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A REVISION OF THE RHOPALOSOMATIDAE (HYMENOPTERA)

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A REVISION OF THE RHOPALOSOMATIDAE (HYMENOPTERA)

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The Rhopalosomatidae is a small family of wasps that are parasites of Gryllidae. Specimens have been scarce in collections because most species are nocturnal or crepuscular and are not collected on flowers as are most other wasps. When use of Malaise traps recently became popular these wasps turned up in the traps in some numbers. Now, there are enough specimens available for a substantial advance in the systematics of the family. Specimens of the flightless genus Olixon, however, are still in short supply.

Some characteristics of the Rhopalosomatidae, in addition to those common to other Aculeata, are as follows: Notaulus and prepectal carina absent. Mesopleurum without a median transverse groove. Mesosternum with a pair of plates on its hind edge that partially cover the bases of the middle coxae. Femora without bristles, the tibiae without bristles or with only small weak bristles. Female tarsi weakly to strongly widened, with dense suberect hairs beneath. Male tarsal claws with a tooth near apical point. Female tarsal claws simple or with a postmedian tooth, sometimes also with a subbasal low rounded tooth. Abdomen flexible between segments 1 and 2. Male clasper ending in a long upcurved spine. Female subgenital plate roundly folded on midline, triangular in side view, with short dense hairs. Female pygidium with a vertical bare area on each side of which the hairs are a little longer and sparser. Sting upcurved.

There is a wingless or brachypterus genus, Olixon, and three fully winged genera. In the winged genera the inner margin of the eye is notched, the flagellar segments (at least the basal segments) have a pair of conspicuous bristles at the apex of each, and the female tarsi are strongly expanded. In the flightless genus Olixon the eye margin is not notched, the bristles on the flagellum are small or absent, and the female tarsi are only weakly expanded.

There has been speculation about the systematic position of the Rhopalosomatidae. It is certain that the family belongs in the Aculeata, but I am not prepared to say to which other aculeate families it is most closely related. Ashmead in 1895 gave a summary of the opinions expressed up to that date (Proc. Ent. Soc. Washington 3: 303-309). The interested reader should refer to this publication. Brothers (1975. Univ. Kansas Sci. Bul. 50: 483-648) relates it to the Psammocharidae.

Some details are known about the biology of one species, the Nearctic Rhopalosoma nearcticum. It parasitizes crickets of the genera Hapithus and Orocharis. These crickets are frequently found with a blackish larva adhering to one side, above the base of a hind femur. If captured and confined, such a parasitized cricket will soon succumb and the full-grown larva will burrow into the soil, spin a cocoon, and hibernate until it is ready to emerge as an adult the next summer. Gurney (1953. Proc. U. S. Natl. Mus. 103: 19-34) gives

biological details about this species. One other species has been reared, the wingless Olixon australiae, as a parasite of a trigonidiine cricket. It is probable that the entire family has an essentially similar biology.

The family contains four genera: Olixon (wingless or brachypterous) with species in North America, South America, Africa, and Australia; Liosphex with one species ranging from Florida to Brazil and another species in Mindanao; Paniscomima with species in Africa, Madagascar, Sri Lanka, India, and Nepal; and Rhopalosoma with one species in eastern United States and sixteen species Neotropical.

Specimens used in this study were from the following collections. After the name of each collection is the name of the person who aided this work by sending the specimens on loan.

Cambridge (Museum of Comparative Zoology, Harvard University).
Prof. E. O. Wilson.
East Lansing (Department of Entomology, Michigan State University).
Prof. Roland Fischer.
Ithaca (Department of Entomology, Cornell University).
Dr. L. L. Pechuman.
La Plata (Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata). Prof. Luis De Santis.
London (British Museum (Natural History)). Mr. Michael Day.
Ottawa (Canadian National Collection). Dr. Lubomir Masner.
Paris (Muséum National d'Histoire Naturelle). Mlle. S. Kelner-Pillault.
Philadelphia (Academy of Natural Sciences of Philadelphia).
Dr. David C. Rentz.
Strasbourg (Musée Zoologique de l'Université et de la Ville).
Dr. F. Gouin.
Townes (Collection of Henry and Marjorie Townes).
Washington (National Museum of Natural History).
Dr. Arnold Menke.

All holotypes or lectotypes have been seen except for those of Arnold, Enderlein, and Berland. Paratypes of all of Berland's species have been studied. The Arnold and Enderlein species have been identified from their original descriptions, which in these cases seem to be adequate.

I wish to thank the curators who sent specimens on loan, and to thank several collectors who sent specimens for the Townes collection: Dr. and Mrs. Henry Howden, Dr. Sam Breeland, Dr. Lionel Stange, Mr. Luis Pena, and especially Col. Moacir Alvargena. My wife contributed supportive work during the study and in the years leading up to it.

Key to the genera of Rhopalosomatidae

1. Eye margin not notched opposite antennal socket. Wings absent or shorter than thorax. First tergite 0.33 to 0.6 as long as wide. Male subgenital plate triangular, its apical 0.5± margined with short bristles.
1. Olixon (p. 3)

Eye margin notched opposite antennal socket. Wings much longer than thorax. First tergite 1.3 to 6.8 as long as wide. Male subgenital plate triangular with apex narrowly truncate, the truncate portion margined with short bristles. 2

2. Occipital carina lacking. First tergite about 1.5 as long as wide. Anal lobe reaching 0.35 to 0.6 the distance to nervellus.
2. Liosphex (p. 10)

Occipital carina present on upper 0.6 of head. First tergite 2.4 to 6.8 as long as wide. Anal lobe reaching 0.65 to 1.0 the distance to nervellus. 3

3. Postnervulus (= the oblique apical sections of discoideus) arched, the arching strongest at or below middle and flattened or indented at origin of subdiscoideus. Female tarsal claws without a tooth. Penis valve with with its preapical process broadly triangular and overlapped at its apex by basal part of penis head. Ethiopian and Oriental species.
3. Paniscomima (p. 12)

Postnervulus sinuate. Female tarsal claws with a strong tooth near middle, often also with a blunt tooth near base. Penis valve with its preapical process narrow to broad, distant from penis head. American species. . . . . 4. Rhopalosoma (p. 16)

1. Genus Olixon

Olixon Cameron, 1887. Biologia Centrali-Americana. Insecta. Hymenoptera. 1: 412.
Type: Olixon testaceum Cameron. Monobasic.
Harpagocryptus Perkins, 1908. Proc. Hawaiian Ent. Soc. 2: 34.
Type: Harpagocryptus australiae Perkins. Monobasic.
Algoa Brues, 1910. Jour. New York Ent. Soc. 18: 18. Name preoccupied by Gray, 1840 and by Castelnau, 1861. New synonym.
Type: (Algoa heterodoxa Brues) = dentatum Cameron. Monobasic.
Saphobethyllus Kieffer, 1911. Ann. Soc. Sci. Bruxelles (2) 35: 216.
Type: (Saphobethyllus pallidus Kieffer) = testaceum Cameron. Monobasic.
Algoella Kieffer, 1914. Das Tierreich 41: 473. New name for Algoa.
Nealgoa Brues, 1922. Psyche 29: 105.
Type: Nealgoa banksii Brues. Original designation.
Psyllosphex Arnold, 1935. Ann. Transvaal Mus. 15: 479.
Type: Psyllosphex saltator Arnold. Original designation.

Body length 2.9 to 7.0 mm. Wings vestigial or absent, not extending beyond apex of tergite 1. Thorax modified as in other apterous Hymenoptera. Eye elliptic, its inner margin not notched. Ocelli very small or lacking. Temple very weakly convex, long or moderately long, the head not or very little constricted to occipital carina, the occipital carina incomplete below.

Palpi of moderate length. Flagellum short to long, its basal segments sometimes with a short weak bristle at apex on upper side. Hind edge of mesosternum with a very large bilobed flange that is neither impressed nor separated by a groove. Propodeum with a large apicolateral tooth on each side. Front femur swollen, especially in female. Female tarsi weakly to moderately widened and flattened, with dense tenent hairs beneath, the fourth segment more or less bilobed. Male tarsal claws with a large preapical tooth; female tarsal claws stout and simple. First tergite 0.33 to 0.6 as long as wide, usually with a transverse carina near its basal 0.4. Male subgenital plate large, triangular, its apical 0.5± margined with small, short bristles.

Eight species are known, one in the United States, one in Central and South America, four in Africa, and two in Australia. The United States species (banksii) and one of those from Africa (saltator) are reported as running or jumping on sand. The United States species has been found active at night as well as by day. The Neotropic species has been taken in Malaise traps. The species australiae was reared from a trigonidiine cricket. There is circumstantial evidence that O. banksii parasitizes crickets of the genus Nemobius and that O. testaceum parasitizes crickets of the genus Cycloptilum. This is the extent of the available biological data.

Key to the species of Olixon

1. Cheek without a groove from the eye to the mandible. 2
   Cheek with a groove from the eye to the mandible. 4

2. First flagellar segment 1.8 as long as wide. Upper hind edge of eye separated from occipital carina by 1.1 the width of the scape. Eastern Australia. . . . . 1. flavibase, new species (p. 5)
   First flagellar segment 3.0 to 4.2 as long as wide. Upper hind edge of eye separated from occipital carina by 0.25 to 1.0 the width of the scape. 3

3. Body fuscous. Hind femur of female about 2.5 as long as high (male unknown). Ivory Coast. . . 2. majus, new species (p. 5)
   Body fulvous. Hind femur of female about 4.4 as long as high, of male about 5.5 as long as high. Eastern United States; also Mexico. 3. banksii Brues (p. 6)

4. Upper hind edge of eye separated from occipital carina by about 0.3 the width of the scape. Head and body mostly or entirely fulvous. Neotropic Region. 4. testaceum Cameron (p. 7)
   Upper hind edge of eye separated from occipital carina by about 1.1 to 2.6 the width of the scape. Head and body dark brown or blackish, or sometimes the thorax fulvoferruginous. 5

5. First tergite without a subbasal transverse carina. Propodeum without a transverse carina between its apicolateral teeth. Eastern Australia. 5. australiae Perkins (p. 7)
   First tergite with a subbasal transverse carina. Propodeum with a complete or incomplete transverse carina between its apicolateral teeth. 6

6. Front wing reaching to hind end of thorax. Hairs of head and abdomen very dense. First flagellar segment about 2.6 as long as wide. South Africa. 6. saltator Arnold (p. 8)

Front wing minute or absent, not longer than tegula. Hairs of head and abdomen moderately dense (but unusually sparse for the genus Olixon). First flagellar segment 1.4 to 2.2 as long as wide. 7

7. Thorax fulvoferruginous. Apex of scutellum a 90° rounded angle. Upper hind edge of eye separated from occipital carina by 1.5 the width of scape. Front wing present as a small vestige. Rhodesia. 7. myrmosaeforme Arnold (p. 9)

Thorax reddish brown to blackish. Apex of scutellum rounded or subtruncate. Upper hind edge of eye separated from occipital carina by about 2.0 the width of the scape. Front wing absent. Southeast coast of South Africa. . . . . 8. dentatum Cameron (p. 9)

1. Olixon flavibase, new species

Male: Unknown.

Female type: Body 3.8 mm. long. Hind margin of eye separated from occipital carina by 1.3 the width of scape. Front ocellus lacking, the hind ocelli present as small vestiges. Vertex with fine, moderately dense hairs that arise from very small punctures. Cheek without a groove from eye to mandible. First segment of flagellum 1.6 as long as wide. Propodeum with a projecting flange on the median 0.4 of the distance between its apicolateral teeth, rounded on each side between this flange and the apicolateral teeth. Hind femur 4.4 as long as deep. Fourth tarsal segments short, with long apicolateral lobes, one lobe about 2.2 as long as the other. Front wing paddle shaped, reaching to end of first tergite. Hind wing obscured (or absent?). Premedian transverse carina of tergite 1 strong, evenly arched. Upper face of tergite 1 evenly convex.

Fuscous. Scape, pedicel, coxae, trochanters, base of hind femur, and tibial spurs stramineous or yellowish, the scape brownish medially and the coxae brownish basally.

Type: ♀, Cairns [Australia], Feb. 1902 (London).

2. Olixon majus, new species

Male: Unknown.

Female type: Length 7.7 mm. Eye separated from occipital carina by 0.25 the width of scape. Ocelli lacking. Vertex with fine, short, dense hairs that arise from dense, very small punctures. Cheek without a groove from eye to mandible. First flagellar segment 4.2 as long as wide. Propodeum between its apicolateral teeth with a transverse carina on only the median 0.3 of the distance and this median portion weak at center. Hind femur 2.5 as long as deep. Front wings paddle-shaped, reaching base of tergite 2. Hind wing a small, narrow vestige. Tergite 1 with a strong premedian transverse carina, behind the transverse carina weakly flattened medially and with a median longitudinal carina.

Fuscous. Mandible, antenna, and legs beyond trochanters brown. Palpi, coxae, and trochanters pale brown. Front wings weakly infuscate.

Type: ♀, "Lampto" [biological station], Ivory Coast, Nov. 11, 1965, Y. Guillon (Paris).

3. Olixon banksii Brues

*Nealgoa banksii Brues, 1922. Psyche 29: 106. ♀. Type: ♀, U. S. A.: Sea Cliff, Long Island, New York (Cambridge). Type studied in 1973.
Nealgoa banksii Reid, 1939. Proc. Roy. Ent. Soc. London 8: 101. des.
Olixon banksii Krombein, 1950. Jour. Elisha Mitchell Sci. Soc. 65: 264-265. ♂, N. C.: Kill Devil Hills. "running swiftly over sand barrens".
Olixon banksii Krombein, 1951. U. S. Dept. Agr. Agr. Monog. 2: 774. N. Y., D. C., N. C., Fla., Ohio, Minn., Kans.

Length 2.9 to 7.0 mm. Eye separated from occipital carina by about 0.3 to 1.0 the width of the scape. Vertex with fine, dense, short hairs that arise from small, closely spaced punctures. Ocelli very small, the median ocellus often lacking. Cheek without a groove from eye to mandible. First flagellar segment about 3.5 as long as wide. Carina between apicolateral teeth of propodeum present only on median 0.3 of the distance. Hind femur about 5.0 as long as high in male, about 4.4 as long as high in female. Female tarsi flattened beneath and widened, the fourth segment short and with apicolateral angles long, the angle on one side about 1.5 as long as on the other. Front wing paddle-shaped and reaching about to base of tergite 2, or sometimes present as a small narrow strap that is about as long as tegula. Hind wing a tiny linear vestige. Premedian transverse carina of tergite 1 strong, dipped and irregular at midline. Tergite 1 behind its transverse carina with a weak median longitudinal impression, often with a short median ridge in the impression which connects with the transverse carina.

Light fulvous. Flagellum brown apically. Front wing weakly infuscate. Apical 0.4± of middle and hind femur often brownish. Subapical 0.4± of hind tibia often darkened in female. Subapical band on tergite 2 and apical tergites sometimes infuscate, the band on tergite 2 narrowed medially and not reaching sides of the tergite.

Specimens: 16♂, 12♀ from the United States in Arkansas (Mississippi Co.); District of Columbia (Washington); Florida (Arcadia, Gainesville, Hillsboro Co., and Welaka); Georgia (Mosquito Creek and Spring Creek, both in Decatur Co.); Kansas (Pottawatomie Co. and 7 miles west of Lawrence); Louisiana (Chicot State Park in Evangeline Co.); Maryland (Plummers Is.); New York (Farmingdale); North Carolina (Kill Devil Hills); and Ohio (Sandusky). One additional specimen is from "Mexico".

Dates of collection are from May 26 to June 15 for males and from June 28 to Sept. 10 for females; also a female collected March 30 to Apr. 1 at Arcadia, Fla. One female is labeled as "collected on sand". Dr. P. A. Kannowski informs me (in litt.) that specimens collected by him in Decatur Co., Ga. were found while collecting at night (8:30-10:30 P.M.). They were running around swiftly in leaf litter. Krombein (1950) reported finding males "running swiftly over sand barrens". In the U. S. National Museum is a nymph of Nemobius sp. from Plummers Is., Md., that bears a small larval case of a rhopalosomatid. This case, because of its small size and the small size of its host, is presumed to be that of the present parasite.

This species occurs in the eastern United States in the Upper and Lower Austral Zones, and there is a record from "Mexico".

4. Olixon testaceum Cameron

*Olixon testaceum Cameron, 1887. Biologia Centrali-Americana. Insecta. Hymenoptera. 1: 412. ♀. des., fig. Type: ♀, Panama: Bugaba (London). Type studied in 1974.
*Saphobethyllus pallidus Kieffer, 1911. Ann. Soc. Sci. Bruxelles (2) 35: 216. ♂. Type: ♂, Mexico: Teapa in Tabasco (London). Type studied in 1974.
Saphobethyllus pallidus Kieffer, 1914. Das Tierreich 41: 288. ♂. des.
Olixon testaceum Turner & Waterston, 1917. Ann. Mag. Nat. Hist. (8) 20: 107. syn., des.
Olixon testaceum Reid, 1939. Proc. Roy. Ent. Soc. London 8: 95-97. ♂, ♀. des., fig.
Olixon pallidum Evans, 1964. Bul. Mus. Comp. Zool. 132: 16. syn.

Body 3.7 to 5.0 mm. long. Hind margin of eye separated from occipital carina by about 0.3 the width of the scape. Ocelli lacking. Vertex with fine dense hairs that arise from very dense small punctures. Cheek with a groove from eye to front condyle of mandible. First segment of flagellum about 4.0 as long as wide. Propodeum with a complete transverse carina between its teeth. Hind femur about 5.1 as long as deep. Fourth tarsal segment of female short, with long apicolateral lobes, one lobe about twice as long as the other. Front wing paddle-shaped, reaching to middle of first tergite. Hind wing a tiny linear vestige. Premedian transverse carina of tergite 1 strong, evenly arched. Upper face of tergite 1 evenly convex.

Pale fulvous, the mouth parts, coxae, and trochanters stramineous. First four incisures between flagellar segments and a line along the vertical groove in cheek infuscate. Front wing faintly infuscate. Second tergite with a pair of transverse subapical fuscous areas that make a medially interrupted subapical fuscous band. The type of pallidus, however, has the second tergite entirely pale fulvous.

Specimens: ♂, 2♀ (including the type of pallidus), Teapa, Tabasco, Mexico, March, H. H. Smith (London). ♂, Botanic Gardens, Georgetown, British Guiana, Jan. 13, 1926, L. D. Cleare, Jr. (London). ♀, Manaus, Amazonas, Brazil, Jan. 1972, F. M. Oliveira (Ottawa). 3♀, Represa Rio Grande, Guanabara, Brazil, Dec. and Feb. 1966 and 1967, M. Alvarenga (Townes). ♀ (type of testaceum), Bugaba, Panama, Champion (London).

The four specimens from Brazil were apparently all collected in Malaise traps. In the U. S. National Museum is an adult male cricket from Honduras, determined as Cycloptilum trigonipalpum (probably by Caudell), which bears a small rhopalosomatid larva. Because of the small size of the cricket and its parasite, the larva is presumed to belong to the present species.

This species ranges from southern Mexico to southern Brazil.

5. Olixon australiae Perkins

*Harpagocryptus australiae Perkins, 1908. Proc. Hawaiian Ent. Soc. 2: 34. ♀. des. Type: ♀, Australia: Queensland (London). "Larva forming a case on the side of abdomen of small crickets (Trigonidiidae)". Type studied in 1973.
Harpagocryptus australiae Kieffer, 1914. Das Tierreich 41: 289. translation of original des.

Harpagocryptus australiae Reid, 1939. Proc. Roy. Ent. Soc. London 8: 99-100. notes from original des.
Olixon australiae Perkins, 1976. Handbooks for the identification of British insects 6 (3a): 1. syn.

Male: Unknown.

Female: Length 3.4 mm. Eye separated from occipital carina by 1.5 the width of the scape (this figure estimated as the specimen at hand lacks antennae). Ocelli very small, the median ocellus vertical. Vertex weakly mat, with short, fine, rather dense hairs that arise from very fine punctures. Cheek with a groove from eye to front condyle of mandible. Antennae lacking in the specimen at hand, described originally by Perkins as being "much longer than head and thorax together, the scape is stout and about as long as the front funicle joint, which is decidedly shorter than the next, while those following are all subequally elongate, many times as long as thick". Propodeum rounded and not carinate between its apicolateral teeth. Hind femur 4.4 as long as deep. Tarsi moderately widened, flat beneath, their fourth segments of moderate length and with long apicolateral angles, one angle about 2.2 as long as the other. Front wing present as tiny narrow vestige that is not longer than tegula. Tergite 1 without a premedian transverse carina, evenly convex above.

Blackish brown. Clypeus, mouth parts, coxae, and trochanters light brown. Antennae lacking in specimen at hand. Legs beyond trochanters dark brown.

Specimen: Described from a female in London that lacks a locality label, determined by R. C. L. Perkins and believed to be the original type. The type was described as from Queensland, Australia, and as reared from a small trigonidiine cricket.

6. Olixon saltator Arnold

*Psyllosphex saltator Arnold, 1935. Ann. Transvaal Mus. 15: 480. ♀. des., fig., biol. Type: ♀, South Africa: Beach Bush in Durban (Bulawayo). Identification from description.

Length: 4.6 to 6.2 mm. Eye separated from occipital carina by 1.15 to 1.3 the width of the scape. Ocelli very small. Vertex with slender rather dense hairs that arise from small dense punctures. Cheek with a groove from eye to front condyle of mandible. First flagellar segment about 2.6 as long as wide. Hind femur 4.8 as long as deep in male, 3.8 as long as deep in female. Female tarsi moderately widened, flattened beneath, the fourth segments with long apicolateral angles that are equal in length. Front wing paddle-shaped, reaching to base of tergite 1. Hind wing a small narrow vestige. Tergite 1 with a distinct premedian carina, behind the carina evenly convex.

Black. Mouth parts, antenna, front legs, and middle and hind legs beyond trochanters dark brown. Middle and hind coxae and trochanters pale brown. Front wing moderately infuscate. Free margins of abdominal tergites and sternites brown.

Specimens: ♂, ♀, Burman Bush, Durban, South Africa, H. N. Empey, the ♂ dated Dec. 3, 1960 and ♀ dated March 18, 1963 (London). ♂, Durban, South Africa, Apr. 16, 1914, G. B. Cooper (London).

7. Olixon myrmosaeforme Arnold

*Psyllosphex myrmosaeformis Arnold, 1935. Ann. Transvaal Mus. 15: 482. ♀. des., fig. Type: ♀, Rhodesia: Bulawayo (Bulawayo). Identification from description.

Male: Unknown.
Female: Length 4.0 mm. Eye separated from occipital carina by 1.5 the width of scape. Ocelli very small. Vertex polished, with fine, moderately dense hairs that arise from very small punctures. Cheek with a groove from eye to front condyle of mandible. First flagellar segment 2.2 as long as wide. Apex of scutellum a rounded 90° angle. Propodeum with a strong transverse carina between its apicolateral teeth. Hind femur 4.0 as long as deep. Tarsi weakly widened and flattened below, the apicolateral angles of segments 4 moderately long, one angle about 1.2 as long as the other, the angles not tipped with bristles. Front wing a vestige that is a little longer than tegula. Hind wing absent. Tergite 1 with a premedian transverse carina, behind the carina faintly flattened on midline.

Head and abdomen blackish brown, the temple and lower 0.4± of the rest of head reddish brown. Mouth parts and segments 1-3 of antenna light brown, the rest of antenna dark brown. Thorax and legs fulvoferruginous, the femora tinged with brown toward apex.

Specimen: ♀, Rhodesia, Oct. 18, 1944, R. H. R. Stevenson (London).

8. Olixon dentatum Cameron

*Apteropompilus dentatus Cameron, 1904. Ztschr. System. Hymen. Dipt. 4: 176. [♂]. Type: ♂, South Africa: Dunbrody in Cape Colony (London). Type studied in 1973.
Apteropompilus dentatus Cameron, 1905. Ztschr. System. Hymen. Dipt. 5: 136. ♂. des. South Africa: Dunbrody in Cape Colony.
*Algoa heterodoxa Brues, 1910. Jour. New York Ent. Soc. 18: 18. ♀. des., fig. Lectotype: ♀, (labeled by Townes, 1973 and hereby designated), South Africa: Algoa Bay, Dec. 25, 1896, H. Brauns (Cambridge). Lectotype studied in 1973. New synonym.
Algoella heterodoxa Kieffer, 1914. Das Tierreich 41: 273. ♀. des., fig.
Algoa heterodoxa Brues, 1922. Psyche 29: 101, 108. ♂, ♀. des.
Psyllosphex dentatus Arnold, 1935. Ann. Transvaal Mus. 15: 482. ♂. des.
Psyllosphex dentatus Reid, 1939. Proc. Roy. Ent. Soc. London 8: 95-99. ♂, ♀. des., fig.
Algoa heterodoxa Reid, 1939. Proc. Roy. Ent. Soc. London 8: 97, 99-101. ♀. des., fig.
Algoella dentata Brues, 1943. Ann. Ent. Soc. America 36: 311. syn., des.
Algoella heterodoxa Brues, 1943. Ann. Ent. Soc. America 36: 311. syn., des.

Length 3.5 to 5.2 mm. Eye separated from occipital carina by about 2.0 the width of scape. Ocelli very small, the median ocellus absent or vestigial. Vertex polished, with numerous short hairs that are not dense, these arising from very small punctures. Cheek with a groove from eye to front condyle of mandible. First flagellar segment about 1.4 to 1.7 as long as wide. Apex of

scutellum rounded or subtruncate. Propodeum with a complete carina between its apicolateral teeth, or sometimes the carina interrupted sublaterally. Hind femur about 4.5 as long as deep in male, 3.5 to 4.2 as long as deep in female. Tarsi of female only a little widened, their fourth segments moderately long, with acute but not elongate apicolateral corners, the corners usually tipped with a long bristle. Wings absent, the tegula very small. First tergite with a premedian transverse carina, behind the carina without a median impression or irregularity.

Blackish brown, the antenna, mouth parts, and legs dark brown with the basal 2.5 or 3.0 segments of antenna fulvous. In a specimen from Durban, South Africa, the thorax, legs, and first tergite are brownish ferruginous rather than blackish.

Specimens: 4♀, Algoa Bay, South Africa, Oct. 11, 1896, Dec. 25, 1896, and undated, H. Brauns (3♀, including lectotype of heterodoxa in Cambridge; 1♀ in Washington). ♂ (type of dentatum), Dunbrody (near Grahamstown), South Africa, Sept. 20, 1900 (London). ♀, Durban, South Africa, Apr. 1914, G. B. Cooper (London).

This species occurs on the southeast coast of South Africa. It is variable in structure and color. Possibly it should be subdivided into several species.

2. Liosphex, new genus

Front wing 5.0 to 9.4 mm. long. Body moderately slender. Eye large, its inner margin with a large notch above antennal socket. Ocelli moderately small. Temple of moderate width, convex. Occipital carina absent. Palpi long. Flagellum of moderate length, its basal 7 or 8 segments with an apical pair of bristles on upper side or upper and inner sides, one of the pair usually longer than the other. Propodeum smoothly convex. Hind edge of mesosternum with a parallel pair of large triangular flanges that are separated from mesosternum by a groove but are in almost the same plane as the mesosternum. Front femur of female weakly to moderately swollen. Segments 2-5 of female tarsi wide, flat beneath, and with dense tenent hairs. Male tarsal claws with a pair of parallel points at apex and a large angulate lobe a little behind apex. Female tarsal claws stout, simple. First tergite about 1.5 as long as wide. Anal lobe reaching 0.35 to 0.6 the distance to nervellus.

Genotype: Liosphex varius, new species.

The generic name is from λεῖος (smooth), plus σφηξ (wasp), referring to the smooth body contures and lack of sculpture.

Two species are known, one ranging from the Gulf shores of southern United States to southern Brazil and the other known from the Philippines.

Key to the species of Liosphex

1. Nervulus distad of basal vein by about 0.5 its length. Angle between first recurrent vein and cubitus about 50°. Metapleurum with short fine hairs all over, the hairs a little sparser medially. Philippines.
   1. trichopleurum, new species (p. 11)

   Nervulus distad of basal vein by about 1.75 its length. Angle between first recurrent vein and cubitus about 25°. Metapleurum with short fine hairs on its anteroventral 0.2, the rest bare. Southern United States to Brazil. . . . 2. varius, new species (p. 11)

1. Liosphex trichopleurum, new species

Male: Unknown.

Type female: Front wing 8.3 mm. long. Side of thorax (including side of pronotum and of propodeum) covered with short moderately dense hairs, their distribution even except for a slight thinning on collar of pronotum, near mesopleural fovea, and near center of metapleurum. Bristles on hind tibia of moderate length. Longest spur of hind tibia reaching a little past apex of hind basitarsus. Anal lobe reaching about 0.6 the distance to nervellus. Angle between first recurrent vein and cubitus about 50°. Nervulus distad of basal vein by about 0.5 its length.

Head stramineous, black on its hind side, vertex, and frons except laterally. Antenna blackish above, fulvous below. Mouth parts stramineous except that segments 2-5 of maxillary palpus are mostly fuscous. Thorax black, the tegula and upper half of pronotum stramineous. Front leg stramineous, its femur with a fuscous mark on base behind and tarsus dark brown above. Middle leg stramineous, the basal margin of coxa, basal 0.8 of trochanter, basal 0.15± of femur, and the upper side of tarsus fuscous. Hind leg black, the apical 0.4 of coxa, apical 0.2 of trochanter, apical margin of femur, and under side of tarsus stramineous. Wings faintly brownish. Tergites 1, 4, 5, and 6 black with brownish apical and lateral stains. Tergites 2 and 3 stramineous, their bases fuscous.

Type: ♀, Kolambugan, Mindanao, Philippines, C. F. Baker (Washington).

2. Liosphex varius, new species

Front wing 5.0 to 9.4 mm. long. Sides of thorax (including side of pronotum and of propodeum) with short moderately dense hairs, the hairs lacking in the following areas: collar except its upper part, mesepisternum except for marginal areas, metapleurum except its anteroventral 0.2 and its upper front area, and central 0.5± of lateral aspect of propodeum. Bristles on hind tibia rather long and conspicuous. Longest spur of hind tibia reaching 0.85 the length of hind basitarsus. Anal lobe reaching about 0.5 the distance to nervellus. Angle between first recurrent vein and cubitus about 25°. Nervulus distad of basal vein by about 1.75 its length.

Body and legs varying from mostly pale fulvous to almost entirely black, the wings tinged with brown. The lightest and darkest specimens of the series are colored as follows:

Lightest coloration: Pale fulvous. Head stramineous but vertex black between the eyes and frons. Face and clypeus pale yellow. Scape and pedicel each with a fuscous spot above. Median spot on front end and lateral 0.25± of mesoscutum, spot at base of each wing, and sublateral stripe on propodeum fuscous. Median part of first tergite light brown. Wings yellowish brown.

Darkest coloration: Black. Area in eye notch, clypeus except for median apical area, basal 0.65 of mandible, apical part of palpi, hind corner and upper margin of pronotum, and tibial spurs whitish. Wings weakly infuscate.

The upper margin of the pronotum and the space within the eye notch is always white, usually also the clypeus, cheek, and mouth parts. The antenna is usually fulvous below and fuscous above. The tibiae and tarsi are usually largely or entirely fulvous. Basal 0.3± of tergites 1-3 and apical 0.2± of tergite 1 usually fulvous, the abdomen often more extensively fulvous.

Type: ♀, from Malaise trap, Tall Timbers (near Tallahassee), Fla., U. S. A., June 29 to July 11, 1971, R. H. Arnett (Townes).

Paratypes: ♀, from Malaise trap, Chicot State Park, Evangeline Co., La., U. S. A., June 28 to July 5, 1971 (Ottawa). ♂, from Malaise trap, Fortin de las Flores, 3,400 ft., Mexico, Aug. 20, 1963, R. H. and E. M. Painter (Townes). ♂, Mt. San Salvador, El Salvador, June 24, 1963, M. E. Irwin (Cambridge). ♀, Ongota, southeast of Tena, Ecuador, May 1963, L. Peña (Cambridge). ♂, Ecuador or Peru, 1963, L. Peña (Townes). 3♂, Avispas, 400 m., Peru, Sept. 10 to 20, 1962, L. Peña (Cambridge). 3♀, Nova Teutonia, Santa Catarina, Brazil, January 1939, Feb. 10, 1952, and Dec. 4, 1952, Fritz Plaumann (Cambridge, Ithaca, and Ottawa). ♀, Repressa Rio Grande, Guanabara, Brazil, Feb. 1968, M. Alvarenga (Townes). ♀, Rio de Janeiro, Brazil, Jan. 1939, R. C. Shannon (Washington).

This species ranges from the Gulf shores of the United States to southern Brazil.

3. Genus Paniscomima

Paniscomima Enderlein, 1904. Zool. Anz. 27: 465.

Type: Paniscomima erlangeriana Enderlein. Monobasic.

Hymenochimaera Brues, 1926. Psyche 33: 19. New synonym.

Type: (Rhopalosoma abnorme "Cameron") = abnorme Morley.

Rogezia Berland, 1951. Mém. Inst. Sci. Madagascar (A) 15: 300. New synonym.

Type: Rogezia seyrigi Berland. Monobasic.

Front wing 6.7 to 15 mm. long. Apical 0.65± of fifth segment of female tarsi parallel-sided. Female tarsal claws stout, with a strongly curved apical tooth, without a preapical tooth. Postnervulus arched and strongly oblique, most strongly arched at or below middle and flattened or indented at origin of subdiscoideus. First tergite 2.4 to 3.7 as long as wide. Preapical process of male penis broadly triangular, its apex narrowly overlapped by base of penis head.

Species of Paniscomima are Ethiopian and Oriental. They are separable from Rhopalosoma by the characters given in the key but otherwise are very similar to that genus. There are no rearing records.

Key to the species of Paniscomima

1. Nervulus basad or opposite basal vein, or distad by less than 0.25 its length. Oriental species. 2

   Nervulus distad of basal vein by more than 0.4 its length. Ethiopian species. 3

2. Nervulus basad of basal vein by about 0.9 its length. Anal cell of front wing with a longitudinal spurious vein near its center. India and Sri Lanka. . . . . 1. abnormis Morley (p. 13)

   Nervulus opposite basal vein or distad by as much as 0.2 its length. Anal cell of front wing without a spurious vein. Nepal.
   2. opposita, new species (p. 14)

3. Nervulus distad of basal vein by about 0.6 its length, straight and strongly reclivous. Postnervulus flattened at origin of subdiscoideus. Africa. 3. erlangeriana Enderlein (p. 14)
Nervulus distad of basal vein by 0.8 to 2.0 its length, weakly or moderately reclivous. Postnervulus indented at origin of subdiscoideus. Madagascan species. 4

4. Ocelli small, the lateral ocellus separated from eye by about 2.0 its long diameter. Wings tinged with yellow, the apex of front wing weakly infuscate. Median vein fulvoferruginous. Madagascar. 4. seyrigi Berland (p. 14)

Ocelli medium sized to large, the lateral ocellus separated from eye by less than 1.5 its diameter. Wings uniformly subhyaline. Median vein dark brown. 5

5. Flagellum fuscous. Nervulus distad of basal vein by about 1.6 its length. Madagascar. . . . . 5. bekilyi Berland (p. 15)
Flagellum brownish fulvous. Nervulus distad of basal vein by 1.0 to 1.45 its length. 6

6. Nervulus distad of basal vein by about 1.45 its length. First intercubitus about 0.7 as long as second section of cubitus. Tergites 4-6 fulvous. Madagascar. . . . . 6. rufoantennata Berland (p. 15)
Nervulus distad of basal vein by about 1.0 its length. First intercubitus about 1.0 as long as second section of cubitus. Tergites 4-6 infuscate. Madagascar. . . . . 7. curta, new species (p. 16)

1. Paniscomima abnormis Morley, new combination

*Rhopalosoma abnorme Morley, 1910. Trans. Ent. Soc. London 1910: 386. ♂, ♀. des., fig. Type: ♀, Sri Lanka: Mankulam (London). India: Calcutta. Type studied in 1974.
Hymenochimaera abnormis Brues, 1926. Psyche 33: 19. syn., des.

Male: Not available for study.

Female: Front wing 6.7 mm. long. Lateral ocellus separated from eye by 1.0 its long diameter. First intercubitus 1.2 as long as second section of cubitus. Nervulus basad of basal vein by 0.9 its length, vertical. Anal cell of front wing with a longitudinal spurious vein near its middle. Basal section of radiella moderately reclivous. First tergite 2.9 as long as wide.

Light fulvous. Interocellar area infuscate. Flagellum reddish brown. Wings hyaline, their veins medium brown to dark brown.

Specimen: Redescribed from type, a female labeled Mankulam, N. P. [Sri Lanka], Nov. 1908, Wickwar (London). Morley had a second specimen, a male from Calcutta, India. This I have not seen. Dr. Karl Krombein informs me that he has recently collected a male and female in Sri Lanka. His specimens are in Washington.

2. Paniscomima opposita, new species

Male: Front wing 7.8 to 10.3 mm. long. Lateral ocellus separated from eye by about 0.2 of its long diameter. First intercubitus about 2.2 as long as second section of cubitus. Nervulus opposite basal vein or distad of it by less than 0.25 its length, weakly inclivous. Anal cell without a spurious vein. Basal section of radiella moderately inclivous. First tergite about 2.7 as long as wide.

Pale fulvous. Interocellar area, flagellum, tergite 7, and sternite 7 dark brown. Wings hyaline, the wing veins brown.

Female: Unknown.

Type: ♂, in Malaise trap, near Simra Adhabar, 600 ft., Nepal, Aug. 23 to 28, 1967, Canadian Nepal Expedition (Ottawa).

Paratypes: 4♂, same data as type (Ottawa).

3. Paniscomima erlangeriana Enderlein

*Paniscomima Erlangeriana Enderlein, 1904. Zool. Anz. 27: 466. ♀. des., fig. Type: ♀, Somali: Umfudu (Berlin). Identification from description.

Rhopalosoma erlangerianum Schulz, 1906. Spolia hymenopterologica, p. 223-225. key, syn., des.

Paniscomima erlangeriana Brues, 1926. Psyche 33: 18. des. South Africa: Windenham in Natal.

Rhopalosoma erlangerianum Krombein, 1951. U. S. Dept. Agr. Agr. Monogr. 2: 771. syn.

Front wing 7.3 to 12 mm. long. Lateral ocellus separated from eye by about 0.15 its long diameter in male, by about 0.18 its long diameter in female. First intercubitus about 1.0 as long as second section of cubitus. Nervulus distad of basal vein by about 0.6 its length, strongly reclivous. Anal cell without a spurious vein. Basal section of radiella vertical. First tergite about 2.3 as long as wide in male, about 3.7 as long as wide in female.

Pale fulvous. Interocellar area black. Flagellum ferruginous brown to dark brown. Wings subhyaline, the wing veins brown or dark brown.

Specimens: 21♀, Morogoro, 500 m., Tanzania, Jan. and Feb., 1962, Gerd Heinrich (Townes). 6♀, Uluguru, 700 to 1,800 m., Tanzania, Dec. 1961 and Jan. 1962, Gerd Heinrich (Townes). ♂, Mlanje, Malawi, Dec. 11, 1912, S. A. Neave (London). ♀, Otavifontein, Southwest Africa, Nov. 20, 1933, K. Jordan (London). 3♂, Tzaneen, South Africa, Jan. 11 and 18, 1971, H. and M. Townes (Townes). ♀, Tongaat, Natal, South Africa, 1909, H. C. Burnap (London).

This species is widely distributed in tropical Africa.

4. Paniscomima seyrigi Berland, new combination

*Rogezia Seyrigi Berland, 1951. Mém. Inst. Sci. Madagascar (A) 15: 301. ♂, ♀. des., fig. Type: ♀, Madagascar: Ivondro (Paris). Paratype studied in 1974. The ♂ described by Berland is considered to be a separate species, treated below as P. curta.

Male: Unknown.

Female: Front wing 10.6 mm. long. Head more swollen than in other species of the genus. Lateral ocellus separated from eye by 2.0 its long diameter. First intercubitus 1.25 as long as second section of cubitus. Nervulus distad of basal vein by 1.5 its length, weakly inclivous. Anal cell without a spurious vein. Basal section of radiella strongly reclivous. First tergite 2.4 as long as wide.

Light fulvous. Interocellar area, tergites 3-6, and sternites 3-6 black. Flagellum fulvous. Wings tinged with fulvous, the apex of front wing weakly infuscate. Wing veins fulvous.

Specimen: ♀ (paratype), eastern edge of forest, Rogez, Madagascar, 1935, A. Seyrig (Paris). Besides this paratype Berland had a ♀ from Ivondro, and another ♀ from south of the Bay of Antongil (both Madagascar).

5. Paniscomima bekilyi Berland, new combination

*Rhopalosoma bekilyi Berland, 1951. Mém. Inst. Sci. Madagascar (A) 5: 297. ♂, ♀. des., fig. Type: ♀, Madagascar: Bekily (Paris). Paratypes studied in 1974.

Front wing 8.3 to 15 mm. long. Lateral ocellus separated from eye by about 0.12 its long diameter. First intercubitus about 1.25 as long as second section of cubitus. Nervulus distad of basal vein by about 1.6 its length, weakly inclivous. Anal cell without a spurious vein. Basal section of radiella weakly reclivous. First tergite about 2.9 as long as wide in male, about 3.8 as long as wide in female.

Fulvous. Ocellar area fuscous. Pedicel and flagellum dark brown. Wings subhyaline. Wing veins brown or dark brown.

Specimens: 3♂, 3♀ (all paratypes), Bekily, Madagascar, Oct., Nov., and Dec., 1936, A. Seyrig (Townes, Washington, and London). ♂, Isalo, 1,000 m., Madagascar, R. M. G. and P. D. (London). Berland reported specimens also from the localities Behara and Antanimora, both in Madagascar.

6. Paniscomima rufoantennata Berland, new combination

*Rhopalosoma bekilyi var. rufoantennata Berland, 1951. Mém. Inst. Sci. Madagascar (A) 15: 298. Types: Madagascar (Paris). One syntype studied in 1974.

Male: Unknown.

Female: Front wing 13 mm. long. Nervulus distad of basal vein by 1.45 its length. Pedicel and flagellum brownish fulvous. Otherwise similar to P. bekilyi.

Although Berland described this as a variety of bekilyi, the constant difference in the color of the antenna and the slight difference in the position of the nervulus indicate that more probably it is a distinct species.

Specimen: ♀ (syntype), Fort Dauphin, Madagascar, Dec. 1936, A. Seyrig (Townes). Berland reported 8 additional specimens, from the "same localities" as his P. bekilyi.

7. Paniscomima curta, new species

Rogezia Seyrigi Berland, 1951. Mém. Inst. Sci. Madagascar (A) 15: 301.
♂ only.

Male: Front wing 6.9 to 9.0 mm. long. Lateral ocellus separated from eye by about 0.45 its long diameter. First intercubitus about 1.0 as long as second section of cubitus. Nervulus distad of basal vein by about 1.0 its length, weakly inclivous. Anal cell without a spurious vein. Basal section of radiella weakly reclivous. First tergite about 2.4 as long as wide.

Fulvous. Interocellar area blackish. Flagellum fulvous. Wings subhyaline, their veins dark brown. Tergites and sternites 4-7 infuscate.

Female: Unknown.

Berland described this as the male of his P. seyrigi. Several conspicuous differences in structure and color, however, make it more likely that it is a separate species. The types designated below were originally paratypes of seyrigi. There were originally 27 male paratypes. I have not seen the rest of them.

Type: ♂, Ivondro, Madagascar, Dec. 1938, A. Seyrig (Paris).

Paratypes: 2♂, same data as type (Townes and Washington). ♂, Périnet, Madagascar, Feb. 1939, A. Seyrig (Townes).

4. Genus Rhopalosoma

Figures 1-44

Rhopalosoma Cresson, 1865. Proc. Ent. Soc. Philadelphia 4: 58.
Type: Rhopalosoma poeyi Cresson. Monobasic.
Sibyllina Westwood, 1868. Trans. Ent. Soc. London 1868: 329.
Type: (Sibyllina aenigmatica Westwood) = poeyi Cresson. Monobasic.

Front wing 4.8 to 17 mm. long. Body slender, coloration stramineous to ferruginous. Eye large, its inner margin with a sharp notch just above antennal socket. Ocelli moderately large to very large. Temple short, weakly convex. Occipital carina present on upper 0.6± of head, absent below. Palpi long. Flagellum long, its basal 5 to 8 segments with an apical pair of bristles on upper and inner sides. Propodeum smoothly convex. Hind edge of mesosternum with a parallel pair of triangular flanges that are separated from mesosternum by a groove and strongly impressed. Front femur of female not swollen. Female tarsi very wide, weakly concave beneath and with dense tenent hairs. Male tarsal claws with a pair of parallel points at apex and a large angulate lobe a little behind apex. Female tarsal claws long, with a median or subapical tooth and sometimes with an additional blunt tooth toward base. First tergite 4.0 to 6.8 as long as wide. Anal lobe reaching approximately 0.65 to 1.0 the distance to nervellus.

This is a moderate sized genus that is restricted to the Neotropic Region, except for one species in the southeastern United States. The species are active in late afternoon and at night. They are commonly collected in Malaise traps and at light. In flight they resemble ichneumonids of the genus Netelia or the subfamily Ophioninae and like these ichneumonids they rest in low dense vegetation during the day. The one species whose host is known (nearcticum) parasitizes crickets of the subfamily Eneopterinae. Its larva lives in a black

sac on the side of the cricket until it kills its host.

Key to the species of Rhopalosoma

1. Front spur of middle and hind tibiae with basal 0.22± forming a narrow basal neck, then suddenly enlarged to an elongate lanceolate distal portion. Head mostly black. Lanceolatum Group.
17. lanceolatum, new species (p. 27)

Front spur of middle and hind tibiae without a narrow basal neck, the basal 0.6± parallel-sided and apical 0.4± gradually tapered. Head fulvous or ferruginous, the ocellar area fuscous. 2

2. Nervulus vertical, straight or weakly curved. Apical 0.65 of fifth segment of female tarsi parallel-sided. Isopus Group. 3

Nervulus reclivous, moderately to strongly curved. Apical 0.65 of fifth segment of female tarsi tapered, about 0.8 as wide at apex as at basal 0.35. Poeyi Group. 4

3. Basal section of radiella reclivous at about 40°. Front wing 6 to 8 mm. long. Body ochraceous. Northwestern Argentina.
1. minus, new species (p. 19)

Basal section of radiella almost vertical. Front wing 11 to 14 mm. long. Body ferruginous. Brazil. . . . . 2. isopus, new species (p. 19)

4. Lateral ocellus separated from eye by 1.0 to 1.25 its long diameter. . 5

Lateral ocellus separated from eye by 0.25 to 0.9 its long diameter. . 6

5. Nervulus distad of basal vein by about 2.0 its length, about 2.0 as far from basal vein as from first recurrent vein.
3. missionicum Ogloblin (p. 20)

Nervulus distad of basal vein by about 2.7 its length, about 3.1 as far from basal vein as from first recurrent vein.
4. impar, new species (p. 20)

6. Basal section of radiella with a bend of 85° to 110°. Cubitella meeting basal section of radiella at 25° to 30°. 7

Basal section of radiella with a curve rather than a bend, its two ends 30° to 80° from each other. Cubitella meeting basal section of radiella at 35° to 70°. 10

7. Notch in eye margin 0.8 as deep as width of median ocellus. Bend in basal section of radiella rather broad. Bolivia.
5. bolivianum Brues (p. 20)

Notch in eye margin about 0.55 as deep as width of median ocellus. Bend in basal section of radiella sharper. 8

8. Flagellar segments 1-5 fuscous. Mexico to Panama.
6. simile Brues (p. 21)

Flagellar segments 1-5 fulvous to brown. 9

9. Bend in basal section of radiella about 90°. Lateral ocellus separated from eye by about 0.75 its long diameter. Body ochraceous. Flagellum

fulvous. Southeastern United States. . . 7. nearcticum Brues (p. 21)
Bend in basal section of radiella about 100°. Lateral ocellus separated from eye by about 0.55 its long diameter. Body ferruginous. Flagellum dark fulvous to brown. Brazil. . . . 8. angulare, new species (p. 22)

10. Flagellar segments 1-5 fulvous to ferruginous. 11
Flagellar segments 1-5 brown to black. 13

11. Lateral ocellus separated from eye by 0.25 its long diameter. Haiti.
9. haitiense, new species (p. 23)
Lateral ocellus separated from eye by 0.3 to 0.6 its long diameter. . 12

12. Second section of cubitus about 0.65 as long as third section. Basal section of radiella strongly arched, its two ends divergent at about 70°. Postnervulus moderately sinuate. Caribbean islands.
10. poeyi Cresson (p. 23)
Second section of cubitus about 0.5 as long as third section. Basal section of radiella moderately arched, its two ends divergent at about 45°. Postnervulus strongly sinuate. Brazil.
11. bahianum Schulz (p. 24)

13. Basal section of radiella inclivous at about 18°. Second cubital cell 2.1 as wide as high. Mexico. . . . . 12. obliquum, new species (p. 24)
Basal section of radiella approximately vertical. Second cubital cell 2.6 to 3.1 as wide as high. 14

14. Scape entirely fuscous. Nervulus weakly curved. Bolivia.
13. scaposum, new species (p. 25)
Scape fulvous or ferruginous, usually infuscate apically. Nervulus weakly to strongly curved. 15

15. Eye notch small, about 0.45 as deep as width of median ocellus. Panama to Bolivia and Surinam. . . . . 14. guianense Schulz (p. 25)
Eye notch larger, about 0.8 as deep as width of median ocellus. 16

16. Nervulus distad of basal vein by about 1.55 its length, the front end of nervulus a little closer to basal vein than to first recurrent vein. Thorax ochraceous. Panama. . . 15. breelandi, new species (p. 26)
Nervulus distad of basal vein by about 2.1 its length, the front end of nervulus a little farther from basal vein than from first recurrent vein, or equidistant. Thorax fulvous to feruginous. Brazil.
16. alvarengai, new species (p. 26)

Isopus Group

Front spur of middle and hind tibiae without a narrow basal neck, the basal 0.6± parallel-sided and apical 0.4± gradually tapered. Apical 0.65 of fifth segment of female tarsi parallel-sided. Nervulus vertical, straight or weakly curved.

The parallel-sided segment 5 of the female tarsi is a character shared with the Old World genus Paniscomima, which on other characters is definitely more primitive than Rhopalosoma. This is evidence that the Isopus Group

is the primitive species group of Rhopalosoma.

There are two species of this group, occurring in Brazil and Argentina.

1. Rhopalosoma minus, new species

Figures 1 (head); 17 (venation); and 32 (♂ genitalia)

Front wing 5.6 to 8.7 mm. long. Notch in eye about 0.66 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.3 its long diameter. Female tarsal claws moderately long, with a postmedian acute tooth, the apical tooth stout. First intercubitus about 1.0 as long as second section of cubitus. Nervulus vertical, almost straight, distad of basal vein by about 2.0 its length. Basal section of radiella almost straight, reclivous at about 40° from the vertical. Male genitalia as in figure 32.

Ochraceous, including the flagellum. Ocellar area dark brown. Wings tinged with ochraceous, the veins light brown.

Type: ♀, 11 kilometers west of Las Cejas, Tucumán, Argentina, March 9 to 26, 1967, Lionel Stange (Townes).

Paratypes: 3♂, same locality and collector as type, dated Jan. 15 to Feb. 14, 1967, March 9 to Apr. 11, 1968, and April 26 to 29, 1967 (Townes). ♀, Las Cejas, Tucumán, Argentina, Jan. 21 to Feb. 21, 1968, C. C. Porter (Cambridge). ♂, San Pedro Colalao, Tucumán, Argentina, Feb. 1966, Lionel Stange (Townes).

This species occurs in northwestern Argentina.

2. Rhopalosoma isopus, new species

Figures 2 (head); 18 (venation); and 33 (♂ genitalia)

Front wing 11 to 13 mm. long. Notch in eye about 0.75 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.45 its long diameter. Female tarsal claws short, with a large postmedian tooth and with a very stout, short, strongly curved apical point. First intercubitus about 0.82 as long as second section of cubitus. Nervulus vertical, weakly curved, distad of basal vein by about 1.7 its length. Basal section of radiella weakly curved, subvertical or slanted about 10° from the vertical. Male genitalia as in figure 33.

Ferruginous, including the flagellum. Ocellar area blackish. Wings tinged with brown, their veins medium brown.

Type: ♀, Jatai, Goiás, Brazil, Nov. 1972, F. M. Oliveira (Townes).

Paratypes: 2♂, 7♀, same data as type (Townes). 4♀, Sinop, 12° 31' S 55° 37' W, Brazil, Oct. 1975, M. Alvarenga (Townes).

Poeyi Group

Front spur of middle and hind tibiae without a narrow basal neck, the basal 0.6± parallel-sided and apical 0.4± gradually tapered. Apical 0.65 of fifth segment of female tarsi tapered, about 0.8 as wide at apex as at basal 0.35. Nervulus reclivous, strongly curved.

This group contains the majority of the genus.

3. Rhopalosoma missionicum Ogloblin

*Rhopalosoma missionicum Ogloblin, 1951. Rev. Soc. Ent. Argentina 15: 11. ♂. des., fig. Type: ♂, Argentina: Loreto in Misiones (La Plata). Type studied in 1976.

Male type: Front wing 6.9 mm. long. Lateral ocellus separated from eye by 1.0 its long diameter. First intercubitus 1.0 as long as second section of cubitus. Nervulus distad of basal vein by 2.0 its length, 2.0 as far from basal vein as from first recurrent vein. Otherwise similar to R. impar. The male genitalia of this species have not been examined.

Specimen: ♂ (type), Loreto, Misiones, Argentina, Feb. 15, 1934 (La Plata).

4. Rhopalosoma impar, new species

Figures 3 (head); 19 (venation); and 34 (♂ genitalia)

Front wing 6 to 11 mm. long. Eye notch about 0.65 as deep as width of median ocellus. Lateral ocellus separated from eye by about 1.25 its long diameter. Female tarsal claws long, with a postmedian tooth, the apical tooth of moderate length, rather weakly curved. First intercubitus about 1.25 as long as second section of cubitus. Nervulus sinuate, strongly reclivous, separated from basal vein by about 2.7 its length, relatively close to first recurrent vein, about 3.1 as far from basal vein as from first recurrent vein. Basal section of radiella bowed, subvertical or weakly inclivous, joining cubitella at an angle of about 40°, its two ends divergent at about 70°. Male genitalia as in figure 34.

Fulvoferruginous, the flagellum brownish ferruginous and interocellar area blackish. Wings tinged with brown, their veins brown.

Type: ♀, Pedra Azul, 800 m., Minas Gerais, Brazil, Nov. 1972, Alvarenga and Seabra (Townes).

Paratypes: 2♀, same data as type (Townes). ♂, 2♀, Piracicaba, São Paulo, Brazil, Jan. 12, 20, and 22, 1965, C. A. and W. E. Triplehorn (Ithaca and Townes). ♂, Nanawa, Chaco, Paraguay, Oct. to Nov. 1926, A. Pride (London).

This species occurs in Paraguay and southern Brazil.

5. Rhopalosoma bolivianum Brues

Figures 4 (head) and 20 (venation)

*Rhopalosoma bolivianum (as boliviense in Fig. 3) Brues, 1943. Ann. Ent. Soc. America 36: 316. ♀. key, des., fig. Type: ♀, Bolivia: Buena Vista near Santa Cruz (Ithaca). Type studied in 1974.

Male: Unknown.

Female: Front wing 12 mm. long. Eye notch 0.8 as deep as width of median ocellus. Lateral ocellus separated from eye by 0.67 its long diameter. Tarsal claws moderately long, with a postmedian tooth, the apical tooth of moderate length and moderately curved. First intercubitus 0.78 as long as second section of cubitus. Nervulus sinuate, reclivous, distad of basal vein

by 1.6 its length. Basal section of radiella weakly inclivous, with a median 90° bend, joining cubitella at an angle of 30°.

Fulvous, the flagellum medium brown. Interocellar area brown. Wings tinged with fulvous brown, the veins brown.

Specimen: ♀ (type), Buena Vista, near Santa Cruz, Bolivia, 1928, J. Steinbach (Ithaca).

6. Rhopalosoma simile Brues

Figures 5 (head) and 35 (♂ genitalia)

*Rhopalosoma simile Brues, 1943. Ann. Ent. Soc. America 36: 317. ♂, ♀. key, des., fig. Type: ♀, Barro Colorado Island, Panama (Washington). Type studied in 1974.

Front wing 8.2 to 16.5 mm. long. Scape dark brown. In all other respects similar to R. nearcticum. Male genitalia as in figure 35.

This will probably prove to be only subspecifically distinct from R. nearcticum.

Specimens: 15♂, 53♀ from Mexico (Atoyak in Vera Cruz, Catemaco at 1,100 ft. in Vera Cruz, 20 miles north of Huixtla in Chiapas, Mazatlán in Sinaloa, Minatitlán in Vera Cruz, and Mérida in Yucatán); Guatemala (Cayuga and Quiriguá); British Honduras (Camp Sibim in Coyo District and Middlesex at 125 m.); El Salvador (Lake Ilopango near Apulo and Alta Marina at 2,500 ft. in San Salvador); Costa Rica (Turrialba at 600 m.); and Panama (Barro Colorado Island and Trinidad River). Collection dates are distributed from March 25 to October 6. Two of the specimens were collected at lights, others in Malaise traps. Specimens are in the collections of East Lansing, London, Ottawa, Townes, and Washington.

This species ranges from Mexico to Panama.

7. Rhopalosoma nearcticum Brues

Figures 6 (head) and 21 (venation)

Rhopalosoma poeyi Ashmead, 1896. Proc. Ent. Soc. Washington 3: 304. Mo.: St. Louis. N. C. Fla.: St. Augustine. Ky.: Louisville. Misdetermination.

Rhopalosoma poeyi Hood, 1913. Proc. Ent. Soc. Washington 15: 145-147. fig., biol. Md.: Plummers Island. Host: Orocharis saltator. Misdetermination.

Rhopalosoma poeyi Rohwer, 1913. Proc. Ent. Soc. Washington 15: 147-148. discussion, distribution. Misdetermination.

Rhopalosoma poeyi Cresson, 1916. Mem. Amer. Ent. Soc. 1: 71. N.C. Misdetermination.

Rhopalosoma poeyi Brimley, 1938. The insects of North Carolina . . ., p. 436. N. C.: Raleigh. Misdetermination.

*Rhopalosoma nearcticum Brues, 1943. Ann. Ent. Soc. America 36: 316. ♂, ♀. key, des., fig. Type: ♀, Florida: Kissimmee (Cambridge). Fla.: Seminole Co., Hillsboro Co., Ft. Meade, Gulfport, St. Augustine. Md.: Plummers Island. Type studied in 1973.

Rhopalosoma nearcticum Gurney, 1953. Proc. U. S. Natl. Mus. 103: 19-34. biol., figs. Ga., Fla., Ind., Md., Miss., Mo., N. C., S. C., Va. Hosts: Hapithus agitator, H. brevipennis.

Front wing 7.0 to 13.2 mm. long. Eye notch about 0.44 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.75 its long diameter. Female tarsal claws long, with a postmedian pointed tooth and subbasally a smaller rounded tooth, its apical tooth short, stout, and with a moderately strong curvature. First cubital vein about 0.90 as long as second section of cubitus. Nervulus sinuate, strongly reclivous, distad of basal vein by about 1.9 its length. Basal section of radiella strongly inclivous, with a bend of about 90° that is centered above the middle, the radiella meeting cubitella at an angle of about 25°. Male genitalia similar to those of R. simile (figure 35).

Ochraceous. Ocellar area black. Flagellum fulvous. Wings tinged with ochraceous, the veins light brown.

Specimens: 46♂, 66♀ from Florida (Fort Myers, Gulfport, Homestead, Jacksonville, Kissimmee, Lake Placid, Martin Co., Orange Co., Palm Beach Co., St. Augustine, Seminole Co., and Tall Timbers near Tallahassee); Georgia (Atlanta and Stone Mt.); Kentucky (Golden Pond); Louisiana (Bayou Chicot in Evangeline Co.); Maryland (Berlin, Mayo, and Plummers Island); Missouri (Columbia and Williamsville); North Carolina (Long Beach and Oxford); South Carolina (Greenville); Tennessee (Knoxville?); and Texas (Sinton). Collection dates in Florida range from April 23 to August 28, with a peak of collections in May and June. Farther north, the collection dates are from July 9 to October 29, and from San Patricio Co., Texas, there is a specimen dated June 17. About half of the total number of specimens were collected in Malaise traps. Two of the specimens are labeled as having been collected at lights.

In my own experience this species is locally common in the south Atlantic states, in dense shrubby vegetation where the humidity is high. Adults fly shortly before sunset and at least until dark, just above the bushes. In flight they resemble Ophion and Netelia except for their somewhat stouter appearance. Crickets of the genera Hapithus and Orocharis are often found with a bulging blackish larva of this parasite stuck on one side near the base of a hind leg, forcing the leg outward in an unnatural position. From such parasitized crickets there have been rearings by Hood (from Orocharis saltator) and by Gurney (from Hapithus agitator). Both of these workers published their observations (see synonymy above) and Gurney gave a detailed account of the biology with figures of the larva.

This species occurs in the Upper and Lower Austral zones of the eastern United States. It parasitizes crickets of the genera Orocharis and Hapithus.

8. Rhopalosoma angulare, new species

Figures 7 (head); 22 (venation); and 36 (♂ genitalia)

Front wing 11 to 17 mm. long. Eye notch about 0.63 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.55 its long diameter. Female tarsal claws long, with a postmedian pointed tooth and subbasally a smaller rounded tooth, its apical tooth stout, weakly curved. First intercubitus about 1.15 as long as second section of cubitus. Nervulus sinuate, reclivous, separated from basal vein by about 2.2 its length. Basal section of radiella inclivous, with a sharp bend of about 100° that is centered just above the middle, the radiella meeting cubitella at an angle of about 25°. Male genitalia as in figure 36.

Fulvoferruginous. Ocellar area blackish, the blackish mark extending a

little beyond the ocellar interspace. Flagellum dark fulvous to brown. Wings with a fulvoferruginous tinge, the veins ferruginous brown. Abdomen often somewhat infuscate beyond segment 3.

Type: ♀, Encruzilhada, 960 m., Bahia, Brazil, Nov. 1972, M. Alvarenga (Townes).

Paratypes: 5♂, 22♀, same data as type (Townes). ♂, 8♀, Encruzilhada, 980 m., Bahia, Brazil, Nov. 1974, M. Alvarenga (Townes). ♀, Caruaru, 900 m., Pernambuco, Brazil, Apr. 1972, M. Alvarenga (Townes). 5♀, Linhares, Espirito Santo, Brazil, Nov. 1972, M. Alvarenga (Townes). ♀, Pedra Azul, Minas Gerais, Brazil, Nov. 1972, Alvarenga and Seabra (Townes).

This species occurs in eastern and southeastern Brazil.

9. Rhopalosoma haitiense, new species

Figures 8 (head) and 23 (venation)

*Rhopalosoma aenigmaticum Brues, 1943. Ann. Ent. Soc. America 36: 315.
♀. key, des., fig. Haiti. Misdetermination of aenigmaticum Westwood.

Male: Unknown.

Female type: Front wing 10.2 mm. long. Eye notch 0.75 as deep as width of median ocellus. Lateral ocellus separated from eye by 0.25 its long diameter. Tarsal claws moderately long with a postmedian tooth and near the base with a very low rounded tooth, its apical tooth of moderate stoutness and curvature. First intercubitus 0.88 as long as second section of cubitus. Nervulus sinuate, reclivous, distad of basal vein by 1.7 its length. Basal section of radiella inclivous, with a strong even curvature, its two ends divergent at 75°, the radiella meeting cubitella at 30°.

Ochraceous, the flagellum fulvous. Interocellar area dark brown. Wings subhyaline, the veins light brown.

Type: ♀, Manneville, Haiti (Cambridge). This specimen is one of those reported by Brues in 1943 incorrectly as R. aenigmaticum. Brues had an additional 2♂, 1♀ from the same locality. These I have not seen.

10. Rhopalosoma poeyi Cresson

Figures 9 (head); 24 (venation); and 37 (♂ genitalia)

*Rhopalosoma Poeyi Cresson, 1865. Proc. Ent. Soc. Philadelphia 4: 58.
♂, ♀. des., fig. Lectotype: ♀ (designated by Cresson, 1916), Cuba (Philadelphia). Lectotype studied in 1974.
*Sibyllina aenigmatica Westwood, 1868. Trans. Ent. Soc. London 1868: 329.
♀. des. Lectotype: ♀ (labeled by Townes, 1973, hereby designated), Haiti (London). Lectotype studied in 1973. New synonym.
Sibyllina aenigmatica Smith, 1869. Trans. Ent. Soc. London 68 (proc.): LI.
des.
Rhopalosoma aenigmatica Westwood, 1874. Thesaurus entomologicus oxoniensis p. 130-132. des., fig. Cuba. Haiti.
Rhopalosoma poeyi Schulz, 1906. Spolia hymenopterologica, p. 226. key.
Rhopalosoma poeyi Cresson, 1916. Mem. American Ent. Soc. 1: 71. Lectotype designation.
Rhopalosoma poeyi Brues, 1943. Ann. Ent. Soc. America 36: 315. ♀. key, des. Cuba.

Rhopalosoma poeyi Krombein, 1953. Amer. Mus. Novitates 1633: 7. des.
Bahamas: South Bimini.

Front wing 4.8 to 8.2 mm. long. Notch in eye about 0.70 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.5 its long diameter in male, by about 0.4 its long diameter in female. Female tarsal claws long, with a postmedian tooth, the apical tooth strongly curved and rather short. First intercubitus about 0.83 as long as second section of cubitus. Nervulus moderately sinuate or curved, weakly reclivous, distad of basal vein by about 2.0 its length. Basal section of radiella strongly curved, meeting cubitella at an angle of about 30°, its two ends divergent at about 70°. Male genitalia as in figure 37.

Fulvoferruginous, including the flagellum. Interocellar area partly or entirely dark brown. Wings tinged with fulvous brown, their veins brown.

Specimens: 3♂, Man-o-War Cay, Bahamas, Aug. 23 and 30, 1971, H. and A. Howden (Townes). ♂, South Bimini Island, Bahamas, June 8, 1950, Cazier and Rindge (Washington). 2♂, 6♀, in light trap, interior of Cayman Island, behind Stakes Bay, Apr. 17 to Aug. 26, 1938, C. B. Lewis and C. H. Thompson (London and Townes). ♀ (type of poeyi), Cuba (Philadelphia). ♀, Jamaica (London). 2♀ (lectotype and paratype of aenigmatica), Santo Domingo, [Haiti] (London).

This species occurs in the Caribbean Islands, from the Bahamas to Hispaniola.

11. Rhopalosoma bahianum Schulz

Figures 10 (head); 25 (venation); and 38 (♂ genitalia)

*Rhopalosoma bahianum Schulz, 1906. Spolia hymenopterologica, p. 222, 226. ♀. key, des. Type: ♀, Brazil: Orobó in Bahia (Strasbourg). Type studied in 1974.

Front wing 8.8 to 11.3 mm. long. Eye notch about 0.67 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.36 its long diameter. Female tarsal claws of moderate length, with a postmedian tooth but no subbasal tooth, the apical tooth moderately stout and weakly curved. First intercubital vein about 1.1 as long as second section of cubitus. Nervulus strongly curved and strongly reclivous, distad of basal vein by about 1.8 its length. Basal section of radiella long, weakly inclivous, evenly curved, its two ends divergent at about 45°, the radiella meeting cubitella at about 60°. Male genitalia as in figure 38.

Fulvous, the flagellum fulvous brown. Interocellar area black. Wings with a weak fulvous brown tinge, the veins brown.

Specimens: 2♂, 4♀, Encruzilhada, 960 m., Bahia, Brazil, Nov. 1972, M. Alvarenga (Townes). ♀, Barialba, 400 m., Ceará, Brazil, May 1969, M. Alvarenga (Townes).

12. Rhopalosoma obliquum, new species

Figures 11 (head); 26 (venation); and 39 (♂ genitalia)

Male type: Front wing 10.2 mm. long. Eye notch 0.70 as deep as width

of median ocellus. Lateral ocellus separated from eye by 0.47 its long diameter. First intercubitus 1.25 as long as second section of cubitus. Nervulus sinuate, reclivous, distad of basal vein by 1.44 its length. Basal section of radiella inclivous at 35° from the vertical, moderately curved, meeting cubitella at 70°. Genitalia as in figure 39.

Pale fulvous. Flagellum black. Pedicel fuscous. Scape stramineous, infuscate above. Ocellar area fuscous and the fuscous area reaching laterad to eye. Wings with a fulvous tinge, the veins light brown. Abdomen infuscate beyond segment 3.

Female: Unknown.

Type: ♂, 12 miles south of Valle Nacional, 3,000 ft., Mexico, May 17, 1971, Henry Howden (Townes).

13. Rhopalosoma scaposum, new species

Figures 12 (head); 27 (venation); and 40 (♂ genitalia)

Male type: Front wing 8.7 mm. long. Eye notch 0.56 as deep as width of median ocellus. Lateral ocellus separated from eye by 0.80 its long diameter. First intercubitus 0.85 as long as second section of cubitus. Nervulus weakly curved, strongly oblique, basad of basal vein by 1.12 its length. Basal section of radiella almost vertical, strongly bowed at middle with the two ends divergent at 75°, radiella meeting cubitella at 45°. Genitalia as in figure 40.

Pale fulvous. Ocellar area and frons fuscous, the frons fulvous along its lateral and lower edges. Antenna entirely black. Wings tinged with pale fulvous, the veins light brown.

Female: Unknown.

Type: ♂, Crystal Mayu, 300 m., Cochabamba, Bolivia, Dec. 5, 1949, L. Peña (Townes).

14. Rhopalosoma guianense Schulz

Figures 13 (head); 28 (venation); and 41 (♂ genitalia)

*Rhopalosoma guianense Schulz, 1906. Spolia hymenopterologica, p. 221, 226. ♀. key, des. Type: ♀, British Guiana: Oyapok [in Pará] (Strasbourg). Type studied in 1974.

*Rhopalosoma martinezi Ogloblin, 1951. Rev. Soc. Ent. Argentina 15: 14. ♀. des., fig. Type: ♀, Bolivia: Santa Cruz (La Plata). Type studied in 1976. New synonym.

Front wing 9.8 to 16.0 mm. long. Eye notch small and shallow, about 0.50 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.90 its long diameter. Female tarsal claws long, with a postmedian tooth and a low rounded tooth near base, the apical point moderately stout and curved. First intercubitus about 0.80 as long as second section of cubitus. Nervulus strongly curved, reclivous, distad of basal vein by about 2.6 its length. Basal section of radiella weakly inclivous, weakly curved, its two ends divergent by about 60°, radiella meeting cubitella at about 70°. Note: The radiella figured is less curved than normal, and less inclivous than normal. Male genitalia as in figure 41.

Fulvoferruginous. Head black between ocelli and the black area extending

ventrolaterally to reach or almost reach the eye margins. Flagellum blackish. Scape and pedicel infuscate above. Wings tinged with brown, the veins brown. Abdomen sometimes infuscate beyond segment 2 or beyond segment 3.

Specimens: 12♂, 37♀ from Costa Rica (Sixola River); Panama (Almirante, Barro Colorado Island, Darien, Margarita, Pipeline Road near Gamboa, San José in the Pearl Islands, and Trinidad River); Colombia (Coqueto on the Rio Orteguaza near Rio Peneya); Ecuador (Coca); Peru (Avispas at 400 m. and Chanchamayo at 1,300 m.); Bolivia (Alto Palmar at 1,100 m. in Cochabamba); Trinidad (Morne Bleu at 2,700 ft.); British Guiana (Blairmont, Demarara in Georgetown, King Frederick William IV Falls on the upper Courantyne River, and Moraballi Creek of the Essequibo River); and Surinam (45 kilometers south of Paramaribo). One of the specimens is labeled as collected at light. The specimens from Trinidad River, Panama and from Sixola River, Costa Rica are paratypes of R. simile Brues (misdetermined). Specimens are in the collections of Cambridge, London, Ottawa, Townes, and Washington.

This species ranges from Central America to Bolivia and Surinam.

15. Rhopalosoma breelandi, new species

Figures 14 (head); 29 (venation); and 42 (♂ genitalia)

Male: Front wing 9.3 to 10.3 mm. long. Eye notch about 0.93 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.60 its long diameter. First intercubitus about 0.82 as long as second section of cubitus. Nervulus sinuate, reclivous, distad of basal vein by about 1.55 its length. Basal section of radiella subvertical, bowed at center, its two ends divergent at about 70°, radiella joining cubitella at about 60°. Genitalia as in figure 42.

Ochraceous. Pedicel brown. Flagellum dark brown. Interocellar area fuscous and the fuscous area extending laterally to reach the eye margin. Wings with an ochraceous tinge, the veins light brown.

Female: Unknown.

Type: ♂, Margarita, Canal Zone, Panama, Jan. 1960, Sam Breeland (Townes).

Paratype: ♂, same locality and collector as type, dated June, 1960 (Townes).

16. Rhopalosoma alvarengai, new species

Figures 15 (head); 30 (venation); and 43 (♂ genitalia)

Front wing 7.7 to 14 mm. long. Eye notch about 0.70 as deep as width of median ocellus. Lateral ocellus separated from eye by about 0.43 its long diameter. Female tarsal claws long, with a postmedian tooth and subbasally with a low rounded prominence, the apical point stout and moderately curved. First intercubitus about 0.74 as long as second section of cubitus. Nervulus reclivous, strongly curved, distad of basal vein by about 2.1 its length. Basal section of radiella weakly inclivous, strongly curved, its two ends divergent at about 60°, radiella meeting cubitella at about 60°. Male genitalia as in figure 43.

Ferruginous. Ocellar area dark brown, the brown mark extending laterally to eye margin, often this dark area covering also the upper part of frons. Pedicel and flagellum blackish. Scape infuscate apically. Wings tinged with brown,

the veins brown. Abdomen of male often infuscate beyond second segment.

Type: ♀, Represa Rio Grande, Guanabara, Brazil, Jan. 1968, M. Alvarenga (Townes).

Paratypes: 33♀, same locality and collector as type, dated Jan., Feb., Mar., Sept., Oct., Nov., and Dec., 1967, 1968, 1969, 1970, and 1972 (Townes). 2♀, Alto da Serra, Moretes, Brazil, Feb. 12 and 18, 1966, H. and M. Townes (Townes). ♀, Campina Grande (near Curitiba), Brazil, Feb. 16, 1966, H. and M. Townes (Townes). 3♀, Caruaru, Brazil, Apr. 1972, M. Alvarenga (Townes). 4♂, 13♀, Encruzilhada, 960 m., Bahia, Brazil, Nov. 1972, M. Alvarenga (Townes). 2♂, 6♀, Encruzilhada, 980 m., Bahia, Brazil, Nov. 1974, M. Alvarenga (Townes). 6♂, 11♀, Linhares, Espirito Santo, Brazil, Sept. 1972, M. Alvarenga (Townes). 2♀, Margaritiba, Muriqui, Rio de Janeiro, Brazil, July 1969, M. Alvarenga (Townes). 3♂, Rio de Janeiro, Brazil, Jan. 1939, R. C. Shannon (Washington). ♂ (paratype of R. simile Brues, misdetermined), Tuis, 2,400 ft., Costa Rica, C. H. Lankester (Washington).

This species is known from eastern and southeastern Brazil and from Costa Rica.

Lanceolatum Group

Front spur of middle and hind tibiae with a narrow basal neck that is about as long as diameter of their basitarsi, distad of the neck swollen and continued in a narrowly lanceolate shape, bent about 15° at the distal end of the neck. Nervulus straight, vertical.

One species is known, and this only in the male sex.

17. Rhopalosoma lanceolatum, new species

Figures 16 (head); 31 (venation); and 44 (♂ genitalia)

Male type: Front wing 10.9 mm. long. Eye notch 0.65 as deep as width of median ocellus. Lateral ocellus separated from eye by 0.5 its long diameter. First intercubitus 1.2 as long as second section of cubitus. Nervulus weakly inclivous, almost straight, distad of basal vein by 1.55 its length. Basal section of radiella vertical, weakly curved. Genitalia as in figure 44.

Fulvous. Antenna entirely black. Head black, the cheek, clypeus, and occiput fulvous. Maxillary palpus weakly infuscate except basally. Wings with a fulvous tinge. Abdomen blackish beyond the first segment except that segment 2 is stained with fulvous, more strongly fulvous toward base.

Female: Unknown.

Type: ♂, Nova Teutonia, 27° 11' S, 52° 23' W, 300-500 m., Brazil, Nov. 1968, Fritz Plaumann (Ottawa).

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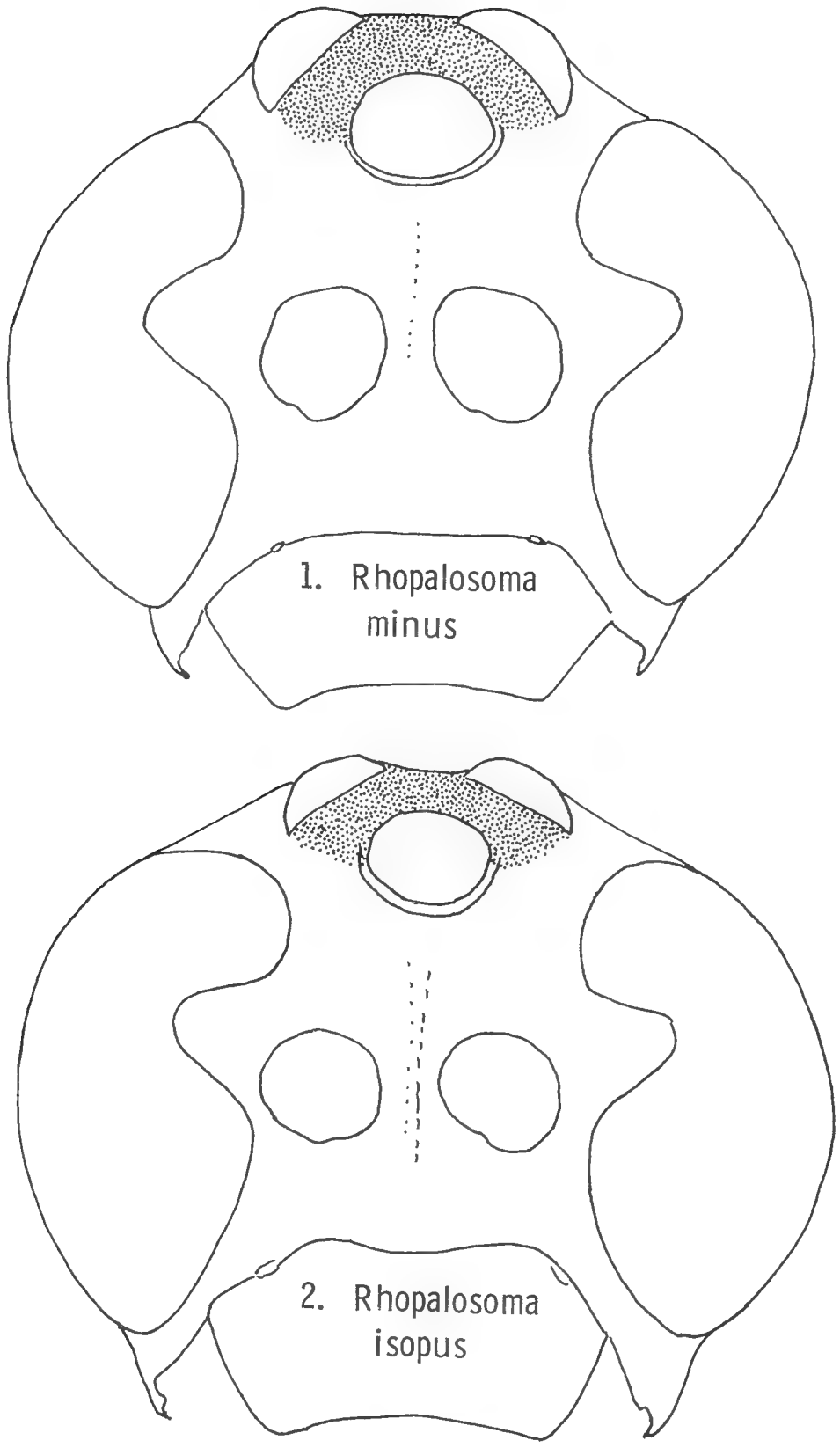
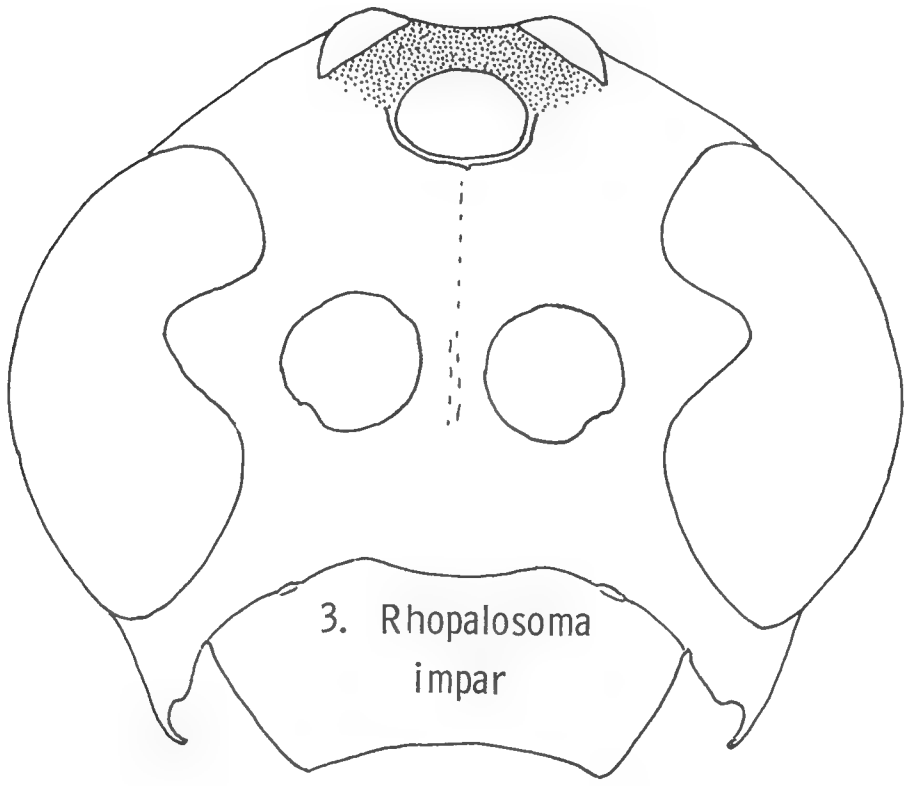
17-31. Rhopalosoma, venational features (2nd cubital cell, nervulus and postnervulus, and radiella).
32-44. Rhopalosoma, male genitalia (penis valve, and volsella and digitus).


