuscatus; 343. Culex (Micr.) intermedius; 348. Culex (Micr.) reducens; 357. Culex (Anoed.) canaanensis; 362. Culex (Car.) antunesi; 365. Culex (Car.) wilsoni.*

In addition to the description of the above 95 species, **Lane** participated as junior author in the description of 8 species: 2 species with **Antunes**: *243. Aedes (O.) pennai* and *364. Culex (Car.) soperi*, whose holotypes are FH; 1 species with **Cerqueira**: *361. Culex (Car.) anduzei* (FH); 4 species with **Ayroza Galvao**: *30. Anopheles (N.) limai; 40. Anopheles (N.) pessoai; 54. Anopheles (N.) noroestensis* and *59. Anopheles (N.) metcalfi*, for the type material of these species see **Galvao**; and 1 species, *42. Anopheles (N.) paulistensis*, with **Ayroza Galvao** and **Correa**, the location of whose type is unknown (see **Galvao**).

Laveran, Charles-Louis Alphonse. Type material of *160. Limatus curvirostris*, the only species described from Brazil by Laveran, is non-existent (NE).

Lima, Angelo da Costa. Type material of all but 1 of the 10 Brazilian nominal species described by Costa Lima as sole author are in the IOC collection. The following 6 species are represented by holotypes or lectotypes: *11. Anopheles (A.) evandroi; 93. Trichoprosopon (L.) brevipes; 114. Wyeomyia (W.) pintoi; 203. Mansonia (M.) chagasi; 220. Orthopodomyia townsendi; 221. Orthopodomyia sampaioi.* The following 3 species are represented by syntypes that need careful study before designating lectotypes: *21. Anopheles (A.) minor; 78. Toxorhynchites (L.) pusillus; 111. Wyeomyia (W.) lutzi.* Belkin did not find any type material of *245. Aedes (O.) rhyacophilus* in IOC where it was deposited; its location is considered unknown

(LU) for the present as it may have been borrowed. We have restricted the type locality of this species to the vicinity of Sao Joao de Petropolis, one of the cities in the valley of Canaa mentioned in the original description.

Costa Lima was the senior author with **Guitton** and **Ferreira** of 1 species, *71. Toxorhynchites (A.) catharinensis*, whose holotype is in IOC.

Judging by the notation on the record cards, Costa Lima was responsible for the reorganization of the mosquito collection at the Instituto Oswaldo Cruz. The specimens were apparently transferred from small insect boxes into individual tubes. The majority of them are without labels on the pins and with fragmentary data only on the tubes or with brief notation on the record cards. The transfer was not completed, the remainder of the specimens are in 10 small boxes in 2 drawers (see **Lutz**).

Lopes, Oscar de Souza. See **Forattini** for the 1 species described by Forattini, Rabello and Lopes.

Lutz, Adolpho. After examining Lutz material in European museums, Belkin (1968:48-51) discussed the involved problem of the determination of the type specimens of the nominal species described by this author. In July and August 1969 Belkin found that the only remaining authentic type material of Lutz in Brazil was in the Instituto Oswaldo Cruz in Rio de Janeiro. This material is in general in poor condition and often without labels on the pins. Part of it was apparently studied by A. da Costa Lima and incorporated by him into the general collection of the institute, usually with only the notation that the specimens were from the old collection of the institute; the majority of these specimens have no labels at all on the pins. The remainder of the Lutz material, apparently not previously studied, is stored separately in 15 small insect boxes, 1-9 in one drawer and 10-15 in another. These specimens are all numbered (2550-2664) but not all numbers in this series are present and it is evident that some specimens were removed from these boxes, probably by Costa Lima. No record cards could be located in the institute for the numbers on the specimens remaining in the small boxes. A typed species label precedes the series of specimens of each species. Some specimens bear labels with locality and data, others lack labels. The data on the labels of only a few specimens indicate that they were undoubtedly part of the original type series of some of Lutz's species.

Since Lutz did not designate holotypes for any of his species described from more than 1 specimen and since apparently all the remaining type material has now been located in the BM, IOC or USNM collections, we have designated here lectotypes for all his species except as noted below. These lectotypes have been designated with due regard to the original data, agreement with original description as well as the current interpretation of the involved species.

Lutz was the sole author of 33 nominal species. Type material of the following is in existence. In the BM collection, 13 species: *79. Toxorhynchites (L.) solstitialis; 91. Trichoprosopon (T.) pallidiventer; 112. Wyeomyia (W.) medioalbipes; 113. Wyeomyia (W.) oblita* (syntype; also IOC); *134. Wyeomyia (D.) personata; 164. Sabethes (S.) albiprivatus; 184. Sabethes (Sabethinus) aurescens; 187. Sabethes (Sabethinus) intermedius; 250. Aedes (Finlaya) fluviatilis; 253. Aedes (F.) leucomelas; 256. Aedes (F.) oswaldi; 281. Culex (C.) spinosus; 322. Culex (Mel.) theobaldi.* In the USNM collection, the lectotype of *346. Culex (Micr.) neglectus.* In the IOC collection, 3 species: *107. Wyeomyia (W.) arthrostigma; 116. Wyeomyia (W.) serrata; 218. Orthopodomyia albicosta.* The following 6 species are apparently represented by type material in IOC but lectotype designations have not been made either because of fragmentary data or because of the need of careful study of the specimens: *6. Anopheles (S.) lineatus; 86. Trichoprosopon (T.) compressum; 95. Trichroprosopon (S.) longipalpis; 113. Wyeomyia (W.) oblita* (also BM); *299. Culex (Mel.) fasciolatus; 309. Culex (Mel.) lugens.* The neotype of *363. Culex (Car.) iridescens* is in FH. The types of the following 3 species, stated to be in IOC by Lane (1953) and Stone, Knight and Starcke (1959) were not found in this collection in 1969: *1. Chagasia fajardi; 263. Haemagogus (S.) capricornii; 352. Culex (Aed.) amazonensis;* their location is unknown (LU) at present. No type material of the following 7 species has been found by Belkin or other workers in the past anywhere and is considered non-existent (NE): *74. Toxorhynchites (A.) neglectus; 88. Trichoprosopon (T.) splendens; 120. Wyeomyia (M.) leucostigma; 123. Wyeomyia (D.) bourrouli; 125. Wyeomyia (D.) confusa; 258. Aedes (H.) fulvithorax; 330. Culex (Micr.) albipes.*

Lutz also described 4 species with **A. Neiva** as junior author. Type material of all these species is apparently in IOC, the holotype of *15. Anopheles (A.) mattogrossensis* and probably the syntypes of *75. Toxorhynchites (L.) bambusicola; 82. Toxorhynchites (L.) posticatus* and *234. Psorophora (G.) scutipunctata.* Lectotypes for the latter 3 species are not designated at this time because of the need of further study.

Several species described by Lutz, and by Theobald from Lutz material, did not have a locality specified in the original description and were reported from one or more states in Brazil. In those instances where labels on extant original material did not indicate a specific locality we have used the distribution data on Lutz material in Peryassu (1908:59-75) as an indication of the type locality. All records from Sao Paulo without a specific locality we have interpreted as being from the city of Sao Paulo or its vicinity.

Dr. Bertha Lutz, the daughter of Adolpho Lutz, has informed us that the Fazenda do Bonito, Serra da Bocaina, belonged to her father and uncle and that it was in the possession of the family before 1900. It is probably therefore that our interpretation of the place of capture of the lectotype of *256. Aedes (F.) oswaldi* is correct.

Macquart, P. Justin M. All 3 species described by Macquart from Brazil, without locality specified, were probably based on material obtained by C. Gaudichaud from the "Uranie" world expedition. We are restricting the type locality of these species to the vicinity of Rio de Janeiro, the only area in Brazil visited by this expedition. The holotypes of *237. Aedes (O.) albifasciatus* and *259. Aedes (S.) toxorhynchus* are in MNHP; the type material of *223. Psorophora (P.) pilipes* is non-existent (NE).

Martini, Erich C.W. The holotype of *4. Chagasia stigmopteryx,* the only species described by Martini from Brazil and formerly believed to be non-existent, has been located in DEI through the courtesy of G. Morge.

Matheson, Robert. The holotype of *318. Culex (Mel.) putumayensis,* the only Brazilian species described by Matheson, is in USNM. The type locality, stated to be the Amazon River near Peru, is here restricted to Santo Antonio do Ica (Amazonas), near the mouth of the Putumayo River (Rio Ica).

Neiva, Arthur. Belkin did not find the type material of the 2 species described by Neiva as sole author that was presumed to be in IOC: *28. Anopheles (A.) tibiamaculatus* and *168. Sabethes (S.) belisarioi.* However, Belkin's search was not exhaustive and for the present we consider that the location of these types is unknown (LU).

The types 2 of the 4 species described by **Neiva** and **Pinto** are in IOC: *62. Ano-*

pheles (N.) rondoni and *64. Anopheles (N.) cuyabensis.* We have designated lectotypes for both species and restricted the type locality of *rondoni.* We found no type material of *63. Anopheles (N.) triannulatus* or *215. Uranotaenia noctivaga* in IOC where it should be, but consider its location unknown (LU) pending exhaustive search in this collection.

Neiva was the junior author of 4 other species with **Adolpho Lutz** (see). He also proposed the new name *adolphoi* for *66. Anopheles (K.) lutzii* Theobald, 1901 whose lectotype is in BM.

Neveu-Lemaire, Maurice. Type material is non-existent (NE) of the 2 nominal species described by Neveu-Lemaire from Brazil (as French Guiana): *248. Aedes (O.) mathisi* and *354. Culex americanus (nomen dubium).*

Newstead, Robert. The lectotypes of *219. Orthopodomyia longipalpis* and *323. Culex (Mel.) chrysothorax,* described by **Newstead** and **Thomas**, are in BM.

Paraense, Wladimir Lobato. See **Cerqueira** for the 1 species described by Cerqueira and Paraense.

Peryassu, Antonio Goncalves. Apparently all the extant type material of the 16 nominal species described by Peryassu is in IOC or in the Museu Nacional in Quinta da Boa Vista in Rio de Janeiro. The material in the latter institution was discovered by Belkin in 1969. Careful study of the material in both institutions is needed before lectotype designations can be made since several Peryassu species were composite ones. Therefore we have designated lectotypes here only when the specimens agreed with the current interpretation of Peryassu species. At this time the definite types of only the following 4 nominal species are recognized, all in IOC: *177. Sabethes (S.) purpureus; 191. Coquillettidia (R.) albicosta; 226. Psorophora (J.) albigenu; 291. Culex (Mel.) chrysothorax.* Apparently authentic original material of the following 6 nominal species is either in IOC or MusNac as indicated: *13. Anopheles (A.) intermedius* (IOC); *25. Anopheles (A.) pseudomaculipes* (IOC); *29. Anopheles (N.) allopha* (MusNac); *58. Anopheles (N.) oswaldoi* (MusNac); *85. Toxorhynchites (L.) fluminensis* (IOC); *194. Coquillettidia (R.) chrysonotum* (IOC and MusNac). No authentic original material of following 6 nominal species was found in either institution but since an exhaustive search was not made it is possible that some is extant and therefore the location is recorded as unknown (LU) for the present: *3. Chagasia maculata; 18. Anopheles (A.) rockefelleri; 23. Anopheles (A.) alagoanii; 69. Anopheles (L.) gilesi; 178. Sabethes (S.) quasicyaneus; 216. Uranotaenia argenteopennis.*

More or less specific localities were mentioned by Peryassu in the original descriptions. We have restricted the type locality of *69. Anopheles (L.) gilesi* to the vicinity of Lassance, the area in the valley of the Rio das Velhas where C. Chagas collected anophelines in 1907 (Root, 1926:704). The type locality of *18. Anopheles (A.) rockefelleri* was not specified; we have restricted it to the vicinity of the city of Rio de Janeiro, where Peryassu was working at the time of the description of this species.

Peryassu's major work on the Culicidae of Brazil (1908) is an important source of information on the species described from Brazil prior to its date of publication, particularly the section dealing with the distribution of the species (p. 59-75). Apparently all the material then in IOC (at that time, Instituto de Manguinhos) was examined and recorded by Peryassu, including the species described by Adolpho Lutz, Carlos Chagas, Oswaldo Cruz and Arthur Neiva.

Pessoa, Samuel Barnsley. The holotype of *350. Culex (Micr.) worontzowi* described by **Pessoa**-and **Galvao** is in FMSP.

Pinto, Cesar. See **Neiva** for the 4 species described by Neiva and Pinto.

Prado, Alcides. The holotypes of both species described by Prado are in IB: *192. Coquillettidia (R.) albifera; 211. Uranotaenia ditaenionota.*

Rabello, Ernesto Xavier. See **Forattini** for 1 species described by Forattini, Rabello and Lopes; and **Lane** for 1 species described by Lane, Forattini and Rabello.

Ramalho, Gabriel R. See **Lane** for 1 species described by Lane and Ramalho, and **Correa** for 5 species described by Correa and Ramalho.

Ramos, Alberto da Silva. The location of the type material is unknown (LU) for the 1 species described by Ramos as sole author: *36. Anopheles (N.) guarujaensis.*
See **Correa** for 1 species described by Correa and Ramos; and **Fonseca** for 2 species described by Fonseca and Ramos.

Robineau-Desvoidy, Andre Jean-Baptiste. All the original culicid material of Robineau-Desvoidy is non-existent (NE; see Belkin, 1968:52). The 4 species described from Brazil did not have a locality specified, we are restricting it to the vicinity of Rio de Janeiro (Guanabara) for all these: *37. Anopheles (N.) argyritarsis; 171. Sabethes (S.) locuples; 222. Psorophora (P.) tibialis; 366. Culex pallipes.*

Rondani, Camillo. The location of the type material is unknown (LU) for the 2 species described by Rondani from Brazil, without specified locality. We have restricted the type locality for both species to the vicinity of Rio de Janeiro (Guanabara): *87. Trichoprosopon (T.) digitatum; 246. Aedes (O.) scapularis.*

Root, Francis Metcalf. Holotypes or lectotypes of all 24 nominal species described by Root from Brazil are in USNM: *12. Anopheles (A.) fluminensis; 41. Anopheles (N.) darlingi; 43. Anopheles (N.) strodei; 131. Wyeomyia (D.) melanoides; 149. Phoniomyia incaudata; 154. Phoniomyia pilicauda; 266. Culex (C.) acharistus; 275. Culex (C.) lygrus; 284. Culex (Mel.) andricus; 294. Culex (Mel.) exedrus; 295. Culex (Mel.) dyius; 298. Culex (Mel.) evansae; 305. Culex (Mel.) cenus; 315. Culex (Mel.) automartus; 316. Culex (Mel.) oedipus; 317. Culex (Mel.) plectoporpe; 320. Culex (Mel.) serratimarge; 326. Culex (Mochl.) megapus; 331. Culex (Micr.) aphylactus; 334. Culex (Micr.) trychnus; 337. Culex (Micr.) gairus; 338. Culex (Micr.) hedys; 345. Culex (Micr.) microphyllus; 351. Culex (Aed.) accelerans.*
All these species are based on material collected in the vicinity of the city Rio de Janeiro and in the states of Rio de Janeiro and Minas Gerais from April to June 1925, primarily by Root himself.

Rozeboom, Lloyd E. The holotype of the 1 species described from Brazil by **Rozeboom**, with **Gabaldon** as junior author, is in USNM: *56. Anopheles (N.) goeldii.*

Sampaio, M.M. See **Causey.**

Santos, O.B. dos. The type material of *401. Dixella limai*, stated to be in Univ. Minais Gerais was not examined by us.

Serafim, Jose Jr. The holotype of *241. Aedes (O.) jacobinae*, described by **Serafim** and **Davis**, is in USNM.

Shannon, Raymond C. The holotypes of all 3 Brazilian species described by Shannon as sole author are in USNM: *7. Anopheles (S.) lewisi (thomasi*, new name*).*

52. Anopheles (N.) guarani; 198. Coquillettidia (R.) lynchi.

The holotype of *231. Psorophora (J.) lanei*, described by **Shannon** and **Cerqueira**, was not found in IOC and its location is unknown (LU).

See **Dyar** for 4 species described by Dyar and Shannon.

Stone, Alan. The holotypes of the 2 Brazilian species described by Stone are in USNM: *89. Trichoprosopon (T.) townsendi; 99. Trichoprosopon (R.) cerqueirai.*

Theobald, Frederick V. Holotypes or lectotypes of 42 of the 44 nominal species described by Theobald from Brazil are extant and all are in the BM collection: *14. Anopheles (A.) maculipes; 17. Anopheles (A.) mediopunctatus; 51. Anopheles (N.) niger; 66. Anopheles (K.) lutzii; 72. Toxorhynchites (A.) purpureus; 80. Toxorhynchites (L.) chrysocephalus; 94. Trichoprosopon (S.) fluviatile; 103. Trichoprosopon (R.) lunatum; 130. Wyeomyia (D.) luteoventralis; 150. Phoniomyia longirostris; 152. Phoniomyia pallidoventer; 155. Phoniomyia quasilongirostris; 159. Limatus durhamii; 161. Limatus paraensis; 163. Sabethes (S.) albiprivus; 170. Sabethes (S.) nitidus; 176. Sabethes (S.) purpureus; 181. Sabethes (Sabethoides) confusus; 188. Sabethes (Sabethinus) albiprivatus; 193. Coquillettidia (R.) arribalzagae; 201. Mansonia (M.) amazonensis; 206. Mansonia (M.) pseudotitillans; 213. Uranotaenia geometrica; 217. Uranotaenia pallidoventer; 232. Psorophora (J.) lutzii; 233. Psorophora (G.) apicalis (neoapicalis,* new name*); 238. Aedes (O.) crinifer; 247. Aedes (O.) serratus; 251. Aedes (F.) mediomaculatus; 252. Aedes (F.) tripunctatus; 270. Culex (C.) corniger; 272. Culex (C.) bilineatus; 302. Culex (Mel.) humilis; 304. Culex (C.) indecorabilis; 310. Culex (Mel.) nigrescens; 312. Culex (Mel.) nigricorpus; 314. Culex (Mel.) ocellatus; 339. Culex (Micr.) imitator; 340. Culex (Micr.) argenteoumbrosus; 347. Culex (Micr.) pleuristriatus; 359. Culex (Anoed.) luteopleurus; 394. Sayomyia braziliensis.*

The holotype of *175. Sabethes (S.) lutzii* may be in the IOC collection. The type material of *282. Culex (C.) virgultus*, originally in BM, has not been located (LU; see Stone, 1957:341-342; Belkin, 1968:21).

There has been some confusion regarding several nominal species described as new by Theobald (1907) with supposed Lutz manuscript names. In the Addenda (p. [630]) in the same work Theobald gives references to Lutz's descriptions (1905, incorrectly as 1906) of these species as well as to his own. Therefore we consider that Theobald did not propose new nominal species and merely redescribed Lutz's species, in spite of the fact that later (Theobald, 1910) he attributed 2 of these species to himself and the remainder to Lutz in Theobald, 1907. Stone, Knight and Starcke (1959) did not consider the Theobald descriptions as valid proposals of new taxa except for *Sabethinus aurescens*. Belkin (1968:30) followed the above authors and listed *aurescens* Theobald, 1907 among the validly proposed nominal taxa. We see no reason for this exception and therefore are eliminating this name also.

The majority of the Brazilian species described by Theobald were based on material sent by Adolpho Lutz. In instances where the localities were not specified for this material we have followed the same practice in restricting them as with species described by Adolpho Lutz himself (see). We have also restricted type localities for some species based on material from other sources as follows. E.E. Austen collected *201. Mansonia (M.) amazonensis* aboard a ship on the Amazon; the locality is restricted here to one of the ports mentioned, Gurupa. The type material of *72. Toxorhynchites (A.) purpureus* was collected by H.W. Bates in the Amazon region; its locality is restricted to Manaus. H.E. Durham (1902) collected all his material in Para, the contemporary name for the city of Belem; accordingly the type locality of all the 9 species described by Theobald from Durham material is restricted to this city. The same restriction is made for the type locality of species based on E.A. Goeldi material stated to be from Para.

Thomas, Harold Wolferstan. See **Newstead** for the 2 Brazilian nominal species described by Newstead and Thomas.

Toda, Amazonia. See **Forattini** for 1 species described by Forattini and Toda.

Trapido, Harold. See **Galindo** for the 1 species described from Brazil by Galindo, Carpenter and Trapido.

Unti, Ovidio. Belkin did not find type material of the 5 nominal species or subspecies described by Unti in any of the Brazilian institutions and therefore we consider that these types are non-existent (NE): *44. Anopheles (N.) ramosi; 45. Anopheles (N.) arthuri; 46. Anopheles (N.) artigasi; 47. Anopheles (N.) albertoi; 55. Anopheles (N.) ayrozai.*

Walker, Francis. The holotypes or lectotypes of all but 1 of the 7 species described from Brazil or South America without locality specified are in BM: *207. Mansonia (M.) titillans; 224. Psorophora (P.) scintillans; 228. Psorophora (J.) discrucians; 240. Aedes (O.) flavicosta; 255. Aedes (F.) terrens; 260. Aedes (S.) exagitans.* The holotype of *235. Psorophora perterrens* is non-existent (NE).

Since the locality of Para [Belem] was given for 2 of the above species, we have restricted the type locality to the vicinity of Belem for another species, *titillans*, which was described from Brazil. For *flavicosta*, stated to be from the Amazon Region, we have designated Manaus as the type locality. We have restricted the type locality to the vicinity of the city of Rio de Janeiro for 3 species, *discrucians, perterrens* and *terrens*, which were stated to be from South America.

Whitman, Loring. See **Lane** for 11 species described by Lane and Whitman.

Wiedemann, Christian R.W. Type material of all 6 species described by Wiedemann from Brazil is in existence: in ZMC, *172. Sabethes (S.) remipes* (holotype); in SNG, *73. Toxorhynchites (A.) trichopygus* (syntypes), *239. Aedes (O.) fulvus* (holotype); in NMW, *81. Toxorhynchites (L.) ferox* (syntypes, also in SNG), *83. Toxorhynchites (L.) violaceus* (lectotype), *279. Culex (C.) aestuans.*

In only one instance, *violaceus*, was a specific locality (Bahia) indicated, however we have restricted the type localities of all the other species to the vicinity of Salvador (Bahia), the current name of the same city.

DEPOSITORIES

A (Author's collection) - Private collections; see Duret.

BM (British Museum (Nat. Hist.), Cromwell Road, London, S.W. 7). The BM collection contains the type of the largest number of topotypic Brazilian species (83): 1 species described by **Christophers**; 3 by **Edwards**, 7 by **Evans**, 1 by **Giles**, 6 by **Gordon & Evans**, 2 by **Lane**, 13 by **Lutz**, 2 by **Newstead & Thomas**, 42 by **Theobald** and 6 by **Walker**. Except as noted all of these are represented by holotypes or previously designated lectotypes: *14. Anopheles (A.) maculipes; 16. Anopheles (A.) amazonicus* (type locality restricted); *17. Anopheles (A.) mediopunctatus; 51. Anopheles (N.) niger; 66. Anopheles (K.) lutzii (cruzii* and *adolphoi*, new names*); 72.*

Toxorhynchites (A.) purpureus (type locality restricted); *76. Toxorhynchites (L.) horei; 79. Toxorhynchites (L.) solstitialis* (new lectotype); *80. Toxorhynchites (L.) chrysocephalus; 91. Trichoprosopon (T.) pallidiventer* (new lectotype); *94. Trichoprosopon (S.) fluviatile; 103. Trichoprosopon (R.) lunatum; 112. Wyeomyia (W.) medioalbipes* (new lectotype); *113. Wyeomyia (W.) oblita* (syntype; also IOC); *130. Wyeomyia (D.) luteoventralis; 133. Wyeomyia (D.) negrensis; 134. Wyeomyia (D.) personata* (new lectotype); *150. Phoniomyia longirostris; 152. Phoniomyia pallidoventer; 155. Phoniomyia quasilongirostris; 159. Limatus durhamii; 161. Limatus paraensis; 163. Sabethes (S.) albiprivus; 164. Sabethes (S.) albiprivatus* (new lectotype); *165. Sabethes (S.) amazonicus; 166. Sabethes (S.) longfieldae; 169. Sabethes (S.) argyronotum; 170. Sabethes (S.) nitidus; 176. Sabethes (S.) purpureus; 181. Sabethes (Sabethoides) confusus; 184. Sabethes (Sabethinus) aurescens* (new lectotype); *187. Sabethes (Sabethinus) intermedius* (new lectotype); *188. Sabethes (Sabethinus) albiprivatus* (*melanonymphe*, new name); *193. Coquillettidia (R.) arribalzagae; 201. Mansonia (M.) amazonensis* (type locality restricted); *206. Mansonia (M.) pseudotitillans; 207. Mansonia (M.) titillans* (type locality restricted); *209. Uranotaenia albitarsis; 213. Uranotaenia geometrica; 217. Uranotaenia pallidoventer; 219. Orthopodomyia longipalpis; 224. Psorophora (P.) scintillans; 228. Psorophora (J.) discrucians* (type locality restricted); *229. Psorophora (J.) arribalzagae; 232. Psorophora (J.) lutzii; 233. Psorophora (G.) apicalis* (*neoapicalis*, new name); *238. Aedes (O.) crinifer; 240. Aedes (O.) flavicosta* (type locality restricted); *247. Aedes (O.) serratus; 249. Aedes (F.) braziliensis; 250. Aedes (F.) fluviatilis* (new lectotype); *251. Aedes (F.) mediomaculatus; 252. Aedes (F.) tripunctatus; 253. Aedes (F.) leucomelas* (*leucocelaenus*, new name; new lectotype); *255. Aedes (F.) terrens* (type locality restricted); *256. Aedes (F.) oswaldi* (new lectotype); *260. Aedes (S.) exagitans; 270. Culex (C.) corniger; 272. Culex (C.) bilineatus* (type locality restricted); *281. Culex (C.) spinosus* (new lectotype); *283. Culex (Mel.) gordoni; 287. Culex (Mel.) innominatus* (type locality restricted); *296. Culex (Mel.) manaosensis; 302. Culex (Mel.) humilis; 304. Culex (Mel.) indecorabilis; 310. Culex (Mel.) nigrescens; 311. Culex (Mel.) clarki* (type locality restricted); *312. Culex (Mel.) nigricorpus; 314. Culex (Mel.) ocellatus; 322. Culex (Mel.) theobaldi* (new lectotype); *323. Culex (Mel.) chrysothorax; 324. Culex (Mel.) thomasi; 328. Culex (Mochl.) innovator* (type locality restricted); *339. Culex (Micr.) imitator; 340. Culex (Micr.) argenteoumbrosus; 347. Culex (Micr.) pleuristriatus; 353. Culex (Aed.) hildebrandi* (type locality restricted); *359. Culex (Anoed.) luteopleurus; 360. Culex (Anoed.) originator; 375. Corethrella kummi* (type locality restricted); *380. Corethrella tarsata; 394. Sayomyia braziliensis* (type locality restricted); *397. Edwardsops brevisector.*

The only type material of Brazilian mosquitoes that is missing in the BM collection is for *235. Psorophora perterrens* and *282. Culex (C.) virgultus.*

Casal (Osvaldo H. Casal, Departamento de Entomologia Sanitaria, Instituto Nacional de Microbiologia, Avda. Velez Sarsfield 563, Buenos Aires). The only type material in the private collection of Casal is that of *355. Culex (Aed.) clastrieri.*

DEI (Deutsches Entomologisches Institut; now Institut fur Pflanzenschutzforschung, Zweigstelle Eberswalde, Abteilung Taxonomie der Insekten, Schicklerstrasse 5, 13 Eberswalde, DDR). The holotype of *4. Chagasia stigmopteryx* Martini, 1932, formerly believed to be non-existent, has been located in DEI by G. Morge.

Duret (Jose P. Duret, Venezuela 2130, Buenos Aires). The holotypes of 15 species described by **Duret** and 2 species described by **Duret** and **Damasceno** are in the private collection of Duret: *278. Culex (C.) paramaxi; 286. Culex (Mel.) bahiensis; 290. Culex (Mel.) mojuensis; 292. Culex (Mel.) contei; 293. Culex (Mel.) cristovai; 297. Culex (Mel.) ernanii; 300. Culex (Mel.) faurani; 301. Culex (Mel.) flochi; 306. Culex (Mel.) isabelae; 307. Culex (Mel.) johnnyi; 308. Culex (Mel.) kerri; 319. Culex (Mel.) rachoui; 321. Culex (Mel.) silvai; 327. Culex (Mochl.) galvaoi; 329. Culex (Mochl.) palaciosi; 356. Culex (Anoed.) belemensis; 358. Culex (Anoed.) damascenoi.*

FH (Faculdade de Higiene e Saude Publica, Av. Dr. Arnaldo, 715, Caixa Postal 8099, Sao Paulo, S.P.). The FH collection is in excellent condition, but the type material is not segregated. The type material originally in SPM has been transferred to FH. At present the collection contains type material of 76 species: 2 species described by **Antunes & Lane**, 1 by **Barretto & Coutinho**, 7 by **Cerqueira**, 1 by **Cerqueira & Lane**, 1 by **Correa**, 1 by **Correa & Cerqueira**, 5 by **Correa & Ramalho**, 1 by **Correa & Ramos**, 1 by **Coutinho & Forattini**, 2 by **Fonseca & Ramos**, 1 by **Forattini, Rabello & Lopes**, 1 by **Forattini & Toda**, 1 by **Galindo, Carpenter & Trapido**, 2 by **Galvao**, 1 by **Galvao & Lane**, 38 by **Lane**, 1 by **Lane & Antunes**, 2 by **Lane & Cerqueira**, 2 by **Lane & Coutinho**, 1 by **Lane & Forattini**, 1 by **Lane, Forattini & Rabello**, 1 by **Lane & Guimaraes**, 1 by **Lane & Ramalho**, and 1 by **Lutz**. Except as noted, all the species are represented by holotypes or previously designated lectotypes: *8. Anopheles (A.) anchietai; 9. Anopheles (A.) bustamentei; 19. Anopheles (A.) limai (costalimai,* new name*) 20. Anopheles (A.) costai; 26. Anopheles (A.) rachoui* (new lectotype)*; 32. Anopheles (N.) imperfectus; 54. Anopheles (N.) noroestensis* (new lectotype; possibly partly in FMSP)*; 67. Anopheles (K.) montemor; 68. Anopheles (K.) laneanus; 96. Trichoprosopon (I.) luederwaldti; 108. Wyeomyia (W.) downsi; 117. Wyeomyia (C.) dyari; 142. Phoniomyia antunesi* (syntypes)*; 145. Phoniomyia diabolica; 148. Phoniomyia galvaoi; 151. Phoniomyia lopesi; 173. Sabethes (S.) forattinii; 174. Sabethes (S.) lanei; 179. Sabethes (S.) shannoni; 180. Sabethes (S.) spixi; 183. Sabethes (Sabethoides) tridentatus; 195. Coquillettidia (R.) hermanoi; 199. Coquillettidia (R.) neivai; 200. Coquillettidia (R.) shannoni; 205. Mansonia (M.) pessoai; 210. Uranotaenia davisi; 212. Uranotaenia burkii; 214. Uranotaenia mathesoni; 227. Psorophora (J.) amazonica; 243. Aedes (O.) pennai; 254. Aedes (F.) leucophoebus; 262. Haemagogus (S.) baresi; 265. Culex (C.) abnormalis; 267. Culex (C.) airozai; 268. Culex (C.) brami; 271. Culex (C.) deanei; 273. Culex (C.) foliaceus; 274. Culex (C.) forattinii; 276. Culex (C.) mauesensis; 280. Culex (C.) renatoi; 344. Culex (Micr.) lanei; 349. Culex (Micr.) shopei; 361. Culex (Car.) anduzei; 363. Culex (Car.) iridescens* (neotype)*; 364. Culex (Car.) soperi; 368. Corethrella confusa; 369. Corethrella bromelicola; 370. Corethrella cardosoi; 371. Corethrella edwardsi* (type locality restricted)*; 372. Corethrella flavitibia; 373. Corethrella fulva; 374. Corethrella infuscata; 376. Corethrella lopesi; 377. Corethrella pillosa; 378. Corethrella selvicola; 379. Corethrella striata; 381. Corethrella travassosi; 382. Corethrella vittata; 383. Corethrella whitmani* (type locality restricted); *384. Lutzomiops alticola; 386. Lutzomiops barrettoi; 387. Lutzomiops coutinhoi; 388. Lutzomiops niger; 389. Lutzomiops iridescens; 390. Lutzomiops juquianus; 391. Lutzomiops lutzi; 392. Lutzomiops manaosensis; 393. Lutzomiops nigrescens; 395. Sayomyia antunesi; 396. Sayomyia souzai, 398. Edwardsops magnificus; 399. Edwardsops unicolor; 400. Dixella chapadensis; 402. Dixella paulistana; 403. Dixella torrentia; 404. Dixella wygodzinskyi* (new lectotype).

As noted under **Lane** in the authors section, we consider that the specimens in FH labelled as holotypes of the following species are only paratypes: *143. Phonio-*

myia bonnei; 144. Phoniomyia davisi; 156. Phoniomyia neivai and *157. Phoniomyia theobaldi.*

Type material of *109. Wyeomyia (W.) leucotarsis*, stated to be in FH by Stone, Knight and Starcke (1959:79), is not in this collection.

FMRP (Departamento de Parasitologia, Faculdade de Medicina, Ribeirao Preto, S.P.). The holotypes of the 3 species described by **Duret** and **Barretto**, *285. Culex (Mel.) aureonotatus, 289. Culex (Mel.) bifoliolatus and 325. Culex (Mel.) trilobulatus*, were not examined by Belkin but J.P. Duret assurred him that they are in FMRP.

FMSP (Departamento de Parasitologia, Faculdade de Medicina, Sao Paulo, S.P.). It appears that the mosquito collection in FMSP has not been taken care of in several years. It is in deplorable condition and unless prompt action is taken the remaining type material will be lost. The only type material found by Belkin in 1969 was for the following 7 species: *31. Anopheles (N.) marajoara* Galvao & Damasceno (doubtful syntypes); *34. Anopheles (N.) antunesi* Galvao & Amaral (holotype); *40. Anopheles (N.) pessoai* Galvao & Lane (holotype); *48. Anopheles (N.) galvaoi* Causey, Deane & Deane (lectotype by present designation); *49. Anopheles (N.) lanei* Galvao & Amaral (holotype); *70. Anopheles (L.) pseudotibiamaculatus* Galvao & Barretto (holotype); *350. Culex (Micr.) worontzowi* Pessoa & Gàlvao (holotype).

Type material of the following 2 species, originally stated to be in FMSP, was not found; its location is considered unknown (LU) for the present, although it seems probable that it has been lost: *60. Anopheles (N.) konderi* Galvao & Damasceno; *208. Mansonia (M.) wilsoni* Barretto & Coutinho.

A male of *54. Anopheles (N.) noroestensis* Galvao & Lane, 1937 in FMSP (343) may be the specimen from which the genitalia, designated as lectotype of this species (in FH), was removed.

IB (Instituto Butantan, Butanta, Sao Paulo, S.P.). The small mosquito collection in IB is in good condition. The specimens have been renumbered but there is a cross reference to the original numbers. The few Adolpho Lutz specimens do not include any type material. The only type material in IB consists of the holotypes of the 2 species described by Prado: *192. Coquillettidia (R.) albifera* and *211. Uranotaenia ditaenionota.*

IBSP (Instituto Biologico, Sao Paulo, S.P.). The mosquito collection in the Animal Parasitology section of the institute is in poor condition; its register has been lost. Fortunately some type material of the only species originally deposited in this collection, *269. Culex (C.) carcinoxenus*, was found in IOC (see).

IOC (Instituto Oswaldo Cruz, Av. Brasil, Manguinhos, Rio de Janeiro, GB.). The mosquito collection in IOC is the oldest in Brazil. As indicated in the authors section under **Lima** and **Lutz**, apparently the specimens were at one time pinned in small boxes. This arrangement may date back to **Lutz** or to **Peryassu** or **Neiva**. Later some of the specimens from the old collection were transferred to individual tubes, probably by **Costa Lima**. Others are still in the original boxes. Additions to the collection were put in individual tubes except for the types of sabethines described by Lane and Cerqueira which are in unit trays. We have not been able to find in IOC some of the types stated to have been deposited in this collection by the original authors with indication of collection number. We did not find a register of the collection numbers in IOC. The only records available to us were cards arranged in a taxonomic order. It is apparent that IOC has had a very liberal policy of loaning type specimens. In a few instances notations were made on the cards but in other cases it seems that the cards were either removed from the file or no record of the loan was entered. We did not locate the collection of the Rockefeller Foundation Laboratory which was originally in IOC.

We found apparently authentic type material of 77 topotypic Brazilian nominal species in IOC: 1 species described by **Castro**; 1 by **Cerqueira**; 3 by **Chagas**; 3 by **Cruz**; 1 by **Del Ponte**; 3 by **Del Ponte** and **Cerqueira**; 31 species by **Lane** and **Cerqueira**; 9 by **Lima**; 1 by **Lima, Guitton** and **Ferreira**; 9 by **Lutz**; 4 by **Lutz** and **Neiva**; 2 by **Neiva** and **Pinto**; 8 by **Peryassu**; 1 by **Theobald.** Because of insufficient data on the specimens and need for further study of the material we have refrained from designating lectotypes or positively identifying the holotypes of several species as indicated in the following list; the species without notation are represented by holotypes: *6. Anopheles (S.) lineatus* (possibly holotype)*; 11. Anopheles (A.) evandroi; 13. Anopheles (A.) intermedius* (possibly syntype)*; 15. Anopheles (A.) mattogrossensis; 21. Anopheles (A.) minor* (syntypes)*; 22. Anopheles (A.) lutzi (peryassui*, new name; possibly syntypes*); 25. Anopheles (A.) pseudomaculipes* (possibly syntype)*; 39. Anopheles (N.) braziliensis* (syntypes)*; 50. Anopheles (N.) lutzii* (syntypes)*; 61. Anopheles (N.) parvus* (possibly syntypes)*; 62. Anopheles (N.) rondoni* (new lectotype)*; 64. Anopheles (N.) cuyabensis* (new lectotype)*; 71. Toxorhynchites (A.) catharinensis; 75. Toxorhynchites (L.) bambusicola* (syntypes)*; 78. Toxorhynchites (L.) pusillus* (syntypes)*; 82. Toxorhynchites (L.) posticatus* (syntypes)*; 85. Toxorhynchites (L.) fluminensis* (possibly syntype)*; 86. Trichoprosopon (T.) compressum* (syntypes)*; 90. Trichoprosopon (T.) obscurum; 92. Trichoprosopon (T.) soaresi; 93. Trichoprosopon (L.) brevipes* (new lectotype)*; 95. Trichoprosopon (S.) longipalpis* (possibly syntype)*; 97. Trichoprosopon (C.) walcotti; 98. Trichoprosopon (R.) castroi; 100. Trichoprosopon (R.) edwardsianum; 101. Trichoprosopon (R.) humboldti; 104. Trichoprosopon (R.) reversum; 105. Trichoprosopon (R.) simile; 106. Trichoprosopon (R.) theobaldi; 107. Wyeomyia (W.) arthrostigma* (new lectotype)*; 110. Wyeomyia (W.) limai; 111. Wyeomyia (W.) lutzi* (syntypes)*; 113. Wyeomyia (W.) oblita* (syntype; also BM)*; 114. Wyeomyia (W.) pintoi; 115. Wyeomyia (W.) sabethea; 116. Wyeomyia (W.) serrata* (new lectotype)*; 118. Wyeomyia (C.) kummi; 121. Wyeomyia (A.) rooti (alani*, new name*); 122. Wyeomyia (D.) airosai; 124. Wyeomyia (D.) cesari; 126. Wyeomyia (D.) finlayi; 127. Wyeomyia (D.) howardi; 128. Wyeomyia (D.) kerri; 129. Wyeomyia (D.) knabi; 136. Wyeomyia (D.) rooti* (new lectotype)*; 137. Wyeomyia (D.) delpontei; 138. Wyeomyia (D.) shannoni; 140. Wyeomyia (D.) tarsata; 141. Wyeomyia (D.) undulata; 143. Phoniomyia bonnei; 144. Phoniomyia davisi; 147. Phoniomyia flabellata; 153. Phoniomyia palmata; 156. Phoniomyia neivai; 157. Phoniomyia theobaldi; 167. Sabethes (S.) batesi; 175. Sabethes (S.) lutzii* (possibly holotype)*; 177. Sabethes (S.) purpureus (remipusculus*, new name; new lectotype*); 185. Sabethes (Sabethinus) fabricii; 186. Sabethes (Sabethinus) lutzianus; 189. Sabethes (Sabethinus) soperi; 190. Sabethes (Sabethinus) whitmani; 191. Coquillettidia (R.) albicosta* (new lectotype)*; 194. Coquillettidia (R.) chrysonotum* (syntypes, also in Mus Nac)*; 196. Coquillettidia (R.) juxtamansonia* (new lectotype)*; 203. Mansonia (M.) chagasi; 218. Orthopodomyia albicosta* (new lectotype)*; 220. Orthopodomyia townsendi; 221. Orthopodomyia sampaioi; 225. Psorophora (P.) genumaculata* (new lectotype)*; 226. Psorophora (J.) albigenu; 230. Psorophora (J.) forceps; 234. Psorophora (G.) scutipunctata* (possibly syntypes)*; 269. Culex (C.) carcinoxenus* (new lectotype)*; 291. Culex (Mel.) chrysothorax* (new lectotype)*; 299. Culex (Mel.) fasciolatus* (possibly syntypes)*; 309. Culex (Mel.) lugens* (syntypes).

Type material of the following species, stated to be in IOC, was not located in this collection; it was probably borrowed and not returned or misplaced: *1. Chagasia fajardi; 28. Anopheles (A.) tibiamaculatus; 63. Anopheles (N.) triannulatus; 119. Wyeomyia (C.) mattinglyi; 135. Wyeomyia (D.) brucei; 162. Limatus flavisetosus; 168. Sabethes (S.) belisarioi; 215. Uranotaenia noctivaga; 236. Aedes (O.) aenigmaticus; 242. Aedes (O.) lepidus; 244. Aedes (O.) perventor; 245. Aedes (O.) rhyacophilus; 261. Haemagogus (L.) tropicalis; 352. Culex (Aed.) amazonensis.*

For other material possibly in IOC see **LU** under the following senior authors: **Chagas; Castro; Cerqueira; Cruz; Del Ponte; Lane; Lima; Lutz; Neiva; Peryassu; Shannon.**

LU (Location unknown). Listed here are 49 nominal species whose types have not been located but may be extant. They are arranged according to senior authors with indication of depositories where additional search should be made before their type material can be declared to be non-existent.

Barretto & Coutinho; possibly in FMSP: *202. Mansonia (M.) cerqueirai; 208. Mansonia (M.) wilsoni.*

Castro; should be in IOC: *162. Limatus flavisetosus.*

Cerqueira & Antunes; Cerqueira & Costa; Cerqueira & Paraense; should be in IOC: *236. Aedes (O.) aenigmaticus; 242. Aedes (O.) lepidus; 244. Aedes (O.) perventor; 261. Haemagogus (L.) tropicalis.*

Chagas; should be in IOC: *53. Anopheles (N.) nigritarsis.*

Cruz; should be in IOC: *2. Chagasia neivae.*

Del Ponte; Delponte & Cerqueira; should be in IOC or FH: *135. Wyeomyia (D.) brucei; 139. Wyeomyia (D.) subcomplosa.*

Dyar & Knab; possibly in NMW: *84. Toxorhynchites (L.) ambiguus.*

Galvao; Galvao & Damasceno; Galvao, Lane & Correa; should be in FMSP: *33. Anopheles (N.) domesticus; 42. Anopheles (N.) paulistensis; 60. Anopheles (N.) konderi; 65. Anopheles (N.) chagasi.*

Kumm; possibly in IOC or USNM: *335. Culex (Micr.) davisi.*

Lane; should be in IOC or FH: *109. Wyeomyia (W.) leucotarsis; 119. Wyeomyia (C.) mattinglyi.*

Lane & Whitman; originally in Rockefeller Foundation Laboratory at IOC: *313. Culex (Mel.) nigrimacula; 332. Culex (Micr.) aureus; 333. Culex (Micr.) carioca; 336. Culex (Micr.) dubitans; 341. Culex (Micr.) retrosus; 342. Culex (Micr.) fuscatus; 343. Culex (Micr.) intermedius; 348. Culex (Micr.) reducens; 357. Culex (Anoed.) canaanensis; 362. Culex (Car.) antunesi; 365. Culex (Car.) wilsoni.*

Lima; should be in IOC: *245. Aedes (O.) rhyacophilus.*

Lutz; should be in IOC: *1. Chagasia fajardi; 263. Haemagogus (S.) capricornii* (neotype)*; 352. Culex (Aed.) amazonensis.*

Neiva; Neiva & Pinto; should be in IOC: *28. Anopheles (A.) tibiamaculatus; 63. Anopheles (N.) triannulatus; 168. Sabethes (S.) belisarioi; 215. Uranotaenia noctivaga.*

Peryassu; should be in IOC or MusNac: *3. Chagasia maculata; 18. Anopheles (A.) rockefelleri; 23. Anopheles (A.) alagoanii; 69. Anopheles (L.) gilesi; 178. Sabethes (S.) quasicyaneus; 216. Uranotaenia argenteopennis.*

Ramos; possibly in SPM: *36. Anopheles (N.) guarujaensis.*

Rondani; possibly in Bologna (see Belkin, 1968:53): *87. Trichoprosopon (T.) digitatum; 246. Aedes (O.) scapularis.*

Shannon & Cerqueira; should be in IOC: *231. Psorophora (J.) lanei.*

Theobald; should be in BM: *282. Culex (C.) virgultus.*

MNHP (Museum National d'Histoire Naturelle, Laboratoire d'Entomologie Generale, 45 bis r. Buffon, Paris, V^{e}). The holotypes of 2 Brazilian species described by Macquart are in MNHP: *237. Aedes (O.) albifasciatus* and *259. Aedes (S.) toxorhynchus.*

Museu Nacional, Rio de Janeiro (Quinta da Boa Vista, Rio de Janeiro, GB.). Syntypes of 3 **Peryassu** species were found in this collection: *29. Anopheles (N.) allopha; 58. Anopheles (N.) oswaldoi; 194. Coquillettidia (R.) chrysonotum.* For additional species possibly to be found in this collection see LU under **Peryassu.**

NE (Non-existent). Type material of the following 27 species, listed by authors, has not been located and it is reasonably certain that it is non-existent.

Bonne-Wepster & Bonne, originally in USNM: *158. Phoniomyia tripartita.*

Bourroul: *77. Toxorhynchites (L.) mariae.*

Causey, Deane & Deane: *5. Chagasia rozeboomi.*

Correa: *10. Anopheles (A.) geometricus.*

Galvao & Lane; originally in FMSP: *30. Anopheles (N.) limai.*

Kollar: *367. Culex molestus.*

Laveran: *160. Limatus curvirostris.*

Lutz; originally probably in IOC: *74. Toxorhynchites (A.) neglectus; 88. Trichoprosopon (T.) splendens; 120. Wyeomyia (M.) leucostigma; 123. Wyeomyia (D.) bourrouli; 125. Wyeomyia (D.) confusa; 258. Aedes (H.) fulvithorax; 330. Culex (Micr.) albipes.*

Macquart; originally in MNHP: *223. Psorophora (P.) pilipes.*

Neveu-Lemaire; originally in FMP: *248. Aedes (O.) mathisi; 354. Culex americanus.*

Robineau-Desvoidy; originally some in MNHP: *37. Anopheles (N.) argyritarsis; 171. Sabethes (S.) locuples; 222. Psorophora (P.) tibialis; 366. Culex pallipes.*

Unti: *44. Anopheles (N.) ramosi; 45. Anopheles (N.) arthuri; 46. Anopheles (N.) artigasi; 47. Anopheles (N.) albertoi; 55. Anopheles (N.) ayrozai.*

Walker; originally in BM: *235. Psorophora perterrens.*

NMW (Naturhistorisches Museum, Burgring 7, Wien 1). Type material of only 3 Brazilian species is in NMW: *81. Toxorhynchites (L.) ferox* (*wiedemanni*, new name; syntypes; also in SNG)*; 83. Toxorhynchites (L.) violaceus* (lectotype)*; 279. Culex (C.) aestuans* (lectotype); all described by **Wiedemann.**

SNG (Natur-Museum and Forschungs-Institut Senckenberg, Senckenberg-Anlage 25, 6 Frankfurt 1). Type material of only 3 Brazilian species is in SNG: *73. Toxorhynchites (A.) trichopygus* (syntypes)*; 81. Toxorhynchites (L.) ferox (wiedemanni,* new name; syntypes; also in NMW*), 239. Aedes (O.) fulvus;* all described by **Wiedemann.**

SPM (Servico de Profilaxia da Malaria, Sao Paulo, S.P.). All the type material formerly in the SPM collection has been transferred to FH. See also **LU** under **Ramos.**

Universidade do Minas Gerais (Belo Horizonte). The exact location of the type of *401. Dixella limai*, described by **Santos**, is unknown.