1. Rhopalosoma minus

2. Rhopalosoma isopus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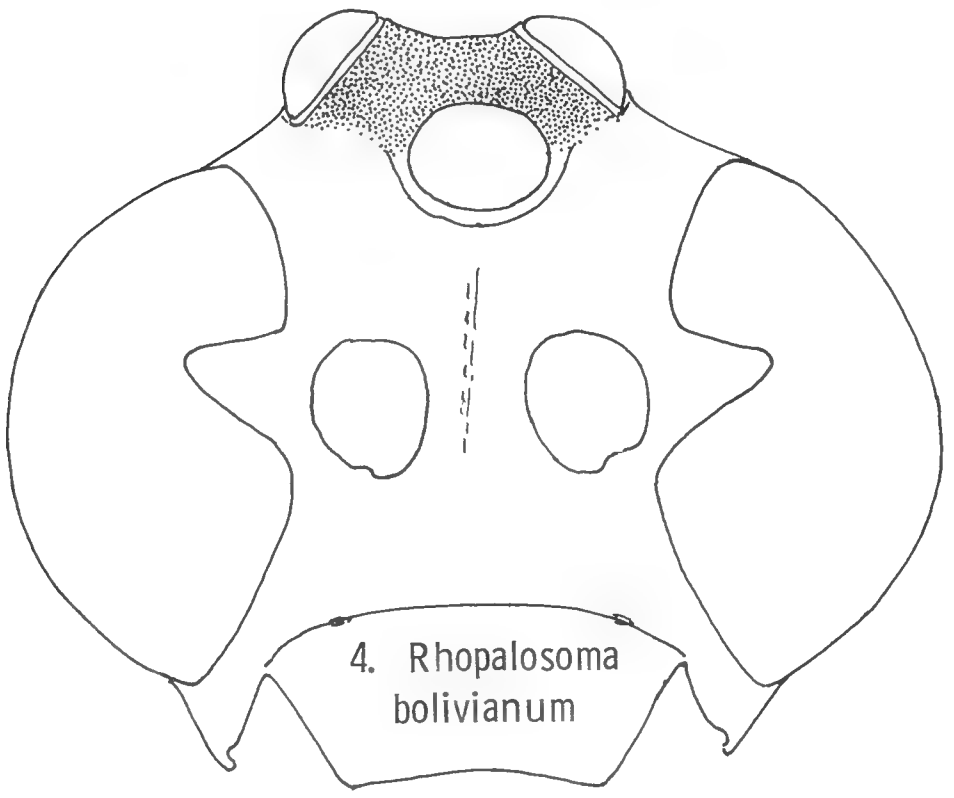
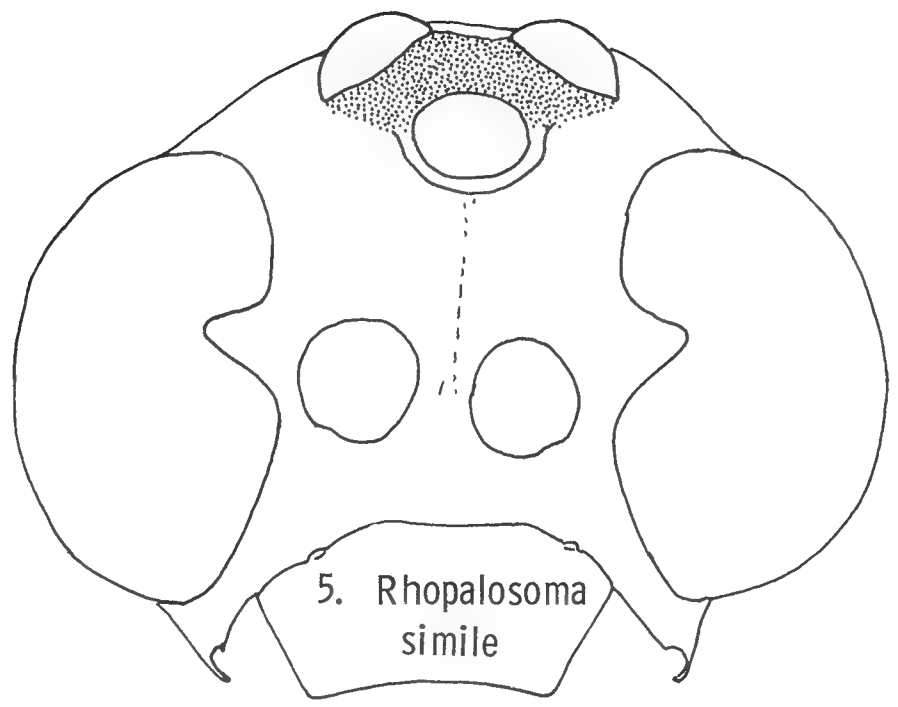
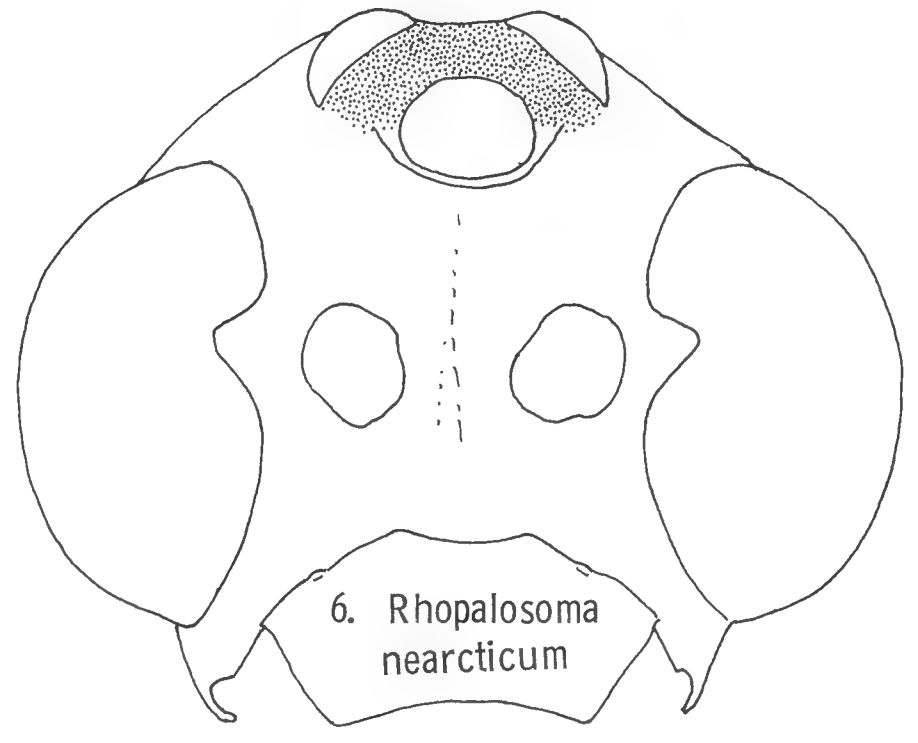
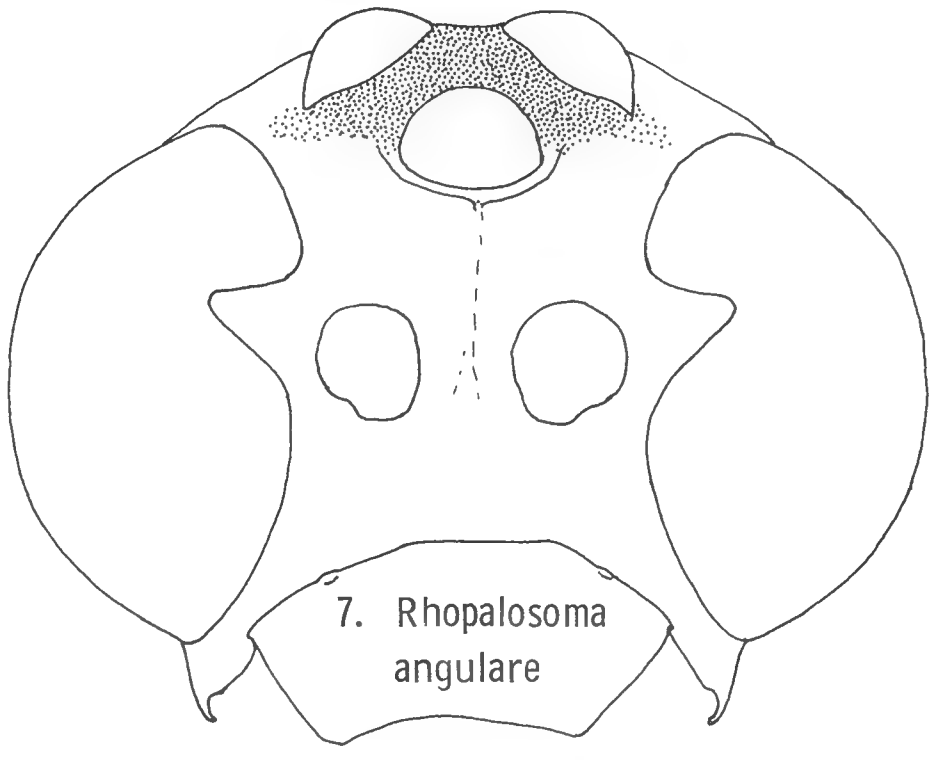
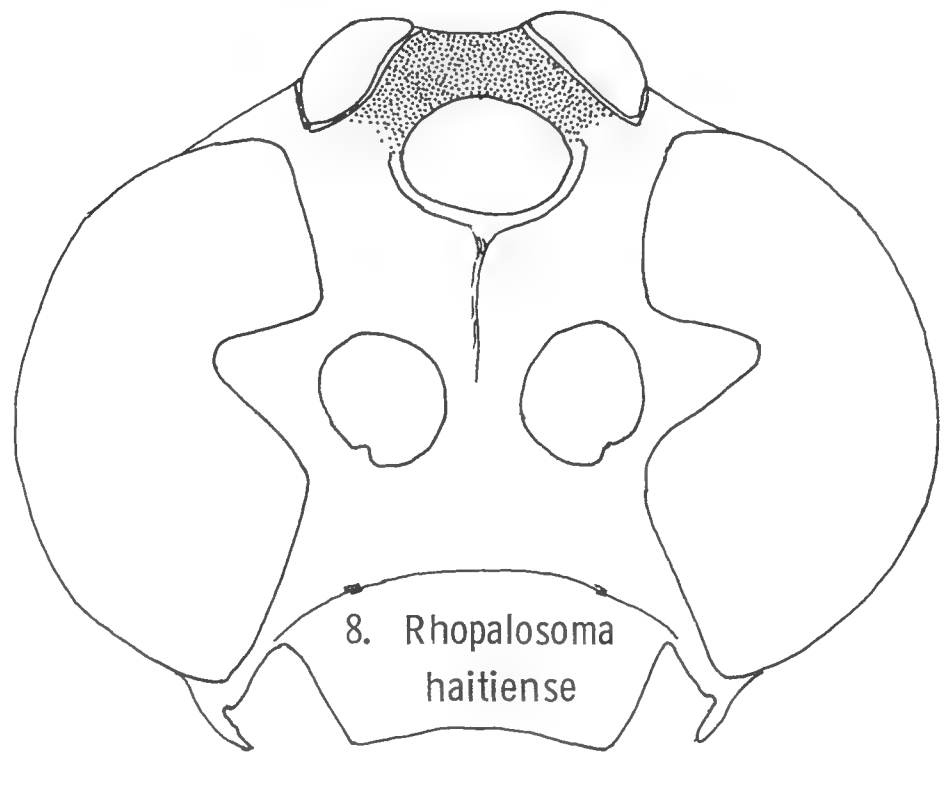
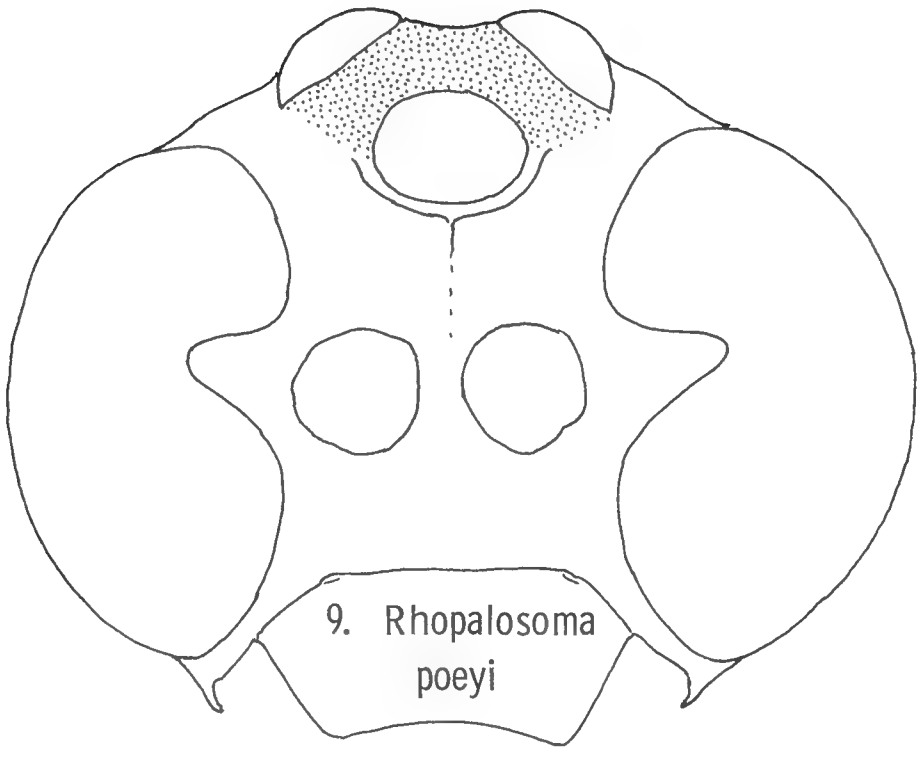

4. Rhopalosoma bolivianum


5. Rhopalosoma simile

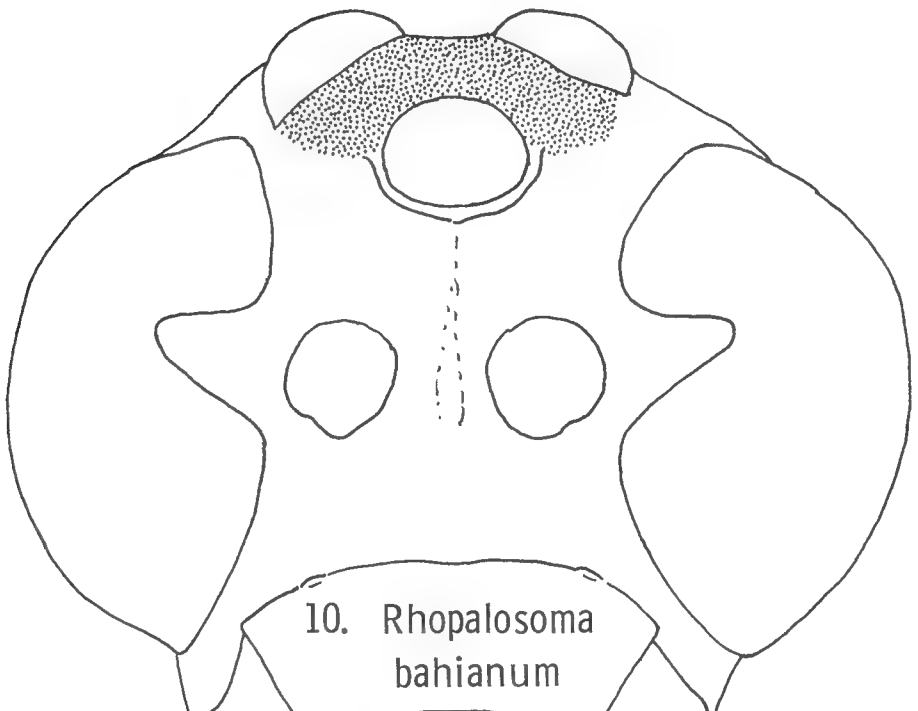

6. Rhopalosoma nearcticum


7. Rhopalosoma angulare

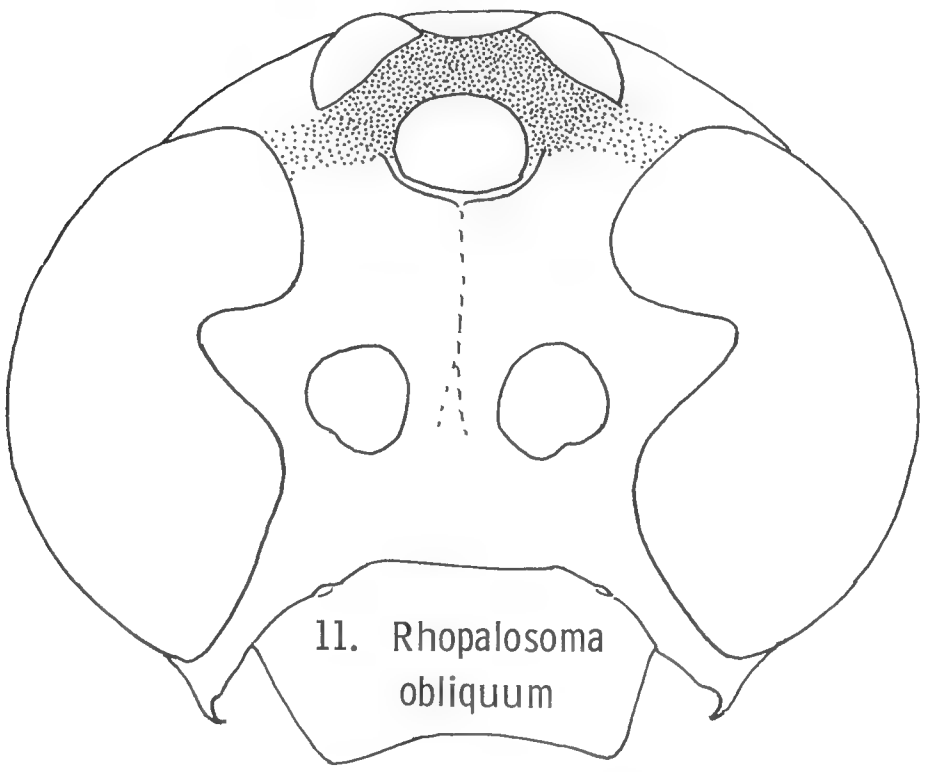

8. Rhopalosoma haitiense



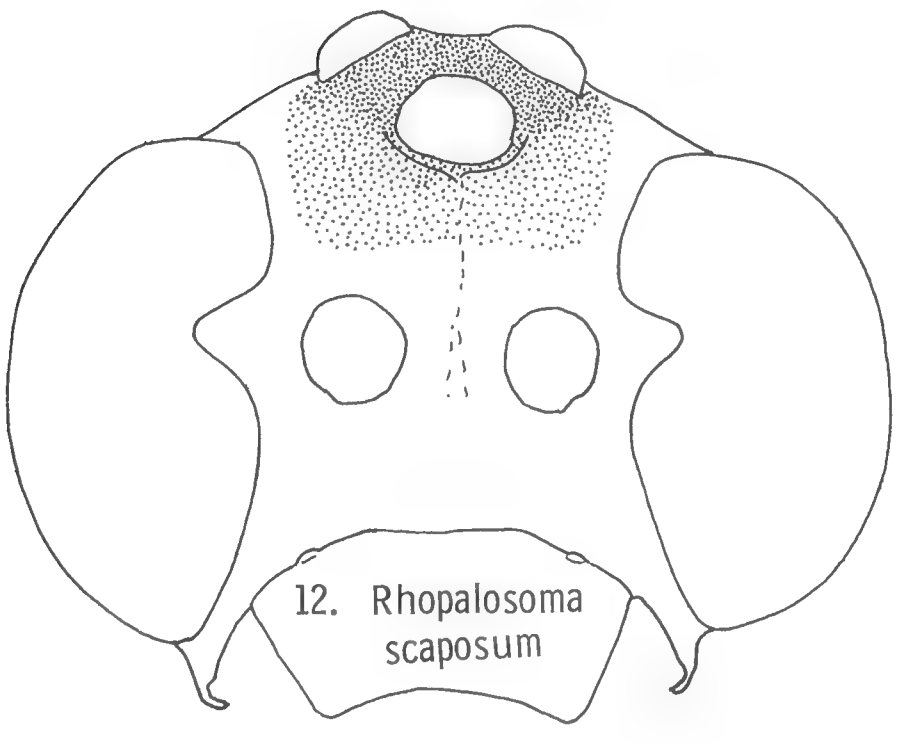
9. Rhopalosoma poeyi



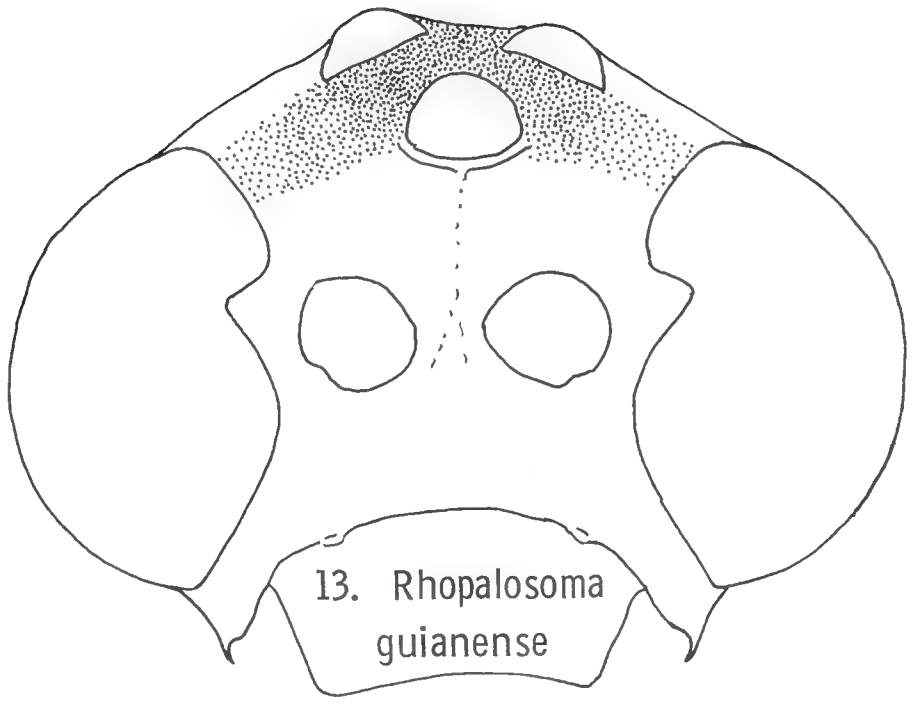
10. Rhopalosoma bahianum



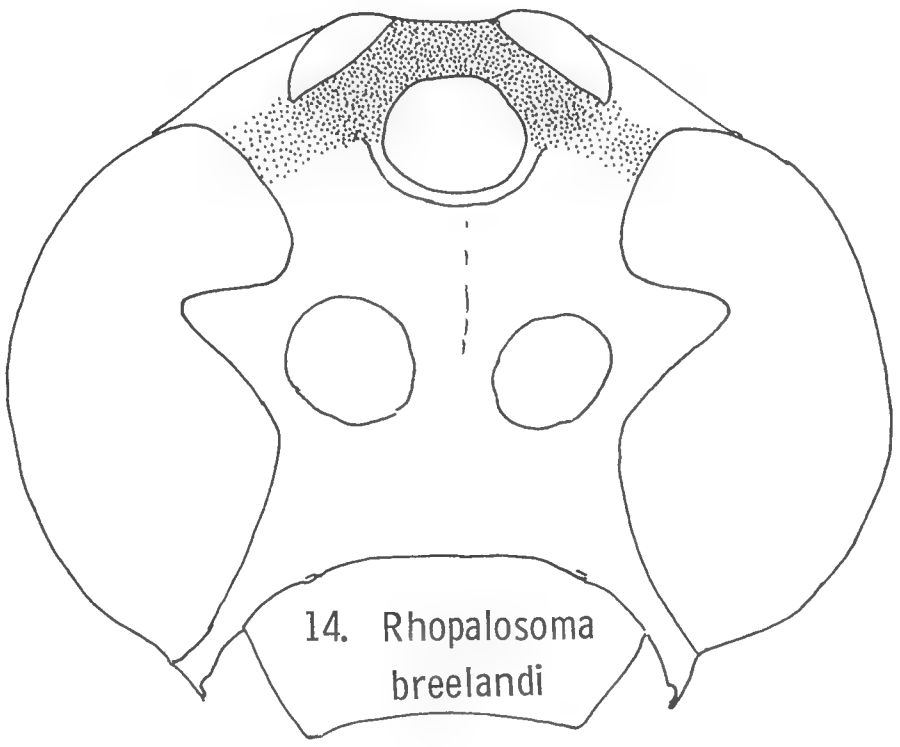
11. Rhopalosoma obliquum



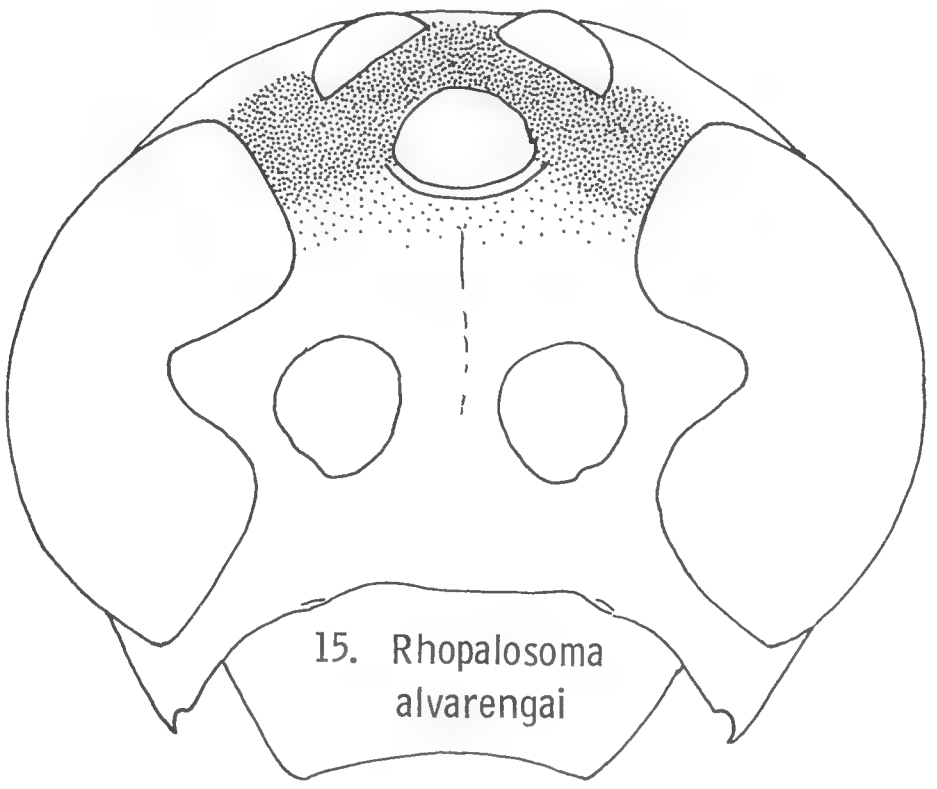
12. Rhopalosoma scaposum



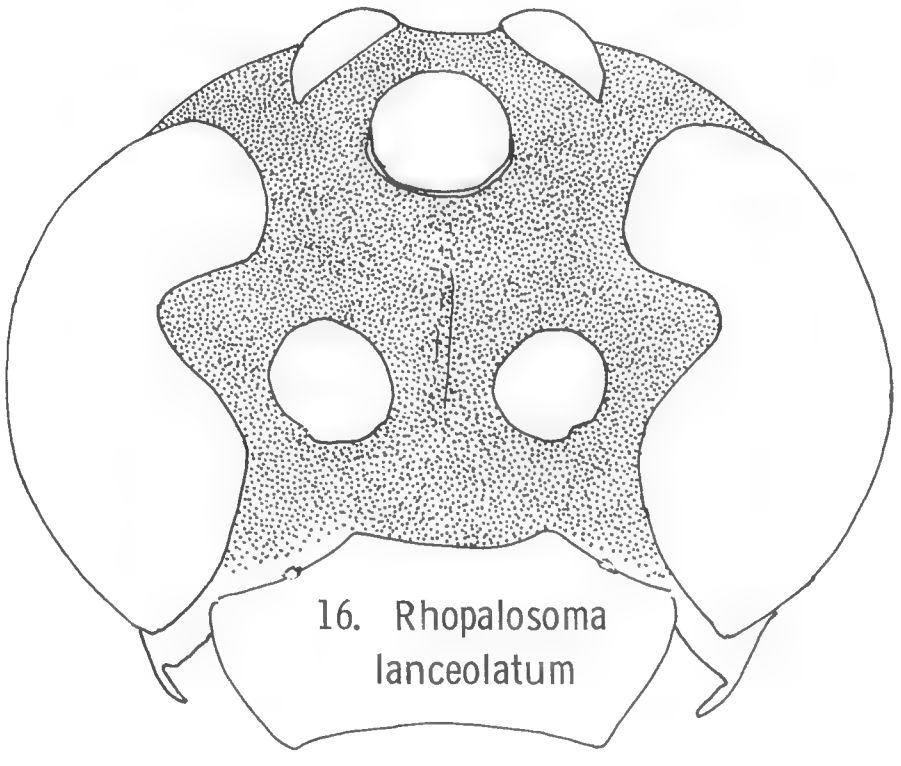
13. Rhopalosoma guianense



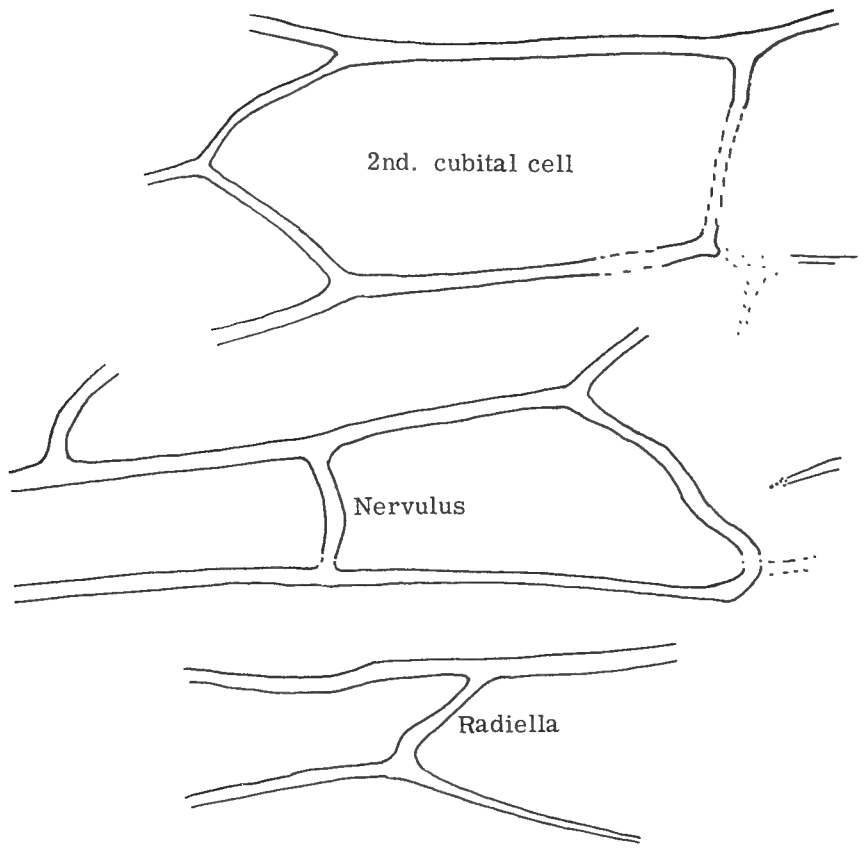
14. Rhopalosoma breelandi



15. Rhopalosoma alvarengai



16. Rhopalosoma lanceolatum



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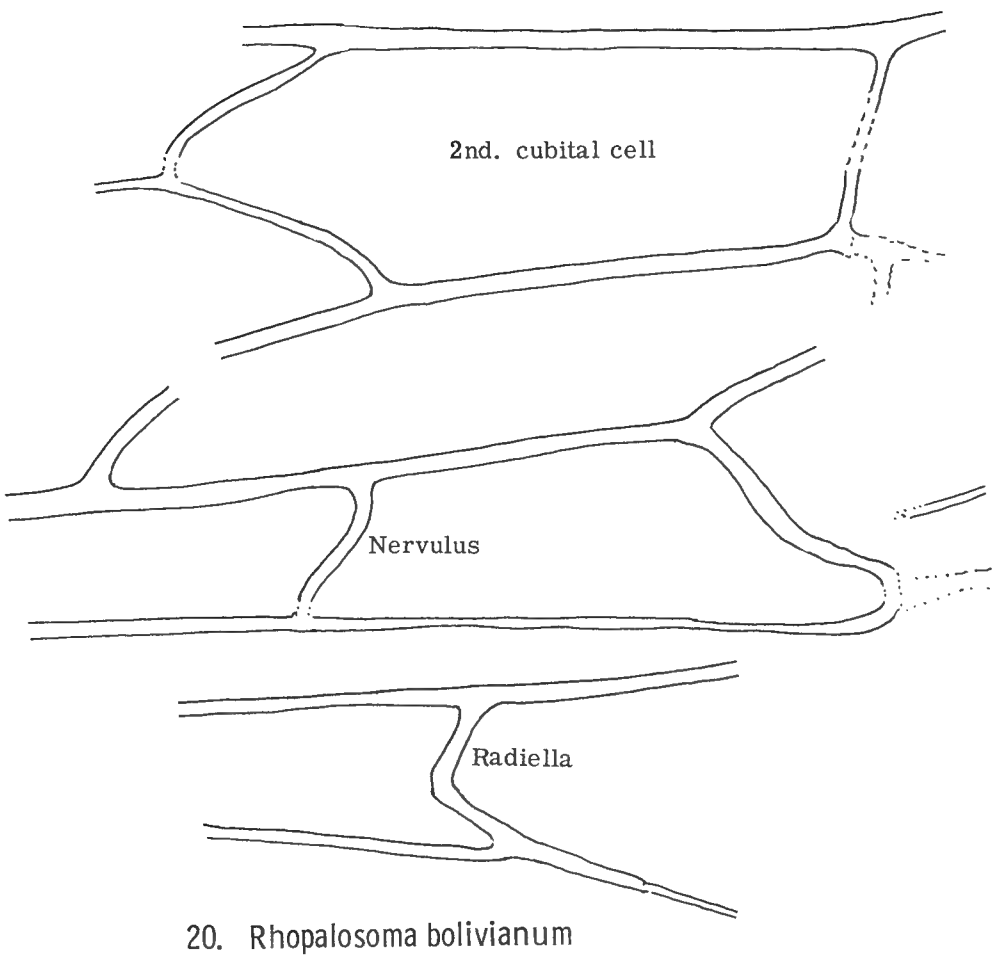

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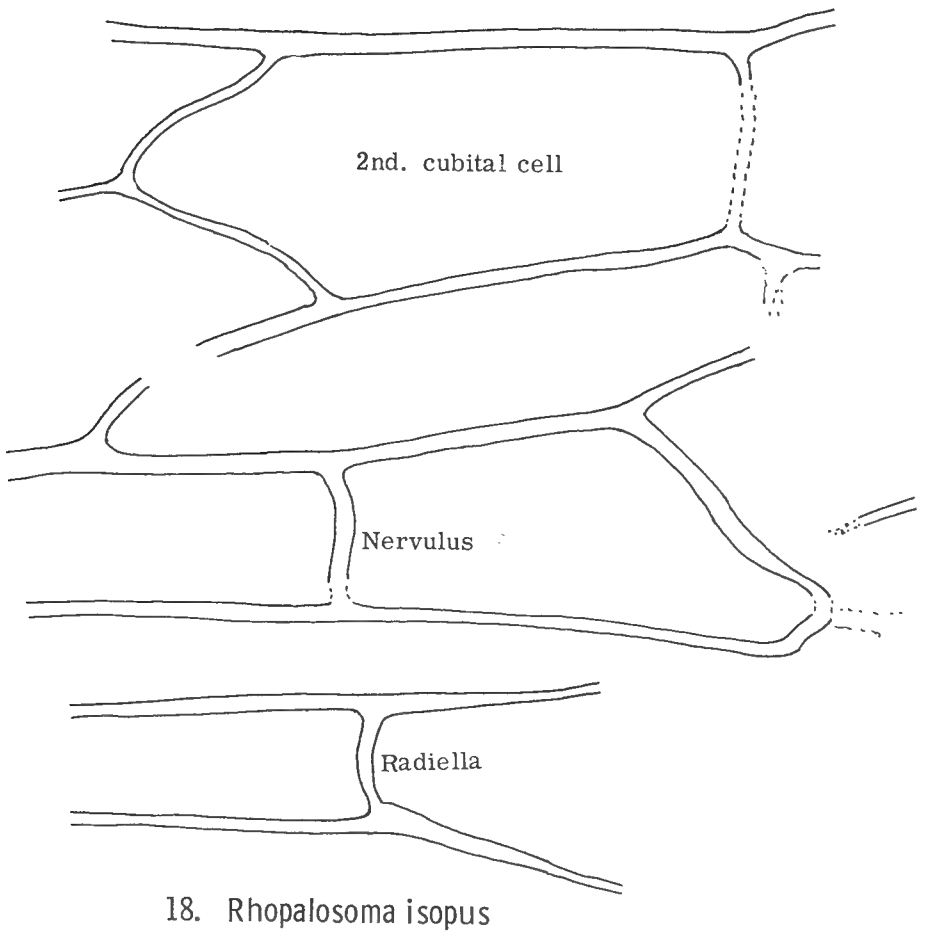

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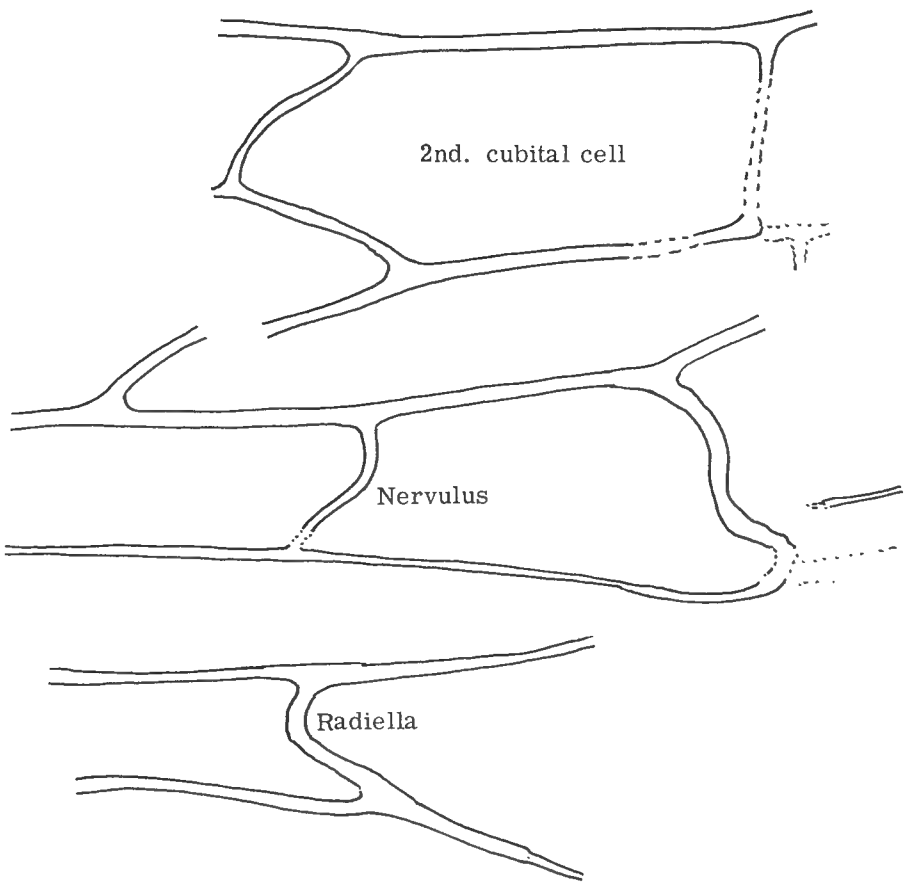

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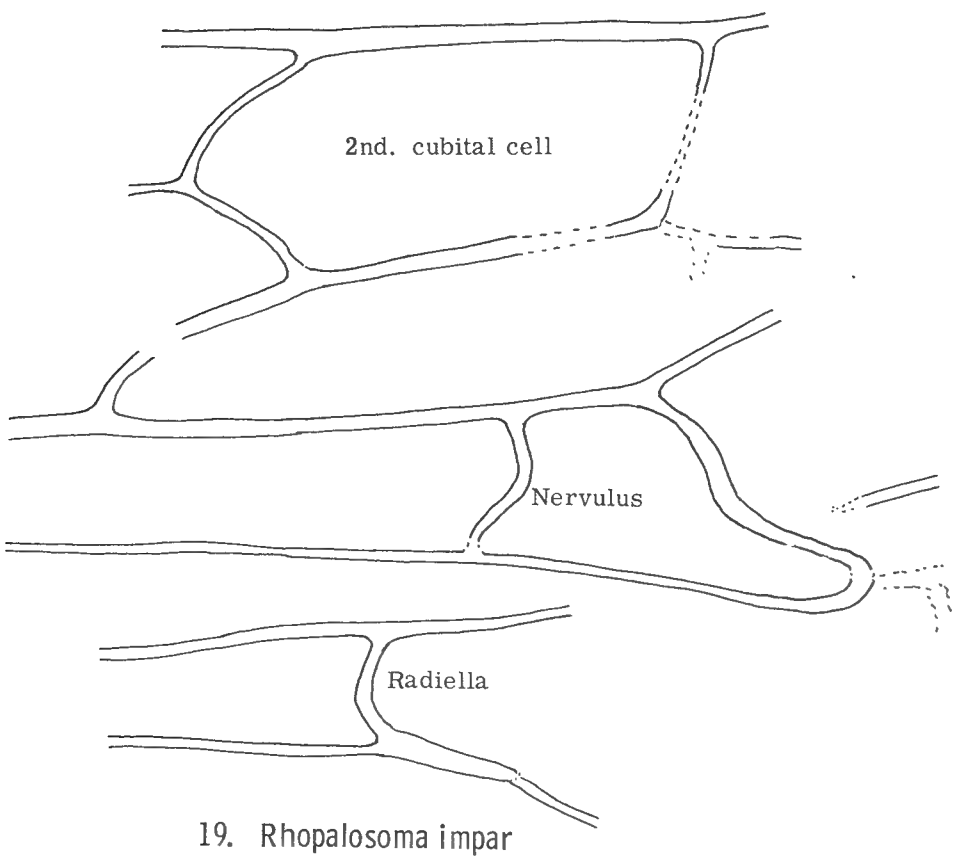
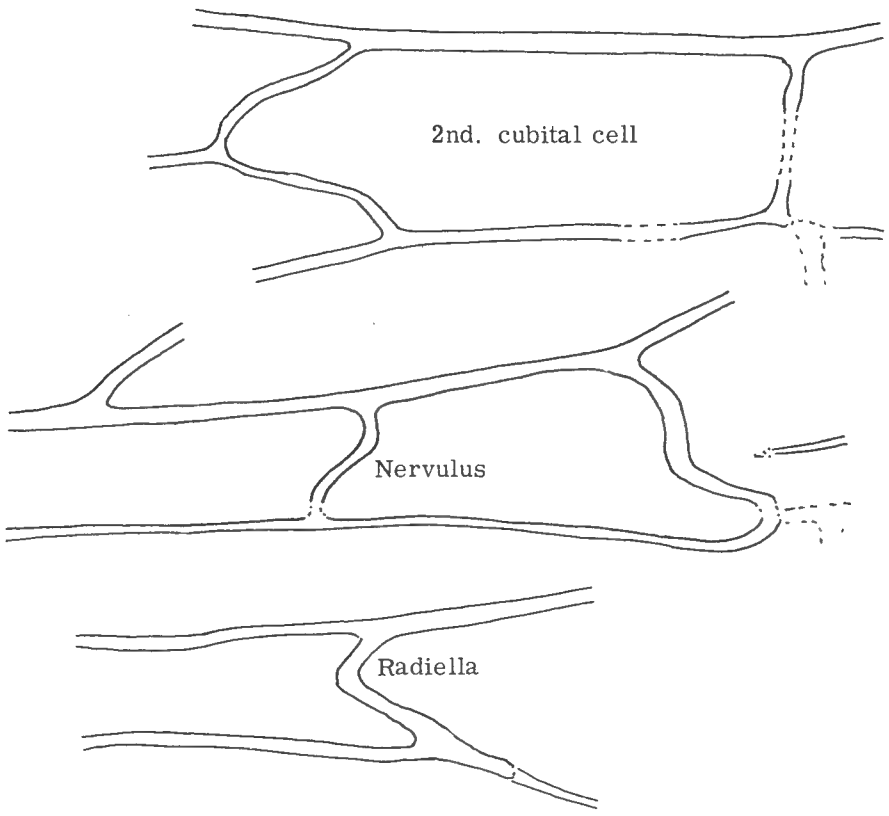
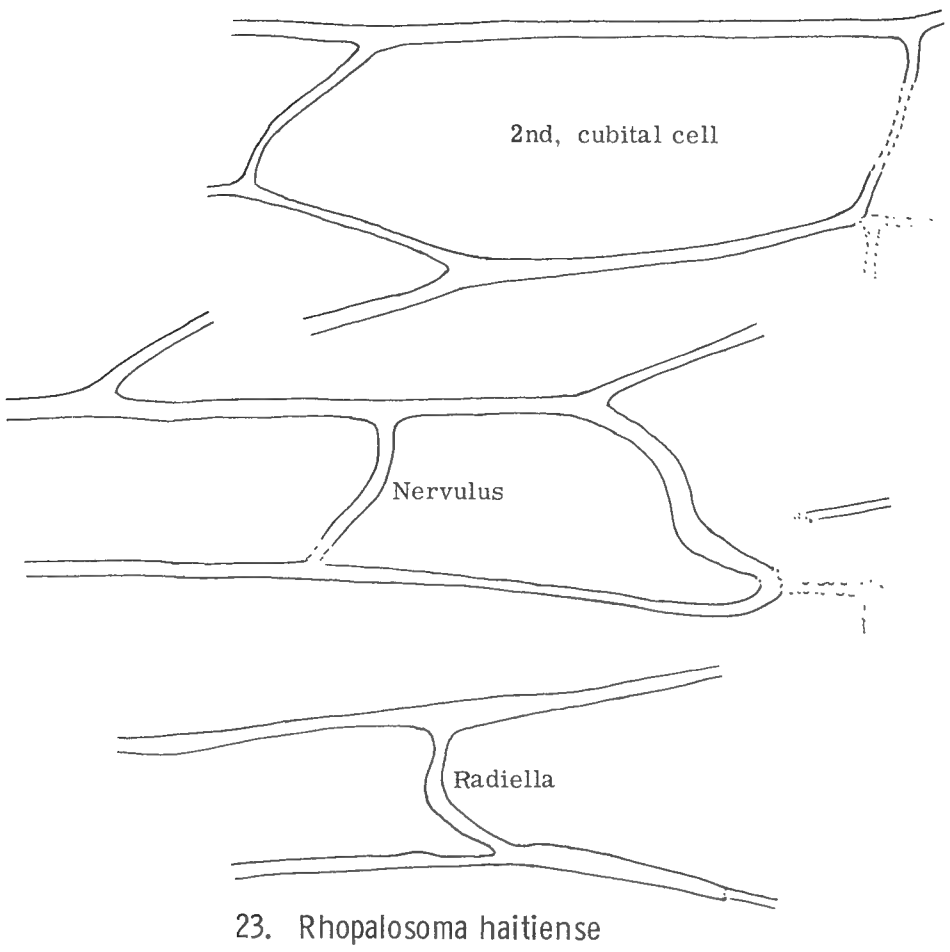


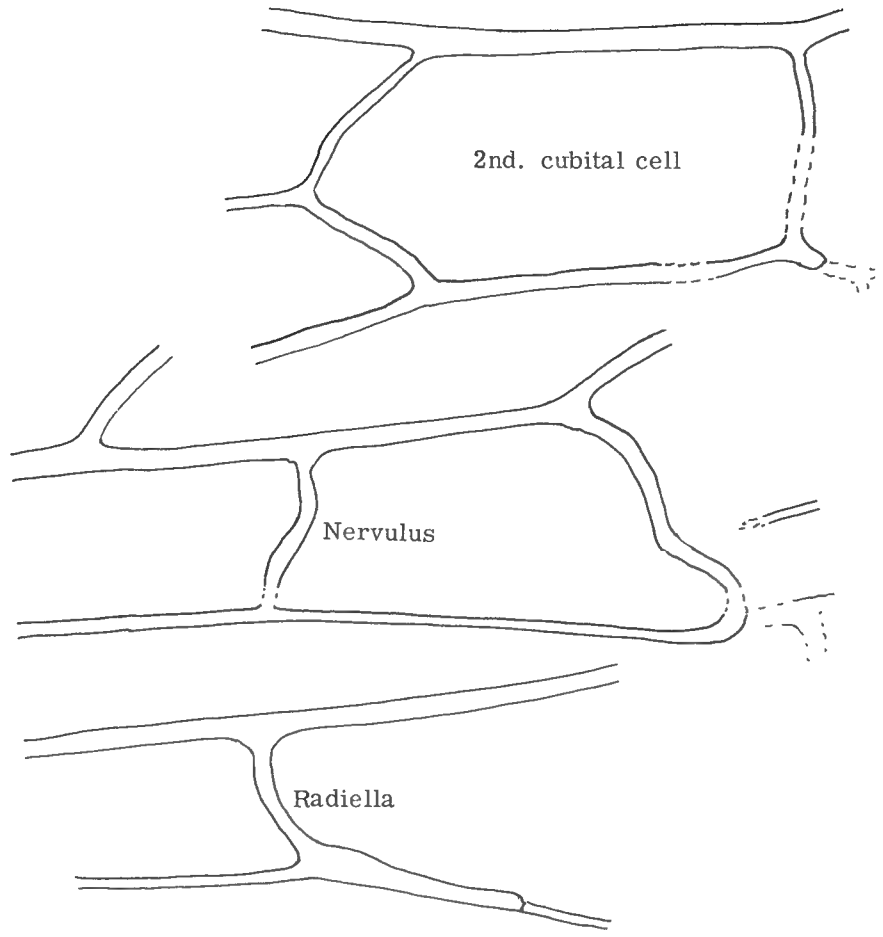
19. Rhopalosoma impar



22. Rhopalosoma angulare



23. Rhopalosoma haitiense



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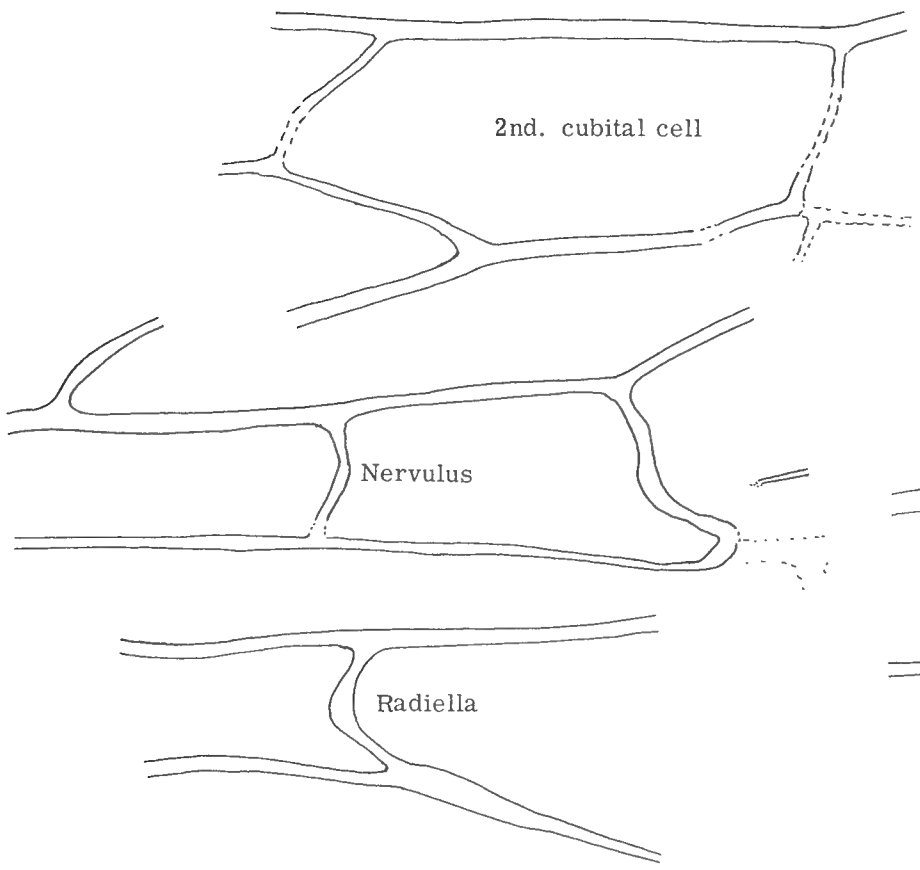
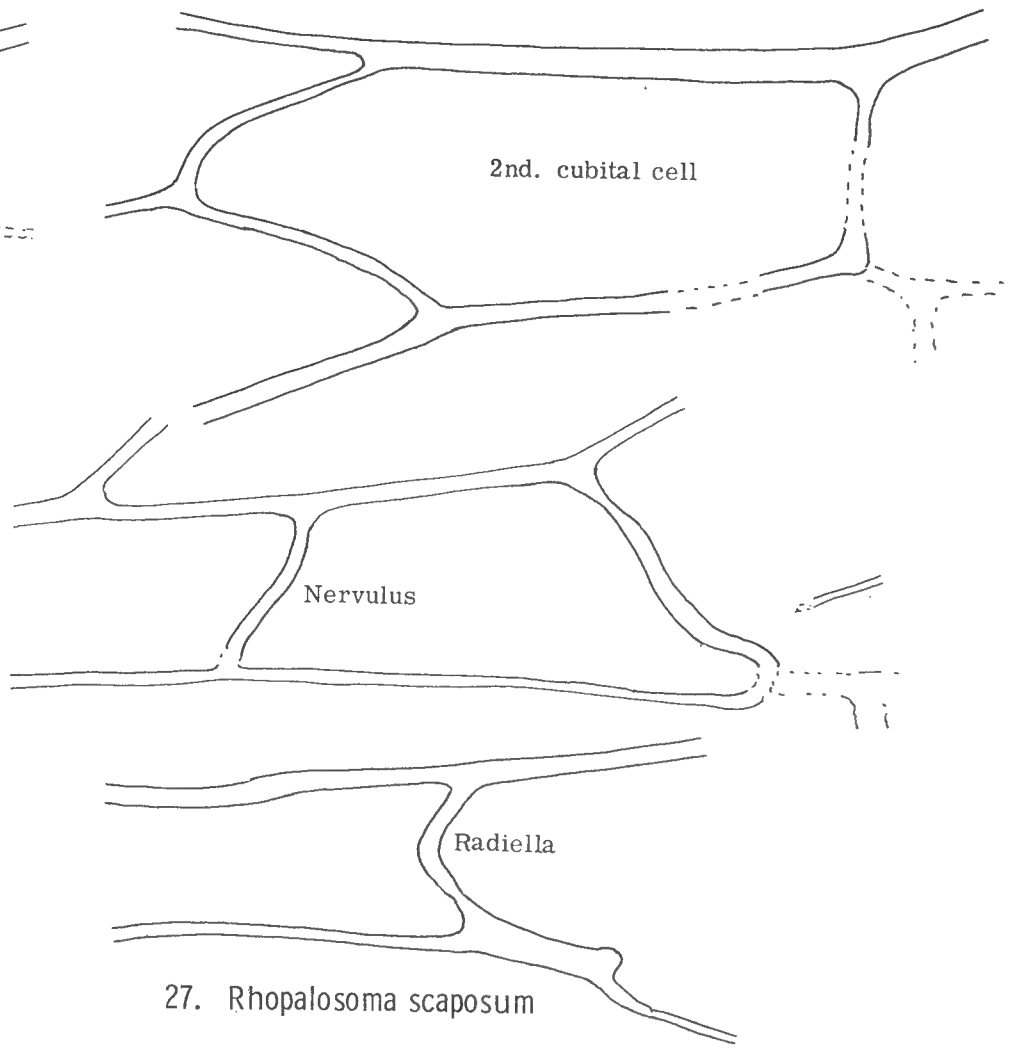
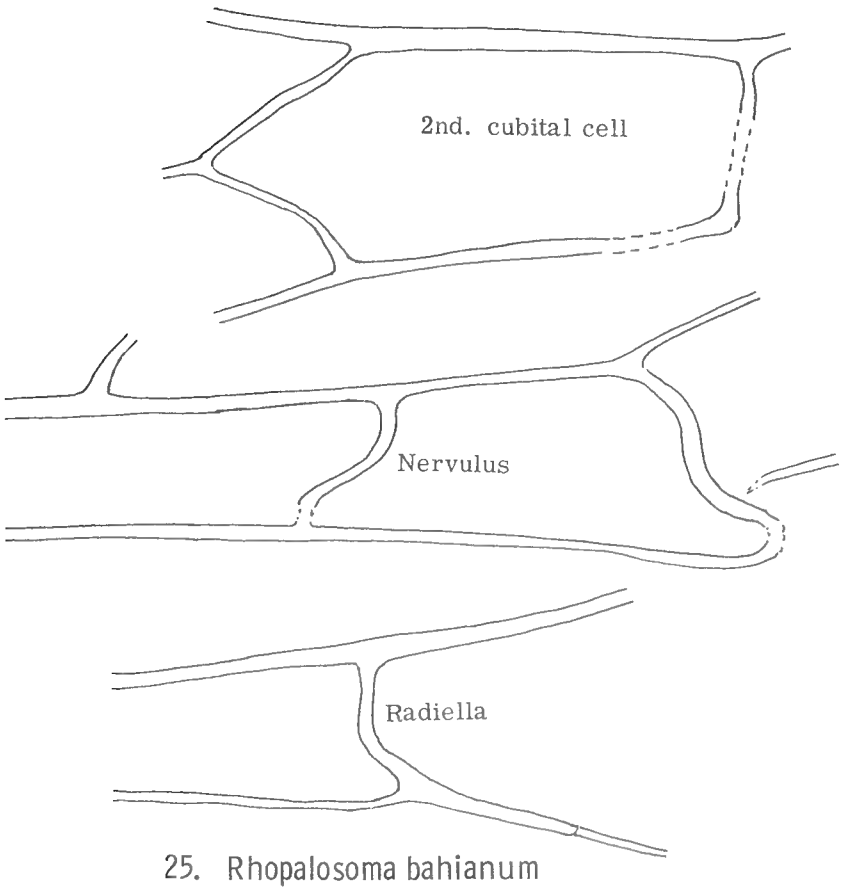


24. Rhopalosoma poeyi

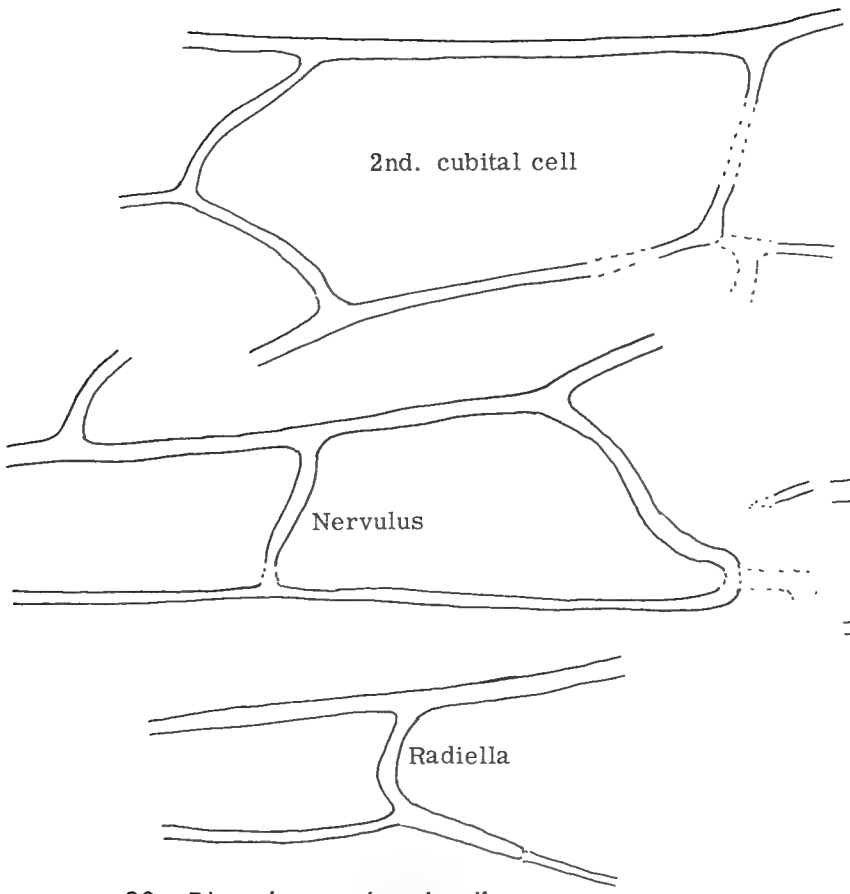


27. Rhopalosoma scaposum

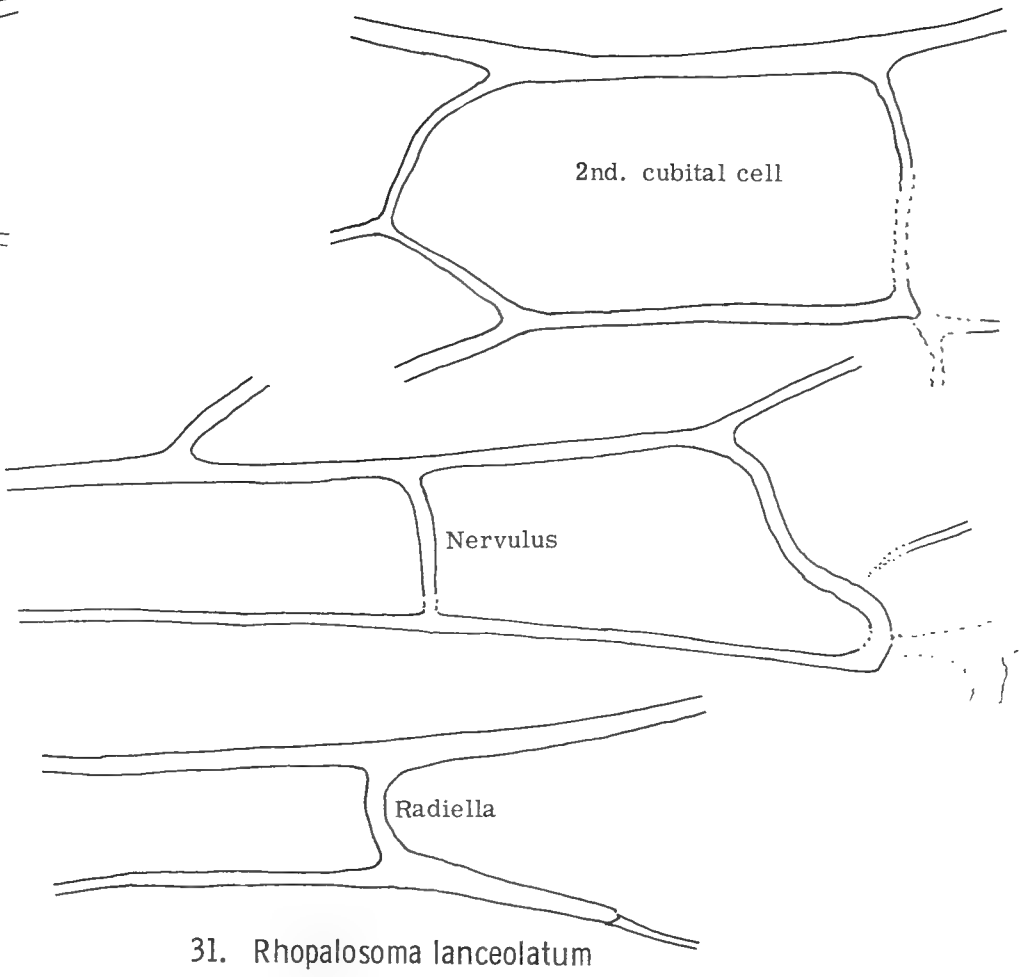


25. Rhopalosoma bahianum

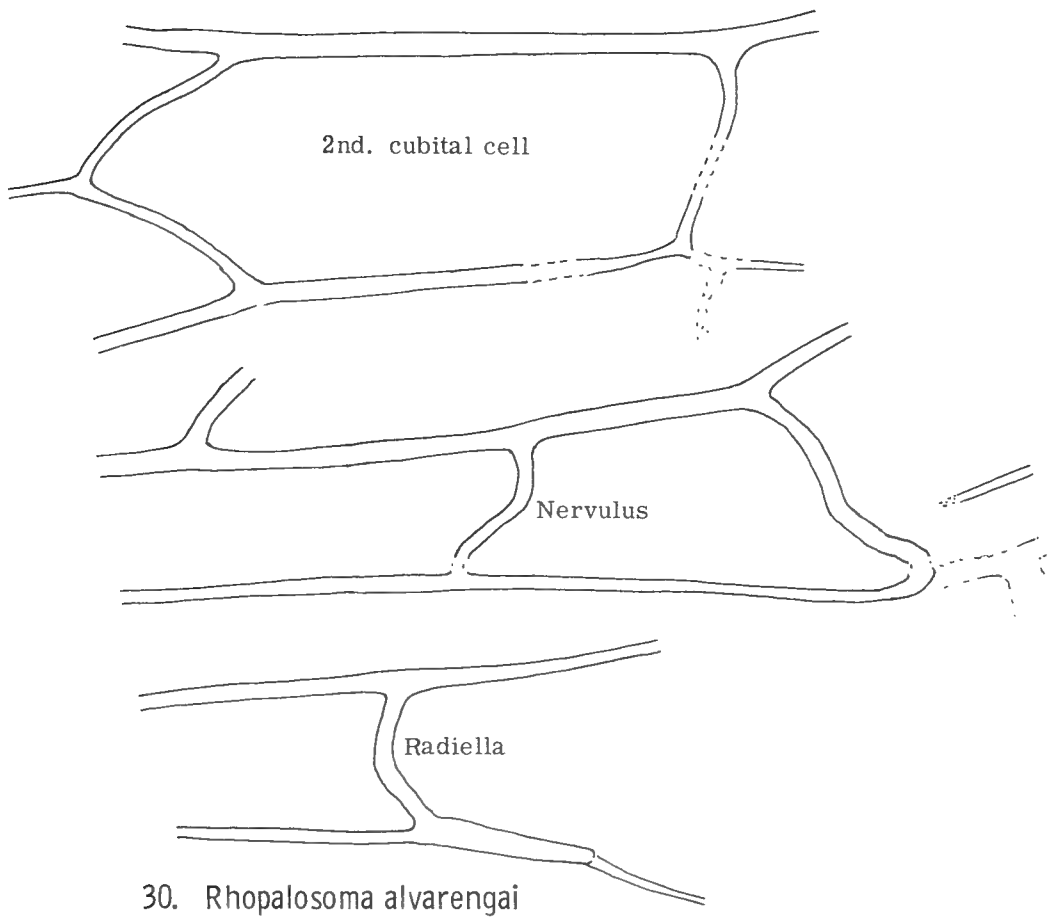
28. Rhopalosoma guianense



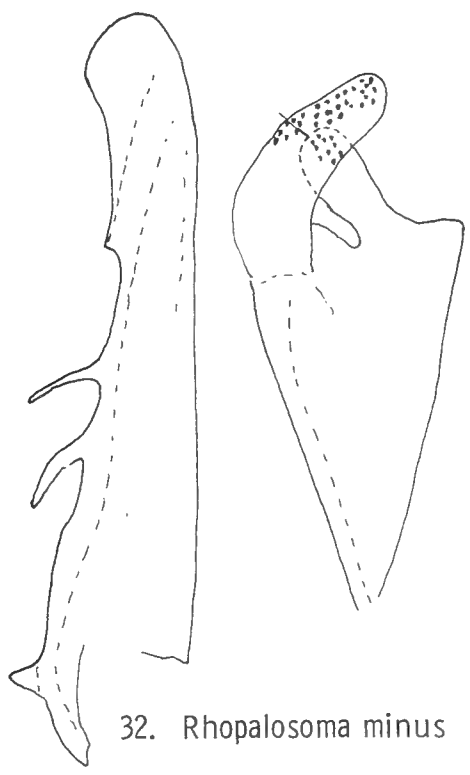
29. Rhopalosoma breelandi



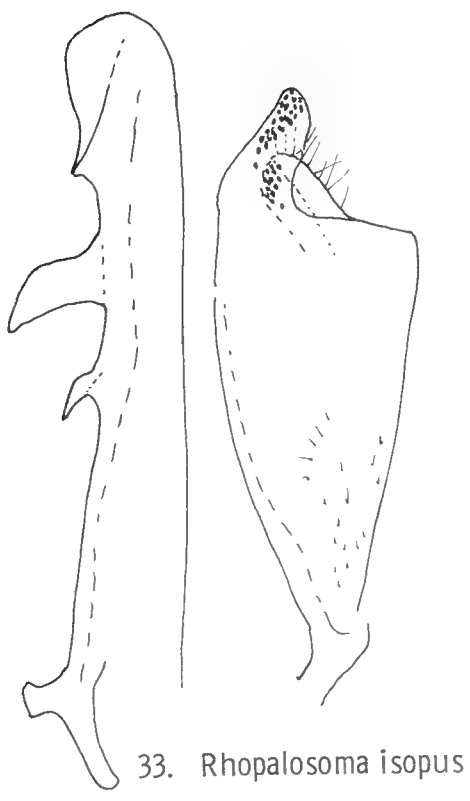
31. Rhopalosoma lanceolatum



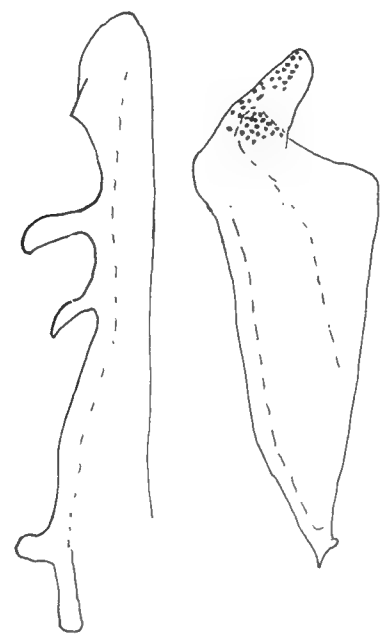
30. Rhopalosoma alvarengai



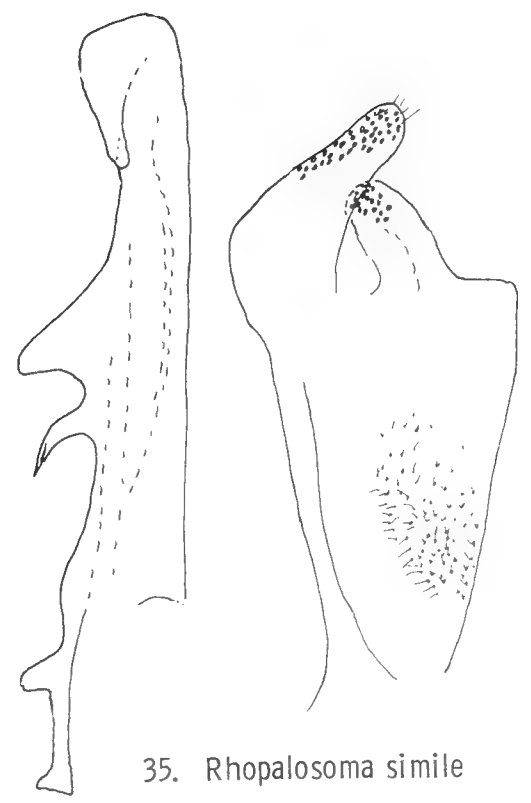
32. Rhopalosoma minus



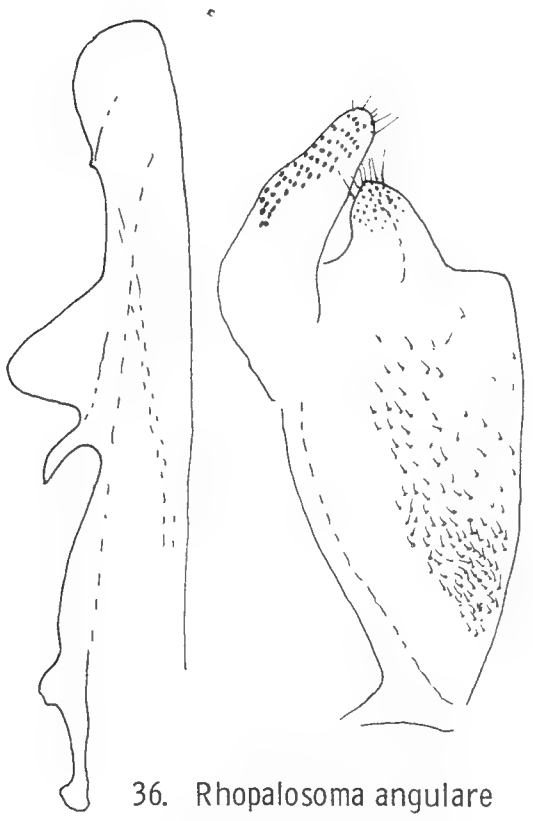
33. Rhopalosoma isopus



34. Rhopalosoma impar



35. Rhopalosoma simile



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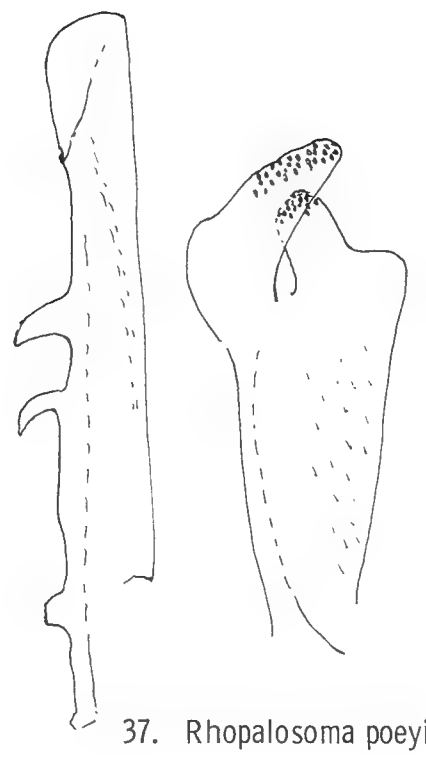
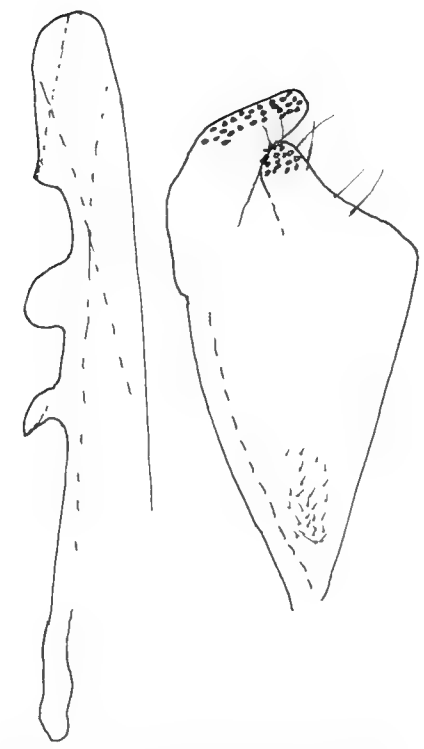
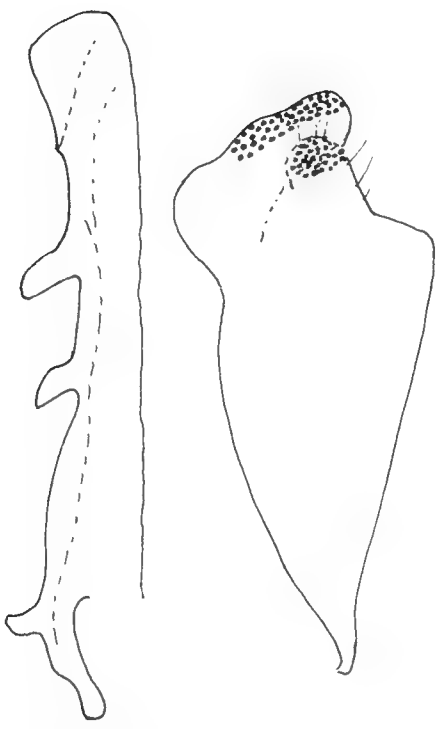


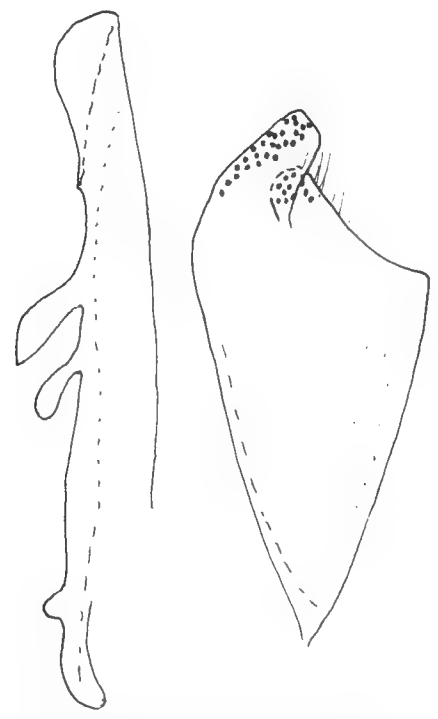
37. Rhopalosoma poeyi



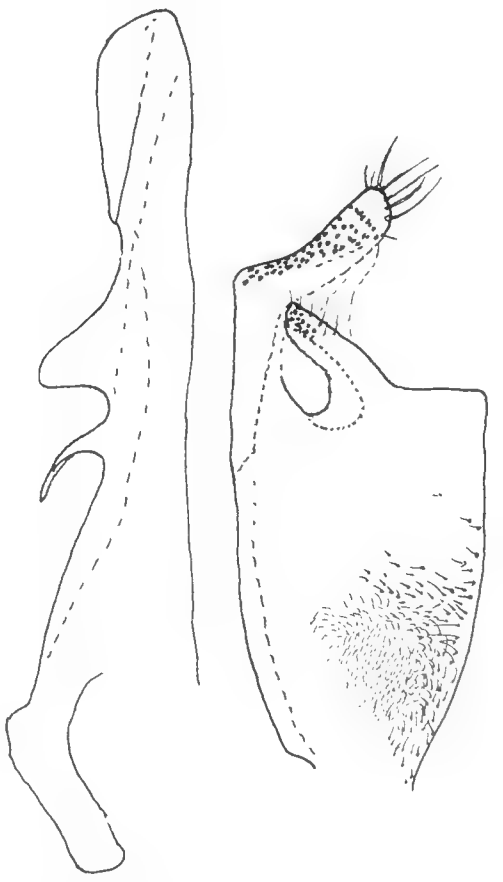
38. Rhopalosoma bahianum



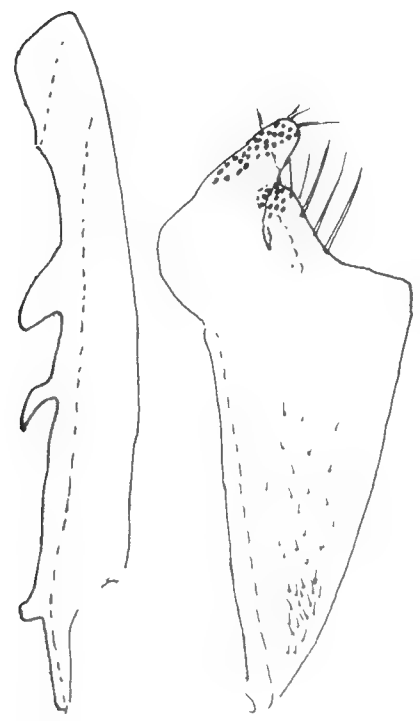
39. Rhopalosoma obliquum



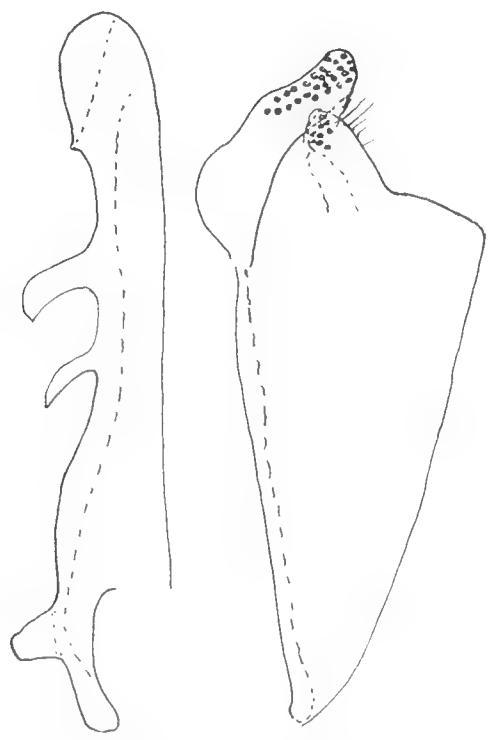
40. Rhopalosoma scaposum



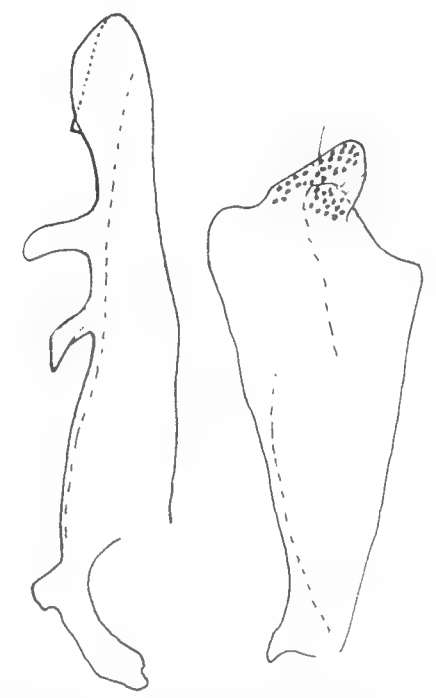
41. Rhopalosoma guianense



42. Rhopalosoma breelandi



43. Rhopalosoma alvarengai



44. Rhopalosoma lanceolatum

INDEX TO RHOPALOSOMATIDAE

*An asterisk indicates a synonym, misspelling, or misidentification.

Contributions
of the
American Entomological Institute

Volume 15, Number 2, 1977

A REVISION OF THE HELORIDAE (HYMENOPTERA)

by
Henry Townes

American Entomological Institute
5950 Warren Road, Ann Arbor, Michigan

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A REVISION OF THE HELORIDAE (HYMENOPTERA)

By Henry Townes

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5950 Warren Rd., Ann Arbor, Michigan, U. S. A.

The only living genus of the Heloridae is Helorus. The genera Ropronia, Vanhornia, Tetraconus, Monomachus, and Austronia were placed in the Heloridae by Riek (1955. Australian Jour. Zool. 3: 258-259). These have venations somewhat similar to that of Helorus but have conspicuous differences in body structure. The resemblances in venation are due to their having unspecialized venation of the serphoid type rather than to a close phyletic relationship with Helorus or between themselves. I exclude them from the Heloridae. The genera Ropronia, Monomachus, and Austronia may be considered the only living representatives of the families Roproniidae, Monomachidae, and Austroniidae, at least till there is clearer evidence as to their individual relationships. Vanhornia is believed to be an aberrant and primitive member of the Serphidae. Judging from the original description, Tetraconus is a synonym of Monomachus.

All species of Helorus are parasites of Chrysopidae. Oviposition is into a chrysopid larva. The host larva is killed after it has spun a cocoon. Helorus pupates within the chrysopid cocoon and the adult cuts a circular hole in the cocoon for emergence. Clancy (1946. Univ. California Pub. Ent. 7: 407-418) gives details of the life history of Helorus anomalipes (under the name H. paradoxus).

This revision was substantially assisted by a revision of the European Helorus by Pschorn-Walcher (1955. Mitt. Schweizerischen Ent. Gesell. 38: 233-250). Pschorn-Walcher's paper contains discussions of the types, variability, distribution, hosts, and some of the previous confusions in the determinations of European species. These discussions will not be repeated here. I have differed from Pschorn-Walcher's revision in treating corruscus as a synonym of ruficornis, rugosus as a synonym of nigripes, and meridionalis as a synonym of striolatus.

The following collections were studied:

British Museum (Natural History), London, England.
Curator: Mr. N. Fergussen.
Canadian National Collection, Ottawa, Ontario, Canada.
Curator: Dr. Lubomir Masner.
Instituto Miguel Lillo, Tucumán, Argentina. Curator: Dr. Abram Willink.
Michigan State University, East Lansing, Michigan.
Curator: Prof. Roland Fischer.
National Museum of Natural History, Washington, D. C.
Curator: Mr. C. F. W. Muesebeck
Townes Collection, Ann Arbor, Michigan.
Curators: Henry and Marjorie Townes

I wish to thank the curators who loaned specimens, and especially to thank my brother, George Townes, who collected a substantial amount of material. My wife has given assistance in a number of ways. Dr. D. W. Clancy generously gave permission to reproduce his figure of Helorus anomalipes.

Genus Helorus

Helorus Latreille, 1802. Histoire naturelle . . . des Crustaces et des insectes 3: 309. Type: (Helorus ater Latreille) = anomalipes Panzer. Monobasic.

Copelus Provancher, 1881. Nat. Canad. 12: 206. Type: (Copelus paradoxus Provancher) = anomalipes Panzer. Monobasic.

The genus is best described by giving a figure, as below. The venation, body shape, and pectinate claws make it easy to recognize. The size varies from a front wing length of 2.5 mm. to a front wing length of 4.3 mm. The head and body are black in all species except in the Neotropic H. brèthesi, in which the thorax is partly red.

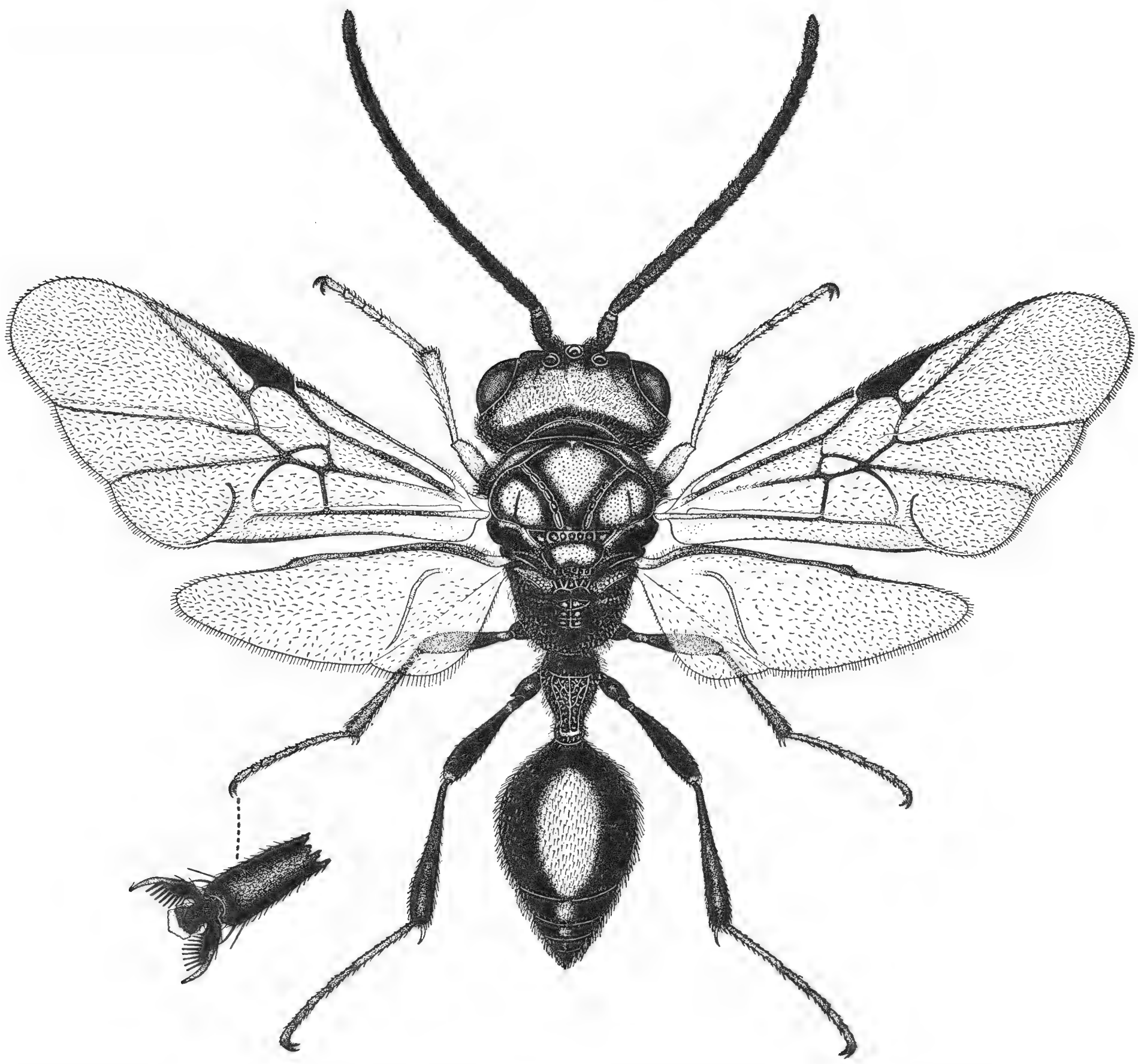


Figure 1. Helorus anomalipes ♀. Republished from Clancy, 1946.

Key to the species of Helorus

1. First abdominal segment 2.5 to 3.8 as long as wide. Face and mesocutum essentially smooth, their punctures so fine and shallow as to be inconspicuous. 2
First abdominal segment about 1.8 as long as wide (about 2.3 as long as wide in H. australiensis). Face and mesoscutum with punctures that are small but deep, or very coarsely rugoso-punctate. 5

2. Concave part of side of pronotum smooth or with a few weak wrinkles. Nervulus basad of basal vein by about 0.3 its length. Mesoscutum partly or entirely ferruginous. Neotropic Region.
1. brèthesi Ogloblin (p. 3)
Concave part of side of pronotum with strong horizontal wrinkles. Nervulus opposite basal vein, or distad, or basad of basal vein. Mesoscutum black. 3

3. Trochanters and middle femur blackish. Stigma about 3.1 as long as deep. Mesopleurum with a wide foveolate band behind prepectal carina. Base of tergite 1 with a relatively large oblique truncation. Palearctic Region. . . . . 4. striolatus Cameron (p. 6)
Trochanters and middle femur pale fulvous. Stigma about 2.2 as long as deep. Mesopleurum with a narrow foveolate band behind prepectal carina. Base of tergite 1 with a small obliquely truncate area. . . 4

4. Nervulus basad of basal vein by 0.5 its length. First tergite about 3.8 as long as wide. Kenya. . . . . 2. elgoni Risbec (p. 4)
Nervulus opposite basal vein or basad of it by up to 0.23 its length. First tergite about 3.0 as long as wide. Holarctic and Ethiopian regions.
3. ruficornis Foerster (p. 4)

5. Face, vertex, and median lobe of mesoscutum very coarsely rugoso-punctate. Europe. . . . . 7. nigripes Foerster (p. 9)
Face, vertex, and median lobe of mesoscutum with moderately small punctures. 6

6. Trochanters reddish brown. Front and middle femora reddish brown. Eastern Australia. . . . . 5. australiensis New (p. 7)
Trochanters black or blackish. Front and middle femora fuscous near base, apically fulvous. Holarctic Region.
6. anomalipes Panzer (p. 7)

1. Helorus brèthesi Ogloblin

Figure 2 (side view)

Helorus Brèthesi Ogloblin, 1928. Rev. Soc. Ent. Argentina 1928: 77. des., figs. Type: sex?, Loreto, Misiones, Argentina (La Plata). Type not seen. Description adequate for identification.

Front wing 2.6 to 3.0 mm. long. First flagellar segment about 5.7 as long as wide in male, about 6.0 as long as wide in female. Second flagellar segment about 3.5 as long as wide in male, about 4.7 as long as wide in fe-

male. Face and mesoscutum polished, with very fine faint punctures. Lateral part of pronotal collar rugose and rounded, surmounted by an irregular and incomplete longitudinal carina. (In all other species of Helorus the lateral part of pronotal collar is surmounted by a strong longitudinal carina.) Concave part of side of thorax smooth or with a few irregular wrinkles (in all other species of Helorus with strong, horizontal, parallel wrinkles). Mesopleurum with a single row of moderately small foveae behind prepectal carina. Scutellum smooth, polished, with sparse hairs that arise from almost invisible punctures. Stigma about 3.1 as long as deep. Nervulus basad of basal vein by about 0.3 its length. First tergite about 3.6 as long as wide, tapered to apex from widest point at basal 0.3, its baso-dorsal slope an almost vertical truncation and surrounded by a rim. Basal 0.3± and subapical 0.2± of surface of first tergite with longitudinal wrinkling and sparse shallow punctures, the rest of its surface almost smooth.

Black. Mouth parts yellowish white, the apical part of mandible dark. Antenna fulvous or stramineous at base, gradually darkening to dark brown at apex. Hind margin and hind corner of pronotum, usually upper part of pronotum, much or all of mesoscutum, and axillary areas ferruginous, sometimes the thorax more extensively ferruginous with only the under side and most of propodeum blackish. Tegula whitish. Legs stramineous or pale fulvous, the hind coxa and hind femur except its base and apex medium brown. Basal 0.25 of hind tibia whitish. Wings hyaline.

Specimens: ♂, Horco Molle (near Tucumán), Argentina, May 6 to 14, 1966, Lionel Stange (Townes). 2♀, Horco Molle (near Tucumán), Argentina, December 10 to 23, 1967, C. C. Porter (Cambridge). ♂, ♀, Horco Molle (near Tucumán), Argentina, May 15-21 and June 12-25, 1966, Lionel Stange (Tucumán). ♂, ♀, Tucumán, Argentina, December 1968 and December 1972, J. Foerster and F. M. Oliveira (Ottawa). ♂, Jatai, Goiás, Brazil, November 1972, F. M. Oliveira (Ottawa). ♀, Motozinha, 3,000 ft., Chiapas, Mexico, June 6, 1969, W. R. M. Mason (Ottawa). ♀, Yerba Buena, 6,500 ft., 20 miles north of Bochil, Chiapas, Mexico, June 9 to 24, 1969 (Ottawa).

This species ranges from southern Mexico to northern Argentina.

2. Helorus elgoni Risbec

Helorus elgoni Risbec, 1950. Trav. Lab. d'Ent. Sect. Soudanais Rech. Agron. 2: 514. ♀. des., fig. Type: ♀, Kenya: Elgon Sawmill on Mt. Elgon (Paris). Type studied in 1975.

Similar to H. ruficornis, from which it differs in having nervulus basad of basal vein by 0.5 its length; first tergite about 25% longer than in ruficornis; flagellum a little longer than in ruficornis; and front and middle tarsus entirely fulvous.

Specimen: Known only from the type, a ♀ from Mt. Elgon in Kenya.

3. Helorus ruficornis Foerster

Figure 3 (side view)

Helorus ruficornis Foerster, 1856. Hymenopterologische Studien, p. 143. ♀. key, des. Type: ♀, Germany: Aachen (Vienna). Type studied in 1975.

Helorus coruscus Haliday, 1857. Nat. Hist. Review 4 (proc.): 168. ♂. des. Types: ♂, England and Germany: Westphalia (Dublin). Study of types reported by Pschorn-Walcher, 1955. New synonym.

Helorus flavipes Kieffer, 1907. In André: Species des hyménoptères d'Europe et d'Algérie . . . 10: 267. ♂. Lectotype: ♂ (labeled by Townes, 1975 and hereby designated), France: Chanville (Paris). Lectotype studied in 1975.

Front wing 2.8 to 3.7 mm. long. First flagellar segment about 2.8 as long as wide in male, about 4.2 as long as wide in female. Second flagellar segment about 2.7 as long as wide male, about 3.8 as long as wide in female. Face and mesoscutum polished, with very small punctures that are separated by about 2.5 their diameter on face, by about 3.5 their diameter on mesocutum. Mesopleurum polished, smooth, its punctures very small, behind the prepectal carina with a narrow band of foveae, the band one fovea wide. Scutellum polished, smooth, its punctures very small, and moderately sparse. Stigma about 2.2 as long as deep. Nervulus opposite basal vein or basad by as much as 0.23 its length. First tergite about 3.0 as long as wide, its baso-dorsal truncation small, about 50^{o} from the vertical, not bordered by a ridge, the surface of tergite coarsely punctato-rugose with a longitudinal bias, or with strong irregularly longitudinal wrinkling. Punctures on female pygidium small, deep, separated from each other by about 0.7 their diameter.

Black. Mouth parts whitish, the mandibular teeth dark brown. Antenna light brown to dark brown, rarely fuscous. Tegula pale fulvous. Front and middle coxae brown, paler apically. Front and middle legs beyond coxae fulvous. Hind coxa blackish. Hind trochanters fulvous. Hind femur brown, paler basally. Fifth segment of front and middle tarsi brown. Hind tibia and tarsus light brown. Wings hyaline.

Palearctic specimens: 6♂, 3♀, Skåne, Sweden, June and July, 1969, Bo Svenson (Townes). ♂, Dorking, Surrey, England, July 11, 1964, H. and M. Townes (Townes). 2♂, New Forest, England, July 12, 1964, H. and M. Townes (Townes). 6♂, 4♀, Leicester, England, June, July, and August, 1972 and 1973, Jennifer Owen (Townes). ♀, reared from Chrysopa prasina, Röserntal, Bale-Liestal, Switzerland, June 13, 1935, W. Elgin (London). ♀, Seegraeben, Switzerland, June 7, 1951, V. Delucchi (Ottawa). ♂, ♀, Pizzighettone, Italy, June 11, and May 31 to June 7, 1973, Franco Frilli (Townes). ♀, near Linz, Austria, July 6, 1947, H. Priesner (Washington). ♀, Igls, 900 m., Tirol, Austria, Aug. 31, 1953, J. R. Vockeroth (Ottawa). ♀, Rawalpindi, Pakistan, June 16, 1958, Murree (Washington). ♀, reared from chrysopid on Abies pindrow, Pakistan, June 6, 1959, Murree, (London). ♂, Pulchauki, 6,800 ft., Katmandu, Nepal, July 21, 1967 (Ottawa).

Ethiopian specimens: ♂, Grahamstown, South Africa, Dec. 1971, Fred Gess (Townes). ♀, Kloof, 1,500 ft., Natal, South Africa, Sept. 1926, R. E. Twiner (London).

Nearctic specimens: 13♀, Dryden, Me., Aug. 4, 6, 7, and 8, 1971, H. and M. Townes (Townes). ♀, Pinkham Notch, N. H., Aug. 23, 1951, H., M., and D. Townes (Townes). ♀, Mt. Washington, 5,100 ft., N. H., Aug. 25, 1951, H. and D. Townes (Townes). ♂, ♀, Aylmer West, Ont., July 20 to 24 and Aug 8 to 14, 1972 (Ottawa). ♀, Point Pelee, Ont., Oct. 22, 1968 (Ottawa). 13♂, 3♀, Cleveland, S. C., May 23, June 1, 7, 13, and 25, and July 4, 5, 7, 15, and 19, all in 1971, G. Townes family (Townes).

Pschorn-Walcher records specimens from Finland, Sweden, Ireland, Czechoslovakia, Austria, Switzerland, and Tirol. He records Chrysopa

ventralis and Chrysopa prasina as hosts.

This species is widespread in Eurasia, eastern part of South Africa, and eastern North America. In North America it is a recent introduction, as the earliest collection there was in 1951. Probably its occurrence in Africa is also due to introduction.

4. Helorus striolatus Cameron

Figure 4 (side view)

Helorus striolatus Cameron, 1906. Jour. Bombay Nat. Hist. Soc. 7: 98. ♂, des. Type: ♂ (lacking head), Pakistan: [Quetta] in Baluchistan (London). Type studied in 1975.

Helorus meridionalis Pschorn-Walcher, 1955. Mitt. Schweizerischen Ent. Gesell. 28: 247. ♂, ♀. key, des., figs. Type: ♀ (reared from Chrysopa flavifrons), Italy: near Bologna (Geneva?; not in Vienna in 1975). Type not seen but description adequate. New synonym.