USNM (U.S. National Museum of Natural History, Wash., D.C. 20560). Holotypes or lectotypes of 51 topotypic Brazilian nominal species are in USNM: 1 species described by **Berlin**; 1 by **Causey**; 1 by **Causey, Deane, Deane & Sampaio**;

1 by **Davis**; 5 by **Dyar**; 4 by **Dyar & Shannon**; 1 by **Forattini**; 1 by **Galvao & Lane**; 1 by **Komp**; 1 by **Lane**; 1 by **Lane & Cerqueira**; 1 by **Lutz**; 1 by **Matheson**; 24 by **Root**; 1 by **Rozeboom & Gabaldon**; 1 by **Serafim and Davis**; 3 by **Shannon**; 2 by **Stone**. *7. Anopheles (S.) lewisi (thomasi,* new name*); 12. Anopheles (A.) fluminensis; 24. Anopheles (A.) celidopus; 27. Anopheles (A.) shannoni; 35. Anopheles (N.) emilianus; 38. Anopheles (N.) sawyeri; 41. Anopheles (N.) darlingi; 43. Anopheles (N.) strodei; 52. Anopheles (N.) guarani; 56. Anopheles (N.) goeldii; 57. Anopheles (N.) dunhami; 59. Anopheles (N.) metcalfi; 89. Trichoprosopon (T.) townsendi; 99. Trichoprosopon (R.) cerqueirai; 102. Trichoprosopon (R.) trichopus; 131. Wyeomyia (D.) melanoides; 132. Wyeomyia (D.) mystes; 146. Phoniomyia edwardsi; 149. Phoniomyia incaudata; 154. Phoniomyia pilicauda; 182. Sabethes (Sabethoides) glaucodaemon; 197. Coquillettidia (R.) hypocindyna; 198. Coquillettidia (R.) lynchi; 204. Mansonia (M.) indubitans; 241. Aedes (O.) jacobinae; 257. Aedes (H.) aureolineatus; 264. Culex (L.) brasiliae; 266. Culex (C.) acharistus; 275. Culex (C.) lygrus; 277. Culex (C.) oswaldoi; 284. Culex (Mel.) andricus; 288. Culex (Mel.) bequaerti; 294. Culex (Mel.) exedrus; 295. Culex (Mel.) dyius; 298. Culex (Mel.) evansae; 303. Culex (Mel.) inadmirabilis; 305. Culex (Mel.) cenus; 315. Culex (Mel.) automartus; 316. Culex (Mel.) oedipus; 317. Culex (Mel.) plectoporpe; 318. Culex (Mel.) putumayensis; 320. Culex (Mel.) serratimarge; 326. Culex (Mochl.) megapus; 331. Culex (Micr.) aphylactus; 334. Culex (Micr.) trychnus; 337. Culex (Micr.) gairus; 338. Culex (Micr.) hedys; 345. Culex (Micr.) microphyllus; 346. Culex (Micr.) neglectus; 351. Culex (Aed.) accelerans; 385. Lutzomiops amazonicus.*

ZMC (Universitetets Zoologiske Museum, Universitetsparken 15, Kobenhavn). The only Brazilian culicid type material in ZMC is the holotype of **Wiedemann's** *172. Sabethes (S.) remipes.*

LOCALITIES

ACRE

Feijo: *254. Aedes (F.) leucophoebus.*
Rio Branco: *48. Anopheles (N.) galvaoi.*

ALAGOAS

Maceio: *23. Anopheles (A.) alagoanii.*

AMAPA

Cunani: *248. Aedes (O.) mathisi; 354. Culex americanus.*

AMAZONAS

Coari: *60. Anopheles (N.) konderi.*

Itacoatiara: *287. Culex (Mel.) innominatus; 312. Culex (Mel.) nigricorpus; 328. Culex (Mochl.) innovator; 353. Culex (Aed.) hildebrandi.*

Manaus and vicinity: *16. Anopheles (A.) amazonicus; 65. Anopheles (N.) chagasi; 72. Toxorhynchites (A.) purpureus; 76. Toxorhynchites (L.) horei* (Macapa)*; 88. Trichoprosopon (T.) splendens; 133. Wyeomyia (D.) negrensis* (Macapa)*; 165. Sabethes (S.) amazonicus* (Macapa)*; 173. Sabethes (S.) forattinii* (km 23, route 17)*; 174. Sabethes (S.) lanei* (km 23, route 17)*; 175. Sabethes (S.) lutzii; 179. Sabethes*

(S.) shannoni (Igarape do Leao); *180. Sabethes (S.) spixi* (km 23, route 17); *183. Sabethes (Sabethoides) tridentatus* (Igarape de Bolivia); *209. Uranotaenia albitarsis* (Macapa); *219. Orthopodomyia longipalpis; 227. Psorophora (J.) amazonica* (Igarape do Taruma);*240. Aedes (O.) flavicosta; 249. Aedes (F.) braziliensis* (Macapa); *262. Haemagogus (S.) baresi* (Igarape do Taruma); *283. Culex (Mel.) gordoni* (Bosque); *296. Culex (Mel.) manaosensis; 300. Culex (Mel.) faurani; 311. Culex (Mel.) clarki; 323. Culex (Mel.) chrysothorax* (inner Flores swamp, Pensador); *324. Culex (Mel.) thomasi; 352. Culex (Aed.) amazonensis; 360. Culex (Anoed.) originator* (Macapa); *392. Lutzomiops manaosensis; 397. Edwardsops brevisector.*

Maues: *276. Culex (C.) mauesensis.*

Rio Maues: *361. Culex (Car.) anduzei.*

Rio Parauari: *267. Culex (C.) airozai.*

Rio Preto, municipio Joao Goulard: *307. Culex (Mel.) johnnyi; 308. Culex (Mel.) kerri; 358. Culex (Anoed.) damascenoi.*

Santo Antonio do Ica: *318. Culex (Mel.) putumayensis.*

Tefe: *57. Anopheles (N.) dunhami; 102. Trichoprosopon (T.) trichopus.*

BAHIA

Camacari: *380. Corethrella tarsata.*

Caravelas: *97. Trichoprosopon (Ct.) walcotti.*

Gois Calmon (Muriqueira): *127. Wyeomyia (D.) howardi; 147. Phoniomyia flabellata.*

Itaparica, Ilha de: *77. Toxorhynchites (L.) mariae; 330. Culex (Micr.) albipes.*

Jacobina: *241. Aedes (O.) jacobinae.*

Piraja: *189. Sabethes (Sabethinus) soperi; 257. Aedes (H.) aureolineatus.*

Salvador (Bahia) and vicinity: *7. Anopheles (S.) lewisi; 73. Toxorhynchites (A.) trichopygus; 81. Toxorhynchites (L.) ferox; 83. Toxorhynchites (L.) violaceus; 84. Toxorhynchites (L.) ambiguus; 112. Wyeomyia (W.) medioalbipes; 119. Wyeomyia (C.) mattinglyi; 139. Wyeomyia (D.) subcomplosa* [see also Cuiaba (Mato Grosso); Belem and Curralinho (Para); Sergipe]; *172. Sabethes (S.) remipes; 210. Uranotaenia davisi; 239. Aedes (O.) fulvus; 279. Culex (C.) aestuans; 335. Culex (Micr.) davisi; 375. Corethrella kummi.*

Santo Amaro (municipio), Acude Sao Bento: *26. Anopheles (A.) rachoui.*

Urucuca: *286. Culex (Mel.) bahiensis.*

CEARA

Sao Benedito: *5. Chagasia rozeboomi; 38. Anopheles (N.) sawyeri.*

ESPIRITO SANTO

Santa Teresa: *122. Wyeomyia (D.) airosai.*

Sao Joao de Petropolis (Vale do Canaa): *92. Trichoprosopon (T.) soaresi; 190. Sabethes (Sabethinus) whitmani; 245. Aedes (O.) rhyacophilus; 357. Culex (Anoed.) canaanensis; 362. Culex (Car.) antunesi; 365. Culex (Car.) wilsoni; 383. Corethrella whitmani.*

Vale do Rio Doce (see also Baixada Fluminense, state of Rio de Janeiro): *58. Anopheles (N.) oswaldoi; 194. Coquillettidia (R.) chrysonotum.*

GOIAS

Anapolis: *140. Wyeomyia (D.) tarsata.*

Inhumas: *368. Corethrella confusa.*

Ponte Ipe-Arcado: *258. Aedes (H.) fulvithorax.*

GUANABARA

Rio de Janeiro and vicinity: *13. Anopheles (A.) intermedius* (see also Xerem, state of Rio de Janeiro); *18. Anopheles (A.) rockefelleri; 29. Anopheles (N.) allopha* (see also state of Rio de Janeiro, Baixada Fluminense); *37. Anopheles (N.) argyritarsis; 50. Anopheles (N.) lutzii* (Lagoa Rodrigo de Freitas); *66. Anopheles (K.) lutzii; 78. Toxorhynchites (L.) pusillus* (Alto da Boa Vista); *85. Toxorhynchites (L.) fluminensis; 87. Trichoprosopon (T.) digitatum; 93. Trichoprosopon (L.) brevipes* (Laranjeiras); *99. Trichoprosopon (R.) cerqueirai; 101. Trichoprosopon (R.) humboldti* (Paineiras); *103. Trichoprosopon (R.) lunatum* (Maua); *111. Wyeomyia (W.) lutzi* (Alto da Boa Vista); *121. Wyeomyia (A.) rooti; 132. Wyeomyia (D.) mystes; 143. Phoniomyia bonnei; 149. Phoniomyia incaudata; 150. Phoniomyia longirostris; 152. Phoniomyia pallidoventer; 153. Phoniomyia palmata; 155. Phoniomyia quasilongirostris* (Maua) ; *157. Phoniomyia theobaldi; 160. Limatus curvirostris; 171. Sabethes (S.) locuples; 176. Sabethes (S.) purpureus; 215. Uranotaenia noctivaga* (Gavea); *216. Uranotaenia argenteopennis* (see also Baixada Fluminense, state of Rio de Janeiro); *221. Orthopodomyia sampaioi* (Tijuca); *222. Psorophora (P.) tibialis; 223. Psorophora (P.) pilipes; 228. Psorophora (J.), discrucians; 230. Psorophora (J.) forceps* (Jacarepagua); *232. Psorophora (J.) lutzii* (Quinta da Boa Vista); *233. Psorophora (G.) apicalis; 235. Psorophora perterrens; 237. Aedes (O.) albifasciatus; 246. Aedes (O.) scapularis; 247. Aedes (O.) serratus* (Quinta da Boa Vista); *255. Aedes (F.) terrens; 259. Aedes (S.) toxorhynchus; 282. Culex (C.) virgultus* (Quinta da Boa Vista); *291. Culex (Mel.) chrysothorax* (Copacabana); *313. Culex (Mel.) nigrimacula; 315. Culex (Mel.) automartus* (Jardim Botanico); *317. Culex (Mel.) plectoporpe* (Bangu); *332. Culex (Micr.) aureus; 333. Culex (Micr.) carioca; 336. Culex (Micr.) dubitans; 337. Culex (Micr.) gairus* (Jardim Botanico); *340. Culex (Micr.) argenteoumbrosus; 341. Culex (Micr.) retrosus; 342. Culex (Micr.) fuscatus; 343. Culex (Micr.) intermedius; 348. Culex (Micr.) reducens; 366. Culex pallipes; 367. Culex molestus.*

MATO GROSSO

Acampamento dos Morros Azues: *195. Coquillettidia (R.) hermanoi.*

Boa Esperanca (see also Pocinho): *109. Wyeomyia (W.) leucotarsis.*

Coronel Ponce: *212. Uranotaenia burkii; 265. Culex (C.) abnormalis.*

Cuiaba: *124. Wyeomyia (D.) cesari; 128. Wyeomyia (D.) kerri; 135. Wyeomyia (D.) brucei; 136. Wyeomyia (D.) rooti; 137. Wyeomyia (D.) delpontei; 139. Wyeomyia (D.) subcomplosa* [see also Salvador (Bahia); Belem and Curralinho (Para); Sergipe]; *141. Wyeomyia (D.) undulata; 200. Coquillettidia (R.) shannoni.*

Ladario, on Rio Paraguai: *62. Anopheles (N.) rondoni.*

Lagoa de Mandiore [as Manicore and Mandicore]: *15. Anopheles (A.) mattogrossensis.*

Maracaju: *202. Mansonia (M.) cerqueirai; 231. Psorophora (J.) lanei; 236. Aedes (O.) aenigmaticus; 388. Lutzomiops niger.*

Melguierra, Ribeirao Amolar, headwaters of Rio Paraguai south of Diamantino: *166. Sabethes (S.) longfieldae; 169. Sabethes (S.) argyronotum.*

Pocinho (see also Boa Esperanca): *109. Wyeomyia (W.) leucotarsis.*

Portinha, Chapada region: *400. Dixella chapadensis.*

Salobra, on Rio Miranda: *371. Corethrella edwardsi; 381. Corethrella travassosi;*

398. Edwardsops magnificus; 399. Edwardsops unicolor.

Sao Joao (Fazenda), right bank of Rio Cuiaba: *63. Anopheles (N.) triannulatus; 64. Anopheles (N.) cuyabensis.*

MINAS GERAIS

Belo Horizonte: *242. Aedes (O.) lepidus.*

Bicudo(s), Rio: *22. Anopheles (A.) lutzi; 168. Sabethes (S.) belisarioi; 203. Mansonia (M.) chagasi.*

Cambuquira: *3. Chagasia maculata.*

Engenheiro Dolabela: *278. Culex (C.) paramaxi.*

Juiz de Fora and vicinity: *2. Chagasia neivae; 43. Anopheles (N.) strodei* (near Agua Limpa station)*; 177. Sabethes (S.) purpureus; 196. Coquillettidia (R.) juxtamansonia; 266. Culex (C.) acharistus* (Agua Limpa).

Lassance and vicinity, Vale do Rio das Velhas: *39. Anopheles (N.) braziliensis; 69. Anopheles (L.) gilesi; 284. Culex (Mel.) andricus.*

Oliveira: *28. Anopheles (A.) tibiamaculatus; 53. Anopheles (N.) nigritarsis; 61. Anopheles (N.) parvus.*

Uberaba, near Belo Horizonte: *401. Dixella limai.*

PARA

Belem (Para) and vicinity: *27. Anopheles (A.) shannoni; 35. Anopheles (N.) emilianus; 130. Wyeomyia (D.) luteoventralis; 139. Wyeomyia (D.) subcomplosa* [see also Curralinho; Salvador (Bahia); Cuiaba (Mato Grosso); Sergipe]*; 159. Limatus durhamii; 161. Limatus paraensis; 170. Sabethes (S.) nitidus; 178. Sabethes (S.) quasicyaneus* (Utinga)*; 181. Sabethes (Sabethoides) confusus; 193. Coquillettidia (R.) arribalzagae; 198. Coquillettidia (R.) lynchi; 204. Mansonia (M.) indubitans; 207. Mansonia (M.) titillans; 217. Uranotaenia pallidoventer; 224. Psorophora (P.) scintillans; 251. Aedes (F.) mediomaculatus; 260. Aedes (S.) exagitans; 270. Culex (C.) corniger; 301. Culex (Mel.) flochi* (Rio Moju)*; 304. Culex (Mel.) indecorabilis; 349. Culex (Micr.) shopei* (Utinga)*; 355. Culex (Aed.) clastrieri; 356. Culex (Anoed.) belemensis; 359. Culex (Anoed.) luteopleurus.*

Boa Vista, Rio Tapajos: *56. Anopheles (N.) goeldii; 89. Trichoprosopon (T.) townsendi; 220. Orthopodomyia townsendi.*

Breves: *206. Mansonia (M.) pseudotitillans.*

Cachoeira do Arari, Ilha do Marajo: *31. Anopheles (N.) marajoara; 33. Anopheles (N.) domesticus.*

Curralinho: *118. Wyeomyia (C.) kummi; 139. Wyeomyia (D.) subcomplosa* (Rio Canaticu) [see also Belem; Salvador (Bahia); Cuiaba (Mato Grosso); Sergipe]*; 261. Haemagogus (L.) tropicalis.*

Guama (Sao Miguel do): *292. Culex (Mel.) contei.*

Gurupa: *201. Mansonia (M.) amazonensis.*

Oriboca, Rio Guajara: *290. Culex (Mel.) mojuensis.*

Paragominas, municipio Capim: *319. Culex (Mel.) rachoui.*

Santarem and vicinity: *100. Trichoprosopon (R.) edwardsianum* (Belterra)*; 396. Sayomyia souzai.*

PARANA

Curitiba: *205. Mansonia (M.) pessoai.*

Iguacu: *52. Anopheles (N.) guarani.*

Londrina: *110. Wyeomyia (W.) limai; 156. Phoniomyia neivai.*

RIO DE JANEIRO (STATE)

Angra dos Reis and vicinity: *326. Culex (Mochl.) megapus; 338. Culex (Micr.) hedys; 376. Corethrella lopesi* (Japuiba).

Baixada Fluminense, coastal lowlands: *29. Anopheles (N.) allopha* (see also Rio de Janeiro, Guanabara); *58. Anopheles (N.) oswaldoi* (see also Vale do Rio Doce, Espirito Santo); *194. Coquillettidia (R.) chrysonotum* (see also Vale do Rio Doce, Espirito Santo); *216. Uranotaenia argenteopennis* (see also Rio de Janeiro, Guanabara); *295. Culex (Mel.) dyius.*

Cachoeira: *129. Wyeomyia (D.) knabi.*

Chere: *327. Culex (Mochl.) galvaoi.*

Imbarie (Estrella): *21. Anopheles (A.) minor.*

Itaperuna: *12. Anopheles (A.) fluminensis.*

Mage: *104. Trichoprosopon (R.) reversum; 106. Trichoprosopon (R.) theobaldi; 131. Wyeomyia (D.) melanoides; 275. Culex (C.) lygrus; 298. Culex (Mel.) evansae; 305. Culex (Mel.) cenus; 316. Culex (Mel.) oedipus; 345. Culex (Micr.) microphyllus; 393. Lutzomiops nigrescens.*

Mangaratiba: *90. Trichoprosopon (T.) obscurum; 138. Wyeomyia (D.) shannoni; 144. Phoniomyia davisi; 244. Aedes (O.) perventor.*

Mendes: *114. Wyeomyia (W.) pintoi.*

Orgaos, Serra dos; woods near Rio Soberbo at crossing of railroad from Mage to Teresopolis: *331. Culex (Micr.) aphylactus; 334. Culex (Micr.) trychnus.*

Petropolis: *75. Toxorhynchites (L.) bambusicola; 82. Toxorhynchites (L.) posticatus; 86. Trichoprosopon (T.) compressum* (see also Sao Paulo, Sao Paulo); *117. Wyeomyia (C.) dyari.*

Porto das Caixas and vicinity: *41. Anopheles (N.) darlingi* (Caxiribu); *59. Anopheles (N.) metcalfi; 146. Phoniomyia edwardsi; 154. Phoniomyia pilicauda; 294. Culex (Mel.) exedrus; 351. Culex (Aed.) accelerans.*

Sant'Anna: *320. Culex (Mel.) serratimarge.*

Sao Bento: *11. Anopheles (A.) evandroi.*

Teresopolis: *98. Trichoprosopon (R.) castroi; 115. Wyeomyia (W.) sabethea.*

Tingua: *167. Sabethes (S.) batesi; 185. Sabethes (Sabethinus) fabricii; 186. Sabethes (Sabethinus) lutzianus.*

Xerem: *13. Anopheles (A.) intermedius* (see also Rio de Janeiro, Guanabara); *25. Anopheles (A.) pseudomaculipes; 126. Wyeomyia (D.) finlayi; 191. Coquillettidia (R.) albicosta.*

RIO GRANDE DO NORTE

Ares, near Sao Jose de Mipibu: *273. Culex (C.) foliaceus.*

Natal, Macaphyba: *277. Culex (C.) oswaldoi.*

RONDONIA

Porto Velho: *385. Lutzomiops amazonicus.*

RORAIMA

Boa Vista: *297. Culex (Mel.) ernanii; 329. Culex (Mochl.) palaciosi.*

Caracarai: *293. Culex (Mel.) cristovai; 306. Culex (Mel.) isabelae; 321. Culex*

(Mel.) silvai.

Carmo: *24. Anopheles (A.) celidopus.*

San Alberto [?] : *182. Sabethes (Sabethoides) glaucodaemon.*

Sororoca: *288. Culex (Mel.) bequaerti.*

SANTA CATARINA

Brusque: *71. Toxorhynchites (A.) catharinensis.*

Ribeirao Pequena, municipio Laguna: *9. Anopheles (A.) bustamentei.*

SAO PAULO

Avare, Fazenda Jose Euphrasio: *96. Trichoprosopon (I.) luederwaldti.*

Bertioga, municipio Santos: *269. Culex (C.) carcinoxenus; 344. Culex (Micr.) lanei.*

Bocaina, Serra da; Fazenda do Bonito: *256. Aedes (F.) oswaldi.*

Boraceia, municipio Salesopolis: *268. Culex (C.) brami.*

Cabreuva: *243. Aedes (O.) pennai.*

Campos do Jordao and vicinity: *34. Anopheles (N.) antunesi* (Emilio Ribas)*; 49. Anopheles (N.) lanei* (Emilio Ribas)*; 68. Anopheles (K.) laneanus* (1600 m)*; 105. Trichoprosopon (R.) simile; 142. Phoniomyia antunesi; 384. Lutzomiops alticola* (1700 m)*; 404. Dixella wygodzinskyi* (Vila Capivari, 1700 m).

Canaan: *226. Psorophora (J.) albigenu.*

Cantareira and vicinity: *51. Anopheles (N.) niger; 134. Wyeomyia (D.) personata; 184. Sabethes (Sabethinus) aurescens; 188. Sabethes (Sabethinus) albiprivatus; 218. Orthopodomyia albicosta* (Serra da Cantareira)*; 263. Haemagogus (S.) capricornii* (Horto Florestal)*; 346. Culex (Micr.) neglectus* (Serra da Cantareira)*; 363. Culex (Car.) iridescens* (Serra da Cantareira).

Caraguatatuba: *67. Anopheles (K.) montemor.*

Casa Grande, municipio Mogi das Cruzes: *70. Anopheles (L.) pseudotibiamaculatus; 370. Corethrella cardosoi; 386. Lutzomiops barrettoi.*

Cubatao: *213. Uranotaenia geometrica.*

Cubatao, Serra do: *162. Limatus flavisetosus.*

Diabo, Serra do; rio Cuiaba, municipio Venceslau: *145. Phoniomyia diabolica.*

Franca: *253. Aedes (F.) leucomelas.* See also Rio Grande.

Guaratingueta: *55. Anopheles (N.) ayrozai.*

Guaruja and vicinity: *10. Anopheles (A.) geometricus; 36. Anopheles (N.) guarujaensis; 148. Phoniomyia galvaoi* (Parada 24 de Outubro)*; 151. Phoniomyia lopesi* (Parada 24 de Outubro).

Itaici (Estacao de): *123. Wyeomyia (D.) bourrouli.*

Itapura, Rio Tiete immediately above: *234. Psorophora (G.) scutipunctata.*

Jaragua: *391. Lutzomiops lutzi.*

Juquia and vicinity: *199. Coquillettidia (R.) neivai; 214. Uranotaenia mathesoni; 369. Corethrella bromelicola* (Poco Grande)*; 372. Corethrella flavitibia; 374. Corethrella infuscata; 377. Corethrella pillosa* (Poco Grande)*; 378. Corethrella selvicola; 382. Corethrella vittata; 389. Lutzomiops iridescens; 390. Lutzomiops juquianus* (Poco Grande)*; 395. Sayomyia antunesi; 403. Dixella torrentia* (Salto do Poco Grande).

Lagoa: *309. Culex (Mel.) lugens; 322. Culex (Mel.) theobaldi.*

Lorena: *44. Anopheles (N.) ramosi.*

Lussanvira: See Pereira Barreto.

Mirassol: *108. Wyeomyia (W.) downsi.*

Palmeira: *379. Corethrella striata; 387. Lutzomiops coutinhoi.*

Pereira Barreto (Lussanvira, Novo Oriente): *42. Anopheles (N.) paulistensis; 54. Anopheles (N.) noroestensis.*

Perus: *364. Culex (Car.) soperi; 373. Corethrella fulva* (Agua Fria).

Ribeirao Preto: *285. Culex (Mel.) aureonotatus* (Fazenda Monte Alegre); *289. Culex (Mel.) bifoliolatus* (Fazenda Monte Alegre); *325. Culex (Mel.) trilobulatus* (Rio Tamandua).

Rio Grande, near Franca: *250. Aedes (F.) fluviatilis; 252. Aedes (F.) tripunctatus.*

Rio Paraiba do Sul, valley of: *45. Anopheles (N.) arthuri; 46. Anopheles (N.) artigasi; 47. Anopheles (N.) albertoi.*

Santa Cruz do Rio Pardo: *274. Culex (C.) forattinii.*

Santos: *225. Psorophora (P.) genumaculata.*

Sao Paulo and vicinity: *1. Chagasia fajardi; 4. Chagasia stigmopteryx* (Butantan); *6. Anopheles (S.) lineatus; 8. Anopheles (A.) anchietai* (Cangaiba); *14. Anopheles (A.) maculipes; 17. Anopheles (A.) mediopunctatus; 30. Anopheles (N.) limai* (Pinheiros and Butantan); *40. Anopheles (N.) pessoai* (left bank of Rio Pinheiros, Pinheiros); *74. Toxorhynchites (A.) neglectus; 79. Toxorhynchites (L.) solstitialis; 80. Toxorhynchites (L.) chrysocephalus; 86. Trichoprosopon (T.) compressum* (see also Petropolis, Rio de Janeiro); *91. Trichoprosopon (T.) pallidiventer; 94. Trichoprosopon (S.) fluviatile; 95. Trichoprosopon (S.) longipalpis; 107. Wyeomyia (W.) arthrostigma; 113. Wyeomyia (W.) oblita* (Pacaembu); *116. Wyeomyia (W.) serrata* (Rio Frio, Pindamonhangaba); *120. Wyeomyia (M.) leucostigma; 125. Wyeomyia (D.) confusa* (woods near); *158. Phoniomyia tripartita; 163. Sabethes (S.) albiprivus; 164. Sabethes (S.) albiprivatus; 187. Sabethes (Sabethinus) intermedius* (near); *192. Coquillettidia (R.) albifera* (Rio Pinheiros, Butantan); *197. Coquillettidia (R.) hypocindyna; 208. Mansonia (M.) wilsoni; 211. Uranotaenia ditaenionota; 229. Psorophora (J.) arribalzagae; 238. Aedes (O.) crinifer; 264. Culex (L.) brasiliae; 271. Culex (C.) deanei* (Campo de Marte, Santana); *272. Culex (C.) bilineatus; 280. Culex (C.) renatoi* (Bairro Sao Miguel Paulista); *281. Culex (C.) spinosus; 299. Culex (Mel.) fasciolatus* (wooded mountains near); *302. Culex (Mel.) humilis; 303. Culex (Mel.) inadmirabilis; 310. Culex (Mel.) nigrescens* (Santo Amaro); *314. Culex (Mel.) ocellatus; 339. Culex (Micr.) imitator; 347. Culex (Micr.) pleuristriatus; 394. Sayomyia braziliensis; 402. Dixella paulistana* (Campo Experimental da Agua Funda).

Sao Vicente: *19. Anopheles (A.) limai; 20. Anopheles (A.) costai.*

Tabatinguera: *350. Culex (Micr.) worontzowi.*

Vera Cruz: *32. Anopheles (N.) imperfectus.*

SERGIPE

Locality not specified: *139. Wyeomyia (D.) subcomplosa* [see also Salvador (Bahia); Cuiaba (Mato Grosso); Belem and Curralinho (Para)].

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Volume 7, Number 6, 1971

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XXVI. Winter biology of *Culex tarsalis* in Imperial Valley, California

by
Michael J. Nelson

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MOSQUITO STUDIES (Diptera, Culicidae)

XXVI. Winter biology of *Culex tarsalis* in Imperial Valley, California

by
Michael J. Nelson

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MOSQUITO STUDIES (Diptera, Culicidae)

XXVI. WINTER BIOLOGY OF *CULEX TARSALIS* IN IMPERIAL VALLEY, CALIFORNIA[1]

by

Michael J. Nelson[2]

ABSTRACT

Culex tarsalis Coquillett, 1896 is the most important vector of the viruses of western equine encephalomyelitis and St. Louis encephalitis in the western United States during the summer, but the overwintering mechanism for these 2 viruses is unknown. In most areas, *tarsalis* cannot carry virus through the winter because blood-fed females do not survive the coldest months. Overwintering females develop a large fat body and experience a developmental diapause. They usually do not take their first blood meal until the late winter or early spring. However, the mild winters in the Imperial Valley of southern California are more conducive to mosquito activity.

From September 1967 until April 1970, a population of *tarsalis* was studied at the Wister Unit of the Imperial Waterfowl Management Area, Imperial County, California, to determine to what degree feeding and other activities were maintained throughout the year. Each month, adult mosquitoes were collected in light traps with CO_2 attractants, CO_2 bait can traps, and resting shelters. Monthly searches for breeding sites were made.

The following characteristics of the females were recorded: external condition, insemination, stage of ovarian development, presence or absence of muscle tissue remnants, meconium, vertebrate blood, fat body, coiled ovarian tracheoles, and follicular relics. The degree of error in the interpretation of these age-grading criteria due to autogeny was similar to that of comparable studies of the winter biology of *tarsalis* in the Central Valley of California.

There were 2 depressions of the population density each year: a major one in the winter and a lesser in the summer. In contrast to studies to the north, at Wister during every winter month females were attracted to CO_2, males were found in shelters, and pupae and larvae of all instars were collected. Fat body developed only slightly and was largely exhausted before the coldest days of winter. The percentages

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[1] Contribution from project "Mosquitoes of Middle America" supported by U.S. Public Health Service Research Grant AI-04379 and U.S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478. Based on PhD dissertation submitted to the University of California, Los Angeles.

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of blood-engorged, gravid, and parous females decreased in the autumn, but recovered in December.