Front wing 2.6 to 3.4 mm. long. First flagellar segment about 2.9 as long as wide in male, about 3.4 as long as wide in female. Second flagellar segment about 2.8 as long as wide in male, about 3.2 as long as wide in female. Face and mesoscutum polished, with very small punctures that are separated by about 2.5 their diameter on face, by about 3.5 their diameter on mesoscutum. Mesopleurum polished, with moderately small punctures on its lower 0.3, the rest impunctate and variously smooth or weakly wrinkled, behind the prepectal carina with a wide, mostly single row of strong foveae. Scutellum polished, smooth except for moderately sparse very small punctures. Stigma about 3.1 as long as deep. Nervulus opposite basal vein or basad by as much as the width of nervulus. First tergite about 3.0 as long as wide, its baso-dorsal truncation of moderate size, about 40^{o} from the vertical, and bordered by a rim, the surface of tergite with strong wrinkles that have a longitudinal bias, its setiferous punctures very small and hardly visible. Punctures on female pygidium moderately small, deep, separated by about 0.7 their diameter.

Black. Mouth parts whitish to medium brown. Tegula, apical 0.65± of front femur, apical 0.1± of middle and hind femora, and front and middle tibiae and tarsi light brownish fulvous. Hind tibia and tarsus brown. Wings subhyaline.

Specimens: ♂, Helsinki, Finland, Aug. 7, 1962, O. Ranin (Townes). ♂, ♀, Helsinki, Finland, Aug. 14, 1968, H. and M. Townes (Townes). 4♂, Eberswalde, East Germany, July 5 and 6, 1964, H. K. Townes (Townes). ♀, "Kopl. Aschachtal", Austria, Aug. 29, 1962, H. Priesner (Washington). ♀, Marchtrenk, Austria, July 15, 1938, H. Priesner (Washington). ♀, Naturno, Trentino, Italy, July 18, 1958, David Townes (Ottawa). 3♂, 2♀, reared from Chrysopa, in forest, "Sh. Neumark", Israel (Washington).

Pschorn-Walcher records this from Italy, Hungary, and Finland, and as having been reared from Chrysopa flavifrons and Chrysopa septempunctata. Kozlov has recorded it from Mongolia (1972. Insects of Mongolia 1: 646).

This species is widely distributed in Eurasia.

5. Helorus australiensis New

Helorus australiensis New, 1975. Jour. Australian Ent. Soc. 14: 15. ♂, ♀. des., figs. Type: ♀, reared from Chrysopa cocoon, Australia: Bundoora in Victoria (Canberra). Australia: Murphy's Creek near Helidon in southwestern Queensland. Hosts: Chrysopa ramburi, Chrysopa near dispar, and Chrysopa near signata. Types not seen.

Front wing 2.5 to 2.7 mm. long. First flagellar segment of female about 3.2 as long as wide. Second flagellar segment of female about 3.4 as long as wide. Face with dense white pubescence. Mesoscutum with fine punctures and hairs that are less dense than on face. Scutellum mostly smooth. Stigma about 3.2 as long as deep. Nervulus opposite basal vein. First tergite slightly furrowed longitudinally, about 2.3 as long as wide.

Black. Scape and pedicel reddish. Flagellar segments 1-3 usually reddish, sometimes darker. Mandible reddish toward apex. Tegula reddish. Coxae mostly black, the rest of legs reddish brown but hind femur sometimes darkened.

This species has not been seen. It is placed in the key and redescribed from data in the original description.

Specimens: Known only from the types (7♂, 11♀) from eastern Australia.

6. Helorus anomalipes Panzer

Figures 5 and 6 (side view)

Sphex anomalipes Panzer, 1798. Faunae insectorum germaniae . . . heft 52, plate 23. Type: ♀?, Germany (lost). Description and figure sufficient for identification.

Helorus ater Latreille, 1802. Histoire naturelle . . . des crustacés et des insectes. 3: 309. sex? Type: France? (lost). Description by mention of name under the new genus Helorus, but without distinguishing specific characters. First revisor was Latreille, 1809, who synonymized his ater with anomalipes.

Copelus paradoxus Provancher, 1881. Nat. Canad. 12: 207. ♀. des., fig. Lectotype: ♀ (designated by Gahan and Rohwer, 1916), Quebec: Cap Rouge (Sainte Foy). Lectotype and paratype studied in 1975. New synonym.

?Helorus anomalipes var. bifoveolata Gregor, 1938. Časopis Česk. Spol. Ent. 34: 15. ♂. des. Type: ♂, Czechoslovakia: Nový Jičín (Prague?). Type not seen.

?Helorus coruscus nigrotibia Hellén, 1941. Notulae Ent. 21: 30. Types: Finland: localities and sexes not specified (location of types unknown). Types not seen.

Front wing 3.1 to 3.8 mm. long. First flagellar segment about 2.9 as long as wide in male, about 3.9 as long as wide in female. Second flagellar segment about 2.4 as long as wide in male, about 2.8 as long as wide in female. Face and mesoscutum polished, with medium sized or small deep punctures that are separated by about 0.7 their diameter on face, by about 1.5 to 2.5 their diameter on mesoscutum. Mesopleurum with moderate sized punctures that usually are crowded, with some rugosity, smoother in specular area.

Behind the prepectal carina a band of coarse foveae, the band about 2 foveae wide. Scutellum foveolate or rugose near apical margin, or with more extensive rugosity that covers its hind half or more, sometimes the rugosity rudimentary and the scutellum almost smooth. Non-rugose part of scutellum with moderately sparse small weak punctures. Stigma about 3.6 as long as deep. Nervulus opposite basal vein or basad or distad by as much as 1.5 the width of nervulus. First tergite about 1.8 as long as wide, its baso-dorsal truncation large, about 45^{o} from the vertical, bordered by a strong rim. First tergite in dorsal view tapered to apex from a little behind its basal truncation, its surface with a strong rugose reticulation and with strong longitudinal wrinkles or carinae and not distinctly punctate, or in some European specimens its surface smoother and distinctly punctate. Punctures on female pygidium deep, moderately small to medium sized.

There is much variation in the sculpture of the first abdominal segment, sculpture of the scutellum, size of the punctures on lower part of mesopleurum, and size of punctures on the pygidium. Figure 5 shows a specimen with normal scupture; figure 6 shows one with the first tergite unusually smooth. Specimens similar to figure 6 are frequently found in Europe but never in North America.

Black. Mandible, tegula, and tibiae fulvous brown. Front and middle femora fuscous or black basally, fulvous brown apically, the front femur less extensively fuscous than middle femur, sometimes the front femur entirely fulvous brown. Tarsi brown.

Specimens from Europe: 25♂, 30♀ from Austria (Winden and near Linz); Czechoslovakia (Černovice); England (Aldeburgh in Suffolk, Cambridge, Dartmoor, Faversham in Kent, Horsell Common in Surrey, Mill Hill, Nottingham, Tunbridge Wells, and Windsor Forest); France (Landes on Cap Breton); East Germany (Beekow); Germany (Eisen and Mainz); Hungary; Spain (Grenada); Sweden (Degaberga in Skåne and Löderup); and Turkey (Ankara).

Specimens from North America: 85♂, 100♀ from Alberta (Jumping Pound 20 miles west of Calgary, Lancaster Park, Lethbridge, and Rockyford); British Columbia (Agassiz, Atlin, Garibaldi Park at 3,400 to 4,800 ft., Hudson Hope, Robson, Salmon Arm, and Terrace); California (Topaz Lake); Colorado (Boulder, Estes Park, and Morley); District of Columbia (Washington); Georgia (Ringgold); Iowa (Sioux City); Kansas (Lawrence); Kentucky (Golden Pond); Louisiana (Tallulah); Maryland (Laurel, Takoma Park, and Plummers Is.); Massachusetts (Arlington, North Saugus, and Holliston); Michigan (Ann Arbor, Antrim Co., Bay City, Benzie Co., Crystal Falls, East Lansing, Galien, Glen Haven, Grand Traverse, Gull Lake Biological Station in Kalamazoo Co., Hart, Hickory Corners, Iron River, Ontonagan Co., Roscommon Co., St. Charles, and Wexford Co.); Manitoba (Brandon and Riding Mt. National Park near Norgate); Minnesota (Cloquet and Eaglenest); Missouri (Webster Groves); Nebraska (Halsey); Nevada (Wine Cup Ranch in Elko Co.); New Brunswick (Fredericton and Nerepis); New York (Bemus Point, Farmingdale, Northwest, and Riverhead); North Carolina (Hickory); North Dakota (McHenry Co.); Ontario (Bancroft, Belleville, Chatterton, North Bay, Ottawa, St. Davids, Simcoe, and Toronto); Pennsylvania (North East and Inglenook); Prince Edward Island (Atherton); Quebec (Aylmer, Cross Point on the Gaspé Peninsula, Forestville, Hemmingford, and Hull); Rhode Island (Westerly); Saskatchewan (Dunblane, Minton, and Saskatoon); South Carolina (Greenville); Virginia (Charlottesville and Winchester); Washington (Yakima); Wisconsin (Lake Madeline); Wyoming (6 miles northwest of Newcastle); and Yukon Territory (mile 2 on the Dawson Road and Whitehorse). Collection dates are from early summer to mid fall,

with the majority in July and August. There are two reared specimens, one from Chrysopa sp. and one from "Chrysopa sp. (probably rufilabris)".

There is a good account of the biology of this species by Clancy (1946. Univ. California Pub. Ent. 7: 407-418), who reared it from Chrysopa majuscula. Koslov has recorded the species from Mongolia (1972. Insects of Mongolia 1: 645).

This species is widespread in Europe and in North America. It occurs over the entire extent of the United States and southern Canada but is rare or absent in arid habitats. It is uncertain whether it is native to both Europe and North America or was introduced from one to the other.

7. Helorus nigripes Foerster

Figure 7 (side view)

Helorus nigripes Foerster, 1856. Hymenopterologische Studien, p. 143. ♂. key, des. Type: ♂, Germany: Aachen (lost, not found in Vienna in 1975). Foerster's statement "Mesonotum ganz grob runzlig" makes the specific identity clear.

Helorus rugosus Thomson, 1858. Öfvers. Svenska Vet.-Akad. Forh. 15: 380. ♀. des. Type: ♀, Sweden: Skane (lost, not found in Stockholm in 1975). Description sufficient for identification.

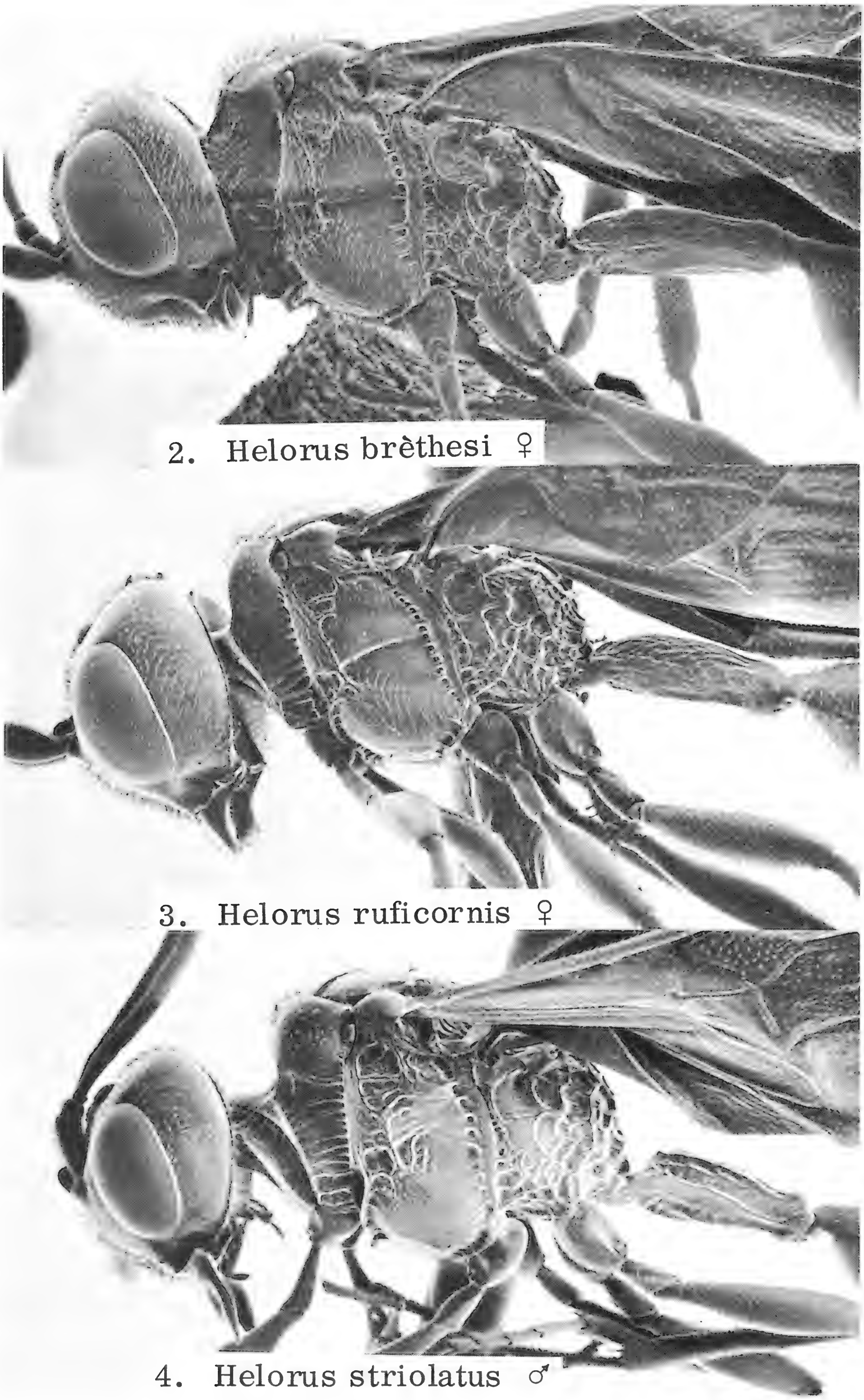
Front wing 3.7 to 4.3 mm. long. Face and mesoscutum with strong, very coarse punctato-rugosity, but the sublateral 0.2± of mesoscutum nearly smooth. First flagellar segment about 3.3 as long as wide in male, about 3.7 as long as wide in female. Second flagellar segment about 2.5 as long as wide in male, about 3.2 as long as wide in female. Mesopleurum very coarsely and strongly rugose except for a large specular area. Scutellum coarsely, strongly punctato-rugose. Stigma about 3.3 as long as deep. Nervulus opposite basal vein or basad of it by as much as 2.0 the width of nervulus, or sometimes a little distad of basal vein. First tergite about 1.85 as long as wide, its baso-dorsal truncation large, about 15° from the vertical and bordered by a projecting rim. General surface of tergite 2 strongly and coarsely reticulate-rugose, with a median dorsal carina or wrinkle and traces of other longitudinal wrinkles. Punctures on female pygidium small and deep, separated by about 0.6 their diameter.

Black. Mandible dark brown to blackish. Palpi brown. Flagellum black, brownish below. Tegula black. Legs black or blackish brown, the front leg with tibia, tarsus, and apical 0.3± of femur brown. Wings subhyaline to faintly infuscate.

Specimens: 6♂, 8♀ from Austria (Winden); England (Leicester); East Germany (Eberswalde); and France (Hyères).

Seven specimens from Hyères, France, were reared from Chrysopa cocoons.

Pschorn-Walcher (1955. Mitt. Schweizerischen Ent. Gesell. 28: 247) records 16 specimens of this species from Sweden, Austria, Czechoslovakia, and Hungary. One of these specimens was reared from Chrysopa nigricortala and one from Chrysopa sp.



2. Helorus brèthesi ♀

3. Helorus ruficornis ♀

4. Helorus striolatus ♂

5. Helorus anomalipes ♀

6. Helorus anomalipes var. ♂

7. Helorus nigripes ♀

INDEX TO HELORIDAE

* An asterisk indicates a synonym, misspelling, or misidentification.

Contributions
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A REVISION OF THE CENTRAL AND SOUTH AMERICAN *NOTOXUS* AND DESCRIPTION OF A NEW GENUS, *PLESIONOTOXUS* (Coleoptera: Anthicidae)

by
Donald S. Chandler

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INTRODUCTION

Notoxus is one of the last large anthicid genera of the New World which is badly in need of revision. The North American (the United States and Canada) species have been adequately collected and described, with only a few species remaining still unnamed. The species from Central America (Mexico through Panama) are less well known. Recent collecting in Mexico has revealed that the Central Plateau is the center of species diversity for the New World.

This revision of the Central and South American species includes some twenty-seven previously named species and twenty which are described as new. The relationships within the genus are primarily derived from a numerical analysis of all the New World species (a total of seventy-two species). Most of the South American species which had been placed in *Notoxus* have been removed to *Mecynotarsus* (Chandler 1977) or are placed in a new genus, *Plesionotoxus* (p. 8).

Acknowledgments

Many individuals deserve my deepest thanks for their help in this study. The following list indicates those curators of collections and private collectors who cooperated with the loan of specimens. Most of the abbreviations of the collections are from Arnett & Samuelson (1969). The abbreviations are used to indicate the present location of types or of the specimens studied for the revision.

Public collections:

AMNH: American Museum of Natural History; Lee H. Herman, Jr.
BMNH: British Museum (Natural History); C. M. F. von Hayek.
CASC: California Academy of Sciences; H. B. Leech, P. H. Arnaud, Jr., D. H. Kavanaugh.
CDAE: California Department of Agriculture; F. G. Andrews.
CISC: University of California, Berkeley; J. T. Doyen.
CNCI: Canadian National Collection; E. C. Becker.
CUIC: Cornell University; L. L. Pechuman.
FMNH: Field Museum of Natural History; H. S. Dybas.
LACM: Los Angeles County Museum of Natural History; J. P. Donahue.
MCZC: Museum of Comparative Zoology; J. F. Lawrence, J. C. Scott.
MNHN: Museum National d'Histoire Naturelle, Paris.
MSUC: Michigan State University, R. L. Fischer.
OSUC: Ohio State University; C. A. Triplehorn.

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[2]This paper is a portion of the dissertation submitted to the Ohio State University in partial fulfillment of the requirements of the Doctor of Philosophy Degree at that institution.

TAMU: Texas A & M University; H. R. Burke, S. J. Merritt.
TTCC: Texas Tech University; D. E. Foster.
UCDC: University of California, Davis; R. O. Schuster.
UMMC: University of Michigan; R. D. Alexander.
USNM: United States National Museum; T. J. Spilman.
Private collections:
DSC: Donald S. Chandler, Safford, Arizona.
FGW: Floyd G. Werner, Tucson, Arizona.
HAHC: Henry Howden, Ottawa, Ontario, Canada.
KSC: Karl Stephan, Tucson, Arizona (now placed in the Florida Department of Agriculture, Gainesville, Florida).
MGF: Gerhard Frey, Tutzing bei Munchen, West Germany.

C. M. F. von Hayek of the British Museum (Natural History) helped greatly by lending several of the Champion types. J. C. van Hille of Rhodes University, Republic of South Africa, graciously sent specimens of *Pseudonotoxus* Pic for comparison with *Plesionotoxus*. A portion of a trip to Mexico was funded by a Sigma Xi Grant-in-Aid in 1974. Dr. Alejandro Ortega of C.I.M.M.Y.T., Texcoco, Mexico, graciously arranged an insect collecting permit for the summer of 1975 in Mexico. Dr. D. E. Johnston deserves my thanks for his guidance of the numerical analysis, Drs. D. J. Horn and D. J. Borror for reading this paper and offering numerous suggestions, and Dr. C. A. Triplehorn for his help and encouragement in the preparation of this paper. Dr. F. G. Werner, University of Arizona, offered suggestions on the general organization and the key to species. Lastly, I would like to thank my wife, Christine A. Janus-Chandler, for her help and encouragement in the preparation of this paper.

TAXONOMIC HISTORY

Fabricius (1801) described *Notoxus monodon* from "Virginia" for the first record of the genus from the New World. Say (1817), LeConte (1824, 1847) and Hentz (1827) added four more species from the eastern United States. LaFerté-Senectere (1848) treated the family for the world and described four new species from the United States, two from Mexico and two from South America.

In the period following LaFerté's work, many of the United States species were described (LeConte 1851, 1852, 1876; Horn 1884, 1892; Casey 1895). No new species have been added since the works of Fall (1902, 1916, 1932) and Blaisdell (1929, 1936). Recently Chandler and Hagen (1977) listed a number of new synonymies for North America.

In contrast the Central American fauna was largely ignored until near the end of the nineteenth century. Two species were described from the West Indies (Chevrolat 1877; Quedenfeldt 1886), and fourteen new species were added to the Central American fauna by Champion (1890) in his revision of the Anthicidae for the Biologia Centrali-Americana. The remainder of the neotropical species were added by Pic (1901a, 1901b, 1904, 1912, 1913, 1914a, 1914b, 1916, 1918) and Heberdey (1936).

Champion's work (1890) is still useful as he described the male characters of the species and had excellent illustrations. Pic's descriptions are almost completely useless since he seldom mentions any characters of use in separating species. Many of Pic's species have been removed to *Mecynotarsus* (Chandler 1977) or to *Plesionotoxus*, new genus. Of the four Pic names re-

tained in *Notoxus*, one is a senior synonym, two are junior synonyms, and the last is placed as *Incertae sedis*.

The last paper dealing with the Central American *Notoxus* was Pallister's (1955) identification of the Anthicidae collected on the Central Plateau of Mexico. This work is of some importance in that several species from the United States were recorded from Mexico for the first time.

BIOLOGY

Most of the available biological information on *Notoxus* is restricted to the types of habitat in which the adults have been collected. No life histories have been described for any of the species. The only larvae figured have been of *N. monoceros* (Boving & Craighead 1930), an unknown species of *Notoxus* (Peterson 1951) and of *N. monodon* (Cuthbert 1967). The larva described by Peterson was collected in soil from a peach orchard, while the *monodon* larvae (misidentified as *N. calcaratus* in Cuthbert) apparently will bore into the roots of sweetpotatoes. The larvae have a well-developed mola on the mandible and probably feed on plant material. The pupa of *monodon* is also figured in Cuthbert.

The adults are known to be associated with vegetation and flowers (Blatchley 1910). I have collected the majority of my specimens by beating vegetation or examining the ground beneath low vegetation. Other collection methods are based on the adults' attraction to white or ultra-violet light and to cantharidin or meloid beetles. Almost all of the New World species have fully developed wings, with both sexes of *obesulus* and females of other species in the *sparsus*-group being exceptions. The majority of the winged species have been attracted to white, arc or ultra-violet lights. One of the more recent methods of collecting *Notoxus* is based on their attraction to cantharidin, which is found in meloid beetles. Abdullah (1964) lists the Old World Anthicidae which have been attracted to cantharidin and dead meloids, while van Hille (1954) used cantharidin as a collecting bait. Chandler (1976) used both cantharidin and meloid beetles as baits and found that both were very effective in attracting various species of *Notoxus*. Only two species, *N. eximius* and *N. opacus*, were known to be near these baits and not attracted. Blaisdell (1936) mentions that he used "chemical" traps to collect several species of California *Notoxus*, but the chemical used was not indicated.

The adults are known to eat a wide variety of foods. Abdullah (1969) observed *N. monoceros* feeding on bread, sugar water, minced beef, freshly cut grasshoppers and a banana skin. Hinton (1945) notes that *N. monodon* was found on some apples sent from North America to Germany. Records in this revision indicate that *N. apicalis* is attracted to freshly harvested crops. Essig (1926) mentions that the "fruit *Notoxus*", *N. constrictus* (his figure of this species is actually *N. calcaratus*), was common in orchards feeding on damaged or drying fruit. Also mentioned is that *N. calcaratus* acts similarly and that *N. monodon* (= *desertus*) was collected boring into twigs of apple trees in California. This latter record is almost certainly incorrect as the beetles were probably just resting in these holes. In Colorado Gill (1913) noted that *N. monodon* (= *desertus*) would feed on the pupae of the fruittree leafroller, *Archips argyrospila* Walker. *Notoxus* often have been observed feeding on the dead insects which accumulate at lights. Loan (1972) mentions that *N. anchora* was common in and feeding on alfalfa in Ontario, although it apparently is not considered a pest.

There have been two instances where the biological control value of *N. calcaratus* has been examined. Butler (1966) in Arizona noted that this species would feed on the eggs of the cotton bollworm in the field. Orphanides *et al* (1971) found that *calcaratus* in California would feed on the eggs and first instar larvae of the pink bollworm in the laboratory. Both studies noted that although the adults did not eat many eggs or larvae, this species could be very common in the field and thus may have a noticable effect on a pest population.

The use of the pronotal horn apparently has not been previously recorded. Specimens of several species collected in New Mexico and Arizona were placed in a vial containing sand, water and food. As midday approached the beetles would become very active even though the vials had been placed in some shade. Many individuals were observed to move about until encountering a depression or crack in the sand. The head and pronotum were then worked alternately up and down as the beetles burrowed down into the depression forming a tunnel which could be more than an inch long. Species of the genus are often found in or near sandy areas. Another Notoxine genus, *Mecynotarsus*, is known to be associated with dunes, and individuals will quickly burrow into loose sand when disturbed using a similar motion of the head and pronotum.

There is one known case of parasitism of *Notoxus*. Loan (1972) noted that a braconid wasp, *Syrrhizus agilis* (Cresson), was an internal parasite of adults of *N. anchora*. The only mating behavior known was recorded by Abdullah (1969) for *N. monoceros*.

ZOOGEOGRAPHY

Notoxus is recorded from all the continents except Antarctica, with very few species being known from South America and Australia. The majority of the species are recorded from three general areas: the southeastern quarter of Africa, the eastern Mediterranean and central Mexico. These regions are generally semiarid and have an important grassland component with various interrupting mountain ranges. Species diversity is apparently highest at the grassland-forest interface.

Only one group, the *monoceros*-group in Eurasia, has received a recent thorough taxonomic treatment (Heberdey 1936). Recent faunal works have been by Bonadona (1974) for France, Kaszab (1969) for central Europe and van Hille for South Africa (1961). The relationships between the faunas of the different continents have been unexplored and there have been few attempts to define the genera.

The area under consideration in this study, Central and South America, includes all of the Neotropical faunal province and the portion of the Nearctic faunal province present in northern Mexico. The genus in the New World is predominantly Nearctic with all of the species-groups (see p. 7 and Figure 65 for discussion of species-groups) having most of their members in Mexico or the United States.

Two species-groups, the *monoceros*- and *sparsus*-groups, have the majority of their species in the western United States. Previously the *monoceros*-group was known only from the Palearctic region. Five Nearctic species are here placed in this group with four of the five species occurring in an area extending from northern California to Washington. Most of the species in this group have asymmetrical genitalia, which is a characteristic of the Nearctic species, with a few of the Palearctic species possessing symmetrical genitalia.

The *sparsus*-group is almost completely restricted to the western coastal

states. This group possesses symmetrical genitalia. Both groups have in common robust genitalia and lateral apical tubercles on the elytra of the male. The form of the symmetrical genitalia in both groups is similar. The distribution pattern of both groups, principally in the western and northern United States, is a pattern common to many groups introduced to the New World from Eurasia via the Bering Land Bridge. Taking into account the fact that the two groups are more difficult to separate in the Old World, it appears likely that both groups originated in Eurasia and were introduced across the Bering Land Bridge which was periodically present during the late Pliocene (Gressitt 1974). A re-examination of the Old World species in the *monoceros*-group is needed to firmly delineate the group characteristics.

The remaining species-groups appear to have originated in the region of central and southern Mexico. The greatest species diversity is found on the southern half of the central plateau where there is an intermixing of the mesquite-grassland and pine-oak forest zones (Leopold 1950). At least one member of all the species-groups (except the *montanus*-group and excluding the *sparsus*- and *monoceros*-groups) and most of the species which were not placed in groups are found in this area. Many of the species-groups exhibit a simple pattern in which one species is found on the eastern half of the Central Plateau, another on the western half, and often a third species in the southwestern United States.

Rosen (1975) recently analyzed the patterns of animal distribution in the Caribbean region. *Notoxus* species-groups appear to fit the North American-Caribbean Track (distribution pattern) fairly well, even though Rosen had applied it only to lowland groups. Groups placed in this pattern have Mexico containing the greatest number of species and with a few species ranges extending into the southern United States, the most northern portion of South America, and the Antilles. The *monodon*-group, which is primarily found in the lowlands, exhibits this pattern perfectly with two species in the Greater Antilles, two reaching northern South America, three in the United States and four in Mexico.

Continental land bridges have been of variable importance in influencing the distribution of *Notoxus*. The Bering Land Bridge was probably the means of introduction of members of the *monoceros*- and *sparsus*-groups, while the land bridge between Central and South America apparently has been of little importance in *Notoxus* movement. Rosen (1975) believes that the Central America region was mainly occupied by various islands from the Mesozoic until the Pliocene when the first complete land bridge was formed. Two members of the *monodon*-group are isolated in the Greater Antilles, but, using Rosen's model of Caribbean continental drift, they probably were isolated on these islands when they drifted east from their alignment near the North American Plate. Since only three species are present in South America, with two of these being widespread through Central America, it appears that *Notoxus* could not traverse this island chain and was probably introduced in or after the Pliocene when the Panama Land Bridge was formed.

Climate has probably been the greatest influence in determining the distribution of *Notoxus*. Perhaps the most important change occurred in the middle and late Cenozoic when extensive mountain building began taking place along the axis of the present-day Sierra Madre Occidental. As a result of this mountain formation rain shadows were formed in central Mexico and the Madro-Tertiary Geoflora (Axelrod 1958) evolved rapidly. By the late Miocene this flora extended from the current southern apex of the Central Plateau to the northern edge of the Great Basin. This flora is typical of the semiarid condi-

tions which *Notoxus* favors.

Other climatic changes of lesser influence were the pluvials and interpluvials of the Pleistocene, and the following Xerothermic Interval of the Recent. All of these have undoubtedly influenced *Notoxus* distributions by providing suitable climates for dispersal between mountain ranges, and then following with drier periods which would then isolate populations in the different major mountain ranges. The major separations apparently are between the Sierra Madre Oriental, the area around the Mexican state of Puebla, the Sierra Madre Occidental, and the southern apex of the Rocky Mountains in New Mexico-Arizona.

A reconstruction of the past history of the New World species can be derived from these events and current distributions. *Notoxus* probably evolved from seashore species which moved inland and eventually became isolated from the other groups of the Notoxinae. The genus is characterized by having few seashore species. A portion of the genus was then isolated in the Mexico area following the breakup of the supercontinents in the late Mesozoic. With the rise of the Madro-Tertiary Geoflora, extensive areas of Mexico gradually became drier and the conditions which *Notoxus* species appear to favor became widespread. *Notoxus* populations expanded northward with the geoflora into the United States. These populations were then confined to the margins of the mountain ranges when the grassland-forest areas were reduced by the continued drying on the plateau. This led to some degree of isolation of populations between the major mountain ranges, and eventually to speciation. Possibly the ancestors from which the species-groups are derived were present at this time.

Many of the present species which are not placed in a group are found at the southern apex of the Central Plateau, as are members of every group except the *montanus* group. This area apparently is the most heterogeneous favorable habitat for *Notoxus*.

With the onset of the Pleistocene pluvials, species could disperse between mountain ranges and were then isolated in the following dry periods. With this fragmentation the present species-groups appeared as populations which were isolated during one of the dry periods following dispersal. This would explain the distribution of many of the species-groups which have a different species on each half of the plateau and one or more species isolated in the southwestern United States. With following moister periods several species in a few of the groups have expanded their ranges and are now sympatric in the Chihuahua-Durango area and the Mexico City region.

METHODS AND MATERIALS

Over 3,000 specimens of *Notoxus* from Central and South America were studied. The specimens were separated into species by comparison of their external appearance and genitalia. Names were assigned to these species following the examination of all the types of the species, except for the LaFerté, Chevrolat, and Pic types in the Museum National d'Histoire Naturelle, Paris. Fortunately, specimens compared to most of the LaFerté types were available from the F. G. Werner collection, and the description or locality of most of the Chevrolat and Pic types was sufficient to associate names with species.

Each previously described species is represented by a general statement on the variation and characters of the species and the measurements of a redescribed male. Types were not used to represent the species in the description since they were available for only short periods of time and were seldom

in the best of condition. The redescribed males were considered to be typical of the species and were generally collected near the middle of the species range. Males were used since they have more unique characters than females.

Comparisons were made using a Leitz Wetzlar stereo microscope at 64X. Male genitalia were prepared and examined following the procedure of Werner (1964). All genitalia were placed in genitalia capsules containing glycerine following study.

Measurements were taken using an ocular reticule and are entered in millimeters in the species descriptions. Drawings of the elytra and male fifth sternite were made using the ocular reticule at 64X. Drawings of the genitalia were made by sketching the general outlines as projected by a Ken-a-Vision slide projector and then filling in the fine details while observing the genitalia with the Leitz.

The distribution of each species is mapped only for Central America, unless it is a new species. In this case the distributions are continued into the United States as far as the map permits.

The classification used is based on a phenogram produced by a numerical analysis of the New World species (Fig. 65, Chandler 1976a). The limits of the species-groups were delineated through the patterns of groupings in the phenogram. Several species were not placed in a species-group as they either were not very similar to other species or the clusters produced contained a heterogeneous assemblage of species.

The similarity measure used was correlation and the phenogram was constructed using UPGMA. The numerical analysis was performed on the IBM 350 at the Ohio State University Computer and Research Center using the NT-SYS program package developed by F. J. Rohlf, J. Kishpaugh and D. Kirk.

NEW WORLD NOTOXINAE

The Notoxine anthicids are easily recognized by the protruding horn extending anteriorly over the head, and also by the lateral expansion of the mandibles. Three of the current Notoxinae genera (*Pseudonotoxus* Pic, *Hypaspistes* Waterhouse, and *Leptoprion* Krekich) are found only in the Old World. Both of the Notoxine genera known from the New World (*Mecynotarsus* LaFerté, and *Notoxus* Fabricius) are also found in the Old World. A new genus, *Plesionotoxus*, is proposed for a number of South American species which were formerly placed in *Notoxus*.

The following characterization of the genus *Notoxus* is based on all of the species available, which includes some twenty species from the Palearctic, Oriental and Ethiopian regions. The genus *Notoxus* is here defined as those Notoxinae with the following characters: erect tactile setae on the head outlining the horn when head is raised, mandibular explanation often with posterior margin, eyes with short aciculate setae between the facets, setae over body aciculate, not noticeably thickened or flattened; pronotum with distinct pit above the cervical notches, these pits densely setate, antebasal transverse impression distinct; lateral mesosternal margins straight or slightly curved outwardly; hind wings with 1A and 2A parallel, with cross vein at middle (Fig. 1); male genitalia with distinct phallobase, parameres large, either free or fused near base, penis or median lobe well developed (Fig. 2); the genitalia laterally flattened in general appearance.

Plesionotoxus is here defined as those Notoxinae with the following characters: erect tactile setae on the head outlining the horn when head is raised,

mandibular explanation with faint posterior margin, eyes without any setae between facets; pronotum with nude pit above the cervical notches, anteriorly directed setae near ventral margin of pronotum obscuring pits; horn with crest indistinct, lateral carinae from horn base to the cervix anterior to the pronotal pits, pronotum with antebasal transverse impression distinct; setae over body aciculate; lateral mesosternal margins straight to slightly curved inwardly; wing venation similar to *Notoxus*, with large sclerotized patch lateral to apex of Cu_1; male genitalia with phallobase and penis closely joined (Fig. 3, 4), partially fused, parameres distinct and joined to genitalia in apical third; genitalia flattened dorso-ventrally. This genus is easily separated from *Notoxus* by the anteriorly directed setae on the lateral margins of the pronotum and the carinae extending laterally from the horn base to the cervix.

The genus *Mecynotarsus* is very difficult to characterize on a world basis, or even for only the New World. There are several well-defined groups placed in the genus which are sufficiently distinct to be placed in new genera (Chandler 1977). This genus can be separated from the others in the New World by the lack of the pronotal pit above the cervical notches and the metatarsi being longer than the metatibiae.

Notoxus is represented by seventy-two species in the New World with most of these occurring in Mexico. *Plesionotoxus* consists of seven species with all of these being restricted to South America. *Mecynotarsus* contains thirteen species with the majority occurring in Mexico.

GENUS PLESIONOTOXUS, NEW GENUS

The type-species of *Plesionotoxus* is designated as *Notoxus lebasi* LaFerté. The genus is restricted to South America and is easily distinguished from *Notoxus* by the lateral carinae extending from the horn base to the cervix and the anteriorly directed setae over the pronotal pits. The species included in the genus are very similar externally and a revision of the group will require that the genitalia of the types be examined.

Plesionotoxus is perhaps most similar to *Pseudonotoxus* Pic by the form of the genitalia and the lateral carinae at the base of the pronotal horn. It is easily separated by the lack of setae between the eye facets, the absence of any modified setae on the body, and the distinct antebasal impression of the pronotum.

Plesionotoxus lebasi (LaFerté)

(Fig. 3, 4)

Notoxus Lebasii (sic) LaFerté 1848: 51-2, Table 21, fig. 16. Type locality: Colombia. Generotype of *Plesionotoxus*. Werner 1965: 22. Also known from Bolivia, Brazil, Panama and Peru.

Plesionotoxus argentinus (Pic)

Notoxus argentinus Pic 1912: 456. Type locality: Mendoza, Argentina. Bruch 1928: 193; 1938: 165.

Plesionotoxus boliviensis (Pic)

Notoxus boliviensis Pic 1914a: 250. Type locality: Bolivia.
v. *Germaini* (sic) Pic 1914b: 61. Type locality: Bolivia.
v. *innotatipennis* Pic 1914b: 61. Type locality: Peru.

Plesionotoxus informicornis (Krekich)

Notoxus informicornis Krekich 1913: 135-6. Type locality: Mendoza, Argentina. Bruch 1928: 193; 1938: 167.

Plesionotoxus gounellei (Pic)

Notoxus Gounellei (sic) Pic 1901b: 227. Type locality: Brazil.

Plesionotoxus venustus (Pic)

Notoxus venustus Pic 1901b: 227. Type locality: Argentina Pic 1911: 13. Bruch 1928: 193; 1938: 166.

GENUS NOTOXUS FABRICIUS

Notoxus Geoffroy 1762: 356 (not binomial, see Hemming 1954). Fabricius 1792: 210; 1801: 289. Say 1817: plate IV; 1824: 21; 1827: 38. LeConte 1824: 170 *(Anthicus)*; 1851: 152; 1852: 92; 1876: 518. Hentz 1827: 375. LaFerté 1848: 21. Chevrolat 1877: ix. Horn 1884: 165; 1892: 47. Casey 1884: 189; 1895: 756. Quedenfeldt 1886: 121. Champion 1890: 203; 1893: 461. Pic 1894: 46; 1897: 215; 1901a: 227; 1901b: 89; 1904: 228; 1911: 5; 1912: 456; 1913: 8; 1914a: 61; 1914b: 250; 1916: 11; 1918: 117. Fall 1902: 257; 1916: 33; 1932: 56. Blatchley 1910: 1334. Krekich 1913: 135. Leng 1920: 162. Blaisdell 1929: 57; 1936: 144. Bruch 1928: 193; 1938: 165. Barber 1941: 25. Pallister 1955: 5. Werner 1964: 200; 1965a: 124; 1965b: 123. Generotype *Meloe monoceros* Linnaeus (cited as generotype in Bonadona 1971).
Monocerus Faldermann 1837: 106. LeConte 1847: 89. Generotype *Monocerus brachycerus* Faldermann, fixed by monotypy.

Geoffroy's (1762) work was rejected by the International Commission on Zoological Nomenclature (Hemming 1954) on the basis that it was not binomial. The first use of the genus *Notoxus* with a specific name was by Fabricius (1792), according to the literature dates in Pic (1911).

Three of the species named by LaFerté were collected by Piccolomini in "California." As has been noted by Werner (1964: 200), this locality is erroneous and the material was probably collected in the area around Mexico City. The three species of *Notoxus* collected by Piccolomini are commonly collected around Mexico City and this is probably the type locality.

Taxonomic Characters

Color and patterns: Color is expressed in simple English rather than Latin. The elytra exhibit the most useful color patterns. The basic pattern consists of light elytra with a median or postmedian band and darkened omoplates (a hump centered between the humeri, elytral suture and postbasal band, Fig. 7A). There is often an apical or postbasal band. For a species the general position of the bands does not vary, but the smoothness of the margins and the degree that they may extend anteriorly may vary considerably. One species has completely dark elytra with the elytral pattern being formed by dark and light setae. Several species have all dark or light elytra without any setal patterns.

The pronotal horn may be abruptly darker than the remainder of the pronotum. The head is usually slightly darker or the same color as the pronotum. The light areas of the elytra are lighter than the pronotum and head, and vary from tan to brown.

Setation: The setae of the head, pronotum and elytra are often raised and their appearance is one of the best characters for recognition of species. The lengths of the raised setae of the head which outline the pronotal horn are usually highly correlated with the lengths of the raised pronotal and elytral setae, but in a few species these setae are very reduced in the male and normal in the female.

The pronotum of most species will have some setae which are raised, while for a few species all the setae are appressed. The average lengths of the raised elytral setae and their average angles from the elytral surface are characteristic for each species. The setae vary from appressed (about 8^{o}) to decumbent (about 14^{o}) to distinctly raised (20^{o} to 85^{o}).

Head: The mandibles have the peculiar lateral explanation which is a characteristic of the Notoxinae (Fig. 6). The posterior margin of the explanation may be very distinct or obsolete. The distance between the two margins in a ventral view is useful in the separation of species-groups.

The last segment of the maxillary palpus varies slightly in shape, but is best characterized as being subangulate. The length/width ratios of the antennomeres were recorded and the results from the numerical analysis indicated that the ratios of I, II, III, V-IX, X and XI were significantly different from each other for many of the species.

Pronotum: The pronotal horn provides a number of useful characters. On the pronotal horn is a shorter, median elevated area, the crest, which extends posteriorly to the pronotal disc (Fig. 5). The horn proper either has several ventro-lateral pits or lacks them completely. The horn margin may be smooth or possess up to twelve denticles or teeth. The apex is usually smooth, with the teeth being on the lateral margins or near the base. The crest usually has a smooth margin, but may have a series of sharp denticles representing the margin which will often indistinctly merge anteriorly with the horn. The crest apex varies from rounded to pointed with the apically pointed crests generally depressed anteriorly. Some species may have a smooth, median longitudinal ridge on the crest (Fig. 5).

There is a deep pubescent pit dorsal to each pronotal cervical notch. The size of these pits is stable for a species and is useful in recognizing species-groups. One species has a lateral carina on each side of the pronotum extending from the horn base to the cervix just anterior to the pronotal pits. In dorsal view the general shape of the pronotal disc is globose, but may be shortened

to appear transverse.

Elytra: Elytra of many species are distinctly widest at the middle, but a few species are only slightly wider medially and have the lateral margins of the elytra appearing almost parallel. The shape of the elytral apices is difficult to characterize except for the more extreme variations. A few species have the elytra distinctly narrowed in the apical half with the apices acuminate (Fig. 21A). In some species the females have the elytra protruding at the elytral suture (Fig. 42F) while others have the elytra somewhat shortened and truncate. Males of some species have an acute protuberance on the lateral apical angles (Fig. 50A). Males of two species have a median preapical impression which is densely setate.

Mesosternum: The lateral margins of the mesosternum vary from straight to slightly curved outwardly. The anterior margin is pointed and reaches the prothorax. The median process between the mesocoxae is narrow and truncate at the apex.

Abdomen: In the females of all but one species, the last tergite, the morphological seventh, is in the form of a broadly rounded triangle. The exception has a large apical tubercle arising from this tergite which extends beyond the elytral apices (Fig. 43F). The last sternite in the males is rounded. The morphological eighth tergite is usually barely visible between the apparent last tergite and the last sternite. In females this eighth tergite is not visible. The sternites in the females are generally unmodified with the apex varying slightly from rounded-triangular to triangular. Modifications in the male are almost always confined to the last (morphological seventh) sternite, but in one species the first four sternites may be flattened. The apex of the last sternite varies from broadly rounded to truncate to deeply emarginate. There may be an oval or transverse impression before the apex or no impression. The impression may be shallow or deep. In two cases there is a transverse carina at the center of the sternite. The apex may be straight or sharply downcurved in lateral view.

Males are best separated from females by the form of the last sternite. This sternite in the females will always be pointed to some degree and lacking in other modifications. In all males this sternite will never be simply pointed, but will be broadly rounded or have various modifications.

Legs: The first and second protarsomeres may have a distinct spur at the lateral apical margin, or these spurs may be reduced or lacking in either or both sexes. A few males have a median tubercle on the protibiae. One species has a prominent tubercle on both the pro- and mesofemora. Another species has the first tarsomere of the last leg enlarged and flattened.

Hind wings: The hind wings are usually fully developed. The wing venation did not vary in all of the species examined (Fig. 1).

Genitalia: The genitalia of the females was found to be membraneous and no characters could be found which are taxonomically useful. The male genitalia are heavily sclerotized and exhibit many valuable specific characters. The parameres may have lobes at various points and vary in general shape. The median lobe or penis exhibits a variety of modifications, particularly near the apex. Before the apex there may be a dorsal notch (Fig. 52E), segments, or an oval opening. The apex may be pointed, rounded, truncate, forked, split dorso-ventrally (Fig. 13E), split laterally, with an apical hook (Fig. 50D) or with a combination of these characters. The internal sac is membraneous and lacking in obvious signs of sclerotization.

Key to the Central and South American Notoxus

In the following key I have attempted to use characters which will enable the user to identify both sexes. However, several species can be positively identified using only male genitalia. Several United States species which occur near the Mexican border are included in the key as they probably will be found in the northern mountains and deserts of Mexico.

1. Lateral carina extending from horn base to pronotal pits at neck; elytra unicolorous; southern Brazil. . . . . Notoxus sp. (p. 63)
   Lateral margins of pronotum adjacent to horn smoothly rounded. . 2

2. (1) Venter of horn with lateral pits. 3
   Venter of horn smoothly rugulose, without pits. 14

3. (2) Elytral apices acuminate (Fig. 22A); crest margin crenulate; male fifth sternite emarginate at apex, transverse ridge before apex (Fig. 22B); Chiapas to Guatemala. . acuminatus Champion (p. 30)
   Elytral apices rounded (Fig. 7A); crest margin smooth; male fifth sternite variable. 4

4. (3) Elytra with distinct dark median band (Fig. 7A); crest often with median ridge. 5
   Elytra with dark postmedian band or spots, or unicolorous; crest without median ridge. 6

5. (4) Midband with very irregular margins (Fig. 10A); male fifth sternite slightly emarginate; males with setaceous impression near elytral apices and lacking a medial tubercle on the profemora; throughout Mexico. . . . . hirsutus Champion (p. 21)
   Midband with smoother margins (Fig. 11A); male fifth sternite with apical triangular impression; medial tubercle on male protibiae and lacking any setaceous impressions on elytra; northwestern Mexico. . . . . calcaratus Horn (p. 22)

6. (4) Horn with three or less teeth on margins; mandibular explanation narrow in ventral view, hind margin meeting mandible at lower level than front; male fifth sternite emarginate. pallidus Fall (p. 44)
   Horn with three or more teeth; both margins of mandibular explanation meeting mandible at same level; male fifth sternite broadly rounded. 7

7. (6) Elytra unicolorous, without markings. 8
   Elytra with dark band or spots on elytra. 10

8. (7) Raised elytral setae bristling, average angle 69°; Peru and Bolivia. peruvianus Pic (p. 38)
   Raised elytral setae at average angle of 35°; Central America. . . 9

9. (8) Horn abruptly darker than rest of pronotum; Guatemala to Panama ruficollis Champion (p. 38)

Horn and rest of pronotum same color; northeastern Mexico to Guatemala. . . . . murinipennis (LeConte) (p. 37)

10. (7) Present in the West Indies. 11
Present on the mainland. 12

11. (10) Penis apex truncate, with small indentation; Jamaica. jamaicus Pic (p. 36)
Penis apex deeply split; Puerto Rico. bipunctatus Chevrolat (p. 35)

12. (10) Penis simple, not split at apex (Fig. 23D); through much of Mexico to Guatemala. . . . . desertus Casey (p. 33)
Penis split dorso-ventrally at apex (Fig. 24D). 13

13. (12) Penis with strong dorsal tooth at apex (Fig. 24D); central Mexico north to Chihuahua. . . . . celatus, n. sp. (p. 32)
Penis without dorsal tooth (Fig. 24D); northeastern Mexico to Venezuela. . . . . cumanensis LaFerté (p. 31)

14. (2) Pronotum with antebasal pubescent band unbroken; males with lateral apical tubercles on elytra. 15
Pronotum with antebasal pubescent band widely broken at center; male elytra with lateral tubercles in two rare species. 17

15. (14) Elytral setae appressed; crest elevated slightly above horn margin; penis with deep dorsal notch at apex; Baja California. conformis LeConte (p. 54)
Some elytral setae erect, average angle greater than 45°; crest and penis apex variable. 16

16. (15) Crest width at base one-half greatest width; penis with narrow dorsal notch at apex; Baja California Sur. . . bajae, n. sp. (p. 53)
Lateral margins of crest about parallel; penis with broad dorsal notch at apex; Baja California. . . . . sparsus LeConte (p. 52)

17. (14) Elytral setae in postbasal impression directed laterally (Fig. 19A); elytra narrowed in apical half. 18
Setae on elytra directed posteriorly; elytral apices variable. . . 19

18. (17) Crest margin crenulate, apex indistinctly merging into horn; central Mexico to Colombia. . . . . lateralis, n. sp. (p. 28)
Crest margin smooth, apex distinct and elevated above horn margin; Baja California. . . . . solus, n. sp. (p. 29)

19. (17) Crest margin roughly crenulate, apex indistinctly merging into horn. 20
Crest margin smooth, apex distinct. 22

20. (19) Raised elytral setae bristling, about 62°; mandibular explanation narrow in ventral view, hind margin obsolescent; northern Mexico. . . . . anchora Hentz (p. 50)

Raised elytral setae appressed; mandibular explanation wide in ventral view, with both margins distinct. 21

21. (20) Elytra with postmedian light markings evenly curved anteriorly to near elytral suture (Fig. 18A); setae dense on elytra; elytra slightly narrowed in apical half; central Mexico to Panama. eximius Champion (p. 27)

Elytra with postmedian light band meeting broadly at elytral suture (Fig. 21A); setae sparse on elytra; elytra narrowed in apical half; Chiapas to El Salvador. . . . . impressus Champion (p. 29)

22. (19) Elytra with all setae appressed to decumbent, or with a few setae slightly raised (ignore very short tactile setae at 80° and less than one-third length of other setae). 23

Elytra with some setae raised, distinct from other setae, average angle of raised setae greater than 20°, usually much longer than other setae. 34

23. (22) Pronotum with all setae appressed; males with fifth sternite emarginate, circular impression before apex (Fig. 42B); females with elytral apices spinose (Fig. 42F). 24

Pronotum with some setae raised, distinct from other setae, may be sparse-if apparently absent then males with large circular impression of fifth sternite (Fig. 32B) and females with elytral apices rounded. 26

24. (23) Pronotum unicolorous, only slightly darker than the light areas on elytra; females with pygidium simple; northwestern Mexico. photus, n. sp. (p. 49)

Pronotum distinctly darker than light areas on elytra, horn lighter than rest of pronotum. 25

25. (24) Females with pygidium apex slightly produced; males with shallow impression before apex of fifth sternite, never densely setate; central Mexico. . . . . talpa LaFerté (p. 47)

Females with apical protuberance from pygidium (Fig. 43F); males with deep circular impression on fifth sternite, margin of impression often densely setate; south-central Mexico. pygidialis, n. sp. (p. 48)

26. (23) Body brownish-black, rarely with faint lateral light markings; brownish setae forming median band, outlined by white setae (Fig. 45A); males with fifth sternite emarginate, slight to deep transverse impression before apex (Fig. 45B); central Mexico. fraternus Champion (p. 56)

Body with distinct elytral ground color pattern, if completely dark then setae are all whitish and males with circular or oval impression on fifth sternite. 27

27. (26) Elytra with slightly postmedian band, apices dark (Fig. 33A); males with fifth sternite distinctly emarginate, circular impression at apex; mandibular explanation usually narrow in ventral view (Fig. 33C). 28

Elytra trifasciate with light apices, to completely dark; mandibular explanation moderately wide in ventral view (Fig. 16C); males with fifth sternite truncate to slightly emarginate, no impressions before apex. 31

28. (27) Elytra with postbasal band rarely broken at elytral suture; male fifth sternite with shallow circular impression; northeastern Mexico. . . . . orientalis, n. sp. (p. 42)
Elytra with only omoplates dark near base; male fifth sternite with deep impression. 29

29. (28) Often with some elytral setae slightly raised giving slightly ruffled appearance; horn margins rarely extending posteriorly past crest apex; northeastern Mexico. . . . . postictus, n. sp. (p. 41)
All setae appressed; horn margins often extending well past crest apex; northwestern Mexico. 30

30. (29) Crest narrowly rounded at apex; horn margins extending past first quarter of crest; horn slightly depressed before apex, not scoop-like; males with at most fourth sternite slightly flattened medially. . . . . nuperus Horn (p. 39)
Crest usually broadly rounded at apex; length of horn margins variable; horn often centrally depressed before apex to form scoop-like structure; males with sternites I-IV often flattened medially. haustrus, n. sp. (p. 40)

31. (27) Elytra dark or with faint lateral light areas (Fig. 14A), not trifasciate; head and pronotum about same color; male fifth sternite distinctly emarginate; Durango. . . . durangoensis, n. sp. (p. 24)
Elytra trifasciate (Fig. 16A); male fifth sternite truncate or very slightly emarginate. 32

32. (31) Elytra obscurely trifasciate; pronotum much lighter than head; male fifth sternite slightly emarginate; ventral portion of penis same width through length; Durango. . . . . nubilus, n. sp. (p. 25)
Elytra markedly trifasciate; pronotum about same color as head; male fifth sternite truncate. 33

33. (32) Ventral portion of penis same width (Fig. 15E); Arizona. balteatus Casey (p. 23)
Ventral portion of penis enlarged at apex (Fig. 16E); central Mexico to Durango. . . . . toltecorum, n. sp. (p. 26)

34. (22) Elytra completely brown, setae unicolorous; raised setae long, about two-thirds as long as eye, average angle 32°; male fifth sternite emarginate, not impressed; northeastern Mexico. campus, n. sp. (p. 60)
Elytra brown with tan areas; setal length variable; usually not occurring in northeastern Mexico. 35

35. (34) Elytra with raised setae bristling, average angle greater than 50°; often with median ridge on crest; apex of crest distinct and well elevated above horn margin. 36

Raised elytral setae at average angle of 45° or less, if greater than mandibular explanation narrow in ventral view (Fig. 47C); median ridge lacking in all except one rare species *(caudatus)*. 39

36. (35) Crest about as long as width at base; males with fifth sternite broadly rounded, small triangular impression at apex; northwestern Mexico. . . . . gelidus, n. sp. (p. 20)
Crest nearly or greater than twice as long as width at base. . . 37

37. (36) Crest apex broadly pointed; raised elytral setae almost as long as eye; northwestern Mexico. . . . . occidentalis, n. sp. (p. 55)
Crest apex narrowly rounded to broadly rounded; raised elytral setae not more than two-thirds eye length. 38

38. (37) Parameres bulging laterally near base, not swollen near apex in lateral view (Fig. 7E); central Mexico.
pueblensis Champion (p. 18)
Parameres parallel at base, swollen near apex in lateral view (Fig. 8E); Nuevo Leon. . . . . leonensis, n. sp. (p. 19)

39. (35) Slight longitudinal ridge on crest; males with shallow densely setate impression near apex of elytra, elytra truncate near apex; New Mexico. . . . . caudatus Fall (p. 18)
Without trace on longitudinal ridge on crest; males lacking setate impressions on elytra. 40

40. (39) Elytra with preapical band or spots (Fig. 51A); mandibular explanation narrow in ventral view, hind margin obsolescent; raised setae on elytra bristling; male elytra with lateral apical tubercles; Chihuahua. . . . . serratus (LeConte) (p. 51)
Elytra with median, postmedian or apical bands, or unicolorous; mandibular explanation with hind margin distinct; male elytra lacking lateral apical tubercles. 41

41. (40) Male protibiae with median tubercle; male fifth sternite slightly emarginate; raised elytral setae more than two-thirds eye length, raised at 40-45°; elytra with median band; Arizona to New Mexico.
montanus Casey (p. 23)
Males lacking median tubercle on protibiae; if setae long, then elytra with postmedian band; male fifth sternite variable. . . 42

42. (41) Mandibular explanation narrow in ventral view (Fig. 47C), hind margin recessed; raised elytral setae at average angle of 30-65°, often bristling; elytra with postmedian band; males with fifth sternite truncate to slightly emarginate, usually with shallow transverse impression before apex. 43
Mandibular explanation wide to moderately wide in ventral view (Fig. 41C), hind margin prominent; average angle of raised elytral setae 20-45°; elytra usually with median band; males with fifth sternite usually emarginate. 45

43. (42) Raised elytral setae relatively short, less than half of eye length (0.15-0.16), average angle 30-40°; northern Mexico.
marginatus LeConte (p. 45)

Raised elytral setae long, bristling, about two-thirds eye length (0.18-0.22), average angle 50-65°. 44

44. (43) Horn margin with 4-8 teeth; central Mexico to Sonora.
mexicanus Champion (p. 46)
Horn margin with 1-4 teeth; northern Mexico.
apicalis LeConte (p. 44)

45. (42) With 3-8 teeth on horn margin; crest margin smooth to smoothly crenulate. 46
With 0-2 teeth on horn margin; crest margin smooth. 49

46. (45) Postmedian band reflexed anteriorly along elytral suture (Fig. 40A); males with fifth sternite deeply emarginate, transverse impression before apex; first metatarsomere enlarged and flattened; central Mexico. . . . . opacus Champion (p. 62)
Median band straight across elytra (Fig. 41A); males with fifth sternite slightly emarginate, oval impression before apex; metatarsomeres cylindrical. 47

47. (46) Penis apex truncate; Chiapas and Guatemala.
crucifer Champion (p. 61)
Penis apex pointed; central Mexico to Sinaloa.
zapotecorum, n. sp. (p. 60)

48. (45) Elytra with preapical band (Fig. 13A); crest elevated well above horn; male fifth sternite slightly emarginate; northwestern Mexico. . . . . arizonensis Fall (p. 24)
Elytra with apical band; crest and male fifth sternite variable. . 49

49. (48) Males with apex of fifth sternite rounded, no impression before apex; mandibular explanation wide; western Texas to Arizona.
brevicornis Fall (p. 55)
Males with apex of fifth sternite emarginate; mandibular explanation moderately wide to wide. 50

50. (49) Males with fifth sternite emarginate into large circular impression (Fig. 39B); phallobase longer than wide; Jalisco to Sonora.
stephani, n. sp. (p. 57)
Males with transverse impression or flat before apex; phallobase wider than long; central Mexico. 51

51. (50) Penis widely forked at apex (Fig. 38D); male fifth sternite flattened; Durango. . . . . desperatus, n. sp. (p. 58)
Penis truncate at apex; male fifth sternite variable. 52

52. (51) Male fifth sternite with transverse impression before apex.
truncatipennis Champion (p. 59)
Male fifth sternite flattened before apex.
aztecorum, n. sp. (p. 57)

Pueblensis-group

The *pueblensis*-group is defined as those *Notoxus* with the following characters: mandibular explanation wide, prominent hind margin meeting mandible at same level as front margin; raised pronotal setae distinct, pubescent antebasal band widely separated; crest margin smooth, apex rounded and distinct, median crest usually present; elytra with median band, raised elytral setae longer than half eye length; males without lateral apical projections on elytra; fifth sternite without impression before apex; parameres with lobes or penis divided dorso-ventrally.

Central American species included are *calcaratus* Horn, *hirsutus* Champion, *pueblensis* Champion, *gelidus* n. sp. and *leonensis* n. sp. There is only one United States species in this group, *caudatus* Fall. It is included in the key to the species because it has been collected near the Mexico-New Mexico border and will probably be found in the northern montane regions of Mexico.

Notoxus pueblensis Champion

(Figs. 7, 55)

Notoxus pueblensis Champion 1890: 214, Table IX, fig. 24. Type locality: Puebla, Puebla, MEXICO, type series in BMNH. Pic 1894: 47; 1911: 11.

Length 2.78-3.48. Head and pronotum tan to red-brown, elytra tan with brown to dark brown markings: oval mark on omoplates, irregular preapical band, flanks of elytra dark posteriorly to midband. Setae brownish when arising from dark areas, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 64°. Mandibular explanation moderately wide, front and hind margins meeting at same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-2 teeth on margins. Crest distinct, elevated well above horn, with short median ridge, rounded at apex. First and second protarsomeres with spur on posterior apical margin.

Males with fifth sternite emarginate at apex. Penis divided dorso-ventrally at apex. Spurs on protarsomeres small.

Females with fifth sternite rounded-triangular. Spurs on protarsomeres large and easily distinguished.

Redescribed ♂: 7 mi NE Atlixco, Puebla, MEXICO (DSC). Length 2.82. Head 0.58 long, eye 0.26 long, raised setae above eyes average 0.14 long; antennomere ratios: I 1.94, II 1.42, III 2.33, IV 1.85, V 1.86, VIII 1.60, X 1.28, XI 1.94; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.09 long, 0.05 wide. Pronotum 0.90 long, length from base to point of greatest width 0.32, break in antebasal band 0.24 wide; horn 0.37 long, 0.27 wide at base, 1 tooth on margin; crest 0.21 long, 0.10 wide at base, with short median ridge; crest apex 0.10 above horn margin, horn apex 0.20 from crest apex; pronotal pit 0.10 long. Raised elytral setae 0.15 long, average angle 65°. Emargination of fifth sternite 0.14 wide, 0.01 deep.

Specimens examined, 31: MEXICO: Puebla: May, A. Fenyes coll. (CASC); San Martin, 26 May 1922, E. G. Smyth (USNM); Puebla, 28 May 1922, E. G. Smyth (USNM); Santa Maria, May, A. Fenyes coll. (CASC); Tehuacan, A. Fenyes coll. (CASC); 7 mi NE Atlixco, 26 July 1974, R. L. Mangan & D. S. Chandler, under low vegetation in corn field (DSC); same locality, 26 June

1975, D. S. Chandler, under low plants in corn field (DSC). Mexico: Chapingo, 22 July 1964, T. R. E. Southwood (BMNH). 1 specimen with "Mex.", F. C. Bowditch coll. (MCZC) and two specimens with "X" and "IX" (USNM).

Distribution: The semiarid region in and around the state of Puebla. Collected underneath and on vegetation in corn fields. Present from May through July.

Discussion: Very similar to *leonensis* in general appearance and form of the genitalia. It is separated by the apically narrowing parameres and its distribution in central Mexico.

Notoxus leonensis, n. sp.

(Figs. 8, 55)

Length 2.70-3.62. Head and pronotum orange, pronotum brown laterally, elytra orange with brown markings: band across omoplates interrupted at elytral suture, usually meeting median band. Pubescence brownish when arising from markings, yellowish over rest of elytra. Raised setae long and erect on pronotum and elytra, average angle on elytra 55°. Mandibular explanation moderately wide, front and hind margins meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate. Penis divided dorso-ventrally at apex, apices bilobed.

Females with fifth sternite rounded-triangular.

♂ holotype: 18 mi SW Linares, Nuevo Leon, MEXICO. Length 3.25. Head 0.60 long, eye 0.26 long, raised setae above eyes average 0.13 long; antennomere ratios: I 2.51, II 1.91, III 2.26, IV 1.67, V 2.04, VIII 1.69, X 1.51, XI 2.42; fourth maxillary palpus 0.22 long, 0.10 wide; mandibular explanation 0.10 long, 0.04 wide. Pronotum 0.97 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.24 wide; horn 0.38 long, 0.28 wide at base, 1 tooth on margin; crest 0.23 long, 0.08 wide at base; crest apex 0.12 over horn margin, horn apex 0.21 from crest apex; pronotal pit 0.08 long. Raised elytral setae 0.18 long, average angle 49°. Emargination of fifth sternite 0.17 wide, 0.01 deep.

Specimens examined, 5: HOLOTYPE ♂, 18 mi SW Linares, Nuevo Leon, MEXICO, 2 July 1974, Clark, Murray, Ashe, Schaffner, at light (USNM). PARATYPES: MEXICO: Nuevo Leon: 1♂, 1♀, eutopotypical (DSC, TAMU); 2♀♀, 16 mi W Linares, on Mexico 60, 2200', 26-29 May 1971, A. Newton, canyon bottom, UV trap (FGW).

Distribution: Known from the Sierra Madre Oriental in Nuevo Leon. Adults collected at light and ultra-violet light. Present in June and July.

Discussion: Very similar to *pueblensis*. Separated by the apically enlarged parameres and its distribution at the northern end of the Sierra Madre Oriental.

Notoxus gelidus, n. sp.

(Figs. 9, 55)

Length 2.81-3.69. Head and pronotum tan to red-brown, elytra tan with brown to dark brown markings: circular mark on omoplates, irregular median band, irregular preapical band which may be broken at middle. Setae brownish when arising in markings, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 53°. Mandibular explanation moderately wide, front and hind margins meeting at same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-3 teeth on margins. Crest distinct, elevated well above horn, with short median ridge, widely rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded, small triangular impression at apex. Parameres with long medial flange near middle.

Females with fifth sternite rounded-triangular.

♂ holotype: Sunnyside, Arizona. Length 3.30. Head 0.68 long, eye 0.34 long, raised setae over eyes average 0.12 long, antennomere ratios: I 2.35, II 2.00, III 2.67, IV 2.23, V 2.21, VIII 2.20, X 1.76, XI 2.88; fourth maxillary palpus 0.21 long, 0.10 wide; mandibular explanation 0.08 long, 0.05 wide. Pronotum 0.95 long, length from base to point of greatest width 0.36, break in antebasal pubescent band 0.29 wide; horn 0.35 long, 0.24 wide at base, one tooth on margin; crest 0.15 long, 0.13 wide at base, with short median ridge; crest apex 0.15 over horn margin, horn apex 0.23 from crest apex; pronotal pit 0.10 long. Elytra with raised setae 0.16 long, average angle 56°.

Specimens examined, 33: HOLOTYPE ♂, Sunnyside, Cochise County, Arizona, 27 August 1973, K. Stephan (CNCI). PARATYPES: Arizona: Cochise Co.: 5♂♂, 4♀♀, eutopotypical (DSC, KSC); 1♂, Sunnyside, 20 June 1970, K. Stephan (DSC). Chiricahua Mountains - 1♂, 6000', 29 June 1968, K. Stephan (DSC); 1♂, 2♀♀, 26 July 1952, D. J. & J. N. Knull (OSUC); 1♂, Turkey Creek Camp, 6400', 14 June 1964, J. Burger, UV light (FGW); 1♂, Southwest Research Station, 5 mi W Portal, 1 September 1959, J. R. Powers, at light (CISC); same locality, 1♂, 4 August 1961, J. M. Linsley (CISC); same locality, 1♂, 5 August 1967, F. G. Andrews and 1♀, 28 August 1967, F. G. Andrews (CDAE); 1♂, Stewart Camp, 1 mi S Portal, 18-20 July 1971 (CISC). Huachuca Mountains - 1♀, Miller Canyon, 2.7 mi W parking area, 5800', 6 June 1964, J. Burger, UV light (FGW); same locality, 1♀, 5700', 10 August 1974, D. S. Chandler (DSC); 1♀, Ramsey Canyon, 13 July 1955, F. G. Werner & G. D. Butler (FGW). Santa Cruz Co.: 1♀, Madera Canyon, 9 August 1961, Werner & Nutting, UV light (FGW); 1♀, same locality, 4880', 25 September 1963, V. L. Vesterbey (UCDC); 1♂, same locality, 2 September 1960, F. G. Andrews (CDAE); 1♂ same locality, 8 September 1970, E. A. Kane, UV light (CDAE). MEXICO: Sonora: 1♀, Sierra del Ajos, Canyon de Evans, 15 July 1970, V. Roth (DSC). Durango: 2♂♂, 26 mi W Durango, 13 July 1974, R. L. Mangan & D. S. Chandler, beating oak (DSC).

Distribution: Montane areas in southern Arizona south through the Sierra Madre Occidental. Apparently associated with the oak zone. Karl Stephan noted that a portion of the type series was collected on a cold night at light, while little else was attracted. Present from June through September.

Discussion: Most similar to *pueblensis* and *leonensis* in appearance. Distinct by its high, almost semicircular crest and the medial flanges on the parameres.

Notoxus hirsutus Champion

(Figs. 10, 55)

Notoxus hirsutus Champion 1890: 211, Table IX, fig. 20. Type locality: near Mazatlan, Sinaloa, MEXICO, BMNH Lectotype ♀, designated by Chandler, 1975. Pic 1894: 47; 1911: 8. Not Pallister 1955: 10.

Notoxus cristatus Champion 1890: 213-4, Table IX, fig. 23. Type localities: Guanajuato, Guanajuato, and Cuernavaca, Morelos, MEXICO, type series in BMNH and F. G. Werner collection. Pic 1894: 46; 1911: 7. Pallister 1955: 10, in part. NEW SYNONYMY.

Length 2.95-3.70. Head and pronotum tan to dark reddish-brown, elytra tan with brown markings: oval mark on omoplates, irregular median band, irregular preapical band, marks on flanks behind humeri in few specimens. Pubescence brownish when originating in darkened areas, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 70°. Mandibular explanation wide, with front and hind margins meeting at same level at mandible. Pronotum with pubescent antebasal band widely broken. Horn with pits beneath, 1-8 teeth on margin. Crest elevated and distinct, apex rounded, usually with distinct median ridge. First and second protarsomeres with strong spur on posterior apical margin.

Male with circular impressed area near apex of elytron, densely setate. Fifth sternite slightly emarginate at apex. Penis split dorso-ventally, with dorsal part bilobed at apex.

Female without setate impressed area on elytron, fifth sternite rounded-triangular.

Redescribed ♂: 2 mi N Jojutla, Morelos, MEXICO (DSC). Length 3.50. Head 0.75 long, eye 0.34 long, raised setae over eyes average 0.20 long; antennomere ratios: I 2.30, II 1.69, III 2.20, IV 1.94, V 1.79, VIII 1.58, X 1.35, XI 2.39; fourth maxillary palpus 0.24 long, 0.12 wide; mandibular explanation 0.08 long, 0.06 wide. Pronotum 1.16 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.25 wide; horn 0.46 long, 0.38 wide at base, 2 teeth on margin; crest length 0.25, width at base 0.12, with median ridge; crest apex 0.15 above horn margin, crest apex 0.24 from horn apex; pronotal pit 0.14 long. Raised elytral setae 0.22 long, average angle 71°. Emargination of fifth sternite 0.18 wide, 0.01 deep.

Specimens examined, 79: MEXICO: Chihuahua: Ciudad Jimenez; Catarinas, 5800'. Durango: Rio Florido, nr. Las Nieves, 5200'. Sinaloa: Presidio (Mazatlan), Forrer, Lectotype female of *hirsutus* (BMNH); 5.5 mi NW Choix. Nayarit: Arroyo Santiago, nr. Jesus Maria. Zacatecas: 28 mi S Jalpa. San Luis Potosi: Tamazunchale, Rt. 1, km. 365; 1 mi SW Tamazunchale. Queretaro: 1 mi NW Ayutla. Guanajuato: Guanajuato, type of *cristatus;* Silao. Guerrero: Xalitla; 17 mi E Acapulco. Morelos: 2 mi N Jojutla; Cuernavaca, type of *cristatus;* 3 mi N Alpuyeca, 3400'. Puebla: Tepexco, Rt. 115, 4000'; 12 mi SE Izucar de Matamoros. Oaxaca: Oaxaca; Yagul ruins; 10 mi N Miltepec. Chiapas: 31 mi SE Comitan; 29 mi SW Cintalapa. Specimens present in collections of: AMNH, BMNH, CDAE, CISC, CUIC, DSC, FGW, TAMU, UCDC.

Distribution: From New Mexico through most of Mexico. Specimens have been collected by beating vegetation and are attracted to ultra-violet light and cantharidin. Present from February through August.

Discussion: *Hirsutus* is most similar to *caudatus* Fall, which also has the setate impressions on the male elytra. *N. hirsutus* can be separated from *caudatus* and the others in the group by the very irregular midband. *N. caudatus* males have a deeply emarginate fifth sternite and an apically pointed fifth tergite, which will also separate this species from the others in the group. The size of the elytral impression appears to diminish in a northerly direction as the specimens of *hirsutus* from New Mexico have the impressions small and easily overlooked in a quick examination.

Notoxus calcaratus Horn

(Figs. 11, 55)

Notoxus calcaratus Horn 1884: 170-1. Type locality: Arizona, MCZC type #3041, ♂. Champion 1890: 211, Table IX, fig. 21. Pic 1894: 46; 1911: 6. Casey 1895: 759. Leng 1920: 163. Pallister 1955: 9.

Length 2.65-4.15. Head and pronotum tan, elytra tan with brown markings: circular mark on omoplates, irregular midband and band at apex. Pubescence brownish when arising in markings, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 71°. Mandibular explanation wide, with front and hind margins meeting at same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 3-8 teeth on margin. Crest elevated and distinct, usually with distinct median ridge, rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Male protibiae with medial tooth on proximal margin, fifth sternite truncate at apex, triangularly impressed anteriorly from apex. Parameres with outer lobe near apex and strong outer angulations at apex.

Female without modifications of the protibiae, fifth sternite rounded-triangular.

Redescribed ♂: 3 mi N La Puerta, Baja California, MEXICO (DSC). Length 4.00. Head 0.74 long, eye 0.28 long, raised setae over eyes average 0.29 long; antennomere ratios: I 2.50, II 2.00, III 2.20, IV 2.13, V 2.33, VIII 1.84, X 1.65, XI 2.64; fourth maxillary palpus 0.24 long, 0.13 wide; mandibular explanation 0.14 long, 0.08 wide. Pronotum 1.28 long, length from base to point of greatest width 0.42, break in antebasal pubescent band 0.31 wide; horn 0.54 long, 0.46 wide at base, 4 teeth on margin; crest 0.32 long, 0.08 wide at base, with median ridge; crest apex 0.22 above horn margin, horn apex 0.38 from crest apex; pronotal pit 0.15 long. Raised elytral setae 0.30 long, average angle 70°. Truncation of fifth sternite 0.22 wide.

Specimens examined, 217: MEXICO: Baja California: 3 mi N La Puerta; Rancho El Topo, 3 mi NE Sierra Juarez; 26 mi S San Felipe. Baja California Sur: 15 mi N San Ignacio; 3 mi W San Miguel de Commondú; 10 mi SW San Jose del Cabo; 6 mi N San Jose del Cabo; 6 mi SW Santiago; 4 mi N Todos Santos; La Paz; 12 mi NW La Paz; 3.5 mi NE San Pedro. Sonora: Alamos; 10 mi N Santa Ana; Saric; Rancho La Floresta, 8 mi E Tastiota; Imuris; 10 mi NE Cananea; Navojoa; 20 mi NNE Obregon; 4 mi NE Altar; 2 mi E Huatabampo. Sinaloa: Los Mochis; 5.5 mi NW Choix; Wollamo. Chihuahua: 12 mi N Escalon; Ciudad Jimenez; 5 mi N Matamoros; Delicias; 6 mi NE Meoqui; Buena

Vista; Samalayuca; Catarinas; Valle de Olivos; Primavera; Santa Clara Canyon, 5 mi W Parrita; 11 mi W Gran Morelos; Rio Conchos, 2 km W Oginaga. Durango: 26 mi W Durango; Tepehuanes; 25 mi NE Bermejillo; 2 mi N Cerro Gordo; 2 mi NW Nombre de Dios; Sombrerte; Gomez Palacio; 11 mi W Cuencame. Zacatecas: 16 mi NW Fresnillo; 15 mi NE Fresnillo. Coahuila: Boquillas del Carmen. Nuevo Leon: Monterrey; 5 mi S Monterrey. Specimens present in collections of: AMNH, CISC, DSC, FGW, LACM, MSUC, TAMU, TTCC, USNM.

Distribution: Throughout the southern half of the United States and south into the northern semiarid portions of Mexico. Specimens have been collected on *Opuntia invicta* flowers, *Prosopis*, *Hoffmannseggia*, cotton, under low plants in corn fields and are attracted to white light, ultra-violet light and drying meloid beetles. This species is fairly common on cotton and is of some economic importance in that it will eat the eggs of lepidopterous pests. Present in Mexico from April through September.

Discussion: This species and *hirsutus* are the only species in the group with lateral pits on the ventral surface of the horn. Only *calcaratus* has the medial tooth on the protibiae of the males. The smooth median band on the elytra will separate this species from similar appearing species of the *monodon*-group, which also have the pits beneath the horn.

Montanus-group

The *montanus*-group is defined as those *Notoxus* with the following characters: mandibular explanation wide; raised pronotal setae distinct, pubescent antebasal band widely broken; horn without median ridge, lacking pits beneath horn; raised elytral setae distinct and elevated, elytra with slightly postmedian band. Males with simple elytra; protibiae with a median tubercle; fifth sternite emarginate, without impressions; penis either dorsoventrally or laterally split at apex.

Three United States species are included: *montanus* Casey, *intermedius* Fall and *schwarzi* Horn. Of these species *montanus* occurs in the montane regions of eastern Arizona and probably occurs in northern Mexico. The other two species are found from the upper Sonoran desert of California to Alberta, Canada. *N. montanus* is separated in the key to species.

Arizonensis-group

The *arizonensis*-group is defined as those *Notoxus* with the following characters: mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin; raised pronotal setae distinct, pubescent antebasal band widely broken; horn without lateral pits, crest margin smooth, apex rounded, no median ridge; raised elytral setae slightly longer than other setae; males with simple elytra and legs, fifth sternite truncate to slightly emarginate; parameres simple, penis divided dorso-ventrally through apical half, dorsal thorn at apex.

Central American species included are *arizonensis* Fall, *durangoensis* n. sp., *nubilus* n. sp. and *toltecorum* n. sp. One United States species, *N. balteatus* Casey, is included. It has been most commonly collected in Arizona near the Mexico border and probably occurs in northern Mexico. For this reason it is separated in the key to species.

Notoxus arizonensis Fall

(Figs. 13, 39)

Notoxus arizonensis Fall 1916: 36-7. Type locality: Chiricahua Mountains, Cochise Co., Arizona. MCZC type #24326, ♂. Leng 1920: 163.
Notoxus talpa, Pallister 1955: 7, misidentification.

Length 3.30-4.00. Head and pronotum orange to red-brown, elytra tan to orange with brown markings: oval mark covering omoplates, median band rarely connected to mark on omoplates, preapical band often advancing anteriorly along elytral suture, rarely meeting median band. Pubescence brownish when arising from markings, whitish over rest of body. Raised setae moderately long and distinct on pronotum and elytra, average angle on elytra 31°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth. Apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate or often appearing only truncate. Penis split dorso-ventrally near apex, with dorsal thorn at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Nogales, Santa Cruz Co., Arizona (DSC). Length 3.31. Head 0.68 long, eye 0.24 long, raised setae over eyes average 0.14 long; antennomere ratios: I 2.75, II 1.67, III 2.25, IV 1.69, V 1.93, VIII 1.44, X 1.20, XI 2.11; fourth maxillary palpus 0.18 long, 0.09 wide; mandibular explanation 0.11 long, 0.05 wide. Pronotum 1.08 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.30 wide; horn 0.46 long, 0.32 wide at base, 1 tooth on margin; crest 0.32 long, 0.13 wide at base; crest apex 0.11 above horn margin, horn apex 0.21 from crest apex; pronotal pit 0.08 long. Raised elytral setae 0.11 long, average angle 33°. Truncation of fifth sternite 0.15 wide.

Specimens examined, 17: MEXICO: Chihuahua: Chihuahua, Wickham (MCZC); Primavera, 550-6000', 30 June 1947, Cazier (AMNH); Santa Clara Canyon, 5 mi W Parrita, 6 July 1954, J. W. MacSwain, *Baccharis* (CISC); same locality and collector, 1 September 1956, *Salix* (CISC). Nayarit: La Mesa de Navarit, 19 July 1955, B. Malkin (CISC).

Distribution: Southeastern Arizona south through the Sierra Madre Occidental. Collected on *Baccharis* and *Salix*. Adults present from June through August.

Discussion: Most similar to *durangoensis* and *nubilus* by the form of the genitalia. Separated from them by the raised elytral setae and the largely light elytra. The lack of a postbasal band separates it from *toltecorum* and *balteatus*.

Notoxus durangoensis, n. sp.

(Figs. 14, 59)

Length 2.78-4.35. Head and pronotum brown, elytra brown, rarely with faint postbasal and preapical lateral markings. Pubescence whitish over body. Raised setae distinct on pronotum, on elytra setae appressed, average angle 8°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-1 teeth on margin. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with

strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate. Penis with apex divided dorso-ventrally, with dorsal thorn at apex.

Females with fifth sternite rounded-triangular.

♂ holotype: 25 mi W Durango, Durango, MEXICO. Length 3.63. Head 0.75 long, eye 0.26 long, raised setae above eyes average 0.10 long; antennomere ratios: I 2.50, II 1.72, III 2.14, IV 1.80, V 1.88, VIII 1.56, X 1.53, XI 2.37; fourth maxillary palpus 0.20 long, 0.12 wide; mandibular explanation 0.14 long, 0.05 wide. Pronotum 1.16 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.26 wide; horn 0.52 long, 0.32 wide at base, no teeth on margin; crest 0.26 long, 0.14 wide at base; crest apex 0.12 above horn margin, horn apex 0.29 from crest apex; pronotal pit 0.10 long. Elytral setae 0.08 long, average angle 10°. Emargination of fifth sternite 0.20 wide, 0.01 deep.

Specimens examined, 49: HOLOTYPE ♂, 25 mi W Durango, 29 June 1964, H. F. Howden (CNCI). PARATYPES: MEXICO: Durango: 2♂♂, 10♀♀, eutopotypical (CNCI); 5♂♂, 6♀♀, same data except 23 June 1964 (CNCI); 1♂, 6♀♀, 10 mi W El Salto, 29 June 1964, H. F. Howden (CNCI); 1♂, same data except 23 July 1964 (CNCI).

Distribution: Only known from the Sierra Madre Occidental in Durango. Adults present in June and July.

Discussion: Most similar to *nubilus* by the appressed elytral setae and the general form of the genitalia. It can be separated by the larger dorsal thorn on the penis. Distinct in the group by the unicolorous elytra which rarely have faint light lateral markings.

Notoxus nubilus, n. sp.

(Figs. 15, 59)

Length 2.88-3.48. Head brown, pronotum orange, elytra red-brown with brown markings: basal, medial and preapical bands, basal band interrupted along elytral suture. Pubescence brownish when arising from bands, whitish over rest of body. Raised setae distinct on pronotum, setae on elytra appressed, average angle 6°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 1 tooth on margin. Crest margin smooth, apex distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite truncate. Penis with apex divided dorso-ventrally, with dorsal thorn at apex.

Females with fifth sternite rounded-triangular.

♂ holotype: 24 mi W La Ciudad, Durango, MEXICO. Length 3.23. Head 0.67 long, eye 0.22 long, raised setae over eyes average 0.08 long; antennomere ratios: I 2.33, II 1.64, III 2.27, IV 1.77, V 1.60, VIII 1.50, X 1.28, XI 2.06; fourth maxillary palpus 0.15 long, 0.10 wide; mandibular explanation 0.10 long, 0.04 wide. Pronotum 0.96 long, length from base to point of greatest width 0.28, break in antebasal pubescent band 0.24 wide; horn 0.40 long, 0.25 wide at base; crest 0.20 long, 0.10 wide at base, apex pointed; crest apex 0.08 above horn margin, horn apex 0.24 from crest apex; pronotal pit 0.08 long. Elytral setae 0.07 long, average angle 5°. Truncation of fifth sternite 0.20 wide.

Specimens examined, 3: HOLOTYPE ♂, 24 mi W La Ciudad, Durango, MEXICO, 4 June 1964, H. F. Howden (CNCI). PARATYPES: MEXICO: Durango: 1♂, 1♀, 24 mi W La Ciudad, 30 July 1964, H. F. Howden (CNCI, DSC).

Distribution: Only known from the Sierra Madre Occiental in Durango. Adults present from June through July.

Discussion: Similar to *toltecorum* and *balteatus* by the banding on the elytra, but most similar to *durangoensis* by the form of the genitalia. Separated from *durangoensis* by the faint bands on the elytra, the light pronotum and the narrow thorn at the penis apex. Separated from the other species by the more slender genitalia.

N. nubilus may be a population of *durangoensis* with larger light elytral markings, but the genitalic differences, although slight, have been consistent in the specimens examined.

Notoxus toltecorum, n. sp.

(Figs. 16, 59)

Length 2.82-3.50. Head and pronotum orange to brown, elytra orange to tan with brown markings: basal, median and preapical bands, basal band usually interrupted at elytral suture. Pubescence brownish when arising from marks, whitish over rest of elytra. Raised setae distinct on pronotum, on elytra appressed, average angle 10°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-1 teeth on margin. Crest margin smooth, apex distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite truncate. Penis with apex divided dorso-ventrally, with dorsal thorn at apex.

Females with fifth sternite rounded-truncate.

♂ holotype: 6 mi NE Zacatepec, Puebla, MEXICO. Length 3.30. Head 0.70 long, eye 0.24 long, raised setae above eyes average 0.10 long; antennomere ratios: I 2.50, II 1.82, III 2.09, IV 1.54, V 1.65, VIII 1.28, X 1.32, XI 2.00; fourth maxillary palpus 0.18 long, 0.10 wide; mandibular explanation 0.12 long, 0.05 wide. Pronotum 1.07 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.30 wide; horn 0.46 long, 0.28 wide at base, no teeth on margin; crest 0.28 long, 0.11 wide at base, apex pointed; crest apex 0.08 above horn margin, horn apex 0.24 from crest apex; pronotal pit 0.08 long. Elytral setae 0.08 long, average angle 10°. Truncation of fifth sternite 0.18 wide.

Specimens examined, 13: HOLOTYPE ♂, 6 mi NE Zacatepec, Puebla, MEXICO, 27 June 1975, D. S. Chandler, meloid trap (USNM). PARATYPES: MEXICO: Durango: 1♂, Palos Colorados, 8000', 5 August 1947, Schramel (AMNH). Distrito Federal: 1♀, Valley of Mexico, July 1929, Y. Mexia (CASC). Puebla: 3♂♂, 2♀♀, eutopotypical (DSC); 3♀♀, same data except cantharidin trap (DSC); 2♀♀, same data except sweeping vegetation (DSC).

Distribution: Montane areas of central and west Mexico. Adults collected sweeping vegetation, and are attracted to cantharidin and freshly killed meloid beetles. Present from June through August.

Discussion: Most similar to *balteatus* Casey by the trifasciate elytra and the general form of the genitalia. It is separated by the abruptly swollen ventral portion of the penis apex and the apically thickened parameres.

Eximius-group

The *eximius*-group is defined as those *Notoxus* with the following characters: mandibular explanation wide, the hind margin prominent; setae on pro-

notum usually appressed, pubescent antebasal band widely broken, crest without median ridge, margin variable; elytra with median band, elytra narrowed in apical half, apices often acuminate. Males without modified elytra; fifth sternite truncate to slightly emarginate; penis simple.

The species included are *eximius* Champion, *lateralis* n. sp., *impressus* Champion, *solus* n. sp. and *acuminatus* Champion.

There is also an undescribed species known from the southwestern United States.

Notoxus eximius Champion

(Figs. 18, 56)

Notoxus eximius Champion 1890: 206-7, Table XI, fig. 15. Type localities: GUATEMALA: near Guatemala City; Duenas; Zapote. NICARAGUA: Chinandega. PANAMA: Tolé. Types in BMNH, FGW, MCZC.
Pallister 1955: 6.

Notoxus solarii (sic) Pic 1916: 11. Type locality: NICARAGUA.
NEW SYNONYMY.

Length 2.07-2.95. Head and pronotum reddish-brown to dark brown, elytra brown to dark brown with tan to light brown markings: thin, light band across base of elytra, posthumeral band from lateral margin inward and posterior to near elytral suture, postmedian light band curving anteriorly from lateral margins to near suture, in lighter specimens these bands join to form outward facing semicircles. Pubescence white when arising from markings, rest of pubescence on elytra brownish. Setae on pronotum and elytra appressed, on elytra average angle 5°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 6-10 teeth on margin. Crest crenulate, anterior margin pointed and indistinct. First and second protarsomeres lacking strong spur on posterior apical margin. Elytra slightly narrowed in apical half.

Males with fifth sternite emarginate at apex, with very short raised setae above eyes, average length 0.02. Parameres with lateral protuberances near apex.

Females with fifth sternite narrowed to apex, with raised setae above eyes averaging 0.12.

Redescribed ♂: 6 km San Jose, San Jose Province, COSTA RICA (DSC). Length 2.54. Head 0.55 long, eye 0.18 long, raised setae over eyes average 0.02 long; antennomere ratios: I 2.00, II 1.67, III 2.56, IV 1.90, V 2.00, VIII 1.33, X 1.19, XI 2.14; fourth maxillary palpus 0.18 long, 0.09 wide; mandibular explanation 0.08 long, 0.05 wide. Pronotum 0.88 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.20 wide; horn 0.34 long, 0.22 wide at base, 6 teeth on margin; crest 0.24 long, 0.10 wide at base; crest apex 0.02 above horn margin, horn apex 0.12 from crest apex; pronotal pit 0.10 long. Elytral setae 0.06 long, average angle of setae 6°. Emargination of fifth sternite 0.18 wide, 0.04 deep.

Specimens examined, 362: MEXICO: Ixtlan del Rio. Morelos: 2 mi N Jojutla; Xochitepec. Tamaulipas: Matamoros. Veracruz: Alvarado; Veracruz; Tampico; Laguna Verde. Oaxaca: La Ventosa, 72 mi E Oaxaca. GUATEMALA: Zapote, types of *eximius;* Yepocapa; Gualan; Los Amates; El Rancho. HONDURAS: La Ceiba; 12 km W Olanchito. EL SALVADOR: La Libertad; Cerro Verde; San Salvador. NICARAGUA: San Marcos. COSTA RICA: San Jose, 6 km NW San Jose, Rio Virilla; San Pedro de Montes de Oca. PANAMA: Tolé, part of type series (not seen). Present in all collections.

Distribution: From the neotropical portions of Mexico through central

America. Found throughout the year on a variety of plants (*Cordia alba*, *Sechium edrile*, *Inga edulis*, *Musa paradisiaca*, *Citrus* sp.). Collected by beating vegetation, sweeping shrubs on beach, and is attracted to light.

Discussion. It is the most similar to *lateralis* by the crenulate crest merging into the horn and the elytral pattern. Separated from *lateralis* by all the elytral setae being directed posteriorly.

Notoxus lateralis, n. sp.

(Figs. 19, 56)

Length 2.30-2.91. Head, pronotum and markings on elytra reddish-brown to dark brown, remainder of elytra tan; thin mark arising near humeri passing over omoplates and joining irregular midband near elytral suture, preapical band often incomplete. Pubescence brownish when arising from dark portions of elytra, yellowish in light areas. Setae on pronotum and elytra appressed, on elytra average angle 7°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 5-9 teeth on horn margin. Crest serrate, anterior margin usually pointed and indistinct. First and second protarsomeres lacking strong spur on posterior apical margin. Elytra narrowed in apical half.

Males with fifth sternite emarginate at apex, very short raised setae above eyes, average length 0.02.

Females with fifth sternite triangular, raised setae over eyes longer, average length 0.03.

♂ holotype: 5 mi N Cuernavaca, Morelos, MEXICO. Length 2.56. Head 0.54 long, eye 0.17 long, raised setae over eyes average 0.02 long; antennomere ratios: I 2.00, II 1.89, III 2.10, IV 2.40, V 2.00, VIII 1.40, X 1.33, XI 2.13; fourth maxillary palpus 0.18 long, 0.10 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 0.90 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.27 wide; horn 0.34 long, 0.22 wide at base, 6 teeth on margin; crest 0.20 long, 0.08 wide at base; crest apex at same level as horn margin, horn apex 0.14 from crest apex; pronotal pit 0.10 long. Elytral setae 0.06 long, average angle of setae 5°. Emargination of fifth sternite 0.19, 0.02 deep.

Specimens examined, 46: HOLOTYPE ♂, 5 mi N Cuernavaca, Morelos, MEXICO, 28 August 1958, H. F. Howden (CNCI). PARATYPES: MEXICO: Nayarit: 4♂♂, 3♀♀, San Blas, 6 October 1964, W. L. Nutting, at light 200 yards from beach (FGW); 4♀♀, same locality, 5 July 1972, K. Stephan (KSC). Michoacan: 5♂♂, 9♀♀, Uruapan, 10 August 1949, L. J. Bottimer (CNCI); 1♀, Tancitaro, 6000', 27 June 1941, H. Hoogstraal (FMNH). Mexico: 1♀, Real de Arriba, Temescaltepec, 6-7000', 1932 (BMNH). Morelos: 1♀, Cuernavaca, 12/19 July 1961, R. & K. Driesbach (MSUC); 1♀, eutopotypical, beating oak (CNCI); 7♀♀, 7 mi S Tres Cumbres, 7 July 1975, D. S. Chandler, cantharidin trap (DSC). San Luis Potosi: 1♂, Xilitla, 23 July 1954, R. R. Driesbach (MSUC). Veracruz: 1♀, El Palmar, 16 km W Tetzonapa, 600', 9/15 June 1948, F. Werner & W. Nutting, jungle rubber area, beaten from vegetation (FGW). Chiapas: 1♂, 2♀♀, Junction Highways 190-195, 6 June 1969, H. F. Howden (CNCI). No state, 1♂, 1♀, Texpan, 7500', 12 August 1954, R. R. Driesbach (MSUC). GUATEMALA: 1♀, Escuintla Tiquisate, 7 km from coast near Junction Zanjons del Mico de Noria, 8 May 1956, T. H. Hubbell (UMMZ). COLOMBIA: 1♀, Rio Frio, Magdalena, Darlington (MCZC).

Distribution: Through neotropical Central America to Colombia. This species has been collected by beating oak and vegetation, and is attracted to light and cantharidin. Present from May through October.

Discussion: It is most similar to *eximius*, but it can be separated by the presence of the laterally directed setae in the elytral postbasal impression. The crenulate crest separates it from *solus*, the other species with laterally directed setae.

Notoxus solus, n. sp.

(Figs. 20, 56)

♂ holotype: 10 mi S Catavina, Baja California, MEXICO. Head and pronotum tan, elytra tan with brown markings: thin band at base of elytra, smooth median band, wide apical band. Pubescence brownish when arising from dark areas, tan over rest of body. Setae on pronotum and elytra appressed, on elytra average angle 10°. Mandibular explanation moderately wide, with front and hind margins on same level at mandible. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 2 teeth on horn margin. Crest margin smooth, anterior margin pointed and distinct. First and second protarsomeres with strong spur on posterior apical margin. Elytra narrowed in apical half.

Male with fifth sternite emarginate.

Length 2.64. Head 0.62 long, eye 0.18 long, raised setae over eyes average 0.14 long; antennomere ratios: I 2.33, II 1.90, III 2.00, IV 2.00, V 2.10, VIII 1.73, X 1.05, XI 1.95; fourth maxillary palpus 0.20 long, 0.12 wide; mandibular explanation 0.12 long, 0.06 wide. Pronotum 1.00 long, length from base to point of greatest width 0.30, break in antebasal pubescent band 0.26 wide; horn 0.40 long, width at base 0.24; crest 0.30 long, 0.15 wide at base; crest apex 0.04 above horn margin, horn apex 0.15 from crest apex; pronotal pit 0.06 long. Elytral setae 0.08 long. Emargination of fifth sternite 0.14 wide, 0.01 deep.

Specimens examined, 1: HOLOTYPE ♂, 10 mi S Catavina, Baja California, MEXICO, 29 July 1938, Michelbacher & Ross (CASC).

Distribution: The single specimen is known from the southern portion of Baja California.

Discussion: Most similar to an undescribed species from Arizona by the laterally directed setae in the elytral postbasal impression and the smoothly margined crest. It can be separated by the apex of the fifth sternite being emarginate rather than bisinuate.

Notoxus impressus Champion

(Figs. 21, 56)

Notoxus impressus Champion 1890: 206, Table IX, fig. 14. Type series localities: GUATEMALA: Aceytuno; Guatemala City; Capetillo. Type series in BMNH and FGW. Pic 1874: 47; 1911: 8.

Length 1.62-3.18. Head and pronotum reddish-brown to dark brown, elytra tan with brown markings: omoplates dark, in some specimens with irregular midband proceeding anteriorly along elytral suture to join mark on omoplates, mark on flanks of humeri joining midband, wide apical band. Pubescence brownish when arising from marks on elytra, yellowish in lighter areas. Setae on elytra and pronotum appressed, on elytra average angle 10°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn

without pits beneath, 6-9 teeth on horn margin. Crest crenulate, anterior margin pointed and indistinct. First and second protarsomeres lacking strong spur on apical posterior margin. Elytra narrowed in apical half.

Males with fifth sternite emarginate, slightly bisinuate, transverse depression immediately anterior to apical margin. Penis acutely pointed at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Cerro Verde, EL SALVADOR (DSC). Length 3.24. Head 0.68 long, eye 0.25 long, raised setae over eyes average 0.12 long; antennomere ratios: I 2.28, II 1.67, III 2.50, IV 2.50, V 2.23, VIII 2.33, X 1.50, XI 1.94; fourth maxillary palpus 0.21 long, 0.12 wide; mandibular explanation 0.12 long, 0.07 wide. Pronotum 1.10 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.25 wide; horn 0.48 long, 0.28 wide at base, 6 teeth on margin; crest 0.32 long, 0.12 wide at base; crest apex 0.01 above horn margin, horn apex 0.07 from crest apex; pronotal pit 0.14 long. Elytral setae 0.07 long, average angle 14°. Emargination of fifth sternite 0.18 wide.

Specimens examined, 14: GUATEMALA: Capetillo, G. C. Champion, paratype (FGW); Finca San Rafael, Sacatepeque, 6900', 28 June 1948, R. D. Mitchell (FMNH). EL SALVADOR: Cerro Verde, 6800', 29 June 1963, D. Q. Cavagnaro & M. E. Irwin (CASC); same locality, 18 June 1958, L. J. Bottimer (USNM); same locality, 2000 meters, 1 May 1971, H. F. Howden (CNCI).

Distribution: The central plateau in Guatemala and El Salvador. Present from May to June.

Discussion: It is actually quite distinct in appearance, but keys to near *eximius* by the crenulate crest merging into the horn. It can be separated by the sparse setae on the elytra, the more acuminate elytral apices and the complete postmedian light band.

Notoxus acuminatus Champion

(Figs. 22, 56)

Notoxus acuminatus Champion 1890: 210-11, Table IX, fig. 19. Type locality: Quezaltenango, 7800', GUATEMALA. BMNH. Lectotype ♂, designated by Chandler 1975. Pic 1894: 46; 1911: 5.

Length 3.05-3.80. Head and pronotum tan to brown, elytra tan with brown markings: oval marks on omoplates, often connected to irregular midband along elytral suture, preapical band present with apices tan, mark beneath humeri on flanks. Pubescence brownish when arising from dark areas, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 42°. Mandibular explanation wide, with front and hind margins at same level at mandible. Pronotum with pubescent antebasal band widely separated. Horn with pits beneath, 5-9 teeth on margins. Crest crenulate, pointed at apex, anterior margin indistinct. Elytra narrowed in apical half.

Males with fifth sternite widely emarginate at apex, with transverse ridge across center. Penis short, with apex slightly split into lateral parts. Lacking strong spur on posterior apical margin of first and second protarsomeres. Protibia with medial spine near middle.

Females with fifth sternite triangular, with median longitudinal ridge; first and second protarsomeres with strong spur on posterior apical margin.

Redescribed male: Junction of Highways 190 & 195, Chiapas, MEXICO

(DSC). Length 3.79. Head 0.79 long, eye 0.28 long, raised setae over eyes average 0.19 long; antennomere ratios: I 2.65, II 1.50, III 2.33, IV 2.26, V 2.12, VIII 1.89, X 1.47, XI 2.03; fourth maxillary palpus 0.24 long, 0.12 wide; mandibular explanation 0.12 long, 0.07 wide. Pronotum 1.28 long, length from base to point of greatest width 0.50, break in antebasal pubescent band 0.29 wide; horn 0.52 long, 0.39 wide at base, 6 teeth on margin; crest 0.32 long, 0.13 wide at base; crest apex 0.20 above horn margin, horn apex 0.18 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.18 long, average angle 32°. Emargination of fifth sternite 0.22 wide, 0.02 deep.

Specimens examined, 32: MEXICO: Chiapas: Junction of Highways 190-195, 8 May 1969, H. F. Howden (CNCI); same locality 6 June 1969, H. F. Howden (CNCI); same locality, 24 June 1973, G. Ekis (DSC, USNM); same locality, 32 mi W San Cristobal, 12 May 1969, H. J. Teskey (CNCI); 19 mi SE Tuxtla Gutierrex, 23 July 1963, J. Doyen (CISC). GUATEMALA: Quezaltenango, 7800', Champion, Lectotype and Syntype of *acuminatus* (BMNH); Antigua, 2000 meters, 20 June 1973, G. Ekis (DSC).

Distribution: Chiapas and Guatemala. Present from May through July.

Discussion: It is distinct in the group by the presence of lateral pits on the horn, the raised setae on the pronotum and the medial tubercle of the male protibiae.

Monodon-group

The *monodon*-group is defined as those *Notoxus* with the following characters: mandibular explanation wide, with hind margin prominent; pronotum with distinct raised setae, pubescent antebasal band widely broken; horn with lateral pits; crest without median ridge, margin smooth or crenulate; elytra unicolorous or with postmedian band, some setae raised. Males lacking modifications of elytra and legs; fifth sternite broadly rounded or truncate, without impressions, parameres simple, penis often split laterally at apex.

The Central American species are *desertus* Casey, *cumanensis* LaFerté, *celatus* n. sp., *jamaicus* Pic, *bipunctatus* Chevrolat, *murinipennis* (LeConte), *ruficollis* Champion and *peruvianus* Pic. The United States species included are *monodon* Fabricius, *planicornis* LaFerté and *filicornis* Casey.

This group is the most difficult to identify using color patterns. Examination of the genitalia and the collecting locality are the two tools used here for species identification, particularly for the maculate species near *N. monodon*. The genitalic differences are subtle, but consistent in the populations examined. Also most of these species are allopatric and restricted to islands or to separate areas on the mainland. It is possible that these species are in reality subspecies or "incipient species." The numerical analysis recognized these very similar species as being distinct, which can be justified here on the basis of the genitalic differences. There are names available for all of these species. Further collecting may reveal areas of sympatry, which would lend credence to the assumption that they are distinct species.

Notoxus cumanensis LaFerté

(Figs. 25, 57)

Notoxus cumanensis LaFerté 1848: 38-9. Type locality: Cumaná, VENEZUELA. Type series in MNHN.

Notoxus monodon var. *cumanensis*, Champion 1890: 212. Pic 1911: 10.
Werner 1965b: 22.
Notoxus monodon, auctorum.

Length 2.83-3.83. Head and pronotum tan, elytra tan with brown markings: circular mark on omoplates, postmedian irregular band protruding anteriorly along elytral suture, anterior flanks of elytra may be darkened. Pubescence brownish when arising from markings, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 70°. Mandibular explanation wide, with front and hind margins meeting at same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 5-9 teeth on margin. Crest elevated and distinct, rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded. Penis split laterally at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Rio Hato, PANAMA (DSC). Length 3.14. Head 0.64 long, eye 0.28 long, raised setae over eyes average 0.19 long; antennomere ratios: I 2.47, II 1.73, III 2.08, IV 1.92, V 1.87, VIII 1.73, X 1.29, XI 2.22; fourth maxillary palpus 0.19 long, 0.09 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.07 long, length from base to point of greatest width 0.36, break in antebasal pubescent band 0.22 wide; horn 0.42 long, 0.28 wide at base, 6 teeth on margin; crest 0.24 long, 0.11 wide at base; crest apex 0.08 above horn margin, horn apex 0.24 from crest apex; pronotal pit 0.16 long. Raised elytral setae 0.20 long, average angle 71°.

Specimens examined, 39: MEXICO: Tamaulipas: Victoria; 3 mi N Cd. Victoria, 800'; 47 km S Cd. Victoria, 900'; 8.5 mi S Soto la Marina; Santa Engracia; Gomez Farias. San Luis Potosi: Cuesta de los Cedros, 36 km E Cd. del Maiz, 2250'; El Salto de Agua, 100'; 8.7 mi S Santa Mario del Rio. Veracruz: El Palmar, 16 km W Tetzonapa, 600'; Jalapa; Orizaba; Cotaxtla Experiment Station, Cotaxtla. Tabasco: 59.4 mi SE Villahermosa, 100'. Oaxaca: Salina Cruz. BELIZE: Rio Hondo, Bluncaneau. HONDURAS: La Ceiba. PANAMA: Old Panama; Rio Hato: Canal Zone, Ancon. Collected in quarantine on orchids from COLOMBIA. Specimens in collections of: AMNH, CASC, CISC, CNCI, DSC, FGW, FMNH, MCZC, TAMU, TTCC, USNM.

Distribution: The moister areas of the east slope of the Sierra Madre Oriental in Mexico, south through Central America to Venezuela. Apparently present throughout the year. Attracted to light, ultra-violet light, arc light and cantharidin.

Discussion: Very similar in appearance to the other banded species in the group. The genitalia are similar to *monodon* and *jamaicus* by the laterally split apex of the penis. *N. jamaicus* is an island species with the parameres as long as the penis. *N. cumanensis* has the penis distinctly longer than the parameres and only a small dorsal hump near the penis apex. *N. monodon* has the parameres protruding beyond the penis and has a small dorsal tubercle near the penis apex.

Notoxus celatus, n. sp.

(Figs. 24, 57)

Length 2.70-3.68. Head and pronotum tan, elytra tan with brown markings: circular mark on omoplates, irregular postmedian band protruding

anteriorly along elytral suture, mark on flanks of elytra behind humeri. Pubescence brownish when originating in markings, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 64°. Mandibular explanation wide, with front and hind margins meeting on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 3-8 teeth on margin. Crest elevated and distinct, rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded. Penis split dorso-ventrally at apex, with strong dorsal tooth near apex.

Females with fifth sternite rounded-triangular.

♂ holotype: 2 mi N Jojutla, Morelos, MEXICO. Length 2.99. Head 0.64 long, eye 0.25 long, raised setae over eyes average 0.18 long; antennomere ratios: I 2.47, II 1.64, III 2.27, IV 2.09, V 1.92, VIII 1.87, X 1.67, XI 2.17; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.09 long, 0.06 wide. Pronotum 0.96 long, length from base to point of greatest width 0.30, break in antebasal pubescent band 0.20 wide; horn 0.38 long, 0.26 wide at base, 6 teeth on margin; crest 0.18 long, 0.10 wide at base; crest apex 0.08 above horn margin, horn apex 0.22 from crest apex; pronotal pit 0.14 long. Raised elytral setae 0.17 long, average angle 62°.

Specimens examined, 241: HOLOTYPE ♂, 2 mi N Jojutla, Morelos, MEXICO, 20 July 1974, R. L. Mangan & D. S. Chandler, cantharidin trap (USNM). PARATYPES: Chihuahua: Catarinas, 5800'. Jalisco: 3 mi SE Plan de Barrancas. Michoacan: 12 mi S Tzitzio on Huetamo Road, 1050 meters; Tuxpan, 6720'. Guerrero: 8 mi SE Iguala; Iguala. Mexico: 2 mi NE Ixtapan de la Sal; Real de Arriba, Temescaltepec, 6-7000'; Tejupilco, ca. 400'; Temescaltepec, ca. 5000'. Morelos: Xochitepec; Cuernavaca; 3 mi N Alpuyeca, 3400'; 5 mi N Axochiapan; 2 mi N Jojutla; 4.4 mi E Cuernavaca; 10 mi E Cuernavaca; 7 mi E Cuernavaca. Puebla: Atlixco; Puebla; 4 mi NW Tehuitzingo, 3500'; 13.3 mi NE Tehuitzingo; 1.1 mi W Acatlan; 11 mi SE Acatlan; 7 mi SW Izucar de Matamoros; 12 mi SW Izucar de Matamoros; 11.8 mi W Izucar de Matamoros; 5 mi SW Chipilo; Tehuacan, ca. 5200'; 6 mi SW Tehuacan; 4 mi S Petalcingo, 5150'. Oaxaca: Huajuapan de Leon; 10 mi NE Huajuapan de Leon. One specimen, state unknown, Rio Blanco. Paratypes in collections of: AMNH, BMNH, CASC, CISC, CNCI, CUIC, DSC, FGW, FMNH, MCZC, MSUC, TAMU, TTCC, UCDC, UMMZ, USNM.

Distribution: The higher elevations of central Mexico, extending north to Chihuahua. It has been collected from April to August by beating vegetation, mesquite, acacia and looking under recently uprooted weeds. Attracted to light, ultra-violet light, cantharidin and drying meloid beetles.

Discussion: It is similar in external appearance to the other banded species in the group. It is separated from these species by having the penis split laterally and dorsoventrally at the apex. There is a dorsal, anteriorly directed process near the apex of the penis which is also not found in the other species.

Notoxus desertus Casey

(Figs. 23, 57)

Notoxus desertus Casey 1895: 767-8. Type locality: Tucson, Arizona. USNM Type #36536. Leng 1920: 163.

Notoxus constrictus Casey 1895: 768. Type locality: coast regions of California. USNM Type #36527. Leng 1920: 163. Fall 1902: 33, 182.

Length 2.83-4.18. Head and pronotum tan, elytra tan with brown markings: circular mark on omoplates, irregular postmedian band protruding anteriorly along elytral suture, form of band variable, may reach anteriorly almost to omoplates or may have straight or irregular margins, mark may be present along anterior flanks. Pubescence brownish when arising from markings, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 72°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 4-9 teeth on margin. Crest elevated and distinct, usually faintly crenulate, rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Rio Vista, California (DSC). Length 3.22. Head 0.66 long, eye 0.23 long, raised setae over eyes average 0.21 long, antennomere ratios: I 2.35, II 1.91, III 2.27, IV 2.27, V 2.00, VIII 1.67, X 1.24, XI 2.35; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.02 long, length from base to point of greatest width 0.30, break in antebasal pubescent band 0.24 wide; horn 0.41 long, 0.30 wide at base, 8 teeth on margin; crest 0.26 long, 0.12 wide at base; crest apex 0.11 above horn margin, horn apex 0.19 from crest apex; pronotal pit 0.18 long. Raised setae 0.21 long, average angle 66°.

Specimens examined, 344: MEXICO: Baja California: Misíon; Hamilton Ranch; Ensenada. Baja California Sur: Mulegé; 15 mi N San Ignacio; La Paz; 12 mi NW La Paz; 3.5 mi NE San Pedro; 2 mi SE Todos Santos. Sonora: Alamos: 13 mi SE Alamos; Navajoa; 10 mi E Navajoa; 16 mi NE Cd. Obregon; Saric; Sinaloa: San Javier; Mazatlan; 5 mi N Mazatlan; Los Mochis; 13 mi N Los Mochis; Choix; 5.5 mi NW Choix; 35 mi S Escuinapa; 21 mi E Villa Union; Venedio; 26 mi N Pericos; Los Mayos; 20 mi E Guasave; 5 mi E Concordia; 1 mi W San Blas; Culiacan. Nayarit: San Blas; Rio de las Canyas, 8 mi NW Acaponeta; Tepic; Arroyo Santiago, nr. Jesus Maria; Arroyo Canaveral, nr. Jesus Maria; La Mesa de Nayarit. Chihuahua: Delicias; 10 mi S Delicias. Durango: 2 mi NW Nombre de Dios. Zacatecas: 4 mi E Zacatecas; 15 mi NE Fresnillo; 28 mi S Jalpa. Coahuila: 10 mi S Allende; Boquillas del Carmen; 12 mi N Hermanas. Nuevo Leon: Monterrey; 5 mi S Monterrey; Apodaca; 6 km S Galeana; Linares, Rio Camacho; Mamulique Pass. Tamaulipas: Tampico; 39.5 mi S Jaumave. Hidalgo: Zimapan; 1 mi SE Yolotepec. Queretaro: 12 mi N Vizarrón; Tequisquiapan. Guanajuato: 3 mi N Irapuato. Aguascalientes: Aguascalientes. Jalisco: Lagos de Moreno; Oblatos Canyon, Guadalajara; Chapala; Tecalitlan; Catalitlan. Oaxaca: Oaxaca; 15 mi NW Oaxaca; Mitla; 11.3 mi SE Totolapan; Yagul ruins. Veracruz: Veracruz; Sontecomapan; Jicacal, 7 mi N Sontecomapan; 2 mi NE Catemaco; 2 mi SE Nautla. Tabasco: Frontera. GUATEMALA: Atitlan-see. Specimens in collections of: AMNH, CASC, CDAE, CISC, CNCI, DSC, FGW, FMNH, LACM, MCZC, MSUC, OSUC, TAMU, UCDC, USNM.

Distribution: Found through all of the United States except Southeast, extending south through most of Mexico to Guatemala. Present year-round. This species does not appear to occur in the moister areas of the Sierra Madre Oriental and the region centered by Mexico City. It has been collected sweeping, under low vegetation in corn fields, beating, on *Hoffmannseggia*, on

Helenium nudifloris, on *Medicago*, on roses and on shelled corn. It is attracted to light, ultra-violet light, drying meloid beetles and cantharidin.

Discussion: It is similar to all of the banded species in the group due to the variation in the elytral color pattern. The penis is not split laterally at the apex and is most similar to *bipunctatus*. It is separated from that species by being present on the mainland and lacking the more extensive dark areas on the elytra.

Notoxus bipunctatus Chevrolat

(Figs. 26, 57)

Notoxus bipunctatus Chevrolat 1877: ix. Type locality: Puerto Rico. Type in MNHN. Pic 1894: 46; 1911: 6.
Notoxus Krugi (sic) Quedenfeldt 1886: 121-2. Type locality: Puerto Rico. Pic 1894: 47; 1911: 47.

Length 2.80-3.38. Head and pronotum yellow-brown, elytra yellow-brown with brown markings: usually with oval mark on omoplates, very irregular postmedian band, usually anterior flanks of elytra darkened. Pubescence brownish when arising from marks, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 44°. Mandibular explanation moderately wide, with front and hind margins meeting on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 4-6 teeth on margin. Crest distinct and elevated, pointed or rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded. Penis slightly split laterally at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Ponce, PUERTO RICO (DSC). Length 3.22. Head 0.62 long, eye 0.28 long, raised setae over eyes average 0.16 long; antennomere ratios: I 2.00, II 1.36, III 2.00, IV 1.99, V 1.99, VIII 1.71, X 1.53, XI 2.60; fourth maxillary palpus 0.18 long, 0.10 wide; mandibular explanation 0.08 long, 0.06 wide. Pronotum 0.92 long, length from base to point of greatest width 0.29, break in antebasal pubescent band 0.30 wide; horn 0.37 long, width at base 0.28, 4 teeth on margin; crest 0.22 long, 0.12 wide at base; crest apex 0.07 above horn margin, horn apex 0.16 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.13 long, average angle 40°.

Specimens examined, 18: PUERTO RICO: Ponce, 1/15 June 1945, J. M. Capriles, light trap (USNM); same locality, 21 September 1933, R. G. Oakley, *Scirpus validus* (DSC, USNM); same data except, San Juan, 31 August 1933 (USNM); Coamo Springs, 2 April 1931, S. T. Danforth (MCZC); same locality, 11 February (AMNH); Rio Piedras, July 1931, Alsina (MCZC); Anasco district, 3 July 1917, H. Morrison (USNM).

Distribution: The island of Puerto Rico. Collected on *Scirpus validus* and attracted to light. Present year-round.

Discussion: It is most similar to *desertus* in having the penis without a deep lateral split, although it does have a notch at the apex. Separated from the other species by its occurrence on the island of Puerto Rico.

Notoxus jamaicus Pic

(Figs. 27, 57)

Notoxus jamaicus Pic 1913: 8-9. Type locality: Jamaica. Type in MNHN.
Notoxus quinquemaculatus Pic 1918: 117. Type locality: Jamaica. Type in MNHN. NEW SYNONYMY.

Length 2.70-3.50. Head and pronotum yellow-brown to dark red-brown, pronotum dark brown in lower half, elytra yellow-brown with dark red-brown markings: oval mark on omoplates, rectangular mark along sides of elytral suture at middle, lateral oval marks at end of this mark, these marks often connected together and with mark on omoplates, mark on flanks of elytra curving inward to elytral suture near apex. Pubescence brownish when arising from dark portions of body, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 53°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 3-7 teeth on margin. Crest distinct and elevated, usually rounded at apex. First and second protarsomeres with strong spur on posterior apical margin.

Male fifth sternite broadly rounded. Penis split laterally at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Alligator Pond, JAMAICA (DSC). Length 2.95. Head 0.66 long, eye 0.28 long, raised setae over eyes average 0.15 long; antennomere ratios: I 2.18, II 1.73, III 2.00, IV 2.00, V 2.00, VIII 1.89, X 1.44, XI 2.24; fourth maxillary palpus 0.18 long, 0.12 wide; mandibular explanation 0.09 long, 0.06 wide. Pronotum 0.93 long, length from base to point of greatest width 0.28, break in antebasal pubescent band 0.28 wide; horn 0.38 long, 0.32 wide at base, 4 teeth on margin; crest length 0.22, width at base 0.12; crest apex 0.08 above horn margin, horn apex 0.17 from crest apex; pronotal pit 0.16 long. Raised elytral setae 0.15 long, average angle 49°.

Specimens examined, 23: JAMAICA: Alligator Pond, 20 February, Chaplin & Blackwelder (DSC, USNM); Alligator Pond Bay, 25 February 1937, Station 410, Chaplin & Blackwelder (USNM); Santa Cruz, 24 February 1937, Station 421, Chaplin & Blackwelder (USNM); Morant Bay, 6 February 1937, Station 391, Chaplin & Blackwelder (DSC, USNM); Spanish Town, 2 February 1936, Station 377, Chaplin & Blackwelder, flying at dusk (USNM); Milk River, 25 February 1937, Station 415, Chaplin & Blackwelder (USNM); Trelawney, Duncans, 4 August 1966, Howden & Becker (CNCI); same locality, 7 August 1966, A. T. Howden, at light (HAHC); St. Andrew Parish, Bull Run, 19 April 1959, Farr & Sanderson, on *Agave americana* (FGW).

Distribution: The island of Jamaica. Collected on *Agave* and attracted to light. Probably present year-round.

Discussion: It is most similar to *cumanensis* and *monodon* by the penis being laterally split at the apex. The parameres are as long as the penis which places it as an intermediate between the other two species. There is no trace of a dorsal hump near the penis apex.

Notoxus murinipennis (LeConte)

(Figs. 28, 57)

Anthicus bicolor Say 1817: plate IV (not bicolor Oliver). Type locality: New Jersey and Pennsylvania. Say 1824: 21; 1827: 38.
Anthicus murinipennis LeConte 1824: 170. Type locality: Georgia. MCZ Type #4889.
Monocerus bicolor, LeConte 1847: 90.
Notoxus bicolor LaFerté 1848: 53. LeConte 1852: 94. Horn 1884: 167. Champion 1890: 205. Casey 1895: 756. Pic 1911: 6. Leng 1920: 162.
Notoxus murinipennis, Barber 1941: 26.

Length 2.91-3.90. Head and elytra varying from tan to blue-brown, pronotum varying from tan to orange. Pubescence whitish over all of body. Raised setae distinct on pronotum, of moderate length on elytra, average angle 35°. Mandibular explanation wide, with front and hind margins meeting on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 6-10 teeth on margin. Crest margin crenulate, front rarely indistinct and merging with horn, front pointed. First and second protarsomeres with strong spur on posterior apical margin.

Male with fifth sternite broadly rounded at apex. Penis slightly split laterally at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 2 mi E Roper, North Carolina (DSC). Length 3.34. Head 0.67 long, eye 0.28 long, raised setae over eyes average 0.14 long; antennomere ratios: I 2.92, II 2.00, III 2.45, IV 1.61, V 1.78, VIII 1.86, X 1.37, XI 2.33; fourth maxillary palpus 0.18 long, 0.10 wide; mandibular explanation 0.08 long, 0.05 wide. Pronotum 1.10 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.26 wide; horn 0.46 long, 0.32 wide at base, 10 teeth on margin; crest 0.32 long, 0.15 wide at base; crest apex 0.05 above horn margin, horn apex 0.15 from crest apex; pronotal pit 0.18 long. Raised elytral setae 0.11 long, average angle 30°.

Specimens examined, 19: MEXICO: San Luis Potosi: Tamazunchale, Rt. 1, km 365, 31 May 1948, F. Werner & W. Nutting, river in tropical area, light trap (FGW); same locality, 1 May 1955, Buliofer & Guelo (USNM). Veracruz: Cordoba, 19 April 1908, A. Fenyes (USNM); same data except, April 30, 1908 (USNM); same locality (CASC); Fortin de las Flores, 24 December 1963, L. B. & C. W. O'Brien (CASC); same locality, 28 June 1975, D. S. Chandler, meloid trap, ultraviolet light (DSC). Oaxaca: 11 mi N Matias Romero, 6 June 1971, Clark, Murray, Hart, Schaffner (TAMU). GUATEMALA: Gualan, 13 February 1906, J. S. Hine (OSUC). Collected in quarantine at Brownsville, Texas, with avocados and on bag of green pepper (USNM).

Distribution: From the southeastern portion of the United States through the moist eastern slope of the Sierra Madre Oriental to Guatemala. Apparently present throughout the year. Collected by beating vegetation and attracted to harvested crops, ultra-violet light and drying meloid beetles.

Discussion: It is most similar to *ruficollis* by the short raised elytral setae and the unicolorous elytra. It can be separated by the unicolorous pronotum and the parameres paralleling the penis.

Notoxus ruficollis Champion

(Figs. 29, 57)

Notoxus ruficollis Champion 1890: 205, Table XI, fig. 13. Type locality: San Lorenzo, Chiriqui, PANAMA. Type series in BMNH. Pic 1894: 47; 1911: 11.
Notoxus atripennis Champion 1890: 205. Type locality: Chacoj, Polochic Valley, GUATEMALA. Type in BMNH, ♀. Pic 1894: 46; 1911: 6. NEW SYNONYMY.

Length 2.41-2.46. Head, horn on pronotum and elytra blue-orange, rest of pronotum dusky-orange. Pubescence whitish over all of body. Raised setae distinct on pronotum, of moderate length on elytra, average angle 35°. Mandibular explanation wide, with front and hind margins meeting at same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 9-11 teeth on margin. Crest margin crenulate, front indistinctly merging with horn. First and second protarsomeres with strong spur on posterior apical margin.

Male with fifth sternite broadly rounded. Apical half of parameres bent laterally.

Female with fifth sternite rounded-triangular.

Redescribed ♂: Trece Aguas, Alta Vera Paz, GUATEMALA (USNM). Length 2.41. Head 0.72 long, eye 0.28 long, raised setae over eyes average 0.14 long; antennomere ratios: I 2.15, II 1.78, III 1.78, IV 1.44, V 1.45, VIII 1.67, X 1.28, XI 2.05; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.12 long, 0.07 wide. Pronotum 1.12 long, length from base to point of greatest width 0.46, break in antebasal pubescent band 0.22 wide; horn 0.38 long, 0.28 wide at base, 11 teeth on margin; crest 0.25 long, 0.13 wide at base; crest apex merging with horn; horn apex 0.10 from crest apex; pronotal pit 0.24 long. Raised elytral setae 0.07 long, average angle 35°.

Specimens examined, 2: GUATEMALA: Cacao, Trece Aguas, Alta Vera Paz, April 1923, Schwarz & Barber (USNM); Chacoj, Vera Paz, Champion, Holotype of *Notoxus atripennis* Champion (BMNH).

Distribution: From Guatemala to Panama.

Discussion: It is most similar to *murinipennis*. It can be separated by the horn being abruptly darker than the pronotum and the laterally spread parameres.

Notoxus peruvianus Pic

(Figs. 30, 58)

Notoxus peruvianus Pic 1904: 228. Type locality: Cuzco, PERU. Type in MNHN. Pic 1914: 183.

Length 2.70-3.74. Head and pronotum tan, elytra tan to blue-orange. Pubescence yellowish. Raised setae long and erect on pronotum and elytra, average angle on elytra 69°. Mandibular explanation wide, with front and hind margins meeting on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn with pits beneath, 6-11 teeth on margin.

Crest crenulate, anterior margin usually distinct, apex usually pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite broadly rounded at apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 16 km N Barranca, PERU (DSC). Length 3.60. Head 0.75 long, eye 0.32 long, raised setae over eyes average 0.20 long; antennomere ratios: I 2.30, II 1.40, III 1.53, IV 1.39, V 1.67, VIII 1.70, X 1.45, XI 2.15; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.12 long, 0.06 wide. Pronotum 1.14 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.26 wide; horn 0.48 long, 0.28 wide at base, 6 teeth on margin; crest 0.30 long, 0.11 wide at base; crest apex 0.02 above horn margin, horn apex 0.18 from crest apex; pronotal pit 0.18 long. Raised elytral setae 0.19 long, average angle 72°.

Specimens examined, 39: PERU: 16 km N Barranca, 15 March 1951, Ross & Michelbacher (CASC); Casma, 24 March 1951, Michelbacher & Ross (CASC); 10 km S Chiclayo, 19 March 1951, Ross & Michelbacher (CASC); Amotape, 13 November 1938, D. & H. Frizzell (FGW); Chancay, 25 March 1951, Ross & Michelbacher, river valley (CASC); Lima, J. Wille (USNM); Lima, 13 March 1931, F. Wille (USNM); Yantan, September 1929, Wille (USNM); Canete, May and June 1941, C. P. Clause (USNM); Montevideo, South America Paras Laboratory, 30 December 1941, Berry (USNM). BOLIVIA: Chaco-Chalumani, 25 May, G. L. Harrington (CASC).

Distribution: Peru and Bolivia. Apparently present throughout the year.

Discussion: It is most similar to *murinipennis* and *ruficollis* by the unicolorous elytra. It can be separated by the longer and more erect setae of the elytra.

Nuperus-group

The *nuperus*-group is defined as those *Notoxus* with the following characters: mandibular explanation narrow to wide; pronotal tactile setae short and distinct, usually uncommon, pubescent antebasal band widely broken; horn without lateral pits; crest margin smooth, apex pointed or rounded; elytral setae appressed; males with simple elytra and legs; fifth sternite emarginate, circular impression before apex.

The species included in the group are *nuperus* Horn, *haustrus* n. sp., *posticus* n. sp. and *orientalis* n. sp.

Notoxus nuperus Horn

(Figs. 32, 60)

Notoxus nuperus Horn 1884: 168. Type locality: Arizona. MCZC Type #3043, ♂. Pic 1894: 47; 1911: 10. Casey 1895: 757. Leng 1920: 162. Pallister 1955: 11, in part.

Length 3.30-4.48. Head and pronotum tan to red-brown, elytra tan with brown markings: postmedian band extending anteriorly along elytral suture to omoplates, apical band extending along elytral suture to postmedian band, flanks often dark. Pubescence brownish when arising from marks, whitish over rest of body. Raised setae uncommon but distinct on pronotum, setae on elytra appressed, average angle 9°. Mandibular explanation moderately wide,

often front and hind margins meet mandible at same level. Pronotum with antebasal band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth, apex distinct, pointed or rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite deeply emarginate into deep circular impression. Fourth sternite often slightly flattened medially.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Texas Canyon, Cochise County, Arizona (DSC). Length 3.56. Head 0.67 long, eye 0.26 long, raised setae over eyes average 0.10 long; antennomere ratios: I 2.67, II 1.83, III 2.00, IV 1.78, V 2.00, VIII 1.40, X 1.13, XI 2.24; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.12 long, 0.05 wide. Pronotum 1.09 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.28 wide; horn 0.48 long, 0.33 wide at base, no teeth on margin; crest 0.35 long, 0.14 wide at base, apex pointed; crest apex 0.08 above horn margin, horn apex 0.16 from crest apex; pronotal pit 0.12 long. Elytral setae 0.08 long, average angle 8°. Emargination of fifth sternite 0.18 wide, 0.06 deep.

Specimens examined, 78: MEXICO: Chihuahua: 5 mi NE Hidalgo del Parral, 6000'; Catarinas, 5800'; Valle de Olivos, 5500'; Primavera, 5500-6000'; 6 mi S Villa Matamoros; 15 mi E Cuauhtemoc, 6600'; Santa Clara Canyon, 5 mi W Parrita. Durango: Tepehuanes; Durango; 5 mi W Durango; 23 mi S Durango. Jalisco: 5 km W Lagos, 6000'. Specimens in collections of: AMNH, CASC, CISC, CNCI, DSC, FGW, MCZC, TTCC, UCDC, USNM.

Distribution: From southeastern Arizona through the western half of the central plateau of Mexico. Attracted to white and ultra-violet light. Present from June through August.

Discussion: Very similar to *haustrus* by the deep impression of the male fifth sternite and the general external appearance. It is separated by having at the most the fourth sternite slightly flattened, the presence of some erect setae on the pronotum, and the mandibular explanation being moderately wide to wide. Similar to *orientalis* in the appressed setae on the elytra, but easily separated by the deep impression on the male fifth sternite.

Notoxus haustrus, n. sp.

(Figs. 33, 60)

Notoxus nuperus, Pallister 1955: 11, in part.

Length 2.90-4.38. Head and pronotum tan to orange-brown, elytra tan with brown markings: irregular postmedian band extending anteriorly along elytral suture, flanks often dark, apical band extending anteriorly along elytral suture. Pubescence brownish when arising from marks, whitish over rest of body. Setae on pronotum and elytra appressed, on elytra average angle 10°. Mandibular explanation narrow, with hind margin indistinct and meeting mandible at lower level than front margin. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite deeply emarginate into large circular impression. All sternites usually medially flattened.

Females with fifth sternite rounded-triangular.

♂ holotype: Colossal Cave County Park, Pima County, Arizona. Length

3.59. Head 0.70 long, eye 0.30 long, raised setae above eyes average 0.10 long; antennomere ratios: I 2.35, II 1.54, III 1.92, IV 1.33, V 1.47, VIII 1.14, X 0.83, XI 1.70; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.10 long, 0.05 wide. Pronotum 1.05 long, length from base to point of greatest width 0.35, break in antebasal pubescent band 0.38 wide; horn 0.50 long, 0.33 wide at base, no teeth on margin; crest 0.26 long, 0.16 wide at base; crest apex 0.12 above horn margin, horn apex 0.19 from crest apex; pronotal pit 0.10 long. Elytral setae 0.08 long, average angle 8°. Emargination of fifth sternite 0.24 wide, 0.08 deep.

Specimens examined, 225: HOLOTYPE ♂, Colossal Cave County Park, Pima Co., Arizona, 8 July 1973, K. Stephan, UV light (USNM). PARATYPES: Montana: Broadwater Co.: Toston. Utah: San Juan Co.: Monticello; Poverty Flats. New Mexico: McKinley Co.: Tohatchi; Gallup. Bernalillo Co.: Albuquerque; 7 mi NE Albuquerque. Doña Ana Co.: Las Cruces. Luna Co.: 40 mi S Deming. Arizona: Apache Co.: Ganado. Gila Co.: Cutter; Globe; Claypool. Graham Co.: Bonita. Yavapai Co.: Dewey; Kirkland; Skull Valley. Pinal Co.: 5 mi N Mammoth. Pima Co.: Tucson; Corona de Tucson; I. B. P. site, Santa Rita Range Reserve; Continental; 7 mi SE Continental; 5 mi E Sahuarita; 4 mi NNW Redington; Arizona-Sonora Desert Museum; mouth of Bear Canyon, Santa Catalina Mtns.; Chutum Vaya Canyon, Baboquivari Mtns.; Brown's Canyon, Baboquivari Mtns.; Bog Springs, Madera Canyon. Santa Cruz Co.: Tumacacori; 8 mi N Nogales; Sycamore Canyon, nr. Ruby; Peña Blanca, 10 mi W Nogales; 1 mi S Patagonia; 10 mi S Patagonia; Canelo. Cochise Co.: Pearce; Willcox; Cochise Stronghold, Dragoon Mtns.; Bowie; 5 mi W entrance Chiricahua National Monument. MEXICO: Sonora: Hermosillo; 40 mi N Hermosillo; Saric; Navajoa; 20 mi NE Obregon. Sinaloa: Los Mochis. Chihuahua: Santa Clara Canyon, 5 mi W Parrita; 3 mi S Villa Ahumada; Chihuahua; 5 mi N Cerro Campana; Primavera; Delicias; 25 mi SW Camargo; 5 mi S Galeana. Zacatecas: Laguna Balderama, 25 mi W Fresnillo. Paratypes in collections of: AMNH, CASC, CDAE, CISC, DSC, FGW, MCZC, OSUC, TTCC, USNM.

Distribution: The Great Plains to northwestern Mexico. Collected on cotton, alfalfa, *Salix*, *Baccharis glutinosa*, *Prosopis glandulosa*, *Chilopsis linearis* and *Sapindus saponaria*. Attracted to light, ultra-violet light and drying meloid beetles (Werner 1964 as *N. nuperus*). Present from June to September.

Discussion: It is most similar to *nuperus*. Separated by the narrow mandibular margin, the appressed setae on the pronotum, and by usually having the first four sternites medially flattened in the male, along with the differences in horn structure used in the key to species. *Nuperus* and *haustrus* are the only species of the *nuperus*-group found on the western half of the Mexican central plateau.

Notoxus postictus, n. sp.

(Figs. 34, 60)

Length 2.80-3.39. Head and pronotum orange to brown, elytra tan with brown markings: circular mark on omoplates, postmedian band slightly curved anteriorly to elytral suture, occasionally reaching marks on omoplates, apical band often meeting postmedian band along elytral suture, flanks usually dark. Pubescence brownish when arising from marks, whitish over rest of body. Raised setae distinct on pronotum, setae on elytra decumbent,

average angle of setae at greatest elevation 20°. Mandibular explanation narrow, hind margin meeting mandible on lower level than front margin. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-4 teeth on margin. Crest margin smooth, apex distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite deeply emarginate into deep, slightly transverse impression.

Females with fifth sternite rounded-triangular.

♂ holotype: Santa Engracia, Tamaulipas, MEXICO. Length 3.48. Head 0.72 long, eye 0.30 long, raised setae above eyes average 0.12 long; antennomere ratios: I 2.17, II 1.67, III 2.31, IV 1.47, V 1.47, VIII 1.20, X 0.87, XI 1.75; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.10 long, 0.04 wide. Pronotum 1.10 long, length from base to point of greatest width 0.37, break in antebasal pubescent band 0.27 wide; horn 0.44 long, 0.31 wide at base, 1 tooth on margin; crest 0.26 long, 0.12 wide at base, apex pointed; crest apex 0.09 above horn margin, horn apex 0.22 from crest apex; pronotal pit 0.13 long. Raised setae 0.10 long, average angle 19°. Emargination of fifth sternite 0.16 wide, 0.04 deep.

Specimens examined, 38: HOLOTYPE ♂, Santa Engracia, Tamaulipas, MEXICO, 23 June 1969, J. M. Mathieu & M. W. Sanderson, black light trap (USNM). PARATYPES: Texas: Brewster Co.: 2♂♂, 1♀, 9 mi W Alpine, 17 August 1969, J. C. Schaffner, at light (TAMU). Crosby Co.: 1♂, 1♀, Post & Crosbyton, 27 June, T. C. Clark & L. J. Muchmore (LACM). Culberson Co.: 1♂, Pine Springs, 18 August 1970, C. W. O'Brien (TTCC). Randall Co.: 1♂, Palo Duro State Park, nr. Amarillo, 27 June 1968, J. E. Slansky (UCDC). Uvalde Co.: 2♂♂, Garner State Park, 22/24 June 1961, R. L. Westcott (LACM). MEXICO: Coahuila: 1♂, 10 mi S Allende, 11 August 1958, H. F. Howden (CNCI). Nuevo Leon: 1♀, Mamulique Pass, 18 June 1975, D. S. Chandler, UV light (DSC); 1♀, Linares, Rio Camacho, 21/22 June 1965, O. S. Flint (USNM); 1♂, 15 mi W Linares, 27 August 1969, J. Doyen & J. Haddock (CISC); 1♀, 20 mi W Linares, 8 November 1946, E. S. Ross (CASC); 2♂♂, 2♀♀, Huasteca Canyon, nr. Monterrey, 11 July 1963, H. F. Howden (CNCI); 1♂, 6 km S Galeana, 25/26 June 1969, M. W. Sanderson & J. M. Mathieu, black light trap (FGW). Tamaulipas: 4♂♂, 1♀, eutopotypical; 4 mi SW Cd. Victoria, 1100'; 3♂♂, 10 July 1963 and 1♂, 5 August 1963, Duckworth & Davis (USNM); 1♂, 29 km S Hidalgo, 11 July 1952, F. & F. Werner (FGW). San Luis Potosi: 1♂, 1♀, Tamazunchale, Rt. 1, km 365, 31 May 1948, F. Werner & W. Nutting, river in tropical area, light trap (FGW); 1♂, same locality, 1 May 1955, Buliofer & Guelo (USNM); 5♀♀, 1 mi SW Tamazunchale, 7 July 1966, P. M. Wagner, at light (TAMU).

Distribution: Western Texas into northern Mexico east of the Sierra Madre Oriental. Attracted to light and ultra-violet light. Present from May to November.

Discussion: It is similar to *haustrus* and *nuperus* in the deep impression of the male fifth sternite. Easily separated from the other species in the group by the slightly raised elytral setae. The only species of this group which are on the east side of the Central Plateau are *postictus* and *orientalis*.

Notoxus orientalis, n. sp.

(Figs. 35, 60)

Length 2.82-3.55. Head brown to dark brown, pronotum orange to red-

brown, elytra tan with brown markings: postbasal band across omoplates often interrupted at elytral suture, irregular postmedian band advanced along elytral suture, rarely meeting postbasal band, apical band extending anteriorly along elytral suture. Pubescence brownish when arising from dark areas, whitish over rest of body. Raised setae distinct on pronotum, setae on elytra appressed, average angle 8^{o}. Mandibular explanation narrow, hind margin meeting mandible at lower level than front margin. Pronotum with antebasal pubescent band widely broken. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate, shallow circular impression from apex.

Females with fifth sternite rounded-triangular.

♂ holotype: 6 km S Galeana, Nuevo Leon, MEXICO. Length 3.58. Head 0.65 long, eye 0.24 long, raised setae above eyes 0.08 long; antennomere ratios: I 2.25, II 1.50, III 2.00, IV 1.64, V 1.59, VIII 0.96, X 0.86, XI 1.54; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.11 long, 0.04 wide. Pronotum 1.14 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.26 wide; horn 0.44 long, 0.32 wide at base, no teeth on margin; crest 0.28 long, 0.14 wide at base; crest apex 0.12 above horn margin, horn apex 0.22 from crest apex; pronotal pit 0.10 long. Elytral setae 0.08 long, average angle 7^{o}. Emargination of fifth sternite 0.16 wide, 0.01 deep.

Specimens examined, 69: HOLOTYPE ♂, 6 km S Galeana, Tamaulipas, MEXICO, 25/26 June 1969, M. W. Sanderson & J. M. Mathieu, black light trap (USNM). PARATYPES: MEXICO: Coahuila: 1♀, 21 mi SE Saltillo, 6000', 18 July 1963, H. F. Howden (CNCI). Nuevo Leon: 5♂♂, 1♀, 3 mi S Galeana, 5400', 29 May 1971, A. Newton, blacklight-thorn scrub (FGW); 8♂♂, eutopotypical; 1♂, 16 mi W Linares on Mex. 60, 2200', 26/29 May 1971, A. Newton, canyon bottom, UV trap (FGW); 2♂♂, 40 mi NW Junction Highway 57 & 60, 22 June 1971, C. W. O'Brien & Marshall (TTCC); 1♂, Cerro Potosi, 10,200' Schaffner (TAMU); 9♀♀, 18 N La Escondida, 4 July 1974, Clark, Murray, Ashe, Schaffner (TAMU); 1♀, 3 mi S Pacheco, 3/4 July 1974, Clark, Murray, Ashe, Schaffner (TAMU). San Luis Potosi: 3♂♂, 3♀♀, km 710, Highway 57 N of San Luis Potosi, 11 July 1969, Ward, Tenorio, Bennett, host: mesquite (TTCC); 1♂, 2♀♀, 19 mi N San Luis Potosi, 1 September 1958, H. F. Howden (CNCI); 3♀♀, 11 mi N Matehuala, 2 September 1958, H. F. Howden (CNCI). Hidalgo: 13♂♂, 1♀, Zimapan, 11/14 June 1951, P. D. Hurd, H. E. Evans, at light (CASC); 1♂, 2 mi SE Zimapan, 24 June 1975, D. S. Chandler, beating vegetation (DSC).

Distribution: The drier areas around the Sierra Madre Oriental. Collected on mesquite and by beating vegetation. Attracted to light and ultra-violet light. Present from May through September.

Discussion: Similar to *nuperus* and *haustrus* in the appressed elytral setae. It is very distinct in the shallow impression of the male fifth sternite and the very irregular postmedian band.

Apicalis-group

The *apicalis*-group is defined as those *Notoxus* with the following characters: mandibular explanation narrow, hind margin meeting mandible at a lower level than the front margin; pronotal tactile setae distinct, pubescent

antebasal band widely broken; crest margin smooth, apex rounded and distinct; elytra with postmedian band, raised setae present; males without modifications of the elytra and legs; fifth sternite emarginate; penis and parameres simple.

The Central American species included are *apicalis* LeConte, *marginatus* LeConte and *mexicanus* Champion. One United States species, *pallidus* Fall, is also included. This species is found along the lower Colorado River and probably also occurs in Mexico along the river. It is included in the key to species.

Notoxus apicalis LeConte

(Figs. 47, 63)

Notoxus apicalis LeConte 1852: 93. Type locality: Detroit, Michigan (probably incorrect). MCZC type #4892, ♀. Horn 1884: 170. Casey 1895: 758. Pic 1911: 5. Leng 1920: 163. *Not* Pallister 1955: 9, misidentification.
Notoxus nuperoides Fall 1916: 33-4. Type locality: Silver City, New Mexico. MCZC type #24331, ♂. Leng 1920: 162.

Length 3.37-4.40. Head and pronotum tan to brown, pronotum often with lateral areas darker, elytra tan with brown markings: circular mark on omoplates, postmedian band often advancing anteriorly along elytral suture to omoplates, flanks rarely dark, apical band often narrowly extended along elytral suture to postmedian band. Pubescence brownish when arising from dark areas, yellowish over rest of body. Raised setae distinct on pronotum, long and erect on elytra, average angle 50°. Mandibular explanation narrow, anterior margin meeting mandible at higher level than posterior margin. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 1-4 teeth on margin. Crest margin smooth, rounded anteriorly. First and second protarsomeres with strong spur on posterior apical margin.

Male with fifth sternite slightly emarginate, transverse depression anterior to apical margin.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 18 mi E El Puerto, Sonora, MEXICO (DSC). Length 4.02. Head 0.79 long, eye 0.32 long, raised setae over eyes average 0.20 long; antennomere ratios: I 2.39, II 1.85, III 2.14, IV 2.00, V 1.76, VIII 1.50, X 1.20, XI 2.24; fourth maxillary palpus 0.22 long, 0.11 wide; mandibular explanation 0.14 long, 0.05 wide. Pronotum 1.34 long, length from base to point of greatest width 0.40, break in antebasal pubescent band 0.36 wide; horn 0.60 long, 0.40 wide at base, 3 teeth on margin; crest 0.41 long, 0.12 wide at base; crest apex 0.08 above horn margin, horn apex 0.24 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.20 long, average angle 55°.

Specimens examined, 83: MEXICO Sonora: 18 mi E El Puerto, 7 August 1960, P. H. Arnaud, Jr., E. S. Ross, D. C. Rentz (CASC). Chihuahua: 20 mi SW Camargo, 13 July 1947, Gertsch (AMNH); 25 mi SW Camargo, 14 July 1947, Cazier, Gertsch (AMNH); Santa Barbara Dist., Santa Barbara, 7500', 18 July 1947, Gertsch (AMNH). Durango: 6 mi S Durango, 4 July 1964, H. F. Howden (CNCI); Rio Florido, nr. Las Nieves, 5200', 3 August 1966, G. E. Ball & D. R. Whitehead, blacklight (FGW).

Distribution: The Great Plains and Great Basin south into Sonora and the Mexican central plateau. It has been collected on alfalfa and cotton and is attracted to white light and ultra-violet light. Present from July through August.

Discussion: This species is most similar to *mexicanus* and *pallidus*. It is separated from *mexicanus* by the horn having less than four teeth on the margin, and can be separated from *pallidus* by the absence of ventro-lateral pits on the horn.

Notoxus marginatus LeConte

(Figs. 48, 63)

Notoxus marginatus LeConte 1852: 93. Type locality: Detroit, Michigan (probably incorrect). MCZC type 34893.
Notoxus apicalis var. *marginatus*, Pic 1911: 6. Leng 1920: 163.
Notoxus apicalis, auctorum.

Length 3.20-4.79. Head and pronotum tan, elytra tan with brown markings: circular mark on omoplates, postmedian band advanced somewhat along elytral suture, mark on posterior flanks of elytra extending to apex and anteriorly along elytral suture. Pubescence brownish when arising from marks, yellowish over rest of body. Raised setae distinct on pronotum, long and erect on elytra, average angle on elytra 35°. Mandibular explanation narrow, hind margin joining mandible at lower lower level than front. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 1-3 teeth on margin. Crest elevated, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate at apex, with shallow transverse impression before apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 3 mi N Las Cruces, Doña Ana Co., New Mexico (DSC). Length 4.50. Head 0.80 long, eye 0.32 long, raised setae over eyes average 0.13 long; antennomere ratios: I 2.37, II 1.53, III 1.93, IV 1.69, V 1.84, VIII 1.60, X 1.32, XI 2.48; fourth maxillary palpus 0.22 long, 0.12 wide; mandibular explanation 0.12 long, 0.04 wide. Pronotum 1.42 long, length from base to point of greatest width 0.44, break in antebasal pubescent band 0.32 wide; horn 0.64 long, 0.36 wide at base, 1 tooth on margin; crest 0.38 long, 0.11 wide at base; crest apex 0.12 over horn margin, horn apex 0.36 from crest apex; pronotal pit 0.12 long. Raised setae 0.14 long, average angle 30°. Emargination of fifth sternite 0.17 wide, 0.01 deep.

Specimens examined, 126: MEXICO: Chihuahua: Samalayuca, 24 June 1947, Gertsch, Cazier, Michener (AMNH); same locality, 6 August 1950, R. F. Smith (AMNH); 25 mi SW Camargo, 14 July 1947, Gertsch, Cazier, Michener (AMNH); Delicias, 4150', 11 July 1947, Schramel, Michener (AMNH). Coahuila: Saltillo, 9 July 1952, F. & F. Werner (FGW); Laguna Coahuila, 26 June 1905, A. L. Herrera (USNM); San Pedro de Colonias, 3700', 20 August 1947, Michener (AMNH); Torreon, 18 July 1918, MacKinney & Loftin (USNM); Boquillas del Carmen, 1850', 23 May 1959, Howden & Becker, at light (CNCI). Durango: Lerdo, 31 June 1918, MacKinney & Loftin (USNM); same data except, 16 July 1918 (USNM); Gomez Palacio, 14 July 1975, D. S. Chandler, meloid trap (DSC). Collected in quarantine at Laredo-on grocery bag, on dry shelled beans, on corn, on chick peas, in shelled corn, in dry corn, on string beans, on dry shelled beans, on Tamarinds, on zinnias, on dry garlic, on apple stem, on garlic; in quarantine at El Paso-on green beans, with Avocado, on vegetable bin, on husk tomatoes, on green corn ears, in seed, on Verbena plants, with carrots, with sugar cane leaves, on mango seeds; in

quarantine at Eagle Pass-on roots.

Distribution: From the Great Basin south to the northern portion of the Central Plateau of Mexico. Collected on a variety of harvested crops, also on *Tamarix* and sorghum in the United States. Attracted to white light, ultraviolet light and drying meloid beetles. Present from May through August.

Discussion: It is distinct from the other species in the group by having the raised elytral setae shorter than half the eye length, and the setae at a lower angle of about 35°. Similar to *apicalis* in the transverse impression on the male fifth sternite and the elytral color pattern.

Notoxus mexicanus Champion

(Figs. 49, 63)

Notoxus mexicanus Champion 1890: 213, Table IX, fig. 22. Type series localities: Mazatlan, Sinaloa; Acapulco and Iguala, Guerrero; Guanajuato, Guanajuato, MEXICO. Type series in BMNH and FGW. Pic 1894: 47; 1911: 9.

Length 3.45-6.18. Head and pronotum tan to red-brown, elytra tan with brown markings: oval mark on omoplates usually joined together and to postmedian band along elytral suture, flanks of elytra dark, apical band advancing anteriorly along elytral suture, often reaching postmedian band. Pubescence brownish when arising from marks, whitish over rest of elytra. Raised setae long and erect on pronotum and elytra, average angle on elytra 60°. Mandibular explanation narrow, posterior margin meeting mandible at lower level than anterior margin. Pronotum with antebasal band widely broken. Horn without pits beneath, 4-8 teeth on margin. Crest margin smooth, anterior margin distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite truncate, shallow transverse impression before apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Arroyo Cuyuchaba, 11.5 mi E Alamos, Sonora, MEXICO (DSC). Length 3.91. Head 0.89 long, eye 0.32 long, raised setae over eyes average 0.21 long; antennomere ratios: I 2.74, II 1.67, III 3.18, IV 2.07, V 1.79, VIII 1.62, X 1.37, XI 2.46; fourth maxillary palpus 0.25 long, 0.14 wide; mandibular explanation 0.15 long, 0.05 wide. Pronotum 1.40 long, length from base to point of greatest width 0.39, break in antebasal pubescent band 0.38; horn 0.60 long, 0.34 wide at base, 6 teeth on margin; crest 0.36 long, 0.24 wide at base, rounded at apex; crest apex 0.06 above horn margin, horn apex 0.17 from crest apex; pronotal pit 0.16 long. Raised elytral setae 0.18 long, average angle 73°.

Specimens examined, 144: MEXICO: Sonora: 5 mi E Alamos; 13 mi SE Alamos; Arroyo Cuyuchaba, 11.5 mi E Alamos. Sinaloa: Choix; 5.5 mi NW Choix; 8 mi S Elota; 21 mi E Villa Union; Los Mayos; Rosario. Nayarit: San Blas; 3 mi SE San Blas; Jesus Maria; Arroyo Santiago, nr. Jesus Maria; Tepic. Zacatecas: 28 mi S Jalpa. Jalisco: 8 mi N Guadalajara. Guerrero: 2 mi S Mexcala; Iguala, Höge, type of *N. mexicanus* (FGW). Morelos: 5 mi N Axochiapan; Tejalpa. Puebla: 7 mi NE Atlixco; 34 mi S Atlixco; 45 mi N Acatlan; Tepexco, Rte. 115, 4000'; Puente Estudo, nr. Tepexco, Rte. 115, 4000'; 5 mi SW Chipilo; 6 mi NE Zacatepec. Oaxaca: Huajuapan de Leon; 10 mi NE Huajuapan de Leon; 25 mi NE Oaxaca; Yagul ruins. All collections con-

taining specimens.

Distribution: Throughout Mexico except the northern desert and the southern tropical regions. Present from June to November. Collected under recently uprooted weeds, under low vegetation in a corn field and sweeping low vegetation. Attracted to light, ultra-violet light and drying meloid beetles.

Discussion: It is most similar to *apicalis* in general appearance. Separated by having four or more teeth on the horn margin.

Talpa-group

The *talpa*-group is defined as those *Notoxus* with the following characters: mandibular explanation narrow to moderately wide; pronotum with tactile setae appressed and not apparent, pubescent antebasal band widely broken; horn without lateral pits; crest margin smooth, apex distinct, no median ridge; elytra with median band, setae appressed. Males with elytra and legs unmodified; fifth sternite emarginate, circular impression before apex; penis and parameres simple. Females with elytra prolonged at the apices.

The species included are *talpa* LaFerte, *photus* n. sp. and *pygidialis* n. sp.

Notoxus talpa LaFerté

(Figs. 42. 63)

Notoxus talpa LaFerté 1848: 50. Type locality: "California" (probably the area near Mexico City). Type series in MHNH. Pic 1911: 12.

Notoxus elegantulus LaFerté 1848: 52, Table 21, fig. 17. Type locality: "California" (probably the area near Mexico City). Type in MNHN. NEW SYNONYMY.

Notoxus ventralis Champion 1890: 207-8, Table IX, fig. 17. Type series localities: Guanajuato, Guanajuato; and Jalapa, Veracruz, MEXICO. Types in BMNH. Champion 1893: 461. Pic 1894: 47; 1911: 13. NEW SYNONYMY.

Length 2.75-3.78. Head and pronotum orange to brown, elytra tan with brown markings: irregular median band usually reaching circular mark covering omoplates and base of elytra, apical band and median band usually forming tan postmedian W-shaped band, specimens from Michoacan with elytra all brown. Pubescence brownish when arising from dark areas, whitish in light areas. Setae appressed on pronotum, decumbent on elytra, average angle 13°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-4 teeth on margin. Crest margin smooth, apex distinct, usually pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate, small circular impression at apex in larger, poorly-defined circular impression.

Females with fifth sternite rounded-triangular. Elytra with apices abruptly pointed.

Redescribed ♂: 4 mi E Zacatecas, Zacatecas, MEXICO (DSC). Length 3.82. Head 0.80 long, eye 0.29 long, raised setae above eyes average 0.08 long; antennomere ratios: I 2.47, II 1.62, III 2.21, IV 1.73, V 1.81, VIII

1.22, X 1.22, XI 2.26; fourth maxillary palpus 0.26 long, 0.12 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.31 long, length from base to point of greatest width 0.39, break in antebasal pubescent band 0.37 wide; horn 0.61 long, 0.41 wide at base, apex pointed, no teeth on margin; crest 0.34 long, 0.14 wide at base; crest apex 0.08 above horn margin, horn apex 0.24 from crest apex; pronotal pit 0.14 long. Elytral setae 0.11 long, average angle 15°. Emargination of fifth sternite 0.16 wide, 0.02 deep.

Specimens examined, 106: MEXICO: Durango: 26 mi W Durango. Zacatecas: Sombrerete, 6000'; 4 mi E Zacatecas. Aguascalientes: 8 mi N Aguascalientes, 6700'. Guanajuato: Guanajuato, type of *N. ventralis*. Queretaro: 10 mi E San Juan del Rio; 1 mi S Palmillas. Mexico: Texcoco; Atlacomulco; Tepotzotlan; 15 mi NW Toluca. Distrito Federal: Chapultepec; Coapa, Mexico, Tlalpan. Michoacan: 11 mi SE Carapan; Uruapan; 10 mi E Zamora on Highway 15; Tancitaro; 3 mi S Carapan. Veracruz: Jalapa, type of *N. ventralis*. Oaxaca: Yagul ruins; 10 mi N Miltepec. Specimens in collections of: CASC, CNCI, DSC, FGW, LACM, MSUC, TAMU, TTCC, USNM.

Distribution: The central plateau to the higher areas of Oaxaca. Collected on beans, under low vegetation in corn field, and in squash flowers. Attracted to light, cantharidin and freshly killed meloid beetles. Present from June through August.

Discussion: This species is most similar to *pygidialis*. The males can be separated by the shallow impression of the fifth sternite which is never obscured by setae. The females have the pygidium simple, not projecting.

Notoxus pygidialis, n. sp.

(Figs. 43, 63)

Length 2.65-3.48. Head and pronotum red-brown to brown, elytra tan with brown markings: median band advancing anteriorly along elytral suture to cover omoplates, apical band advancing anteriorly along elytral suture, usually meeting postmedian band, anterior flanks dark. Pubescence brownish when arising from markings, yellowish in light areas. Setae appressed on pronotum, decumbent on elytra, average angle 16°. Mandibular explanation moderately wide, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth, apex distinct, usually pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate, circular impression before apex, may be shallowly or deeply impressed with dense setae around margin.

Females with fifth sternite rounded-triangular. Elytra slightly truncated, last tergite prolonged apically into distinct protuberance.

♂ holotype: Zacatelco, Tlaxcala, MEXICO. Length 2.81. Head 0.68 long, eye 0.22 long, raised setae above eyes average 0.06 long; antennomere ratios: I 2.53, II 1.55, III 2.18, IV 1.67, V 1.67, VIII 1.30, X 1.05, XI 2.25; fourth maxillary palpus 0.19 long, 0.10 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.00 long, length from base to point of greatest width 0.28, break in antebasal pubescent band 0.23 wide; horn 0.46 long, 0.28 wide at base, no teeth on margin; crest 0.30 long, 0.11 wide at base; crest apex 0.06 above horn margin, horn apex 0.19 from crest apex; pronotal pit 0.09 long. Elytral setae 0.07 long, average angle 12°. Emargination of fifth sternite 0.10 wide, 0.04 deep.

Specimens examined, 124: HOLOTYPE ♂, Zacatelco, Tlaxcala, MEXICO, 26 July 1974, R. L. Mangan & D. S. Chandler, under low vegetation in corn field (USNM). PARATYPES: MEXICO: Tlaxcala: 21♂♂, 24♀♀, eutopotypical (DSC); 2♂♂, 5♀♀, Tepeyanco, 25 June 1975, D. S. Chandler, under low plants in corn field (DSC); 3♂♂, Xicohtzinco, 25 June 1975, D. S. Chandler, under low plants in corn field (DSC). Puebla: 1♀, Puebla, 3 July 1952, C. D. MacNeill (CISC); 6♂♂, 8♀♀, 3 mi E Acatepec, 26 June 1975, D. S. Chandler, under low plants in corn field (DSC); 10♂♂, 4♀♀, same data except, cantharidin trap (DSC); 1♂, 5 mi SW Chipilo, 26 June 1975, D. S. Chandler, sweeping low vegetation (DSC); 7♂♂, 3♀♀, same data except, cantharidin trap (DSC); 10♂♂, same data except, meloid trap (DSC); 10♂♂, 2♀♀, 1 mi E Cholula, 26 June 1975, D. S. Chandler, cantharidin trap (DSC). Morelos: 1♂, Cuernavaca (MCZC); 1♂, 9 km W Tres Cumbres, 7600', Rt. 3, km 60, 24 June 1948, F. Werner & W. Nutting, pine clearing (FGW). Oaxaca: 2♂♂, 10 mi NE Huajuapan de Leon, 25 June 1965, Burke, Meyer, Schaffner (TAMU).

Distribution: South-central Mexico. Collected sweeping low vegetation and under low vegetation in corn field. Attracted to cantharidin and freshly killed meloid beetles. Present in June and July.

Discussion: It is most similar to *talpa* and cannot be separated except by the sexual characters. The males can usually be separated by the deeper and densely setate margin of the impression of the fifth sternite. The females are very distinctive in having the apically produced pygidium.

Notoxus photus, n. sp.

(Figs. 44, 63)

Length 3.00-3.60. Head and pronotum tan to red-brown, elytra tan to red-brown with brown markings: median band often reaching circular mark covering omoplates, apical band extending anteriorly along elytral suture. Pubescence brownish in markings, whitish over rest of body. Setae appressed on pronotum and elytra, average angle on elytra 10°. Mandibular explanation narrow, front and hind margins meeting at mandible on same level. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-4 teeth on margin. Crest margin smooth, apex distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate, circular impression before apex.

Females with fifth sternite rounded-triangular. Elytra truncated, apices spinose.

♂ holotype: Superior, Boyce-Thompson Arboretum, 2500', Gila County, Arizona. Length 3.16. Head 0.71 long, eye 0.26 long, raised setae above eyes average 0.09 long; antennomere ratios: I 2.54, II 1.67, III 2.23, IV 1.85, V 1.74, VIII 1.50, X 1.27, XI 2.11; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.02 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.30 wide; horn 0.44 long, 0.31 wide at base, 1 tooth on margin; crest 0.32 long, 0.10 wide at base, apex pointed; crest apex 0.05 above horn margin, horn apex 0.17 from crest apex; pronotal pit 0.10 long. Elytral setae 0.08 long, average angle 10°. Emargination of fifth sternite shallow, 0.16 wide.

Specimens examined, 199: HOLOTYPE ♂, Superior, Boyce-Thompson Arboretum, 2500', Gila Co., Arizona, 31 July 1948, H. K. Gloyd, white light

trap (USNM). PARATYPES: Arizona: Pima Co., Tucson; Santa Catalina foothills; I. B. P. site, Santa Rita Range Reserve; Colossal Cave County Park; Santa Catalina Mtns., Molino Canyon and Sabino Canyon; Brown Canyon, E slope Babaquivari Mtns. Santa Cruz Co.: Patagonia; 2 mi SW Patagonia; Pajarito Mtns., Peña Blanca Canyon and Sycamore Canyon; Madera Canyon, Santa Rita Mtns. Cochise Co.: Wood Canyon, Bisbee; Cochise Stronghold and West Stronghold, Dragoon Mtns.; Southwest Research Station, Chiricahua Mtns. MEXICO: Chihuahua: 12 mi N Chihuahua. Paratypes in collections of: CASC, CDAE, DSC, FGW.

Distribution: Associated with the oak-juniper zone through southeastern Arizona and south into Chihuahua. The only collection data is that most specimens were collected at light or ultra-violet light. Females are poorly attracted to light as only two are included in the type series. Present from June through September.

Discussion: It is most similar to *talpa*. Easily distinguished by the lighter appearance of the species. The shallow circular impression of the male fifth sternite is similar to that of *talpa*. The female elytral apices are very acute, while those of *talpa* are usually more rounded.

Monoceros-group

The *monoceros*-group is defined as those *Notoxus* with the following characters: mandibular explanation narrow, hind margin obsolete; raised pronotal setae distinct, pubescent antebasal band widely broken; horn without lateral pits; crest margin and apex variable, no median ridge; elytra with preapical band, raised setae present. Males with lateral apical tubercles on the elytra; fifth sternite truncate to shallowly emarginate; penis greatly modified, asymmetrical with dorsal surface as a plate or as a left-directed hook; parameres simple.

Species represented in Mexico are *anchora* Hentz and *serratus* LeConte. Only a single specimen of each has been collected. North American species included are *nevadensis* Casey, *pictus* Casey and *robustus* Casey. There are thirteen Palearctic species which were covered by Heberdey in 1936.

Notoxus anchora Hentz

(Figs. 50, 64)

Notoxus anchora Hentz 1827: 375, Table 13, fig. 4. Type locality: Massachusetts. LaFerté 1848: 33. LeConte 1852: 92. Horn 1884: 173. Casey 1895: 757. Pic 1911: 5. Leng 1920: 162.
Monocerus anchora, LeConte 1847: 89.

Length 2.99-4.38. Head and pronotum tan to brown, elytra tan with brown markings: preapical band extending anteriorly along elytral suture over omoplates to base of elytra, median lateral marks often attached to preapical band. Pubescence brownish when arising from markings, yellowish over rest of elytra. Raised setae long and erect on pronotum and elytra, average angle on elytra 62^{o}. Mandibular explanation narrow, hind margin indistinct, meeting mandible at lower level than front margin. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 3-10 teeth on margin. Crest margin crenulate, anterior margin pointed and indistinctly merging with horn.

First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite truncate at apex, elytra with lateral apical tubercles. Penis with ventral surface modified into a left-directed hook, dorsal surface forming two broad lobes which have two smaller lobes at each apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 1 mi W Nichols, New York (DSC). Length 3.15. Head 0.67 long, eye 0.26 long, raised setae above eyes average 0.12 long: antennomere ratios: I 2.50, II 1.67, III 2.00, IV 1.77, V 1.80, VIII 1.62, X 1.32, XI 2.37; fourth maxillary palpus 0.20 long, 0.10 wide; mandibular explanation 0.10 long, 0.03 wide. Pronotum 1.02 long, length from base to point of greatest width 0.31, break in antebasal pubescent band 0.24 wide; horn 0.43 long, 0.24 wide at base, 6 teeth on margin; crest 0.34 long, 0.18 wide at base; crest apex merging with horn, horn apex 0.16 from crest apex; pronotal pit 0.15 long. Raised elytral setae 0.15 long, average angle 72°. Truncation of fifth sternite 0.10 wide.

Specimens examined, 1: "Mex." (MCZC).

Distribution: Northeastern United States south through the Rocky Mountains. This species is probably found in the northern mountains near the United States border. Collected in the United States by sweeping alfalfa and is attracted to cantharidin. Present in the United States from June through August.

Discussion. It is most similar to *nevadensis* by the crenulate crest margin and the indistinct crest apex. It can be separated by the narrow horn and the presence of a left-directed hook as the ventral portion of the penis. *N. nevadensis* has two narrow lobes at the apex of the ventral plate. *N. robustus* has the crest margin rounded-crenulate, the apex never breaks down anteriorly and merges with the horn.

Notoxus serratus (LeConte)

(Figs. 51, 64)

Monocerus serratus LeConte 1847: 90. Type locality: Rocky Mountains. MCZC Type #4894, ♂.
Notoxus serratus, LeConte 1852: 93. Horn 1884: 172. Pic 1911: 11. Casey 1895: 758. Leng 1920: 163.
Notoxus digitatus LeConte 1876: 518. Type locality: southern Colorado. MCZC Type #4895, ♂.
Notoxus vandykei Blaisdell 1929: 57-9. Type locality: Little Cottonwood Creek, Inyo County, California. CASC Type #2616, ♂. Leng 1933: 26.

Length 3.19-4.60. Head and pronotum red-brown, elytra tan with brown markings: circular mark on omoplates, preapical band often broken along elytral suture, extending anteriorly along elytral suture, rarely reaching omoplates, often with lateral marks in median portion of elytra, all marks may be joined, separated or absent. Pubescence brownish in dark areas, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 58°. Mandibular explanation narrow, with hind margin meeting mandible at lower level than front margin. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 6-10 teeth on margin; crest margin smooth, apex distinct, usually pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate at apex. Penis with ventral surface modified into a left-directed hook, dorsal surface forming two broad lobes.

Each elytron with lateral apical tubercle.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Hallelujah Junction, Lassen County, California (DSC). Length 4.40. Head 0.89 long, eye 0.32 long, raised setae above eyes average 0.20 long; antennomere ratios: I 2.50, II 2.00, III 2.50, IV 1.57, V 2.00, VIII 1.90, X 1.67, XI 2.85; fourth maxillary palpus 0.25 long, 0.14 wide; mandibular explanation 0.16 long, 0.06 wide. Pronotum 1.33 long, length from base to point of greatest width 0.45, break in antebasal pubescent band 0.30 wide; horn 0.58 long, 0.32 wide at base, apex pointed, 7 teeth on margin; crest 0.35 long, 0.12 wide at base, apex pointed; crest apex 0.12 above horn margin, horn apex 0.30 from crest apex; pronotal pit 0.11 long. Raised elytral setae 0.25 long, average angle 68°. Emargination of fifth sternite 0.23 wide, 0.01 deep.

Specimens examined, 1 MEXICO: Chihuahua: 48 km S Juarez, 28 April 1974, D. Giuliani, sand dunes, (CDAE).

Distribution: Montane regions of the western United States and northern Mexico. Collected on grass and *Salix*. Attracted to light, ultra-violet light and cantharidin. Present in the United States from April to September.

Discussion: It is most similar to *pictus* by the high smooth crest margin and is separated by having more than four teeth on the horn margin. It is also similar to *robustus*, but can be separated by the non-crenulate crest margin. Some specimens of *robustus* have crests approaching the smoothness of *serratus*, which can then only be separated by the males of *robustus* possessing a tubercle on the pro- and mesofemora.

Sparsus-group

The *sparsus*-group is defined as those *Notoxus* with the following characters: mandibular explanation wide, hind margin prominent; pronotum with raised setae distinct, pubescent antebasal band complete to widely broken; horn without lateral pits; crest margin and apex variable. Males with lateral apical tubercles on the elytra. The fifth sternite rounded or truncate at apex, with oval impression before apex; parameres simple; penis often thickened dorsoventrally and with preapical notch.

The group is basically Californian with two species, *sparsus* LeConte and *conformis* LeConte, extending south into Baja California. *N. bajae* n. sp. is restricted to Baja California Sur. The United States species included in the group are *cavicornis* LeConte, *denudatus* Horn, *lustrellus* Casey, *spatulifer* Casey, *breviusculus* Fall and *obesulus* Blaisdell.

Notoxus sparsus LeConte

(Figs. 52, 64)

Notoxus sparsus LeConte 1859: 284-5. Type locality: Point Reyes, California. MCZC Type #4898, ♂. Horn 1884: 176 (synonym of *conformis* LeConte). Casey 1895: 757. Pic 1911: 7 (synonym of *conformis*). Leng 1920: 162 (synonym of *conformis*).

Length 2.42-3.08. Head and pronotum red-brown, elytra yellow-brown with brown markings: posthumeral marks on flanks usually joining oval mark on omoplates to form postbasal band, postmedian band usually advanced narrowly along elytral suture, elytral apices obscurely darkened. Pubescence

brownish when arising from marks, whitish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 48°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band complete. Horn without pits beneath, 0-3 teeth on margin. Crest margin smooth, rounded and indistinct anteriorly, entire crest only slightly elevated above distinct margin. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite truncate, slight circular impression anterior to apical margin. Penis swollen dorsoventrally, with shallow dorsal notch near apex.

Females with fifth sternite triangular, elytra truncated at apex.

Redescribed ♂: 12 mi SW Red Bluff, Tehama County, California (DSC). Length 3.08. Head 0.72 long, eye 0.24 long, raised setae above eyes average 0.21 long; antennomere ratios: I 2.53, II 1.84, III 2.59, IV 2.08, V 2.15, VIII 1.71, X 1.34, XI 2.36; fourth maxillary palpus 0.19 long, 0.10 wide; mandibular explanation 0.10 long, 0.05 wide. Pronotum 1.10 long, length from base to point of greatest width 0.32; horn 0.44 long, 0.22 wide at base, 1 tooth on margin; crest 0.29 long, 0.10 wide at base; crest apex 0.04 above horn margin, horn apex 0.20 from crest apex; pronotal pit 0.09 long. Raised elytral setae 0.20 long, average angle of setae 45°. Truncation of fifth sternite 0.12 wide.

Specimens examined, 1: MEXICO: Baja California: Sierra Juarez, 1 mi N El Compadre, 23 January 1965, E. L. Sleeper (CDAE).

Distribution: Through central and coastal California to the northern portion of Baja California. Collected in oak litter in California. Attracted to white light and is present throughout the year in southern California.

Discussion: It is most similar to an undescribed species from California by the long, raised setae on the elytra and the globular (rather than transverse) pronotum. It is best separated by the genitalia with the penis having a distinct shallow preapical notch.

Despite being synonymized under *conformis* by several authors, *sparsus* is easily separated by the elevated tactile setae on the elytra.

Notoxus bajae, n. sp.

(Figs. 54, 64)

♂ holotype: 25 mi W La Paz, Baja California Sur, MEXICO (USNM). Head and pronotum tan, elytra tan with brown markings: mark on omoplates, irregular postmedian band extending anteriorly along elytral suture to near omoplates, posthumeral mark on flanks. Pubescence brownish when arising from markings, yellowish over rest of body. Raised setae long and erect on pronotum and elytra, average angle on elytra 67°. Mandibular explanation wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band complete. Horn without pits beneath, no teeth on margin. Crest margin smooth, rounded and distinct anteriorly. First and second protarsomeres with strong spur on posterior apical margin.

Male with fifth sternite truncate at apex, circular depressed area anterior to margin. Penis with dorsal notch near apex.

Length 4.04. Head 0.86 long, eye 0.28 long, raised setae over eyes average 0.28 long; antennomere ratios: I 2.04, II 2.46, III 2.00, IV 2.33, V 2.06, VIII 1.55, X 1.60, XI 2.37; fourth maxillary palpus 0.21 long, 0.08 wide; mandibular explanation 0.14 long, 0.09 wide. Pronotum 1.32 long, length

from base to point of greatest width 0.40, horn 0.58 long, 0.29 wide at base, no teeth on margin; crest 0.40 long, 0.10 wide at base; crest apex 0.15 above horn margin, horn apex 0.28 from crest apex; pronotal pit 0.13 long. Raised elytral setae 0.26 long. Truncation of fifth sternite 0.18 wide.

Specimens examined, 1: HOLOTYPE ♂, 25 mi W La Paz, Baja California Sur, MEXICO, 4 September 1959, K. W. Radford & F. G. Werner, light trap (USNM).

Distribution: The single specimen is from southern Baja California Sur and was collected at light.

Discussion: It is distinct in the group by having the crest half as wide at base as at the greatest width and having the crest well-elevated above the horn margin. The penis is similar to that of *spatulifer* by the dorsal preapical slit, but the apex is simple, not flattened and dilated.

Notoxus conformis LeConte

(Figs. 53, 64)

Notoxus conformis LeConte 1851: 152. Type locality: Gila River, Arizona. MCZC Type #4896, ♀. LeConte 1852: 92-3. Horn 1884: 174. Casey 1895: 757. Fall 1902: 33, 182. Pic 1911: 7. Leng 1920: 162.

Length 2.60-3.46. Head and pronotum reddish-brown, brown markings on reddish-brown elytra: mark on omoplates offset toward elytral suture, frequently postmedial band extends along elytral suture to meet omoplate marks, posthumeral marks on flanks on elytra, often reaching to postmedian band, obscure darkened band near elytral apices. Pubescence brownish when arising from dark areas, whitish over rest of body. Short scattered raised setae on pronotum, on elytra setae appressed, average angle 10°. Mandibular explanation moderately wide, with front and hind margins on same level at mandible. Pronotum with antebasal pubescent band complete. Horn without pits beneath, 0-2 teeth on margin. Crest smooth, anterior margin rounded, only slightly elevated above horn margin. First and second protarsomeres lacking spur on apical posterior margin.

Males with fifth sternite truncate, circular impression before apex which may be faint, elytra with lateral apical tubercles, anterior margin of crest usually distinct. Penis swollen dorso-ventrally, with deep dorsal notch near apex.

Females with fifth sternite rounded-triangular; anterior margin of crest indistinct, breaking down and merging with horn; elytra appearing slightly truncated; body appearing stouter than males.

♂: Hemet, Riverside County, California (DSC). Length 3.46. Head 0.76 long, eye 0.26 long, raised setae over eyes average 0.16 long; antennomere ratios: I 2.56, II 1.64, III 2.50, IV 2.01, V 2.20, VIII 1.63, X 1.37, XI 2.10; fourth maxillary palpus 0.21 long, 0.12 wide; mandibular explanation 0.12 long, 0.06 wide. Pronotum 1.24 long, length from base to point of greatest width 0.34; horn 0.55 long, 0.32 wide at base, 1 tooth on margin; crest 0.31 long, 0.15 wide at base; crest apex 0.02 above horn margin, horn apex 0.23 from crest apex; pronotal pit 0.08 long. Elytral setae 0.10 long, average angle 13°. Truncation of fifth sternite 0.12 wide.

Specimens examined, 19: MEXICO: Baja California: Sierra San Pedro Martir, La Sanja, 6500', 27 May 1958, J. Powell (CISC); 2.4 mi SE El Consuelo, 24 April 1963, H. B. Leech & P. H. Arnaud, Jr. (CASC).

Distribution: Found in hilly and montane areas of California, Arizona and Baja California. Collected by beating vegetation, sifting oak duff, and has been found on dead yucca and in a swallow nest. Present from February to November in California.

Discussion: It is most similar to *lustrellus* by the decumbent elytral setae. It can be easily separated by the smooth crest margin and few teeth on the horn margin. *N. lustrellus* has the crest crenulate and about five teeth on the horn margin.

Species Not Placed In Groups

The Central American species not placed in any group are *crucifer* Champion, *opacus* Champion, *fraternus* Champion, *truncatipennis* Champion, *aztecorum* n. sp., *campus* n. sp. *stephani* n. sp., *desperatus* n. sp., *zapotecorum* n. sp. and *occidentalis* n. sp. United States species not placed in any group are *brevicornis* Fall and an undescribed species from Texas. An unidentified *Notoxus* female of probable Old World origin is included in this section.

Notoxus occidentalis, n. sp.

(Figs. 12, 55)

Notoxus bifasciatus, Pallister 1955: 6, misidentification.

Length 3.00-3.30. Head and pronotum red-brown to brown, elytra red-brown with brown markings: median band extending anteriorly along elytral suture to cover omoplates, apical band may extend anteriorly along elytral suture to join median band. Pubescence brownish when arising from dark areas, whitish in lighter areas. Raised setae long and erect on pronotum and elytra, average angle on elytra 55°. Mandibular explanation moderately wide, front and hind margins meeting at mandible on same level. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, no teeth on margin. Crest margin smooth, apex pointed and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males unknown.

Females with fifth sternite rounded-triangular.

♀ holotype: San Jose Babicora, Chihuahua, MEXICO. (AMNH). Length 3.00. Head 0.70 long, eye 0.23 long, raised setae over eyes average 0.20 long; antennomere ratios: I 2.47, II 1.73, III 2.08, IV 1.79, V 1.67, VIII 1.50, X 1.33, XI 1.84; fourth maxillary palpus 0.17 long, 0.09 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 1.04 long, length from base to point of greatest width 0.35, break in antebasal pubescent band 0.20 wide; horn 0.42 long, 0.28 wide at base; crest 0.28 long, 0.10 wide at base; crest apex 0.10 above horn margin, horn apex 0.25 from crest apex; pronotal pit 0.08 long. Raised elytral setae 0.20 long, average angle 49°.

Specimens examined, 2: HOLOTYPE ♀, San Jose Babicora, Chihuahua, MEXICO, 5 June 1947, Michener (AMNH). PARATYPE: 1♀, Palos Colorados, 8000', Durango, MEXICO, 5 August 1947, Cazier (DSC).

Distribution: The Sierra Madre Occidental. Adults present from June to August.

Discussion: Collection of the males will be necessary before this species

can be placed positively in a group. The species is either a member of the *montanus*- or *pueblensis*-groups. Pallister (1955) identified the type series as *Notoxus bifasciatus* (LeConte), a species which occurs only in northern and eastern United States.

Notoxus fraternus Champion

(Figs. 45, 61)

Notoxus fraternus Champion 1890: 208-9. Type series localities: Guanajuato, Guanajuato (BMNH) and Jalapa, Veracruz (FGW), MEXICO. Pic 1894: 47; 1911: 8. *Not* Pallister 1955: 8.

Length 2.58-3.45. Head and pronotum brown to dark brown, elytra brown to dark brown, rarely with faint lighter marks laterally behind omoplates and laterally in apical half. Brownish setae forming vague median band, extending anteriorly near elytral suture to cover omoplates, narrow band of white setae behind median band, followed by brownish setae to apex. Upraised setae present on pronotum, setae on elytra decumbent, average angle 12^{o}. Mandibular explanation narrow, with hind margin often meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-1 teeth on margin. Crest margin smooth, apex distinct, usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate at apex, transverse impression before apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: 4 mi SW Perote, Veracruz, MEXICO (DSC). Length 3.04. Head 0.68 long, eye 0.20 long, raised setae above eyes average 0.12 long; antennomere ratios: I 2.65, II 1.59, III 2.34, IV 1.84, V 1.93, VIII 1.35, X 1.21, XI 2.15; fourth maxillary palpus 0.16 long, 0.10 wide; mandibular explanation 0.11 long, 0.05 wide. Pronotum 1.00 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.28 wide; horn 0.38 long, 0.28 wide at base, no teeth on margin; crest 0.28 long, 0.11 wide at base, apex rounded; crest apex 0.07 above horn margin, horn apex 0.14 from crest apex; pronotal pit 0.10 long. Elytral setae 0.09 long, average angle 14^{o}. Emargination of fifth sternite 0.20 wide, 0.01 deep.

Specimens examined, 266: MEXICO: Guanajuato: Guanajuato, type of *fraternus*. Michoacan: 2 mi SE Los Reyes. Mexico: 7 mi S Amecameca, 8000'. Distrito Federal: 2 km S Mexico, 8600'; 16 mi S Mexico City, 7400'; 37 km S Mexico City; Guadalupe; Tlalpan. Tlaxcala: Xicohtzinco. Puebla: 7 mi NE Atlixco; 13.8 mi SW Alchichica. Veracruz: 4 mi SW Perote; 10 mi SW Parote; Jalapa. Specimens in collections of: CASC, CISC, CNCI, CUIC, DSC, FGW, MCZC, TAMU, USNM.

Distribution: The higher areas of south-central Mexico. Collected on corn, on the ground in a moist agriculatural area and under low plants in corn field. Attracted to freshly killed meloid beetles. Present from June through August.

Discussion: It is generally similar to *truncatipennis* by the smooth crest margin and the emarginate fifth sternite. It is separated by the decumbent elytral setae, the more elevated crest and the transverse impression before the down-curved apex of the male fifth sternite.

Notoxus stephani, n. sp.

(Figs. 39, 61)

Length 2.99-4.37. Head and pronotum orange to brown, elytra tan to red-brown with brown markings: oval mark covering omoplates often joined to slightly postmedian band along elytral suture, apical band joined to postmedian band along elytral suture. Pubescence brownish when arising from dark areas, whitish in light areas. Raised setae distinct on pronotum, and elytra, average angle on elytra 32°. Mandibular explanation moderately wide, front and hind margins often meeting on same level at mandible. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 0-1 teeth on margin. Crest margin smooth apex usually pointed, apex indistinct and merging with horn when pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate into large circular impression.

Females with fifth sternite rounded-triangular.

♂ holotype: 5 mi E Alamos, Sonora, MEXICO. Length 4.09. Head 0.84 long, eye 0.30 long, raised setae above eyes average 0.10 long; antennomere ratios: I 2.38, II 1.50, III 2.13, IV 1.81, V 2.00, VIII 1.39, X 1.16, XI 2.17; fourth maxillary palpus 0.18 long, 0.12 wide; mandibular explanation 0.12 long, 0.04 wide. Pronotum 1.32 long, length from base to point of greatest width 0.42, break in antebasal pubescent band 0.30 wide; horn 0.58 long, 0.36 wide at base, 1 tooth on margin; crest 0.42 long, 0.14 wide at base, apex pointed; crest apex 0.02 over horn margin, horn apex 0.24 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.11 long, average angle 41°. Emargination of fifth sternite 0.15 wide, 0.01 deep.

Specimens examined, 19: HOLOTYPE ♂, 5 mi E Alamos, Sonora, MEXICO, 11 August 1973, K. Stephan & D. S. Chandler, blacklight (USNM). PARATYPES: MEXICO: Sonora: 9♂♂, 1♀, eutopotypical (DSC). Jalisco: 1♀, Guadalajara, 12 August 1903, J. F. McClendon (MCZC); 1♀, same locality, 1 August 1903 (MCZC); 1♀, same locality, 8 August 1903 (MCZC); 1♂, 9 mi W Guadalajara, 1550 meters, 16 July 1947, T. H. Hubbell, on Tequila pd. (CASC); 1♂, 13 mi W Guadalajara, 21 August 1964, H. R. Burke & J. Apperson (TAMU); 1♂, 4 mi SW Jalostotitlan, 4 August 1954, E. G. Linsley, J. W. MacSwain, R. F. Smith (CISC); 1♂, 2 mi S Tlaquepaque, 11 July 1953, C. & P. Vaurie (AMNH); 1♂, 6 mi SE Sayula, 23 July 1966, P. M. & P. K. Wagner (TAMU). Zacatecas: 1♂, 10 mi WSW Huejucar, 7200', 22 July 1954, R. H. Brewer (CASC).