In the Imperial Valley of California, winter diapause of *tarsalis* is very weakly expressed. The duration of diapause is different at the various latitudes within the range of this species. A combination of short photoperiod and low temperature apparently initiates diapause at all latitudes. The relatively high fall and winter temperatures in the Imperial Valley are probably largely responsible for the weak expression and short duration of diapause there.

Potentially, *tarsalis* is a good candidate for overwintering arboviruses in the Imperial Valley. However, other workers have thus far failed to isolate the viruses from this species or from vertebrates in December and January at Wister. Without direct evidence of the viruses in the winter, it is not possible to determine the population density of mosquitoes and the level of blood feeding necessary to maintain the cycle of transmission.

INTRODUCTION

Culex tarsalis Coquillett, 1896 is the most important vector of western equine encephalomyelitis virus (WEE) and St. Louis encephalitis virus (SLE) in the western United States. Although the mosquito-avian transmission cycle of these viruses has been well documented for the summer months, the overwintering mechanism is unknown. In most areas, *tarsalis* cannot overwinter virus because blood-fed females do not survive the coldest months. However, the mild winters in the Imperial Valley of southern California are more conducive to mosquito activity.

In August 1967, following a report in June of 2 horse cases of WEE in Imperial County, Dr. Telford H. Work and I made a preliminary mosquito survey of the area. The Wister Unit of the Imperial Wildlife Management Area (p. 7) appeared to be a potentially favorable area for virus activity, as large populations of both mosquitoes and birds were present. Monthly mosquito collections and virus isolation attempts were initiated in September 1967. It soon became evident that, contrary to the behavior of *tarsalis* in other study areas, the Wister population remained relatively active throughout the winter. We speculated that if blood feeding continued at high level throughout the year, a mosquito-avian cycle could continue without interruption, and in the spring migrating birds might carry the virus northward to areas from which it disappeared each winter. Therefore, I initiated a 33-month study to determine to what degree *tarsalis* continued to feed and to maintain other activities throughout the year. Seasonal fluctuations in the following aspects of its biology were investigated and compared to similar studies in other areas:

I. Population density
    A. Mobility
    B. Females
    C. Males
    D. Immatures

II. Physiological parameters
    A. Fat body development
    B. Insemination
    C. Blood feeding and ovarian development
    D. Oviposition

I wish to express my unending gratitude to Dr. John N. Belkin for his invaluable assistance and guidance during this study. I thank Dr. A. Ralph Barr, Dr. Austin J. MacInnis, Dr. Marietta Voge, and Dr. Donald Landenberger for their helpful advice in the development and writing of the dissertation, Dr. William C. Reeves for his critical reading of the manuscript and valuable suggestions, and Dr. Telford H. Work who first stimulated my interest in the mosquitoes of the Imperial Valley of California. I am greatly indebted to the staff of the Imperial Waterfowl Management Area, especially C. Ray Knight, Richard Weaver, and Carl Miller, without whose cooperation this project would not have been possible. I wish also to extend my sincerest appreciation to Claire Price who typed the preliminary and final copies of the manuscript, to Margaret Kowalczyk who did such excellent work in inking the graphs, and Caryle L. Stallard for editorial assistance and the preparation of the text copy for lithoprinting. This investigation was supported in part by U.S. Public Health Service grants T1-AI-132 and T01-AI-00070. Some of the field work was supported by National Science Foundation grant GB 8075.

BACKGROUND

BIONOMICS

Culex tarsalis occurs in the western, central and southern United States, in western Canada north to Northwest Territories (Carpenter and LaCasse, 1955:296) and in Mexico south to the state of Chiapas (Vargas, 1956:27). Jenkins cites collections up to 2700 meters in Utah (1950:914).

Normally, a raft of 200-300 eggs is deposited on the surface of the breeding water and hatching takes place after 2 or 3 days (Brennan and Harwood, 1953:156). The immature stages are found in a variety of habitats, most commonly in still ground pools in hot, irrigated valleys. The breeding water may range from fresh to very foul and usually contains much organic matter (Carpenter and LaCasse, 1955:296; Jenkins, 1950:914; Sjogren, 1968). In the field, larvae survive freezing temperatures (Washino and Bellamy, 1963) and thermal waters at 39° C (Jenkins, 1950:914). The larval stage, consisting of four stadia, lasts only 10 days and the pupal stage 3 days at 24-26° C (Brennan and Harwood, 1953:155-156).

In the summer, females are gonoactive. During the first day or two after emergence they rest, imbibe plant juices and mate. Then a host is sought for a blood meal. Although preferred hosts are homeothermic vertebrates, especially birds (Tempelis et al., 1965), feeding occurs readily on reptiles and amphibians (Gebhardt et al., 1966; Henderson and Senior, 1961) and, in the laboratory, even on caterpillars (Harris et al., 1969). Blood digestion takes about 3 days at 24-27° C, but requires 3 weeks or longer at 10-13° C (Bellamy and Reeves, 1963:320; Rush, Kennedy and Eklund, 1963a:261).

Activities such as flying, mating, host-seeking and feeding occur largely during the twilight hours. During the day, adults rest in protected shelters but will become active and bite if disturbed. Females are capable of dispersing over relatively great distances. Dow, Reeves and Bellamy (1965) showed that marked adults dispersed up to 15 km into a larvicided area, independently of wind direction. Bailey et al. (1965:111) recovered a marked specimen over 24 km downwind from its point of release 2 nights previously. They estimated dispersal distances at 32-40 km.

Longevity is a matter of weeks or months. Bellamy and Reeves (1963:319) reported that some females held at outdoor winter temperatures in San Joaquin Valley, California, survived more than 8 months.

In early fall, the female population is composed of 2 distinct physiological types (Blackmore and Dow, 1962:292; Nelson, 1964:251). The gonoactive group continues to seek hosts, takes blood meals, and oviposit. It is present in ever diminishing numbers, and by late fall almost no individuals of this category are to be found. The females destined to overwinter emerge, mate, feed on plant juices and convert the carbohydrate mainly to lipid in the progressively larger fat body (Harwood and Takata, 1965). These females do not take a blood meal and their ovaries do not develop past the resting stage. They seek protected shelters and are relatively inactive during the winter. Males do not develop a large fat body and do not survive the winter.

Terms such as hibernation, diapause, reproductive diapause, and facultative diapause have been used to describe the winter condition of *tarsalis* females. Arrest of development in mosquitoes may occur in the egg, larval or adult stage, depending on the species (Clements, 1963:220-237). When environment unfavorable for development, such as low temperature, acts directly on an insect and produces torpor only for the duration of the stimulus, it is usually called "quiescence" (Lees, 1955:3). "Diapause" is less dependent on direct influence of unfavorable environment. When development is interrupted in every generation, regardless of external conditions, the term "obligatory diapause" is used. Initiation of diapause may be by indirect effect of the environment, such as decreasing photoperiod, so that some generations do not diapause but others do. This is known as "facultative diapause" (Lees, 1955:5), and Bellamy and Reeves (1963:321) use this term for *tarsalis*. Harwood and Halfhill (1964) and Harwood and Takata (1965) have demonstrated the importance of photoperiod in initiating diapause in *tarsalis*, but low temperature reinforces the effect of shortened day length.

"Hibernation" is often used for the winter reproductive diapause of adult mosquitoes (e.g. Bennington, Sooter and Baer, 1958:299). It is very different from the total arrest of all developmental processes often seen in diapausing embryos or immatures of many insects, where a reactivation period is usually required before cessation of diapause, such as exposure for several weeks to low temperatures, followed by a return to temperature favorable for development. *C. tarsalis* females are moderately active in the winter, unless the temperature is much below freezing (Rush, 1962:180; Bellamy and Reeves, 1963:321) and will feed when transferred to "room" temperature (Rush, 1962:179).

After 2-6 months, depending on the area and the severity of the winter, the overwintered, inseminated, nulliparous females emerge from their shelters, imbibe plant juices, seek a vertebrate host, and take their first blood meal. Early in the season, many females may be attracted to hosts, but the rate of biting is low until the fat body is largely exhausted (Rush and Tempelis, 1967:309). Because of the low ambient temperature, blood digestion and ovarian development are much slower during the first gonotrophic cycle of the overwintered females than later in the season (Rush, Kennedy and Eklund, 1963a:261).

VECTOR RELATIONSHIPS

C. tarsalis is the most important vector of western equine encephalomyelitis (WEE) and St. Louis encephalitis (SLE) in the western United States. Although WEE is usually not fatal to man, the epidemic of 1952 in the Central Valley of California resulted in many human deaths (Longshore et al., 1956:84).

WEE was first isolated from *tarsalis* by Hammon, Reeves, Brookman et al. (1941), and numerous subsequent studies have elucidated its epidemiology. The primary cycle involves *tarsalis* as the vector and wild birds, especially passerines, and domestic fowl as reservoir hosts (Hammon, Reeves and Sather, 1951). Infected mammals, including horses and humans, apparently do not circulate virus in high enough titer to infect mosquitoes, and therefore they are a dead end in the transmission cycle.

After a female mosquito feeds on an infected host, WEE virus invades the midgut cells and replicates. Subsequently it invades almost every other tissue of the body, especially the salivary glands. Although the virus is found in the ovaries of *tarsalis* (Thomas, 1963:159) and has been isolated from males of *Culiseta melanura* (Stamm et al., 1962:74), transovarian transmission is considered unlikely (Reeves, 1961:66; Thomas, 1963:164). The extrinsic incubation period in *tarsalis* can be completed within as short a time as 4 days and a female can transmit the virus for the duration of its life (Barnett, 1956; Bellamy et al., 1967; Thomas, 1963). There have been no indications of pathology in mosquitoes infected with arboviruses (arthropod-borne viruses), except for Semliki Forest virus which causes cytopathology of salivary glands in *Aedes aegypti* (Mims et al., 1966; Lam and Marshall, 1968).

OVERWINTERING OF ARBOVIRUSES

Each winter, many arboviruses, including WEE and SLE, disappear from their vectors and reservoirs, and for many years workers have attempted to determine how the viruses survive the cold months (Reeves, 1958; 1961; 1965).

Possibly, resident birds with chronic latent infections overwinter WEE virus, or migrating birds with short or chronic viremia may reintroduce the virus each spring. Infections usually last a few days (Hammon, Reeves and Sather, 1951:360; Kissling, Chamberlain et al., 1957:49), but Reeves, Hutson et al. (1958) recovered WEE virus from blood and other tissues of several passerine species from 1-10 months after experimental infection. Lord and Calisher (1970) and Stamm and Newman (1963) report southward transport of WEE during fall migrations, but Kissling, Stamm et al. (1957:44) found lower incidence of WEE antibodies in spring migrants than in permanent and winter residents.

Bats have recurrent viremia of SLE virus several weeks after infection (Sulkin, Allen and Sims, 1966:409). Transplacental transmission of virus occurs (Sulkin, Sims and Allen, 1964) and virus and antibodies have been isolated from bats virtually every month of the year (Allen et al., 1970).

WEE has been isolated from 3 genera of snakes, *Thamnophis* (garter snakes), *Pituophis* (gopher snakes) and *Coluber* (racers), and from the frog *Rana pipiens* (Gebhardt, Stanton et al., 1964; Burton et al., 1966). In the laboratory, infected *tarsalis* females transmit the virus to garter snakes (Gebhardt, Stanton and de St. Jeor, 1966), and Thomas and Eklund (1960) showed that snakes inoculated with WEE in the fall could overwinter the virus and transmit it to biting mosquitoes in the spring. Viremia sometimes recurs more than 5 months after initial infection (Burton et al., 1966:1031; Gebhardt and Stanton, 1966:30). Since the virus has been found in the offspring of infected snakes (Gebhardt, Stanton et al., 1964: 173), and both snakes and frogs can be infected orally (Spalatin et al., 1964), many new transmission pathways are feasible: Snakes or frogs may be bitten by infected mosquitoes, they may eat infected mosquitoes, snakes may eat infected frogs, and so on.

The mosquito *Culiseta inornata* (Williston, 1893), a winter species in Imperial

Valley (Chew and Gunstream, 1970:558), is a laboratory vector of WEE (Hammon and Reeves, 1943:433) and harbors the virus in the field (Hammon, Reeves, Benner and Brookman, 1945). However, Washino et al. (1962:270) failed to isolate virus from 4900 females of this species collected mostly in the fall, winter and spring in San Joaquin Valley, California.

In northern Colorado, where winters are severe, 1 winter isolation of western equine encephalomyelitis from *tarsalis* was made from a pool of females collected in a mine on December 30, 1953 (Blackmore and Winn, 1956). However, based on the long and well-defined hibernation of the population in that area, Bennington, Sooter and Baer (1958:304) concluded that *tarsalis* was an unlikely candidate to overwinter the virus. In central Washington, Rush, Brennan and Eklund (1958: 292) failed to isolate WEE virus from overwintering females collected from late September to early April, although many isolations were made in the summer. In eastern Oregon, virus was not found in the cold months, and the earliest isolates from *tarsalis* were in July in one study (Rush, Kennedy and Eklund, 1963b: 286) and not until August in another (Rush and Tempelis, 1967:313). In 13 years of attempts in central North Dakota, the earliest WEE isolation was in June, and in western Idaho, July was the earliest month (Rush, Kennedy and Eklund, 1963a: 260). It is the conclusion of the above workers that *tarsalis* is not a winter vector in the northwestern United States.

Although in San Joaquin Valley, California, diapause is less pronounced, isolates of WEE virus have not been made from November 15 to January 15, the period of minimal blood feeding (Reeves, Bellamy and Scrivani, 1958:82-83). Both WEE virus (Bellamy et al., 1967) and SLE virus (Bellamy et al., 1968) have been experimentally overwintered in *tarsalis*. However, Bellamy and Reeves (1963:322) and Burdick and Kardos (1963:534) concluded that *tarsalis* is not an important overwintering vector of virus because of its winter biology. Nelson (1964:252) speculated that during mild winters this mosquito may occasionally maintain the virus cycle, but that it is probably not the principal overwintering agent.

METHODOLOGY AND PRELIMINARY STUDIES

STUDY AREA

The Imperial Valley is in the southern extreme of California, south of the Salton Sea (fig. 1). Various other studies of *tarsalis* have been made in the Coachella Valley, which is northwest of the Salton Sea, and the Central Valley which is divided into the Sacramento Valley in the north and the San Joaquin Valley in the south.

The Imperial Valley is an irrigated desert of some 2200 km^2 in Imperial County. Water for irrigation of such crops as alfalfa, grains, flax and sugar beets comes primarily from the Colorado River via the All-American Canal and is distributed by a large network of canals. The drains flow into either the Alamo River or New River, both of which empty into the Salton Sea. The Sea is actually an inland lake over 50 km in length, 18 km in width, and approximately 70 m below sea level. It was formed in 1905 when the Colorado River flooded and filled the dry sink. Since water leaves the Salton Sea only by evaporation, the salinity has increased to approximately that of sea water (deStanley, 1966).

The Imperial Waterfowl Management Area was established by the State of California Department of Fish and Game primarily to prevent crop depredation on surrounding farms by migratory waterfowl. It also provides sanctuary for an abundance of wildlife, although hunting is permitted during certain seasons. The Wister Unit of the Area (fig. 2) is on the east shore of the Salton Sea, about 11 km northwest of Niland on State Highway 111. It is about 2 x 6 km, divided into sections by dirt roads, dikes, and canals for irrigation of the marshes. Most irrigation is done during the fall and winter to provide wintering habitat for migratory waterfowl from the north. The 3 main crops, barley, wild millet and alkali bulrush, are harvested each year by the ducks and geese. Cattails are plentiful in the ponds and tamarisk occurs along the borders and in the drier areas with mesquite.

The most common wintering waterfowl are snow goose, Canada goose, pintail duck, green-winged teal and American widgeon. Other common birds are Brewer's blackbird, red-winged blackbird, yellow-headed blackbird, starling, house finch, mourning dove, ground dove, pheasant, Gambel's quail, nighthawk, killdeer, black-necked stilt, avocet and other small shore birds. Common mammals are Audubon cottontail rabbit, black-tailed hare, striped skunk and raccoon. Gopher snakes and rattlesnakes are seen occasionally, frogs are abundant, and several freshwater fish inhabit the ponds, notably *Gambusia affinis*, an efficient predator of mosquito larvae.

Culex tarsalis is the most common mosquito at Wister throughout the year. *Culiseta inornata* is abundant in the winter. *Culex pipiens quinquefasciatus* Say, 1823, *Psorophora confinnis* (Lynch Arribalzaga, 1891), *Aedes vexans* (Meigen, 1830), and *Anopheles franciscanus* McCracken, 1904 are common at other times of the year. *Culex erythrothorax* Dyar, 1907 and *Aedes dorsalis* (Meigen, 1830) are less common.

On the map of Wister (fig. 2), circled numerals mark the sites where the various kinds of collections were made. Sites 1-5, 7, 9 and 10 were on the border of duck ponds that were flooded from about August to March. Sites 6 and 11 were about 0.5 km from the ponds and sites 12 and 13 about 1 km from the ponds. All sites were within a few meters of canals. Sites 7-9 and 11-13 were barley fields where waterfowl fed in the winter.

SAMPLING PROCEDURE

The Wister study was divided into 2 phases: a preliminary phase and a definitive phase. The purpose of the preliminary phase, the 11 lunar months from September 27, 1967 until July 22, 1968, was to determine monthly fluctuations in population density, to gather preliminary data on overwintering activity, and to collect large numbers of mosquitoes for virus isolation attempts done by Dr. Telford H. Work and coworkers at the Division of Infectious and Tropical Diseases, School of Public Health, University of California, Los Angeles. Seven light traps with CO_2 attractant and 7 CO_2 bait can traps were deployed at sites 3-5, 9-11 and 13 (fig. 2) for 3 or 4 consecutive days during the dark phase of the moon each month. Collection dates are given with the population data in tables 5 and 6. On November 30, 1968, use of 3 more light traps and CO_2 traps was initiated at sites 2, 6 and 7. Data from these sites were not included with those from the other 7 sites for estimation of population density for the first 11 months. Routine daytime resting collections from a culvert (site 6) were also initiated in November. Sporadic collections from other culverts and from wooden bridges were made throughout the first 11 months. Occasional larval collections were made.

The definitive phase of the study included the 21 lunar months from August 31, 1968 until April 12, 1970. The emphasis during this period was on the physiological parameters of the population. Again, collections were made each month for 3 days during the dark phase of the moon. Light trap collections were discontinued. CO_2 traps were deployed at sites 2, 6 and 7, and routine shelter collections were made from a culvert (site 6) and from under 4 wooden bridges (sites 1, 2, 5, 7). Routine larval collections were made.

COLLECTING METHODS

Light traps with CO_2 attractant

The CDC (Center for Disease Control, Atlanta, Georgia) miniature light trap (Sudia and Chamberlain, 1962) is a small fan and light assembly mounted in a plastic cylinder. A catching net receives the live insects and an aluminum shade protects them from sun and rain. The trap operates on a 6-volt battery. Phototactic insects are attracted to the light, caught by the suction of the fan and delivered into the catching bag. A block of about 1 kg of dry ice was wrapped in 2 sheets of newspaper, tied with string, and hung next to each light trap at about 1.8 m above the ground (Newhouse, et al., 1966). All traps were deployed before sunset and retrieved shortly after sunrise. Usually, more mosquitoes are attracted to light traps if there are no competing light sources. Although mosquitoes are generally more active during a full moon, more of them are attracted to light traps when there is little or no moonlight (Bidlingmayer, 1967:206). For this reason, I scheduled each collecting trip of 3 or 4 consecutive days at Wister to include the day of the new moon for that month.

The attraction of insects to light is not well understood. One view is that insects utilize a near source of light for a mechanism of orientation which is adapted for distant sources such as the moon (Wigglesworth, 1965:285). While the angle between the line of sight to the moon and the longitudinal axis of the insect remains the same, the insect will fly in a constant compass direction. However, when an insect orients in this manner to a near light source, "The angle of incidence of light can be kept constant only if the insect continually turns towards the source. It will thus move along a logarithmic spiral ending at the light itself..." (Wigglesworth, 1965:285). Another view is expressed by Verheijen (1960). He proposes that animals use light cues of low intensity for orientation at night. A high intensity artificial light source interferes with normal photic orientation, resulting in drifts of the animal toward the light source. Attraction to light varies with species, sex, age and other factors (Southwood, 1966:174-178, 200-201). In my study, light traps were used with CO_2 attractant, which further complicates interpretation of physiological data from mosquitoes collected by this method. For these reasons, use of light traps was discontinued after the preliminary phase of the study. Physiological measurements were made only from females collected in CO_2 traps and shelters.

CO_2 traps

The CO_2 traps (Bellamy and Reeves, 1952) were made from cylindrical "lard cans" (36 cm x 30 cm diam). A circular hole (23 cm diam) was cut in the lid and bottom of each can and replaced by an inwardly pointing, hardware cloth cone. A 2 cm circular opening was left in the apex of each cone. The cans were painted dark red inside and out, and a 1-liter capacity, bottomless, polyethylene cup was fastened to the top of each can on the inside with a strip of sheet metal. The dry ice, prepared in the same manner as for the light traps, was inserted in the cup. Mosquitoes enter the traps through the hole in either cone and are unable to find their way out again. Each trap was suspended from a tree or bush at about 1.5 m above the ground.

Apparently, carbon dioxide activates host-seeking females which then fly upwind to locate the source (Clements, 1963:276). Reeves (1953) found that 3 species of mosquitoes were attracted to CO_2 released from large "stable" traps at rates comparable to those of their preferred hosts. *C. tarsalis*, which feeds on a variety of vertebrates, was attracted to CO_2 released at rates similar to those of chicken, man and horse (or cow). More females were attracted at the higher rate of CO_2 release. Although females of *tarsalis* usually do not bite in the daytime, many attacked the collector when he entered the traps, and mosquitoes were observed probing at the rubber tubing where the gas was released. Of over 8000 adults collected, only 22 were males. In my study only 3 males and 1 engorged female were collected in 444 trap-nights in which 6112 nonengorged females were collected. Therefore, I rejected the possibility that the mosquitoes might be attracted to the traps as daytime resting shelters and considered that the mosquitoes collected in CO_2 traps were seeking hosts. (Although 58 gravid females, each with a very few developing eggs, were collected in the CO_2 traps, I believe that they were also searching for a blood source, p. 18.)

Shelters

A mechanical aspirator (Husbands, 1958) was used to collect mosquitoes from daytime resting shelters. This device was made from a battery-powered vacuum clothes brush that I fitted with a collecting tube (38 cm x 1.27 cm diam) and interchangeable clear plastic cartridges (10 cm x 2.5 cm diam) that held the mosquitoes from each collection. Collections were made at about midday from a cement culvert and 4 wooden bridges. The culvert (fig. 3) consistently contained the largest numbers of mosquitoes. It was a tubular structure (ca. 15 m x 1 m diam) under State Highway 111. It had running or standing water 1-15 cm deep at all times. Mosquitoes were usually distributed about evenly throughout the middle 2/3 of its length. The walls were smooth, and nearly every mosquito could be collected.

The 4 wooden bridges (sites 1, 2, 5, 7) crossed canals at 0.8 km intervals on a dirt road running north to south (fig. 4). Each bridge was supported by wooden beams about 1.5 m above the surface of the slowly moving water in the canal. Mosquitoes rested on the horizontal undersurface of the bridges, on the vertical side of the beams, and on the sloping earth banks. During the first 11 months of the study, all mosquitoes that could be found were collected. However, many parts of the bridges were inaccessible, and even with a flashlight it was difficult to see mosquitoes against the darkly colored, rough wooden and earth surfaces. In August 1968, five 3 gal. (11.4 liter), cylindrical, dark red ice cream cartons were stapled to the southern, interior vertical surface of each bridge between the beams (fig. 5). Collections thereafter were made only from these containers. The red cartons were also placed in various other shaded sites at Wister, but almost no mosquitoes were attracted to them.

Larval collections

Each month, a systematic search for breeding sites was made. A 1-pint (0.473 liter) sauce pan attached to a wooden pole served as the sampling tool. If a breeding site was too shallow for the conventional dipper, a pipette was used to remove all larvae and the mean number of larvae per 0.1 m^2 of water surface was determined. At site 8 (fig. 8), a sewage oxidation pond, routine collections were made from September, 1969 until March, 1970. One dipper of water per 0.1 m^2 of water surface was taken from an area of 6 m^2 of the pond (fig. 9).

SOURCES OF ERROR

There are at least 2 potential sources of error in the data gathered by the methods described above: The first arises from the collecting procedure; the second is introduced by the behavior of the mosquitoes.

Error due to the sampling procedure

The sampling procedure may have been inadequate to describe accurately the Wister population: Collections were made during a very short period each month, samples were not random, and in some months very few mosquitoes were collected.

The monthly collections of 3 or 4 consecutive days were assumed to be representative of the population for the entire lunar month. This probably was not the case when some characteristic of the population was changing rapidly. Temporary aberrant weather surely made some collecting periods very atypical for the month. Biweekly or weekly collections would have been better, and daily collections would have been best, but impractical. In the graphic representations of the various parameters of the population, a line connects the values for each pair of consecutive monthly collecting periods. In this way, seasonal trends can be seen more easily and data from 2 or more collecting methods can be compared on the same graph. However, it must be remembered that each point is an average for 3 or 4 days, not an entire month.

Since samples were taken at the same sites every month, they were not random. The frequency distribution of numbers of mosquitoes per trap per night (trap-night) was not normal. The monthly population means were sometimes influenced by very large or very small numbers of mosquitoes captured at 1 or 2 sites. Standard errors are given (tables 5, 6) to indicate the variability in the numbers of mosquitoes captured, but the standard error cannot be used for statistical tests of differences among the means.

In some months, only a few females were examined for a particular attribute (e.g. fat body development in CO_2 traps and shelters). When sample size (N) was very small (<10), the point on the graph representing the percentage of females with the attribute is bracketed. For all points sample size is given above the graph.

Bias due to the behavior of the mosquitoes

The behavior of *tarsalis* may bias the estimation of physiological parameters in 2 ways: Females may prefer more secluded shelters in the winter, or most of them may disperse to the foothills.