Distribution: The semi-tropical regions on the west coast of Mexico. Collected by sweeping and found on a Tequila pod. Attracted to ultra-violet light. Present from July to August.

Discussion: It is most similar to *truncatipennis* by the low-lying, smooth-ly margined crest and the emarginate male fifth sternite. Easily separated in the males by the deep circular impression at the apex of the fifth sternite.

Notoxus aztecorum, n. sp.

(Figs. 36, 61)

Length 2.91-3.34. Head and pronotum red-brown to brown, elytra tan with brown markings: postmedian band extending anteriorly along elytral

suture to base, apical band extending anteriorly along elytral suture to post-median band. Pubescence brownish when arising in dark areas, yellowish in tan areas. Raised setae distinct on pronotum and elytra, average angle on elytra 18°. Mandibular explanation moderately wide, front and hind margins meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, no teeth on margin. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate at apex.

Females with fifth sternite rounded-triangular.

♂ holotype: Mixcoac, Distrito Federal, MEXICO. Length 3.05. Head 0.65 long, eye 0.24 long, raised setae above eyes average 0.12 long; antennomere ratios: I 2.19, II 1.67, III 2.08, IV 1.70, V 1.74, VIII 1.05, X 0.92, XI 1.71; fourth maxillary palpus 0.18 long, 0.10 wide; mandibular explanation 0.10 long, 0.06 wide. Pronotum 0.98 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.29 wide; horn 0.36 long, 0.30 wide at base; crest 0.28 long, 0.12 wide at base; crest apex 0.04 over horn margin, crest apex 0.14 from horn apex; pronotal pit 0.10 long. Raised setae 0.11 long, average angle 17°. Emargination of fifth sternite 0.23 wide, 0.05 deep.

Specimens examined, 3: HOLOTYPE ♂, Mixcoac, Distrito Federal, MEXICO, Wickham (USNM). PARATYPES: MEXICO: Distrito Federal: 1♂, Barrett (CASC); 1♀, Teotihuacan, 3 June 1948, F. Werner, ground (FGW).

Distribution: The region around Mexico City.

Discussion: It is most similar to *truncatipennis* and *desperatus*. Separated from the former by the lack of an impression on the male fifth sternite. It is separated from the latter by the lack of a carina on the male fifth sternite and the apically rounded penis.

Notoxus desperatus, n. sp.

(Figs. 38, 61)

Length 2.98-3.20. Head and pronotum orange to red-brown, elytra tan with brown markings: postmedian band extending anteriorly along elytral suture, covering omoplates and reaching base of elytra, apical band meeting postmedian band along elytral suture. Pubescence brownish when arising from markings, yellowish over rest of body. Raised setae present on pronotum and elytra, average angle on elytra 20°. Mandibular explanation moderately wide, front and hind margin meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, no teeth on margin. Crest margin smooth, apex distinct, often pointed. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate, flattened and with transverse carina at center. Apex of penis widely split.

Females with fifth sternite rounded-triangular.

♂ holotype: Durango, Durango, MEXICO. Length 3.20. Head 0.68 long, eye 0.22 long, raised setae above eyes average 0.12 long; antennomeres missing; fourth maxillary palpus missing; mandibular explanation 0.12 long, 0.06 wide. Pronotum 1.02 long, length from base to point of greatest width 0.34, break in antebasal pubescent band 0.28 wide; horn 0.42 long, 0.32 wide at base; crest 0.30 long, 0.13 wide at base, apex pointed; crest apex 0.04 above horn margin, horn apex 0.12 from crest apex; pronotal pit 0.11 long. Raised

elytral setae 0.13 long, average angle 24°. Emargination of fifth sternite 0.26 wide, 0.04 deep.

Specimens examined, 3: HOLOTYPE ♂, Durango, Durango, MEXICO (USNM). PARATYPES: MEXICO: Durango: 1♂, eutopotypical (DSC); 1♀, Durango, Wickham (MCZC).

Distribution: Only known from near the city of Durango.

Discussion: It is most similar to *truncatipennis* and *aztecorum*. Separated from both by the medial transverse carina of the male fifth sternite and the apex of the penis being forked.

Notoxus truncatipennis Champion

(Figs. 37, 61)

Notoxus truncatipennis Champion 1890: 209. Type locality: Guanajuato, Guanajuato, MEXICO. BMNH Lectotype ♀, designated by D. S. Chandler, 1975. Pic 1894: 47; 1911: 13.

Length 2.78-2.94. Head and pronotum brown, elytra brown with red-brown markings: median band extending anteriorly along elytral suture over omoplates to base, apical band extending along elytral suture to median band. Pubescence brownish in dark areas, whitish in light areas. Raised setae present on pronotum and elytra, average angle on elytra 31°. Mandibular explanation wide, front and hind margins meeting mandible at same level. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, no teeth on margin. Crest margin smooth, apex pointed, usually distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate, shallow transverse impression before apex.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Ridge NW of Jocoque Dam, Aguascalientes, MEXICO (DSC). Length 2.78. Head 0.62 long, eye 0.21 long, raised setae above eyes average 0.09 long; antennomere ratios: I 2.15, II 1.55, III 2.28, IV 1.59, V 1.58, VIII 1.11, X 1.10, XI 2.00; fourth maxillary palpus 0.16 long, 0.09 wide; mandibular explanation 0.10 long, 0.07 wide. Pronotum 0.96 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.25 wide; horn 0.42 long, 0.30 wide at base; crest 0.32 long, 0.11 wide at base, apex indistinctly merging with horn; crest apex 0.02 above horn margin, horn apex 0.16 from crest apex; pronotal pit 0.08 long. Raised elytral setae 0.09 long, average angle 32°. Emargination of fifth sternite 0.24 wide, 0.02 deep.

Specimens examined, 3: MEXICO: Aguascalientes: Ridge NW of Jocoque Dam, 19 August 1960, P. H. Arnaud, Jr., E. S. Ross, D. C. Rentz (CASC, DSC). Guanajuato: Guanajuato, Lectotype of *truncatipennis* (BMNH).

Distribution: On the southern margin of the Mexican Central Plateau.

Discussion: Similar to *aztecorum*, *desperatus*, *fraternus* and *stephani* by the low-lying, smoothly margined crest and the emarginate fifth sternite. Separated by the shallow medial impression of the fifth sternite of the male.

Notoxus zapotecorum, n. sp.

(Figs. 46, 62)

Length 2.75-3.38. Head and pronotum orange to red-brown, elytra tan with brown markings: circular marks covering omoplates, often meeting postmedian band extending along elytral suture, apical band extending along elytral suture to postmedian band. Pubescence brownish when arising from markings, yellowish in light areas. Raised setae distinct on pronotum and elytra, average angle on elytra 32°. Mandibular explanation narrow, often with margins not meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 2-7 teeth on margin. Crest margin smooth, apex usually rounded. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate, transverse impression before apex.

Females with fifth sternite rounded-triangular.

♂ holotype: Jesus Maria, Nayarit, MEXICO. Length 3.28. Head 0.68 long, eye 0.27 long, raised setae over eyes average 0.10 long; antennomere ratios: I 2.53, II 1.67, III 2.25, IV 2.00, V 1.74, VIII 1.82, X 1.21, XI 2.35; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.10 long, 0.05 wide. Pronotum 1.09 long, length from base to point of greatest width 0.35, break in antebasal pubescent band 0.26 wide; horn 0.46 long, 0.32 wide at base, 2 teeth on margin; crest 0.29 long, 0.12 wide at base, apex rounded; crest apex 0.04 above horn margin, horn apex 0.16 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.11 long, average angle 33°. Emargination of fifth sternite 0.10 long, 0.01 deep.

Specimens examined, 23: HOLOTYPE ♂, Jesus Maria, Nayarit, MEXICO, 6 July 1955, B. Malkin (CASC). PARATYPES: MEXICO: Sinaloa: 2♂♂, Choix, 5 August 1968, T. A. Sears, R. C. Gardner, C. S. Glaser (UCDC); 2♂♂, 5.5 mi NW Choix, 14 July 1968, T. A. Sears, R. C. Gardner, C. S. Glaser (UCDC); 3♂♂, 8 mi S Elota, 26 August 1963, L. A. Stange (UCDC); 1♂, Culiacan, 17 August 1962, A. E. Michelbacher (CISC). Nayarit: 2♂♂, 3♀♀, Jesus Maria, 26 June 1955, B. Malkin (CISC). Puebla: 2♀♀, Tepexco, Route 115, 4000', 9 August 1965, G. E. Ball & D. R. Whitehead, blacklight (FGW); 1♀, 2 mi NW Tehuacan, 25 April 1953, R. C. Bechtel & E. I. Schlinger, sweeping alfalfa (CISC); 1♂, 6 mi SW Tehuacan, 7 July 1973, Mastro & Schaffner, at light (TAMU). Oaxaca: 3♂♂, 10 mi NW Oaxaca, 22 July 1974, R. L. Mangan & D. S. Chandler, attracted to box of drying Meloidae (DSC); 1♂, Huajuapan de Leon, 28 June 1971, C. W. O'Brien & G. B. Marshall (TTCC).

Distribution: Western and south-central Mexico. Collected sweeping alfalfa. Attracted to light, ultra-violet light and freshly killed meloid beetles. Present from April through August.

Discussion: It is most similar to *marginatus* of the *apicalis*-group. It can be separated by the shorter raised elytral setae, the moderately wide mandibular explanation and the smaller size.

Notoxus campus, n. sp.

(Figs. 31, 62)

Length 2.48-3.63. Head and pronotum orange to red-brown, elytra red-

brown, elytra red-brown to brown. Pubescence whitish over body. Raised setae long and erect on pronotum and elytra, average angle on elytra 32°. Mandibular explanation narrow, hind margin meeting mandible at lower level than front margin. Pronotum with pubescent antebasal band widely broken. Horn without pits beneath, 0-2 teeth on margin. Crest margin smooth, apex rounded and distinct. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite emarginate.

Females with fifth sternite rounded-triangular.

♂ holotype: km 210, Highway 57 N of San Luis Potosi, San Luis Potosi, MEXICO. Length 2.89. Head 0.62 long, eye 0.23 long, raised setae over eyes average 0.16 long; antennomere ratios: I 2.25, II 1.54, III 1.77, IV 1.75, V 1.50, VIII 1.56, X 1.25, XI 2.26; fourth maxillary palpus 0.17 long, 0.10 wide; mandibular explanation 0.12 long, 0.04 wide. Pronotum 1.00 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.22 wide; horn 0.42 long, 0.28 wide at base, 1 tooth on margin; crest 0.25 long, 0.10 wide at base; crest apex 0.12 above horn margin, horn apex 0.27 from crest apex; pronotal pit 0.11 long. Raised elytral setae 0.17 long, average angle 35°. Emargination of fifth sternite 0.18 wide, 0.03 deep.

Specimens examined, 24: HOLOTYPE ♂, km 710, Highway 52 N of San Luis Potosi, San Luis Potosi, MEXICO, 11 July 1969, Ward, Tenorio, Bennett (USNM). PARATYPES: Coahuila: 1♂, 1♀, 21 mi SE Saltillo, 6000', 18 July 1963, H. F. Howden (CNCI); 2♂♂, 3♀♀, 33 mi SE Saltillo, nr. Jame, 7500', 18 July 1963, A. T. Howden (CNCI). Nuevo Leon: 2♂♂, 1♀, 10 mi S Junction 57 & 60, 23 June 1971, G. Brothers, acacia (TTCC). San Luis Potosi: 5♂♂, 8♀♀, eutopotypical (TTCC).

Distribution: East side of the Mexican central plateau.

Discussion: It is distinctive in the long erect setae on the unicolorous elytra. The mandibular explanation is narrow and the fifth sternite is emarginate without any impression.

Notoxus crucifer Champion

(Figs. 41, 62)

Notoxus crucifer Champion 1890: 210, Table IX, fig. 18. Type locality: San Geronimo, Guatemala. BMNH Type ♀. Pic 1894: 46; 1911: 7.

Length 2.92-3.75. Head and pronotum red-brown to brown, elytra tan with brown markings: circular mark covering omoplates, median band often reaching omoplates along elytral suture, apical band often reaching median band along elytral suture. Pubescence brownish when arising from dark areas, whitish in light areas. Raised setae distinct on pronotum and elytra, average angle on elytra 42°. Mandibular explanation moderately wide, rarely with front and hind margins meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath, 3-8 teeth on margin. Crest margin often crenulate, apex pointed, usually indistinct and merging with horn. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite slightly emarginate, circular impression before apex.

Females with fifth sternite rounded-triangular. Elytral apices slightly pointed.

Redescribed ♂: Junction Highways 190 & 195, Chiapas, MEXICO (DSC). Length 3.65. Head 0.80 long, eye 0.30 long, raised setae over eyes average 0.11 long; antennomere ratios: I 2.32, II 1.57, III 2.20, IV 1.56, V 1.70, VIII 1.25, X 1.14, XI 2.33; fourth maxillary palpus 0.22 long, 0.13 wide; mandibular explanation 0.11 long, 0.04 wide. Pronotum 1.20 long, length from base to point of greatest width 0.38, break in antebasal pubescent band 0.30 wide; horn 0.52 long, 0.32 wide at base, 3 teeth on margin; crest 0.29 long, 0.10 wide at base, margin crenulate, apex indistinct and merging with horn; crest apex 0.04 over horn, horn apex 0.22 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.12 long, average angle 41°. Emargination of fifth sternite 0.15 wide, 0.01 deep.

Specimens examined, 18: MEXICO: Chiapas: Junction Highways 190 & 195, 20 May 1969, J. M. Campbell (CNCI); same locality, 6 June 1969, H. F. Howden & J. M. Campbell (CNCI); same locality, 24 June 1973, G. Ekis (DSC, USNM); 5 mi W San Cristobal, 7500', 23 May 1969, J. M. Campbell (CNCI); Zinacantlan, 1900 meters, 27 June 1973, G. Ekis (DSC). GUATEMALA: San Geronimo, Champion, Holotype female of *N. crucifer* (BMNH).

Distribution: Chiapas and Guatemala. Present from May through June.

Discussion: It is most similar to *opacus* by the usually crenulate crest margin, the moderately raised setae on the elytra, and the apical emargination of the male fifth sternite. It is separated by the shallow emargination and circular impression of the male fifth sternite, and the cylindrical first metatarsomere of the male.

Notoxus opacus Champion

(Figs. 40, 62)

Notoxus opacus Champion 1890: 207, Table IX, fig. 16. Type locality: Cerro de Plumas, Veracruz, MEXICO. Holotype ♂ in BMNH. Pic 1894: 47; 1911: 10. *Not* Pallister 1955: 6.

Length 3.45-3.85. Head and pronotum red-brown to brown, elytra red-brown to brown with dark brown markings: oval mark on omoplates often expanded laterally to form postbasal band, broken along elytral suture, often extending posteriorly along elytral suture to postmedian band, mark on apices extending anteriorly along elytral suture. Pubescence brownish when arising from marks, whitish over rest of body. Raised setae moderately long and erect on pronotum and elytra, average angle on elytra 40°. Mandibular explanation narrow, rarely with front and hind margins meeting mandible at same level. Pronotum with antebasal pubescent band widely broken. Horn without pits beneath 4-7 teeth on margin. Crest margin usually smooth, apex pointed, rarely with apex indistinct and merging with horn. First and second protarsomeres with strong spur on posterior apical margin.

Males with fifth sternite deeply emarginate, transversely impressed immediately before apex, first metatarsomeres enlarged and flattened.

Females with fifth sternite rounded-triangular.

Redescribed ♂: Puebla, Puebla, MEXICO (CASC). Length 3.38. Head 0.74 long, eye 0.26 long, raised setae over eyes average 0.13 long; antennomere ratios: I 2.50, II 1.25, III 2.50, IV 2.25, V 1.80, VIII 1.45, X 1.34, XI 2.26; fourth maxillary palpus 0.20 long, 0.11 wide; mandibular explanation 0.10 long, 0.04 wide. Pronotum 1.04 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.25 wide; horn 0.44 long,

0.27 wide at base, 5 teeth on margin; crest 0.28 long, 0.08 wide at base, apex distinct and smooth; crest apex 0.04 above horn margin; horn apex 0.16 from crest apex; pronotal pit 0.12 long. Raised elytral setae 0.11 long, average angle 34°. Emargination of fifth sternite 0.15 wide, 0.02 deep.

Specimens examined, 6: MEXICO: Puebla: Puebla, May, A. Fenyes coll. (CASC); 5 mi SW Chipilo, 26 June 1975, D. S. Chandler, sweeping low vegetation (DSC). Oaxaca: 3.2 mi S Ocotlan, 20 July 1974, Clark, Murray, Ashe, Schaffner (TAMU); 30 mi NW Oaxaca, 6500', 27 June 1965, Burke, Meyer, Schaffner (DSC). The holotype record is from Veracruz.

Distribution: South-central Mexico. At 5 mi SW Chipilo two females were collected sweeping, while none were attracted to either cantharidin or drying meloid beetles which had been placed within thirty meters of the collection site. Present from May through July.

Discussion: It is most similar to *crucifer*. It is separated by the deep emargination and transverse impression of the male fifth sternite. The first metatarsomeres of the male are enlarged and flattened.

Notoxus sp.

(Figs. 17, 58)

♀: Foz do Iguacú, Paraná, BRAZIL (MGF). Body brown, no markings on elytra. Pubescence whitish. Raised setae long and erect on pronotum and elytra, average angle on elytra 47°. Mandibular explanation moderately wide, front and hind margins on same level at mandible. Pronotum with antebasal pubescent band widely separated. Horn without pits beneath, 6 teeth on margin. Crest margin serrate, apex pointed and indistinct. Carina extending from horn base to anterior margin of pronotal pits. First and second protarsomeres lacking large spur on posterior apical margin.

Male unknown.

Female with fifth sternite triangular.

Length 2.60. Head 0.58 long, eye 0.17 long, raised setae over eyes average 0.16 long; antennomere ratios: I 2.00, II 1.90, III 2.38, IV 2.25, V 2.25, antennomeres VII-XI missing; fourth maxillary palpus 0.16 long, 0.08 wide; mandibular explanation 0.08 long, 0.05 wide. Pronotum 0.91 long, length from base to point of greatest width 0.32, break in antebasal pubescent band 0.24 wide; horn 0.37 long, 0.29 wide at base; crest 0.24 long, 0.12 wide at base; crest apex merging into horn, horn apex 0.16 from crest apex; pronotal pit 0.11 long. Raised elytral setae 0.15 long.

♀: Foz do Iguacú, Paraná, BRAZIL, November 1955, G. B. Frey (MGF).

Distribution: Southern inland Brazil.

Discussion: This species is very distinct in the possession of lateral carinae between the horn base and the cervix. This character is found only in the African and Indian *Notoxus* with which this species has a high degree of resemblance. It is probable that this species has been introduced from the Old World and it will require the collection of the male in order to decide if the species has been described.

Incertae sedis

Notoxus dugesi Pic

Notoxus Dugesi (sic) Pic 1901: 89. Type locality: Guanajuato, Guanajuato, MEXICO. Type in MNHN. Pic 1911: 7.

Pic's description of this species is typical in its brevity and gives no clues as to which species it could be.

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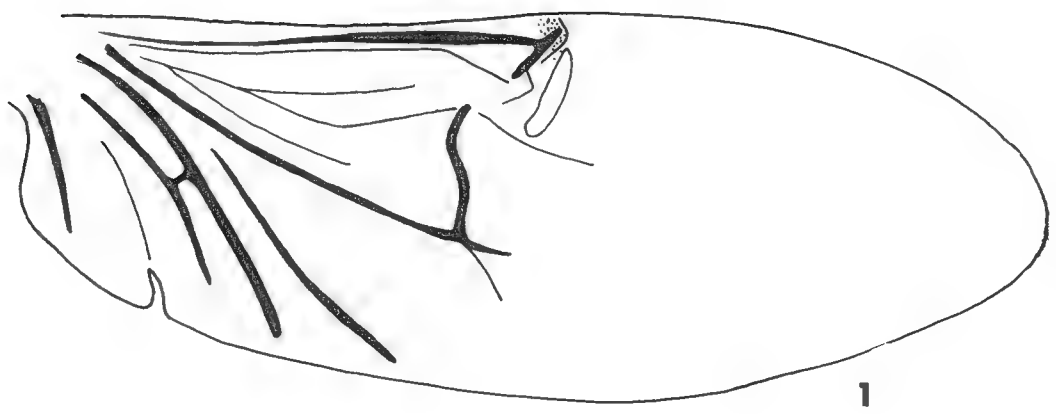

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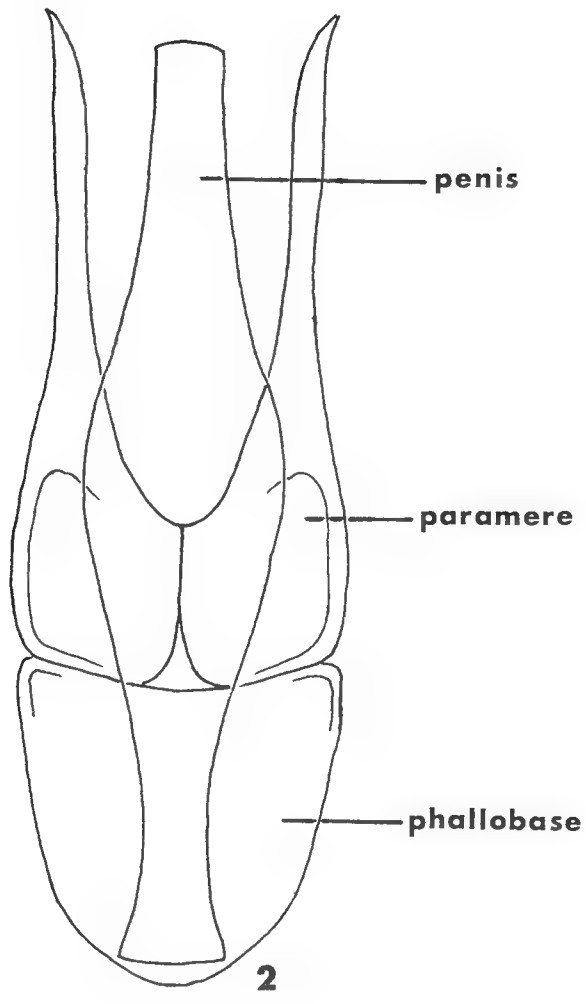

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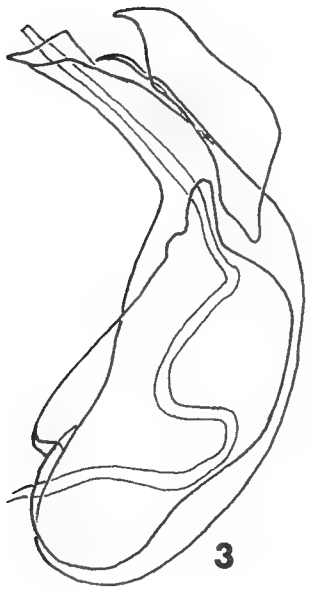

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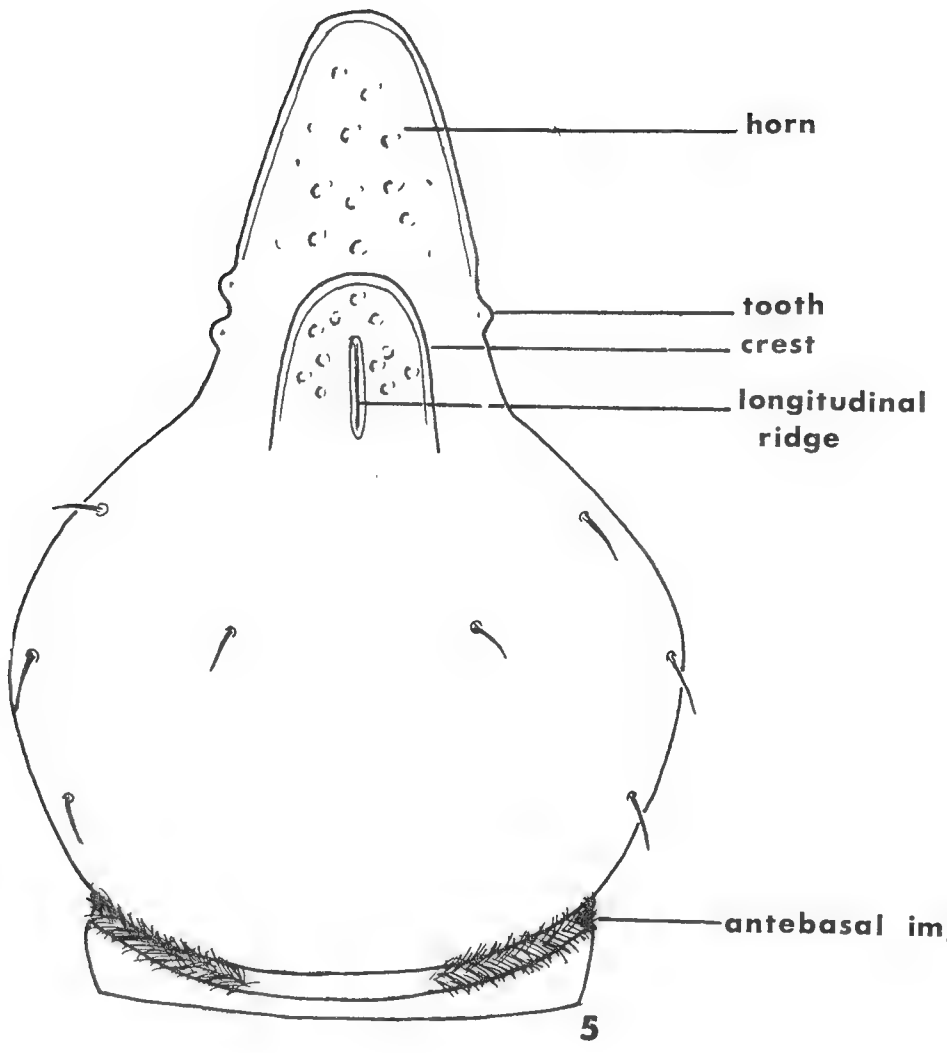

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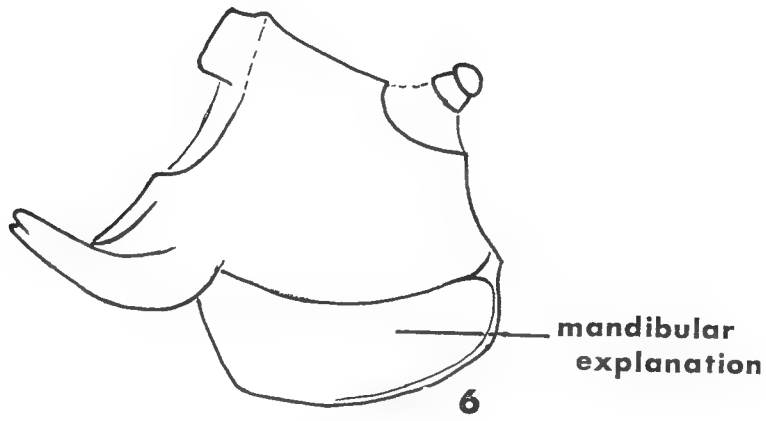

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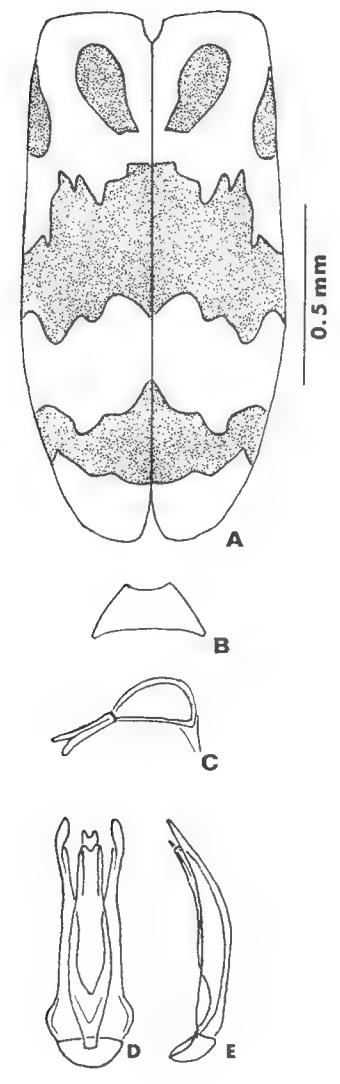
Figures 1-6. 1. Hindwing of *N. arizonensis*. 2. Ventral view of generalized *Notoxus* genitalia. 3. Left lateral view genitalia of *Plesionotoxus lebasi*. 4. Ventral view genitalia of *Plesionotoxus lebasi*. 5. Dorsal view of generalized *Notoxus* pronotum. 6. Posterior view mandibular explanation *N. haustrus*.



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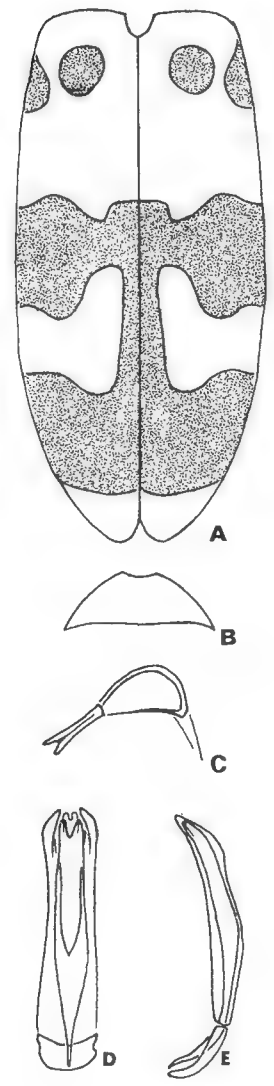

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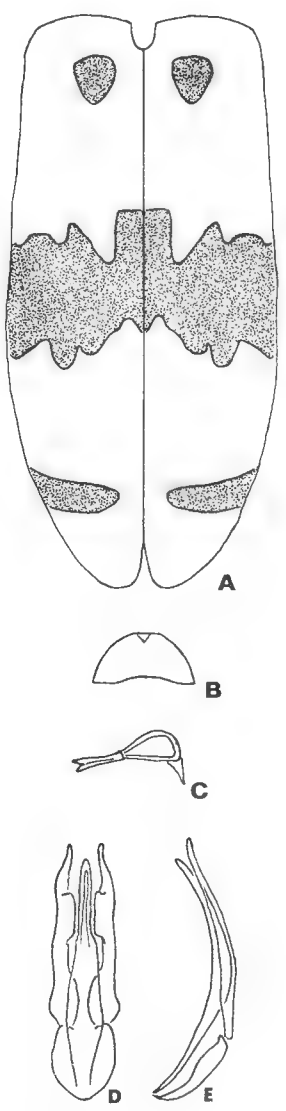

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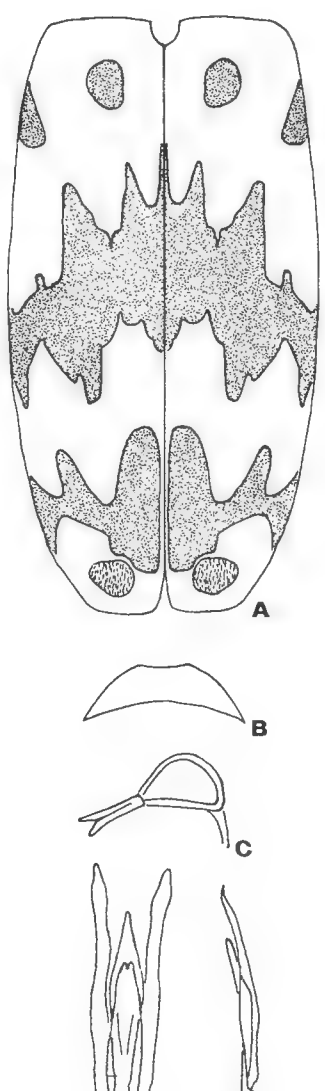

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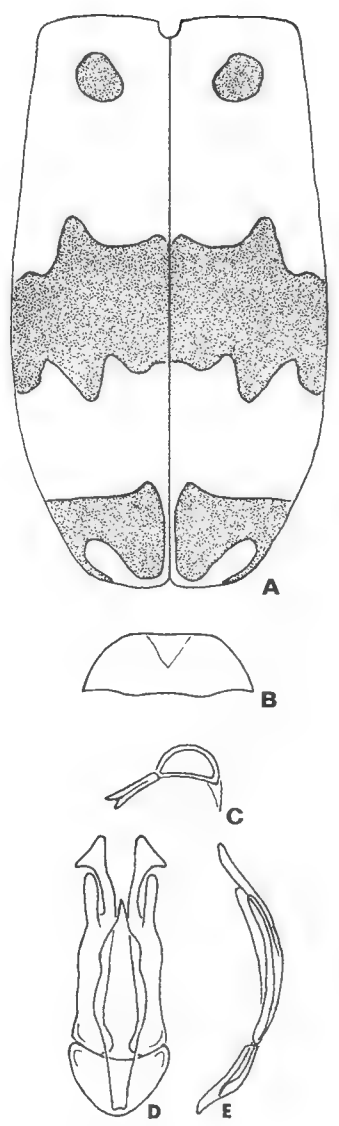

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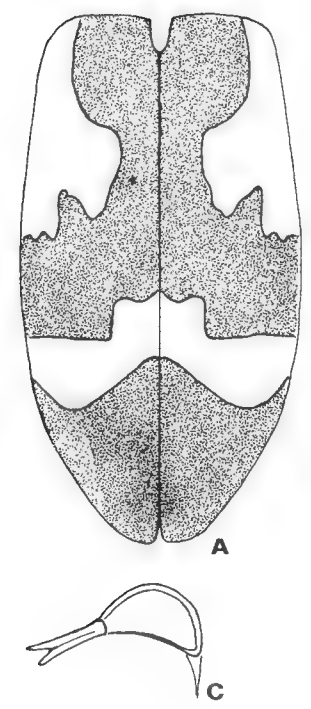

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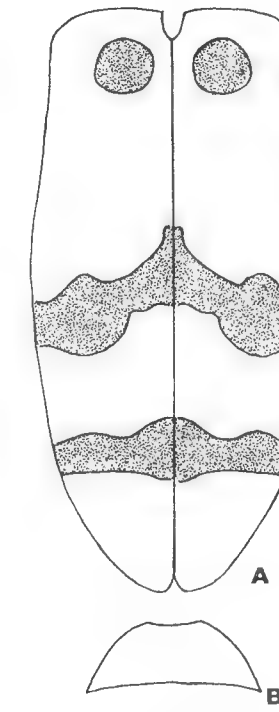

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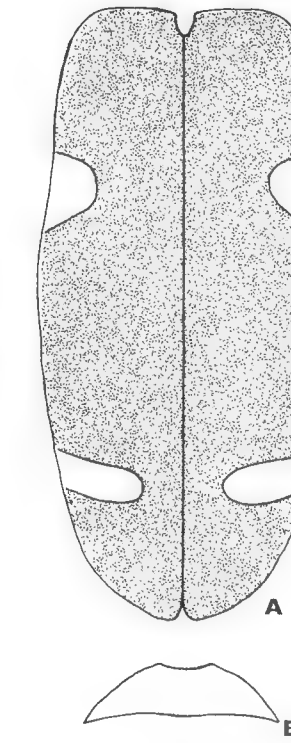

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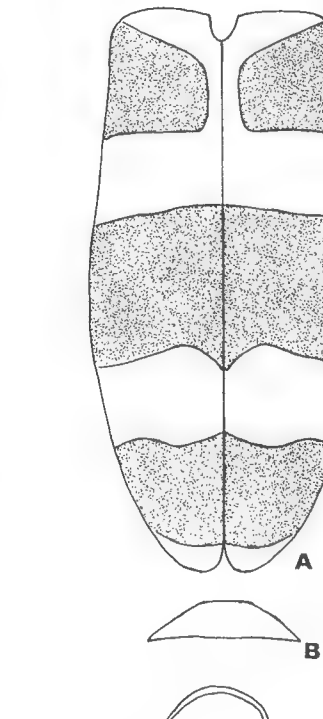
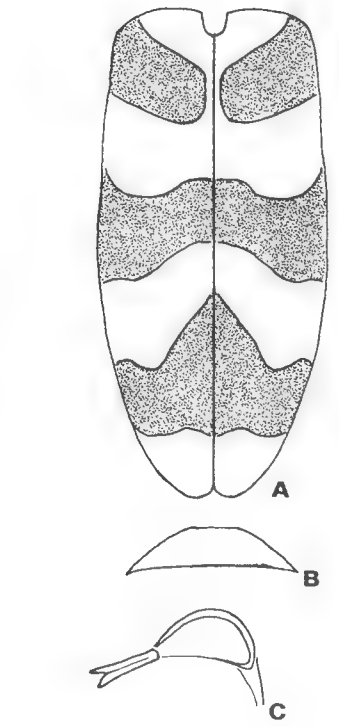
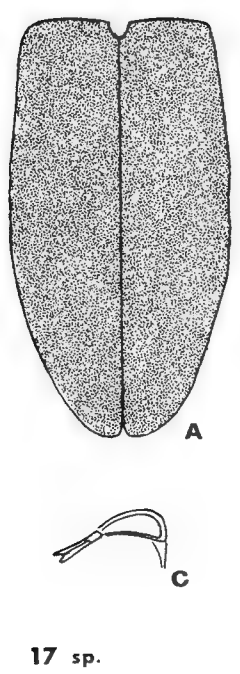


15 nubilus



16 toltecorum

Figures 7-16. *Notoxus* spp. A. Elytral color pattern. B. Male fifth sternite. C. Ventral view mandibular explanation. D. Ventral view male genitalia. E. Left lateral view male genitalia.



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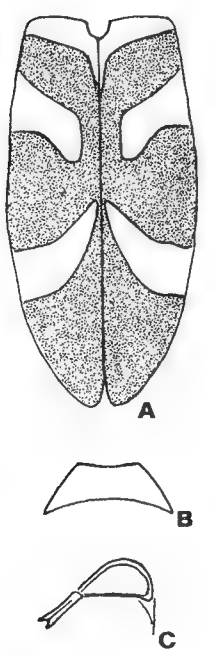

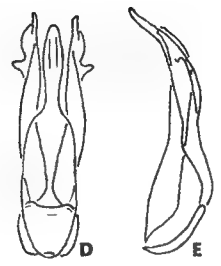

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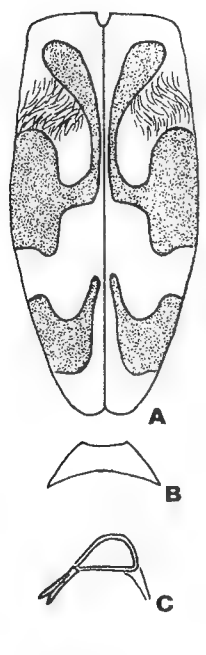
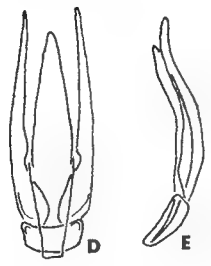
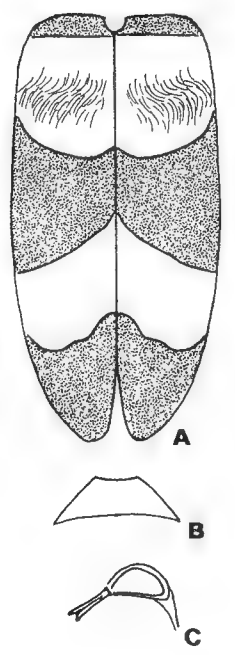
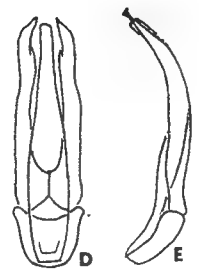


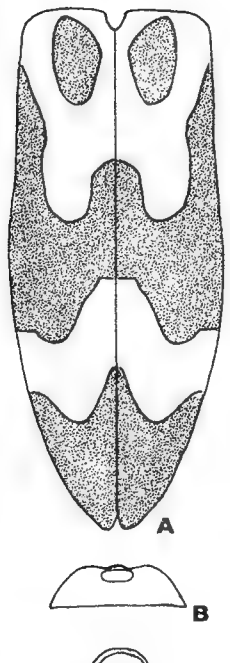


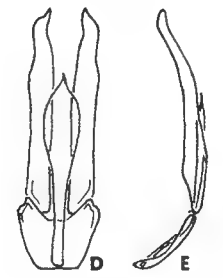
19 lateralis



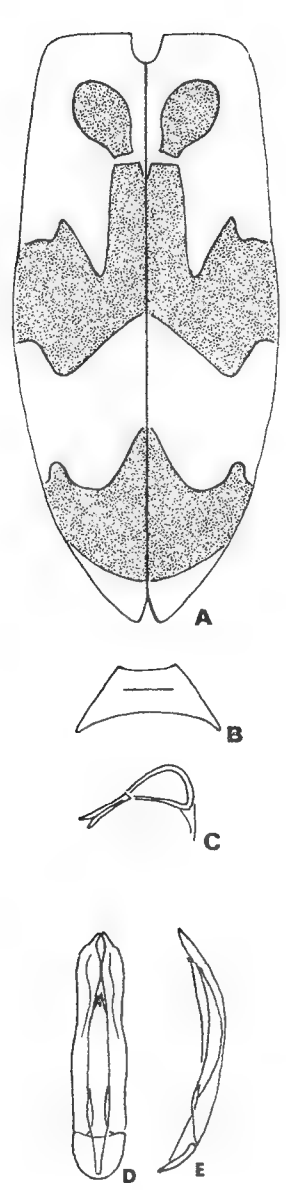


20 solus

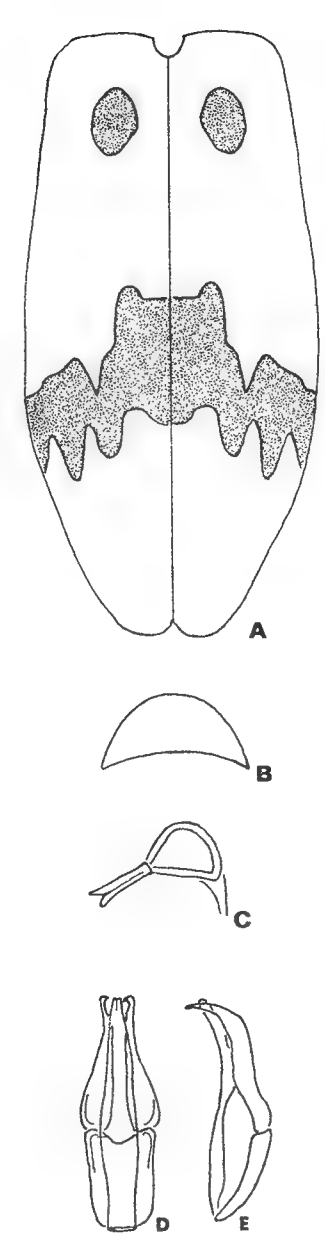




21 impressus



22 acuminatus



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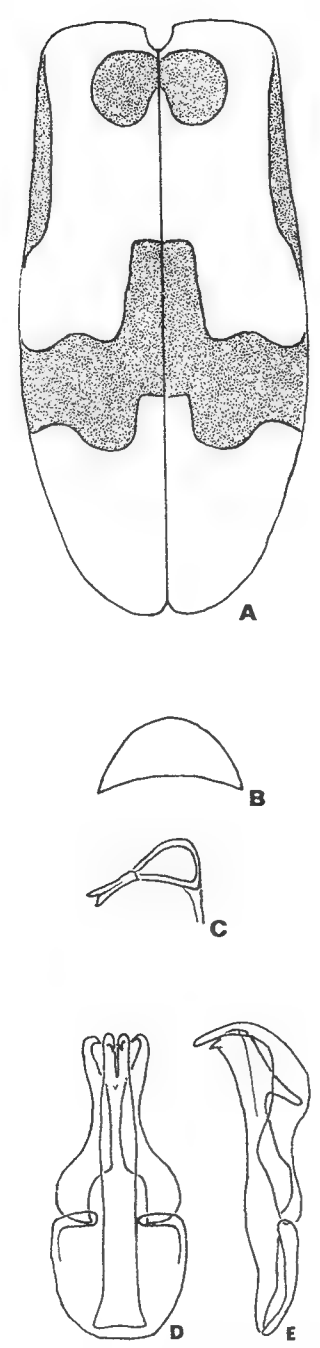

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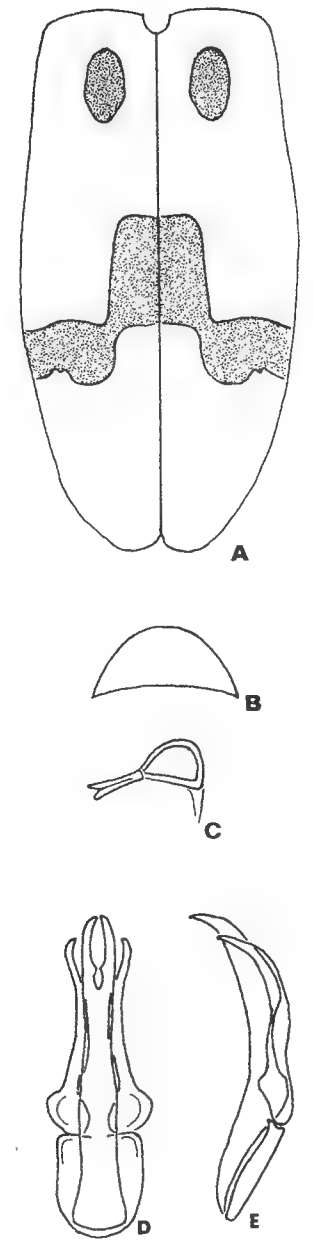
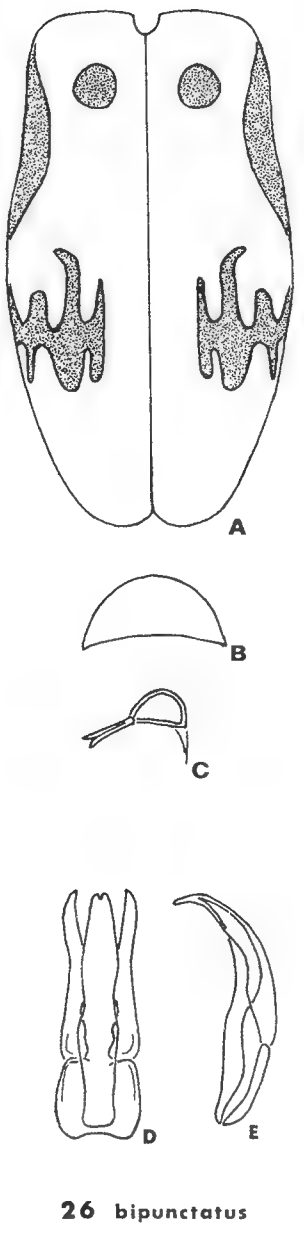
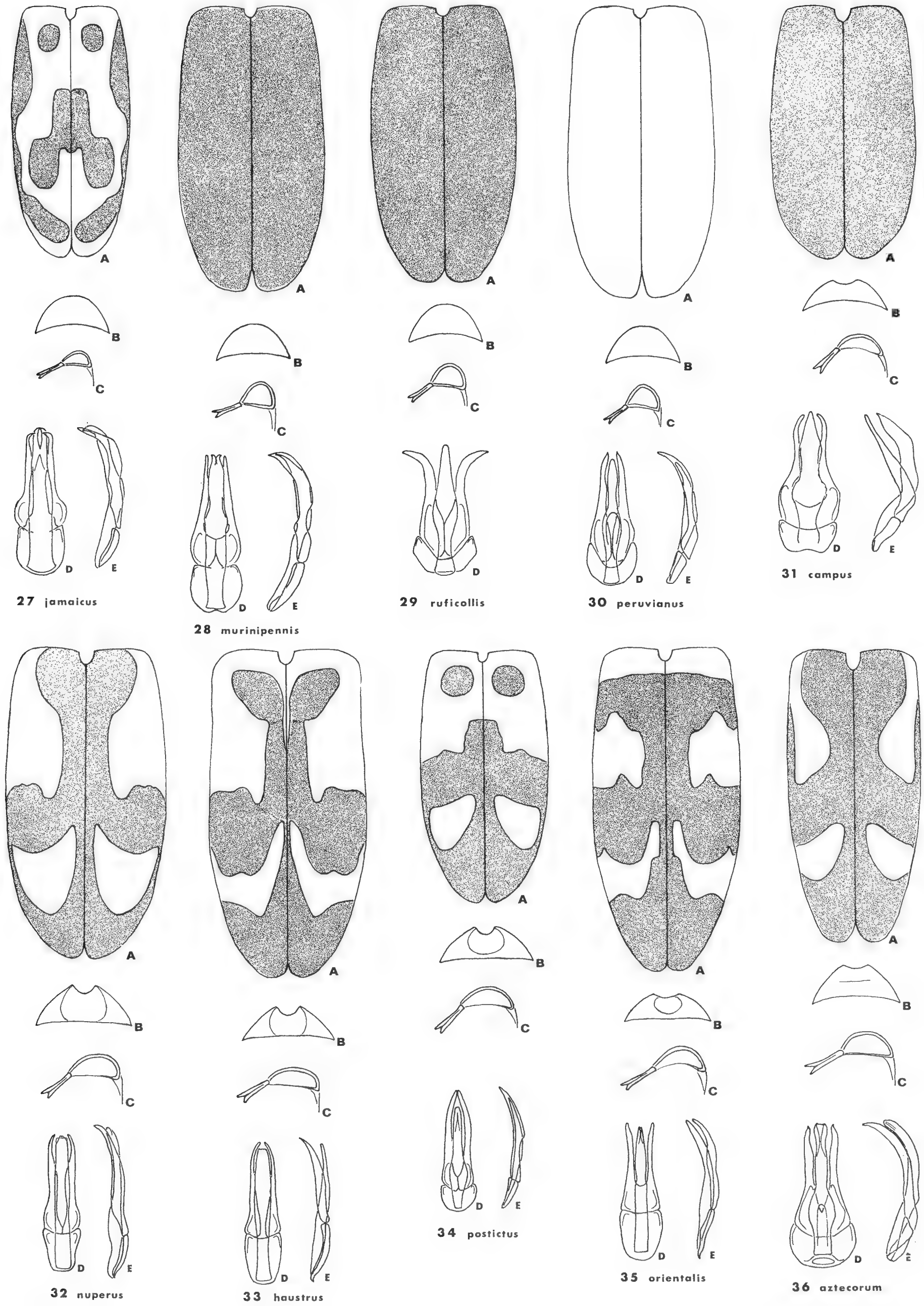


25 cumanensis

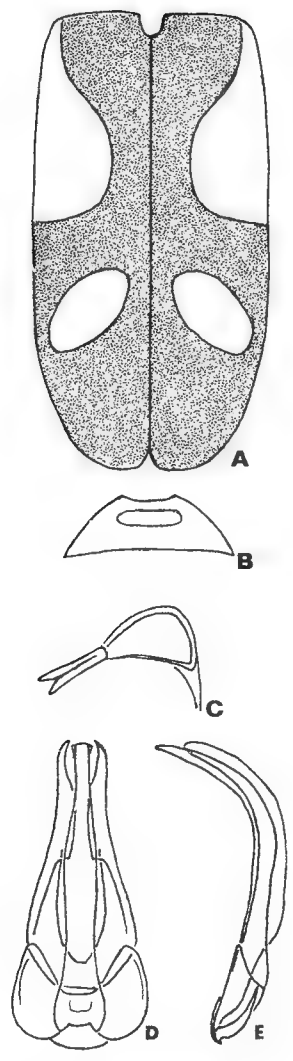


26 bipunctatus

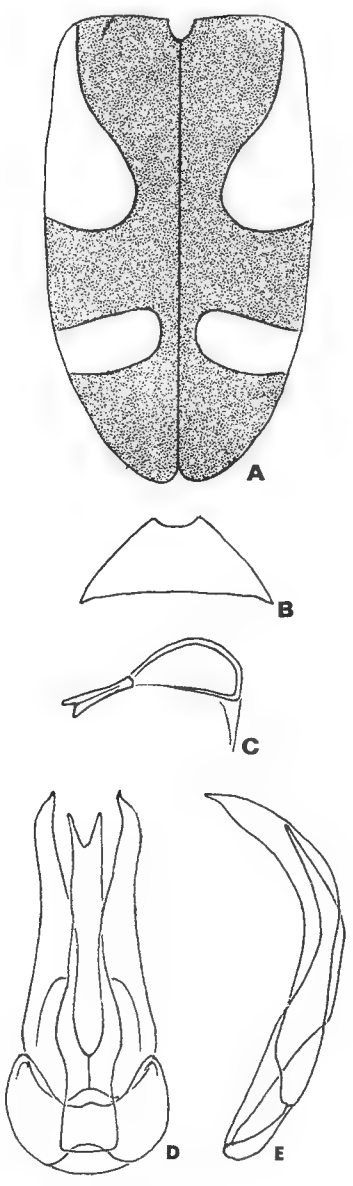
Figures 17-26. *Notoxus* spp. A. Elytral color pattern. B. Male fifth sternite. C. Ventral view mandibular explanation. D. Ventral view male genitalia. E. Left lateral view male genitalia.



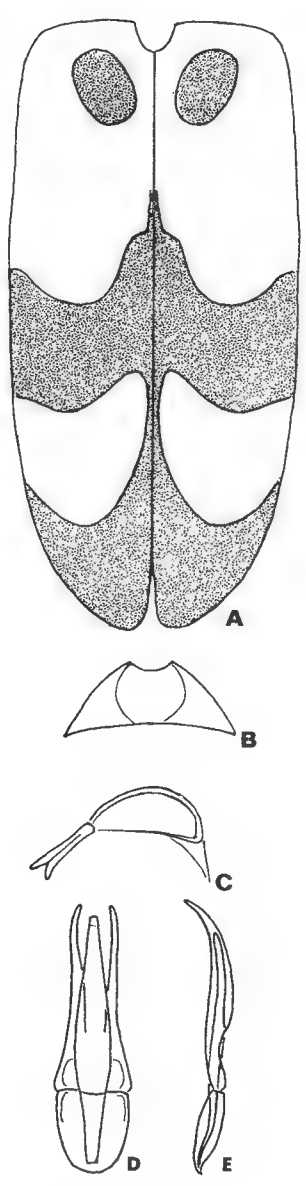
Figures 27-36. *Notoxus* spp. A. Elytral color pattern. B. Male fifth sternite. C. Ventral view mandibular explanation. D. Ventral view male genitalia. E. Left lateral view male genitalia.



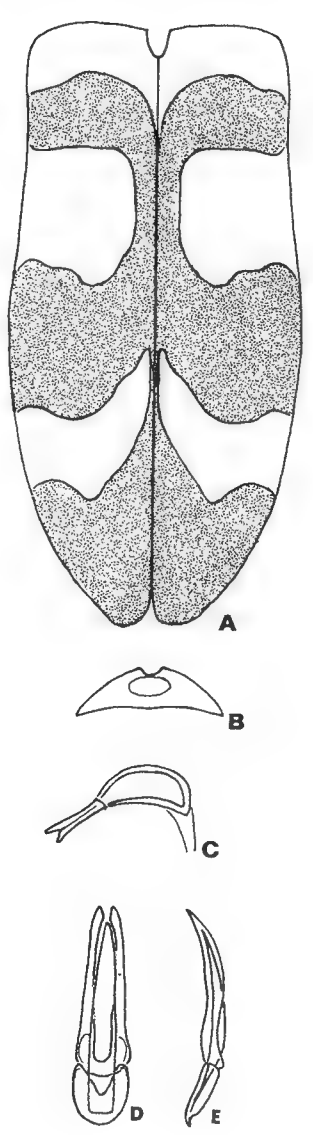
37 truncatipennis



38 desperatus



39 stephani



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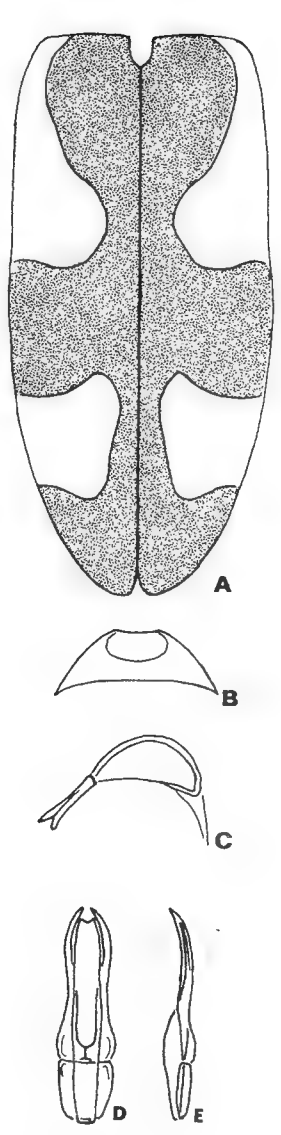
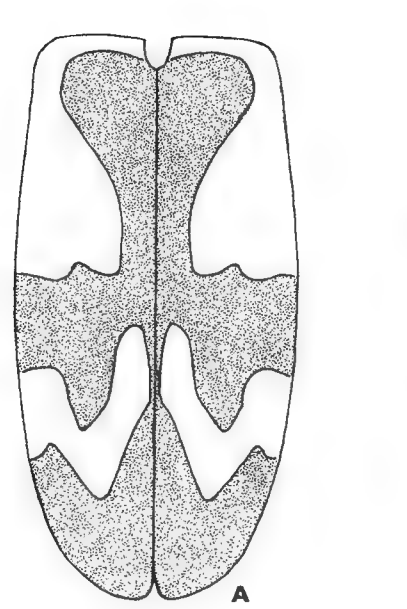


41 crucifer



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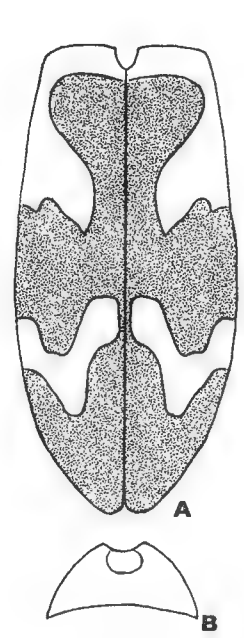
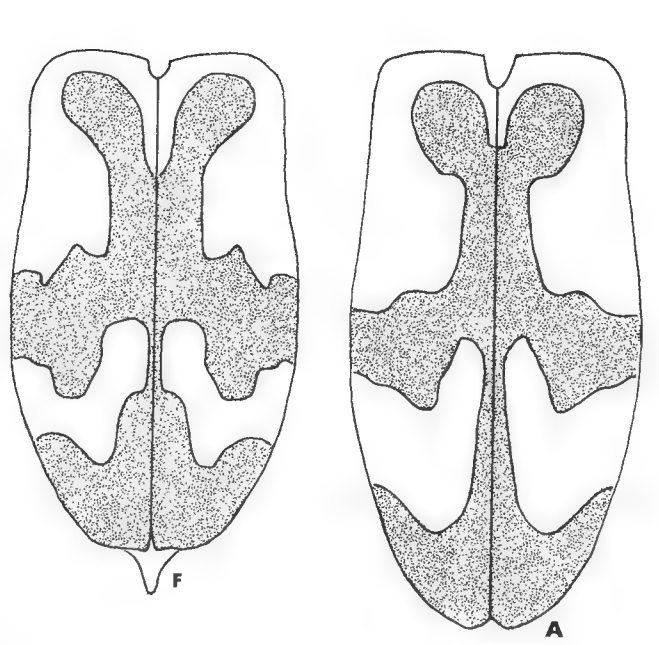
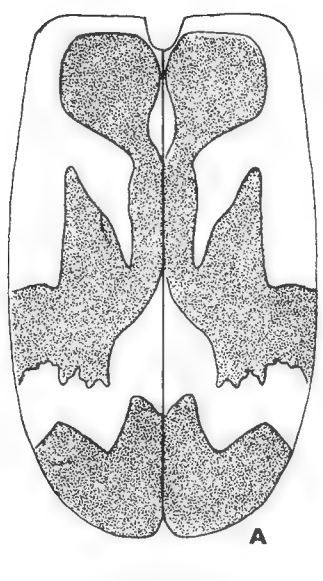


43 pygidialis



44 photus

Figures 37-44. *Notoxus* spp. A. Elytral color pattern. B. Male fifth sternite. C. Ventral view mandibular explanation. D. Ventral view male genitalia. E. Left lateral view male genitalia. F. Female elytra.



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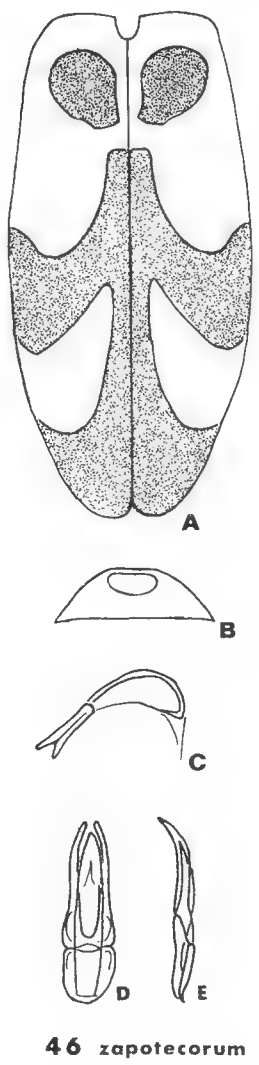
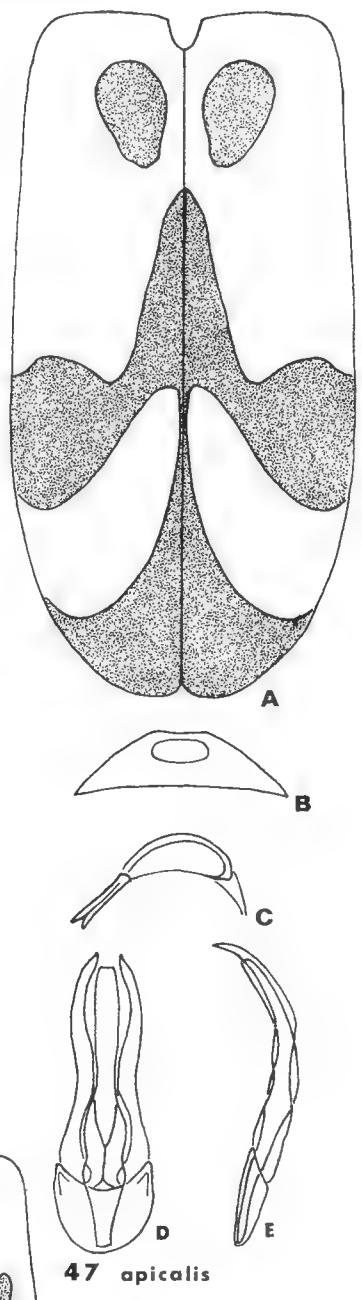
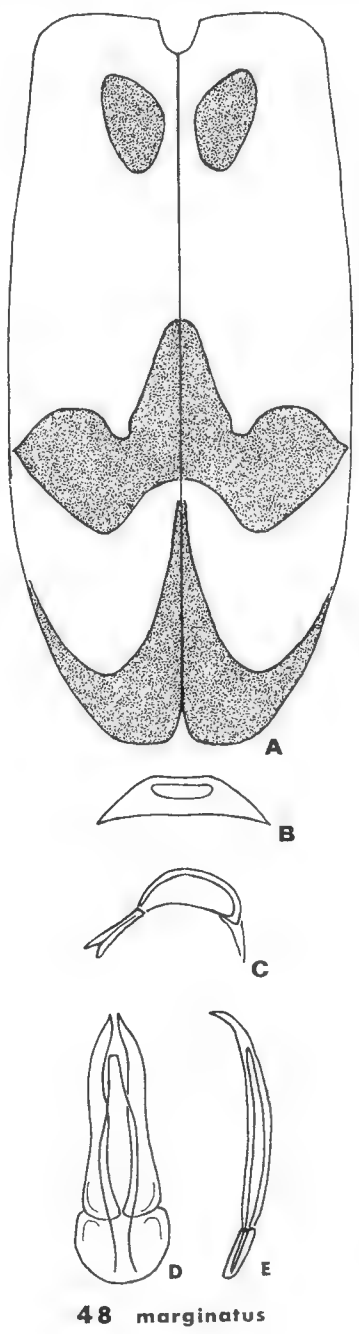


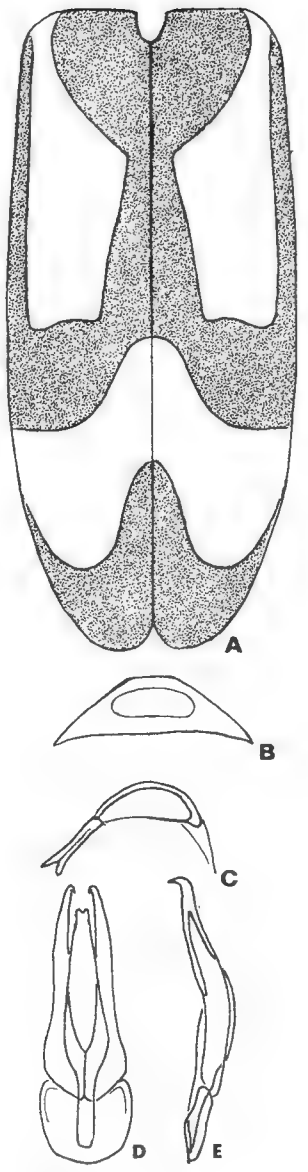
46 zapotecorum



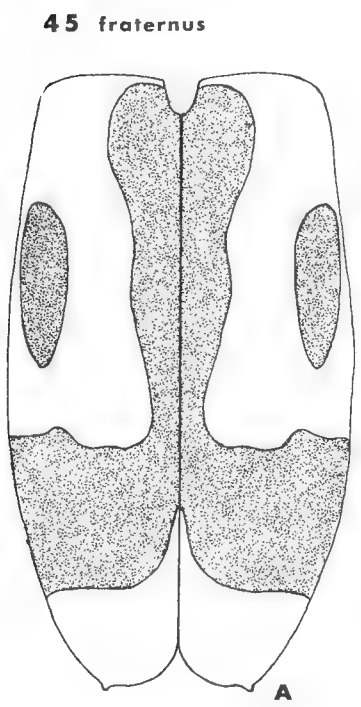
47 apicalis



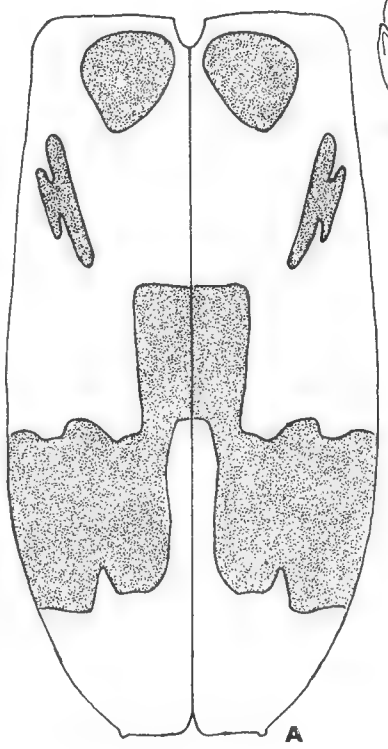
48 marginatus



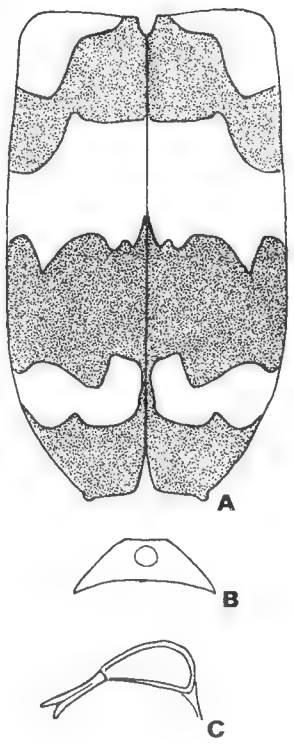
49 mexicanus



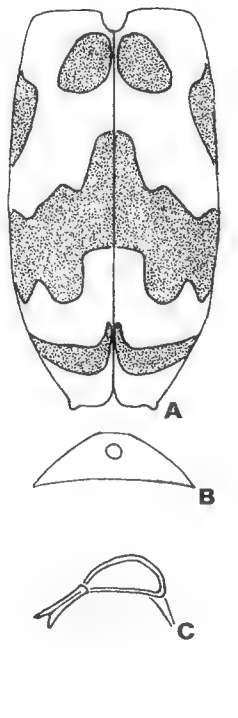
50 anchora



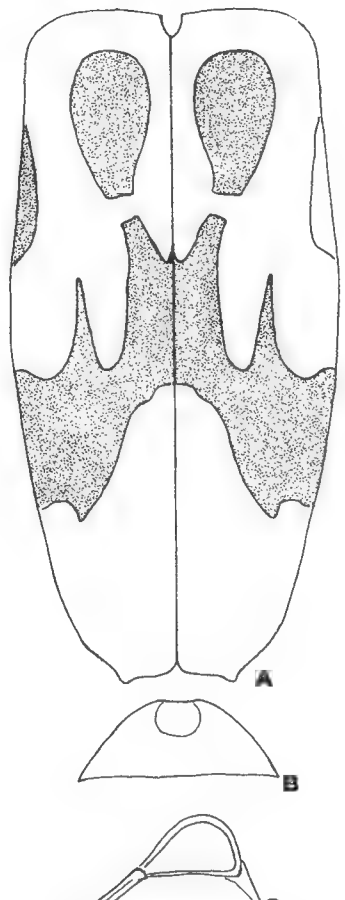
51 serratus



52 sparsus



53 conformis



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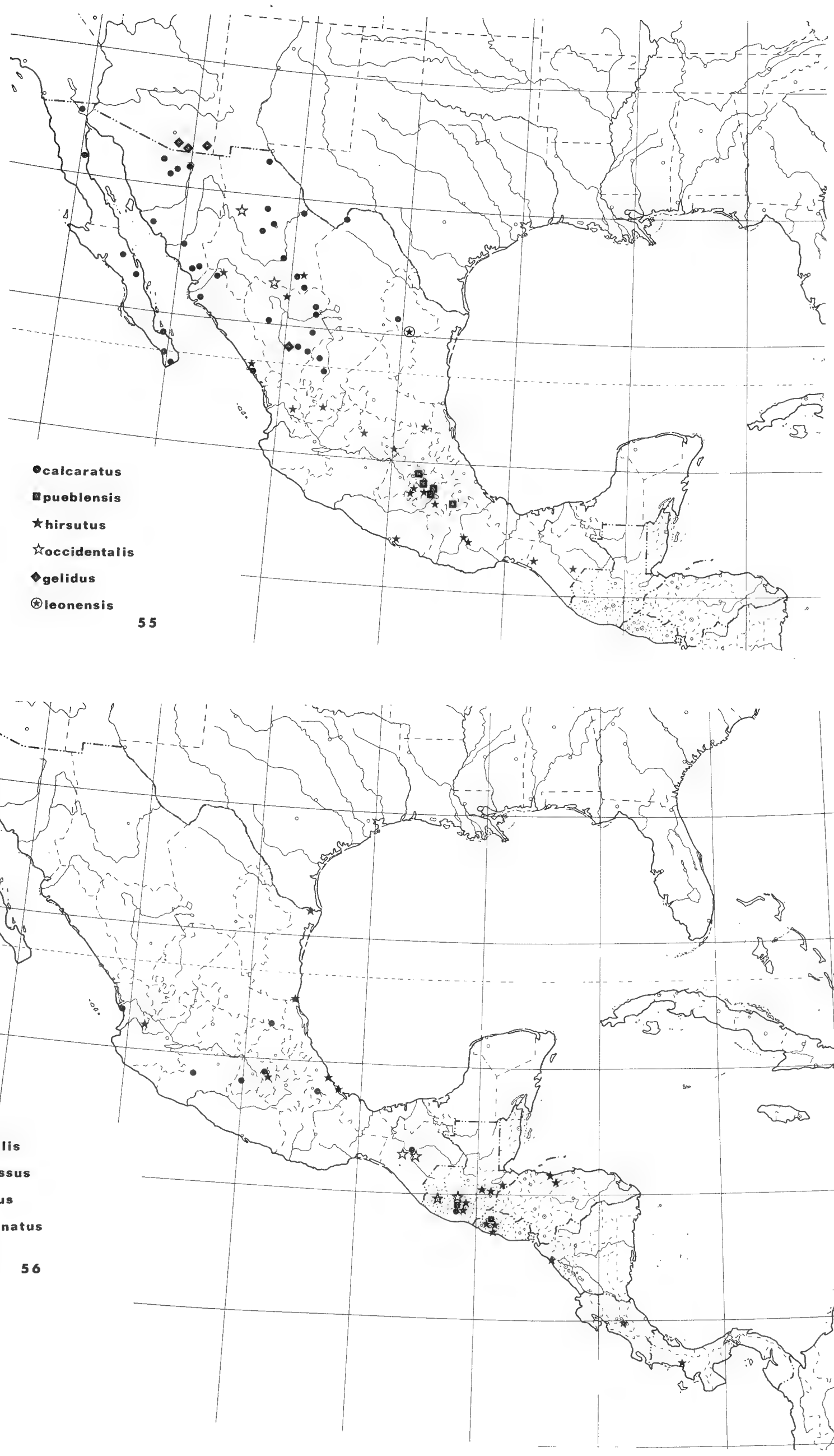

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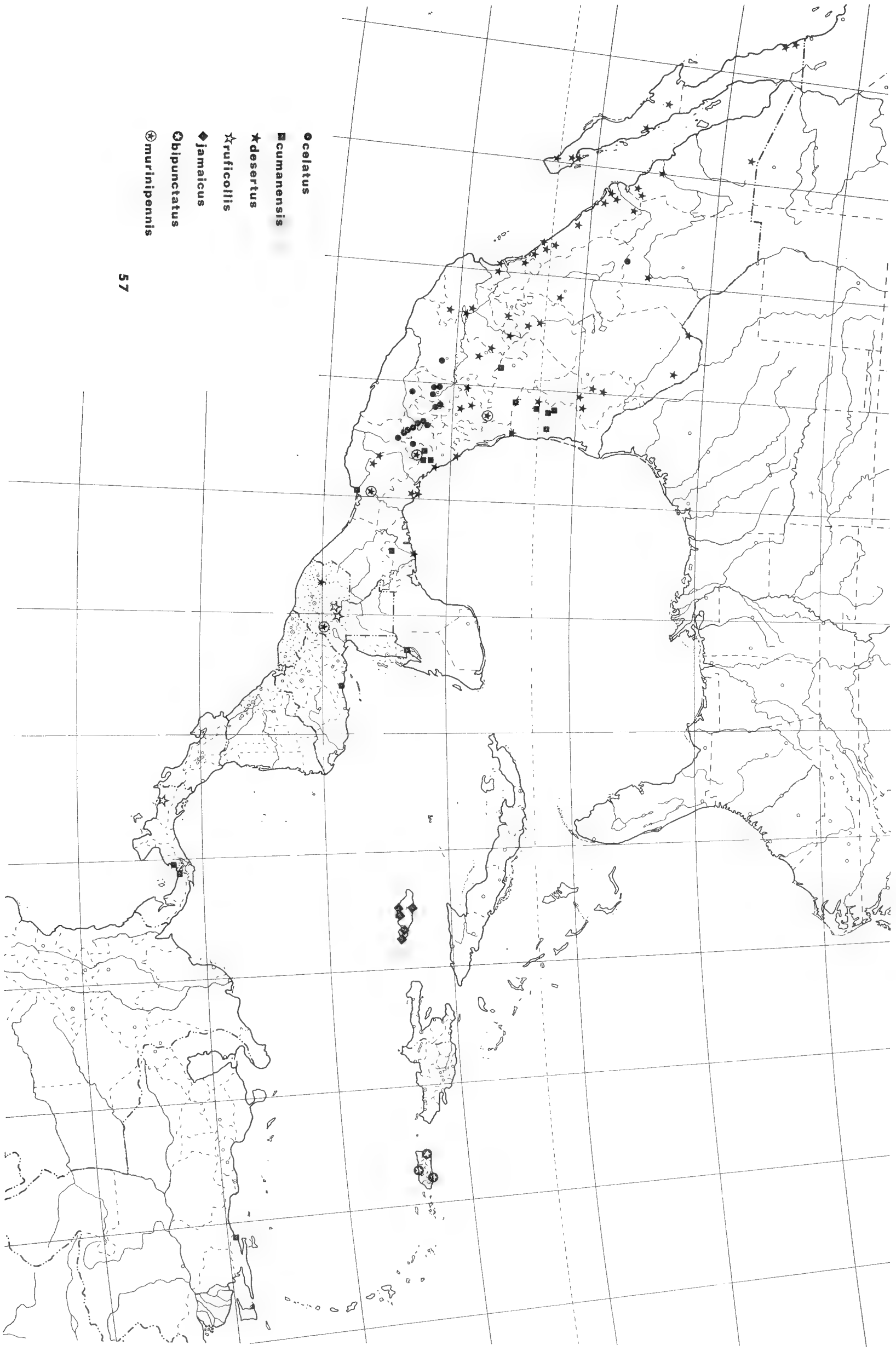

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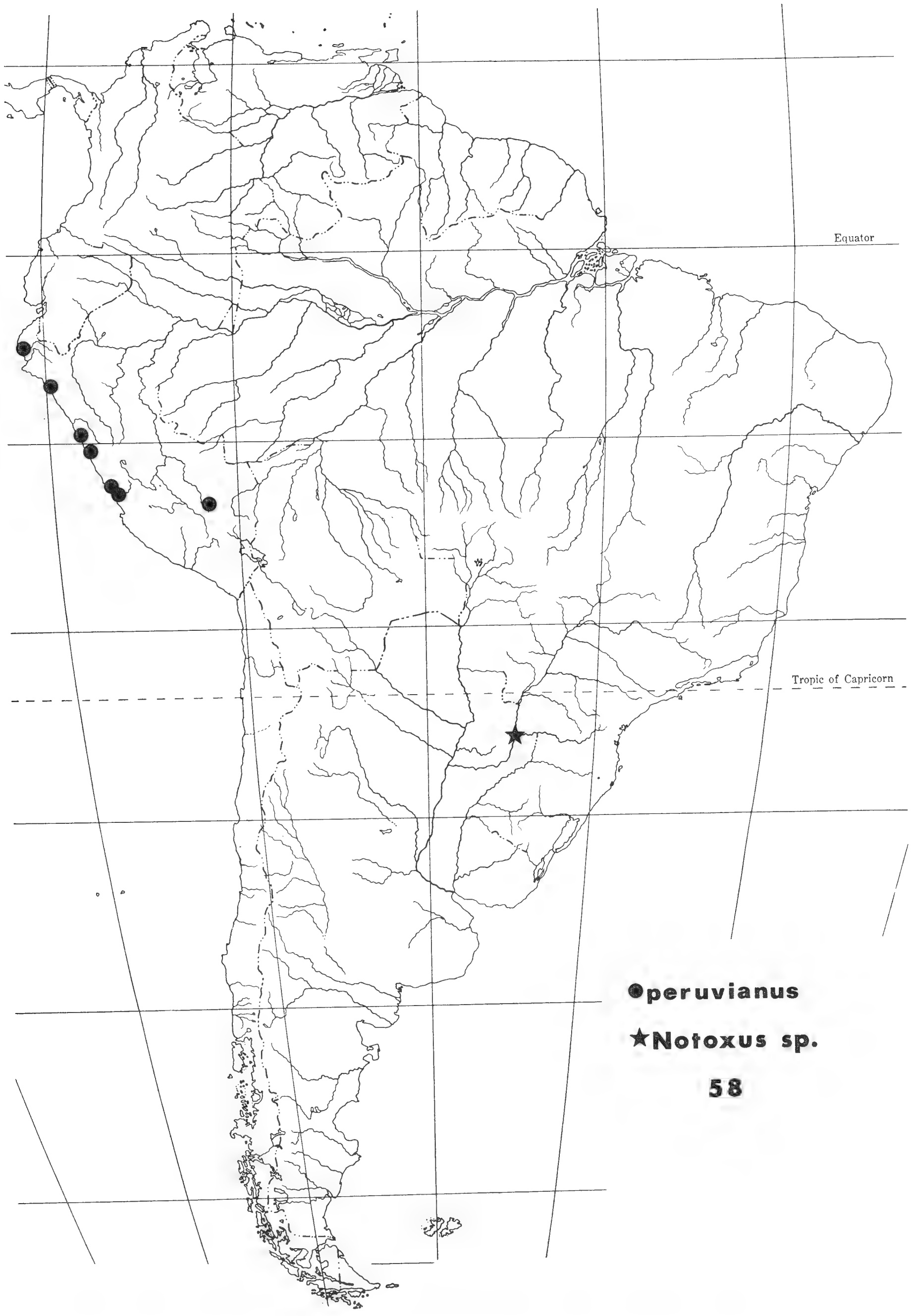

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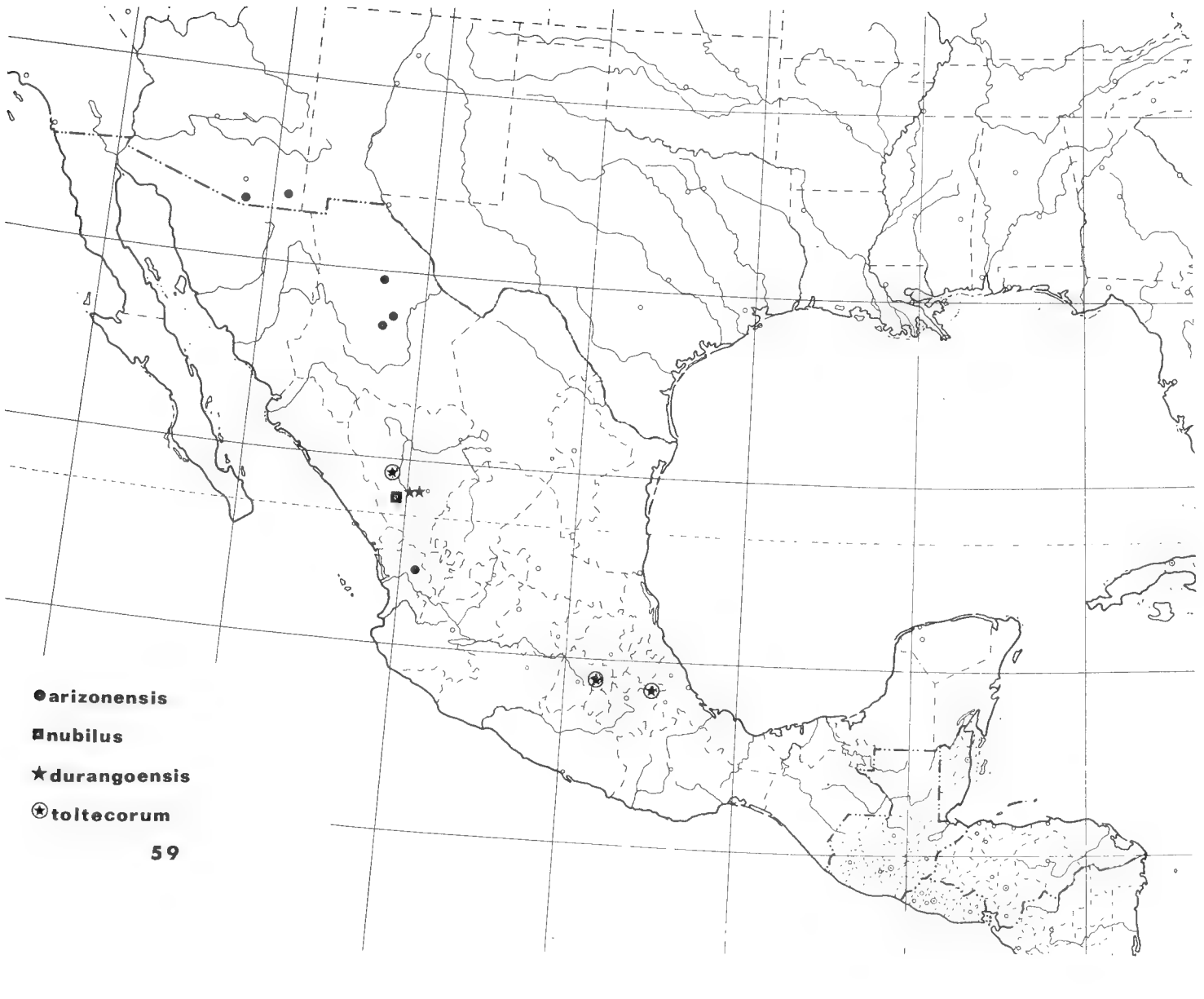

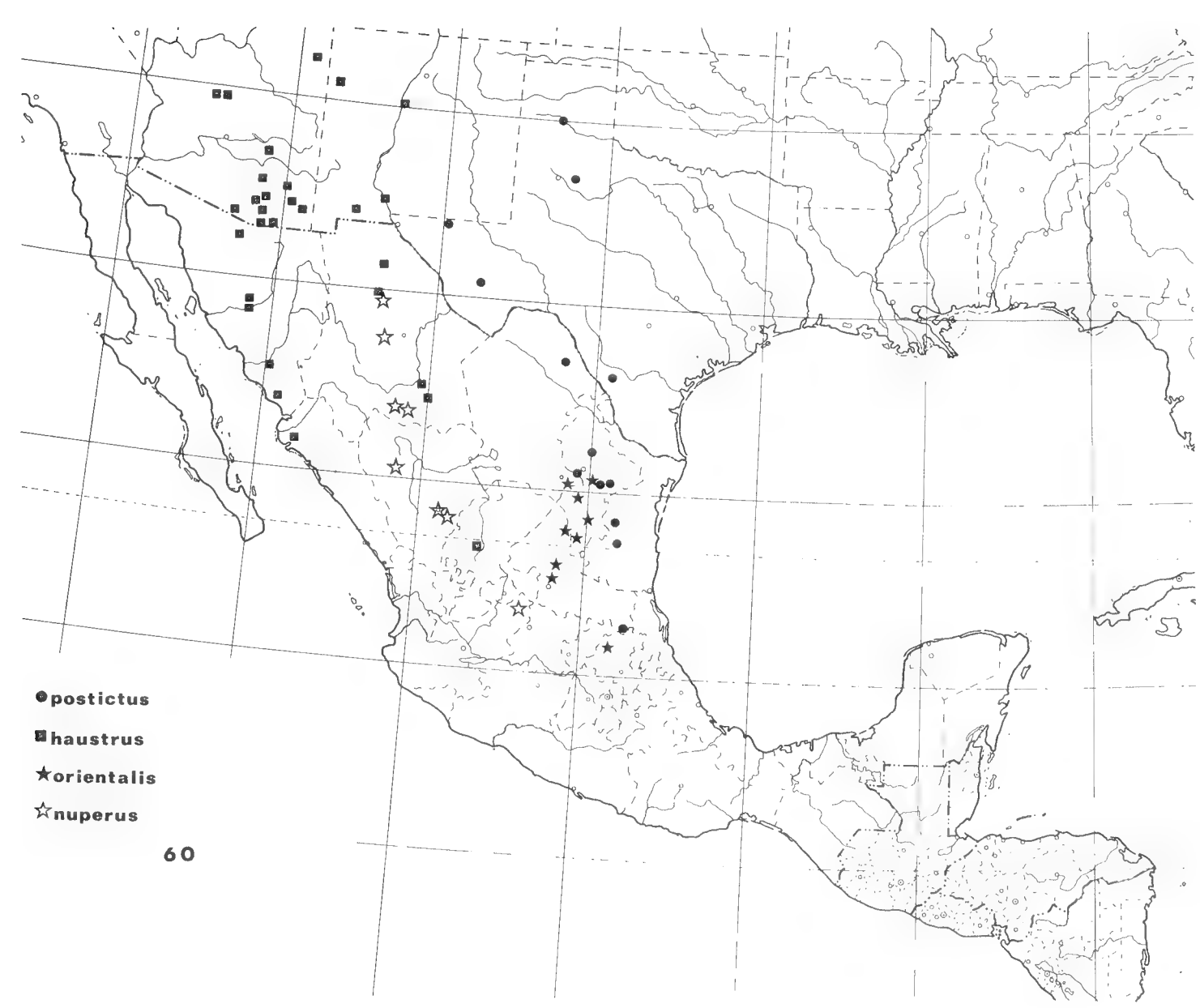

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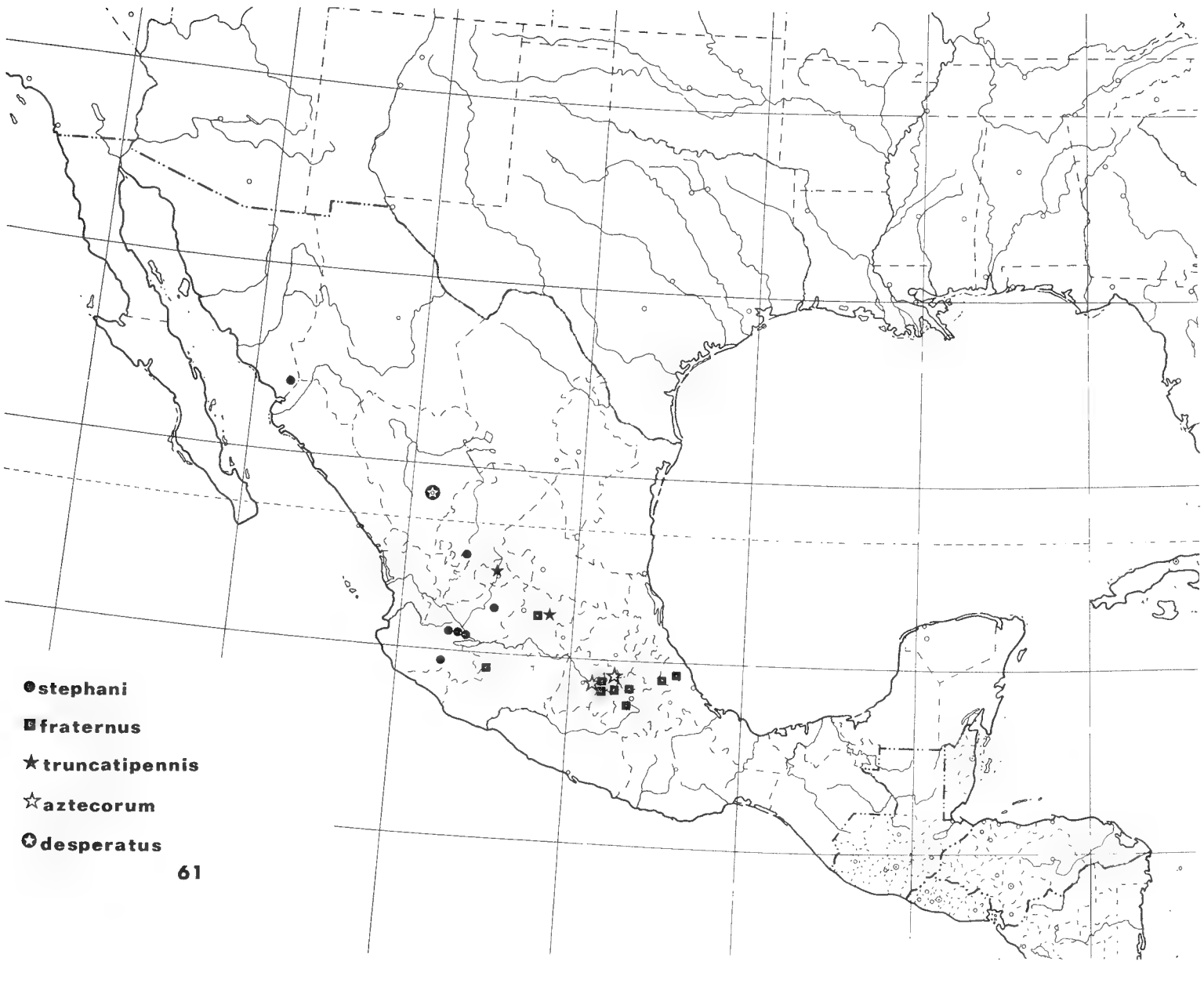

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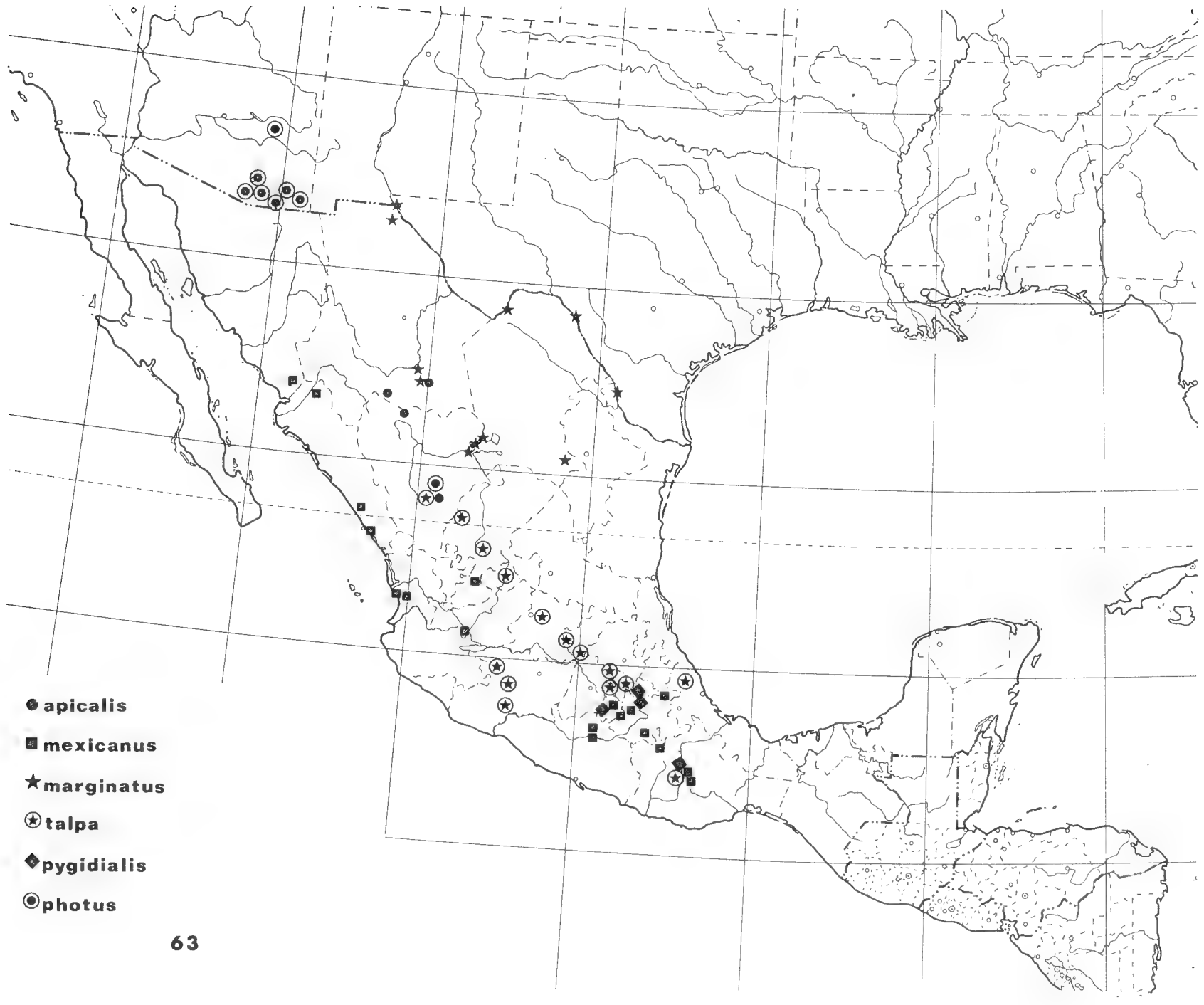

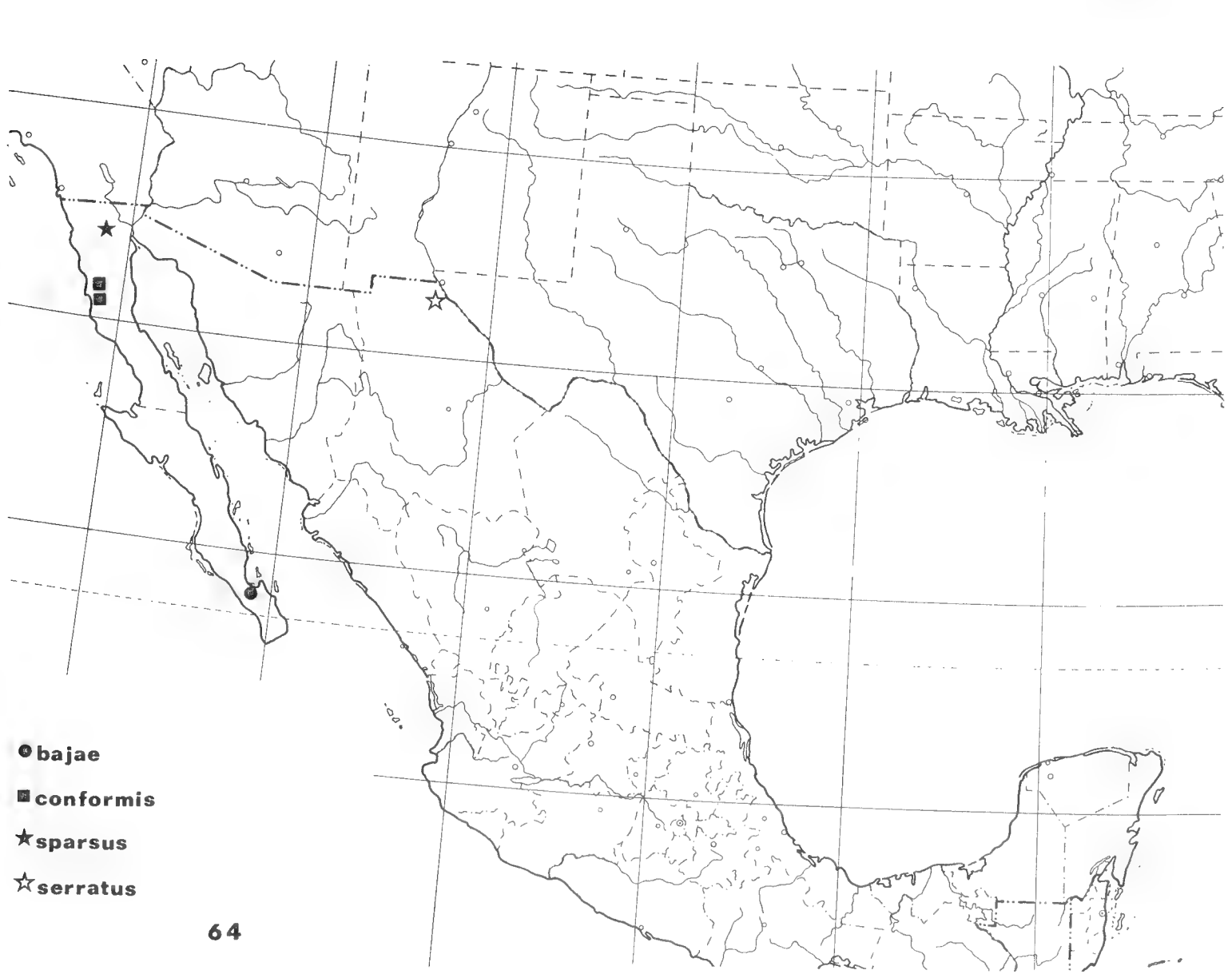

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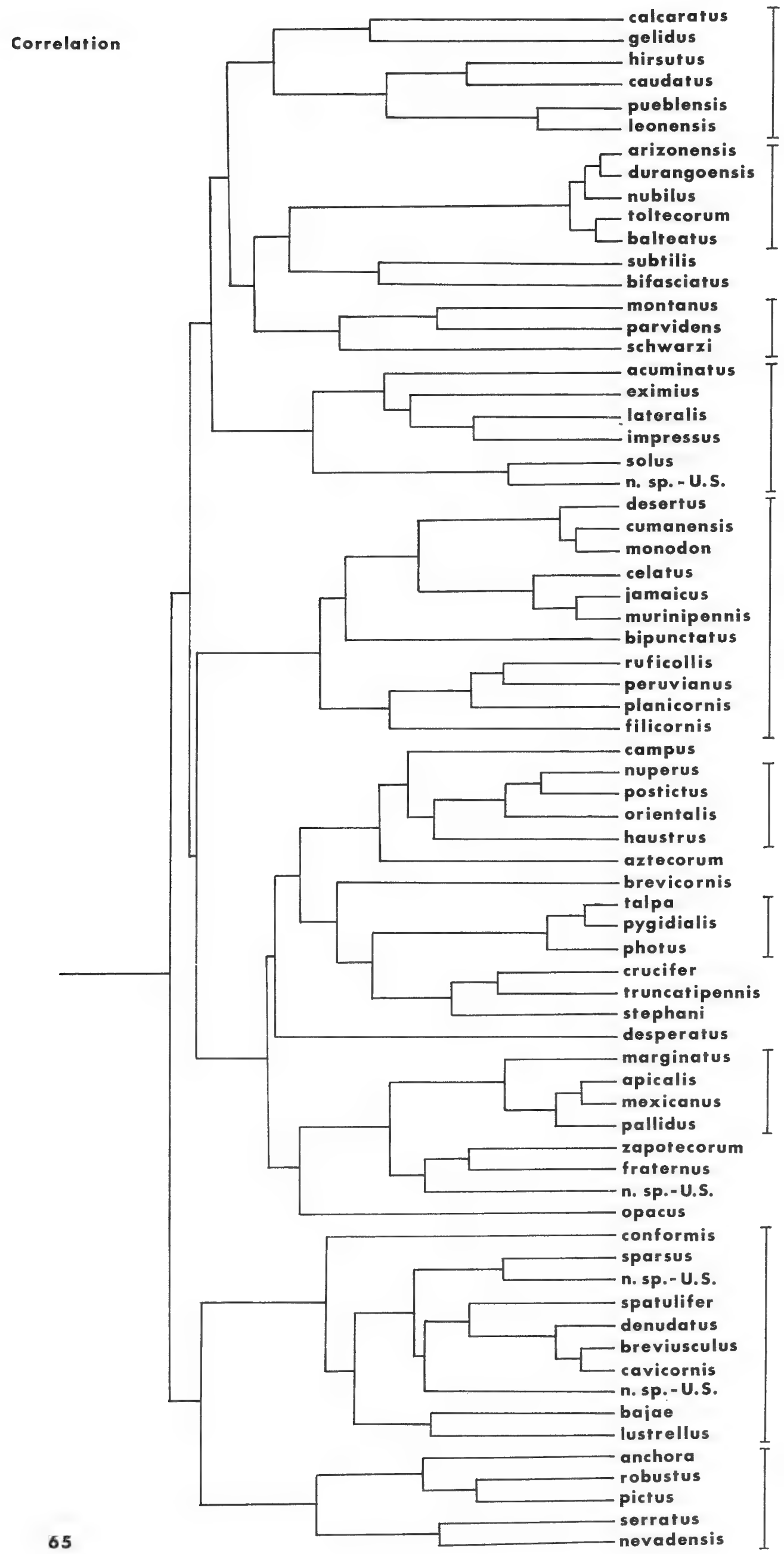

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A REVIEW OF THE NEW WORLD GENUS ATHYREUS MACLEAY (SCARABAEIDAE, GEOTRUPINAE, ATHYREINI)

by

Henry F. Howden and Antonio Martínez

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By

Henry F. Howden[1] and Antonio Martínez[2]

ABSTRACT

Thirty-one species are included in the genus Athyreus Macleay. Seventeen previously proposed names are considered valid, six are considered synonyms, and three names, billbergi Gray, subarmatus Westwood and vicinus Laporte are listed as incertae sedis. Fourteen new species are described: acuticornis from Brazil, alvarengai from Brazil, anneae from Brazil and Paraguay, biarmatus from Trinidad, bilobus from Brazil, brasilicus from Brazil, capricornis from Brazil, conspicuus from Argentina, hypocritus from Argentina and Paraguay, juanae from Brazil, nitidus from Bolivia, parvus from Brazil, pyriformis from Peru, and unicornis from Colombia. The introduction and keys are given in both Spanish and English. Following the incertae sedis a list of the species included in the genera Neoathyreus and Parathyreus is given.

CONTENTS

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INTRODUCTION

In 1819 Macleay proposed the name Athyreus. Until 1963 the genus included a heterogeneous mixture of New and Old World forms with some 61 names being listed in the genus by Boucomont (1912). In 1963 Howden and Martínez created the tribe Athyreini and restricted the genus Athyreus to include only a group

of relatively large, sexually dimorphic species with at least four, often six, relatively distinct intervals on each elytron. Athyreus bifurcatus Macleay was designated as type for the genus but no complete list of included species was attempted at that time as no key or revision for any of the groups had been attempted.

Both authors have slowly been accumulating information and specimens, and many of the types of Athyreus have been studied. We now consider 26 old names referable to Athyreus as presently constituted. Three names are based on females seemingly belonging to the bifurcatus complex of species and we consider them unassignable, listing them as incertae sedis. The other 23 names we believe can be assigned to 17 species with reasonable accuracy. However, there is some uncertainty and when the lack of specimens in series is also considered, we do not consider that a revision of the group is feasible. Hence, we have merely tried to assign the earlier names, describe fourteen new species and to present keys, brief descriptions, and illustrations. The keys, unfortunately, are based largely on males except for the chalybeatus group. Unless males and females can be associated in the field their association is usually questionable.

In Athyreus, well developed males often have a well developed clypeal horn and one or more pronotal horns or strongly elevated lobes. In contrast, females, with one exception (tuberifer), have a transverse carina across the anterior face of the clypeus and a second transverse carina posteriorly at the clypeal-frontal junction. This posterior carina is normally trituberculate, with a distinct median tubercle and a smaller one on each side at the lateral margin. In addition, female pronota may have several conspicuous carinae, particularly in the chalybeatus group, and in the other groups low central tubercles, but in only one species (tuberifer) do females have what could be termed a pronotal "horn". If there is any doubt about the sex it is best to check the genitalia.

Neither the use of the term "groups" in the keys or text nor the sequence used in numbering the species is meant to imply phylogenetic relationships. Rather atypical species, such as gigas Westw., armatus Westw., biarmatus n. sp., unicornis n. sp., and pyriformis n. sp., are arbitrarily placed and pyriformis at least could be assigned to either the aeneus or bifurcatus groups. The divisions were established, at least in part, as a convenient method of proportioning the descriptive work evenly between the authors.

Little can be said about the habits of Athyreus. Almost all specimens have been, as far as we can ascertain, collected at light. A few have been caught flying at dusk (crepuscular) but most are apparently nocturnal. The genus seemingly occurs mainly below 1500 m in elevation in a variety of habitats varying from relatively undisturbed lowland rainforest to seasonally wet, semiarid sandy habitats. Unfortunately, attraction to light seems to be an infrequent occurrence, and the rarity or lack of material in collections has seriously hindered our studies.

We have attempted to avoid special terms but, even so, our attempts to describe the complexities of the pronotal carinae or male genitalia can easily cause some confusion. Hopefully, the numerous illustrations will alleviate this problem to a major degree.

RESUMEN

Los autores presentan una tentativa de revisión del género Athyreus, propuesto por Macleay en 1819. En 1912 Boucomont cataloga unas 60 especies para el mismo, incluyendo formas heterogéneas del viejo y nuevo mundo. En razón de tal anómala situacion, Howden y Martinez en 1963 crean la tribu Athyreini, restringiendo el genero Athyreus para el grupo de especies relativamente grandes, con dimorfismo sexual y como máximo con 4 a 6 claros interespacios en cada elitro, designando como tipo a Athyreus bifurcatus Macleay, pero sin incluír una lista completa de especies, hasta no efectuar una clave o revisión del mismo o de los otros grupo-género por ellos creados.

Durante el tiempo transcurrido desde ése estudio, ambos autores estuvieron acumulando información y material, habiendo sido estudiados en ese lapso muchos de los tipos de Athyreus. En la actualidad han considerado 26 nombres referidos a especies del género; 3 de ésos nombres basados en hembras asignadas al complejo "bifurcatus" y las que han considerado como "incertae sedis". Los otros 23 nombres han podido ser asignados con relativa seguridad a 17 especies. Sin embargo en alguno de los casos, la falta de series de algunas de las especies, ha hecho no poder considerar a este trabajo como una revisión en el sentido estricto y sí, como lo señalan precedentemente como una primera tentativa. Eso ya se nota en la clave, que dasafortunadamente ha tenido que ser basada en machos bien desarrollados, con excepción hecha del grupo chalybeatus, ya que no siempre machos y hembras han podido ser asociados, siendo ésa una investigación de campo.

En los Athyreus bien desarrollados, los machos tienen cuerno clipeal y uno mas cuernos o lóbulos pronotales prominentes. Las hembras, con la sola excepción tuberifer, tienen quilla transversal en la región dorso-anterior del clípeo y una segunda quilla, también transversal, en el limite clípeo-frontal, siendo ésta ultima normalmente tridentada, con el diente o tubérculo mediano más desarrollado y uno menor a cada lado sobre el borde lateral. Sin embargo, el pronoto de las hembras puede tener algunas quillas conspicuas, especialmente en el grupo chalybeatus; en los otros grupos puede haber éstas o tuberculitos centrales, exceptuando una sola especie, tuberifer, en las que las hembras tienen un cuerno pronotal, necesitando, a veces, para salir de dudas acerca del sexo, la verificacion del genital.

Referente a hábitos y comportamiento de Athyreus es muy poco lo que se sabe. Muchos de los ejemplares han sido colectados a la luz. De unos pocos se conoce que vuelan durante el crepúsculo, pero una gran mayoria aparentemente son nocturnos. No son conocidos ejemplares del género capturados por arriba de los 1500 m de altura y su "habitat" son aparentemente los bosques relativamente no perturbados de las regiones bajas en la estacion huméda o regiones arenosas semiaridas. Desafortunadamente la atracción por la luz no es muy frecuente y la rareza o falta de material en las colecciones obstruye muy seriamente los estudios. Es esa falta de series razonables de material en las colecciones, es lo que a hecho hacer un intento de agrupar y no revisar el genero.

Como se nota, en éste intento se ha evitado una terminología especial, por que ello puede llegar a causar alguna confusión cuando son descritos los complejos cuernos, quillas o genitales; por ello son las numerosas ilustraciones que se dan pensando que ése problema puede ser asi solucionado en mayor o menor grado.

Para la mejor comprensión de las personas de lengua española o portuguesa, es que además de la clave en inglés, se dá otra, poco más ampliada, en idioma español.

COLLECTIONS STUDIED

In citing the collections studied we utilize the name of the city in which the museum is situated, and in a private collection, we cite the individual's last name. The major collections studied and the curators assisting are as follows:

Buenos Aires	Museo Argentino de Ciencias Naturales "Bernardino Rivadavia". Dr. M.J. Viana.
Cambridge	Museum of Comparative Zoology, Harvard University. Dr. A. Newton.
Chicago	Field Museum of Natural History. Mr. Henry Dybas.
Leiden	Rijksmuseum van Natuurlijke Historie. Dr. J. Krikken.
London	British Museum (Natural History). Mr. R. Pope.
Ottawa	Canadian National Collection, Biosystematics Research Institute. Dr. A. Smetana.
Oxford	University Museum, Hope Department of Entomology. Mr. E. Taylor.
Paris	Museum National d'Histoire Naturelle. Dr. A. Descarpentries.
Washington	United States National Museum. Dr. R. Gordon.
Hardy	Dr. A. Hardy, Sacramento, California.

The personal collections of the authors.

Deposition of types cited as "Howden" are deposited on loan in the Canadian National Collection, Biosystematics Research Institute, Canadian Department of Agriculture, Ottawa, Canada.

Key to the species of Athyreus Macleay

1. Pronotum in male never with a complete median longitudinal furrow, often with central median horn or tubercle or with nearly cylindrical horn on each side; female pronotum with central horn or with two small tubercles on disc, one on either side of midline, or with transverse carina across midline in anterior third of disc. 2

Pronotum in male with median longitudinal furrow or shallow depression narrow or wide, variable, essentially dividing pronotal prominences (these not cylindrical); female pronotum without tubercles on disc either side of midline or without anterior transverse carina . . . . I. aeneus Group (p. 6)

2. Pronotum of male never with lateral carina extending from edge of a central depression to lateral edge; female pronotum with central horn or with two small tubercles near center of disc, one on either side of midline . . . . . II. bifurcatus Group (p. 8)

Pronotum of male and female with a lateral carina extending from edge of discal depression to lateral edge, carina sometimes briefly interrupted; female with transverse carina in anterior third of discal region . . . . . III. chalybeatus Group (p. 11)

I. aeneus Group

1. Posterior border of pronotum on each side, anterior to humerus, interrupted. Brazil . . . . . 1. cyanescens Klug (p. 20)

Posterior marginal bead or border of pronotum entire 2

2(1). Median anterior margin of pronotum more or less angular and unidentate 3

Median anterior margin of pronotum transversely keeled or not, but never unidentate 7

3(2). Acute tubercle of anterior pronotal margin well marked, sometimes small, tip acute 4

Acute tubercle of anterior pronotal margin poorly developed, obtuse or obsolete 5

4(3). Pronotal disc with anterior transverse carina reaching lateral edge; color dark bluish-green with more or less bronze caste. Brazil . . . . . 3. aeneus Klug (p. 22)

Pronotal disc with lateral carina obsolete, short, situated on posterior half; color largely testaceous or castaneous. Brazil . . . . . 4. vavini Boucomont (p. 23)

5(3). Pronotum of male with anterior depression broadly cordiform; longitudinal carina each side of midline costiform, raised and not dentate; first (most anterior) transverse carina reaching lateral edge; second (lateromedial) carina broad, short, and shiny; third (posterior) carina fine; color of dorsum shiny black with slight steely reflections; pronotum of female with the three lateral transverse carinae as in male. Brazil . . . . . 2. capricornis n. sp. (p. 21)

Pronotum of male with medial depression circular or oval, with longitudinal furrow impressed (distinct); transverse carina, if present, not attaining lateral margin; discal horn or carina on each side of midline dentate; pronotum of female without transverse anterior carina or carina extending to lateral margin; both sexes brown to dark brown dorsally. 6

6(5). Male with horn or keel on either side of depressed midline near middle of pronotum laminiform, the anterior and posterior edges dentate; prescutellar region concave and

with small punctiform impression. Brazil, Paraguay . . . . . 10. anneae n. sp. (p. 30)

Male with carina on each side of medial depression anteriorly unidentate, feebly elevated; prescutellar region with median furrow narrow, well impressed, each side elevated and posteriorly dentiform. Brazil, E. Paraguay and N. Argentina . . . . . 8. hemisphaericus Boucomont (p. 28)

7(2). Anterior margin of pronotum in median fourth distinctly elevated, carinate; carina dentate or abruptly arcuate on each side. 8

Anterior edge of pronotum in median fourth arcuately elevated; obsolete denticle often present at midline 11

8(7). Pronotum of male on each side with lateral border of medial depression elevated into a laminate, bidentate horn or keel. Bolivia . . . . . 9. nitidus n. sp. (p. 29)

Pronotum of male on each side with lateral border of depression elevated; elevated carina or horn with apex blunt to abruptly rounded, never bidentate. 9

9(8). Male with clypeal horn robust, wider than long in cross section, posterior face excavated or flat; pronotum on each side with keel or horn which borders medial depression wide and not angular, apically rounded, sometimes more so posteriorly, terminating in front of and on each side of wide prescutellar depression; depression large, subquadrate, usually wider than long. Brazil, Paraguay. 7. bilobus n. sp. (p. 26)

Male with clypeal horn slender, as long as wide or longer in cross section, posterior face narrow; pronotum with keel or horn on each side of median depression lobate, with apex unevenly rounded, blunt to acute; prescutellar depression small, scarcely wider than scutellum. 10

10(9). Male with prescutellar impression very small, normally elongate and situated in median angle of posterior margin; central depression without longitudinal line of median granulations; medial carina of anterior margin slightly wider than half width of prescutellar region, high, with edge centrally slightly concave and laterally denticulate. N.E. Argentina, Paraguay . . . . . 5. hypocritus n. sp. (p. 24)

Male with prescutellar impression in form of a medial longitudinal furrow; central depression with longitudinal band of granulations which connects anterior and posterior regions; medial carina of anterior margin as wide as width of prescutellar region, low, with edge centrally sinuate, not denticulate laterally. Brazil. . . . . 6. brasilicus n. sp. (p. 25)

11(7). Pronotal depression anterior to horns mostly smooth on either side of median granulate area; setose granules in elytral intervals distinctly separated, third interval with moderately even double row of granules. Bolivia. . . . . 11. forcipatus Boucomont (p. 31)

Pronotal depression anterior to horns almost entirely granulate, briefly smooth in narrow band anterior to each horn; setose granules in elytral intervals close, often almost contiguous, granules in third interval in three irregular rows. Brazil . . . . 12. alvarengai n. sp. (p. 31)

II. bifurcatus Group

1. Prescutellar area of pronotum with deep longitudinal furrow behind horn; declivous sides of furrow posteriorly more or less dentiform; pygidium broadly rounded apically - female (only species with female having median anterior clypeal horn). Brazil, E. Paraguay and N.E. Argentina . . . . 20. tuberifer Felsche (in part) (p. 39)
Prescutellar area of pronotum lacking deep longitudinal furrow behind horn, depression if present not posteriorly dentiform; apex of pygidium narrowly rounded, truncate or otherwise modified - males (females not included in subsequent key - often identifiable only by association with male). 2

2(1). Pronotum with slightly to distinctly overhanging latero-discal expansions on either side of central horn or tubercle(s); anterior margin medially elevated, with feeble median denticle. 3
Pronotum without overhanging latero-discal expansions; anterior margin regular, sometimes medially almost angular and obsoletely unidentate. 4

3(2). Pronotum with central horn slender, cylindrical, anteriorly inclined. (probably Brazil) . . . . 15. armatus Westwood (p. 34)
Pronotum with horn (tubercles) bifurcate, base only slightly elevated. Trinidad . . . . . 16. biarmatus n. sp. (p. 35)

4(2). Pronotum on each side with an oval or circular, slight to distinct depression (not lateral fovea) anteriorly or antero-laterally, situated adjacent to or in front of horns; midline anterior to horn or horns not longitudinally indented. 5
Pronotum without anterior depression either side of midline, at most with shallow medial depression or fine longitudinal furrow anteriorly; pronotal horn single, medial; simple, bidentate or tridentate distally 10

5(4). Disc of pronotum with two horns or triangular corniform lamellae. 6
Disc of pronotum with three horns. 9

6(5). Clypeal armature consisting of three small but distinct horns or prominent tubercles. 7
Clypeal armature consisting of an elongate medial anterior horn, laterally clypeus with or without small denticles. 8

7(6). Pronotal armature consisting of a low, central bifurcate horn, each bifurcation broadly triangular; pronotum anterior and lateral to horn with much of surface smooth, not granulate or setose. Brazil. . . . . 17. gigas Westwood (p. 36)

Pronotal armature consisting of a moderately developed central bifurcate horn, each bifurcation tapered to acute tip; pronotum anterior and lateral to horn with surface granular or punctate, setose. Brazil. . . . . 18. parvus n. sp. (p. 37)

8(6). Clypeal horn inclined anteriorly, posterior face with a very distinct medial carina, latero-posterior carina denticulate in front of canthus; pronotum with lateral concavity large, elongate-oval, shallow, almost reaching posterior edge, horns contiguous or approximate at base and obliquely directed upward and forward. Brazil, E. Paraguay and N. E. Argentina. . . . . 19. bifurcatus Macleay (p. 38)

Clypeal horn nearly vertical, without medial carina on posterior face and latero-posterior carina not denticulate near ocular canthus; pronotum on each side with deep circular fovea situated in front of horn and almost on anterior edge; horns widely separated at base, somewhat compressed and vertical. Peru. . . . . 26. tribuliformis Felsche (p. 46)

9(5). Pronotum with anterior impressions and horns well separated from each other, each impression large and with lateral edge outside ocular canthus; prescutellar horn conical; fore tibia with six teeth on outer margin. Bolivia, Brazil, Peru. . . . . 27. zischkai Martínez (p. 47)

Pronotum with anterior impressions well marked and narrowly separated from each other; lateral edge of impression inside lateral edge of eye canthus; two anterior horns narrowly separated, third prescutellar horn compressed; fore tibia with five teeth on outer margin. Peru, Ecuador. . . . . 28. martinezi Howden (p. 48)

10(4). Middle of pronotal disc with upright longitudinal, laterally compressed horn or keel; in lateral view edge of horn dentate on angles, depressed between. Brazil. . . . . 21. juanae n. sp. (p. 41)

Disc of pronotum with central, nearly cylindrical horn; never with a central longitudinal, laterally compressed median horn or keel. 11

11(10). Disc of pronotum with horn simple, acute apically. 12

Disc of pronotum with horn bi- or tri-dentate at its apex. 13

12(11). Head with clypeal horn, latero-posterior carina on each side subdentate; pronotum with horn conical, vertical; pronotal fossae of anterior edge behind head, small, scarcely evident. Brazil. . . . . 25. acuticornis n. sp. (p. 44)

Head unarmed, without horn, convex anteriorly; pronotum with horn long, directed forward and somewhat ventrally arcuate; pronotal surface in anterior half medially concave, pronotal fossae of anterior margin behind head well marked. Colombia. . . . . 14. unicornis n. sp. (p. 33)

13(11). Pronotal armature apically tridentate 14

Pronotal armature apically bifurcate 15

14(13). Pronotum opaque, except anterior edge of horn which is smooth, rest completely punctate to granulate; color piceous or black. Costa Rica, Panama to western Ecuador. . . . . 24. championi Bates (p. 43)

Pronotum with medial or antero-lateral area or areas impunctate and shiny, sides punctate and granulate; color yellowish to reddish castaneous. S. E. Brazil, Paraguay, E. Bolivia and N.E. Argentina. . . . . 23. tridens Laporte (p. 42)

15(13). Clypeal horn lacking distinct posterior median carina, horn noticeably wider than long in cross section, apex broadly truncate; pronotal horn vertical, slender, apex narrowly divided into two longitudinally plate-like projections, apex of each in lateral view broadly, bluntly rounded. Peru. . . . . 13. pyriformis n. sp. (p. 32)

Clypeal horn with carina or tubercle on posterior median edge, horn not noticeably wider than long in cross section, apex rounded or acute; bifurcation of pronotal horn consisting of divergent, somewhat cylindrical, acutely pointed processes. 16

16(15). Pronotal horn slightly transversely compressed and vertically bifurcate at apex; each side of bifurcation nearly cylindrical, tip acute; horn anteriorly with fine longitudinal median furrow and with punctiform median depression posterior to anterior margin; clypeal horn inclined anteriorly and with posterior median carina. Brazil and N. . 22. bellator Westwood (p. 42)

Pronotal horn consisting of a large protuberance, the apex of which slants anteriorly in two sharp, divergent dentiform processes, surface anterior to horn feebly transversely concave, smooth and shiny, with median longitudinal furrow obsolete and without distinct median impression; head with the clypeal horn strongly inclined anteriorly, posterior edge of horn basally with slightly compressed tooth. Brazil, E. Paraguay and N. E. Argentina. . . 20. tuberifer Felsche (in part) (p. 39)

III. chalybeatus Group

1. Males, pronotum with horn projecting anteriorly, on each side or below horn with a very conspicuous fovea; pronotal disc never with transverse carina at anterior third or fourth; clypeus with anterior median horn. 2
Females, pronotum without horn or antero-lateral fovea; pronotal disc with transverse carina at anterior third or fourth; clypeus without distinct anterior horn. 3

2(1). Pronotal horn situated above wide fovea or medial concavity, central depression often continuous laterally with deep lateral, oval fovea, carina on each side above (posterior to) concavities conspicuous, continuous and not interrupted; clypeus anteriorly with small, slightly recurved horn; posteriorly with transverse carina strongly tridentate; color black or reddish testaceous with elytra black and light metallic bluish green. S. E. Brazil, N. E. Argentina and S. E. Paraguay. . . . . . 29. hastifer Felsche (in part) (p. 49)
Pronotal horn dividing anterior depression, depression forming at each side a very deep oval fovea; adjacent carina irregularly marked and laterally obsolete; clypeus anteriorly with small horn with base posteriorly denticulate; transverse carina lacking or obsolete, a tubercle present on each side near gena; color black with metallic bluish-green reflections. Argentina, Uruguay. . 30. chalybeatus Fairmaire (in part) (p. 50)

3(1). Pronotum medially deeply impressed, cordiform, depression delimited on all sides by carinae, anterior transverse carina slightly dentate on either side of midline; midline of impressed area with two distinct foveae, one anterior, one posterior, united by a fine longitudinal line; color almost uniformly testaceous. (Male unknown). Argentina. . . . 31. conspicuus n. sp. (p. 51)
Pronotum medially shallowly to moderately impressed; anterior transverse carina not tuberculate either side of midline; elytra black with bluish or steely reflections. 4

4(3). Anterior median clypeal tubercle distinct, united to posterior median tubercle of transverse carina by a fine, longitudinal carina; pronotum on either end of anterior median transverse carina with short carina at right angle to transverse carina extending anteriorly about half the distance to anterior margin; fore tibia usually with six distinct teeth on outer margin; color and distribution as described for male. Argentina, Uruguay. . 30. chalybeatus Fairmaire (in part) (p. 50)
Anterior median clypeal tubercle obtuse, not carinate posteriorly; pronotum on each side of anterior median transverse carina lacking distinct anterior carinate extensions; fore tibia usually with five distinct teeth

on outer margin; color and distribution as described for male. S. E. Brazil, N. E. Argentina and S. E. Paraguay. . . . . 29. hastifer Felsche (in part) (p. 49)

Clave para Athyreus Macleay

1. Pronoto en el macho sin surco o depresión longitudinal medial completa; en la hembra con dos pequeños tuberculitos discales paramedios, o con quilla o tubérculo medio anterior, limitando al disco por delante. 2

Pronoto en el macho y hembra con surco o depresión longitudinal medial mas o menos ensanchada marcada y completa; en la hembra sin tuberculitos, quilla o tubérculo discales. . . . . I. Grupo aeneus (p. 12)

2(1). Pronoto del macho nunca con quilla lateral que desde el borde de la depresión llegue al borde lateral; en la hembra con dos pequeños tuberculitos discales paramedios o, tuberifer, con tubérculo medio anterior. . . . . II. Grupo bifurcatus (p. 15)

Pronoto del macho y hembra con quilla lateral que desde el borde de la depresión discal llega al borde lateral; hembra con quilla medial anterior que limita la region discal. . . . . III. Grupo chalybeatus (p. 18)

I. Grupo aeneus

1. Borde posterior del pronoto, próximo al húmero, interrumpido. Brasil. . . . . 1. cyanescens Klug (p. 20)

Borde posterior del pronoto entero. 2

2(1). Margen anterior del pronoto en la mitad más o menos angulado y unidentado. 3

Margen anterior del pronoto en la mitad aquillado o no, pero nunca unidentado. 7

3(2). Dentículo del borde anterior del pronoto bien marcado. . . . 4

Dentículo del borde anterior del pronoto poco marcado, a veces sólo como angulosidad. 5

4(3). Pronoto con quilla transversal anterior que llega al borde lateral; color verde azulado oscuro con visos más o menos bronceados. Brasil. . . . . 3. aeneus Klug (p. 22)

Pronoto con quilla lateral obsoleta, corta, situada en la mitad posterior; color testáceo castaño, generalmente con los lados del pronoto y bordes laterales de los élitros aclarados. Brasil. . . . . 4. vavini Boucomont (p. 23)

5(3). Pronoto del macho con quilla transversal anterior que llega al borde lateral; depresión anterior anchamente cordiforme; surco longitudinal medial poco marcado, sin fosa anterior notable; quilla discal costiforme,

realzada y no dentada; quilla látero-medial ancha y brillante; quilla posterior fina y poco conspicua; cuerno clipeal erecto, pequeño, la base con fina quilla conectada al borde lateral, que es elevado en diente alargado y comprimido, la cara posterior finamente aquillada. Color negro algo brillante con leves matices acerados. Hembra en el pronoto con quilla transversal anterior que llega al borde lateral. Brasil. . . . . 2. capricornis n. sp. (p. 21)

Pronoto del macho sin quilla transversal anterior; la depresión medial circularforme u oval, con surco longitudinal impreso y fosa anterior marcada; quilla discal siempre dentada; sin quilla ántero-medial o ésta angosta; falta la quilla póstero-lateral; cuerno clipeal sin quilla en la cara posterior. Hembra en el pronoto sin quilla transversal anterior. 6

6(5). Macho con la quilla que margina la depresión discal más o menos elevada, laminiforme, alargada y con los bordes anterior y posterior dentados; región pre-escutelar deprimida y con impresion puntiforme marcada. Hembra desconocida. Brasil, Paraguay. . . . . 10. anneae n. sp. (p. 30)

Macho con la carena que margina la depresión discal dentiforme, poco elevada, aproximada a la opuesta y unidentada; región preescutelar con surco medio bien impreso, de borde elevado, por detrás denticulado sobre la región escutelar y sin impresión puntiforme. Hembra con la quilla que margina la depresión discal del pronoto poco marcada, subdentada, posteriormente rasa y no formando dentículo por detrás. Brasil, E. Paraguay y N. Argentina. . 8. hemisphaericus Boucomont (p. 28)

7(2). Borde anterior del pronoto elevado medialmente en quilla transversal a cada lado subdentada o ligeramente arqueada. 8

Borde anterior del pronoto regular, no elevado en quilla ni denticulado. 11

8(7). Macho en el pronoto con el borde lateral de la depresión medial elevado en alto proceso laminiforme bidentado; quilla del borde anterior estrecha, su ancho menor que el ancho de la depresión. Hembra desconocida. Bolivia. . . . . 9. nitidus n. sp. (p. 29)

Macho en el pronoto con el borde lateral de la depresion poco elevado, su ápice romo y nunca dentado; quilla del borde anterior subigual o apenas mas angosta que la depresión en la región preescutelar. 9

9(8). Macho con el cuerno clipeal robusto, la cara posterior excavada o plana, ancha y limitada lateralmente por quilla bien marcada, arqueado-dentada en la base y que alcanza al borde lateral; pronoto con la quilla que bordea la depresión medial poco elevada, a veces

un poco levantada por detrás, pero ancha y no angulosa, terminando por delante y a cada lado de la depresion preescutelar, ésta amplia, impresa y subcuadrada, o más ancha que larga. Hembra: pronoto con el borde anterior medialmente elevado en arista baja, fina y marcada, con su ancho igual al ancho de la región preescutelar. Brasil, Paraguay. . . . . 7. bilobus n. sp. (p. 26)

Macho con el cuerno clipeal grácil, la cara posterior angosta, limitada a cada lado por fina quilla que puede o no perderse hacia la base; pronoto con la quilla que bordea la depresión en lóbulo de ápice convergente y romo; depresión preescutelar no ocupando toda la región. 10

10(9). Macho con la impresión preescutelar muy pequeña, normalmente alargada y situada sobre el ángulo medial del borde posterior; depresión central sin zona longitudinal de escultura granulosa que la divida en dos partes; quilla medial del borde anterior poco más ancha que la mitad del ancho de la región preescutelar, alta, con la arista ligeramente cóncava y denticulada lateralmente; cuerno clipeal con la quilla póstero-lateral poco evidente, perdiéndose hacia la base. N. E. Argentina, Paraguay. . . . . 5. hypocritus n. sp. (p. 24)

Macho con ancha impresión preescutelar en forma de surco longitudinal medial; depresión central con ancha zona longitudinal de escultura granulosa, que conecta las regiones anterior y posterior; quilla medial del borde anterior tan ancha como el ancho de la región preescutelar, baja, de arista sinuosa y no denticulada lateralmente; cuerno clipeal con la quilla póstero-lateral fina, entera, llegando al borde lateral de la cabeza. Brasil. . . . . 6. brasilicus n. sp. (p. 25)

11(7). Pronoto con la depresión anterior, por delante de la carena, con area semicircular lisa y englobando el area granulosa antero-medial; gránulos setiferos de los interespacios elitrales claramente separados, 3er. interespacio con dos hileras de gránulos. Bolivia. . . . . 11. forcipatus Boucomont (p. 31)

Pronoto con la depresión anterior casi enteramente granulosa y con banda lisa corta y angosta por delante del cuerno; gránulos setíferos de los interespacios elitrales frecuentemente contiguos y en el 3er. interespacio ordenados en 3 hileras irregulares. Brasil. . . . . 12. alvarengai n. sp. (p. 31)

II. Grupo bifurcatus

1. Hembra: pronoto en la región preescutelar con surco longitudinal más o menos impreso y dentiforme por detrás; en el disco con tubérculo pequeño y los cuernos dentiformes poco desarrollados, en la parte dorsal y por detrás con un denticulito; mitad anterior con profunda depresión transversal y la superficie centralmente granulosa; cuerno clipeal corto, algo oblicuo y en la cara posterior y basalmente inerme. Brasil, E. Paraguay y N. E. Argentina. . . . . . 20. tuberifer Felsche (parte) (p. 39)

Machos nunca con la región preescutelar surcada longitudinalmente e inerme. 2

2(1). Macho en el pronoto con expansiones alares látero-discales; el borde anterior medialmente elevado en quilla subdentada. 3

Macho en el pronoto sin expansiones alares látero-discales; el borde anterior regular, a lo sumo medialmente algo anguloso y obsoletamente denticulado. 4

3(2). Pronoto con cuerno delgado y dirigido hacia adelante. (Brasil?). . . . . 15. armatus Westwood (p. 34)

Pronoto con dos láminas triangulares corniformes. Trinidad. . . . . 16. biarmatus n. sp. (p. 35)

4(2). Macho en el pronoto, a cada lado, con una depresión oval o circulariforme ánterior o antero-lateral al cuerno discal, estando éste más o menos separado del opuesto en la base interna. 5

Macho en el pronoto sin depresión, a lo sumo con fino surco medial longitudinal anterior; armadura discal única, medial, simple, bidentada o tridentada distalmente. 10

5(4). Macho en el disco del pronoto con dos cuernos o láminas triangulares corniformes. 6

Macho en el disco del pronoto con tres procesos corniformes. 9

6(5). Macho con la armadura clipeal consistente en tres pequeños pero evidentes dientes o cuernos; armadura pronotal formada por dos láminas triangulares divergentes. 7

Macho con la armadura clipeal consistente en un cuerno medial anterior más o menos largo, lateralmente a éste con o sin dentículo; armadura pronotal constituida por un cuerno más o menos cilindroide o algo aplanado, pero más largo que ancho. 8

7(6). Pronoto con areas ántero-laterales impunteadas y brillantes. Brasil. . . . . 17. gigas Westwood (p. 36)
Pronoto con areas laterales totalmente con puntos granulosos. Brasil. . . . . 18. parvus n. sp. (p. 37)

8(6). Macho con la armadura clipeal formada por un cuerno oblicuamente dirigido hacia arriba y adelante, que tiene en la cara posterior una quilla medial bien evidente, la quilla látero-posterior denticulada sobre el canto ocular; pronoto con la impresión grande, alargado-oval bien lateral, casi alcanzando al borde posterior, el cuerno algo aproximado del opuesto en su base interna y oblicuamente dirigido hacia arriba y adelante. Brasil, E. Paraguay y N. E. Argentina. . . . . 19. bifurcatus Macleay (p. 38)
Macho con la armadura clipeal consistente en un cuerno más o menos vertical y algo arqueado, sin quilla medial en la cara posterior y la quilla látero-posterior no denticulada sobre el canto ocular; pronoto con fóvea circulariforme profunda, situada por delante del cuerno y casi sobre el borde anterior, éste ampliamente separado del opuesto en la base, algo comprimido y vertical. Perú. . . . . 26. tribuliformis Felsche (p. 46)

9(5). Macho en el pronoto con la impresión ántero-lateral y cuernos bien separados entre sí, aquella grande y con el borde lateral por fuera del canto ocular, cuerno preescutelar cónico. Bolivia, Brasil. . . . . Peru. . . . . 27. zischkai Martínez (p. 47)
Macho en el pronoto con la impresión ántero-medial muy marcada y conjuntamente con los cuernos subcontiguos, el borde lateral de aquella por dentro del borde lateral del canto ocular; cuerno preescutelar comprimido. Perú. . 28. martinezi Howden (p. 48)

10(4). Macho: pronoto en el disco con quilla longitudinal medial, la arista escotada y dentada sobre los ángulos. Brasil. . . . . 21. juanae n. sp. (p. 41)
Macho: pronoto en el disco nunca con quilla longitudinal medial. 11

11(10). Macho: pronoto en el disco con cuerno simple. 12
Macho: pronoto en el disco con cuerno bi o tridentado en el ápice. 13

12(11). Macho en la cabeza con cuerno clipeal y con la quilla látero-posterior a cada lado de éste subdentada; pronoto con el proceso delgado, coniforme, vertical, la superficie lateral y anteriormente granulosa, la fosa del borde anterior, por détras de la cabeza, pequeña, poco evidente. Brasil. . . . . 25. acuticornis n. sp. (p. 44)

Macho con la cabeza inerme, sin cuerno, convexa anteriormente; pronoto con proceso dirigido hacia adelante, largo y algo arqueado, la superficie en la mitad anterior muy brillante y con sólo algunos puntitos obsoletos lateralmente, fosa del borde anterior, por detrás del borde lateral de la cabeza, bien marcada. Colombia. . . . . 14. unicornis n. sp. (p. 33)

13(11). Macho con la armadura pronotal apicalmente tridentada. 14

Macho con la armadura pronotal apicalmente bifurcada. 15

14(13). Macho con el pronoto opaco, excepto el borde anterior del proceso discal que es liso, totalmente punteado tornándose los puntos granulosos y bien notables hacia los lados; parte posterior de la frente y vértice densa y claramente punteada; color píceo a negro. Costa Rica, Panamá y Ecuador. . . . . 24. championi Bates (p. 43)

Macho en el pronoto con área o áreas medial o ántero-laterales impunteadas y brillantes, hacia los lados punteado o punteado granuloso, los gránulos pequeños; parte posterior de la frente y vértice superficial y poco claramente punteada; color castano amarillento a castano rojizo. S. E. Brasil, Paraguay, E. Bolivia y N. E. Argentina. . . . . 23. tridens Laporte (p. 42)

15(13). Cuerno clipeal sin quilla ni diente en la cara posterior, ensanchado y truncado en el ápice; pronoto con la región preescutelar en surco longitudinal subpiriforme de borde elevado; borde lateral, un poco por delante del angulo medio, brevemente quebrado; la región lisa central no sobrepasando lateralmente el borde lateral del canto ocular: la región lateral con densa granulación pilosa; proceso pronotal regularmente angostado distalmente y allí estrechamente hendido longitudinalmente, formando dos dientecitos comprimidos, la cara posterior claramente surcada y el surco continuandose con el surco preescutelar; élitro con la elevacion costiforme I apareciendo por detrás del escudete; el interespacio II en la mitad basal como el doble de ancho que el III. Perú. . . . . 13. pyriformis n. sp. (p. 32)

Cuerno clipeal con quilla o diente en la cara posterior, aguzado hacia el ápice; pronoto con la región preescutelar plana o ligeramente deprimida, nunca en surco profundo de borde elevado; borde lateral entero; la región lisa central sobrepasando ampliamente el borde lateral del canto ocular; la región lateral lisa o solo con algunos gránulos pilosos dispersos; proceso pronotal en el ápice expandido y bifurcado en horqueta, formando dos claros y

evidentes dientes y sin ningún surco en la cara posterior; élitro con la elevacion costiforme I completa desde la base; el interespacio II subigual en ancho al III. 16

16(15). Macho con la armadura del pronoto consistente en un cuerno alto, un tanto comprimido ánteroposteriormente y bifurcado en el ápice; por delante de este la superficie casi vertical, con fino surco longitudinal medio, que un poco por detrás del borde anterior tiene una fosa pequeña, a los lados de ése lisa o casi lisa, tornándose punteada hacia los bordes laterales; cabeza con el cuerno clipeal algo oblicuo, en la cara posterior con quilla que lo recorre totalmente y sin diente basal. Brasil y N. . . . . 22. bellator Westwood (p. 42)

Macho con la armadura del pronoto consistente en una protuberancia grande, cuyo ápice superior es proyectado hacia adelante en dos cuernos dentiformes aguzados y algo divergentes, por delante de éste la superficie algo cóncava transversalmente, lisa y brillante, con surco longitudinal medial obsoleto y sin impresión puntiforme; cabeza con el cuerno clipeal muy oblicuamente dirigido hacia adelante, en la cara posterior y sobre la base con diente comprimido ligeramente aquillado. Brasil, E. Paraguay y N.E. Argentina. . . . . 20. tuberifer Felsche (parte) (p. 39)

III. Grupo chalybeatus

1. Machos en el pronoto con cuerno proyectado anteriormente, al costado o por debajo de éste con fóvea muy marcada; disco nunca con quilla transversal medial anterior; clípeo con cuerno más o menos desarrollado. 2

Hembras en el pronoto sin cuerno ni fóveas anterolaterales; con quilla medial anterior que limita el disco; clípeo sin cuerno. 3

2(1). Cuerno pronotal situado por encima de la fóvea o depresion medial, ésta muy ancha y corta, continuándose lateralmente con la profunda fóvea lateral ovaliforme, la quilla anterior que la margina superiormente, marcada, contínua y no interrumpida; clípeo anteriormente con pequeño diente corniforme y por detrás de éste con quilla transversal ligeramente angulosa cefalad y fuertemente tridentada; color negro o testáceo rojizo con los élitros negros y visos verde azulados metálicos leves. S. E. Brasil, N. E. Argentina y S. E. Paraguay. . . . . 29. hastifer Felsche (parte) (p. 49)

Cuerno pronotal interrumpiendo la depresión anterior y formando a cada lado una fóvea ovaliforme muy profunda, que no sobrepasa lateralmente a los cantos oculares, la quilla anterior irregularmente marcada

y lateralmente algo obsoleta; clípeo anteriormente
con pequeno diente corniforme, en cuya base
posterior hay un dentículo, sin quilla transversal
y sobre los cantos oculares con otro dentículo
triangulariforme algo comprimido. Color negro
con leves reflejos verdoso azulados metalicos.
Argentina, Uruguay. . . 30. chalybeatus Fairmaire (parte) (p. 50)

3(1). Pronoto con la región discal cordiforme, muy impresa,
marginada por quilla divergente y algo arqueada, que
en la región anterior se acoda fuertemente, para
confluír con la opuesta en una pequeñísima angulosidad
medial, que puede ser ligeramente biimpresa; a cado
lado y en la mitad denticulada y convergiendo por
detrás con la quilla transversal posterior, que es
larga, muy marcada y finaliza sobre la rasa y poco
visible fóvea lateral; la superficie de la región discal
con dos fosas marcadas, unidas por fino surco
longitudinal medial; a cada lado con 4 quillas bien
evidentes, siendo la anterior arqueada; cabeza en la
frente con dos quillitas paramedias algo arqueadas
y notables, el vértice claramente deprimido. Color
general testáceo. Macho desconocido. Argentina. . . . .
. . . . . 31. conspicuus n. sp. (p. 51)
Pronoto con la región discal rombiforme alargada,
marginada por quilla divergente y recta, no
denticulada en el medio y que se pierde a cada lado
de la región preescutelar; carena transversal ántero-
medial inerme; la superficie rasa y sin fosas
marcadas, pero con surco medial longitudinal
impreso; a cada lado con 3 o 4 quillas, en éste
último caso rectas y cortas; la quilla posterior
nunca unida a la quilla longitudinal que limita al
disco; cabeza en la frente con dos tuberculitos
pequeños, obsoletos, a veces un tanto aquillados,
el vértice plano. 4

4(3). Diente clipeal marcado, unido posteriormente al diente
medio de la quilla transversal por fina, pero neta
quillita. Pronoto con la quilla transversal medial
recta; la ántero-lateral corta, recta; la medial an-
terior obsoleta sobre el ángulo ántero-superior de
la fóvea lateral; la quilla posterior marcada desde
el ángulo posterior hasta por detrás de la misma
fóvea; pilosidad del élitro corta. Color y distribución
geográfica similar a la del macho. Argentina,
Uruguay. . . . . 30. chalybeatus Fairmaire (parte) (p. 50)
Diente clipeal marcado como una pequeña angulosidad,
no unido por detrás al diente medio de la quilla
transversal. Pronoto con la quilla transversal
medial un tanto arqueada; la ántero-lateral falta;
la medial anterior bien marcada en toda su longitud;
la quilla posterior fina, irregular; pilosidad de la
superficie del élitro larga. Color y distribución

1. Athyreus cyanescens Klug

Figures 1-3, Map 1

Athyreus cyanescens Klug, 1845, p. 30.

TYPE. Male (Berlin ?), not examined.

MALES. Length 16.0 to 19.0 mm, greatest width 9.5 to 10.0 mm. Dorsally black with bluish tinge. Labrum on anterior median surface with a distinct, anteriorly arcuate, upright tubercle; a character not noted in any other Athyreus. Clypeal horn (Fig. 1) in well developed males approximately as long as length of frons and vertex combined; horn in apical half in cross section wider than long, apex rounded; anterior lateral carina present basally; posterior lateral carina on each side distinct for most of length of horn and curving posteriorly on frons to feebly elevated junction at gena; posterior median carina absent, posterior surface of horn slightly concave. Frons medially moderately, longitudinally convex; surface with scattered punctures; vertex nearly flat, moderately setose-granulate. Pronotum (Fig. 1) with anterior margin between large fossae upwardly and anteriorly angulate, dentate at median angle, a faint raised ridge extending posteriorly from denticle for about 1 mm. Pronotal midline feebly impressed, prescutellar depression lacking; in posterior third on each side raised carina or horn with acute anterior and posterior lobes (see fig. 1), posterior lobes much closer to each other than anterior lobes; on each side anterior to and parallel with pronotal margin, a short carina present anterior to humerus; pronotal margin broken, deeply excised in this area; pronotal surface except for carinae setose-punctate (median third) or granulate. Elytron with margin dentate at anterior-lateral angle. Fore tibia with five teeth on outer margin. Genitalia as in fig. 2.

FEMALES. Length 15.0 to 18.0 mm, greatest width 9.0 to 10.0 mm. Labrum with unusual anterior median tubercle as in male. Clypeal carinae varying from most species in that, in some specimens, the anterior and posterior carinae medially with a longitudinal carina between, in most cases joining both carinae but always contiguous with median tubercle of posterior carina. Pronotum (Fig. 3) with low arcuate carina on either side of indented midline, anterior margin not as elevated as in male but with larger median denticle (tubercle). Pronotal margin near humerus and adjacent short carina as described in male.

MATERIAL EXAMINED: 10 males, 10 females.

BRAZIL (type locality, no other data). Paraná, Curitiba, XI.1940, F. S. Pereira; X.1940, Lange. Santa Catarina, Pinhal, XII.1951, A. Maller; Cauna, XII.1945, A. Maller. São Paulo, Jundiaí, XII.1956; Campos do Jordão, Lane; XII.1945, Pereira. Brasilia, Laferte, ex Musaeo Sharp. Guanabara, Rio de Janeiro.

Specimens are in: London, Ottawa, Paris, Howden, Martínez.

REMARKS. The black color with a distinct bluish caste, the odd tubercle on the anterior dorsal midline of the labrum, and the interrupted pronotal margin adjacent to the elytral humerus are all characters that readily distinguish both males and females of cyanescens from other Athyreus.

2. Athyreus capricornis n. sp.

Figures 4-6, Map 1

DIAGNOSIS. Black with steely hue; males with clypeal horn erect, anterior lateral carina interrupted near base, posterior lateral carina present apically and laterally, posterior median carina pronounced, extending to middle of frons; frons and vertex of both sexes closely, irregularly granulate or punctate; pronotum medially posterior to horns with wide cordiform depression in males; median pronotal area concave anteriorly, horn of males on each side low, irregularly rounded or sinuate, with anterior lateral branch extending to lateral pronotal margin; females with same carina not greatly elevated; two other short carinae present in both sexes on each side, one wide, one narrow, in posterior lateral half of pronotum paralleling posterior margin.

HOLOTYPE. Male, length 15.0 mm, greatest width 9.5 mm. Overall black with steely luster, feebly shining. Labrum short, wide (8:1), anterior median edge with face strongly impressed, concave, impunctate; dorsal surface of labrum confluently coarsely punctate, coriaceous. Clypeus (Fig. 4) anteriorly truncate, the truncate area bordered by a fine carina which is bow-shaped and with apex of upward angle on anterior base of clypeal horn; horn vertical, anterior lateral carina present on each side but not joining bow-shaped carina; posterior lateral carina pronounced on horn, becoming fine basally, laterally carina lobed; posterior median carina pronounced, extending down horn onto middle of frons, there becoming obsolete. Frons and vertex closely, often confluently punctate, posteriorly granulate. Pronotum (Fig. 4) with anterior margin obtusely, feebly tuberculate medially, lateral margins arcuate; posteriorly median depression posterior to horns deeply cordiform, internally smooth with scattered punctures; depression elevated between low rounded horns posterior to pronotal center, midline indicated as impressed line in broader depression; area anterior to horns with scattered punctures, then near anterior margin with large discrete granules; lateral thirds of pronotum excluding carinae closely granulate, setose. Pronotal horn on each side of midline low, cariniform, edge in lateral view rounded anteriorly, downwardly angulately truncate posteriorly; horn continuing anteriorly as carina, dividing at base of horn, pronounced lateral branch extending as sinuous carina of varying width to lateral margin; posterior to this carina and midway to posterior margin a short wide carina and more posteriorly a feebly developed carina. Elytra with six raised, polished intervals between suture and umbone, striae relatively narrow for genus; finely, closely granulate. Fore tibia with six teeth on outer margin. Genitalia (Fig. 5) with parameres apically thickened and lobed, the apical protrusions filiform and medially strongly arcuate.

ALLOTYPE. Female, length 15.0 mm, greatest width 9.0 mm. Clypeus lacking horn, with low anterior transverse carina and trituberculate posterior transverse carina (as is typical for most Athyreus females). Clypeus, frons and vertex all heavily granulate or confluently punctate. Pronotum (Fig. 6) not differing greatly from male; central longitudinal carina on either side of midline not elevated, very wide, posterior end narrowing and curving inward to midline, joining carina from opposite side just anterior to posterior margin; in posterior half midline impressed and smooth, granulate on either side, most deeply impressed posteriorly; pronotal surface granulate except for carinae and midline posteriorly.

TYPE MATERIAL: Holotype, male, Brazil, Estado de São Paulo,

Batatais, V. 1945, F.S. Pereira (Martínez).

Allotype, female, same data as holotype (Martínez).

REMARKS. This species, which has been confused with cyanescens, can be easily distinguished by its uninterrupted lateral pronotal margin, which is broken before the humerus in cyanescens. Also cyanescens has a denticulate labrum. The form of the labrum and anterior lateral carinae will distinguish capricornis from other related species, the closest of which is probably hemisphaericus.

3. Athyreus aeneus Klug

Figures 7-9, Map 1

Athyreus aeneus Klug, 1845, p. 31.

TYPE. Male (Berlin ?), not examined.

MALES. Length 16.0 to 17.0 mm, greatest width 11.0 to 12.0 mm. Dorsally black with distinct greenish reflections, particularly central third of pronotum and elytra. Clypeus (Fig. 7) with stout vertical horn, apex truncate, horn in cross section wider than long; anterior lateral clypeal carina evident only basally; posterior lateral carina well developed for length of horn, basally fine to lateral angulate junction at gena; posterior medial carina absent; posterior surface of horn in apical half shallowly concave. Frons medially distinctly, longitudinally convex; surface of frons and vertex with scattered punctures or granules. Pronotum (Fig. 7) with anterior margin between large fossae strongly elevated, acutely angulate at midline; median angle with faint ridge extending posteriorly almost to small deep fovea at midline, fovea of same diameter as marginal fossae. Midline depressed behind anterior fovea; prescutellar depression posteriorly wider, smooth, extending to pronotal margin. On each side of midline at posterior third an abruptly elevated plate-like horn with truncated apex sloping anteriorly; horns narrowly separated basally. Pronotum on each side lateral to horn with three irregular, obliquely transverse carinae; anterior carina joining lateral margin midway between anterior and median angles, at junction forming small tubercle; median of three carinae short, posterior carina nearly twice as long; all carinae distinct; surface between carinae and in lateral thirds of pronotum with unusually large, coarse granules; granular area setose but setae inconspicuous. Elytra with surface unusually polished, shining, striae feebly depressed, indicated by one or two irregular rows of punctures. Fore tibia with six teeth on outer margin. Genitalia as in fig. 8.

FEMALES. Length 17.0 to 18.0 mm, greatest width 11.0 to 12.0 mm. Head with anterior and posterior clypeal carina, the carinae somewhat atypical; anterior carina arcuate either side of dorsal median denticle, a longitudinal carina extending from denticle posteriorly to median tubercle of posterior, tridentate carina; median tubercle of posterior carina approximately twice size of lateral ones. Dorsal surface of clypeus rugose; frons and vertex granulate. Pronotum (Fig. 9) similar to male but with inner carina not elevated, feebly arcuate either side of deeply indented midline; depression not greatly widened in prescutellar region.

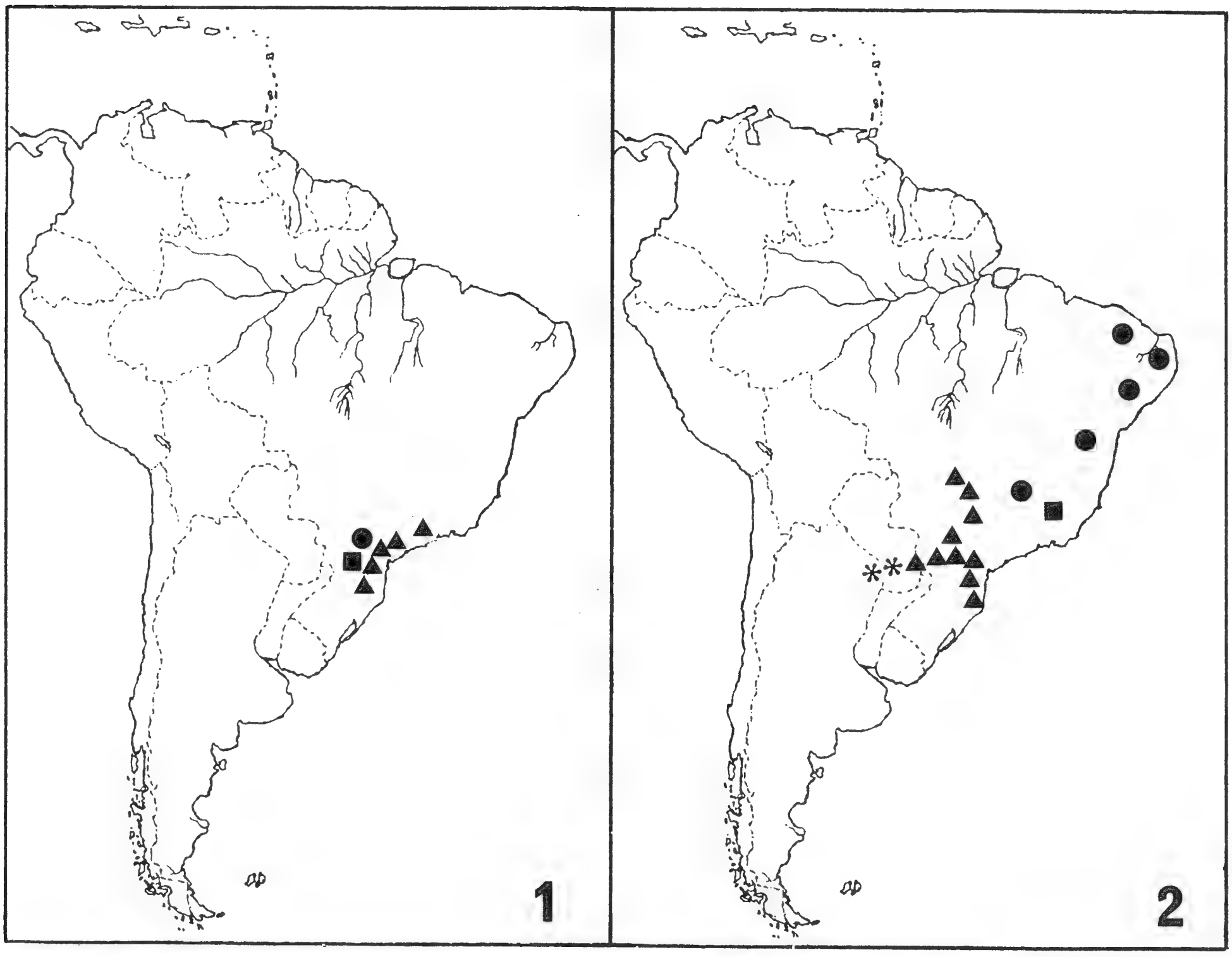
MATERIAL EXAMINED: 2 males, 4 females.

BRAZIL (type locality, no other data): Paraná, Curitiba, II.1935, XI.1936, X.1940, and I.1946.

Specimens are in: Howden, Martínez.

REMARKS. Athyreus aeneus is very distinctive; the black color with a definite greenish luster, relatively shining elytron and the three obliquely

transverse carinae on each side in the posterior half of the pronotum of both sexes should distinguish it from any other species in the genus.



▲ = 1. cyanescens Klug
● = 2. capricornis n. sp.
■ = 3. aeneus Klug

● = 4. vavini Bouc.
* = 5. hypocritus n. sp.
■ = 6. brasilicus n. sp.
▲ = 7. bilobus n. sp.

4. Athyreus vavini Boucomont

Figures 10-12, Map 2

Athyreus vavini Boucomont, 1902a, p. 184; 1902b, p. 583.

TYPE. Male (Paris), examined.

MALES. Length 14.0 to 17.0 mm, greatest width 10.0 to 12.0 mm. Dorsally reddish brown, often tan laterally, some specimens dark brown in center of pronotum and on elytra. Clypeal horn (Fig. 10) erect, stout; vertical portion with four distinct carinae, two anterior lateral and two posterior lateral carinae, near base posterior lateral carinae divided in some well developed males, the inner carinae extending onto frons, there becoming obsolete; usual posterior lateral carina on each side arcuately extending to slightly raised, rounded terminus above antennal insertion. Frons mostly smooth, vertex mostly granulate. Pronotum (Fig. 10) with anterior margin between fossae thickened, abruptly raised into acute tubercle on posterior edge at midline; lateral pronotal margins arcuate. Pronotum in median third

concave, concavity deepest along midline, anteriorly near margin coarsely granulate, mostly smooth in remainder of concavity to base of low, obtusely rounded horn on each side at posterior fourth; a few widely separated granules near base of each horn. Median depression posterior to horns variable; in well developed males depression rapidly deepens and expands to approximately 1 mm anterior to posterior margin, base of horn on each side extending posteriorly and overhanging depression forming posterior denticles; in male minors only a broad shallow posterior depression present, in larger specimens sides become ridged, as in type; however even in male minors low horns obtusely angulate. Fore tibia with five teeth on outer margin. Genitalia as in fig. 11.

FEMALES. Length 15.0 to 17.0 mm, greatest width 11.0 to 12.0 mm. Clypeus typical of Athyreus females, anterior carina upwardly arcuate, posterior carina trituberculate; posterior carina when viewed from above feebly anteriorly arcuate, the median tubercle slightly anterior to lateral ones. Pronotum (Fig. 12) with anterior margin with median tubercle as in male; pronotal midline impressed, area on either side sloping upward, in posterior area depression limited by longitudinal carina on each side, carina slightly divergent anteriorly and becoming obsolete just anterior to middle; a short lateral carina present on either side anterior to humerus. Pronotal surface setose, closely granulate, granules sometimes reduced or absent medially in depression just anterior to middle. The granules and degree of elevation of carina are useful comparative characters.

MATERIAL EXAMINED. 10 males, 5 females.

BRAZIL: (type locality, no other data). Rio Grande do Norte, Natal, I.1950, III/IV.1951, III, VII/VIII.1953, VIII/X.1954, IV.1957, IV.1961, II.1962. Paraíba, Joazeirinho, Soledade, IV.1957. Ceará, Paraguru, III.1953. Bahia, Vitoria da Conquista, IV.1961. Minas Gerais, Paraizo, I.1962; Collectors: Alvarenga, Machado, Pereira, Sebra.

Specimens are in: Paris, Howden, Martínez.

REMARKS. Boucomont's unique type is a relatively minor male with a small clypeal horn and only a moderate prescutellar impression on the pronotum, the impression lacking the dentiform posterior projection on each side.

The relatively small size, color, median tubercle on the anterior margin of the pronotum and the range will separate vavini from related species.

5. Athyreus hypocritus n. sp.

Figures 13-15, Map 2

DIAGNOSIS. Reddish brown to brown; similar to vavini. Males with pronotal concavity broad, as wide as or wider than head; pronotal horns posteriorly acutely rounded; anterior pronotal margin between fossae distinctly elevated, tuberculate on either side of raised margin; pronotal midline posteriorly with small nearly circular depression, depression contiguous to margin, marginal line obsolete medially; pronotal concavity with most or part of median area not granulate. Females with posterior clypeal carina feebly arcuate anteriorly, tridentate; anterior pronotal margin as in male but less distinctly dentate; longitudinal pronotal carina extending anteriorly to anterior third, slightly more widely separated than in vavini.

HOLOTYPE. Male, length 15.0 mm, greatest width 9.5 mm. Dorsally reddish castaneous, labrum, clypeus, sides of pronotum and elytra, and

legs lighter, yellowish tan to light brown. Most closely related to bilobus, differing in having more slender clypeal horn with rounded apex and lacking complete lateral posterior carina; front and vertex with small granulate punctures extending sparsely to near base of horn. Pronotum (Fig. 13) with anterior margin between fossae distinctly elevated, the elevation on either side with a small tubercle, slightly lower at middle than laterally; pronotum posteriorly with small, deep, cordiform (nearly circular) depression posteriorly contiguous with margin, adjacent margin lacking distinct marginal line; horns just anterior to and on either side of midline lobed, acutely rounded, delimiting posterior of broad, largely smooth, concavity; pronotal concavity at anterior base of horns as wide as head, medially in anterior half granulate-setose, posteriorly between horns with only scattered setose punctures. Lateral thirds of pronotum lacking distinct short carinae, granulate-setose. Fore tibia with five teeth on outer margin. Genitalia (Fig. 14) with apical edges of parameres plain, not bent or lobed, the slender protrusion on each paramere long, evenly arcuate.

ALLOTYPE. Female, length 16.0 mm, greatest width 11.5 mm. Carinae (Fig. 15) on head typical for genus, anterior clypeal carina slanted posteriorly, arcuate in frontal view; posterior clypeal carina slightly anteriorly arcuate, trituberculate. Frons and vertex punctate to granulate. Pronotum (Fig. 15) with anterior margin similar to holotype, less distinctly tuberculate laterally; depression between longitudinal carinae anteriorly approximately as wide as vertex, sparsely granulate near center on either side of median granulate band; midline slightly more deeply impressed in scutellar region; longitudinal carina on each side becoming obsolete in anterior half; small transverse lateral carina present on each side of pronotum anterior to humerus.

TYPE MATERIAL: Holotype, male, Argentina, Formosa, Clorinda, XI.1949, Martínez (Martínez).

Allotype, female, Paraguay, Santa Bárbara, III.1948, Schade (Martínez).

PARATYPES: 3 males, 4 females.

ARGENTINA: one male, same data as holotype.

PARAGUAY: Puerto Villeta, I.1945, Tepper. Departamento del Guayrá, Villarrica, III.1941, Schade. Departamento Capital, Trinidad, X. 1948. Asunción, XI.1945, Podtiaguin.

Paratypes are in: Howden, Martínez.

REMARKS. The type series shows little important variation; one male measures 14.5 mm and the allotype represents the maximum size seen. The small male has slightly smaller horns and a deeper indentation in the pronotal prescutellar area. This type of allometric variation is relatively minor for the genus.

The combination of characters mentioned in the diagnosis should serve to identify hypocritus.

6. Athyreus brasilicus n. sp.

Figures 19, 20, Map 2

DIAGNOSIS. Clypeal horn small, slender, erect, similar to bilobus in vavini group; frons and vertex punctate or granulate, setose. Pronotum with anterior margin elevated between fossae, margin thickened, posterior edge sinuate, slightly indented medially, lacking abrupt, tuberculate angle on each side near fossa; concave area of pronotum in central third, including inner

surface of flattened horns mostly smooth, shining, the smooth area divided by median granulate-setose band extending along midline from anterior to posterior margin; median area posterior to horns not sharply depressed nor otherwise modified.

HOLOTYPE. Male, length 13.0 mm, greatest width 9.2 mm. Dorsally brownish black, labrum and lateral portions of pronotum brown, elytral depressions (striae) dull, not shining. Similar to bilobus and hypocritus, differing primarily as follows: clypeal horn (Fig. 19) slender, tapered apically; posterior lateral carina fine, merging with lateral carina above antennal insertion, the carina subdentate or tuberculate. Frons and vertex irregularly punctate or granulate, setose. Pronotum with anterior margin elevated between fossae and thickened, posterior edge of elevated margin slightly sinuate, feebly indented medially, rounded laterally near fossae. Pronotal horn or lobe (Fig. 19) on each side of midline in posterior half laterally compressed, rounded at apex, somewhat longer than high, horn anteriorly divergent from opposite horn. Posterior of pronotum or prescutellar region feebly, longitudinally depressed, surface setose, granulate; the depression and granules continuing anteriorly in a band along midline to base of anterior margin; the granulate band completely dividing smooth areas of anterior central concavity into two. In other related species the median granulate band is incomplete or absent in well developed males. Pronotum laterally granulate, similar to vavini, bilobus and hypocritus in this respect. Fore tibia with five teeth on outer margin. Genitalia (Fig. 20) with ventral apex of each paramere reflexed, thickened, the apical protrusions small, arcuate and acute.

FEMALE. Unknown.

TYPE MATERIAL: Holotype, male, Brazil (Ottawa).

PARATYPES: 2 males.

BRAZIL: Sabara-Bello Horizonte, Rio das Velhao (sic), A.G.N.Chalmers.

Paratypes are in: London, Howden.

REMARKS. Athyreus brasilicus is a member of the vavini complex and may be distinguished from closely related species by the complete granulate band that extends along the midline of the pronotum from the anterior to posterior margins. The two paratypes do not vary significantly from the holotype.

7. Athyreus bilobus n. sp.

Figures 16-18, Map 2

DIAGNOSIS. Color almost uniform brown to dark brown. Related to vavini, hypocritus and brasilicus. Males readily distinguishable from these species by the clypeal horn in cross section wider than long, usually notched at apex, and with posterior vertical surface concave; anterior pronotal margin raised between fossae, edge of raised area relatively thin, truncate, laterally not noticeably tuberculate. Females with anterior pronotal margin between fossae elevated into a low, thin ridge; width of anterior elevation approximately equal to width of prescutellar depression.

HOLOTYPE. Male, length 19.0 mm, greatest width 12.0 mm. Dorsally brown with apices of horns and tubercles darker. Anterior clypeal face vertical, delimited dorsally by a semi-circular ridge, slightly dentate medially; clypeal horn (Fig. 16) immediately posterior to this with anterior face likewise vertical, horn unusually stout, as wide as long or wider in cross section near blunt apex; horn with anterior lateral carina on each side

distinct, not extending to arcuate anterior clypeal ridge; posterior lateral carina on each side extending laterally and slightly arcuately posteriorly to merge with ridge at anterior edge of gena. Frons posterior to horn smooth, sparsely punctate, vertex granulate, setose. Pronotum (Fig. 16) with anterior margin distinctly elevated between fossae, raised area truncate at top, edge relatively thin, not distinctly tuberculate laterally; pronotum posteriorly in prescutellar region with broad, almost circular depression; anterior, strongly declivous margin of depression setose and situated directly between posterior edges of horns; pronotal midline anterior to depression indicated by finely depressed line and small fovea midway between anterior margin and horns; area anterior to broadly lobed horns widely, shallowly concave; concavity largely smooth, punctate near anterior margin and on inner sides of lobes or horns. Pronotum lateral to horn on each side with feebly developed carina extending from near base of horn toward median lateral angle of margin; lateral to horns and concavity pronotum granulate-setose. Fore tibia with five distinct teeth on outer margin, a sixth minute tooth present basally (not present in other specimens). Genitalia (Fig. 17) with a distinct apical lobe on each paramere adjacent to arcuate, long, acute prolongation.

ALLOTYPE. Female, length 18.0 mm, greatest width 11.0 mm. Head with carinae as is typical in genus, the posterior clypeal carina slightly anteriorly arcuate, trituberculate, median tubercle slightly larger. Frons and vertex entirely, irregularly granulate, granules never separated by more than three diameters, usually less. Pronotum (Fig. 18) with raised portion of anterior margin as in male, a faint denticle medially; pronotum almost completely granulate except for carinae, part of midline extending between faint anterior fovea at anterior third and faint fovea at posterior sixth (=prescutellar depression); on either side of midline between foveae granules irregular, sometimes widely separated; longitudinal carina on each side distinct from anterior fifth to posterior sixth; anteriorly separated by approximately width equal to width of clypeus, posteriorly converging to 1/2 anterior width. Lateral oblique carina feebly developed, similar to male.

TYPE MATERIAL: Holotype, male, Brazil, Estado do Paraná, Arapongas, XII.1951, A. Maller (Martínez).

Allotype, female, same data as holotype (Martínez).

PARATYPES: 11 males, 6 females.

BRAZIL: Paraná, XII.1951, XI.1956, A. Maller, XII.1956, Dirings; N. Paraná. São Paulo, Rio Claro, X.1940, I.1952, F.S. Pereira; Araraquara, Rio Aukumas, XII.1954, Olivastro; Ilha Comprida, IV.1969, J.S. Carvalho; Aguapehy, III.1941, Dufaux. D.F., Rio de Janeiro, 1926, Moraes-Mello. Minas Gerais, Rio Preto, II.1962, A. Machado; Belo Horizonte, III.1961, Machado; Varginha, X.1952. Goias, Anápolis, XI.1930, Zellibor.

PARAGUAY: no other data. Guayrá, Villarrica, XI.1941, F. Schade; Colonia Elisa, 17.XI.1940, B. Podtiaguin.

Paratypes are in: Buenos Aires, Cambridge, London, Ottawa, Howden, Martínez.

REMARKS. Variation is not great. Some allometric growth is evident in the variation of male horn length, and the prescutellar depression of the pronotum in males also shows variation in the size and depth of the depression. Color also varies, the dark brown specimens we suspect are older as most are more abraded than lighter colored specimens. Characters needed for identification are summarized in the diagnosis.

8. Athyreus hemisphaericus Boucomont

Figures 25-27, Map 3

Athyreus hemisphaericus Boucomont, 1902a, p. 184; 1902b, p. 582; 1928, p. 206.

Athyreus canaliculatus Boucomont, 1928, p. 206. NEW SYNONYMY.

TYPE, hemisphaericus. Lectotype here designated, female originally described as male by Boucomont, 1902a, p. 184 and 1902b, p. 582 and used for figure 3, plate 5 of volume 71 (1902b). Type locality "Jatahy" (Prov. Goias, Brazil). (Paris), examined.

TYPE, canaliculatus. Male (Paris), examined.

MALES. Length 15.0 to 17.0 mm, greatest width 10.5 to 11.5 mm. Dorsally reddish brown to dark reddish brown, apices of horns, mandibles and margins often darker. Clypeal horn (Fig. 25) small, laterally compressed, anterior face obliquely slanted anteriorly then curved posteriorly in apical fourth, apex rounded, longer than wide in cross section; anterior lateral carina distinct, posterior lateral carina extending from base of horn in some specimens, obsolete in others, when present low and arcuate to junction with gena. Frons nearly flat, closely punctate. Vertex posteriorly concave on each side of convex midline, elevated median area expanding anteriorly, sparsely to densely punctate-granulate, setose. Anterior lateral edge of eye canthus nearly right-angled, not acute or more strongly recurved than remainder of canthus as is typical in related species. Pronotum (Fig. 25) with anterior margin between fossae obtusely angulate and subdentate at midline; pronotal midline deeply, narrowly impressed for most of length, almost forming fovea at anterior third with smooth area on either side extending posteriorly to anterior angles of raised carinae (equivalent to "horns" of vavini and relatives). Pronotum centrally with raised, obtusely angled carina on each side of midline, carina highest anteriorly, low and very slightly convergent posteriorly, ending in obtusely rounded, posteriorly and medially directed lobe just anterior to posterior margin and overhanging deep longitudinal median indentation; indentation 1 to 1.5 mm in length, narrowed anteriorly by overhanging sides, interior of indentation distinctly setose. Angulate pronotal carina anteriorly extending laterally, carina becoming feeble, obsolete in some specimens, joining lateral margin slightly posterior to mid point between anterior and median angle; juncture feebly angulate; a second short carina present on pronotum midway between anterior carina and posterior margin anterior to humerus, carina usually wide and well developed. Lateral pronotal surfaces, excluding carinae, closely granulate, setose. Fore tibia with five distinct teeth on outer margin, a sixth minute basal tooth often present on tibia of unabraded specimens. Genitalia (Fig. 26) with parameres apically simple, moderate in length, protrusion uniformly arcuate.

FEMALES. Length 15.5 to 17.5 mm, greatest width 10.5 to 12.0 mm. Head with typical female carinae, the posterior transverse carina often with median tubercle well developed and slightly anterior to smaller, more oblique lateral tubercle on each side; frons and vertex granulate, vertex not noticeably concave posteriorly near eyes. Pronotum (Fig. 27) with anterior margin and carinae not greatly different from small males; major difference is in lack of deep prescutellar indentation and overhanging lobes; instead area unmodified, midline narrow and deeply impressed, setose from just before posterior margin to anterior fourth; carina on either side almost parallel to anterior angulation, carina extending laterally from angulation to

pronotal margin poorly delimited, in some specimens absent; short carina near posterior pronotal margin anterior to humerus usually well developed.

MATERIAL EXAMINED: 17 males, 16 females.

ARGENTINA: Corrientes, Ituzaingó, Isla Apipe Grande, XI.1945, Martínez. Misionés, Santa María, Viana; Loreto (Exp. St.), Ogloblin; San Ignacio, Villa Lutetia, January, Wagner.

PARAGUAY: Alto Paraná, Hohenau, XI.1941, Jakob.

BRAZIL: São Paulo, Cidade (Ipiranga Santo Amaro), Pastore, Lane, Martínez. Minas Gerais; Uberaba, Summer 1956/57, Mendoza.

Specimens are in: Buenos Aires, London, Ottawa, Paris, Howden, Martínez.

REMARKS. The species is readily recognizable by the uniform reddish brown color, shape of pronotal carinae in both males and females, by the deep, sulcate indentation in the prescutellar region of males and by the male genital characters.

Boucomont originally (1902) confused the females of two different species describing one female (herein chosen as the lectotype of hemisphaericus) as a male. Subsequently when he described canaliculatus (1928) he stated that the male canaliculatus might be the same as hemisphaericus as he had discovered that two females were represented in his original description, the "male" of his description being the female of "canaliculatus". In selecting the lectotype it seemed best to select the female that could be definitely related to males without any doubt that they represented a single species, hence the establishment of canaliculatus as a synonym of hemisphaericus.

9. Athyreus nitidus n. sp.

Figures 21, 22, Map 3

DIAGNOSIS. Dorsally brown; head, pronotum and elytra unusually shiny, granules and punctures greatly reduced; clypeal horn erect, anterior and posterior lateral carinae obsolete at base of horn, distinct on horn; anterior pronotal margin raised and dentate on either side of midline; pronotal horn on either side of midline blade-like, erect, apically bidentate, widely separated; middle third of pronotum broadly, shallowly, concave.

HOLOTYPE. Male, length 15.0 mm, greatest width 10.0 mm. Dorsally shining brown. Clypeal horn (Fig. 21) erect, anterior and posterior lateral carinae present on horn, anterior carina briefly interrupted near base, posterior lateral carina present only on apical half of horn, absent elsewhere; posterior median carina lacking. Frons and vertex with scattered, long, semi-recumbent setae, seta-bearing punctures small, sparse, surface between shining. Pronotum (Fig. 21) with anterior margin between fossae raised medially, an obtuse tooth present on either side of midline; lateral pronotal margin somewhat irregularly arcuate to feebly sinuate near rounded median angle. Pronotum centrally, longitudinally broadly concave; on either side at edge of concavity just behind middle of pronotum with a laterally flattened, erect, blade-like horn having apex bifurcate, the posterior bifurcation much larger. Median posterior (prescutellar) area of pronotum not noticeably depressed, posterior margin at midline very narrow, marginal line obsolete. Elytra with broad indentations (striae) feebly delimited, much of surface unusually smooth and shining. Fore tibia with five teeth on outer margin. Genitalia as in fig. 22, with apical lobes very similar to vavini and hypocritus.

FEMALE. Unknown.

TYPE MATERIAL: Holotype, male, Bolivia, Dpto. Sta. Cruz, Pcia. Cordillera, Rio Seco, II.1962, Martínez (Martínez).

REMARKS. The rather polished, shining brown appearance of nitidus is quite characteristic, and this coupled with the widely separated, blade-like bifurcate pronotal horns should be sufficient for identification.

10. Athyreus anneae n. sp.

Figures 23, 24, Map 3

DIAGNOSIS. Color tan to dark brown. Clypeal horn with anterior lateral carina complete or only slightly interrupted near base; posterior lateral carina present on horn, lacking on base; posterior median carina absent. Pronotum with midline depressed, posterior third with laterally compressed horn on each side adjacent to and paralleling median depression, each horn bidentate, the horn arcuately depressed between anterior and posterior denticles; posterior margin of pronotum not interrupted or greatly modified. Female unknown.

HOLOTYPE. Male, length 21.5 mm, greatest width 13.0 mm. Dorsally light brown. Clypeal horn (Fig. 23) vertical, anterior lateral carina complete, slightly interrupted at base of horn; posterior lateral carina present only on vertical portion of horn, absent elsewhere; posterior median carina absent. Frons and vertex almost completely impunctate, non-granulate; vertex with distinctly circular concavity on each side adjacent to eye, median area longitudinally strongly convex. Pronotum (Fig. 23) with midline indented except at anterior fifth or sixth; horn either side of and paralleling midline in posterior third, apex of horn bidentate, arcuately depressed between acute anterior and posterior denticles; horn separated from one on opposite side by distance of 3 to 4 mm; areas anterior and posterior to horns to margins mostly smooth, impunctate, non-granulate. Outer surface of each horn near base and lateral thirds of pronotum closely setose-granulate; lateral margin arcuate, anterior margin between fossae very obtusely angulate, summit of angulation at midline with minute tubercle; posterior margin at midline obtusely rounded and extended slightly posteriorly, area just anterior to posterior margin and posterior to horns concave, impunctate, non-granulate. Fore tibia with six teeth on outer margin. Genitalia as in fig. 24.

FEMALE. Unknown.

TYPE MATERIAL: Holotype, male, Paraguay, Caaguazú District, Estancia Primera, 28.xii.1931, R.F. Hussey (Howden).

PARATYPES. 2 males.

BRAZIL: São Paulo, Jundiaí, XII.1956, Martínez.

PARAGUAY: Cerro Amambay, X.1939, A. Schultze.

Paratypes are in: Washington, Martínez.

REMARKS. Variation is mainly evident in the allometric growth of the horns, the paratype from Paraguay having the poorest development but with the carinae and shape as described above. In the small paratype the vertex and frons are mostly granulate or punctate and the color is tan rather than brown. The species is named for Anne T. Howden in recognition of her contribution to many aspects of this paper.

11. Athyreus forcipatus Boucomont

Figures 31-33, Map 4

Athyreus forcipatus Boucomont, 1928, p. 207.

TYPE. Male (Paris), examined.

MALES. Length 15.0 to 17.0 mm, greatest width 10.5 to 11.0 mm. Color dorsally varying from brown centrally, tan laterally, to black centrally, brown laterally. Clypeal horn (Fig. 31) almost an equilateral triangle in median cross section, anterior surface flat, posteriorly with posterior lateral carinae joining near base to form single carinate posterior edge; near base of horn anterior and posterior lateral carinae present; posterior median carina absent. Frons and vertex with widely scattered punctures, otherwise smooth, vertex shallowly concave near eye either side of slightly convex midline. Pronotum (Fig. 31) with horn on posterior half either side of midline; viewed laterally horn trilobed, anterior lobe sharp, directed slightly anteriorly, median lobe distinct, usually slightly obtuse and nearly upright, posterior lobe extending horizontally over posterior pronotal margin and partially obscuring scutellum; posterior lobes narrowly, deeply separated; middle lobes separated by approximately 1 mm, anterior lobes by 1.5 to 2.0 mm. Pronotal depression anterior to horns with center of depression granulate, the surrounding area laterally and posteriorly largely smooth, with sparse, scattered punctures, non-granulate; lateral convex portions of pronotum closely granulate, lateral carinae absent; lateral margin arcuate. Elytral depressions or wide striae (Fig. 33) with setose granules distinctly separated, third depression with moderately even double row of granules. Fore tibia with five teeth on outer margin. Genitalia as in fig. 32.

FEMALES. Unknown or unassociated (granules in elytral intervals should be useful for identification of females when distribution is also considered).

MATERIAL EXAMINED: 4 males.

BOLIVIA: La Paz (type locality). Santa Cruz. Cochabamba, Pcia. Chapare, Km. 14, 800 m, Martínez.

Specimens are in: Paris, Washington, Howden, Martínez.

REMARKS. In the four males seen the trilobed horn on each side of the pronotal midline varied both in height and in the degree of anterior-posterior separation of the lobes, the distance between the anterior and median lobes being most noticeable. The widely spaced granules in the elytral intervals seems to be a fairly unique character in the group and this coupled with the large, non-granulate area in the anterior portion of the pronotum should identify the species.

12. Athyreus alvarengai n. sp.

Figures 34-36, Map 4

DIAGNOSIS. Very similar to forcipatus. Males with posterior lateral carinae obsolete near base of clypeal horn; vertex distinctly concave on each side near eye, midline of vertex distinctly convex; pronotal depression anterior to horns largely granulate, granules in elytral depression (striae) dense, third stria with three irregular rows of granules.

HOLOTYPE. Male, length 15.8 mm, greatest width 10.5 mm. Dorsally black with lateral pronotal margins dark brown. Clypeal horn (Fig. 34) more acutely triangular than in forcipatus, anterior-posterior length near

base 1/4 more than in forcipatus; posterior lateral carinae obsolete near base, distinct laterally. Frons mostly punctate; transverse band at junction of frons and vertex impunctate; concave area of vertex on each side near eye impunctate; median convex portion of vertex granulate. Pronotum (Fig. 34) similar to that of forcipatus but with trilobed horn on each side in anterior half separated from horn on other side by 2.5 to 3 mm; concavity anterior to horns occupying median third of pronotum, setose-granulate except for vague non-granular ridge anterior to each horn, the vague ridge delimiting central concavity; pronotum lateral to ridge and horns convex, closely setose-granulate. Elytral striae (Fig. 36) closely setose-granulate, granules in third stria forming three irregular rows. Fore tibia with five teeth on outer margin. Genitalia as in fig. 35.

FEMALE. Unknown.

TYPE MATERIAL: Holotype, male, Brazil, Pernambuco, Escada, X. A. Naller (Martínez).

Paratype, 1 male.

BRAZIL: Pará, Belém, Utinga, IX.1956, Martínez (Howden).

REMARKS. The single male paratype measures 16.0 mm in length and both the clypeal and pronotal horns are reduced in size compared to the holotype. Except for the allometric difference the two specimens are essentially similar.

This species is named for Col. Moacir Alvarenga from Rio de Janeiro in recognition of his numerous entomological endeavors which have advanced entomology in general and greatly aided this study in particular by providing the authors with many rare species of Athyreus.