Shelter preference

Overwintering females of *tarsalis* have been found in a variety of shelters. In northern Utah (Dow et al., 1956), northern Colorado (Blackmore and Winn, 1956;

Mail and McHugh, 1961) and western Nebraska (Keener, 1952), they are commonly found in mines and cellars during the coldest months, but some workers are of the opinion that these do not constitute the successful overwintering population. Dow et al. (1956) found that females disappeared from mines in late winter. The temperature in the mines was about 10° C and the mosquitoes remained active, probably exhausting their energy reserves prematurely. Bennington, Blackmore and Sooter (1958:298) collected 2 overwintering females from rodent burrows where the temperature was below 10° C and noted a correspondence of spring emergence with soil temperature inversion. Mail and McHugh (1961) brought overwintering females into the laboratory and found that survival was longest at high humidity and at a temperature of freezing or slightly below. In southern Alberta, Shemanchuk (1965) found occasional wintering females in large animal burrows where the temperature was considerably higher than the ambient temperature but still dropped below freezing nearly every day. He, too, noted a correspondence of spring emergence and soil temperature inversion. In the summer, Harwood and Halfhill (1960) found females and males in vegetation, rock fissures, and animal burrows, but winter females were found almost exclusively in rock piles and talus slopes in central Washington (Harwood, 1962; Rush et al., 1958) and in eastern Oregon (Rush, 1962; Rush et al., 1963b). Harwood (1962) thought that the colder and more stable northfacing talus slopes were most favorable for overwintering adults by reducing activity and energy utilization.

Some workers in Central Valley, California, believe that *tarsalis* prefers "natural" winter shelters to "artificial" ones. Probably, a more useful distinction would be based on the degree of protection from wind and precipitation, and on regimes of temperature, humidity and light intensity. The man-made structures in question are usually more exposed. Mortenson (1953) collected overwintering female *tarsalis* from such natural sites as tree stumps, tree roots, a tree hole, hollow logs, natural wood piles, brush piles, animal burrows, a woodrat's nest, and a rock ledge in San Joaquin Valley, California. He stated that this species was less abundant in "artificial" shelters. Loomis and Green (1955) continued Mortenson's study and concluded that *tarsalis* females preferred "natural" resting shelters to such artificial sites as chicken houses, bridges, and cellers, but their conclusion was based on the percentage of *tarsalis* of all mosquitoes of various species collected rather than on actual numbers, so that preferences of the other species may have biased the results. Ryckman and Arakawa (1952) found *tarsalis* adults in woodrats' nests in late November and early December in Riverside County, but did not find them in all other habitats searched. Kliewer et al. (1969) in Fresno County, California, observed a decrease in the number of *tarsalis* in culverts in winter after an earlier increase, and thought this might be due to a sudden avoidance of these resting sites. They noticed an apparent preference for piles of rocks. Bailey (1965:109) states that many overwintering females are found in man-made structures, but that they prefer natural shelters in the Sacramento Valley.

At Wister, there may well be a winter preference of the females for sites other than cement culverts and wooden bridges. In fact, this may be the explanation for an apparent decrease in the population at these sites in the fall (fig. 15). However, there is no evidence that the winter biology of a hypothetical, inaccessible, subterranean population of females would be different than that of the females in the more open shelters. The winter studies of *tarsalis* in the San Joaquin Valley of Bellamy and Reeves (1963), Burdick and Kardos (1963), Kliewer et al. (1969) and Nelson (1964) were all based on collections from such man-made shelters as culverts, bridges, sheds and wooden boxes, and a definite period of winter diapause was noted. Since the Wister study was based on collections from the same kinds of shelters, the data can be compared to those from the San Joaquin Valley.

Dispersal

Some workers have indicated that in the fall, *tarsalis* disperses from the valleys to pass the winter in the surrounding foothills. In the Sacramento Valley, California, Bailey et al. (1965:109) concluded that there was a definite fall movement into the foothills, especially to the hills downwind from the valley. This dispersal occurred at the same time that the rice fields, the major breeding source, were drained. Abell (1959) studied mosquito populations in the foothills of Fresno County, California, at an intermittent stream that offered plentiful breeding sites from late fall through spring. Twice as many adults were attracted to light traps from mid-October to mid-November as in July. As breeding did not occur in the foothill area in the fall, the adults probably had dispersed there. In a 5-year study in an adjacent canyon, Kliewer et al. (1969:16-17) did not find *tarsalis* adults in any numbers in culverts until late fall. They were abundant throughout the winter. In the valley below, light trap catches were highest in the summer. Since teneral (recently emerged) adults were absent throughout the spring, summer and early fall in the hills, the population probably did not originate there. Indications were that in the autumn the mosquitoes dispersed from the valley to the foothills where they overwintered. In January, they began to feed and returned to the valley without breeding significantly in the foothills.

In the San Joaquin Valley, both the valley and foothill populations of *tarsalis* experience a well defined winter diapause. Therefore, there is no reason to believe that the females remaining at Wister in the winter may be physiologically different from those that may have dispersed to the foothills.

PHYSIOLOGICAL AGE-GRADING

CRITERIA

Females were dissected and the following attributes related to their winter biology and physiological age were recorded: external condition, insemination, muscle remnants, meconium, fat body development, presence of blood, ovarian development, ovarian tracheation and follicular relics.

As a mosquito ages in the field, the external scales and hairs on the body, legs and wings are rubbed off. I divided the degree of external wear into 3 categories, based on the characters used in taxonomic keys to identify *tarsalis* females: (1) **Recently emerged**: Inverted dark-scaled "V"s on venter of each abdominal segment complete; white tarsal bands complete (Carpenter and LaCasse, 1955:269). (2) **Intermediate**: Inverted "V"s unclear; white tarsal bands complete. (3) **Rubbed**: Inverted "V"s nonexistent; white tarsal bands unclear; white scales present on inner margin of antennal torus, distinguishing *tarsalis* from *Culex peus* Speiser, 1904 and other species of *Culex* (Chaniotis and Iltis, 1960).

A female mates once, soon after emergence from the pupa, and the sperm stored in the spermathecae are used to fertilize all the egg batches she produces. Usually, only recently emerged females are noninseminated. Diapausing females are nearly all inseminated.

A meconium, a mass of greenish-brown semisolid substance in the midgut, occurs only in recently emerged adults, as do certain abdominal muscle tissue remnants, but the time required for the disappearance of these 2 physiological age indicators varies considerably with temperature (Rosay, 1961:528).

The fat body of mosquitoes is not a single organ, but a loose meshwork of lobes dispersed throughout the abdomen. It functions as a food storage organ and as an excretory organ where uric acid accumulates. In mosquito larvae, it contains lipid, glycogen and protein, but protein is never deposited in the adult fat body (Clements, 1963:49-51). The glycogen is used mainly for activities such as flying. The lipids appear to be more important for hibernation (Buxton, 1935; Schaefer and Washino, 1969). In diapausing *tarsalis* females, the fat body becomes large and compact in winter and is largely exhausted by spring. Bullock et al. (1959: 184-185) recognized 4 stages of fat body development in *Culex tritaeniorhynchus* Giles, 1901. Their classification was adapted to *tarsalis* by Burdick and Kardos (1963:530). I modified the latter classification for my study: **Class 0.** – No fat cells seen. **Class 1.** – Fat cells around spermathecae only. **Class 2.** – Traces of fat in the abdomen, anterior to the ovaries. **Class 3.** – Abdomen filled with fat body, but not distended. **Class 4.** – Abdomen distended by fat body. Classes 3 and 4 of my classification are approximately the same as Classes 2 and 3, respectively, of Burdick and Kardos (1963:530).

Blood digestion and ovarian development occur simultaneously. The adjective "engorged" is used to describe females with any amount of blood in the midgut. When the blood has been completely digested, the eggs are usually in Stage IV (see below), and the female is "gravid" until the eggs are deposited. Females with neither blood nor developing eggs are "empty".

The reproductive system of *tarsalis* females consists of 2 ovaries and 2 lateral oviducts that join to form a common oviduct. The 2 ovaries contain a variable number of ovarioles (ca. 300). Each ovariole consists of a growth zone anteriorly (germarium) and usually 2 follicles posteriorly. A follicle contains an oocyte and 7 nurse cells. Only 1 egg at a time develops in each ovariole, and the eggs of most ovarioles develop in synchrony after a blood meal. The fully developed eggs pass through the lateral oviduct, are fertilized from the 3 spermathecae attached to the common oviduct, and are deposited in a raft on the water surface.

Christophers (1911) divided the period of ovarian development into 5 phases (Stages I-V). Mer (1936) added Stage N. The following is a brief summary of the classification as I have adapted it to *tarsalis*: **Stage N.** – The 8 cells of the spherical follicle are undifferentiated. **Stage I.** – The oocyte becomes clearly differentiated from the 7 nurse cells. **Stage II.** – Yolk granules appear around the oocyte nucleus. **Stage III.** – Yolk granules obscure the oocyte nucleus and begin to fill the follicle; the follicle becomes broadly oval. **Stage IV.** – The oocyte fills nearly the entire follicle and begins to elongate. **Stage V.** – The egg becomes fully elongate; the micropyle cup becomes distinct. Stage N is seen only in nulliparous females. Stage I is generally thought to be the resting stage for culicine mosquitoes, but Rosay (1969:610) found that either Stage I or Stage II could be the resting stage for some culicine species before their first blood meal, and some anautogenous *tarsalis* females developed Stage II eggs before a subsequent blood meal.

The tightly coiled "skeins" of the ovarian tracheoles of nulliparous (i.e. no history of oviposition) female mosquitoes are irreversibly stretched during development of the ova in the first gonotrophic cycle (Detinova, 1945; 1962:48-51). After oviposition, the ovary returns to approximately its original size, but the uncoiled tracheoles become visible if the ovary is allowed to dry on a microscope slide. This criterion of parity has been evaluated with *tarsalis* females of known history and applied successfully to field populations, but there is generally a portion of the ovaries that either cannot be read or is intermediate between the normal nulliparous and parous conditions (Blackmore and Dow, 1962; Burdick and Kardos, 1963; Kardos and Bellamy, 1961; Nelson, 1964, 1966).

In a like manner, the stomach tracheation has been used to distinguish blood-fed from non-blood-fed females (Detinova, 1962:51-53). Midgut tracheae of nulliparous females form a series of tight bands with coiled tracheoles. After digestion of a blood meal, the tracheae are stretched and the tracheoles are uncoiled. Plant juices do not stretch the stomach tracheae because they first enter the crop and only gradually pass to the stomach. Detinova (1962:52) reports that this criterion is reliable for distinguishing parous from nulliparous females of *Culex pipiens*, but I found that it was inapplicable to *tarsalis* females from a laboratory colony.

In many species of mosquitoes and other haematophagous Diptera, after each oviposition a "follicular relic" remains, which is seen as a dilatation on the pedicel of the ovariole (Detinova, 1962:25-29; 1968). Polovodova (1949) was the first to use this as a means of determining parity in mosquitoes (with *Anopheles*), but the method was not generally known to the non-Russian speaking world until a 1958 review by Gillies. The Polovodova technique proved to be superior to the ovarian tracheation method to distinguish parous from nulliparous female *tarsalis* in a laboratory colony and in the field (Nelson, 1966), but Nelson (1964:243) was unable to determine the number of ovipositions with this technique. Rosay (1969:608) commonly found fewer dilatations than ovipositions in *tarsalis* females of known history, and she reported dilatations in specimens that had never oviposited.

DISSECTIONS

In the laboratory, field-collected mosquitoes were immobilized by chloroform, sorted to species and sex, and counted. Each *tarsalis* female was placed in a glass "embedding button" (5 mm deep, 20 mm inside diam) with 2 drops of 0.675% NaCl. The buttons were stacked to retain moisture. Identification of each female was verified under 20X of a Bausch and Lomb stereoscopic dissecting microscope, and the external condition was recorded. The mosquito was then oriented ventral side uppermost and head to the left, and held by the thorax with a pair of fine forceps. A minuten pin dissecting needle was inserted between the cerci, and by slight downward pressure the 3 hard, brown, oval spermathecae and their ducts and surrounding tissue were withdrawn. In most cases, active sperm could be seen without crushing the spermathecae. In doubtful cases the spermathecae were transferred to a slide with a drop of saline solution and examined at 100X with a compound microscope.

The points of a second pair of fine forceps were then inserted into the lateral portions of the membrane between the 6th and 7th abdominal segments, and drawn to the right, freeing the gut and ovaries in most cases. The remaining portion of the abdomen was teased open and the degree of fat body development and the presence or absence of muscle remnants were recorded. The midgut was checked for the presence of the meconium and for the presence and degree of digestion of blood.

After the ovaries were separated, 1 was placed on a microscope slide marked with a grid to facilitate counting of developing ova. With minuten pins, the ovarian sheath was removed, and the ovarioles separated. A record was made of Christophers' stage of ovarian development and the presence or absence of dilatations on the pedicel. Two rows of 5 circles were marked on a microscope slide with a grease pencil. If the oocytes were not obscured by yolk (Stages I and II), the second ovary was placed in a drop of distilled water in one of the circles on the slide. When the ovaries had dried, the presence or absence of skeins could be determined at a magnification of 100X.

SOURCES OF ERROR

Generally, for each blood meal taken by a female mosquito a complement of eggs develops, and eggs will not develop without a blood meal. A gravid or parous female is therefore considered to have a history of blood feeding, and a nulliparous female cannot have taken any blood. However, females of some populations of mosquitoes do not always develop eggs after a blood meal (gonotrophic dissociation, gonotrophic discordance) and others develop eggs without blood (autogeny).

Gonotrophic dissociation

"Gonotrophic dissociation" (Swellengrebel, 1929:1378) occurs in several species of *Anopheles* when fat body development rather than egg maturation follows a blood meal in overwintering females (Guelmino, 1951). In the same genus, some species are known to require more than 1 blood meal to initiate egg development. Rao (1947:44) called this phenomenon "gonotrophic discordance". Females that have blood-fed but have not developed eggs are "pre-gravids" (Gillies, 1954:59). Eldridge (1968) has reported that low temperature stimulates gonotrophic dissociation in *Culex pipiens* and suggests that it may occur in *tarsalis* as well, but it has not been observed in several studies (e.g. Bellamy and Reeves, 1963:322).

Autogeny

The adjective "autogene" was coined by Roubaud (1929) to describe females of a population of *Culex pipiens* that produced a small raft of eggs without feeding. "Autogeny" is currently used for the phenomenon of the development of the ovarioles beyond the resting stage without a blood meal (Spielman, 1957:404). The source for ovarian development comes from reserves accumulated during the larval stage with the result that only 1 complement of eggs is produced autogenously. Autogeny in a colony of *tarsalis* was first reported by Bellamy and Kardos (1958) and by Chao (1958) in a subcolony of the same San Joaquin Valley strain. Moore (1963) found high levels of autogeny in field populations in Sacramento Valley, California.

If the percentage of gravid or parous females is to be used as an estimate of blood feeding, this estimate will be too high if the population is autogenous. The complications in the interpretation of data on gonoactivity and parity in *tarsalis* due to autogeny have been discussed by various workers (Burdick and Kardos, 1963:528; Kardos and Bellamy, 1961:450; Kliewer et al., 1969:17; Nelson, 1966: 11). In order to determine the degree of error produced by autogeny, I attempted to estimate its extent in the Wister populations. The following experiments and observations were of a preliminary nature. Only those aspects of autogeny were studied that related to physiological age-grading.

Autogeny is a somewhat elusive phenomenon to investigate because of the apparent interplay among hereditary and environmental factors. It is genetically determined (Spielman, 1957), but its expression in *tarsalis* depends on larval nutrition, photoperiod and temperature (Chaniotis, 1960; Harwood, 1967; Kardos, 1959). Therefore, these 3 factors were kept constant for all laboratory colonies.

Several autogenous colonies of *tarsalis* were established from immatures and adults collected from Wister and vicinity. When workers first attempted to colonize *tarsalis*, they were successful only after subjecting the mosquitoes to a simulated twilight in a large cage (Brennan and Harwood, 1953). I was able to colonize the mosquitoes from Wister in a 1 ft^3 (0.028 m^3) cage without simulated twilight. A photoperiod of 14 hr. light and 10 hr. dark was maintained. Temperature in the colony room fluctuated between 24° C and 27° C and relative humidity varied from 53% to 58%. To increase humidity in the cages, I covered them with plastic bags. Moist raisins were provided as a carbohydrate source. Larvae, reared in 2-liter white enamel pans, were fed either Fleischmann's yeast or laboratory chow (Purina Pigeon Checkers) but this diet was not standardized by weight. The water was aerated to prevent the formation of surface scum.

Three separate criteria were used for detecting autogeny: (1) development of eggs without a blood meal, (2) oviposition without a blood meal, (3) occurrence of Stage III eggs in nonblooded females. Percentage of females that develop eggs without a blood meal was the best index of autogeny. Females with Stage III-V eggs 5-10 days after emergence from pupae were considered autogenous. The second index, percentage of females ovipositing without a blood meal, was used as

Table 1. – Autogeny in *Culex tarsalis* collected as larvae and pupae at Wister and vicinity and reared in the laboratory. 1969.

			NON-BLOOD-FED						BLOOD-FED		
			Index of Autogeny			*Mean No. Eggs per ♀*			*Mean No. Eggs per ♀*		
month collected	site	generation	percent gravid	percent ovipositing	N	developing	oviposited	N	developing	oviposited	N
May	14	F_1		24	436		(162)	3			
Jun	11	P					83	11			
		F_1		40	55						
		F_5							202	153	18
Jul	8	P		5	2057		57	14			
Sep	11	-	47		32	119		10			
	8	-	70		23	105		10			
Oct	11	-	17		30	(42)		5			
	8	-	76		49	77		31			
	15	-	9		33	(66)		3			
	8,11,15	-	83	74	23	96	96	19	212	159	16
Nov	11	-	0		12						
	8	-	55		42	96		18			

a measure of autogeny when females were not dissected. This index tended to be lower than the first, because some females developed eggs but did not oviposit. Also, the number of eggs oviposited tended to be lower, because some of the eggs were occasionally retained in the ovaries. The third index of autogeny, percentage of Stage III females without blood in the midgut, was used on field-collected females. In the laboratory, females with anautogenously developed ovaries always had blood in the midgut until after Stage III. Therefore, nonblooded females from the field with Stage III ovaries were classified as autogenous. This index was lower than the first 2 because many females that oviposit autogenously subsequently blood feed and develop eggs anautogenously.

In June 1969, I found several egg rafts in a colony of non-blood-fed mosquitoes that had been reared from larvae collected at site 12. This colony was maintained for 6 generations without a blood meal before I discontinued it 5 months later. (Each new generation was transferred to a separate cage.) The colony from site 14 was allowed to feed during the parent generation, but thereafter it reproduced autogenously for 6 generations (6 months) before it was discontinued. The colony from site 8 died after 12 generations (10 months) without a blood meal.

Tables 1 and 2 show the preliminary data from experiments and field observations of autogeny: Table 1 for females that were collected as larvae or pupae in the field and table 2 for adult collections. For colonies, the generation (P, F_1, F_2, etc.) is designated. For each collection, the percentage of autogenous females is shown beneath the index used for its determination. Data based on ⟨10 observa-

Table 2. – Autogeny in *Culex tarsalis* collected as adults in CO_2 traps and shelters at Wister. 1969.

			NON-BLOOD-FED							BLOOD-FED		
			Index of Autogeny				*Mean No. Eggs per ♀*			*Mean No. Eggs per ♀*		
month collected	site	generation	percent gravid	percent ovipositing	percent Stage III	N	developing	oviposited	N	developing	oviposited	N
CO_2 trap												
Jun	2	P						20	11			
		F_1		13		76						
		-	12			228	22		25			
Jul		-	20			61	22		11			
Sep		-	20			25	(27)		4			
Oct		-	22			41						
Shelter												
All*		-			30	155	58		10	(113)		9
Jan (1968)	5	-									138	11

* Females collected from sites 1,2,5-7. September 1967-April 1970.

tions are bracketed. Two site numbers are given that are not shown in the map of Wister (fig. 2): Site 14 was a grassy roadside ditch (ca. 60 cm x 300 cm x 12 cm deep), ca. 8 km south of Wister on State Highway 111. Site 15 was a foul, grassy ditch (ca. 1 m x 2 m x 0.5 m deep), ca. 40 km south of Wister on State Highway 86 at the Keystone Avenue intersection.

Consistently, fewer eggs per female were developed autogenously than anautogenously. From a combined collection from sites 8, 11 and 15 in October, 16 of 39 females were allowed to feed on a pigeon, and all females were isolated in 9-dram (16 g) plastic vials. The bottom 1 cm of each vial was filled with water, and a moist raisin was placed on the cheesecloth top. Eighty-three percent of the non-blood-fed individuals developed eggs autogenously, and 74% of them oviposited. The mean number of eggs that developed for 19 females was 96 as opposed to 212 for the blood-fed individuals. The difference between the means was significant ($p = \langle 0.001$). However, the range overlapped: As many as 136 eggs developed autogenously in 1 female and as few as 118 developed anautogenously. In other colonies, the number of eggs oviposited autogenously ranged up to 186 (site 14, F_1), and 1 blood-fed female developed only 25 eggs (site 11, F_5). Females that took small blood meals usually developed fewer eggs. In the Sacramento Valley, Moore (1963:240) reported that 1 female developed 220 eggs autogenously. Mean number of autogenously developing eggs was highest in May at 116 and declined to less than 35 in October. In June, 92% of the females collected as pupae were autogenous. By October only about 20% were autogenous. Burdick and Kardos (1963:533), using intermediate ovarian tracheation as the criterion, concluded that autogeny decreased from September to October in the San Joaquin Valley.

In August and September 1968, 4 gravid females were collected in CO_2 traps at Wister. In 1969, about 20% of the females caught in CO_2 traps from June to October were gravid (table 2). With 1 exception, no engorged females were collected in these traps. None of the females with Stage III ovaries had any trace of blood in the midgut. Therefore, all of the gravid females in CO_2 traps were probably developing eggs autogenously. The average number of developing eggs per female was 22. This is much less than the number of eggs normally produced by autogenous females. The non-blood-fed females of 2 filial generations developed approximately the normal number of eggs for autogenous females. It may be that the field individuals had not stored sufficient reserves during the larval stage to complete the development of a normal number of eggs autogenously. Ovarian development began, but when reserves were exhausted an additional source of protein was sought in the form of a blood meal. An alternative explanation is that these were females that had taken a very small blood meal and had begun ovarian development. By Stage III, the blood meal was completely digested, and they were attracted to CO_2 in search of a second blood meal. In either case, the gravid females in CO_2 traps did not need a blood meal to complete development of their eggs and to oviposit. In 11 such females, an average of 20 eggs was deposited, of which most hatched.

Two criteria for distinguishing parous from nulliparous females are less accurate when the population is autogenous: ovarian tracheation and follicular relics. The degree of stretch of the tracheal skeins is determined by the number of eggs in the ovaries. The skeins of autogenous-parous females are intermediate between those of nulliparous and blooded-parous females, because autogenous females develop fewer eggs. Burdick and Kardos (1963:531) examined a large series of laboratory-reared *tarsalis* females (with histories of ovarian activity unknown to them until after the experiment) in an attempt to separate them into nulliparous, autogenous-parous, and blooded-parous categories on the basis of ovarian tracheation. By assigning all doubtful specimens to the intermediate (autogenous) category, no nulliparous specimens were incorrectly identified as blooded-parous and only 4% of the blooded-parous specimens were judged to be nulliparous. However, so many females in these 2 categories were incorrectly judged to be autogenous-parous, that only 39% of the nulliparous specimens and 68% of the blooded-parous specimens were correctly identified. Eighty percent of the autogenous-parous females were correctly identified. The other 20% were approximately evenly distributed between the other 2 categories, but of all females identified as autogenous-parous, less than a third were correctly identified.

Follicular relics occur in both autogenous-parous and blooded-parous females. Usually more ovarioles of blooded-parous females will have relics because more eggs are developed, but this criterion cannot be used to distinguish them from autogenous-parous females because of the overlap in the range of the number of eggs developed by these 2 groups. Figures 10 and 11 show the frequency distribution of the number of developing eggs per female from collections at Wister. Based on my laboratory observations (table 1), I expected the following 3 peaks in egg frequencies, with a minimum of overlap: retained eggs (ca. 1-10), autogenously developing eggs (ca. 50-100), and anautogenously developing eggs (ca. 200-250), However, there was no clear division into these 3 groups: 116 of the 315 females examined had from 1 to 7 Stage V eggs; 70 of these had 1 egg. These were probably all females with retained eggs, but the Stage V eggs of females with more than 7 may also have been retained. The rest of the distribution was continuous and did not separate into an autogenous and an anautogenous group. Therefore, the frequency distribution of follicular dilatations is not useful to separate autogenous-parous from blood-fed-parous females. However, lack of dilatations is a good criterion for identifying nulliparous individuals (Nelson, 1966).

In summary, at Wister autogenous-gravid or parous females could not be distinguished from blood-fed-gravid or parous females with a high level of accuracy. However, if monthly levels of autogeny in Imperial Valley are similar to those in Central Valley, which probably is the case, based on my limited data and on Central Valley studies, then the bias due to autogeny should be the same in both areas, and the physiological age-grading data can be compared.

ANALYSIS OF DATA

All of the data from each of the 2658 dissections (date, dissection number, collecting method, site and all the age-grading results) were coded and entered onto standard IBM punch cards. The following programs were written in Fortran IV for a Watfor compiler (Blatt, 1968) and were executed on the model IBM 360/91 of the Campus Computing Network of the University of California, Los Angeles: (1) a print-out of all or any portion of the dissection data in easily readable, non-coded form, (2) a 2-way classification table of a variable number of categories to show the frequency of females for each combination of categories (e.g. if the 2 variables were *external wear*, "ext", and *fat body development*, "fat", the table showed frequency of females with the combination of categories ext = 1, fat = 0; ext = 1, fat = 1; ext = 2, fat = 1; etc. for all possible combinations), (3) percentage of females in each of the 6 stages of ovarian development, tabulated by collection method and by month, (4) percentage of females inseminated each month, tabulated by Christopher's stage and by collecting method, (5) histogram of the frequency distribution of the number of developing eggs per female for all months.

Other computations were executed by an Olivetti Underwood Programma 101 desk computer. A prewritten program (Williams, 1968:33) was used to calculate the monthly mean number of males and females per collecting method and the standard error of the mean. A t-test (Williams, 1968:188) was employed to detect the degree of difference between the mean number of eggs developed by blood-fed vs. non-blood-fed females. Short programs were written for computing percentages and confidence intervals.

RESULTS AND DISCUSSION

WEATHER

A standard U.S. Weather Bureau Station was established at Wister in May 1967 but was discontinued in May 1968. The closest other station with complete weather data was operated by the Imperial Irrigation District, about 50 km south of Wister. Differences in temperature were minimal between the 2 stations for the 13 months in question. The monthly mean lows averaged less than 1° C lower at Wister, and the mean highs less than 0.5° C lower. Recorded rainfall was also nearly the same. Therefore weather data for my entire study were taken from the Imperial station.