13. Athyreus pyriformis n. sp.

Figures 37, 38, Map 4

DIAGNOSIS. Males with clypeal horn at apex much wider than long, horn anteriorly-posteriorly compressed, apex nearly truncate. Pronotum with anterior median half, smooth, shallowly concave; concavity rising nearly vertically and narrowing posteriorly, forming an upright horn; horn along median line narrowly, deeply sulcate, the midline indented posterior to sulcus, widening and deepening about 1 mm before posterior pronotal margin; margin posteriorly arcuate at posterior of indentation, marginal line incomplete. Pronotum in lateral view approximately three times higher than long. Females not recognized.

HOLOTYPE. Male, length 16.5 mm, greatest width 10.8 mm. Dorsally black, head and sides of pronotum and elytra very dark brown. Clypeal horn (Fig. 37) with anterior and posterior lateral carinae feebly developed, largely obsolete on horn, posterior median carina absent; horn (in cross section) near base only slightly wider than anterior-posterior length, in apical half two to three times wider than anterior-posterior length; apex bluntly rounded to truncate. Frons and vertex setose-punctate except for small median area in center of vertex smooth, a few scattered punctures present. Pronotum (Fig. 37) with anterior edge of horn rising nearly vertically from posterior edge of large, shallowly concave area extending from just posterior to anterior margin onto face of horn; central anterior half of pronotum smooth. Pronotal horn obliquely blunt in lateral view, in posterior (or anterior) view deeply sulcate the two plates of the horn narrowly separated (0.5 mm at apex); indentation continuing posteriorly down horn, deepening and widening on posterior portion of pronotum, forming oval cavity posteriorly

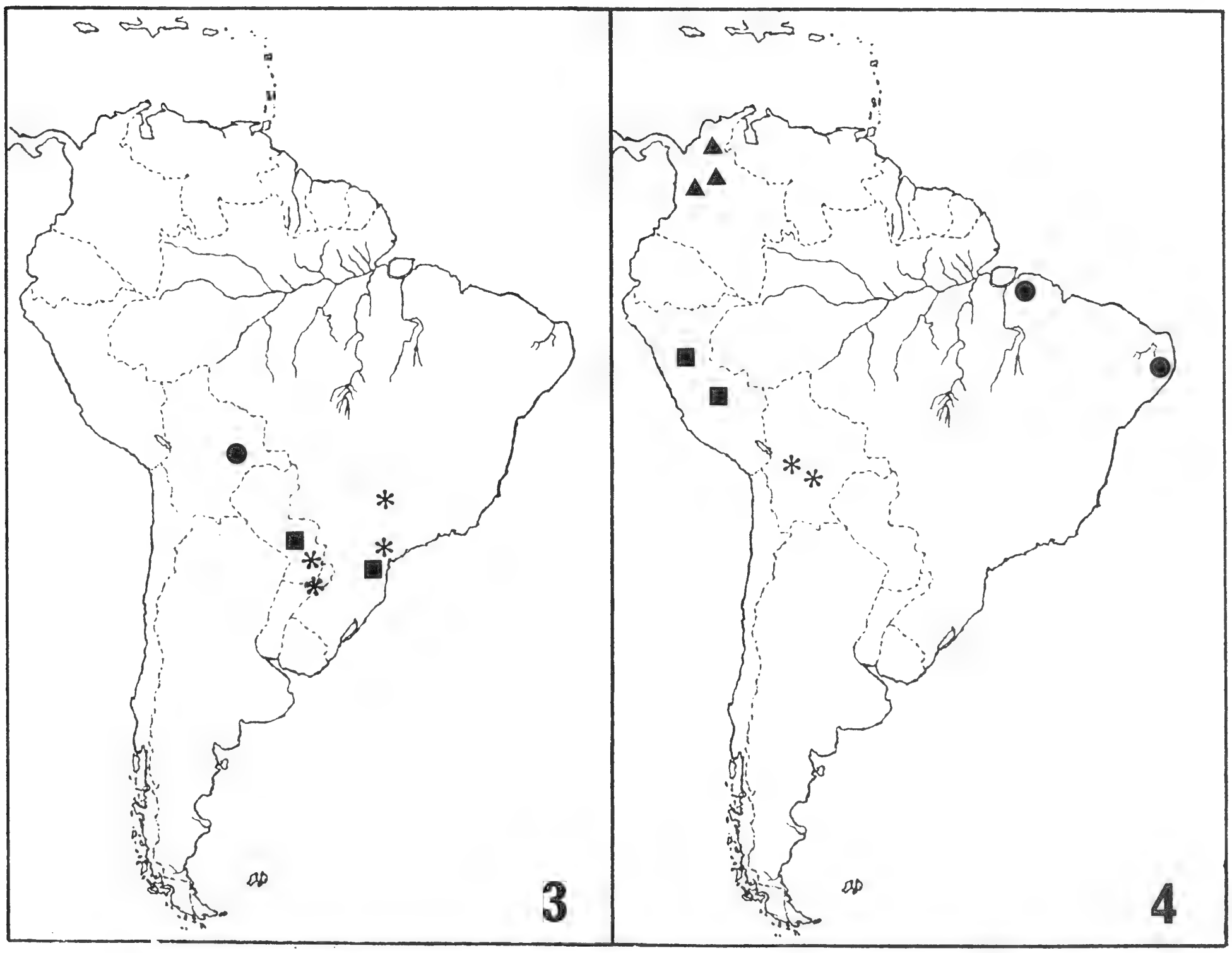
that is delimited by thin posterior pronotal margin, marginal line broken. Pronotum in lateral view much higher than long, lateral third on each side from anterior angles to posterior median depression behind horn closely setose-granulate; lateral pronotal margin just anterior to median angle, very feebly interrupted immediately below lateral fovea. Fore tibia with five teeth on outer margin. Genitalia as in fig. 38, the prolongations of the parameres relatively short for group.

TYPE MATERIAL: Holotype, male, Peru, Junin, Chanchamayo, 3.X. 1961, J. Schunke L. (Howden).

Paratype, 1 male.

PERU: Loreto, Pucallpa, Hocking (Washington).

REMARKS. The single male paratype does not vary significantly from the holotype except that the size is slightly less (about 0.5 mm).



* = 8. hemisphaericus Bouc.
● = 9. nitidus n. sp.
■ = 10. anneae n. sp.
* = 11. forcipatus Bouc.
● = 12. alvarengai n. sp.
■ = 13. pyriformis n. sp.
▲ = 14. unicornis n. sp.

14. Athyreus unicornis n. sp.

Figures 28-30, Map 4

DIAGNOSIS. Males lacking clypeal horn, pronotum with unique slender horn arising from center of pronotum, extending anteriorly and inclined downward over head, terminating near anterior edge of clypeus. Females with

two distinctly separated central pronotal tubercles, a short carina on each side delimiting central dark brown to black area that extends anteriorly to margin; remainder of elytra and sides of pronotum reddish brown. Both sexes with five teeth on outer margin of fore tibia. Occurring in northern Colombia.

HOLOTYPE. Male, length 17.5 mm, greatest width 12.0 mm. Distinctly bicolored dorsally; frons, vertex central third of pronotum and all but lateral and apical fourth or third of elytra very dark brown to black; labrum, clypeus, lateral portions of pronotum and elytra reddish brown. Clypeus (Fig. 28) with a single, uniformly low, arcuate carina extending from above antennal insertion on each side anteriorly to middle of clypeus; clypeus anterior to carina sloping gradually downward to margins; medially, a low tubercle present in center of frons. Frons evenly, vertex less evenly, punctate. Pronotum (Fig. 28) with slender, nearly cylindrical horn extending anteriorly and inclined downward, terminating above anterior margin of clypeus; basal dorsal half of horn and adjacent midline posterior to horn indented, indentation punctate on horn, setose granulate behind. Pronotum on each side with short vague carina near base of horn, second more distinct carina near posterior pronotal margin anterior to elytral umbone. Pronotum anterior to horn smooth and shallowly concave; lateral and posterior thirds of pronotum setose punctate or granulate; lateral pronotal margin on each side between acute anterior angle and median angle bisinuate. Fore tibia with five teeth on outer margin (basal notches between teeth enlarged by some mechanical process in type, not natural abrasion; also same is true for notches of mandibles). Genitalia as in fig. 29, similar to bifurcatus.

ALLOTYPE. Female, length 18.0 mm, greatest width 13.0 mm. Dorsally similar in color to male. Head not differing greatly in shape of carinae from females of related species. Pronotum (Fig. 30) with two central tubercles distinct, conical, separated by approximately 1 mm; on each side at edge of dark area posterior to tubercles a short, poorly developed carina (better developed in paratypes). A short distinct carina present paralleling posterior pronotal margin just anterior to elytral umbone. Pronotal surface entirely setose-granulate; lateral margin on each side between anterior and median angles vaguely sinuate; fovea above median angle, small, oval, moderately deep and shining. Fore tibia with five teeth on outer margin.

TYPE MATERIAL: Holotype, male, Colombia, Valle Medellín, X.1945, F.L. Gallego M., U.S.N.M. Ins. no. 176630. Col. 37-XX3 (Washington). Allotype, female, same data as holotype (Washington).

PARATYPES. 1 male, 3 females.

COLOMBIA: Magdalena, Sierra Nevada de Santa Marta, Pueblo Bello, 1100 m, 10-17.VI.1968, B. Malkin. Santander, Socorro, VIII.1940.

Paratypes are in: Chicago, Howden, Martínez.

REMARKS. Color normally is not a useful character in the bifurcatus group, but coloration is constant in the six specimens seen. At present the range by itself can be considered diagnostic since no other species of Athyreus is known from the area of Colombia in which unicornis occurs.

15. Athyreus armatus Westwood

Figure 39

Athyreus armatus Westwood, 1848, p. 386; 1851, p. 459; Boucomont, 1912, p. 4.

TYPE. Male (Oxford), examined.

MALE. Length 18.0 mm, greatest width about 11.0 mm. Dorsally black with mandibles and sides of pronotum brown. Anterior lobe of each mandible projecting strongly anteriorly, forming an elongate lobe. Clypeus anteriorly with a small median tubercle; a nearly straight carina on each side extending from median tubercle to lateral margin above antennal insertion, there forming a small tubercle. Frons and vertex centrally briefly impunctate, most of frons and vertex setose, punctate or granulate. Pronotum (Fig. 39) very unusual for genus; centrally with a single, anteriorly inclined horn; on each side anterior to horn a rounded, "flap-like" dilation or lobe extending to anterior margin behind eye, the dilation most pronounced near posterior terminus. Lobes or dilations laterally and horn posteriorly effectively delimiting anterior, central half of pronotum; area within shallowly concave and sparsely granulate. Area posterior to pronotal horn medially depressed, closely setose-granulate; pronotum laterally, including indentation below dilations, largely impunctate. Fore tibia with five teeth on outer margin.

MATERIAL EXAMINED: 1 male (holotype).

"AMERICA MERIDIONALI": no other data.

REMARKS. The single male of armatus differs greatly in the pronotal armature from other species of Athyreus. The laterally directed "flap-like" dilations projecting from lateral third of pronotum anterior to transverse line of central horn is nearly unique. The elongate, anteriorly projecting lobe on each mandible resembles to a degree the mandibles of gigas. The essentially hornless clypeus and the anteriorly inclined pronotal horn vaguely resembles unicornis. The lack of any additional specimens since Westwood's description indicates both rarity and lack of collecting. Boucomont, 1911, in his catalogue lists the locality of armatus as "Brazil" (which probably does equal "America meridionali").

16. Athyreus biarmatus n. sp.

Figures 79-81, Map 5

DIAGNOSIS. Male lacking clypeal horn, horn represented anteriorly by a low transverse tubercle; pronotum in anterior half on either side behind eye with a laterally directed lobe slightly overhanging pronotal surface; center of pronotum with horn represented by a low swelling bifurcate apically, each furcation distinct and acutely pointed. Female with very distinct U-shaped carina enclosing a short distinctly raised carina on either side of midline, the U-shaped carina incomplete posteriorly; short inner carinae slightly convergent posteriorly but completely separate.

HOLOTYPE. Male, length 15.0 mm, greatest width 9.9 mm, bicolored dorsally; vertex, longitudinal central half of pronotum, and elytra very dark reddish brown; labrum, lateral fourths of pronotum, and legs light reddish brown. Clypeus (Fig. 79) with complete transverse anterior carina, carina feeble; medially and contiguous to carina a small transverse tubercle; posterior carinae obsolete, evident laterally above antennal insertions; frons slightly tumid, surface of frons and vertex with scattered setose granules. Pronotum (Fig. 79) with central third in anterior half lobed on either side posterior to fossa, the lobe raised, projecting laterally and slightly overhanging lateral surface; viewed from above lobes and anterior margin presenting a broadly U-shaped raised area with central portion slightly depressed and with scattered granules. Immediately behind this area at center of pronotum a feeble swelling present with apex distinctly bifurcate, each

portion of bifurcation abruptly raised,slightly divergent and acute at apex; on each side of horn posteriorly a slightly sinuate carina terminating just posterior and lateral to the posterior terminus of lobe; midline posterior to central horn or swelling shallowly, distinctly indented; surface of pronotum except for raised areas moderately granulate, setose; lateral pronotal margins sinuate. Elytron between suture and umbone with intervals strongly convex; each stria largely represented by irregular, double row of granules. Fore tibia with five teeth on outer margin. Genitalia as in figure 80.

ALLOTYPE. Female, length 17.1 mm, greatest width 10.5 mm. Color, granules, elytra, striae, and fore tibia as described for male. Clypeus anteriorly with evenly arcuate transverse carinae; posterior clypeal carina tridentate, median tubercle better developed and very slightly anterior in position to lateral tubercles. Vertex centrally flat, granules widely spaced. Pronotum (Fig. 81) with longitudinal central third largely enclosed by strongly raised U -shaped carina with greatest elevation near anterior margin; a fine carina extending posteriorly from margin on each side just inside fossa and merging with U -shaped carina; each terminus of U -shaped carina converging posteriorly, terminating approximately 1 mm before posterior margin; area between broadly, shallowly depressed. Center of pronotum on either side of midline with strongly raised longitudinal carina, the two carinae slightly convergent posteriorly.

TYPE MATERIAL: Holotype, male, Trinidad, 92-66 (London). Allotype, female, Trinidad, St. Augustine, 22.8.1925, C.L. Withycombe (London).

REMARKS. The species is closely related to armatus but can be readily distinguished by the bifurcate pronotal horn of the male; the male of armatus has a long, slender, anteriorly inclined horn. The lateral pronotal lobes will distinguish armatus and biarmatus males from all other species.

17. Athyreus gigas Westwood

Figures 40-42, Map 5

Athyreus gigas Westwood, 1848, p. 386; 1851, p. 458.

TYPE. Male (Oxford), examined.

MALES. Length 24.0 to 25.0 mm, greatest width 13.5 mm. Dorsally reddish tan to brown. Each mandible with three lobes in addition to acute apical tooth; anterior apical lobe directed anteriorly, acutely triangular in shape, similar in this respect to armatus. Clypeus (Fig. 40) with three low horns of equal height; one medially at anterior edge of clypeus with vague but typical anterior lateral, posterior lateral and posterior medial carinae evident; obsolete posterior lateral carina on each side forming an acutely triangular horn just anterior to gena, horn projecting slightly outward over antennal insertion. Clypeus and area between horns with scattered, distinctly separated punctures. Frons largely impunctate, posteriorly with a small, low tubercle on each side of midline; vertex posterior to tubercles setose-punctate. Pronotum (Fig. 40) with two divergent, blade-like horns arising from common base, nearly as in some bifurcatus but with horns stouter and recurved upward on anterior edge. Anterior face of horns impunctate, smooth; anterior and posterior surfaces setose-granulate. Pronotum laterally on each side of horns shallowly, broadly concave, the concavity slightly irregular and non-granulate, impunctate; area near anterior angles flat, with minute scattered punctures. Lateral pronotal margin straight from anterior angle to just anterior to median angle where briefly sinuate. Elytral intervals

between suture and umbone poorly delimited, somewhat irregularly spaced. Genitalia (Fig. 41) with prolongation of paramere (Fig. 42) slightly expanded and bluntly rounded at apex.

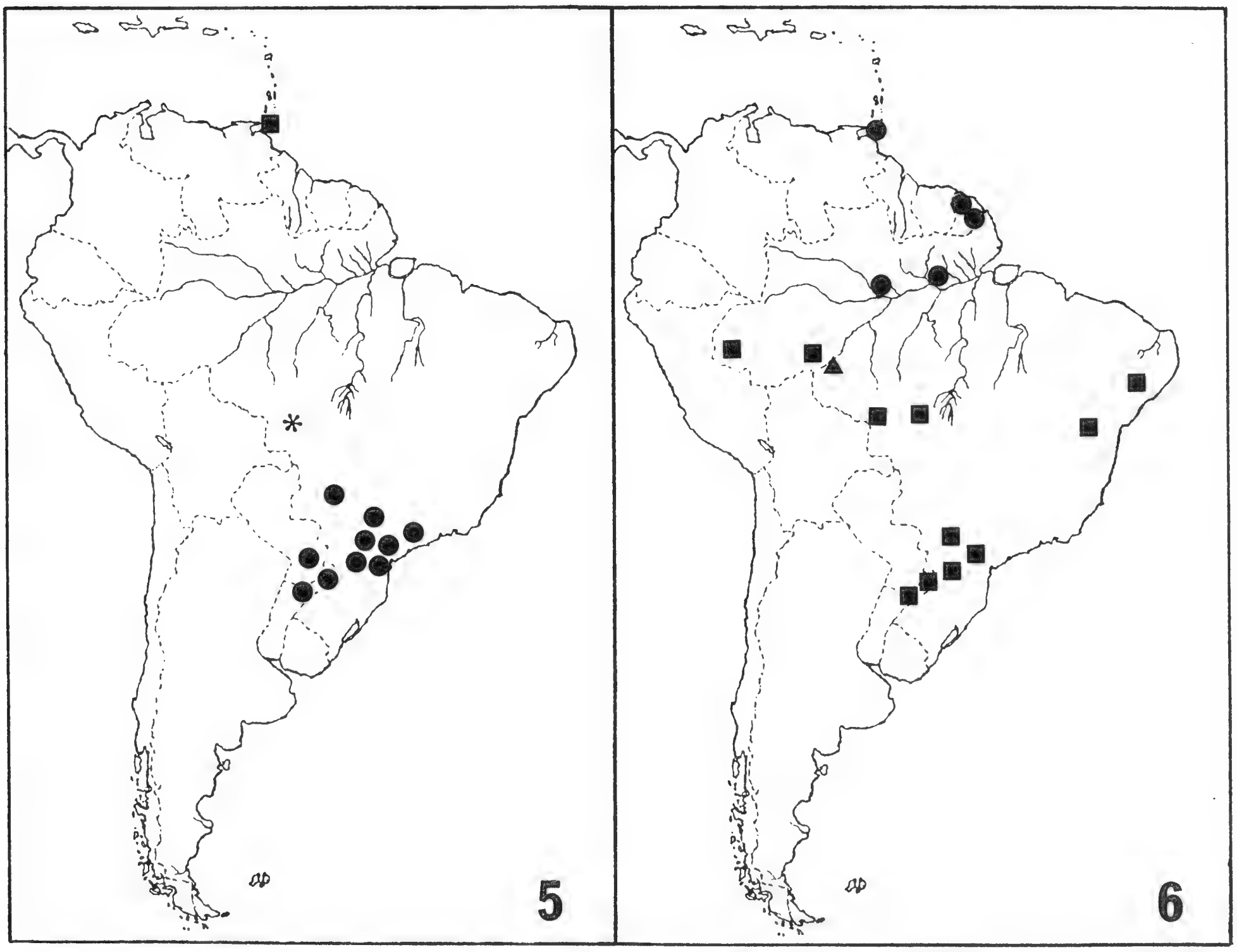
FEMALE. Unknown.

MATERIAL EXAMINED: 2 males.

BRAZIL: no other data (holotype). Mato Grosso, near Cuiabá, XI.43.

Specimens are in: Oxford, Martínez.

REMARKS. The two specimens seen are very similar, and are easily separable from other Athyreus, except possibly for the smaller parvus. The three low horns on the head are an excellent specific character and this, in conjunction with the smooth areas of the pronotum, immediately separates gigas from related species such as parvus and bifurcatus.



■ = 16. biarmatus n. sp.
* = 17. gigas Westw.
● = 19. bifurcatus Macl.

■ = 20. tuberifer Fels.
▲ = 21. juanae n. sp.
● = 22. bellator Westw.

18. Athyreus parvus n. sp.

Figures 82-84

DIAGNOSIS. Clypeus with three horns or large tubercles; anterior median horn with anterior and posterior lateral carinae and feeble median posterior carina; lateral "horn" on each side formed by strongly protruding

angulation of lateral margin positioned above base of mandible distinctly anterior to gena. Central horn of pronotum bifurcate, as in some bifurcatus; a circular concavity present on either side of midline anterior to horn; anterior and lateral surfaces of pronotum granular or punctate, not smooth.

HOLOTYPE. Male, length 14.9 mm, greatest width 9.8 mm. Clypeus (Figs. 82, 83) with three horns or tubercles; anterior central horn most pronounced, occupying most of center of clypeus; anterior face of clypeus nearly vertical, triangular; face delimited on each side by the anterior lateral carina, carina merging with opposite one near slender apex of horn; horn in lateral view broadly triangular, slightly bent posteriorly; posterior median carina feeble; posterior lateral carina on each side strong, elevated, forming a large, acute tubercle or small horn overhanging base of mandible. Frons rising uniformly from vertex to base of clypeal horns or tubercles, inclined surface closely, often confluently punctate; vertex moderately punctate, nearly flat medially, with a minute tubercle on either side of midline in line with posterior margin of eyes. Pronotum (Figs. 82, 83) with central horn strongly bifurcate nearly from base, each furcation inclined anteriorly, divergent from opposite side, and tapered to acute tip. Pronotum on each side anterior to horn with moderately deep, almost circular depression; midline behind horn shallowly impressed; pronotum on each side posterior to horn with two short feeble carinae, posterior one anterior to humerus and parallel to posterior pronotal margin, more anterior and shorter carina positioned midway between base of horn and posterior carina; pronotal surface except for carinae punctate or granulate, largely setose, lacking smooth areas; lateral pronotal margin between anterior and median angles distinctly sinuate. Fore tibia with five teeth on outer margin, a suggestion of a minute basal sixth tooth present on right tibia. Genitalia (Fig. 84) with prolongations of parameres long, stout, feebly twisted and with blunt apices.

FEMALE. Unassociated.

TYPE MATERIAL: Holotype, male, Brazil (Howden).

REMARKS. Athyreus parvus was at first included with a series of bifurcatus because of the shape of the pronotal horn. The small size of parvus originally caused confusion in regards to the short clypeal horn. However when the genitalia was examined the species was found to be only distantly related to bifurcatus. We now consider it to be a well developed male with the clypeal characters showing affinities with gigas. The pronotal depressions and large prolongation of each paramere are similar to the tribuliformis - zischkai - martinezi complex. Athyreus parvus seems to be intermediate between these species and gigas.

19. Athyreus bifurcatus Macleay

Figures 43-45, Map 5

Athyreus bifurcatus Macleay, 1819, p. 124; Guerin, 1956, p. 262; Martínez, 1953, p. 232.

Athyreus herculeanus Laporte, 1840, p. 102; Boucomont, 1911 (1910), p. 346. NEW SYNONYMY.

Athyreus rotundus Westwood, 1848, p. 386; 1851, p. 461. NEW SYNONYMY.

Athyreus tuberculatus Westwood, 1848, p. 386; 1851, p. 460. NEW SYNONYMY.

TYPE, bifurcatus. Male (location uncertain), not examined.

TYPE, herculeanus (possible type). Female (Paris), examined.
TYPE, rotundus. Female (Oxford), examined.
TYPE, tuberculatus. Male (Oxford), examined.

MALES. Length 18.0 to 22.0 mm, greatest width 11.0 to 13.0 mm. Dorsally brown to very dark brown, pronotum often lighter in color than elytra, particularly near margins. Clypeal horn (Fig. 43) strongly inclined anteriorly; anterior lateral, posterior lateral, and posterior median carinae all present; the posterior lateral carina on each side forming an abrupt, sharply pointed low tubercle just anterior to gena. Frons and vertex setose, punctate or granulate. Pronotum (Fig. 43) in well developed males with two widely divergent horns arising from a common base; on each side of horns a large, shallow concavity extending from near posterior pronotal margin 2/3 of distance to anterior margin. Lateral third of pronotal surface usually impunctate; pronotal margin between anterior and median angles sinuate, area just inside anterior angle tumid. In poorly developed males pronotal horns indicated by two slightly separated divergent, longitudinal flaps (as in type of tuberculatus), surface of pronotum largely granular, pronotal concavities lacking, lateral pronotal margins between anterior and median angles nearly straight. Fore tibia usually with six distinct teeth on outer margin. Genitalia as in fig. 44.

FEMALES. Length 17.0 to 24.0 mm, greatest width 11.0 to 14.0 mm. Females are either extremely variable or the series seen is a mixture of species, probably both factors are present. All specimens have six teeth on the fore tibia as do males of bifurcatus. Pronotum (Fig. 45) with central swelling single or double, low or distinctly elevated; carina on either side extending to anterior margin or incomplete laterally, in addition to large arcuate carina, one or two short carinae present.

MATERIAL EXAMINED: 42 males, 48 females (only data from males listed).

ARGENTINA: Misiones, Loreto, XI.1939, Ogloblin; Misiones, Oberá, X.1944, Pastrana; Misiones, San Ignacio, IV.1945, Röhmer; Misiones, Puerto Victoria, XI.1940; Misiones, no other data.

BRAZIL: No other data (type locality). São Paulo, Barueri, 10.IV.1956, K. Lenko; São Paulo, CIPO, 25.II.1974, 18.X.1972, 4.XII.1972, V.N. Alin; São Paulo, Ypiranga, 24.XI.1942, A. Alves. Mato Grosso, Pocone, XII.1948. Minas Gerais, Varginha, X.1950. Paraná, Jaguariaiva, XII.1955; Rio Tijuca, XII.1884, E. Gounelle. Rio de Janeiro.

PARAGUAY: Alto Paraná, Hohenau, 1929, 15.XI.1948, H. Jacob; Hohenau, 23.XII.1945, G. Angel.

Specimens are in: Buenos Aires, Leiden, London, Ottawa, Oxford, Paris, Washington, Hardy, Howden, Martínez.

REMARKS. Males of bifurcatus, except minor specimens, can be distinguished by the distinctly anteriorly inclined clypeal horn, the two laterally divergent pronotal horns with a shallow lateral concavity on each side, and the fore tibia with six teeth. In male minors it is best to check the genitalia (Fig. 44) which have the protrusions of the parameres abruptly widened, almost bifurcate, at the apex. Females can only be determined by association with males.

20. Athyreus tuberifer Felsche

Figures 46-48, Map 6

Athyreus tuberifer Felsche, 1909, p. 762; Martínez, 1953, p. 233 (the female

"Allotype" is not tuberifer).

TYPE. Female (Dresden ?), not examined.

MALES. Not distinguishable from female by usual dimorphism in horns and carinae; males lack median dentate pronotal sulcus just anterior to posterior margin (see female description). Length 20.0 to 24.0 mm, greatest width 14.0 to 15.0 mm. Dorsally dark brown to black with lateral margins of pronotum and elytra often lighter. Clypeus (Fig. 46) with elongate, anterior median horn strongly inclined anteriorly, both anterior lateral and posterior lateral carinae extending nearly to apex; posterior median carina obsolete, represented by a small, abrupt tubercle at base of horn. Frons and vertex centrally impunctate, smooth, shallowly concave. Pronotum (Fig. 46) centrally with a nearly cylindrical horn (the base 1.0 to 1.5 mm high) having a small obtuse denticle at median posterior summit, and with an anterior extension directed slightly upward; apex of extension deeply (1 to 2 mm) bifurcate, each bifurcation slender, acute apically. Surface of central pronotal horn, except base anteriorly, closely punctate; on each side of midline from near base of horn to posterior margin a cluster of setose-granules; remainder of pronotal surface, except near anterior margin, smooth, impunctate, non-granulate; a few small scattered setose punctures present near anterior margin; surface of pronotum of male minors largely granulate. Pronotum either side of horn slightly concave (male majors), margin nearly straight between anterior and median angles; pronotal midline just anterior to posterior margin not modified, impunctate, slightly indented. Fore tibia with six teeth on outer margin. Genitalia as in fig. 47, the apical protrusions of the parameres small, acute.

FEMALES. Readily confused as males of a different but related species unless genitalia examined. Clypeus (Fig. 48) with single anterior, moderately elongate (about 2 mm) horn; anterior base of horn usually arising slightly behind anterior, transversely cariniform edge of clypeus (in males, base of horn anteriorly forms edge of clypeus); horn with both anterior and posterior lateral carinae, but lacking posterior median carina; posterior lateral carina on each side forming distinct tubercle above antennal insertion. Frons and vertex relatively evenly setose-granulate. Pronotum (Fig. 48) in anterior median half with a distinct oval concavity, width approximately equal to width of vertex; a low horn present posterior to and contiguous with concavity, oval horn almost truncate apically except for distinct vertical tooth on each side of anterior edge and vague median tubercle at posterior edge. Pronotum posterior to horn with midline narrowly depressed, an acute, posteriorly directed denticle present on each side of depression just anterior to posterior margin (this character readily identifies the females of tuberifer). Pronotum on either side of horn with one short, distinct and one obsolete carina; pronotal surface largely granulate except for smooth area on each side of central depression. Fore tibia with six teeth on outer margin.

MATERIAL EXAMINED: 9 males, 7 females.

ARGENTINA: Misiones, Loreto; Misiones, Puerto Victoria.

BRAZIL: Pernambuco (type locality). Terr. do Acre, Cruzeiro do Sul, I.1954. Bahia. Terr. Guaporé, Pôrto Velho, III.1944, A. Parko. Pará, Cachimbo, 25.IX-X.1956, Travassos, Oliveira, and Adao. Paraná, Rolandia, II.1955, A. Maller. Rio de Janeiro. São Paulo, Campinas, XI.1955, Martínez, at light; São Paulo, Lusanvira, 1936, H. Zellibor; São Paulo, Pirassununga, I.1951, Schubart; São Paulo, Anhembi, Faz, Barreiro Rico, XI.1965, W.D. Edmonds.

Specimens are in: Dresden (?), London, Paris, Howden, Martínez.

REMARKS. In the original description Felsche (1909) did not state the

sex of the unique type, but from his drawing and description the type is a female. The single horn on the head of the female, normally a male character, has subsequently caused confusion, a female of another species of the bifurcatus group being described as the female of tuberifer (see Martínez, 1953). The species, once the sexual differences are recognized, can be distinguished by the central, oval, anteriorly bifurcate or bidentate and posteriorly, medially obtusely tuberculate horn (Figs. 46 and 48).

21. Athyreus juanae n. sp.

Figures 61, 62, Map 6

DIAGNOSIS. Pronotal horn of males very distinctive; laterally compressed, extending medially from center of pronotum to posterior fourth; horn viewed from posterior or anterior acutely elongate, viewed laterally consisting of anterior and posterior points, apical edge arcuately emarginate between, deepest point slightly anterior in position; pronotum medially between horn and anterior margin feebly concave, concave area and adjacent lateral area on each side not setose-granulate, lateral areas with a few scattered small punctures. Fore tibia with five teeth on outer margin. Females not associated.

HOLOTYPE. Male, length 22.5 mm, greatest width 12.5 mm. Dorsally very dark brown to black, lateral edges of pronotum and elytra dark brown. Clypeal horn (Fig. 61) nearly vertical, inclined slightly forward; anterior lateral carina on each side only evident from outer angle to base of horn; posterior lateral carina on each side distinct to near apex of horn, feebly arcuate from base to terminus with gena; posterior median carina distinct from base of horn nearly to apex, not tuberculate at terminus near middle of frons. Frons and vertex largely punctate or granulate, surface smooth mainly in transverse depression approximating junction of frons and vertex. Pronotum (Fig. 61) with laterally compressed horn extending along midline from center to posterior fourth, horn highest posteriorly, slightly less so anteriorly, the edge between arcuately depressed, deepest at anterior third; apical two-thirds of horn punctate. Area posterior and anterior to horn smooth, non-granulate; anterior area shallowly concave, a smooth area on either side of concavity distinctly delimited by lateral setose-granular area extending from near median angle upward to within 1 mm of base of horn. Side of pronotum straight to slightly arcuate anteriorly. Fore tibia with five teeth along outer margin, the seemingly closely related tuberifer and bifurcatus both having six teeth. Genitalia (Fig. 62) very similar to tuberifer.

FEMALES. Not associated.

TYPE MATERIAL: Holotype, male, Brazil, Guaporé, Pôrto Velho, II.1945, A. Parko (Martínez). Paratype, 1 male, same data as holotype (Howden).

REMARKS. In the bifurcatus group females having five teeth on the fore tibia have at least two distinct types of pronotal carinae. Since none of these females were collected near the type locality no attempt was made to associate one of the forms with juanae.

This species is named for Señora Juana de Martínez.

22. Athyreus bellator Westwood

Figures 49-51, Map 6

Athyreus bellator Westwood, 1848, p. 387; 1851, p. 461.

TYPE. Male (Oxford), examined.

MALES. Length 17.0 to 22.0 mm, greatest width 10.5 to 12.0 mm. Dorsally tan to very dark brown, lateral pronotal margins sometimes lighter. Clypeal horn (Fig. 49) moderately inclined anteriorly, carinate near anterior angles; on each side posterior lateral carina extending along length of horn; posterior median carina extending along length of horn and sometimes onto frons. Frons and vertex, except laterally, largely impunctate; vertex shallowly concave. Pronotum (Fig. 49) with slender, upright central horn laterally bifurcate at apex, the bifurcation V-shaped, anterior midline of horn and pronotum shallowly impressed; pronotum medially posterior to horn with cluster of setae. Pronotal margin anteriorly between marginal fossae upwardly arcuate; pronotal surface laterally setose-punctate, punctures closer posteriorly, surface usually impunctate anterior to horn. Fore tibia with five teeth on outer margin. Genitalia (Fig. 50) with prolongation of parameres relatively short, slightly twisted near apices.

FEMALES. Length 20.0 to 22.0 mm, greatest width 11.0 to 12.5 mm. Pronotum (Fig. 51) with central swelling low, the encompassing carinae often obsolete anteriorly; setose granules near anterior angles separated by approximately 3 to 4 diameters, near posterior angles close, separated by approximately one diameter. Sometimes not separable from females of tridens or females in the bifurcatus group.

MATERIAL EXAMINED: 18 males, 8 females.

BRAZIL: No other data (type locality). Amazonas, Maues, H. Zellibor. Pará, Obidos, IX.1955, Martínez; III.1956, I-III.1959, F. Oliveira.

FRENCH GUIANA: Cayenne (=Cayenna, type locality); St. Jean du Maroni, VIII, Moult; St. Laurent du Maroni, V, Moult.

SURINAM: Zanderij, 26.XII.1961, J. Belle.

TRINIDAD: No other data.

Specimens are in: Cambridge, Leiden, London, Oxford, Paris, Washington, Howden, Martínez.

REMARKS. In all males seen including some relatively "minor" forms the pronotal horn is distinctly bifurcate, although the width and degree of bifurcation varies. In small males most of the pronotum is at least sparsely punctate. The sparsely placed anterior pronotal punctures (males) or granules (females) and the closely spaced posterior punctures or granules also seem characteristic but this, at present, is difficult to assess. Some females that we consider to be bellator have been identified as "billbergi Gray" (London), but the latter name could be referred to any female in the bifurcatus group.

23. Athyreus tridens Laporte

Figures 55-57, Map 7

Athyreus tridens Laporte, 1840, p. 102; Klug, 1843, p. 25; Westwood, 1851, p. 457; Boucomont, 1928, p. 207; Martínez, 1953, p. 232.

Athyreus similis Felsche, 1909, p. 760. NEW SYNONYMY.

Athyreus villosus Boucomont, 1902a, p. 184; 1902b, p. 581; 1928, p. 207.

TYPE, tridens. Male (Paris), not examined.
TYPE, similis. Male (Dresden ?), not examined.
TYPE, villosus. Male (Paris), examined.

MALES. Length 16.0 to 22.0 mm; color tan to brown with the center of pronotum sometimes darker. In well developed males clypeal horn (Fig. 55) either vertical or slightly inclined anteriorly; anterior of horn usually lacking distinct carinae; posterior lateral carinae present; sometimes a median, posterior carina present; frons smooth, not punctate or granulate; vertex shallowly concave, setose-punctate posteriorly. Pronotum (Fig. 55) centrally with erect, nearly cylindrical (flattened on anterior surface) horn, apex distinctly tridentate, an acute tooth present on either side anteriorly, and with single, prominent median posterior tooth; pronotal surface anterior and posterior to horn minutely setose-punctate (Brazil) or not setose and impunctate (usual for Argentina, Bolivia, Paraguay); pronotum anteriorly with small median depression midway between horn and margin; lateral pronotal margin slightly sinuate near median angle. Male genitalia as in fig. 56, with apical prolongation of each paramere abruptly bent near apex.

FEMALES. Apparently quite variable and only placed by association with males taken in same general area. Head and pronotum as in fig. 57; pronotum setose-granulate instead of setose-punctate as in males; median swelling feebly V-shaped to distinctly bituberculate; pronotum anteriorly briefly impunctate; carina on either side poorly developed, arcuate to straight posteriorly.

MATERIAL EXAMINED. 11 males, 5 females.

ARGENTINA: Corrientes, Alto Paraná, Isla Apipé Grande, XI.1945, Martínez. Misiones, Concepción, Sta. Maria.

BOLIVIA: Santa Cruz, Ichilo, Buena Vista, Martínez; Pcia. Sara, XI.

BRAZIL: (Type locality). Paraná, Arapoti, XI, Müller. Goiás, Jatahy; Goiás, Monjolinho, Barreto; Goiás, Rio Verde, 7.XI.1945, Zellibor. Minas Gerais, Sertaó de Diamantina, 10.XI.1902, Gounelle. Rio Grande do Norte, Natal, 2.VIII.1950, 28.VIII.1951, Alvarenga.

PARAGUAY: Dept. del Guayrá, Col. Independencia, XII.1950, Martínez. Asunción, San Lorenzo.

Specimens are in: Buenos Aires, Cambridge, Paris, Howden, Martínez.

REMARKS. All males examined had the central pronotal horn at least feebly tridentate. The only closely related species with a tridentate pronotal horn is A. championi. In championi, which is allopatric (Map 7), the color is normally black, the clypeal horn of the males is anteriorly carinate basally and the pronotum is almost entirely punctate, only the anterior face of the horn sometimes impunctate.

24. Athyreus championi Bates

Figures 58-60, Map 7

Athyreus championi Bates, 1887, p. 108; Boucomont, 1928, p. 207; Howden, 1964, p. 14; 1974, p. 567.

TYPE. Male (London), examined.

MALES. Length 17.0 to 20.0 mm; greatest width 10.0 to 11.0 mm. Color dorsally very dark brown to dull black, often with faint purplish tinge. Head (Fig. 58) with erect clypeal horn; anterior edge of horn arising from anterior clypeal margin; horn triangular in shape, sharp in front and near anterior base bifurcating into two carinae; carinae extending to proximate

anterior angles; posterior flattened surface of clypeal horn faintly carinate; basally, on each side of horn, a carina extending to gena. Surface of frons largely impunctate, with only scattered punctures posteriorly and laterally. Vertex nearly flat and setose-punctate. Disc of pronotum (Fig. 58) with conspicuous, central, trifurcate horn; posterior prong of horn much higher than two anterior ones. Surface of pronotum finely setose-punctate, granulate; area anterior to horn sometimes impunctate. Carina on either side of central horn indistinct. Lateral pronotal margin in front of median angle slightly sinuate. Genitalia as in fig. 59.

FEMALES. Length 20.0 to 22.0 mm; greatest width 11.5 to 12.5 mm. Clypeus anteriorly with sharp, arcuately raised, transverse carina; clypeal surface in front of carina largely impunctate. Clypeus posteriorly with tridentate carina, middle tubercle more anteriorly placed than lateral ones, normally more elongated. Pronotum with central, shining, shallowly bifurcate protrusion (Fig. 60); on either side of central protrusion and joining anterior pronotal margin, a distinct carina forming an inverted "U" around median projection; distinct oval impression present medially, just behind anterior margin; midline shallowly, distinctly impressed near posterior margin; on each side posteriorly, between U-shaped carina and posterior lateral pronotal margin, an indistinct, short, slightly elevated carina occupying the same position as in males. Other characters as described for males.

MATERIAL EXAMINED. 8 males, 6 females.

COSTA RICA: Cartago, Monte Redondo, 15.VI.1893; Turrialba, K. Cooper. San José, 1000-1200m., F. Nevermann, at light; San Vito, VI.1967, Robertson.

ECUADOR: Pichincha, Sto. Domingo de los Colorados, I.1976, Venedictoff.

PANAMA: Canal Zone, Barro Colorado Is., VII.1938, C.E. Williams. Chiriquí, Volcán de Chiriquí, 3000-4000 ft., Champion (Type); Mte. Lirio (nr. Sta. Clara), 4000 ft., 5.VI.1977, R. Hartmann; Boquete, 3.IX.1944, G.B. Fairchild.

Specimens are in: Cambridge, Chicago, London, Ottawa, Washington, Howden, Martínez.

REMARKS. Athyreus championi seemingly is allopatric to all other species in the genus, being the only species so far collected in the wet lowland forests of northwest South America and in Panama and Costa Rica. Even if this is incorrect, championi males can be confused only with males of tridens. Characters separating these species are given under tridens, but the nearly black color of championi alone would serve to distinguish it.

25. Athyreus acuticornis n. sp.

Figures 52-54, Map 7

DIAGNOSIS. Males with central pronotal horn vertical, tapering to slender, acute apex; base of horn, at least anteriorly, impunctate; posterior to horn, a shallow depression present, midway between base and pronotal margin, the depression with distinct, closely clustered group of setae. Clypeal horn nearly vertical, with distinct posterior median carina in addition to anterior and lateral carinae. Females difficult to separate from related forms; pronotum as in fig. 54, with the carina beside the median swelling posteriorly sinuate; the lateral margin posterior to median angle arcuate, curving distinctly inward anterior to elytral humerus.

HOLOTYPE. Male, length 23.0 mm, greatest width 13.5 mm. Color reddish brown; sides of pronotum, labrum, anterior and lateral portion of clypeus reddish tan. Labrum with median length of anterior vertical face equal to median horizontal length of dorsal portion of labrum. Clypeus (Fig. 52) with horn vertical, on each side a carina extending from anterior lateral clypeal angle onto anterior face of horn; posterior lateral carina extending on each side from base of horn to tubercle above mandibular insertion; median posterior carina extending from frons almost to vertex of horn. Frons impunctate except sparsely so laterally and on basal portions of horn between carinae. Vertex shallowly concave, median two-thirds impunctate, laterally with scattered setose punctures or granules. Pronotum (Fig. 52) with anterior margin arcuately raised and thickened between fossae, lateral margins anteriorly arcuate until slightly inwardly arcuate immediately anterior to rounded median angle; posteriorly arcuate until distinctly bowed inwardly anterior to humerus. Pronotum centrally with horn vertical, tapering to acutely pointed apex; horn anteriorly flattened and broader than posteriorly, both surfaces with a fine median indentation extending almost to apex; anterior base of horn smooth, remainder of surface setose-granulate, granules separated by two to three diameters. Pronotum laterally with short carina parallel to posterior margin present just anterior to humerus, length of carina approximately equal to that of umbone; lateral fovea with vague carina at anterior margin. Fore tibia with five teeth on outer margin. Genitalia (Fig. 53) with narrow apical prolongation of each paramere unequally bifurcate.

ALLOTYPE. Female, length 23.5 mm, greatest width 13.6 mm. Head (Fig. 54) with anterior transverse clypeal carina relatively evenly arcuate; posterior clypeal carina distinctly trituberculate, the median tubercle larger and carinate posteriorly; frons and vertex setose-granulate, the granules separated by two to three diameters. Pronotum (Fig. 54) centrally with median swelling briefly V-shaped, bituberculate; anterior face of swelling shining, with scattered punctures, not granulate; median swelling on each side with carina extending posteriorly almost to margin, carina slightly sinuate; near posterior margin midline briefly, sharply indented; lateral carinae, foveae, lateral granulate surface, and elytra similar to male.

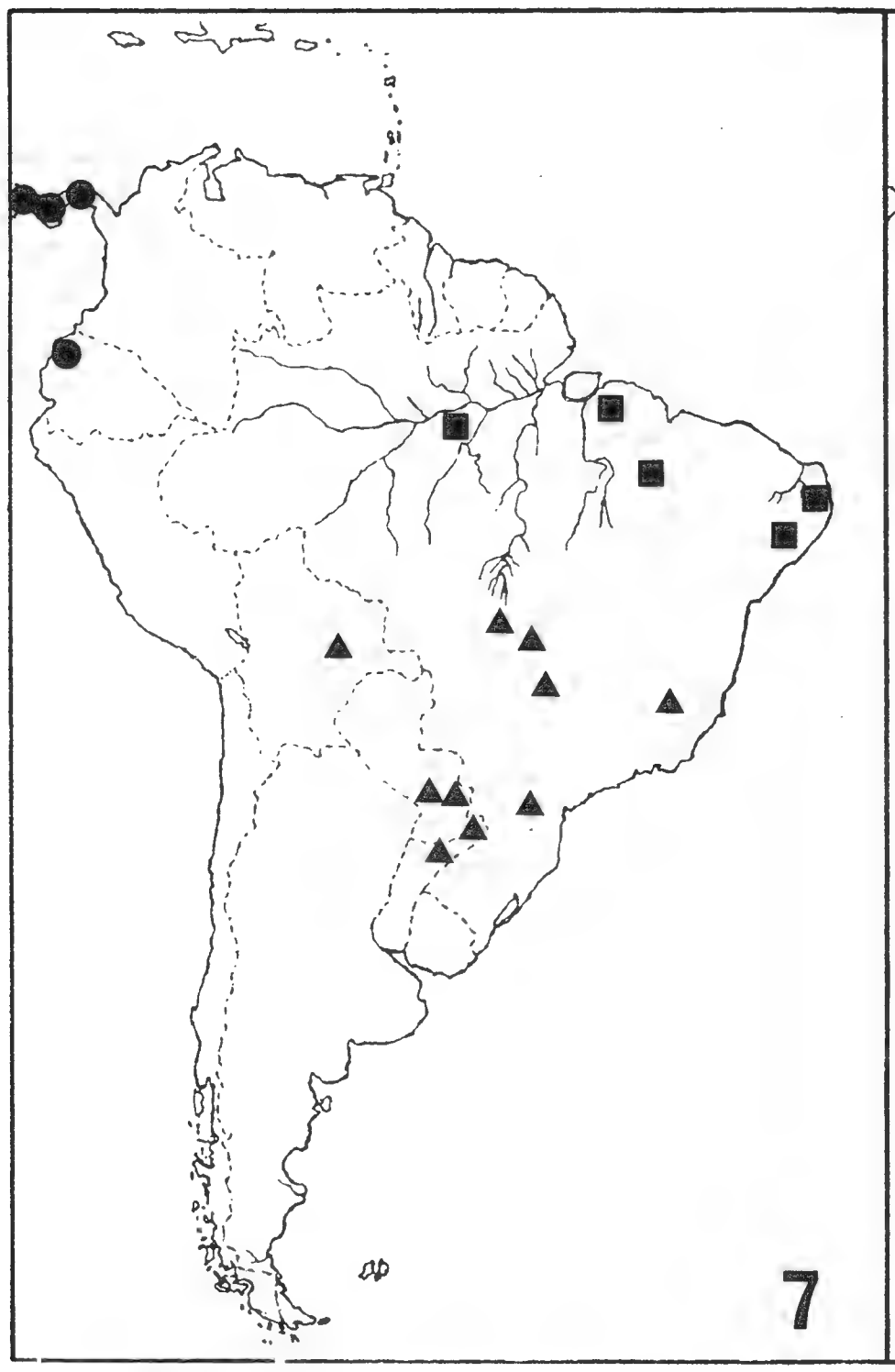
TYPE MATERIAL: Holotype, male, Brazil, Villa Braga, XII, 1919 (Howden). Allotype, female, Brazil, Pernambuco, Taperá, VII.27 (Martínez).

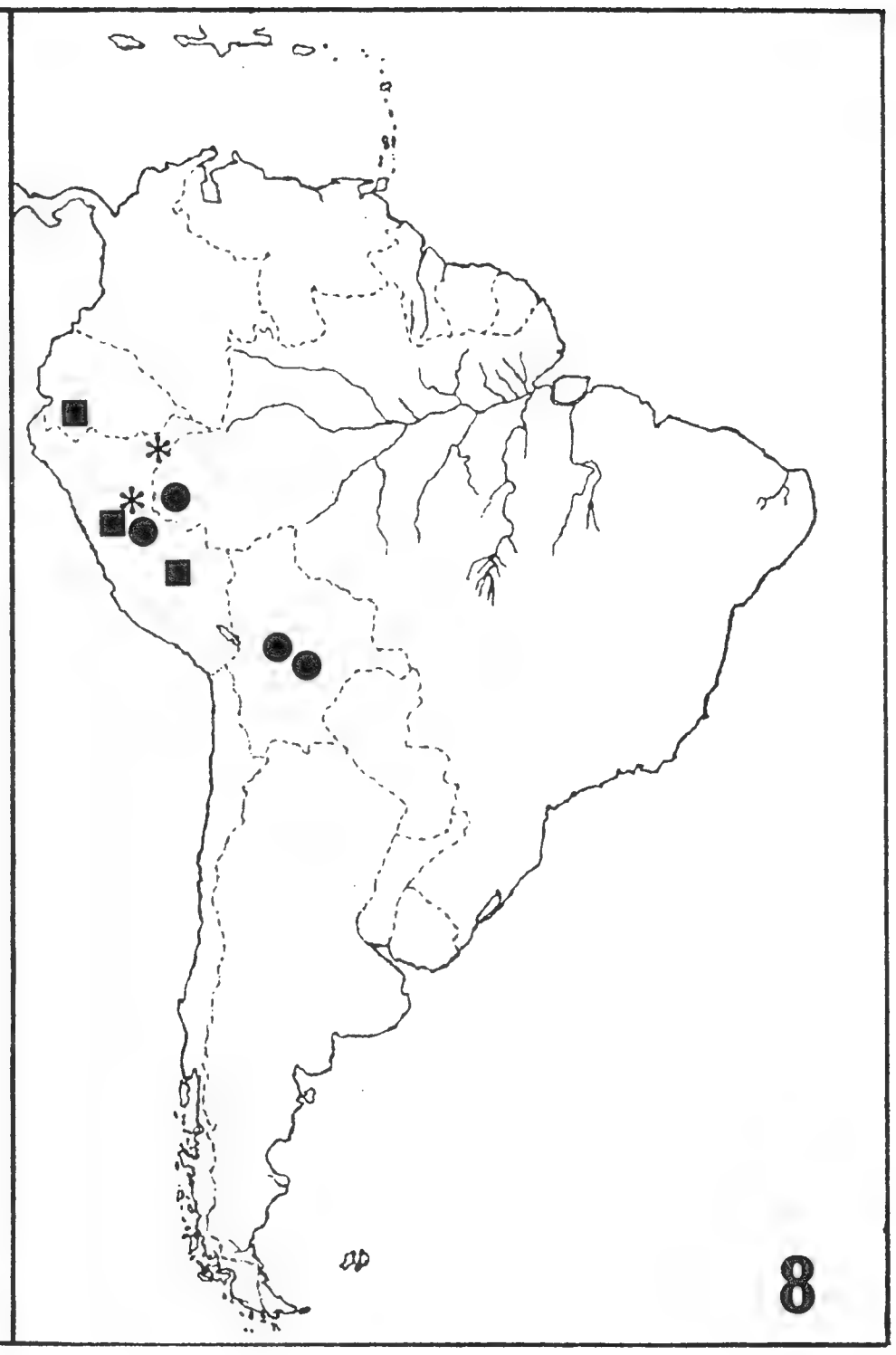
Paratypes; 6 males, 3 females.

BRAZIL: Rio Grande do Norte, Natal, 28.VIII.1951, M. Alvarenga. Maranhão, Barra do Corda, IV.1957, O. Rego. Pará, Belém, XII.1951, Martínez. Paraíba, 4.V.1953, J. Pessoa.

Paratypes are in: Howden, Martínez.

REMARKS. Variation is only moderate when other species in the genus are considered. Size varies from 18 to 24 mm and color varies from specimens similar to the holotype to ones uniformly reddish brown to very dark brown to black. Morphological variation is mainly evident in the development of the male horn and pronotal horn which may be reduced to large acute tubercles approximately 1 to 2 mm high. In large males a small, distinct pit is present on the pronotum approximately midway between horn and anterior pronotal margin. Other characters are quite consistent. The slender, vertical, acutely pointed pronotal horn of the male normally is sufficient for identification.





▲ = 23. tridens Lap.
● = 24. championi Bates
■ = 25. acuticornis n. sp.

* = 26. tribuliformis Fels.
● = 27. zischkai Mart.
■ = 28. martinezi Howd.

26. Athyreus tribuliformis Felsche

Figures 64-66, Map 8

Athyreus tribuliformis Felsche, 1909, p. 760; Howden, 1955, p. 671.

TYPE. Male (Dresden ?), not examined.

MALES. Length 17.0 to 21.0 mm, greatest width 11.0 to 12.0 mm. Dorsally dark reddish brown. Clypeal horn (Fig. 64) nearly vertical, anterior lateral carina on each side extending from anterior clypeal angle to median basal third or half of horn anteriorly; posterior lateral carina on each side extending from apex of horn to junction with gena; posterior median carina absent. Frons and vertex smooth medially, laterally setose-punctate. Pronotum (Fig. 64) anteriorly with a large, deep circular fovea on each side behind eye; fovea and convex area between impunctate, smooth. An upright horn present posterior to each fovea; pronotum posterior to horns flat to convex, median horn lacking; median area near posterior margin smooth, area surrounded by setose-granulate area extending along posterior and lateral margins. Single short pronotal carina present on each side anterior to humeral area. Lateral pronotal margin sinuate near median angle; normally shallow fovea just above median angle small, represented by a single large,

deeply indented, circular puncture. Fore tibia with five or six teeth on outer margin. Genitalia as in fig. 65.

FEMALES. Length 17.0 to 20.0 mm, greatest width 11.0 to 12.0 mm. Head and pronotum (Fig. 66) with all carinae relatively low, not greatly elevated. Pronotum with central swelling low, shining, vaguely V-shaped; encompassed by an arcuate carina on each side extending from anterior nearly to posterior margin; two short carinae present on each side; lateral pronotal fovea above median angle same diameter as anterior marginal fossa, deeply indented. Fore tibia with five teeth on outer margin, a vague sixth tooth sometimes present basally.

MATERIAL EXAMINED: 3 males, 3 females.

PERU: Iquitos, Rio Cachiyacu (type locality); Pucallpa, 250 m., 16.VII.1961, 25.IX.1963, 22.X.1962, J. Schunke L. (some specimens "at light").

Specimens are in: Washington, Hardy, Howden, Martínez.

REMARKS. The upright clypeal horn and the two well separated pronotal horns with the deep fovea anterior to each pronotal horn immediately identify males of tribuliformis. If consistent, the unusually deep circular, small fovea above the lateral median marginal pronotal angle may distinguish females of tribuliformis from those of related species. Also, generally, tribuliformis is slightly smaller in average size than is martinezi, zischkai, and other species in the bifurcatus group.

27. Athyreus zischkai Martínez

Figures 67-69, Map 8

Athyreus zischkai Martínez, 1953, p. 227; Howden, 1955, p. 671.

TYPE. Male (Martínez), examined.

MALES. Length 18.0 to 26.0 mm, greatest width 11.0 to 12.5 mm. Dorsally very dark brown to black, sides of pronotum often brown. Clypeal horn (Fig. 67) nearly vertical, lacking anterior carinae; posterior lateral carina on each side sometimes present (lacking in holotype); posterior median carina absent. Frons entirely or centrally smooth, vertex largely setose-punctate; flat to shallowly concave. Pronotum (Fig. 67) with three horns, one on either side at center of disc behind eye inclined anteriorly and separated by distance equal to distance between eyes; median posterior horn inclined posteriorly, often bent posteriorly, paralleling surface (holotype), sometimes laterally compressed. On each side of horns one (major males) or two (minor males) short carinae present as is normal for genus. Anterior to lateral horns on each side a deep circular or oval fovea separated from opposite fovea by one diameter, area between foveae convex, impunctate; male minors may lack fovea, if so then median surface granulate. Lateral pronotal margin slightly sinuate near median angle. Fore tibia with six teeth on outer margin. Genitalia as in fig. 68, prolongations of parameres evenly curved and narrowed.

FEMALES. Length 20.0 to 27.0 mm, greatest width 11.0 to 13.0 mm. Similar to other females in tribuliformis group but pronotum (Fig. 69) with central swelling often more distinctly elevated and more narrowly divided, sometimes with acute apex. Fore tibia with six teeth (related females usually have five).

MATERIAL EXAMINED: 8 males, 5 females.

BOLIVIA: Cochabamba, Pcia. de Chapare, Villa Gral. Román, 400 m., 18.IX.1952, R. Zischka (type locality). Santa Cruz, Pcia. Sara, Nueva

Moka, XII.1960, Martínez; Reys, X.1921, Mulford Exp.

BRAZIL: Amazonas, Moura, VIII.1943, A. Parko.

PERU: No other data. Chanchamayo, 15.V.1973, J. Schunke L. Loreto, Pucallpa, 6.IV.1973, XI.1969, J. Schunke L.; Loreto, Ucayali Riv., Yarina Cocha, 26.XI.1956, P. Hocking.

Specimens are in: Chicago, Paris, Washington, Howden, Martínez.

REMARKS. The nearly vertical clypeal horn and the three horns on the pronotum will separate males of zischkai from all known species except martinezi. From the latter the more widely spaced foveae and lateral pronotal horns will distinguish males of zischkai. Unworn specimens of zischkai, both male and female, have six teeth on the fore tibia and this normally distinguishes them from the related martinezi.

28. Athyreus martinezi Howden

Figures 70-72, Map 8

Athyreus martinezi Howden, 1955, p. 667.

TYPE. Male (St. Mus. f. Naturkunde, Stuttgart), examined.

MALES. Length 20.0 to 23.0 mm, greatest width 12.0 to 13.0 mm. Chestnut brown to largely black dorsally. Clypeal horn (Fig. 70) vertical, anterior carina on each side extending from anterior-lateral angle of clypeus to center of horn; posterior lateral carina on each side extending down horn and arcuately from base to anterior edge of gena; posterior median carina absent. Frons centrally smooth, remainder of frons and vertex punctate or granulate, setose. Pronotum (Fig. 70) with anterior margin strongly arched, forming small median point. A deep fovea present behind margin on either side of midline, diameter of fovea about 2 mm, interior shining. Foveae separated by less than one fovea diameter. Behind each fovea at summit of pronotum on either side a nearly vertical horn; width between horns less than distance between eyes; posterior to upright horns a median posteriorly inclined, laterally compressed horn projecting over posterior pronotal margin. Two short carinae present on each side laterad to upright horn, the carinae anteriorly divergent, inner carina less conspicuous. Surface of pronotum setose punctate-granulate, each puncture with upright seta, punctures laterally separated by 2 to 3 diameters, medially by 3 to 4 diameters, punctures obsolete in foveae and near apices of horns. Genitalia (Fig. 71) with apical prolongation abruptly bent and widened at middle.

FEMALES. Length 22.0 to 25.0 mm. Very similar to females of tribuliformis differing slightly in shape of central V-shaped swelling in middle of pronotum (Fig. 72). Fore tibia with five teeth (both sexes) on outer margin.

MATERIAL EXAMINED: 3 males, 4 females.

ECUADOR: Loja, Abbé Gaujon.

PERU: No other data (type locality). Junin, Chanchamayo, 1200-1500 m., 4.III.1976, 15.V.1973, 10.XII.1968, J. Schunke L.; Loreto, Pucallpa, 200 m., 22.X.1960, J. Schunke L.

Specimens are in: Paris, Stuttgart, Frey, Howden, Martínez.

REMARKS. The narrowly separated lateral horns and foveae on the male pronotum of martinezi and the five teeth on the fore tibia distinguish it from zischkai. The presence of a posterior median horn immediately separates it from tribuliformis. However, in the case of small males and worn specimens the genitalia should be examined. Females in some cases cannot be identified with certainty, being very similar to other females in the bifurcatus group.

29. Athyreus hastifer Felsche

Figures 73-75, Map 9

Athyreus hastifer Felsche, 1909, p. 759; Bruch, 1914, p. 541.

TYPE. Male (Dresden ?), not examined.

MALES. Length 16.5 to 18.0 mm, greatest width 12.0 to 13.0 mm. Color entirely black with bluish caste (original description) or with entire body generally reddish brown except elytra black, with strong, shiny, steel-like luster. Setae atypical for genus, reddish in color, very dense ventrally, unusually sparse on elytra with single long upright setae arising from scattered strial punctures; entire suture of elytra with dense upright band of reddish setae. Clypeal horn (Fig. 73) strongly inclined anteriorly and upwardly arcuate, wider than long in cross section, shorter in height than length of clypeus, apex rounded; a single lateral carina feebly indicated on each side or obsolete; clypeus posteriorly with trituberculate carina similar to that of females but with tubercles three times as large, median tubercle slightly anterior to lateral ones. Vertex with minute tubercle near anterior third on either side of midline, vertex posterior to tubercles smooth, vertex (laterally and anteriorly) and frons granulate. Pronotum (Fig. 73) with anterior margin only slightly widened medially, anterior angles very broadly rounded, flared obliquely posteriorly so that median angle only slightly posterior to anterior angle; pronotum centrally with anteriorly directed, tapered, laterally compressed horn with acute apex; apex of horn overhanging base of frons; pronotal ridge above large transverse concavity extending 5/6 of distance between lateral margins; concavity with four depressed areas within; one either side of thin, slightly elevated midline, a larger, oval one near each margin; interior of concavity mostly smooth, shining. Pronotum posterior to horn with midline deeply, narrowly impressed, prescutellar region unmodified; pronotum each side with three carinae, anterior one arising either side of midline,then arcuate laterally extending along dorsal posterior edge of concavity, sinuous laterally then flared and anteriorly arcuate at junction with margin; second (middle) carina short, arcuate, anterior to humerus and umbone; posterior marginal carina arising anterior to humerus and terminating laterally at edge of fovea; dorsal surface of horn and surface between carinae granulate, mostly setose. In less well developed males transverse concavity greatly reduced, often forming four feebly concave areas, horn reduced to a large acute tubercle with an anterior branch of anterior carina extending forward on each side, becoming obsolete on transverse line with apex of horn. Fore tibia with five teeth on outer margin. Genitalia as in fig. 74.

FEMALES. Length 16.0 to 17.0 mm, greatest width 11.5 to 12.0 mm. Anterior clypeal carina obtusely angulate, obsoletely tuberculate medially; posterior clypeal carina typically trituberculate; frons and vertex as described for male. Pronotum (Fig. 75) with sides not flared as in male, pronotum similar to male minor except acute central tubercle (horn) replaced by elevated transverse carina that merges on each side with anterior branch of anterior transverse carina; other lateral carinae as described for male; surface between carinae strongly granulate.

MATERIAL EXAMINED: 5 males, 2 females.

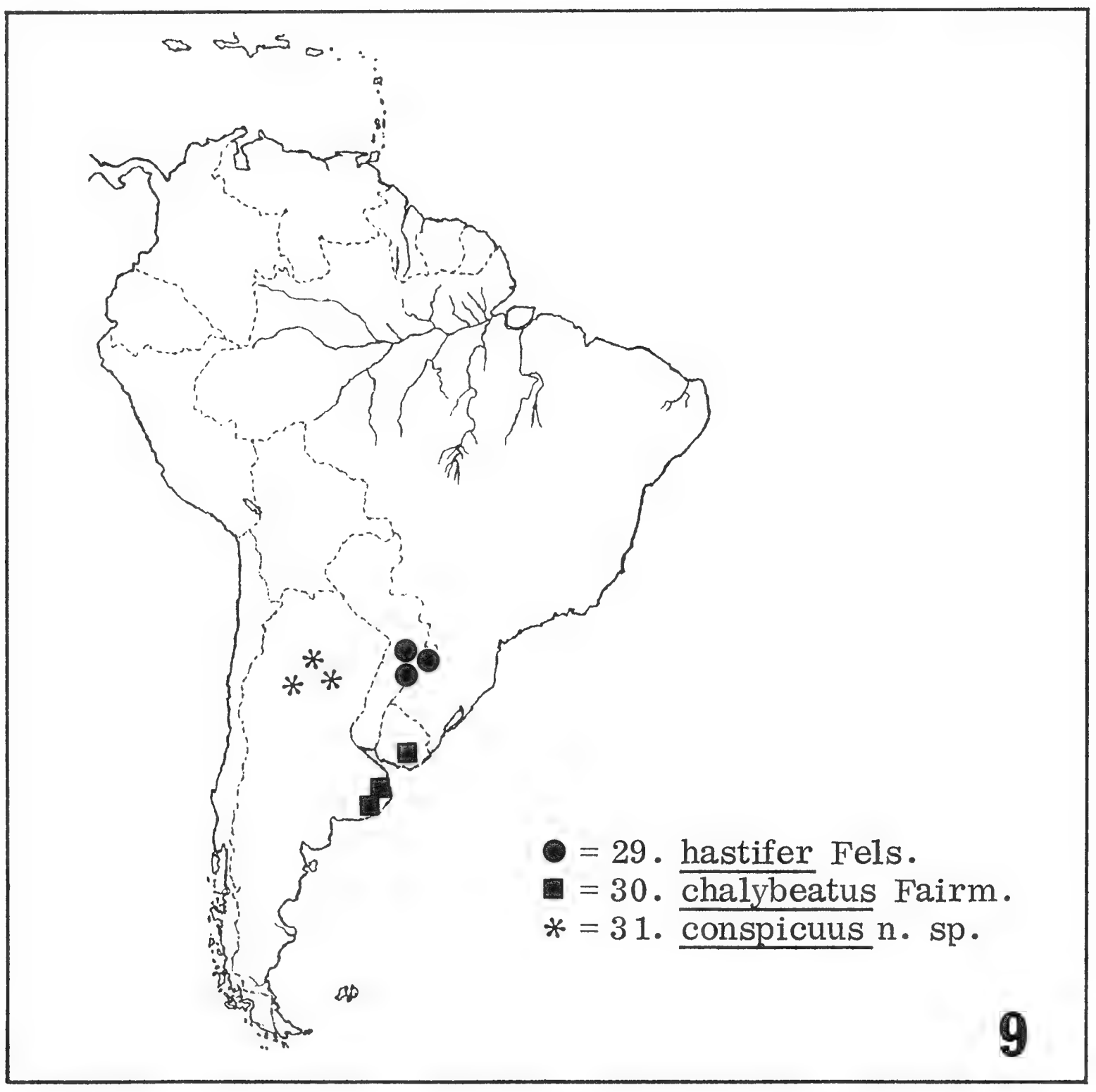
ARGENTINA: Misionés, Loreto, I.1955, F.H. Walz ; Misionés, Pindapoy, XI.1945, Martínez ; Misionés, San Pedro, I.1956; Misionés,no other data, Bonpland.

PARAGUAY: Itapúa, Cantera, 20 m NE Encarnación, XI.1956.

BRAZIL: Rio Grande do Sul, Pôrto Allegro (Type locality from Felsche).

Specimens are in: Buenos Aires, Dresden (?), Ottawa, Howden, Martínez.

REMARKS. The dense band of long setae along the elytral suture will separate hastifer from all other species of Athyreus except chalybeatus which has a somewhat similar line of setae. Size, color, and the presence of only five teeth on the fore tibia will separate hastifer from chalybeatus; the distributional patterns are also different.



30. Athyreus chalybeatus Fairmaire

Figures 76-78, Map 9

Athyreus chalybeatus Fairmaire, 1892, p. 242; Bruch, 1928, p. 1.

TYPE. Female (Paris), examined.

MALES. Length 15.5 to 17.0 mm, greatest width 9.0 to 10.5 mm. Dorsally black with faint aeneous or greenish blue luster; ventral setae and those in elytral suture conspicuous, very dense, yellowish white to tan (in specimens not collected in fluid). Clypeus (Fig. 76) of male majors with short stout horn; anteriorly with lateral carina each side extending to base of horn but not to clypeal margin; other carinae absent, posterior base of horn with distinct contiguous tubercle; laterally above antennal insertion lateral carina obtusely angled. Frons and vertex mostly granulate, vertex anteriorly with minute tubercle on each side of feebly depressed, smooth midline. Pronotum (Fig. 76) with anterior margin between small fossae slightly thickened

but not elevated or tuberculate; anterior angles obtusely rounded; lateral and posterior margins sinuate. Pronotum centrally with acute, anteriorly directed, laterally compressed horn; contiguous to horn on each side in male majors a deep, oblique, oval concavity, interior of each concavity smooth and polished. Posterior to concavity on each side three carinae present nearly paralleling posterior margin. Anterior of three carinae extending from side of deeply indented midline posterior to horn then above (posterior to) concavity becoming obsolete and sinuous anterior to shining, shallow lateral fovea, then distinct, raised abruptly, arcuate anteriorly to overhang, then join lateral margin; second (middle) of three carinae short, feebly arcuate, anterior to humerus in position; third (posterior) carina close to and parallel with posterior pronotal margin, extending from just below humerus to 0.5 mm from lateral margin. Surface of pronotum, except for smooth indentation, concavities and carinae granulate, inconspicuously setose. Elytral intervals shining, striae punctate. Fore tibia with six teeth on outer margin. Genitalia as in fig. 77.

FEMALES. Length 16.0 to 17.0 mm, greatest width 11.0 to 11.5 mm. Anterior face of clypeus delimited dorsally by obtusely triangular carina, feebly tuberculate medially, a longitudinal carina extending posteriorly to strongly developed median tubercle of posterior clypeal carina; frons and vertex as described for males. Pronotum (Fig. 78) laterally similar to males, differing centrally; at anterior third a strongly raised transverse carina extending a distance equal to width of vertex, terminus on each side with carina extending both anteriorly and posteriorly; anterior branch becoming obsolete in 0.5 mm, posterior branch merging with most anterior of the three oblique carinae (as described in males). Midline posterior to transverse carina narrowly, distinctly indented, surface on each side rising to carina. Pronotal surface granulate except for midline, particularly anterior to transverse carina, and near lateral foveae.

MATERIAL EXAMINED: 5 males, 4 females.

ARGENTINA: "Plata orientale" (type locality); Buenos Aires, General Madariaga, San Clemente del Tuyú, XII.1952, II.1957, Kormilev; Buenos Aires, General Lavalle, Punta Norte, I.1936; Buenos Aires, Playa Juancho.

URUGUAY: Montevideo, XII.1946, Ruffinelli, Malvin.

Specimens are in: Buenos Aires, Paris, Howden, Martínez.

REMARKS. The black dorsal color, with faint greenish blue luster and tan ventral surface, odd clypeal armatures of males and females (see description), unmodified anterior pronotal margin and three lateral carinae on each side of pronotum should serve to identify chalybeatus. Male minors lack the deep pronotal concavities and central horn but the characters mentioned as useful for identification seem reasonably consistent.

31. Athyreus conspicuus n. sp.

Figure 63, Map 9

DIAGNOSIS. Color reddish brown to brown. Clypeal characters similar to those of hastifer. Pronotum on each side with four oblique carinae either reaching or extending toward lateral or anterior margins; female (males not known) with cordiform concavity in center of pronotum sharply delimited by surrounding carina, midline of concavity with one anterior and one posterior fossa or small deep fovea; posterior transverse carina of pronotum almost straight; extremely close to posterior pronotal margin from humeral area to midline, this constricted area with distinct, erect band of setae.

HOLOTYPE. Female, length 16.0 mm, greatest width 10.5 mm.

Color reddish brown with carinae on head, central pronotal carinae, margins of mandibles and parts of legs brownish black. Clypeus with anterior carina obtusely angulate, the median angulation with posterior longitudinal carina extending to median tubercle on posterior transverse clypeal carina; posterior clypeal carina nearly straight, trituberculate, central tubercle slightly more elevated. Vertex anteriorly with a short, fine arcuate carina on each side of midline; carina laterally anteriorly arcuate, becoming obsolete near lateral margin. Dorsal surface of clypeus, frons and lateral portion of vertex closely, often confluently punctate. Pronotum (Fig. 63) with anterior margin unmodified, lateral margin angulate at middle where joined by an oblique carina. Pronotum centrally from anterior fourth or third to posterior margin with large cordiform depression, deepest anteriorly, at bottom of depression anteriorly a small deep fossa or fovea, midline faintly impressed posteriorly, extending to second fossa at posterior edge of depression just anterior to carina adjacent to posterior margin; depression widest anteriorly, elevated and subdenticulate on anterior carinate margin on either side of midline, carina then posteriorly arcuate to obtuse, inwardly directed angles on either side near middle of depression, then converging to fuse just behind posterior fossa. Four carinae present on either side of cordiform carina, anteriorly a short carina arising from edge of cordiform carina and extending half distance to anterior margin; second carina arising from just behind obtuse angulation of cordiform carina and extending to and joining lateral margin midway between anterior and median angles, carina sinuous in lateral half, obtusely angled at junction with margin; third carina (adjacent to posterior carina) relatively short, feebly arcuate, relative position anterior to humeral umbone; fourth or posterior carina long and atypically nearly straight, extending from posterior midline to faint lateral fovea near lateral margin; area between carina and posterior pronotal margin and anterior to base of elytron with dense band of erect setae. Surface of pronotum except for carina punctate (in central depression) or granulate, setose. Each elytron with six very convex intervals between suture and umbone. Fore tibia with five teeth on outer margin.

MALE. Unknown.

TYPE MATERIAL: Holotype, female, Argentina, Santiago del Estero, Río Salado, Icaño (Martínez).

Paratypes: 5 females.

ARGENTINA: one, same data as holotype; Santiago del Estero, Añatuya, I.1944. La Rioja, Iliar. Tucumán.

Paratypes are in: Buenos Aires, Tucumán (Instituto Miguel Lillo), Howden, Martínez.

REMARKS. Structural variation occurs primarily in the degree of development of the fine carinae and denticles on the frons and vertex, which in one case is large, arcuate and extends to the margin at the mandibular insertion. Some minor variation occurs in the pronotal carinae,and size varies from 12.5 to 16.0 mm in length.

The reddish brown color, lack of a dense band of long, upright setae along the elytral suture, and the deep central depression of the pronotum will identify female conspicuus. The species is undoubtedly related to hastifer and chalybeatus and males will probably show similar sexual modifications.

Incertae sedis

(Species known only from females not associated with males.)

Athyreus billbergi Gray, 1832, p. 508; Westwood, 1851, p. 462.

Athyreus subarmatus Westwood, 1848, p. 386; 1851, p. 460.

Athyreus vicinus Laporte, 1840, p. 102.

List of species, many described in Athyreus, assigned to Neoathyreus Howden and Martinez, 1963.

(In this and the following genus the numerous new combinations are marked by an asterisk (*) preceding the species name.)

*angulatus (Klug), 1843.

*anthracinus (Klug), 1843.

*arribalzagai (Martínez), 1951.

*biceps (Felsche), 1909.

*bicolor (Laporte), 1840.

*bidentatus (Macleay), 1819.

*castaneus (Guerin), 1829.

*catharinae (Bates), 1887.

*centralis (Westwood), 1848.

*centromaculatus (Felsche), 1909.

*corinthius (Klug), 1843.

*corniculatus (Felsche), 1909.

*excavatus (Laporte), 1840.

fissicornis (Harold), 1880.

*flavithorax (L.-Arribalzaga), 1880.

*fossulatus (Westwood), 1851.

*fulvescens (Blanchard), 1837.

*goyasensis (Boucomont), 1902.

granulicollis Howden, 1964.

hamifer (Boucomont), 1902.

interruptus Howden, 1964.

lanei (Martínez), 1952.

*latecavatus (Boucomont), 1902.

mexicanus (Klug), 1845.

mixtus Howden, 1964.

panamensis (Robinson), 1946.

*pholas (Westwood), 1848.
planatus Howden, 1964.
*purpureipennis (Westwood), 1848.
quadridentatus Howden, 1964.
*reichei (Westwood), 1851.
*sexdentatus (Laporte), 1840.
tridentatus (Macleay), 1819.
tridenticeps (Bates), 1887.
*tweedianus (Westwood), 1848.
*violaceus (Klug), 1843.
*viridis (Boucomont), 1902.
*vulpinus (Harold), 1880.

List of species originally described in Athyreus, here assigned to Parathyreus Howden and Martinez, 1963.

*bahiae (Arrow), 1913.
*fissicollis (Arrow), 1913.
trituberculatus (Klug), 1843.

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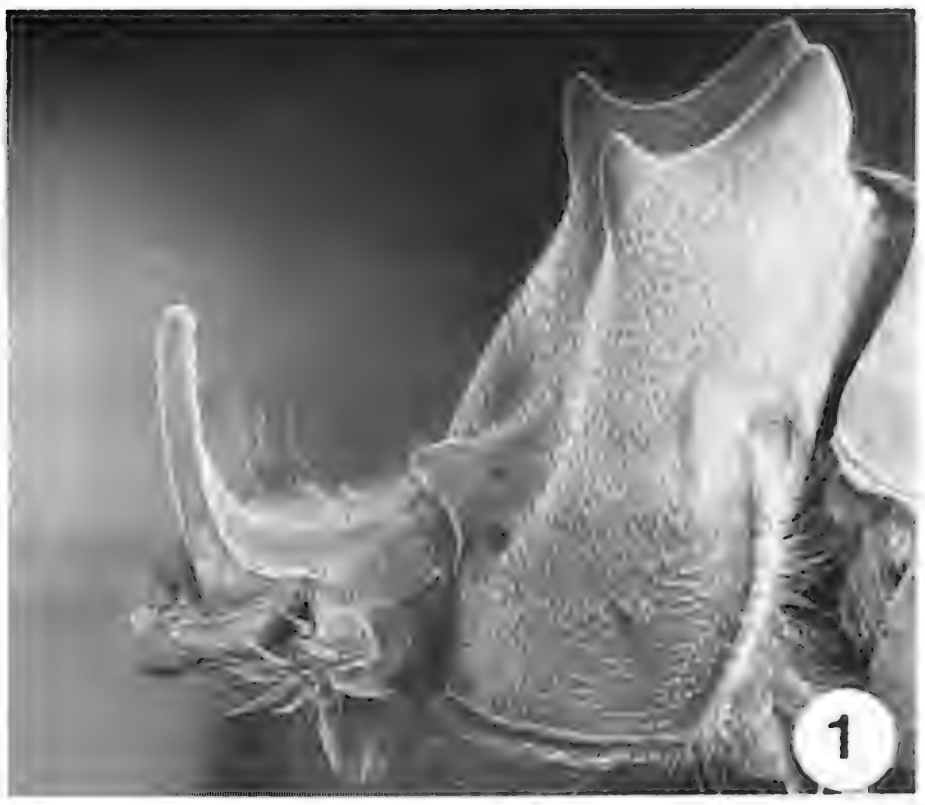
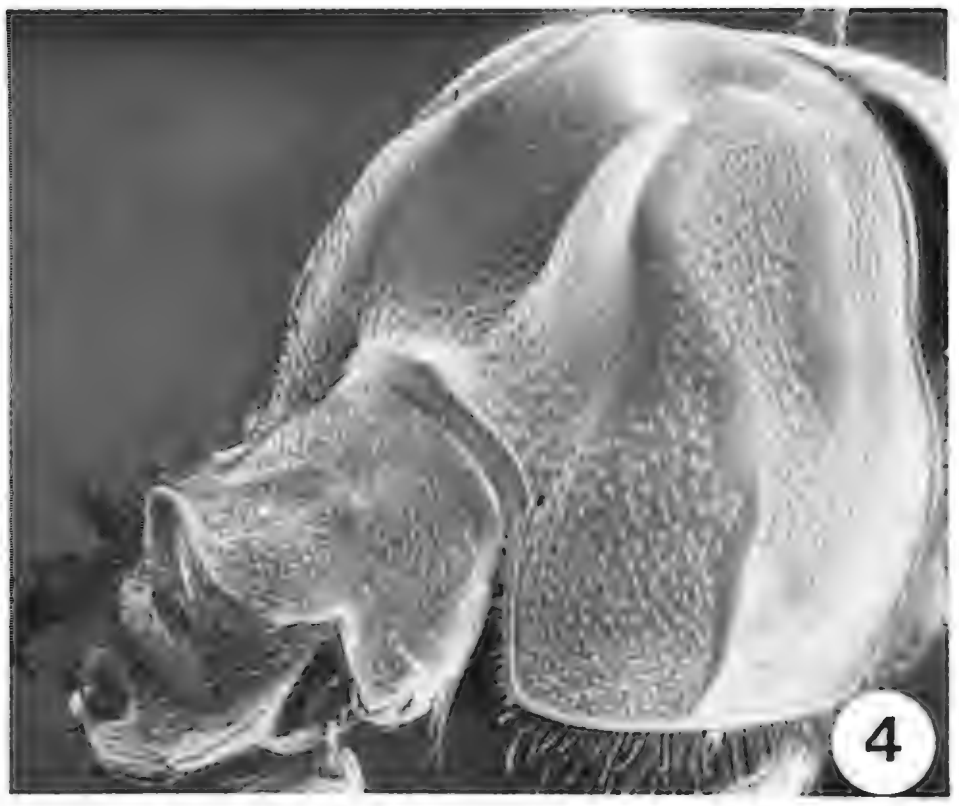
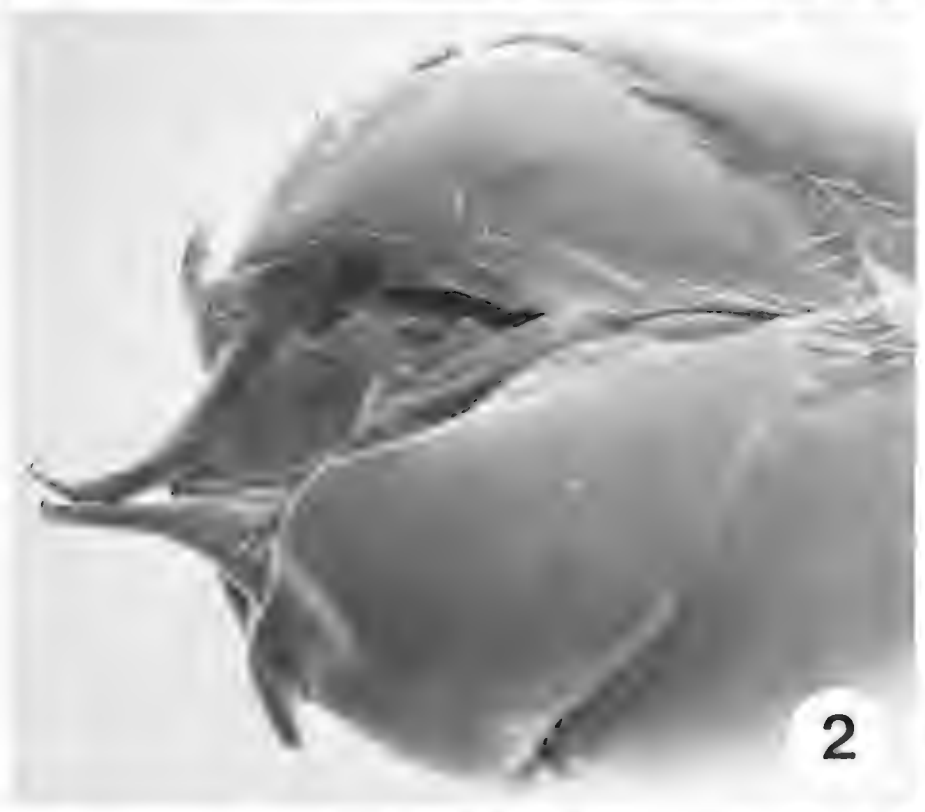
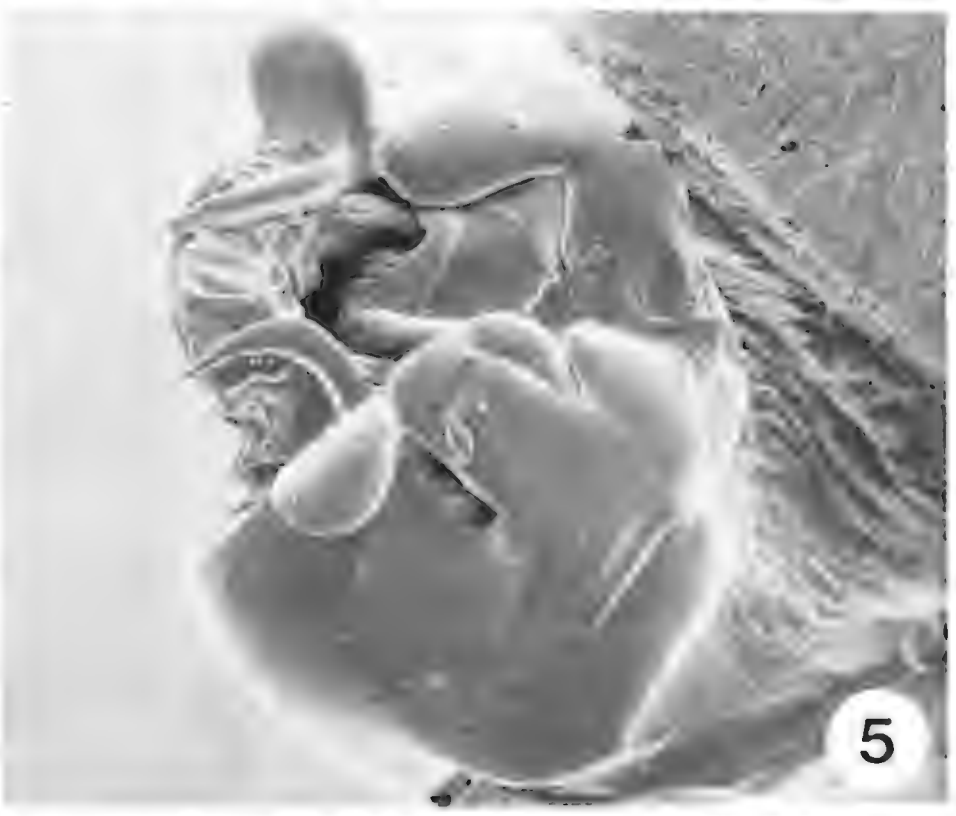
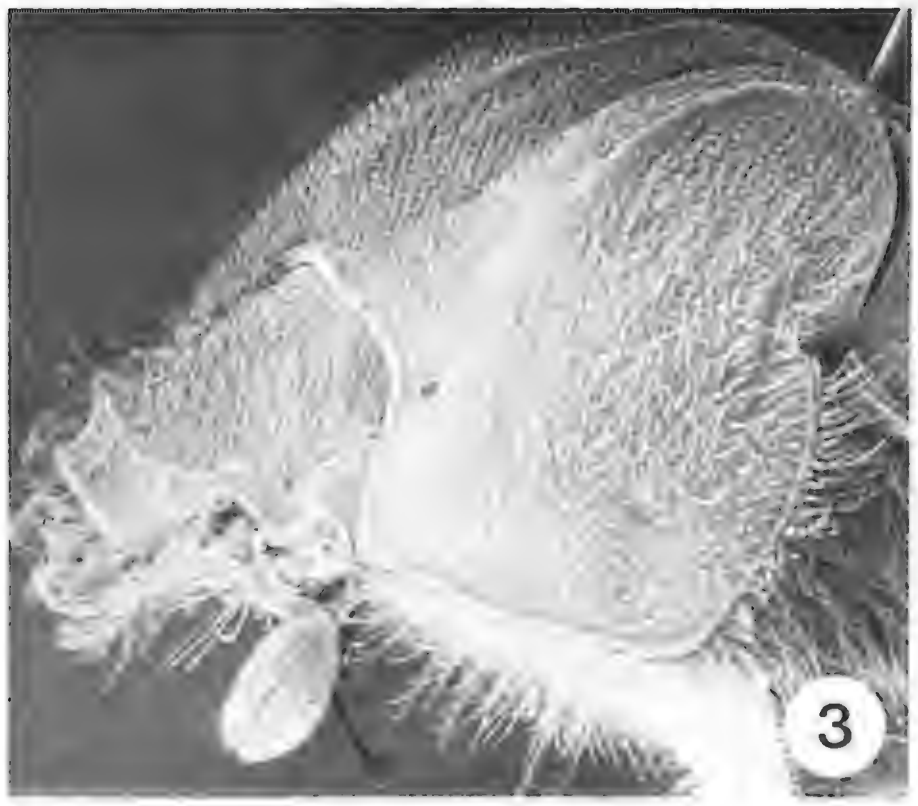




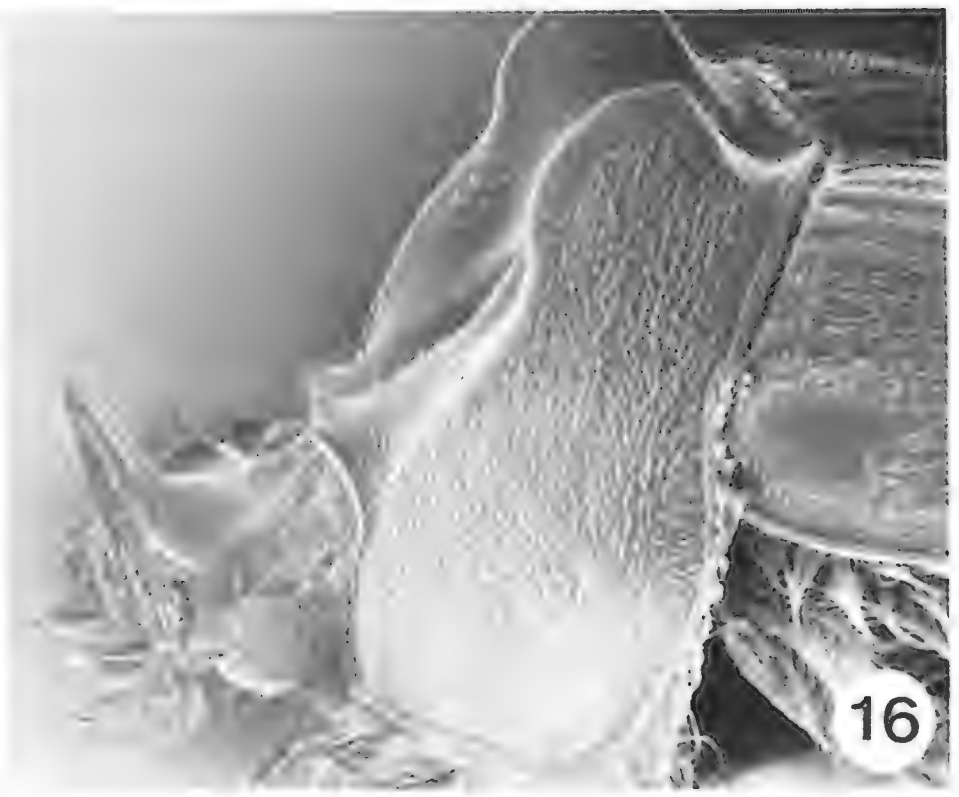


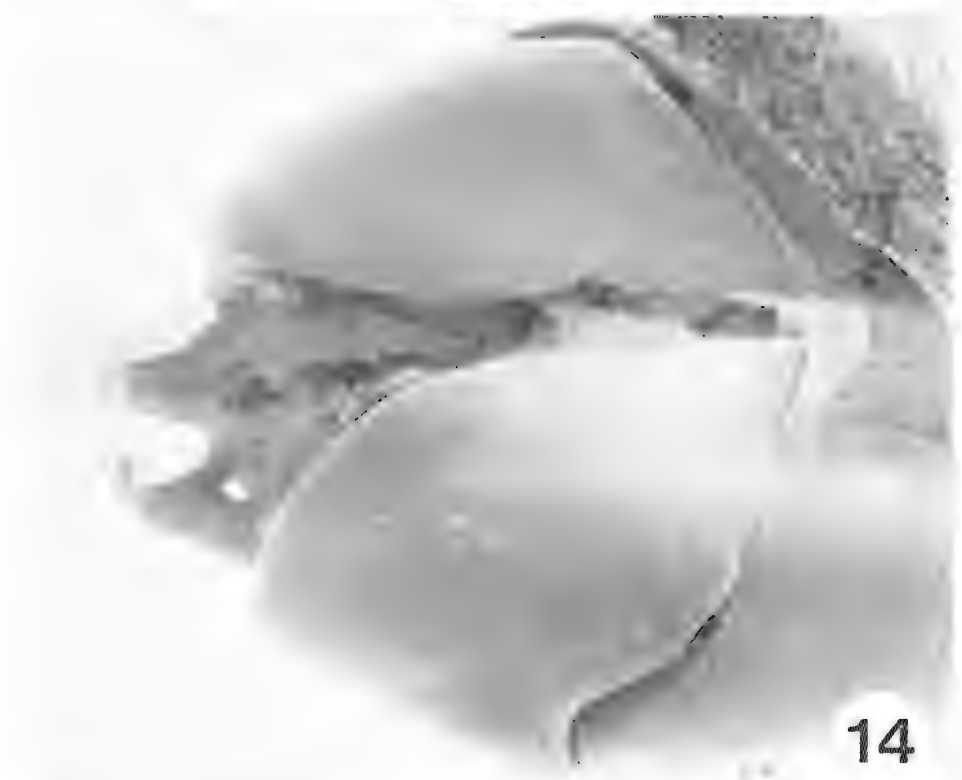


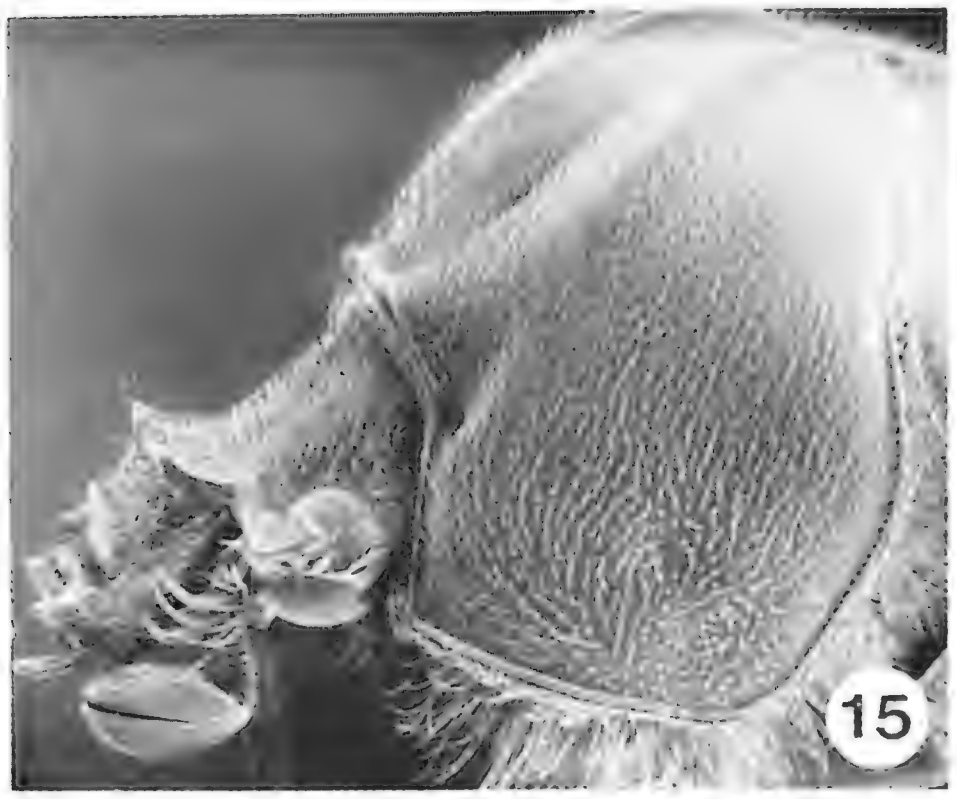


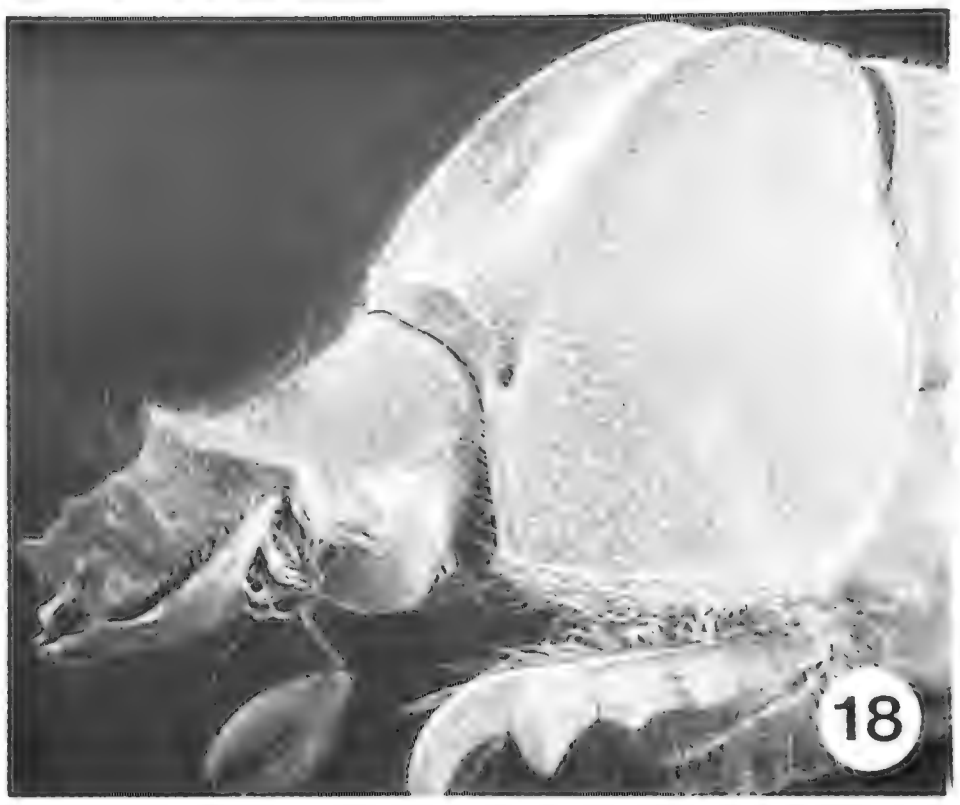
Figs. 1-3. Athyreus cyanescens Klug. 1. Male, head and pronotum; 2. Male genitalia, dorsal view; 3. Female, head and pronotum. Figs. 4-6. Athyreus capricornis n. sp. 4. Male, head and pronotum; 5. Male genitalia, ventral view; 6. Female, head and pronotum.