Winters are mild and summers very hot at Imperial, California (fig. 12, table 3). The coldest months were December and January, but temperatures only rarely dropped below 0° C: not at all in winter 1967-1968, 4 days in December 1968 and 6 days in January 1970. The lowest temperature during the study was –2.8° C for 1 night in December 1968. The mean low temperature for the coldest month was about 5.3° C for 2 winters and 3.3° C for the winter 1968-1969. Summer temperature reached 47.2° C in August 1970. Mean maximum temperature for the hottest month (July or August) exceeded 40° C all 3 summers. Rain occurred sporadically and infrequently, usually in the winter except for a major storm in July 1968. Average annual rainfall for all years recorded by the Imperial station

Table 3. – Winter and summer temperatures (°C) at Imperial, California.

		1967		1968		1969		1970
WINTER								
Coldest month	: mean		11.7		11.1		12.8	
	mean minimum		5.0		3.3		5.6	
Coldest 2 weeks:	mean minimum		3.9		2.2		2.8	
Coldest day	: minimum		0.6		-2.8		-1.7	
SUMMER								
Hottest month	: mean	34.4		32.8		35.6		
	mean maximum	41.7		40.6		42.8		
Hottest day	: maximum	45.0		45.6		47.2		

was 72.7 mm. Relative humidity, recorded daily at 7:30 a.m. PST at Wister from May 1967 to May 1968, ranged from 9% to 98%. Monthly mean relative humidity was approximately 70% in the winter and 50% the rest of the year.

In most areas outside of California, where the winter biology of *tarsalis* has been studied, winters are severe. In southern Alberta, Canada, Shemanchuk (1965: 461) reported an extreme of more than 35° C below zero, and the air temperature was well below freezing nearly every day from November through March. In a western Nebraska study, ambient temperature reached a low of –30.6° C (Keener, 1952:209). In North Dakota, temperatures below –17° C persist for 2 weeks or more, but in central Washington temperatures below –17° C last for only short periods (Anderson and Harwood, 1966:6). Rush, Brennan and Eklund (1958:291-292) reported below freezing temperatures all during January.

In the San Joaquin Valley, California, winter temperatures are milder, but still considerably colder than the irrigated desert of Imperial County, only 2 degrees of latitude to the south. In Kern County, Bellamy and Reeves (1963:318) reported average minimum temperatures of well below 5° C for many 2-week periods during the winter, and there were biweekly lows below –1° C both winters of Nelson's (1964:249) study. Washino and Bellamy (1963:162) reported that temperature fell below freezing and reported a minimum of –7.8° C for 2 days in January. In Fresno County, Kliewer (1969) showed minimum temperatures below freezing for nearly every week during a 2-4 month period for each of 5 years.

POPULATION DENSITY

The numbers of *tarsalis* adults collected by the 3 methods are listed in table 4. Light traps with CO_2 attractant, used only during the first 11 collecting periods (lunar months) of the study, attracted by far the greatest number of adults per trap per night (trap-night), and no trap failed to capture at least a few adults, except in occasional cases of mechanical failure. CO_2 traps and shelters yielded fewer adults per collection, or sometimes none.

Table 4. – Number of adult *Culex tarsalis* collected by 3 methods at Wister, California. September 1967 – April 1970.

	Number Collected	Number of Collecting Periods	Number of Collections	Mean Number per Collection
Light trap with CO_2	33235	11	280	119
CO_2 trap	6115	33	444	14
Shelter	5171	30	366	14
Total	44521			

MOBILITY

If adults are not active every day, or if the population is very small, progressively fewer mosquitoes will be collected at the same site on consecutive days. At Wister, no effect of the 3 sampling procedures on the population was observed. Collecting from a particular site one day tended neither to decrease nor increase the number of mosquitoes collected the next day. Of 134 such comparisons with light traps, 56% were decreases and 44% were increases. (Instances of no change from one day to the next were not counted.) For CO_2 trap collections, 46% of 211 comparisons were decreases, and of 314 comparisons for shelter collections, 44% were decreases. For all 3 methods, decreases and increases for consecutive collections were about equal, even during the winter months when the population density was low. It may be inferred that the population of adults was very large in comparison to the numbers removed by the 3 sampling techniques, and adults were very mobile all year.

In the northwestern United States and Canada, overwintering *tarsalis* females are nearly completely immobilized by the cold (Rush et al., 1958:291); Shemanchuk, 1965:459). Rush (1962:179-180) collected wintering *tarsalis* females in the field and subjected them to various temperatures in the laboratory. Although there was some survival at temperatures as low as –10° C for 24 hours, at –3.3° C only very slow walking was observed, and true flight was not possible until 2.2° C. Strong flight of 9 meters or more was not achieved until 4.4° C. In the San Joaquin Valley, California, where winter temperatures are less severe, overwintering females are immobilized only during brief cold periods, and shelters become repopulated a week after all mosquitoes are collected (Bellamy and Reeves, 1963). In the Imperial Valley, shelters were repopulated daily, and afternoon temperature was never low enough to reduce adult flying ability noticeably.

FEMALES

The best data on the winter fluctuations of the female population density were obtained during the preliminary phase of the project when many samples were taken every month from September 1967 through July 1968 (fig. 13, table 5). The light traps and CO_2 traps showed nearly identical fluctuations, which was to be expected since CO_2 attractant was employed with both. Fewest females per trap-night were found during the late November-early December collecting period, the only time that the number fell below 10 and was less than the number of females of *Culiseta inornata* caught in the same traps. Average monthly minimum temperatures were lowest in December and January during the winter 1967-1968 (fig. 12) and the coldest 2-week period was January 1-15, but progressively more females were obtained by all 3 methods after the collecting period of November 30-December 2. Light traps were not used for the remainder of the study and fewer CO_2 traps were employed. Supplemental shelter collections were made from 3 wooden bridges, but usually only a few adults were found. During the next 2 winters, the fewest females were found after the coldest months. In the winter 1968-1969, the minimum temperature was in December (fig. 12) but the culvert showed the lowest population in February and the CO_2 traps in March (fig. 13, table 6). The trend in 1969-1970 was not clear since collections were discontinued in April. During the coldest months of both winters (December 1968, January 1970), the numbers in the culvert shelter increased while those in CO_2 traps decreased from the previous month.

For both summers, there was an apparent depression in population density during the hottest month, but collection data were incomplete for the first summer, and during both summers there were temporary aberrant weather conditions. In

Table 5. – Population density. Monthly abundance of adult *Culex tarsalis* collected in light traps with CO_2, CO_2 traps, and a culvert shelter (site 6). August 1967–June 1968.

		Light traps with CO_2			CO_2 traps			Culvert				
		♀			♀			♀		♂		
		$\bar{x}$	$\hat{\sigma}_{\bar{x}}$ *	N	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	N	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	N
1967	Sep 27-29	460.9	53.6	21	28.8	8.3	20	-	-	-	-	-
	Nov 2-5	303.3	42.6	28	7.7	1.8	27	-	-	-	-	-
	Nov 30-Dec 2	9.7	3.5	21	0.3	0.3	21	5.7	1.8	21.0	2.1	3
	Dec 28-30	23.5	5.7	21	1.4	0.7	21	11.3	3.2	13.0	4.7	3
1968	Jan 27-30	19.2	4.5	28	1.2	0.4	28	15.0	3.0	2.7	0.9	3
	Feb 29-Mar 2	70.6	13.2	21	8.1	2.4	20	10.7	4.9	12.3	5.8	3
	Mar 25-27	96.6	13.5	21	15.0	4.0	21	19.5	10.5	16.0	-	2
	Apr 27-29	93.9	14.9	21	8.7	2.9	21	19.0	5.7	9.0	2.5	3
	May 25-27	131.1	24.1	21	24.0	5.9	21	10.7	3.2	3.3	1.2	3
	Jun 20-22	39.9	11.3	13	4.4	2.2	7	-	-	-	-	-
	Jul 19-21	9.7	2.4	16	11.0	2.1	3	-	-	-	-	-

* $\hat{\sigma}_{\bar{x}}$ (unbiased estimate of the standard error of the mean) = $\frac{s}{\sqrt{N-1}}$.

Table 6. – Population density. Monthly abundance of adult *Culex tarsalis* collected in CO_2 traps and shelters. September 1968–April 1970.

		Culvert					Bridges					CO_2 traps		
		♀		♂			♀		♂			♀		
		$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	N	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	N	$\bar{x}$	$\hat{\sigma}_{\bar{x}}$	N
1968	Aug 31-Sep 2	164.3	22.4	19.3	3.5	3	4.2	1.2	3.0	1.2	8	105.8	32.9	6
	Sep 22-24	168.3	24.0	104.3	39.0	3	5.2	0.9	4.5	1.1	12	65.8	11.6	9
	Nov 2-4	42.0	18.0	142.3	70.0	3	2.4	0.9	6.7	2.0	12	42.3	12.3	9
	Nov 22-26	14.0	8.5	79.5	41.2	3	2.9	0.9	5.0	1.6	10	5.0	1.5	3
	Dec 11-14	66.3	5.6	101.3	25.1	3	3.3	1.1	5.3	1.5	9	1.2	0.5	6
1969	Jan 18-20	18.3	6.2	7.7	5.8	3	2.2	1.1	0.8	0.3	9	1.7	1.2	9
	Feb 15-17	2.3	1.3	1.7	0.3	3	0.8	0.3	0.4	0.3	9	1.8	0.8	6
	Mar 17-19	3.7	1.8	0.7	0.3	3	0.6	0.2	0.4	0.2	9	0.8	0.6	6
	Apr 19-21	8.7	1.8	2.3	1.3	3	0.6	0.4	0	-	9	5.0	1.2	6
	May 18-21	24.7	10.3	4.7	1.4	3	3.4	0.9	0.9	0.4	9	10.0	3.3	6
	Jun 14-16	64.7	12.7	7.0	1.0	3	5.8	1.5	1.8	0.8	8	51.7	19.0	9
	Jul 11-13	69.3	11.6	6.3	0.3	3	1.7	0.5	0	-	9	63.6	26.2	9
	Aug 14-16	1.7	1.2	0	-	3	0.2	1.4	0	-	9	1.8	0.7	9
	Sep 11-14	72.0	4.4	45.7	10.9	3	2.6	0.9	1.6	0.9	9	11.4	4.0	8
	Oct 10-13	19.8	8.1	11.7	2.4	4	1.2	0.5	1.1	0.4	9	13.1	3.7	9
	Nov 7-10	18.0	12.0	24.7	13.8	3	0.7	0.2	0.2	0.1	9	1.4	1.1	9
	Dec 5-8	1.7	0.3	3.0	2.5	3	0.9	0.5	0.6	0.2	9	1.1	0.6	9
1970	Jan 3-5	5.7	0.7	10.3	2.7	3	1.3	0.4	1.9	0.5	9	0.1	-	9
	Feb 6-8	7.7	2.7	2.0	0.6	3	1.2	0.4	0.1	-	9	4.0	1.7	9
	Mar 6-8	0.3	-	0.7	-	3	0.1	-	0	-	9	1.2	0.5	9
	Apr 11-12	2.0	-	0	-	2	0	-	0	-	6	0	-	6

the summer of 1968, light trap collections were greatest in mid-May and progressively diminished until mid-July, but this collecting method was discontinued after that month. Fewer females were caught in CO_2 traps in June than May, but this collection method was not employed in July. By late August, CO_2 traps attracted 4 times as many as the previous May, and 25 times the June catch. In early July, unusually heavy rains in the nearby Chocolate Mountains caused the canals at Wister to overflow, and a large portion of the area was inundated. This may have lowered the population by flooding the adult resting sites and washing larvae into the Salton Sea. The subsequent increase in population may be attributed to the increase in available breeding ponds as the flood waters receded. In the summer of 1969, a considerable drop in numbers in shelters and CO_2 traps was evident in mid-August. Shelter collections a month before and a month after were high. Shortly before the collecting period in August, there had been a wind storm which may have dispersed the mosquitoes, but high winds during other months had not noticeably reduced the population in shelters. (However, light trap and bait can catches were reduced on windy days.)

The annual population curve is bimodal. Mosquitoes were most abundant in the spring and fall, somewhat less abundant for a short time in the summer and least abundant in winter. Work, Vanis and Wallace (1969) continued the CO_2 baited light trap collections at Wister after I stopped them in July 1968, and they too observed spring and fall population peaks in 1968 and 1969.

Since rainfall in the Imperial Valley is insufficient at almost any time of the year to provide breeding sites, breeding is largely dependent on irrigation practices. Wister is primarily a management area for migratory waterfowl, and the duck ponds are flooded from about August until March. Other areas of Imperial Valley are irrigated in the spring and summer, but the pattern of seasonal abundance is about the same. Magy (1955) maintained light traps in Imperial Valley at sites ranging from about 40 to 65 km south of Wister. In 1954, *tarsalis* females were most abundant in October, with a smaller population peak during April and June. Larval collections showed the same bimodal pattern. Chew and Gunstream (1970: 560) found peak populations of *tarsalis* in light traps in spring and fall in the Coachella Valley, at a site about 50 km northwest of Wister. In a survey of several other areas of southern California, including Imperial Valley, only 1 peak was evident, in the late spring. In all the areas studied, this species was present in light traps every month of the year, and it was the only species besides *Culiseta inornata* that occurred through the winter months in any numbers.

C. tarsalis demonstrates latitudinal differences in seasonality in various parts of its range from western Canada to southern Mexico. Similar differences are seen in several other species, notably *Culiseta inornata*, which is a winter species in Imperial Valley (Chew and Gunstream, 1970:558), but is most active in the spring and autumn in the northern United States and in the summer in Canada (Horsfall, 1955:351; Shemanchuk, 1959:908). Probably the difference in the time of optimal temperature is one of the most important factors influencing this seasonality.

In southern Alberta, Canada, light trap catches of *tarsalis* were highest in July, but by September they dropped to zero (Shemanchuk, 1959:908). In North Dakota, *tarsalis* is inactive sometimes for more than 6 months, but the period of inactivity in central Washington is usually less (Anderson and Harwood, 1966:6). In Washington, the number of adults in light traps were low in May and peaked in July (Hammon, Reeves, Brookman and Gjullin, 1942:281), and by late September virtually all surviving females had migrated to their winter resting sites (Rush, Brennan and Eklund, 1958:289). Emergence of the overwintered population began the first half of March (Rush, Brennan and Eklund, 1958:291; Harwood, 1962:29). In northern Colorado, hibernating females were found in mines at the end of August when the numbers of females attracted to CO_2 traps had declined (Blackmore and Dow, 1962:293). The emergence of overwintered females in that state varied from late March to mid-April (Bennington, Blackmore and Sooter, 1958:298). In western Nebraska, hibernating females disappeared from a cellar at the end of April, but no females were caught in light traps until June (Keener, 1952:208).

In the San Joaquin Valley, California, populations also show a midsummer peak and a winter low, but fall populations are depressed later and spring populations increase sooner. Collections in light traps (Hayes et al., 1958:221; Reeves, 1970: 3), CO_2 traps (Hayes et al., 1958:221), and shelters (Hayes et al., 1958:221; Reeves and Hammon, 1962:176-177) were highest in late July and August. Occasional adults were found throughout the winter in light traps (Hayes et al., 1958: 221), but no mosquitoes were attracted to CO_2 traps during December and January and sometimes not until March or late April (Hayes et al., 1958:221; Nelson, 1964:247).

Jenkins (1950:913) noted that most collection records of *tarsalis* east of the Mississippi River are in late fall. Snow and Pickard (1956:147-148) found peak larval abundance in September in the Tennessee Valley, an area where *tarsalis* is an uncommon species.

Eads (1965) states that on the Lower Rio Grande Valley of Texas, *tarsalis* is a winter mosquito. He presents light trap data for 2 years in which no adults were collected from June to September, although this was the period of greatest abundance for many other mosquito species. On close inspection of his data, I believe that a very definite bimodal pattern is evident for both years. Adults are most abundant in November, common in December and January, and then increase again in February of one year and March of the next. The Lower Rio Grande Valley is semitropical, and the winters are even milder than in Imperial Valley. The average January temperature was 15.6° C, as opposed to 12.2° C at Imperial, but the minimum occasionally dropped below freezing. It is difficult to explain the summer disappearance of *tarsalis* from the Lower Rio Grande, since the average July temperature was 28.9° C, compared to 34.4° C in Imperial Valley, and other species of mosquitoes were abundant. Most of the 760 mm of rainfall occurred in the fall and spring, and standing water was usually more abundant in the winter months, but potential breeding sites were plentiful in the summer due to agricultural irrigation.

Figure 14 is a diagrammatic summary of population fluctuations in the major areas that have been discussed above. *C. tarsalis* is a summer mosquito to the north, a fall and spring species in the Imperial Valley, and a winter mosquito in southern Texas (with a mild midwinter depression). The series cannot be explained entirely by differences in temperature regimes, since the Lower Rio Grande Valley summer temperatures are not excessive.

MALES

Although males collected in shelters at Wister were less abundant in winter than during the fall, they never disappeared (fig. 15, tables 5, 6). During the late fall and early winter of both years, males were distinctly more numerous than females, but during the spring and summer months the converse was true.

Throughout most of the range of *tarsalis*, males do not survive the winter, although Harwood (1962:28-29) did collect 1 male in an emergence trap placed over a talus slope from March 11 to April 29, 1961. Because this collection, and others of male *Anopheles freeborni* Aitken, 1939, were made from a north-facing slope, Harwood (1962:30) speculated that the colder, more stable site was most favorable to hibernation of adults by conserving their energy reserves. Usually, the first males seen in the spring are brightly colored members of the first spring brood, a few weeks after females emerge from their wintering sites (Rush and Tempelis, 1967:309). In southern Alberta, Shemanchuk (1965:459) found females in mammal burrows from September to January and April to June, but males were present in September only. Bennington, Sooter and Baer (1958:300) collected females under a bridge in northern Colorado in mid-April, but males did not appear until late May. Both sexes had virtually disappeared by the end of October. Keener (1952:208) collected females from cellars in western Nebraska from mid-January until the end of April, but no males were found. In Fresno county, California, males were absent from culverts in January, February and March (Kliewer et al., 1969:17), and in Kern County they are absent from shelters for a month or longer, and do not reappear in numbers until late March or April (Bellamy and Reeves, 1963:317; Burdick and Kardos, 1963:533; Nelson, 1964:248).

At Wister, the presence of *tarsalis* males throughout the year is the clearest evidence of a basic difference in winter biology between that population and those mentioned above. Since blooded and gravid females and larvae are also present all winter, there is no distinct "new generation" of adults indicated by the first appearance of males in the spring. Continuous breeding produces a continuous population of males.

The apparent increase in percentage of males in shelters for both winters at Wister may be due to a change in behavior of the females. Perhaps the majority of the females disperse from Wister during the cooler months (p. 12) or seek more secluded resting sites such as animal burrows (p. 10). Bellamy and Reeves (1963: 317,318,321) found a secondary peak of abundance of males in late autumn in Kern County. They thought that there may be an increased tendency for males to congregate in shelters at that season or survival may be better at the cooler autumn temperatures.

IMMATURES

Larvae and pupae were found every month of the year at Wister. Although much of the area was flooded to provide habitat for migratory water fowl, larvae were seldom found in the duck ponds (fig. 6). *Gambusia affinis* (mosquito fish), an efficient predator of mosquito larvae (Hoy and Reed, 1970), was very abundant in the ponds. The best *tarsalis* breeding sites were shallow, grassy ditches (fig. 7) with recent accumulation of seepage from the ponds or the canals. Sporadic breeding occurred at or near almost every site enumerated on fig. 2, especially sites 1, 6 and 12. Unfortunately, these sites were usually dry after a few weeks, and therefore breeding levels over time could not be determined for any one seepage ditch.

Table 7 shows fall and winter collections from site 8, the large sewage oxidation pond which was the only breeding place that contained water all year. One dip was made for each 0.1 m^2 of surface area collected, therefore mean number of larvae per dip can also be interpreted as mean number per 0.1 m^2 of water surface. Lesser numbers of larvae were collected in the winter months, but no trend is readily apparent from the limited data. Frequent changes in the level of

Table 7. – Immatures. Monthly collections of larvae and pupae of *Culex tarsalis* in the sewage oxidation pond (site 8) at Wister, California.

Date of collection		Mean number of immatures per dip	Number of dips
1969	Sep 13	0.8*	60
	Oct 10	50.0*	60
	Nov 9	5.4	60
	Dec 7	9.5	63
1970	Jan 5	0.1+	20
	Feb 7	0.2	20
	Mar 7	0.8	20

* Estimate.

\+ Larvae were plentiful in 3 seepage ditches in January.

the pond corresponded to decreases in numbers collected, even from one day to the next. On January 5, 1970, although plentiful larvae of both *Culiseta inornata* and *Culex pipiens quinquefasciatus* were found in the oxidation pond, only 1 larva of *tarsalis* was collected in 20 dips. However, 3 other temporary breeding sites in the area had larger number of *tarsalis* larvae that month.

In the northwestern United States, *tarsalis* larvae are not found in the winter (Rush, Kennedy and Eklund, 1963a) because females are gonoinactive. In Kern County, California, immature stages do not disappear completely in the winter, but they are apparently much less abundant than in Imperial County. Brookman (1950:85) and Washino and Bellamy (1963) found at least a few immature stages of *tarsalis* throughout the winter months, but as the latter authors state, "during the cold months an exhaustive search was necessary to find any larvae." In January, only third and fourth instar larvae and pupae were found, and in February, in 34 potential breeding sites, 7 larvae were found, all of which were first and and second instar. By March, all larval instars were found, but no pupae. Probably, the January population represented the last of the developing immatures from adults that had been gonoactive in the fall, and the February population of early instars was from females that had overwintered and subsequently became gonoactive. In my study at Wister, immatures were more numerous, and pupae and all larval instars were found every winter month.

On January 6, 1970, at 7:00 a.m., I noticed that Wister site 1, a small grassy seepage ditch approximately 0.5 m x 2 m x 10 cm deep, was frozen over. Ambient minimum temperature for the day was –1° C. Under about 2 or 3 cm of ice, 174 *tarsalis* and 207 *Culiseta inornata* pupae and larvae of all instars were collected by pipette. In the laboratory the collection was divided equally between 2 plastic half-liter cups. The first cup was held at 25.6° C and the other was refrigerated. After 16 hours at 0° C, 5 *tarsalis* and 15 *inornata* larvae were immobilized in the ice on the top two-thirds of the cup. The frozen and liquid portions were separated and incubated at 25.6° C with the control. Almost no mortality was observed for any of the 3 groups, and both species continued development to the adult stage.

Washino and Bellamy (1963) found larvae under ice on 2 occasions in Kern

County. Although development is slower and mortality probably higher at winter temperatures, adults emerged from penned pupae in the field.

Immatures of *tarsalis* can also tolerate relatively high temperatures. In June 1968, active larvae were found in a seepage ditch (site 11) about 5 cm deep where the water temperature was 35° C. Jenkins (1950:914) reports that larvae have been found in thermal waters at temperatures up to 39.0° C.

PHYSIOLOGICAL PARAMETERS

FAT BODY DEVELOPMENT

The percentage of females at Wister with Class 3 fat body (abdomen filled with fat but not distended) was highest in November of both years (fig. 16, table 8). Almost no females had abdomens that were noticeably distended by fat (Class 4). No females collected in March, April or May 1969 had more than a trace of fat body in the abdomen (Class 2). The pattern was nearly identical in the CO_2 traps (although the data are less reliable because fewer females were examined). Females with Class 3 fat body were attracted to CO_2 in the same proportion that they were found in shelters each month. Diapausing females should not be attracted to CO_2 because they do not feed; therefore the maximum amount of fat body developed by females at Wister was not characteristic of diapause.

In other areas where the winter biology of *tarsalis* has been investigated, fat body is strongly developed. Where winters are coldest, *tarsalis* begins to store energy reserves in early fall. By late fall, the abdomen is distended by a compact, lobular fat body (Bennington, Sooter and Baer, 1958:301; Blackmore and Dow, 1962: 293; Harwood and Halfhill, 1964; Rush, Brennan and Eklund, 1958:289). Apparently in the San Joaquin Valley, California, fat body develops less than in Washington (Harwood and Halfhill, 1964:597,598). Burdick and Kardos (1963:533) reported that the largest percentage of females with abdomens filled or distended with fat was in late December (91%) in Kern County. At Wister, the highest level was in November of both years: 59% in 1968 and 38% in 1969.

The differences in degree and duration of fat body development may be due to a direct effect of temperature or to latitudinal differences in response to photoperiod. Although decreasing day length seems to be the important factor for initiation of fat body development in *tarsalis*, its effect is reinforced by low temperature (Harwood and Halfhill, 1964; Harwood and Takata, 1965). Not all populations of the same species of mosquito show the same response to photoperiod, even under a controlled temperature regime. In a laboratory strain of *tarsalis* from Bakersfield, California, Harwood and Halfhill (1964:597) never observed fat body as large or as compact as that found in hibernating females in central Washington. This may reflect a difference in the natural populations of the 2 areas or it may be due to changes in the Bakersfield colony after many years under laboratory conditions. California and Washington strains of *Anopheles freeborni* showed latitudinal differences in fat body response to photoperiod (Depner and Harwood, 1966). The Wister population of *tarsalis* shows no obvious difference in time of initiation of fat body development from the other populations that have been studied, but, probably due to the warmer fall and winter temperatures, the fat body never develops to the same extent, and it is more rapidly metabolized as the females continue to be active.

Table 8. – Fat body development in female *Culex tarsalis* from shelters and CO_2 traps.

DATES	SHELTERS					CO_2 TRAPS				
	Fat Body Class (%)					*Fat Body Class (%)*				
	0	1	2	3	N	0	1	2	3	N
1968 Aug 31-Sep 2			95	5	38	3	16	66	16	77
Sep 22-24	13	1	72	15	95	12	0	54	34	67
Nov 2-4			56	44	32	9	0	41	49	87
Nov 24-26			41	59	29			(33)	(67)	3
Dec 11-14			88	12	101			(43)	(57)	7
1969 Jan 18-20			(71)	(29)	7			(86)	(14)	7
Feb 15-17		58	33	8	12		(50)	(33)	(17)	6
Mar 17-19		(71)	(29)		7		(100)			4
Apr 19-21		52	48		25	4	37	59		27
May 18-21	13	52	35		69	1	57	41		68
Jun 14-16		6	84	10	82	1	1	87	11	171
Jul 11-14			88	12	32			91	9	53
Aug 14-16			(100)		9			82	18	11
Sep 11-14			84	16	74			84	16	25
Oct 10-13			94	6	52			90	10	41
Nov 7-10		2	60	38	42			(38)	(62)	8
Dec 5-8			91	9	11			70	30	10
1970 Jan 3-5					0					0
Feb 6-8			91	9	33			97	3	34

INSEMINATION

C. tarsalis females destined to overwinter usually mate first (Bellamy and Reeves, 1963:319; Burdick and Kardos, 1963:533; Kliewer et al., 1969:15) but insemination is not necessary for the fat body to develop (Harwood and Halfhill, 1964: 598). Since females mate soon after emergence from the pupal stage at all seasons, the high percentage of females inseminated in the winter is probably due to a dearth of immatures at that time that would give rise to noninseminated females.

At Wister, I examined the spermathecae of too few females during some months to form a definite conclusion about the insemination rate in the winter (table 9).

Table 9. – Insemination. Monthly percentage of inseminated female *Culex tarsalis.*

		SHELTER		CO_2 TRAP	
		Percent inseminated	N	Percent inseminated	N
1968	Aug 31-Sep 2	99	92	100	37
	Sep 22-24	86	104	96	57
	Nov 2-4	62	26	94	78
	Nov 24-26	68	44	100	10
	Dec 11-14	84	102	(86)	7
1969	Jan 18-20	98	57	100	13
	Feb 15-17	(100)	4	(100)	1
	Mar 17-19	--	0	--	0
	Apr 19-21	100	19	96	26
	May 18-21	--	0	--	0
	Jun 14-16	--	0	--	0
	Jul 11-13	97	32	98	43
	Aug 14-16	(100)	7	(100)	4
	Sep 11-14	78	63	96	23
	Oct 10-13	82	50	95	38
	Nov 7-10	52	40	(100)	9
	Dec 5-8	46	11	90	10
1970	Jan 3-5	--	0	--	0
	Feb 6-8	97	33	100	34
	Mar 6-8	(100)	1	100	10

In early September 1968, 91 of 92 females examined from shelters were inseminated. The percentage of inseminated females then declined for 2 months to 62% in early November, and then steadily increased to 98% in January 1969. The following winter, there was again a suggestion of a fall decline of insemination rate and subsequent increase by February. Nearly all females captured in CO_2 traps were inseminated.

BLOOD FEEDING AND OVARIAN DEVELOPMENT

Engorged or gravid females were found all year (fig. 17). The percentage of females with blood or developed ovaries was lowest in the late fall, at the same time that percentage of females with fat body was greatest (fig. 16). Before the coldest weeks of winter, fat body development decreased and blood feeding and ovarian development increased. There was another apparent depression of blood feeding and ovarian development in the summer. The data for 1968 are incomplete: the percentage of females engorged or gravid decreased in May and was higher in early September, but shelter collections were not made in June or July. In summer 1969, the lowest level was in July, the month before the apparent depression of the female population (fig. 13). Although August was the hottest month in 1969 (fig. 12), blood feeding increased that month. The level of blood feeding may be influenced by the density of birds at Wister, which is much higher in the winter than in the summer.

Where winters are severe, engorged females are not found for many months. In Utah (Blackmore and Dow, 1962:293) and in Colorado (Bennington, Sooter and Baer, 1958:301), no engorged females are found by October. In the spring, the first females do not bite bait animals until March in Oregon (Rush, Kennedy and Eklund, 1963a:260).

In the San Joaquin Valley, numerous studies have documented the winter depression in blood feeding (Kliewer et al., 1969:15; Nelson, 1964:248; Reeves, Bellamy and Scrivani, 1958:84). Bellamy and Reeves (1963:316,321) found a nearly complete cessation of blood feeding and ovarian development for a period of almost 3 months every year for 4 years, but did not find any period when feeding ceased completely. At Wister, the reduction in blood feeding in the fall was not as extreme as reported for the San Joaquin Valley. In 1967, engorged and gravid females accounted for 23% of the female population during the lowest month of blood feeding (fig. 17), 16% in 1968, and 9% in 1969. Resumption of blood feeding was detected in late December the first two years and in early January of the third. In Kern County, a gradual increase in the percentage of females engorged is usually observed in late January and only rarely as early as late December (Bellamy and Reeves, 1963:316; Nelson, 1964:248).

In the Lower Rio Grande Valley, Texas, where *tarsalis* is essentially a winter species, Eads (1965) collected many engorged or gravid females in light traps from October to January. I have calculated the proportion of engorged or gravid females from the numerical data that he presented: 54% of the females were engorged or gravid in October, but only 19% in November and 34% in December. By January, the level had increased to 63%. No data was given for February or March. These fluctuations in blood feeding occur about a month behind similar fluctuations in population level (p. 26) and, like the population fluctuations, suggest a bimodal curve of activity with a depression in early winter.

The blood meals of 43 females that I collected in September 1969 in the culvert (site 6) were analyzed by precipitin test (Tempelis and Lofy, 1963) by Dr. Tempelis at the University of California, Berkeley (table 10). Of particular interest are the 3 snake bloods. As previously mentioned (p. 5), snakes are currently under study as overwintering candidates of WEE virus. Only rarely are field-collected *tarsalis* females found engorged with reptilian blood. Of over 10,000 engorged females tested, Tempelis et al. (1965:174) detected 3 reptilian bloods in Kern County, and Tempelis and Washino (1967:316) found 1 reptilian blood meal in more than 900 tested in the Sacramento Valley.

Table 10. – Hosts of *Culex tarsalis* as determined by precipitating antisera to blood meals of females collected in shelters. September 1969.

Bird		
	Columbiformes	1
	Negative*	15
Mammal		
	Rabbit	4
	Man	1
Reptile		
	Snake	3
Negative		19

*Class Aves, order not determined.

PARITY

Parous females were found every month of the year at Wister (fig. 18). In shelters, the percentage of parous females decreased in the fall of 1967 and 1969, but by early winter it had increased. This corresponded to the simultaneous increase in blood feeding and ovarian development (fig. 17) and to the decrease in fat body development (fig. 16).

Even at the more northern latitudes, parous females do not disappear completely. In northern Colorado, 2 of 597 females collected in a mine in early December were parous (Blackmore and Dow, 1962:293-294). In eastern Colorado, Rush and Tempelis (1967:311) found parous females in mid-April, before they found evidence of the new spring generation of adults. In the San Joaquin Valley, at least a few parous females are found in shelters throughout the winter (Burdick and Kardos, 1963:532; Kliewer et al., 1969:17). Bellamy and Reeves (1963:319,320) demonstrated experimentally that parous females could survive the winter in Kern County, but survival was inferior to that of females that had not been allowed to take a blood meal.

Although parity of shelter-collected females decreases in the fall in some areas, it increases in females attracted to CO_2. In northern Colorado, progressively fewer females were caught in CO_2 traps in the late summer, but the percentage of those females that were parous reached 100% by late September. The parity of empty females in shelters dropped to zero during the same period (Blackmore and Dow, 1962:292). Nelson (1964:246) reported the same phenomenon in the San Joaquin Valley later in the year. By the end of October, nearly all females collected in CO_2 traps were parous, but parity in empty shelter-collected females had decreased. He suggested that the fall population of *tarsalis* females is divided into two groups: (1) Females that emerge from pupae in the summer take blood meals and oviposit repeatedly for the duration of their lives. They usually do not survive the winter. These are the host-seeking females with a high level of parity found in CO_2 traps in dwindling numbers in the fall. (2) Females that emerge from pupae in the fall experience diapause. They do not blood feed until after they have overwintered (January in Kern County). Hence, few females found wintering in shelters are parous.

At Wister, too few females from CO_2 traps were examined to detect a divergence in level of parity between females from CO_2 traps and those from shelters.

The indication is that there is no divergence. Fluctuations in parity level were similar for the 2 methods from June to October 1969. In mid-October, 56% of 25 CO_2 trap females and 54% of 26 shelter-collected females were parous. In Kern County, from the first to the second half of October 1952, parity decreased from 30% to 17% in shelters and increased from 90% to 93% in CO_2 trap collections (Nelson, 1964:247).

CONCLUSIONS

The Wister population in Imperial Valley, California, remains active all year. Winter diapause is so weakly expressed and of such short duration as to be nearly nonexistent. In the fall, blood feeding and parity are somewhat reduced momentarily and a fat body is developed. However, these indications of diapause begin to disappear even before the coldest days of winter. The amount of fat body developed is less than typical for diapause, and females with a fat body are attracted to CO_2. Males, pupae and larvae of all instars are found throughout the winter.

The duration of diapause is different at various latitudes. In Canada and the northwest United States, it may last 6 months. In California it is shorter. Bennington, Sooter and Baer (1958:303) state that in California "true hibernation" does not occur in *tarsalis* but studies by workers in the San Joaquin Valley have shown almost complete cessation of activity for nearly 3 months. Females develop a fat body and cease feeding almost completely; parous females are rare; males disappear and larvae are very scarce. In the Lower Rio Grande Valley, Texas, there is no winter diapause.

In the Imperial Valley, it does not seem that diapause would be necessary for winter survival of *tarsalis*. Although blood feeding decreases in late fall, it resumes before the coldest weeks of winter. Therefore, the temperature during this period does not appear to inactivate the mosquitoes directly. Progressively shortened day length in the fall may initiate diapause in populations of *tarsalis* at all latitudes, and low temperature probably reinforces the response. The temperature in the fall and winter in the various areas studied is probably largely responsible for the differences observed in degree of expression and duration of diapause. Where winters are less severe, the females are more active, and energy reserves are depleted more rapidly. The stimulus for breaking the diapause may be simply the complete or partial exhaustion of the fat body, or as Bellamy and Reeves (1963:321) suggest, accumulation of a critical amount of heat. In either case, the period of diapause would be shorter where fall and winter temperatures are higher.

Potentially, *tarsalis* in the Imperial Valley is a good candidate for overwintering arboviruses. However, without direct evidence of the viruses in the winter, it is not possible to determine the population density and the level of blood feeding necessary to maintain the cycle of transmission. Work, Vanis and Wallace (1969) made 12 isolations of WEE, 10 of SLE and 21 of Turlock virus from *tarsalis* in 1968 and 1969 at Wister, but none of these isolates was from December or January. Just as in Kern County, California, at Wister no virus has been found when the level of blood feeding is lowest. Further investigations of the viruses and their vectors and reservoir hosts will be necessary for a better understanding of their seasonal relationship.

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Publication dates for Volumes 5 and 6
Contributions of American Entomological Institute

Volume 5

No. 1 January 28, 1970
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No. 5 May 5, 1970
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Volume 6

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No. 2 August 17, 1970

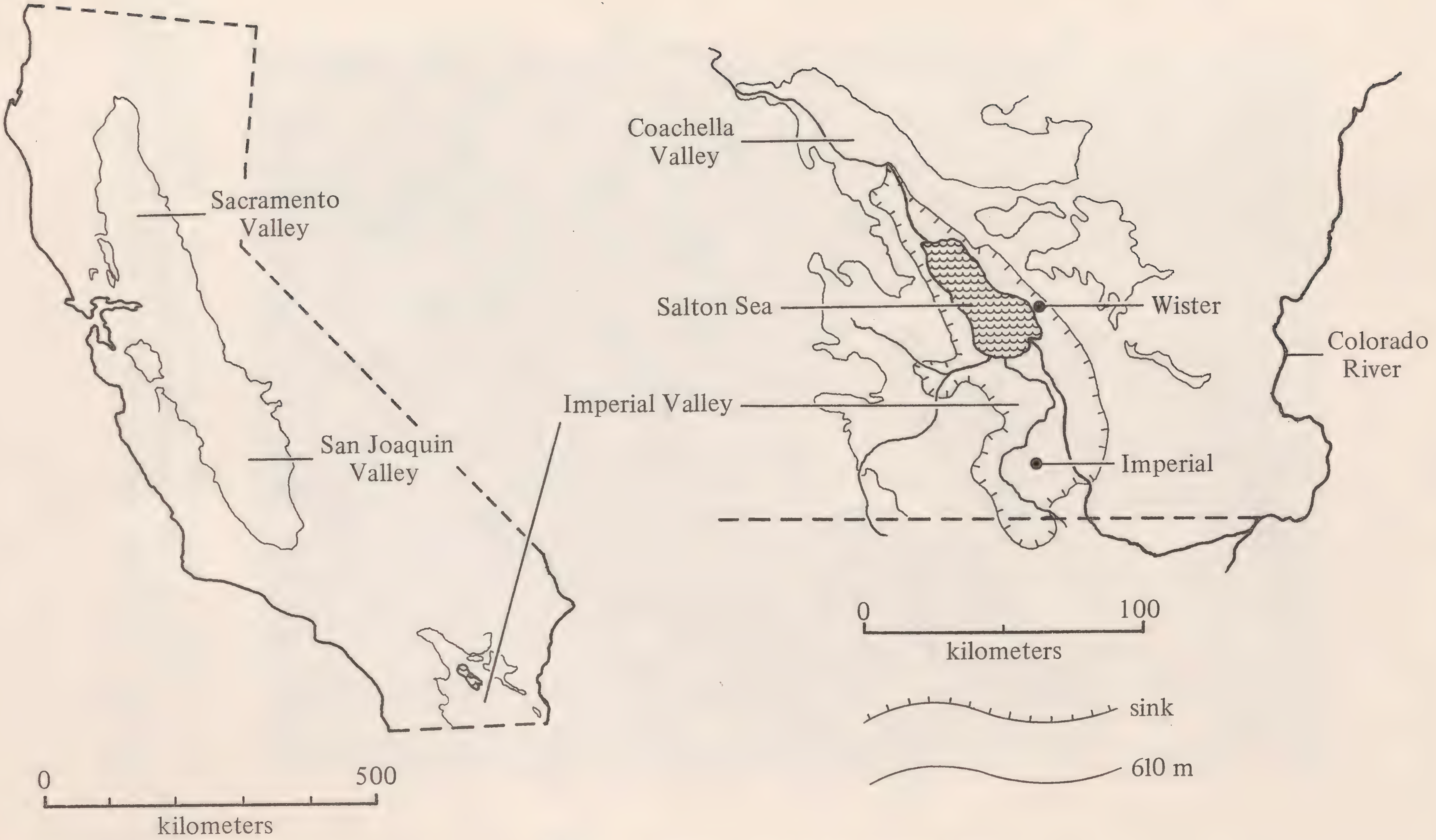

Figure 1.–Maps of California and the Imperial Valley.

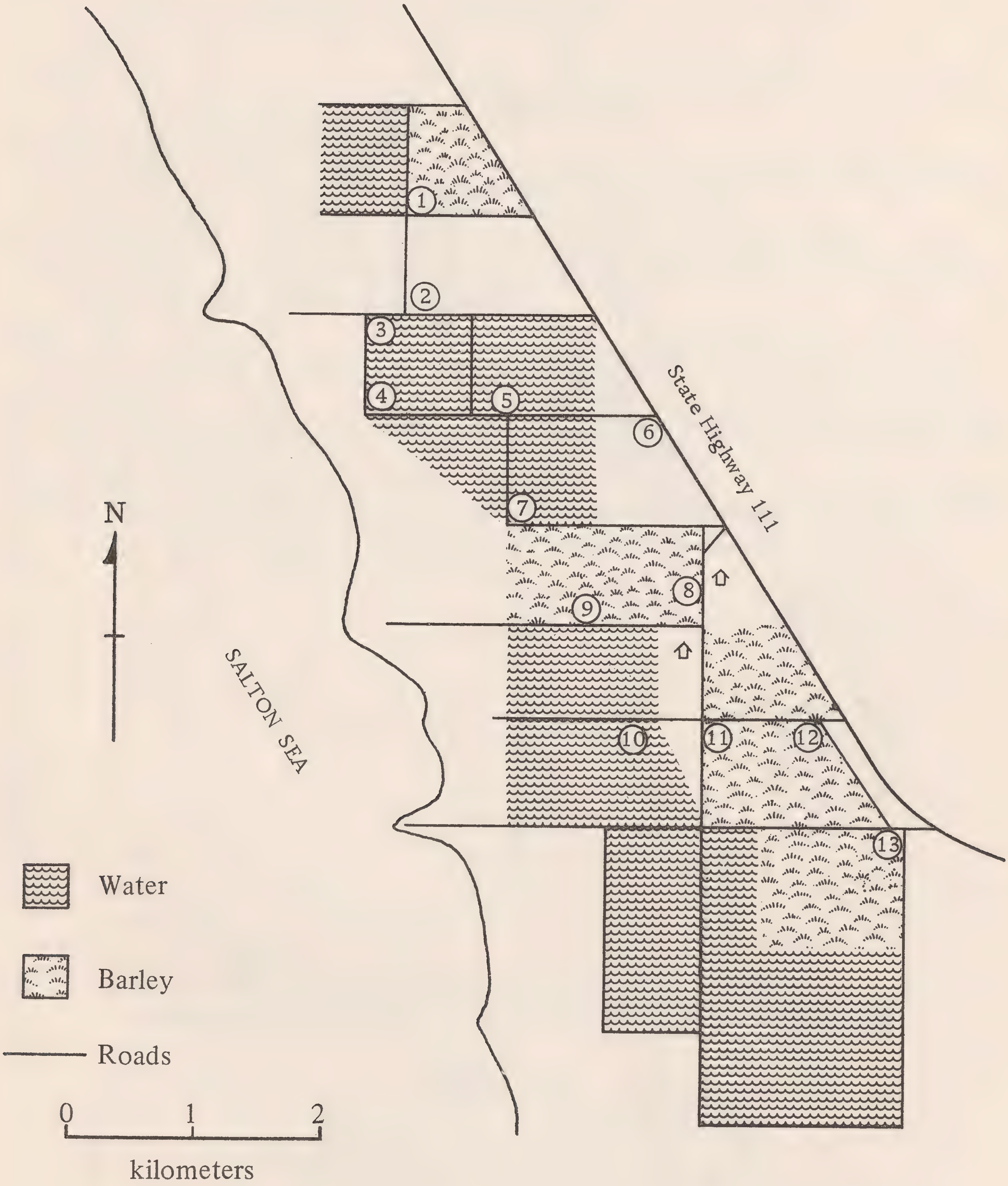

Figure 2.—The Wister Unit of the Imperial Waterfowl Management Area, Imperial County, California. Circled numerals indicate sites where routine collections of *Culex tarsalis* were made.

Figure 3.–A diurnal shelter for *Culex tarsalis* adults: a cement culvert (site 6) under California State Highway 111 at Wister.

Figure 4.–A diurnal shelter for *Culex tarsalis* adults: a wooden bridge (site 5). The 2 m white rod is marked at 0.5 m intervals.

Figure 5.–Red ice cream cartons under a wooden bridge (site 5) from which *Culex tarsalis* adults were collected each month with an aspirator.

Figure 6.–A duck pond at Wister.

Figure 7.–A typical breeding site of *Culex tarsalis* at Wister: a shallow, grassy depression (site 12) with a recent accumulation of seepage from an irrigation canal.

Figure 8.—The sewage oxidation pond at Wister. The arrow indicates the collecting area (site 8) shown in fig. 9.

Figure 9.—Site 8 at the edge of the sewage oxidation pond where immatures of *Culex tarsalis* were collected each month. The wooden stake projects approximately 0.25 m above the water surface.

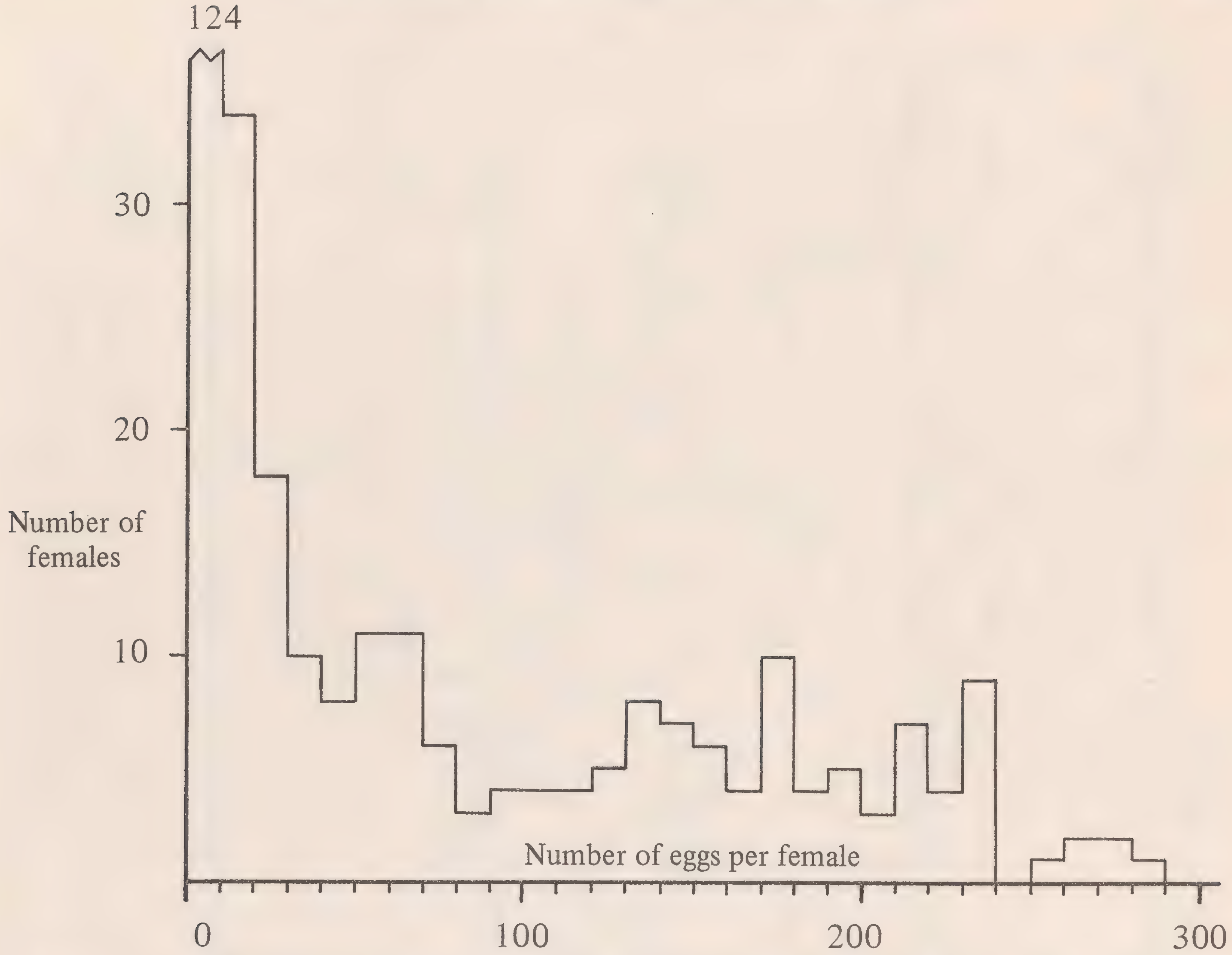

Figure 10.—Frequency distribution of the number of developing eggs (Stages III-V) per female *Culex tarsalis* collected at Wister. September 1967-April 1970.

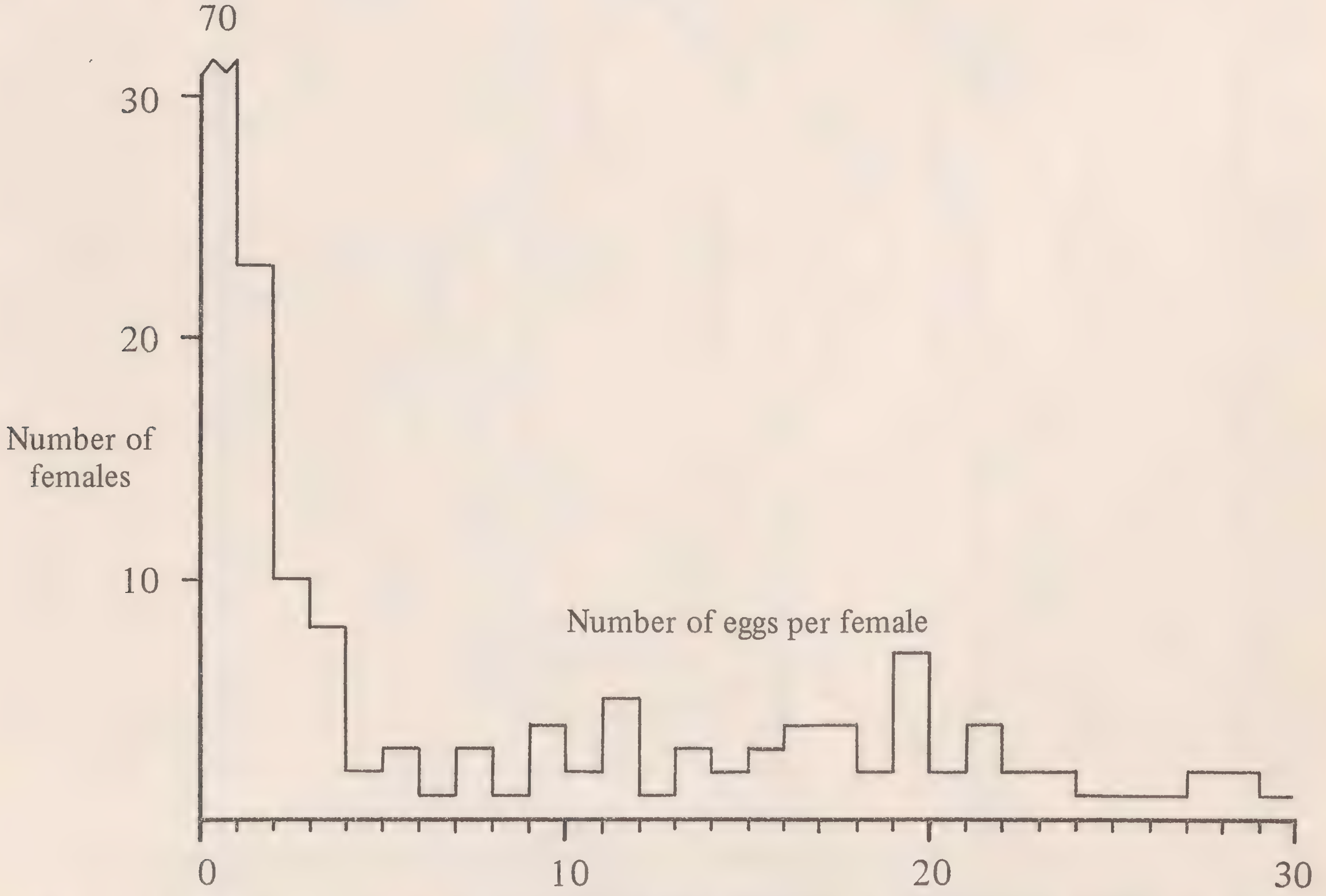

Figure 11.—Frequency distribution of the number of developing eggs per female for those individuals with 30 eggs or less.

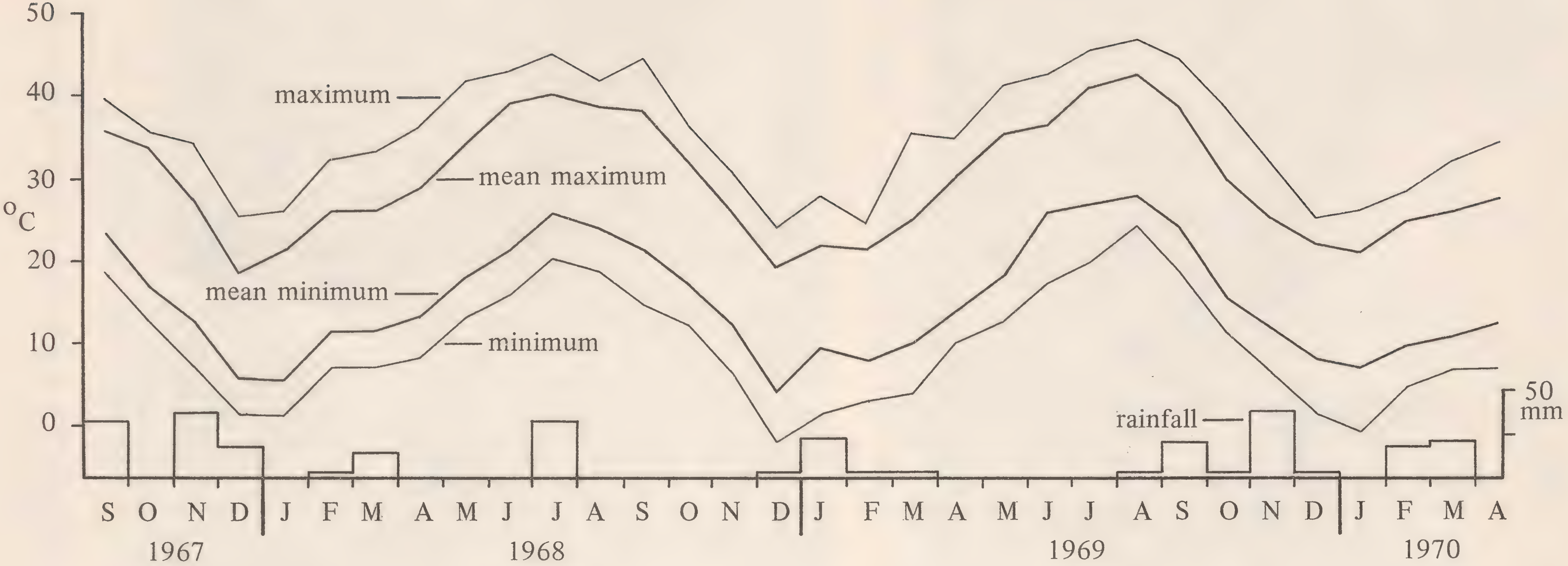

Figure 12.–Monthly mean and extreme temperatures and total monthly precipitation recorded by the Imperial Irrigation District, Imperial, California.

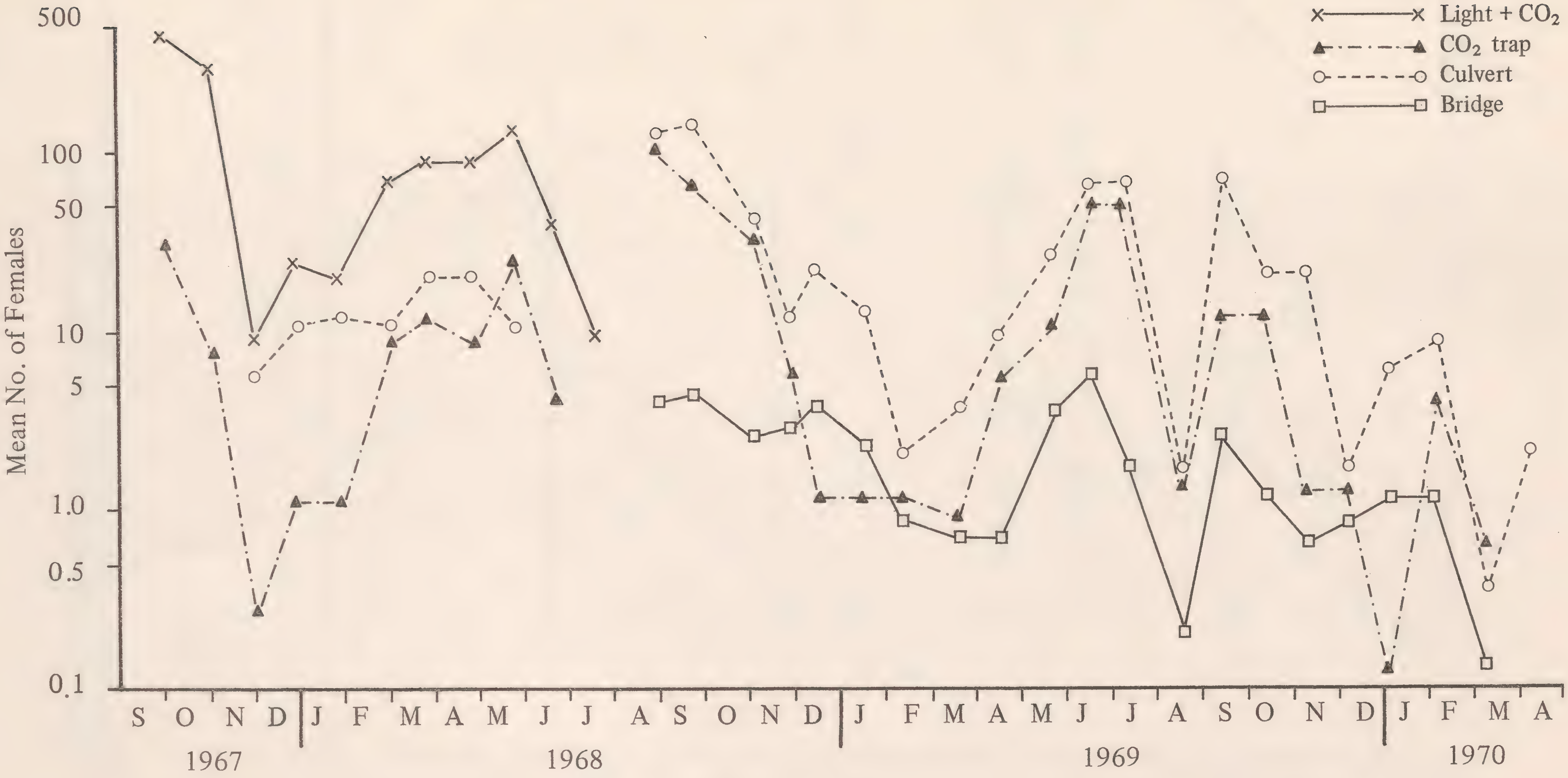

Figure 13.–Numbers of *Culex tarsalis* females collected in light traps with CO_2, CO_2 traps, a culvert shelter (site 6), and 4 bridge shelters (sites 1, 2, 5, 7). Monthly arithmetic means plotted logarithmically.

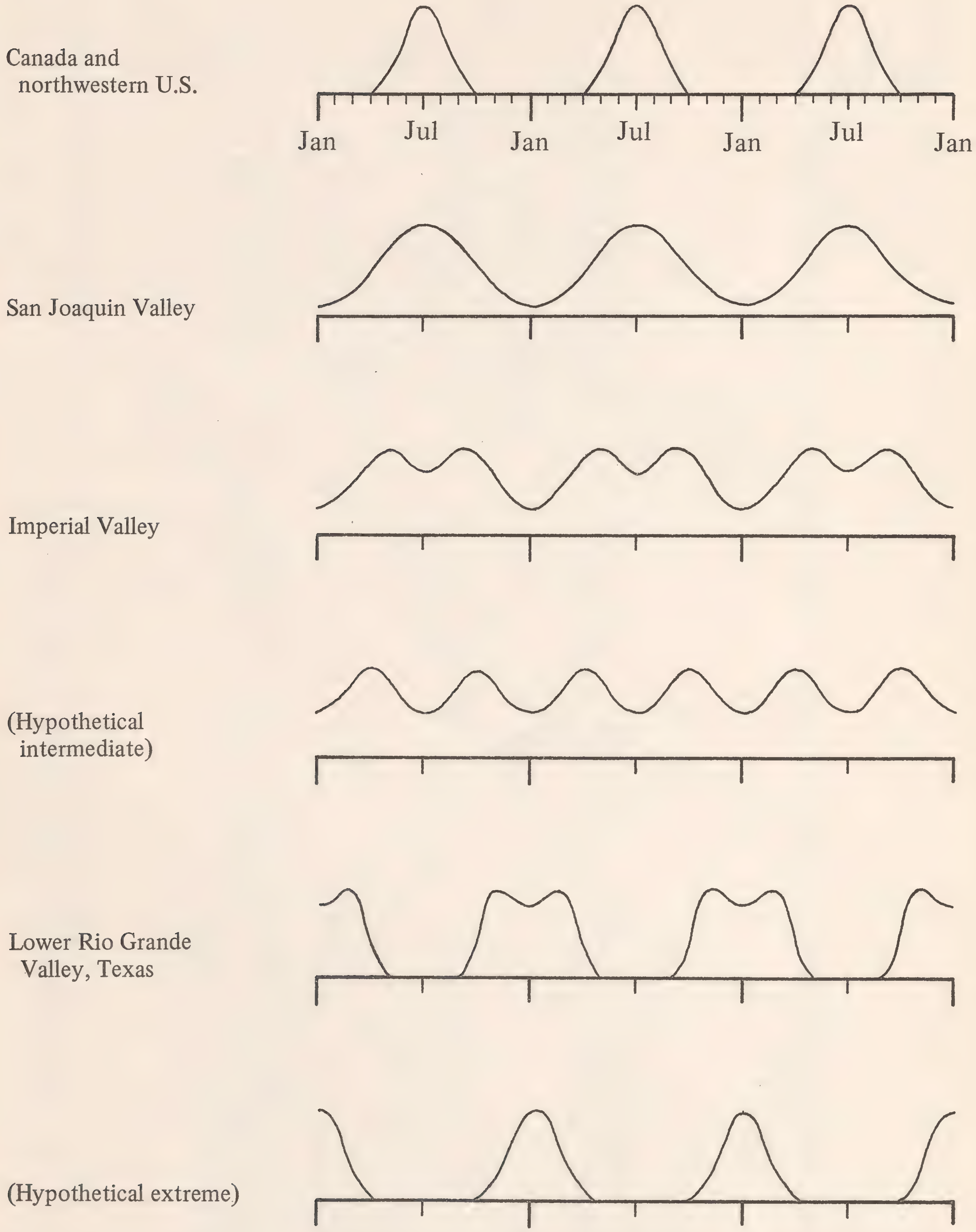

Figure 14.–Diagrammatic representation of the seasonal fluctuations in abundance of *Culex tarsalis* collected in light traps at various latitudes.

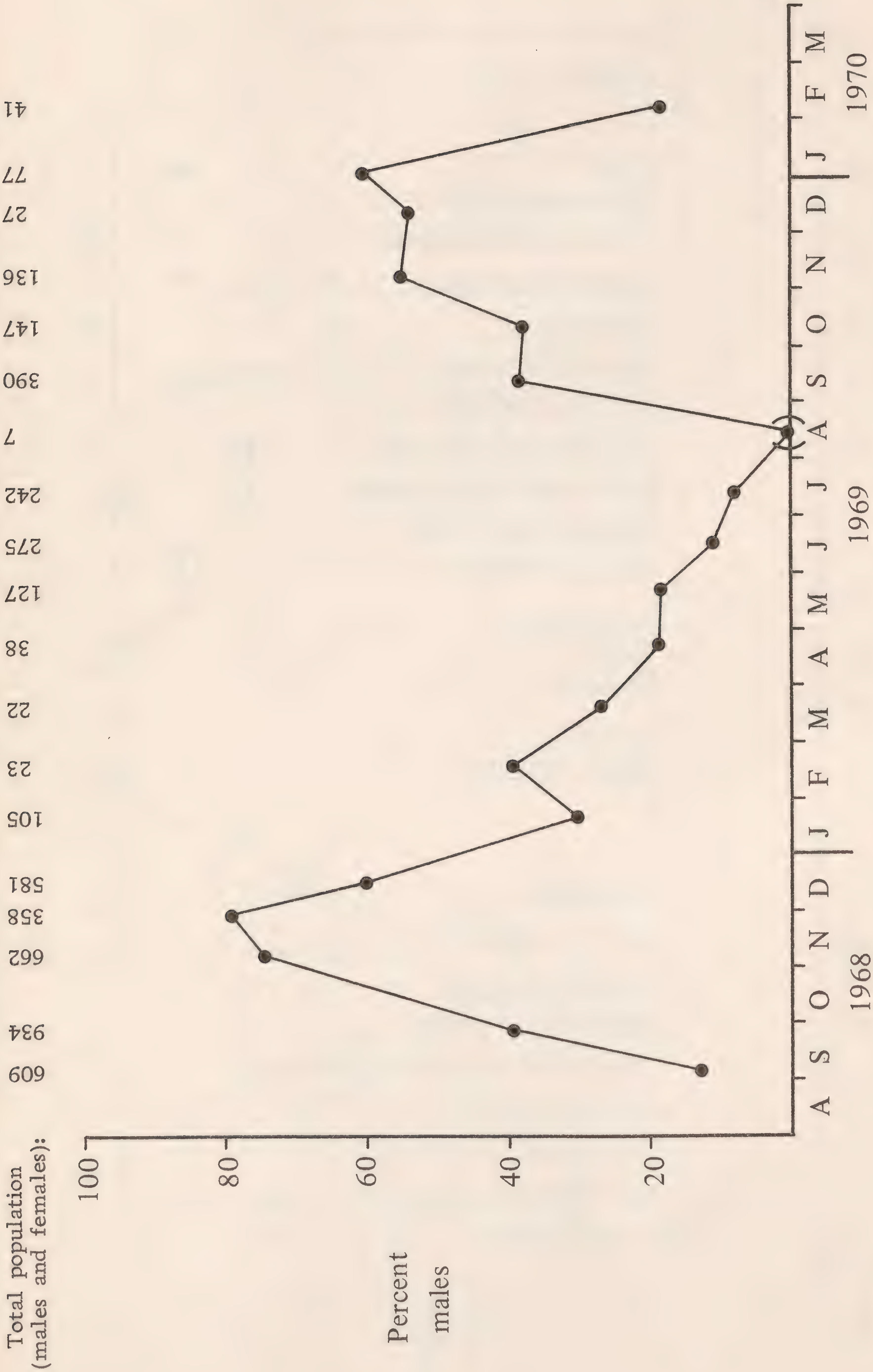

Figure 15.–Monthly percentage of males in the population of *Culex tarsalis* collected in shelters (sites 1, 2, 5-7).

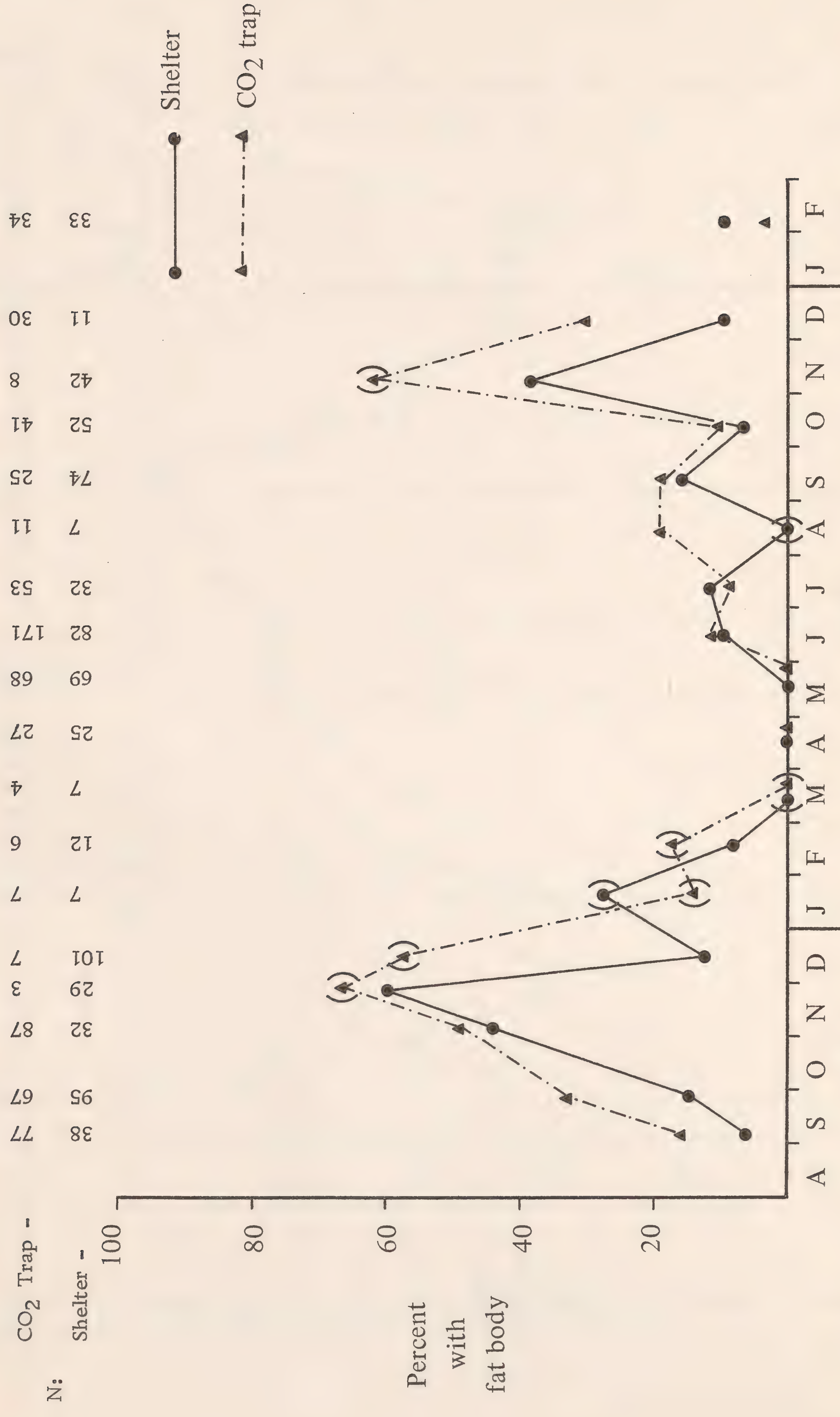

Figure 16.–Fat body. Monthly percentage of female *Culex tarsalis* with Class 3 fat body.

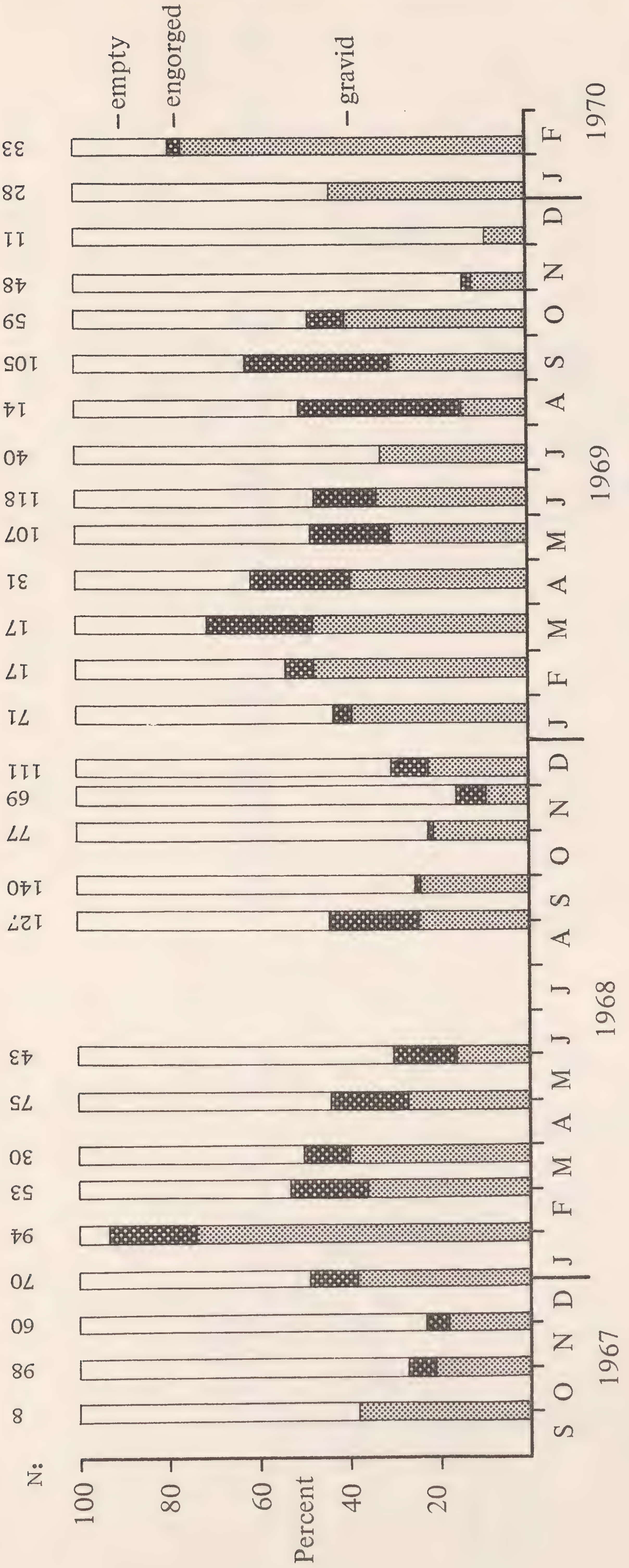

Figure 17.–Monthly percentage of female *Culex tarsalis* empty, engorged or gravid collected in shelters (sites 1, 2, 5-7).

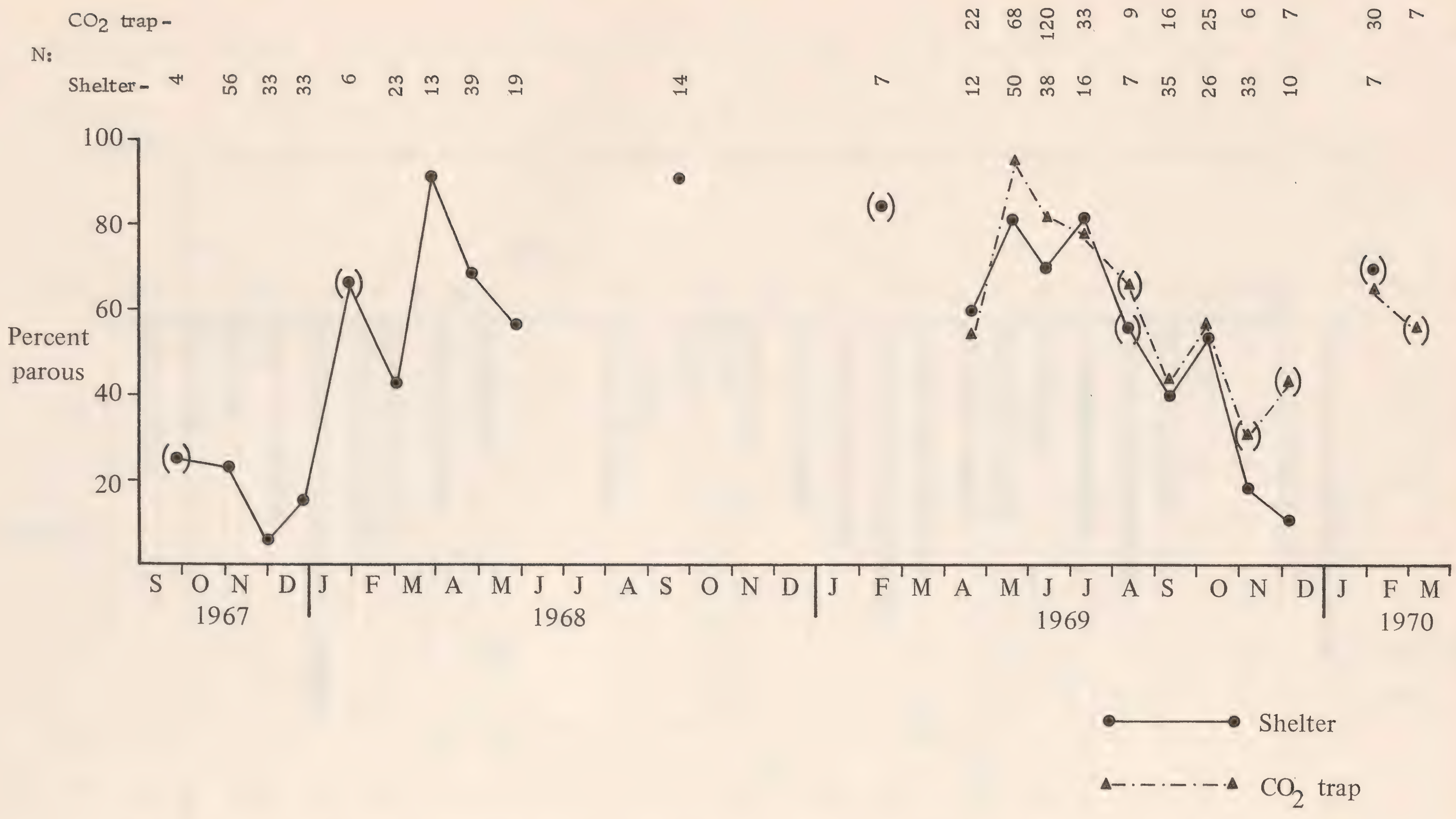

Figure 18.–Parity. Monthly percentage of parous empty *Culex tarsalis* females, collected in shelters and CO$_2$ traps.

(Continued from inside front cover)

Parts of Volume 4, with prices

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