Figs. 7-9. Athyreus aeneus Klug. 7. Male, head and pronotum; 8. Male genitalia, dorsal view; 9. Female, head and pronotum. Figs. 10-12. Athyreus vavini Boucomont. 10. Male, head and pronotum; 11. Male genitalia, dorsal view; 12. Female, head and pronotum.

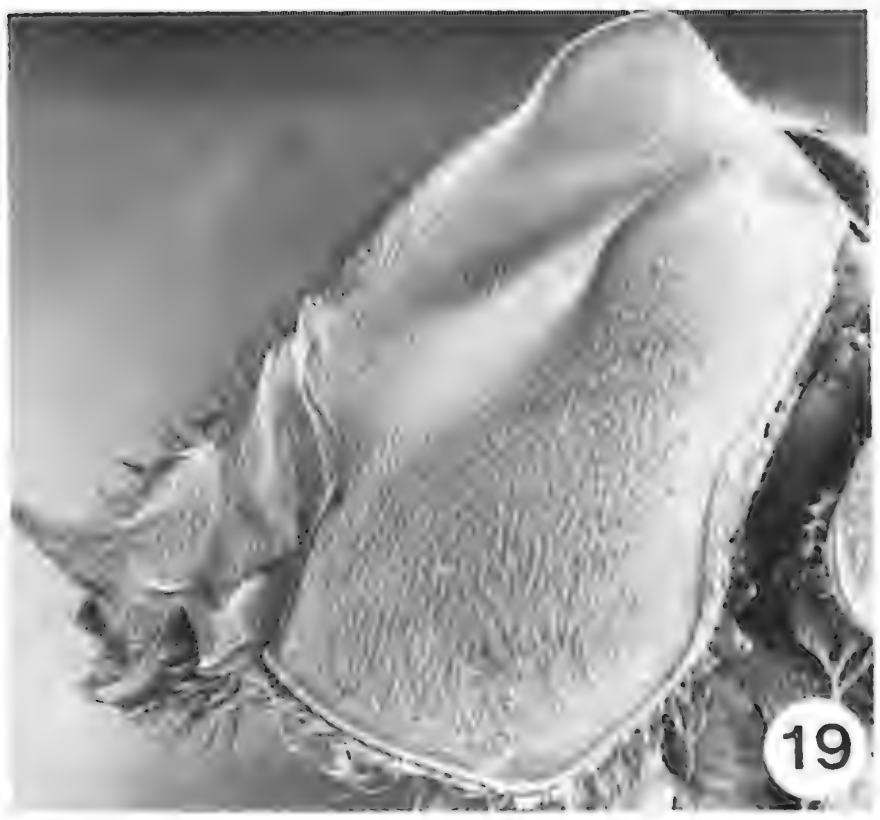


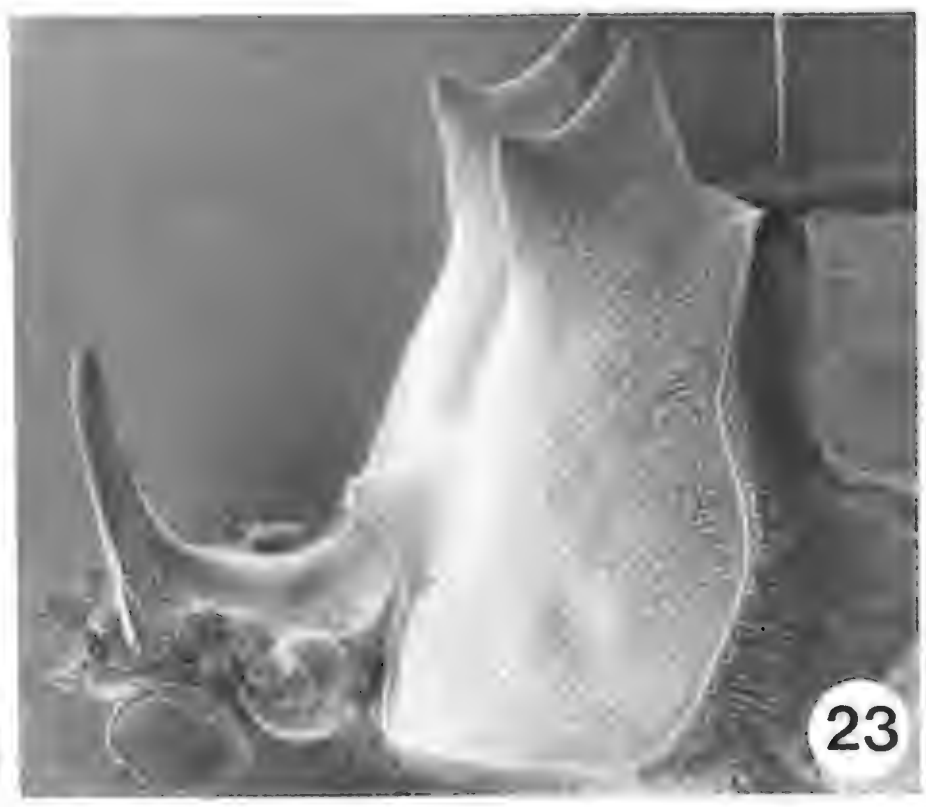




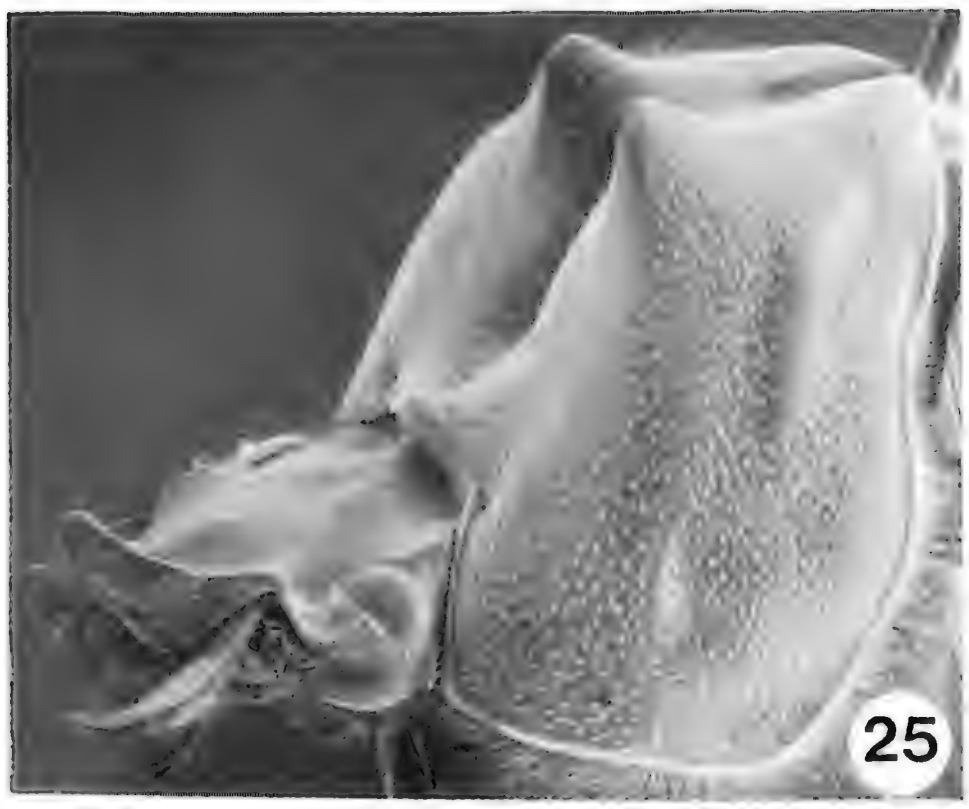


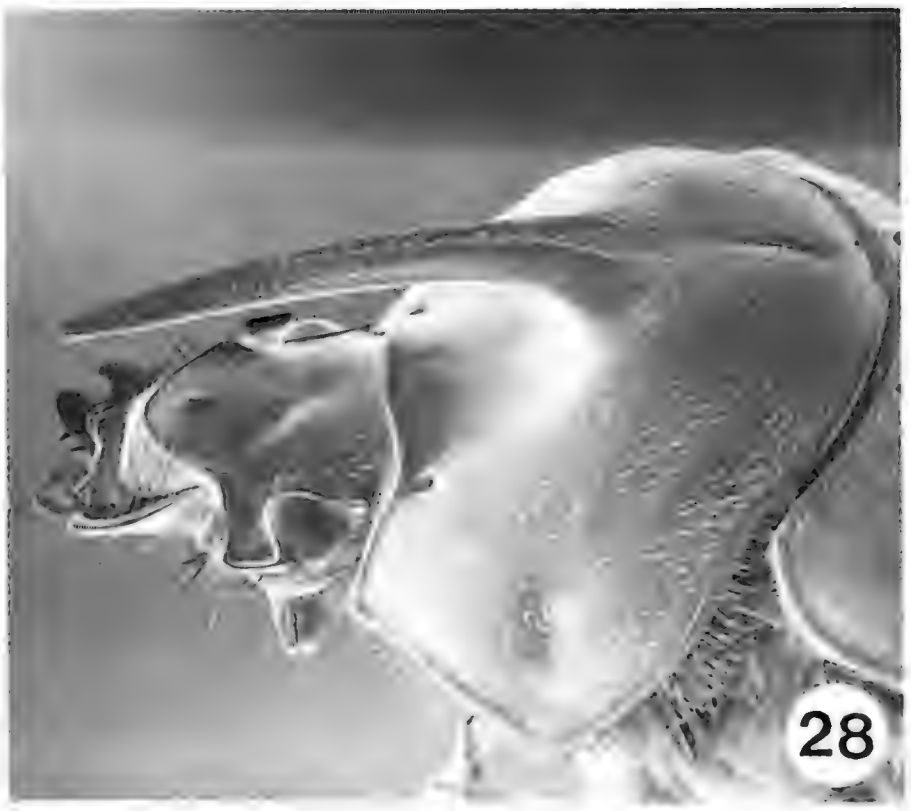
Figs. 13-15. Athyreus hypocritus n. sp. 13. Male, head and pronotum; 14. Male genitalia, dorsal view; 15. Female, head and pronotum.
Figs. 16-18. Athyreus bilobus n. sp. 16. Male, head and pronotum; 17. Male genitalia, dorsal view; 18. Female, head and pronotum.

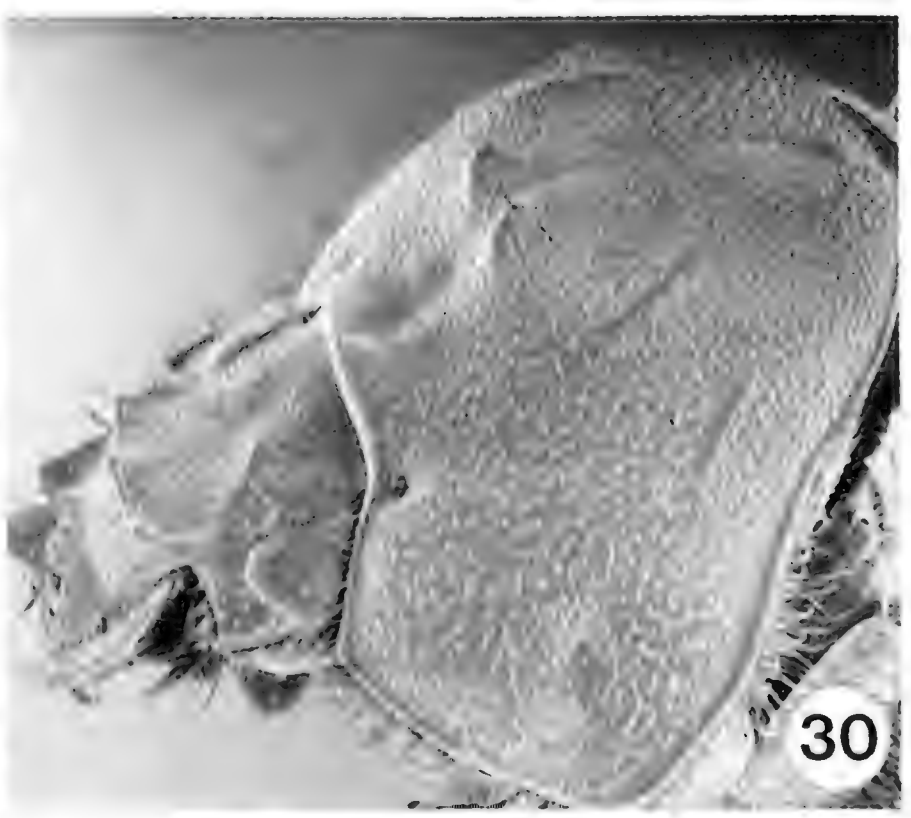




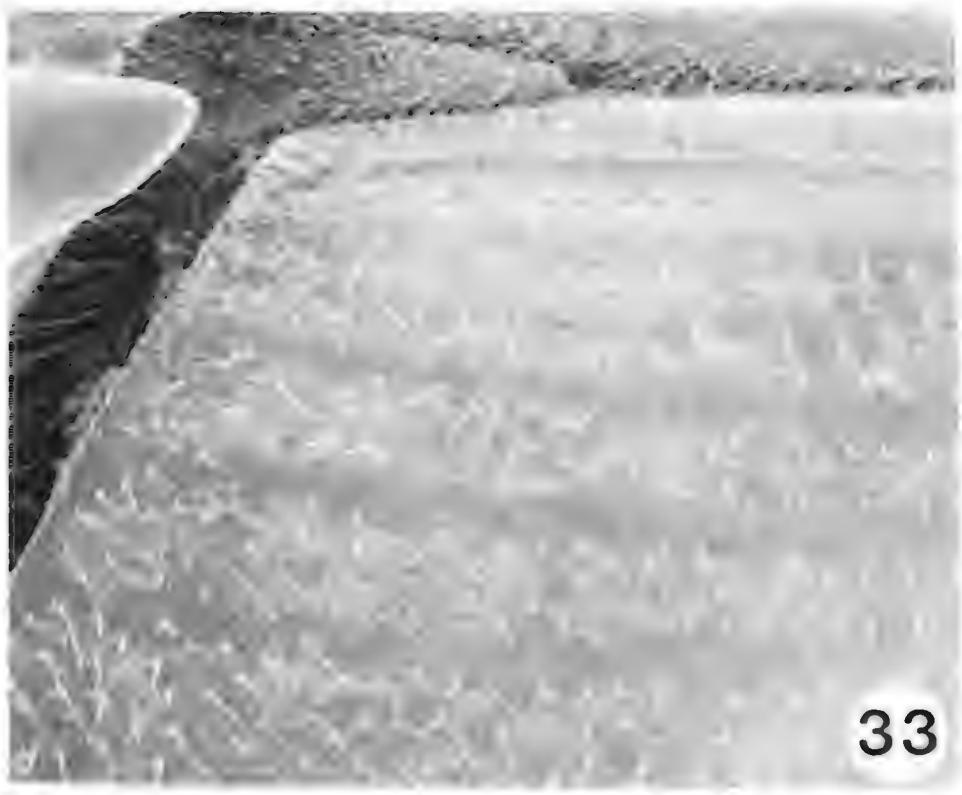
Figs. 19, 20. Athyreus brasilicus n. sp. 19. Male, head and pronotum; 20. Male genitalia, ventral view. Figs. 21, 22. Athyreus nitidus n. sp. 21. Male, head and pronotum; 22. Male genitalia, oblique ventral view. Figs. 23, 24. Athyreus anneae n. sp. 23. Male, head and pronotum; 24. Male genitalia, dorsal view.

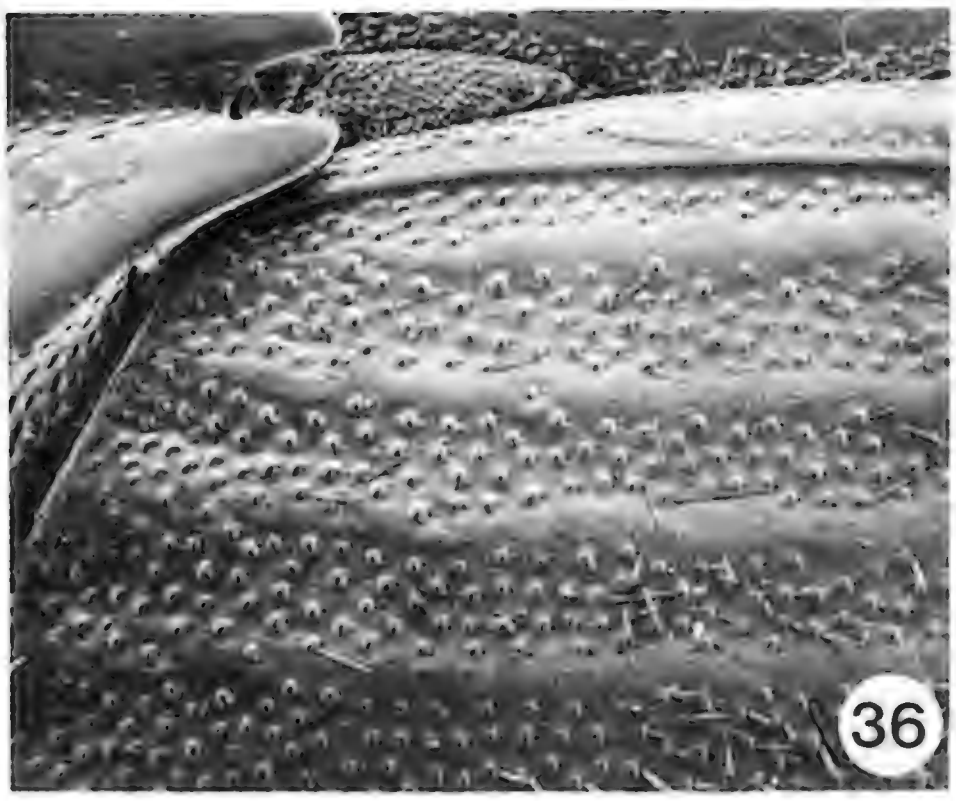




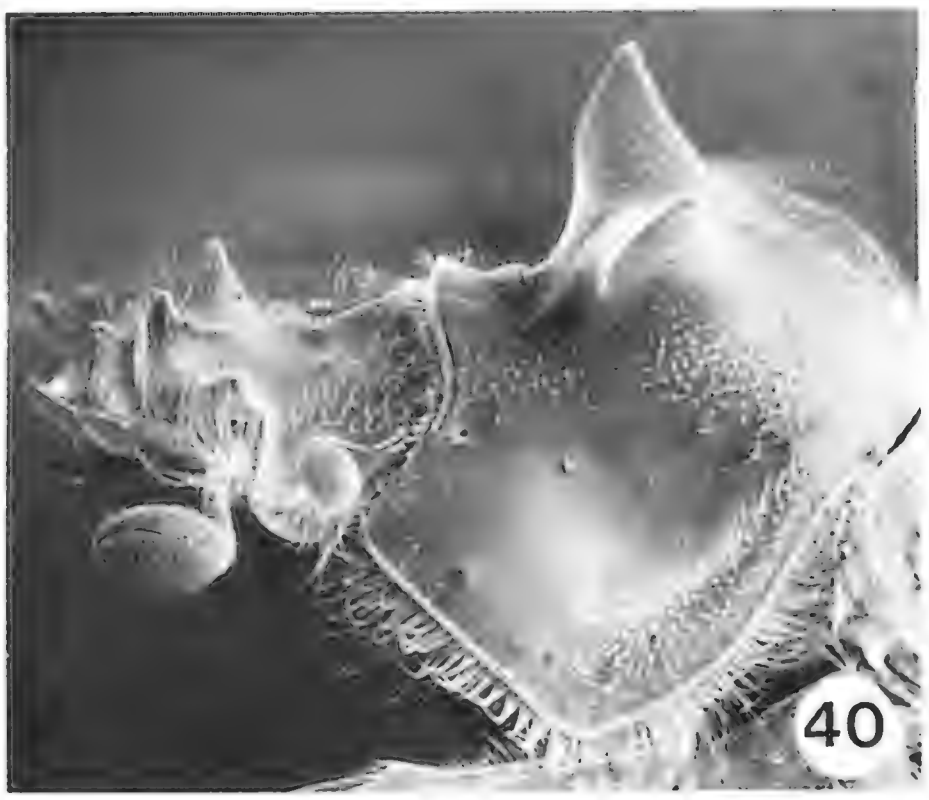


Figs. 25-27. Athyreus hemisphaericus Boucomont. 25. Male, head and pronotum; 26. Male genitalia, dorsal view; 27. Female, head and pronotum. Figs. 28-30. Athyreus unicornis n. sp. 28. Male, head and pronotum; 29. Male genitalia, dorsal view; 30. Female, head and pronotum.

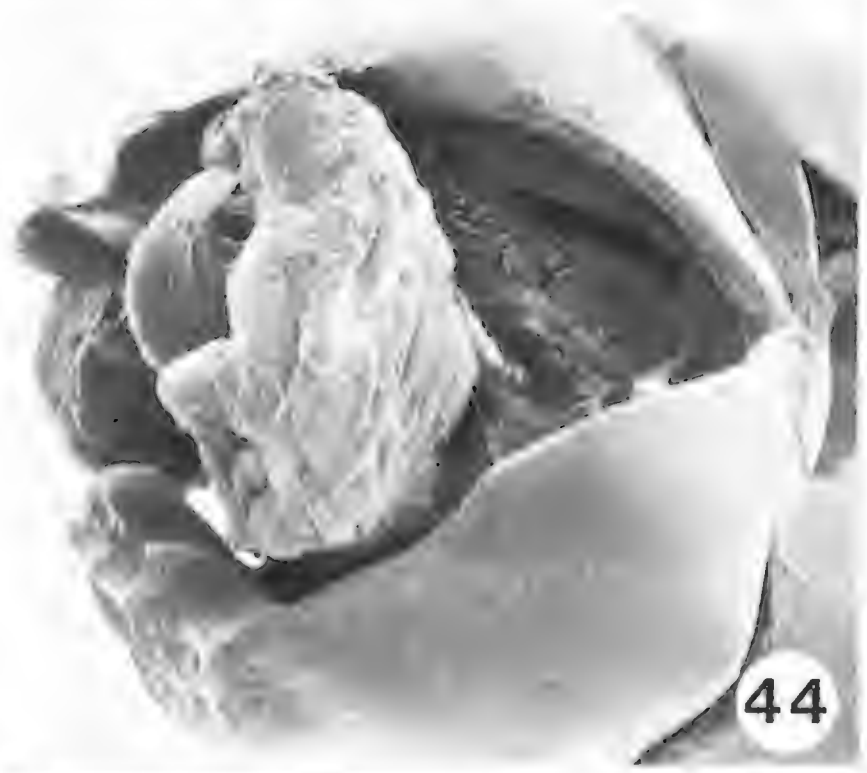


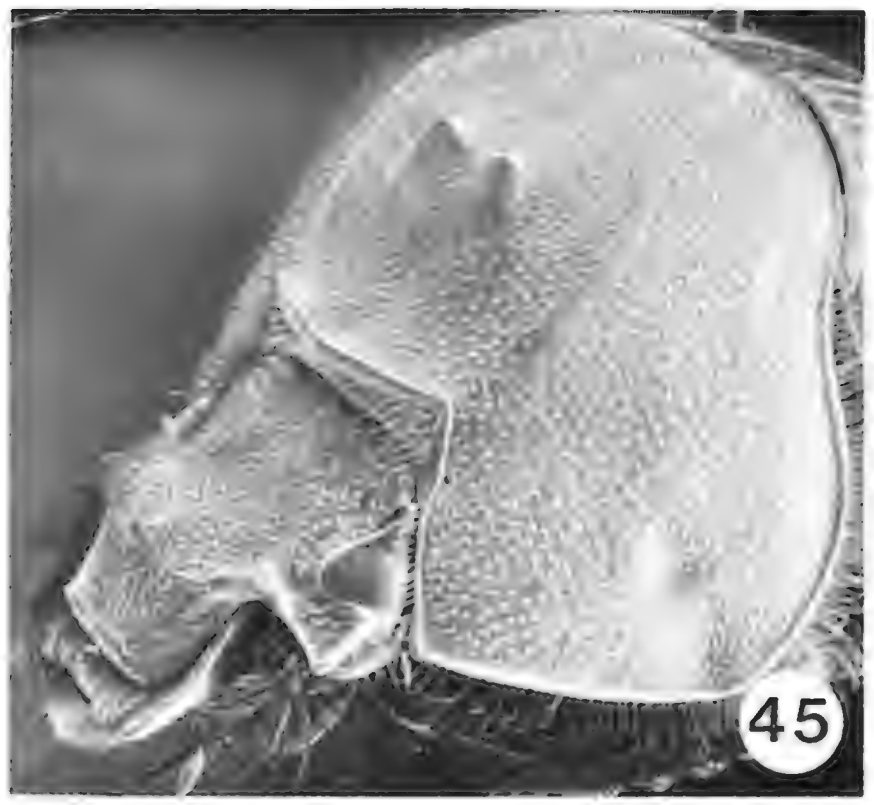


Figs. 31-33. Athyreus forcipatus Boucomont. 31. Male, head and pronotum; 32. Male genitalia, dorsal view; 33. Left elytron, inner basal portion showing striae and intervals. Figs. 34-36. Athyreus alvarengai n. sp. 34. Male, head and pronotum; 35. Male genitalia, dorsal view; 36. Left elytron, inner basal portion showing striae and intervals.

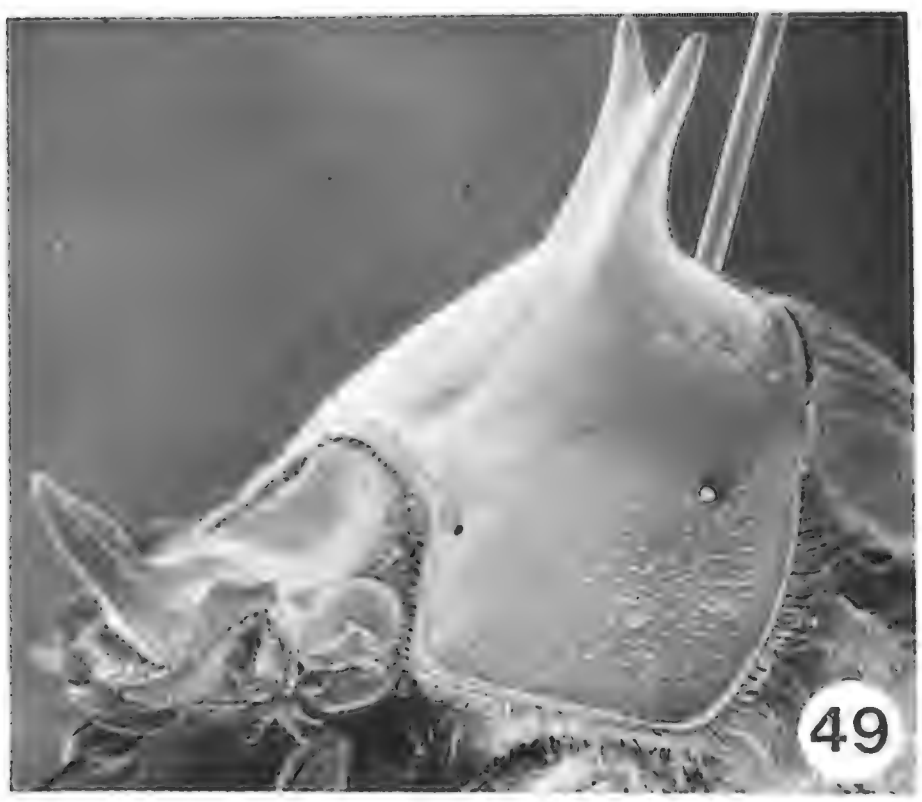


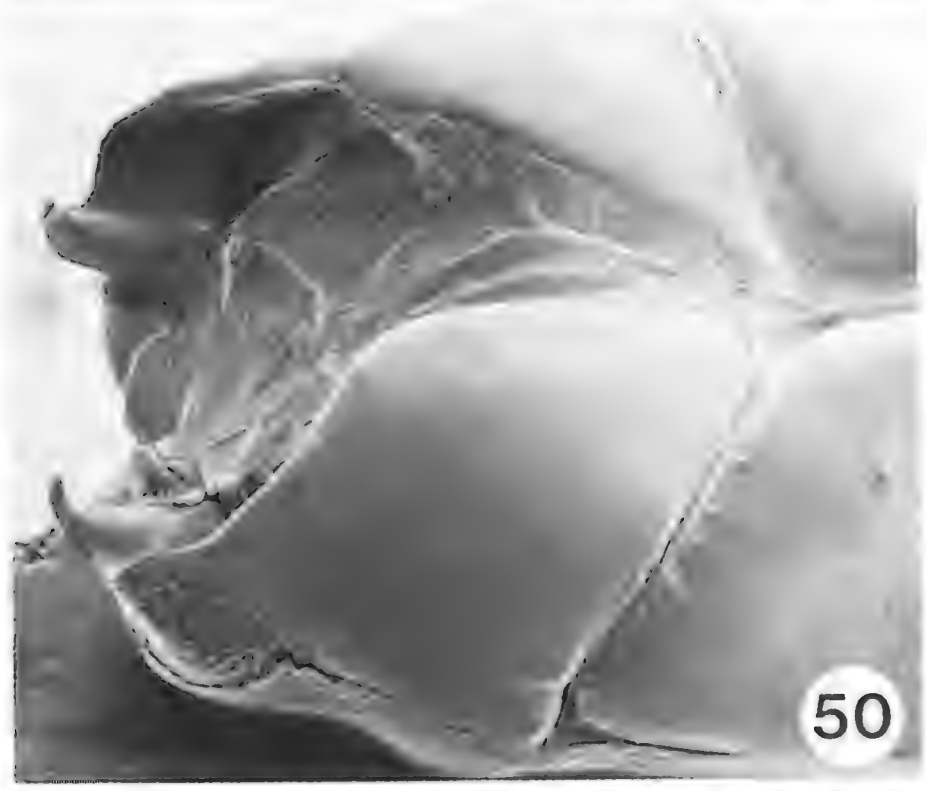
Figs. 37, 38. Athyreus pyriformis n. sp. 37. Male, head and pronotum; 38. Male genitalia, dorsal view. Fig. 39. Athyreus armatus Westwood. 39. Male, head and pronotum (reproduced from 35 mm color slide of type). Figs. 40-42. Athyreus gigas Westwood. 40. Male, head and pronotum; 41. Male genitalia and genital capsule; 42. Male genitalia, apex of left paramere.

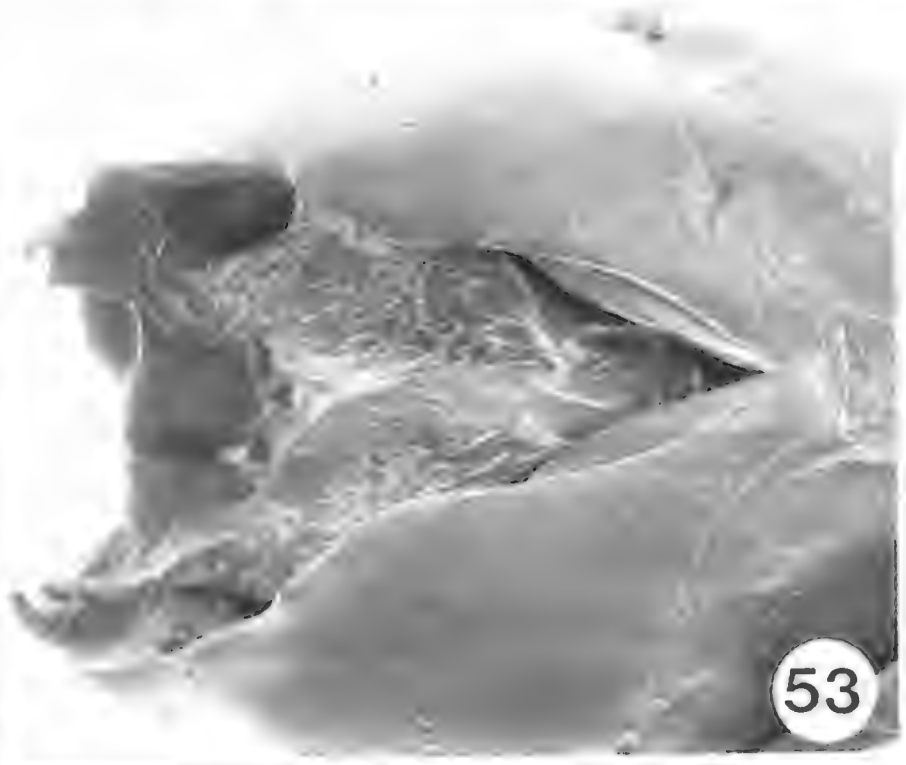




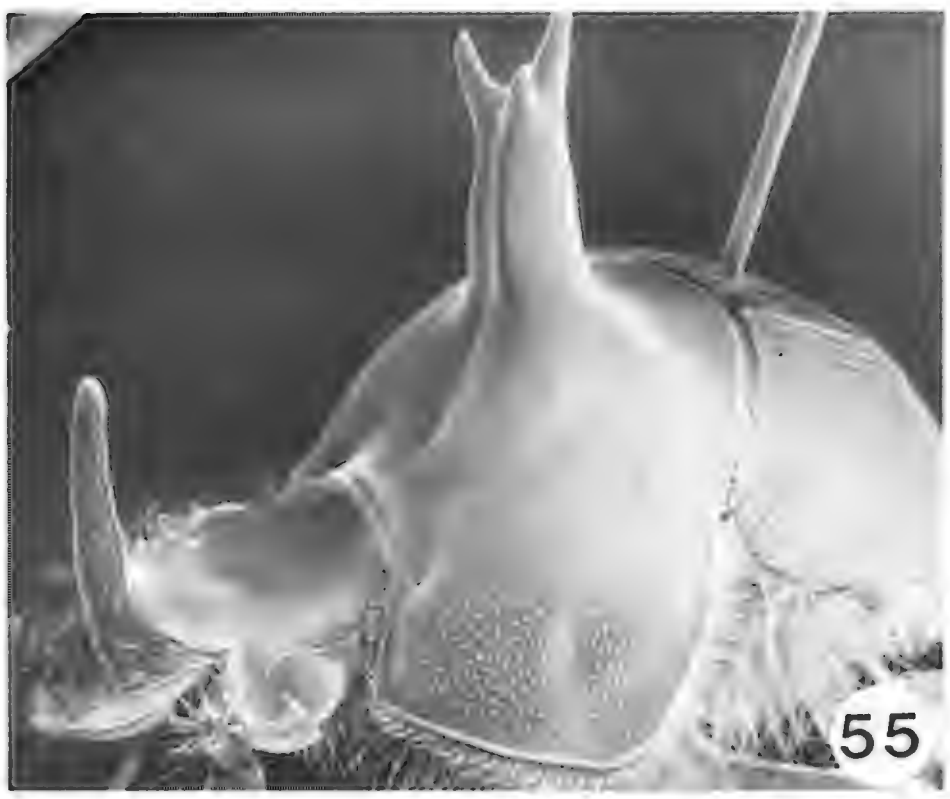
Figs. 43-45. Athyreus bifurcatus Macleay. 43. Male, head and pronotum; 44. Male genitalia, dorsal view; 45. Female, head and pronotum. Figs. 46-48. Athyreus tuberifer Felsche. 46. Male, head and pronotum; 47. Male genitalia, dorsal view; 48. Female, head and pronotum.

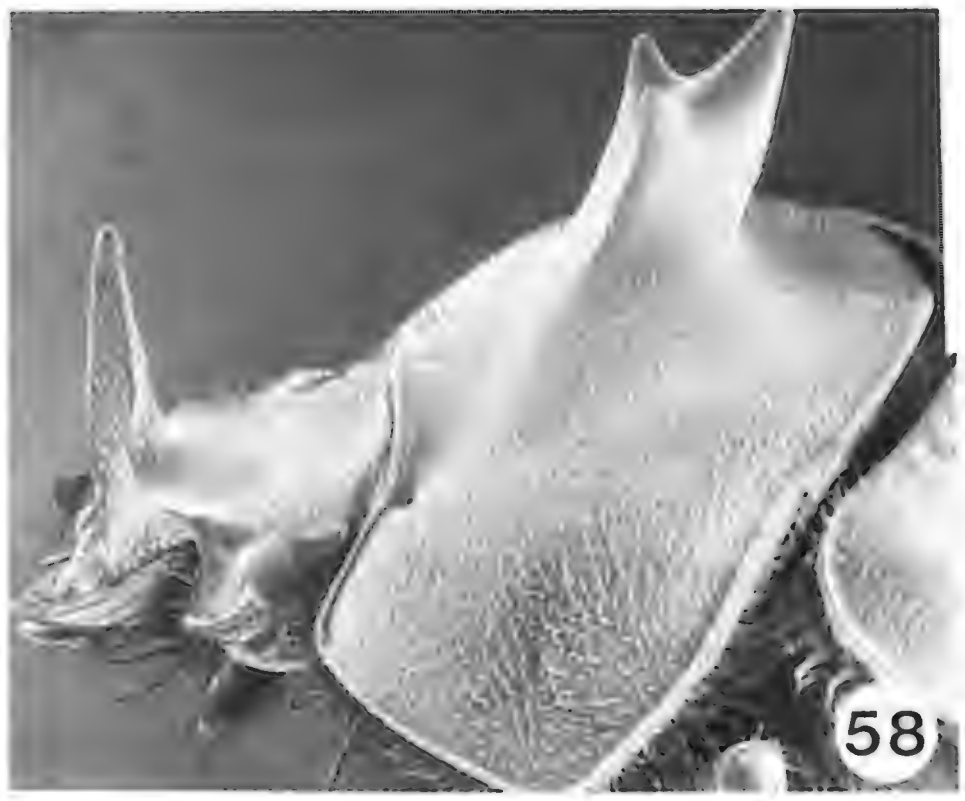


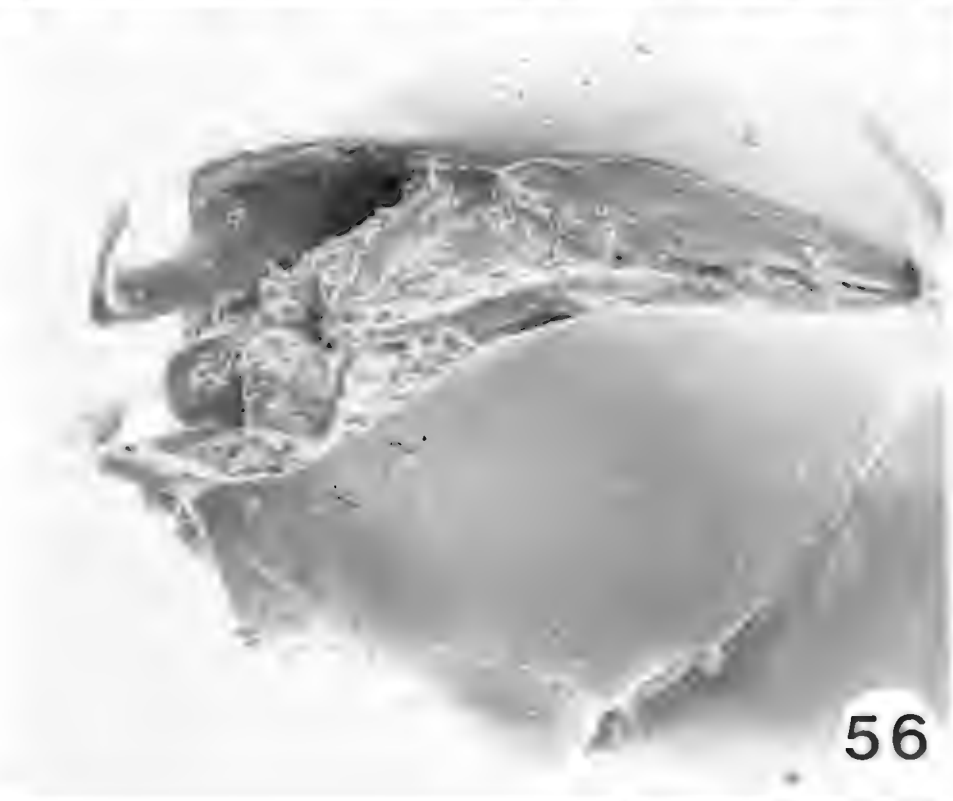


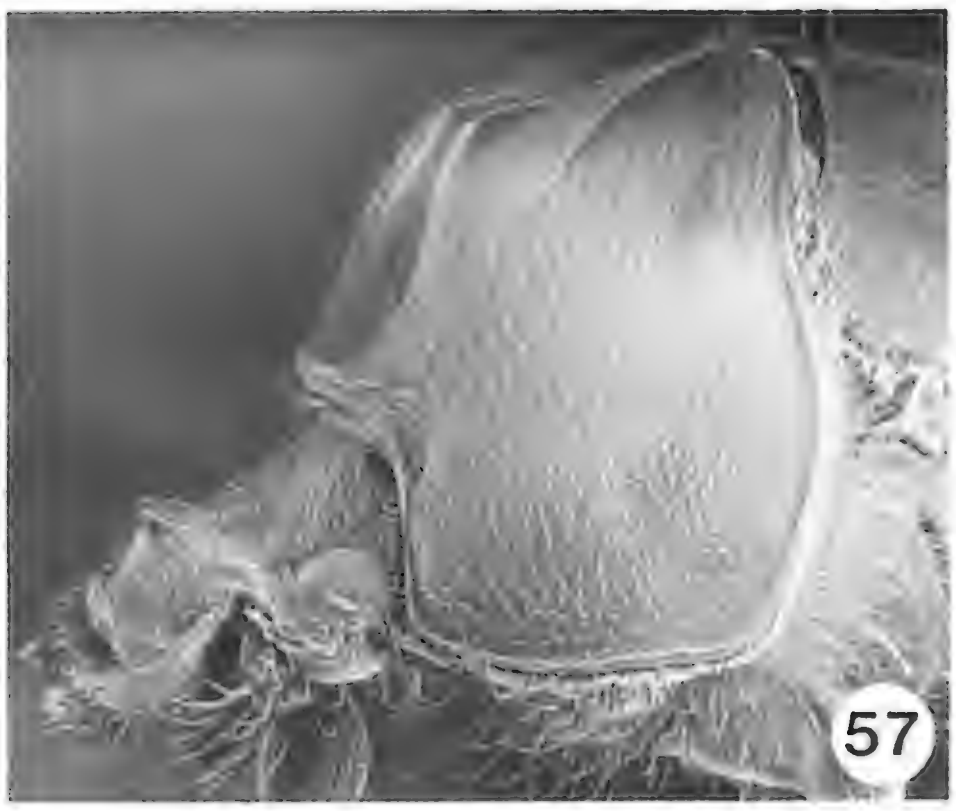


Figs. 49-51. Athyreus bellator Westwood. 49. Male, head and pronotum; 50. Male genitalia, dorsal view; 51. Female, head and pronotum. Figs. 52-54. Athyreus acuticornis n. sp. 52. Male, head and pronotum; 53. Male genitalia, dorsal view; 54. Female, head and pronotum.









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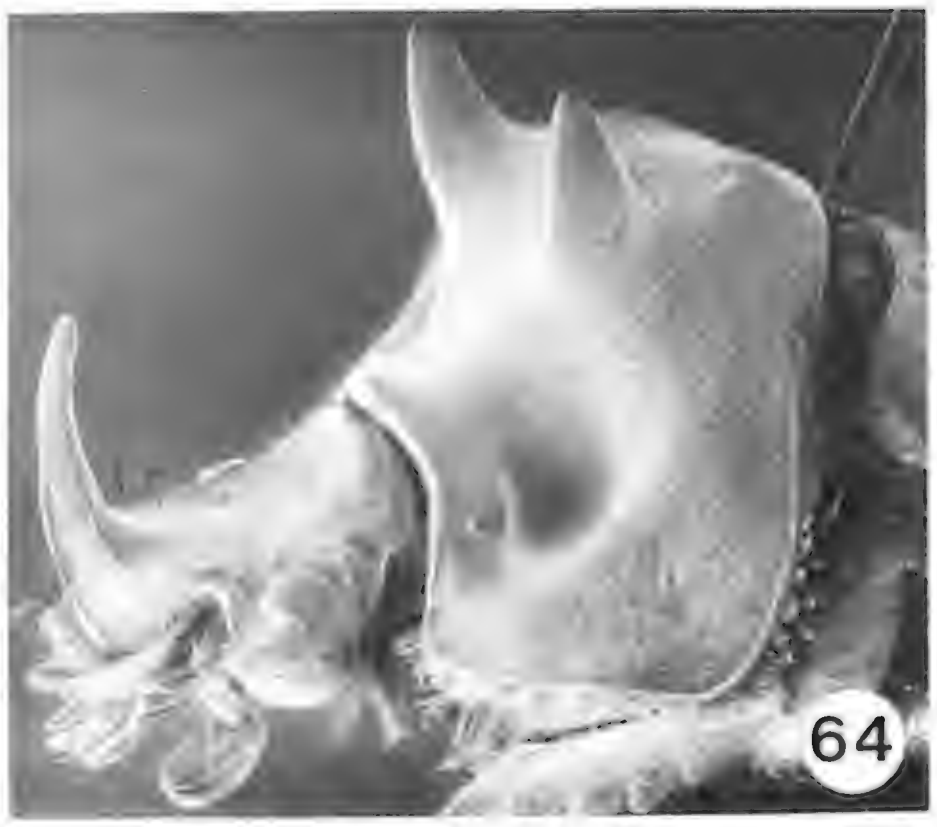
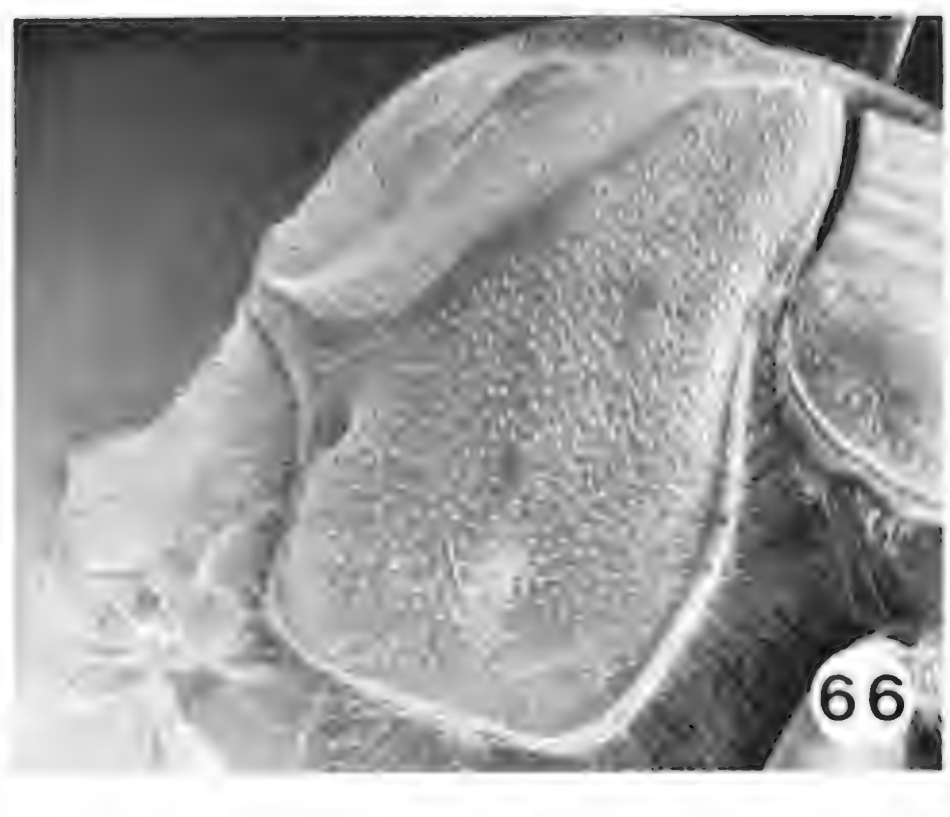
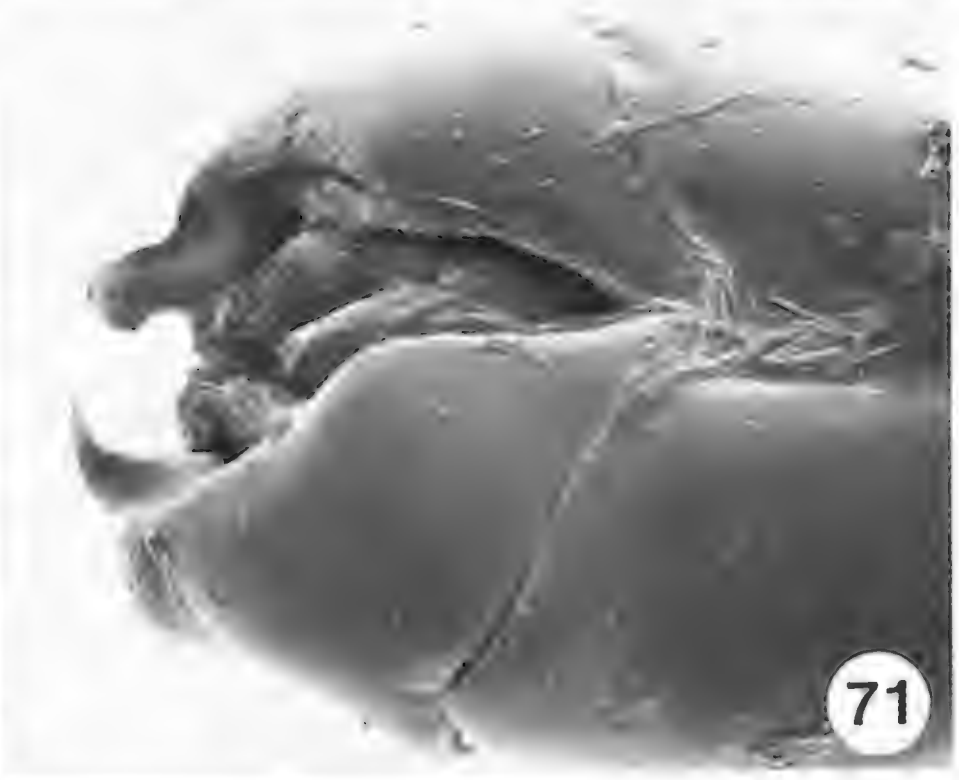
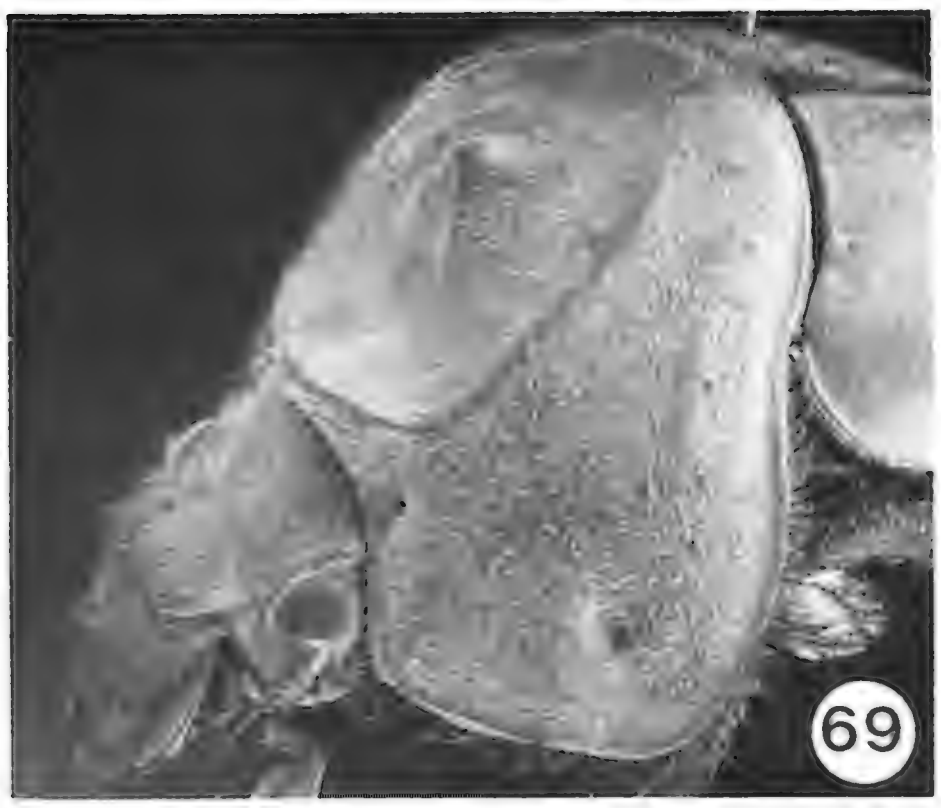




Figs. 61, 62. Athyreus juanae n. sp. 61. Male, head and pronotum; 62. Male genitalia, dorsal view. Fig. 63. Athyreus conspicuus n. sp. 63. Female, head and pronotum. Figs. 64-66. Athyreus tribuliformis Felsche. 64. Male, head and pronotum; 65. Male genitalia, dorsal view; 66. Female, head and pronotum.





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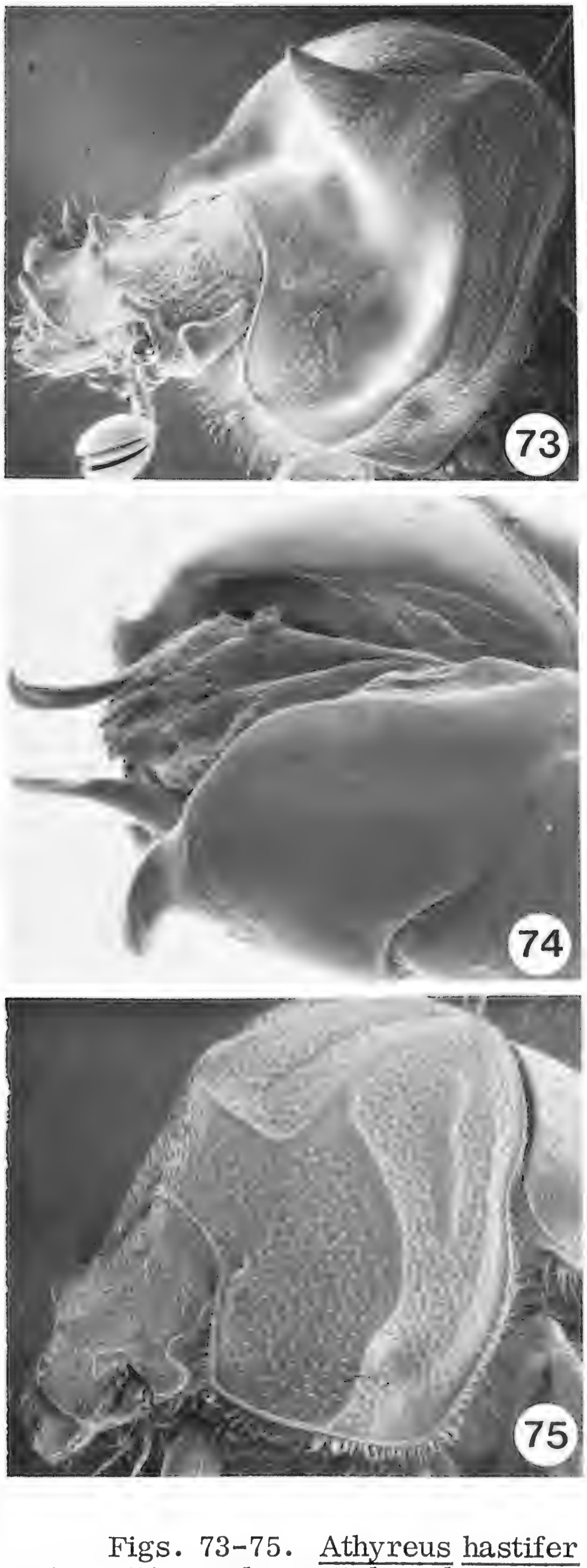

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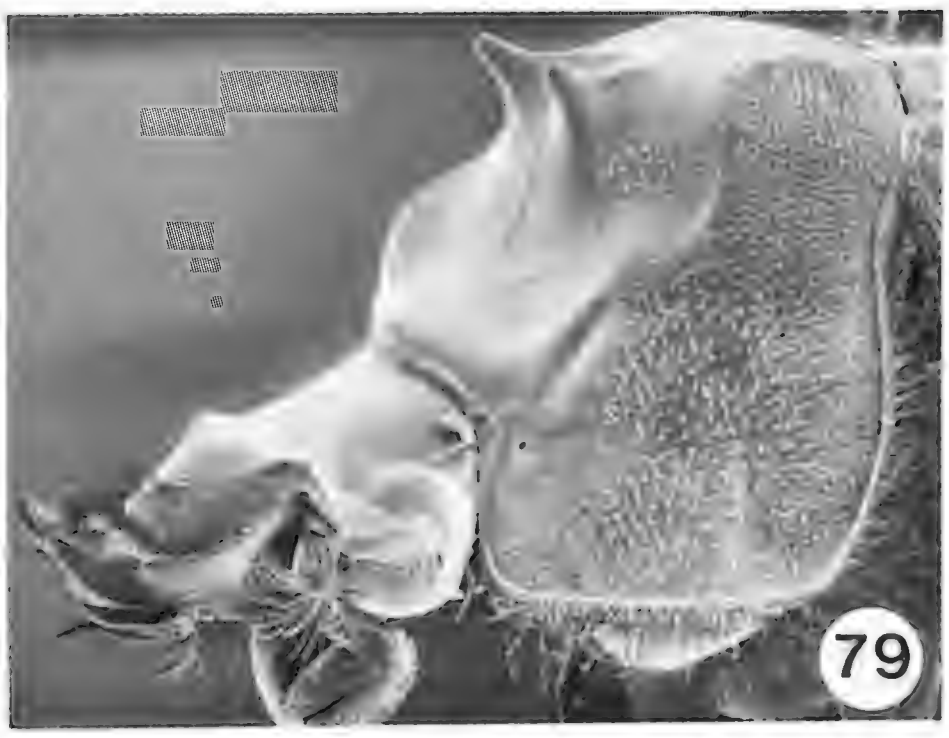

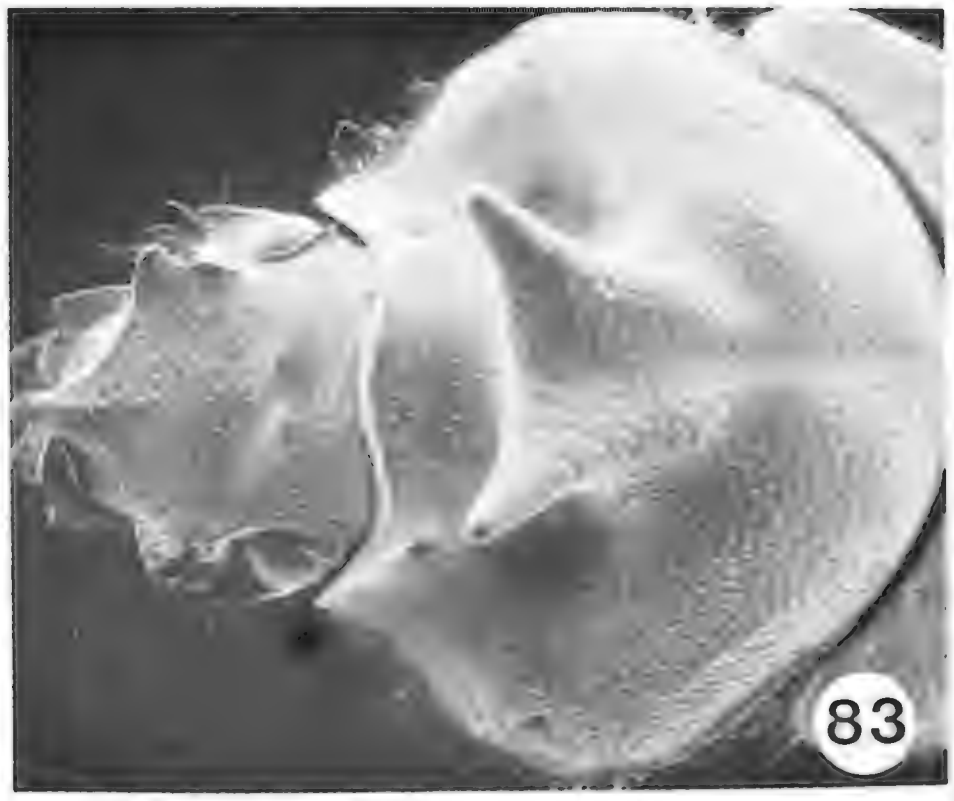

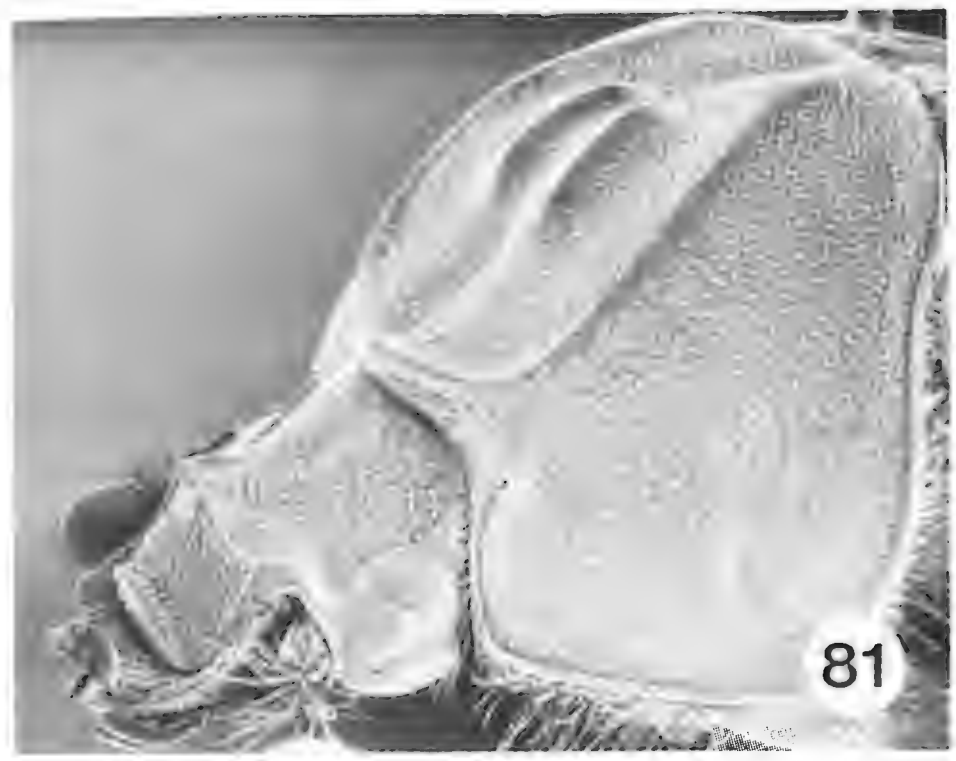

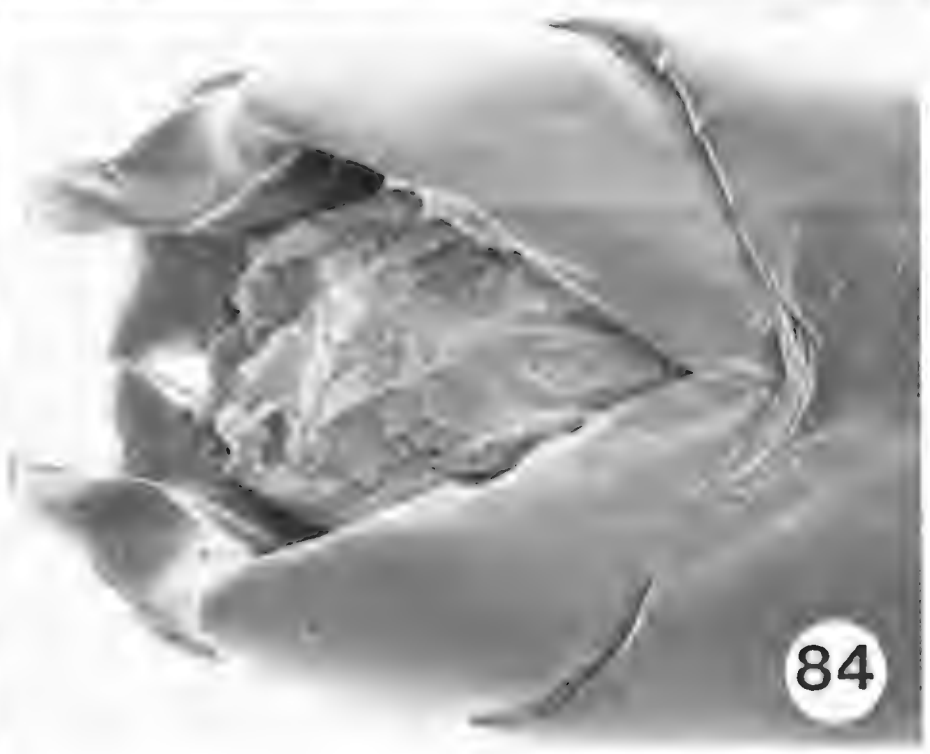

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A REVISION OF THE NEARCTIC SPECIES OF THE GENUS ONTHOPHILUS LEACH (COLEOPTERA: HISTERIDAE)

by

Jussi Helava

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ABSTRACT

The Nearctic species of the histerid genus Onthophilus Leach are revised. Fourteen species are recognized, of which six are described as new: O. deflectus, O. intermixtus, O. wenzeli, O. cynomysi, O. thomomysi and O. giganteus.

All species are described and illustrated with scanning electron microscope pictures. Drawings were made of male genitalia for species in which males are known, of mouth parts for alternatus, and of the hind wing for alternatus and flohri. A key and diagnoses are provided for separating species. The distributions of species are indicated on maps. A brief discussion of the distribution, ecology and taxonomic affinities and evolution is included.

CONTENTS

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INTRODUCTION

Onthophilus Leach is a small genus of the family Histeridae. The strong sculpturing of its dorsal surface makes this a readily identifiable genus, but because it is rarely encountered by general collectors, Onthophilus is never represented by many specimens in most collections. The Palearctic species of Onthophilus were revised most recently by Reichardt in 1933. The Nearctic species have not been revised since Horn's revision of 1873, in which he recognized four species. Since then, four more species have been described and substantially more new material has been accumulated.

This study offers a taxonomic treatment of Nearctic Onthophilus Leach, and consolidates existing information. Fourteen species are recognized. Six are described as new, and previously named species are redefined. An artificial key and diagnostic characters are provided for identifying the species. Brief discussions are included on the distribution, on what is known about the habits of the species, and on the taxonomic affinities of the species.

HISTORICAL REVIEW

Leach erected the genus Onthophilus in 1817 to accommodate two previously described species, Hister striatus Forst. and H. sulcatus Fab. Leach provided a key, based mainly on antennal characters, to separate this genus from others that were extant at that time, but he did not include a description. The genus was better defined by Leconte in 1845, on the basis of three North American species, alternatus Say, nodatus Leconte and pluricostatus Leconte. A more complete description is found in Marseul's Monograph of 1856. Both Leconte's and Marseul's concept of the genus Onthophilus was broad enough to include three species, hispidus Paykull, costipennis Fahrs., and novemcostatus Marseul. These species differ from the other species of Onthophilus in several marked ways. They are covered

dorsally by dense setae or scales which often obscure the elytral sculpture, the prosternum is bicarinate, and they have a pronounced fovea in the front angles of the metasternum. Thirty-two names were proposed before 1891. At that time, Lewis erected the genus Epiechinus to accommodate seven hispid species of Onthophilus. Reichardt's concept of the genus in 1933, comprises those species which were left in Onthophilus after Lewis erected Epiechinus, and is followed here.

The first Nearctic species to be placed in Onthophilus was alternatus, described by Say in 1825 from the Melsheimer collection. Leconte (1845) in his revision of the North American Histeridae, added nodatus and pluricostatus. In addition to these three species, Horn recognized a new species from California, in 1870; in his 1873 revision of the North American species of Histeridae. Horn considered nodatus and pluricostatus as varieties of alternatus. Subsequently various catalogues, for example Bickhardt (1910), have treated the Say and the Leconte species as synonyms, although Lewis (1905) and Reichardt (1933) retained their specific status. They are recognized as valid species in the present paper and types are designated for them. Lewis described two species from Mexico, flohri and julii, in 1888 and in 1892 respectively. In 1893, Casey described a species from Colorado and named it in honour of the collector H. Soltau. Ross (1944b) named a species kirni from Texas in honour of A.J. Kirn with whom he was collecting arthropods associated with Geomys. The numerous species added since 1856, make Marseul's key inadequate for identifying Nearctic material.

The higher classification of the Histeridae is very unclear and is in need of much work. Onthophilus was previously placed close to Abreus in the subfamily Abreinae, for reasons which are difficult to explain. Wenzel (1944) moved Onthophilus to the subfamily Tribalinae, but this genus and other closely related genera, Peploglyptus, Glymma, Stictostix and Epiechinus, can not be placed satisfactorily until a revision of the Histeromorphae is completed.

DISTRIBUTION

At present a total of thirty species of Onthophilus Leach have been described. There are thirteen species, one subspecies and one variety recognized from the Palearctic region. Seven of these are extant in Siberia, China, Formosa and Japan, and six in western Europe, the Near East and northern Africa. All these species are confined to either the eastern or the western part of the region. Two species are recognized from Burma. One was collected from 7000'; no data are provided with the other description. One species, australis, was collected by H.F. Howden in Australia. This is the first record of Onthophilus in that continent.

Fourteen species are recognized from the Nearctic region. Two species, deflectus and pluricostatus, range from Michigan and New York in the north, south along the Appalachians and the Mississippi valley to the Gulf states. Onthophilus alternatus and nodatus are found in the coastal lowlands of the southeastern states; nodatus has been recorded as far west as eastern Texas; giganteus is known only from Archer, Florida. Five species occur in the central states, each recorded from only one locality -- soltaui from Denver, Colorado; cynomysi from Grady Co, Oklahoma; kirni from Somerset, Texas; wenzeli from Nebraska and intermixtus from Graham Co., Arizona. One

species, lecontei, has been collected along the coast of California, from San Francisco to San Diego. Three species are from Mexico; thomomysi from Durango and also Eagle, New Mexico; flohri from Durango; and julii from Mexico and Oaxaca. All three species occur above 8000' in Mexico.

From the distribution patterns noted above, it is evident that Onthophilus is largely confined to temperate climates. Even those species that occur farthest south, in Mexico and Burma, are confined to high elevations.

ECOLOGY

Virtually nothing is known about the biology of Onthophilus. The only source of biological data available is collecting records. Collecting records, however, provide no information that would indicate whether these are the usual habitats in which the species occur, or whether they are only occasional visitors to these habitats.

Adult beetles of most Nearctic species of Onthophilus have been collected in traps baited with malt, carrion or dung. O. pluricostatus has been found under a dog carcass. O. deflectus has been recorded from detritus in tree holes and between tree buttresses, from forest leaf litter, from dead Polypore, from mouse nests, from chicken decay, from under a pig carcass and from cow dung. O. kirni, cynomysi and thomomysi are recorded from prairie dog burrows. O. lecontei has been found in gopher burrows, in a Vespula pennsylvanica nest, and on dandelion.

Most species of histerids are thought to be predators of fly larvae and of other small arthropods, although there are very few literature references that confirm this generalization by direct observation. The structure of the mouth parts of Onthophilus suggests that the species are predators. It is not unlikely, therefore to assume that the adults of this genus, are general predators of fly larvae or of other small arthropods in leaf litter, in dung, in carrion and in the nest and fecal chambers of some rodents and other small mammals. It is their secretive habits and the relatively specialized techniques required to collect them, that undoubtedly account for the poor representation of the various species of Onthophilus in most collections.

No records or biological observations of the larval stages of Onthophilus exist. Because dung and carrion disappear very rapidly in the summer, it is likely that the larvae will be found in some more stable niche, such as rodent burrows in the case of some species, or in leaf litter in others. The larvae of a few other histerid genera are known to be predators on the eggs and larvae of small arthropods. Onthophilus larvae will probably conform to this predatory trend in the Histeridae.

TAXONOMIC AFFINITIES AND EVOLUTION

The family Histeridae is evidently an old one. Onthophilus and the genera related to it, represent an unusual and divergent branch of this family. One fossil species, O. intermedius Handschin (1944) establishes that this genus dates from at least the Oligocene. It may be assumed that in the past this genus had a much more continuous distribution. The present distribution of the species indicates a progressive series of radiations and of subsequent fragmentations.

The species now extant in the Nearctic region are apparently polyphyletic in origin. Those ten species for which males are known can be placed into three groups on the basis of the structure of the male genitalia. These groups may be conveniently referred to by the name of the oldest named species within that group. The composition of the groups is as follows:

(1) lecontei group: lecontei, cynomysi, thomomysi and kirni
(2) alternatus group: alternatus, nodatus and pluricostatus
(3) flohri group: flohri, deflectus and intermixtus

The median lobe of the male aedeagus of the lecontei group, is extruded ventrally between the bifid apex of the parameres. The median lobe of the alternatus group and the flohri group, is extruded dorsally. The flohri group differs from the alternatus group in the form of the basal piece. The basal piece of the alternatus group is long and tubular. The basal piece of the flohri group is short and ovoid. The basal opening is rotated sinistrally 45 degrees from the longitudinal midline and is subapical. These groups share external characteristics within groups, which allows the placement, with some confidence, of wenzeli and soltaui into the lecontei group. The only species which cannot be placed with any confidence is julii. No other species of Onthophilus, anywhere, has such greatly interrupted elytral costae. The only other species which approaches julii in this characteristic, is tuberculatus from Burma. The general outline, punctation and so forth, of julii suggests that it is closer to the flohri group than to either of the other two Nearctic groups.

All three Nearctic groups have close taxonomic affinities to species in the eastern and/or western Palearctic region, but the exact phylogenetic relationships are obscure. For example, the head and thorax of silvae from Japan resemble those of alternatus very much, but its elytral costae are equally well developed. Similarly, the pronotum of wenzeli resembles that found in the alternatus group, but in the rest of its characters, it is very close to the other species of the lecontei group.

The general east-west division of the Nearctic species, is probably an expression of the Tertiary orogeny and the subsequent development of the recent xerophytic vegetation (Axelrod, 1958). Apparently the species of the lecontei group have survived the xeric conditions by utilizing the more amenable conditions found in mammal burrows and similar habitats. It is not clear, whether this is a primitive adaptation of the group, or whether these species invaded these niches and speciated within them after the onset of xeric conditions. Certainly this mode of behaviour is not confined to the lecontei group, but is found in other species of Onthophilus, in the Nearctic and the Palearctic regions (Bedwell, 1907), and in other genera of both the Histerinae and Saprininae.

A more recent distribution pattern that is the result of the Pleistocene glacial cycles is superimposed on the older one. O. deflectus and flohri are two morphologically very similar species. The former is found in eastern United States and the latter in Mexico. This distribution pattern suggests that these species arose from an ancestral population by prolonged isolation during a glacial cycle. Interestingly, this species separation is accompanied by a reduction of the inner wings of flohri. The specimens of flohri that I have seen are from the western edge of the Sierra Madre Occidental at high elevations. Very likely, suitable habitats are sparsely and irregularly distributed in this area and are subjected to strong prevailing winds from the ocean. Under these circumstances the reduction and the consequent loss of flight would have high survival value and would be selected for in order to minimize the loss of individuals. Whether this is also true for other populations of this species, is difficult to say, until further collecting reveals the complete

range of this species. Pleistocene isolation is expressed in other species by pockets of variability within their range. For example, specimens of nodatus from eastern Texas have larger punctures than specimens from the eastern portion of its range. Possibly these specimens represent a population which was separated from the main body of the species during the last glacial period.

METHODS

This study was based on an examination of approximately 500 museum specimens of Onthophilus.

Cleaning: Most specimens of Onthophilus are heavily covered by a waxy exudate to which soil particles and other detritus have adhered. This accretion forms a hard coating which obscures many important taxonomic characters. Many different compounds were tested in attempts to clean specimens. The most successful of these was a 10 % (w/v) solution of sodium phosphate, tribasic (TSP, Na_3PO_4). This solution softened the waxy exudate sufficiently that it could be peeled away with a camel hair brush. In addition this solution relaxes specimens very efficiently.

Dissection Techniques: Male genitalia were extracted through the pygidium of specimens relaxed in hot water or TSP. The genitalia were cleared in a hot 10 % solution (w/v) of potassium hydroxide, prior to the separation of the terminalia and the aedeagus. For further study and illustration, microscope slides were prepared using a glycerin gel medium . Mouth parts, wings and other structures were handled in a similar manner, except that the mouth parts were stained with a 10 % solution of basic fuchsin in 95% ethyl alcohol.

Illustrations: A net reticule was used to make all the measurements and as an aid in making the drawings. The length was measured from the tip of the front angles to the hind margin of the elytra. The width was measured at the widest point. At least one specimen of each species was photographed uncoated, using a JEOL JSM-U3 scanning electron microscope. Magnifications did not exceed 100X.

Terminology: Striae and other surface features are important characters for defining and identifying species of Histeridae. For the terminology of the sclerites and striae, I have followed the useage of Wenzel and Dybas (1941). The following is a definition of the abbreviations used in the text for important costae and carinae that have no prior names.

Head (Fig. 21)

VFC verto-frontal carina, is located along the longitudinal midline reaching from the occipital carina to between the antennae; may be variously reduced.

LFC latero-frontal carina runs from the antennal pit, obliquely across the face to, or just above the clypeus.

Pronotum (Figs. 42, 43, 44)

These costae are bilaterally symmetrical.

PC 1 pronotal costa one is the costa closest to the lateral edge.

PC 2 pronotal costa two is the costa immediately mesad of PC 1.

PC 3 pronotal costa three is the costa closest to the longitudinal midline.

Elytron (Figs. 42, 43, 44)

There are eight striae on the elytron of Onthophilus. Beginning from the

suture and going towards the lateral margin these are as follows: the closest to the suture is the sutural stria; lying to the outside of this are striae five to one, stria five being the closest to the sutural stria; then the internal subhumeral stria; and on the inflexed lateral area of the elytron is a sinuous external subhumeral stria. The striae give their names to the major elytral costae that lie immediately mesad of them. The minor carinae between the striae and costae are not named. The strial numbering in the Histeridae is opposite to that found in most other beetles. This convention is followed because the striae closest to the suture are more frequently obsolete than the striae farthest from the suture.

SC sutural costa lies mesad of the sutural stria, between it and the suture.
EC 5 elytral costa five, lies mesad of stria five.
EC 4 elytral costa four lies mesad of stria four.
EC 3 elytral costa three lies mesad of stria three.
EC 2 elytral costa two lies mesad of stria two.
EC 1 elytral costa one lies mesad of stria one.
ISC internal subhumeral costa lies mesad of the internal subhumeral stria.
ESC external subhumeral costa lies mesad of the external subhumeral stria, and because it is straight and not sinuous it is separated from the stria at its front end by a semicircular area.

Pygidium (Fig. 35)

TC transverse carina runs across the pygidium in the front half; it may be nearly straight or W-shaped.
LC longitudinal carina runs along the longitudinal midline; it may be variously reduced.

Propygidium (Fig. 35)

PMC carina that runs along the longitudinal midline; if present usually tear-shaped.
PLC carina that runs along the lateral margin.

TAXONOMY

Onthophilus Leach[1]

Onthophilus Leach 1817: 78; Leconte 1845: 50; Marseul 1856: 549; Horn 1873: 138.

TYPE SPECIES. Hister sulcatus F. designated by Westwood 1840: 22. (Onthophilus misspelled Orthophilus on pg. 22, corrected on pg. 157.)

The generic characters which are diagnostic for Onthophilus are the following: the prosternal lobe is present but narrow; the antennal scape is not expanded or strongly angulate; the labrum has at least two setiferous punctures; the antennal cavities are in the anterior prothoracic angles and partly covered by the prosternal lobe; the pronotum has two to six costae; the elytron has eight striae and eight costae and appears strongly sculptured; the prosternum is without striae; the metasternum is without pronounced fovea; setae if present on the dorsal and ventral surface are very short and not prominent.

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[1]Only literature dealing with Nearctic species at the revisional level is cited. For literature dealing with Palearctic species refer to Bickhardt 1910: 79.

This combination of characters (based in part on Wenzel, 1962) serves to distinguish Onthophilus from other genera in the family Histeridae and in the subfamily Tribalinae.

The Nearctic species of Onthophilus are dark brown to reddish brown and are under 6.0 mm in length. Their shape is oval and they are moderately convex transversely and longitudinally.

The head is deflexed. The antennae are inserted in front of the eyes, are eleven segmented, the last three are fused into an oval club with the sutures indistinct, and are hidden under the thorax in fossae that are in the anterior angles of the prothorax and are partly covered by lateral extensions of the prosternal lobe. The mouth parts are illustrated in Figs. 1-3.

Pronotum has two or six costae. The marginal and lateral striae of the pronotum are obsolete. Elytron has eight striae with strong punctures and eight strong costae. External subhumeral stria sinuous and subcariniform. Area between this stria and lateral margin of elytron with irregular punctures. Scutellum small and triangular. Propygidium and pygidium strongly deflexed, with or without carinae.

Prosternum without striae. Hind margin emarginate. Mesosternum short, front margin lobed to fit prosternal emargination. Metasternum without fovea. Meso and metaepisterna with large contiguous punctures. Clearly defined by sutures. Legs are short and retractile; femora slightly swollen with minute, elongate punctures; protibia expanded apically and spinulose; meso- and metatibia narrow with few rows of spines, tibial spurs unequal and distinct; tarsi 5-5-5, short with simple claws.

Male aedeagus is surrounded by terminalia composed of the sclerites of the eighth, ninth and tenth abdominal segments. The tegmen is composed of a tubular or ovoid basal piece that is free moving and articulated to the parameres. The parameres are fused for most of their length, forming a tube that surrounds the penis and median lobe; their apex is bifid and strongly curved. The penis is flat, its apex is curved and surrounds the median lobe; its basal end is formed into two apodemes. The median lobe is extruded dorsally or ventrally between the bifid apex of the parameres. Female genitalia with hemisternite narrow and articulated to stylus; no sclerotized spermatheca was observed. The terms follow usage by Lindroth and Palmen (1956) and the male and female genitalia are illustrated in Figs. 7-19.

ARTIFICIAL KEY TO THE NEARCTIC SPECIES OF ONTHOPHILUS LEACH

1. Length from front angles of pronotum to hind margin of elytra greater than 4 mm. . . . . 14. giganteus n. sp. (p. 30)
   Length from front angles of pronotum to hind margin of elytra less than 4 mm. 2

2. Elytral costae one to five interrupted at least three times, consequently costae are reduced to series of elongate tubercles (fig. 38). . . . . 1. julii Lewis (p. 10)
   Elytral costae one to five entire or costa one or three interrupted no more than once. 3

3. Elytral costae two and four much more strongly developed than costae one, three and five (figs. 40, 42). 10

Elytral costae one to five equally, or very nearly equally, strongly developed (figs. 41, 45). 4

4. Pronotum with costae two and three absent, or very faintly indicated by weakly raised, shining areas (figs. 49, 50). 5
Pronotum with costae two and three clearly indicated and entire (figs. 45, 46, 47, 48). 6

5. Elytral costa three interrupted before the front margin by a short, deep, transverse fossa (fig. 50). Metasternum with shallow, fine punctures on the central area (fig. 63). . . . . 13. kirni Ross (p. 29)
Elytral costa three entire to the front margin, without short, deep, transverse fossa. Metasternum with deep, medium sized punctures along front and hind margins; two large, triangular, discal areas with only minute punctures (fig. 62). . . . . 12. thomomysi n. sp. (p. 27)

6. Median longitudinal carina of pygidium strong. Pronotal punctures elongate on discal area; interstices arranged in a strigose pattern (fig. 41). . . . 4. intermixtus n. sp. (p. 15)
Median longitudinal carina of pygidium absent. Pronotal punctures round or oval on discal area; interstices not arranged in a strigose pattern. 7

7. Second pronotal costa strong and complete from front to hind margin (fig. 45). Mesosternum with two rows of punctures only in the middle (fig. 58). . . . . 8. wenzeli n. sp. (p. 22)
Second pronotal costa clear but abbreviated before front and hind margin; the ends sometimes covered with punctures that are nearly as large as those in the intercostal areas (figs. 46, 47, 48). Mesosternum with at least two complete rows of punctures across it. 8

8. Second pronotal costae convergent behind; these costae higher and broader at the hind ends (fig. 46). Metasternum rather densely punctate; without two distinct, triangular discal areas that are punctulate (fig. 59). . . . . 9. cynomysi n. sp. (p. 23)
Second pronotal costae parallel or divergent behind; these costae not distinctly higher and broader in the hind half. Metasternum with two distinct, triangular discal areas that are punctulate; punctures along front and hind margin large, dish-like, sometimes with smaller, deep punctures inside their leading edge (figs. 60, 61). 9

9. Lateral edge of pronotum smoothly arcuate or weakly angulate, never parallel in hind 0.5 (fig. 48). First abdominal sternum with large punctures along front

margin and a distinct, semi-circular median area that is punctulate (fig. 61). . . . . 11. lecontei Horn (p. 26)

Lateral edge of pronotum strongly angulate at midpoint, sides parallel in hind 0.5 (fig. 47). First abdominal sternum rather densely punctate; punctures becoming gradually smaller from front to back (fig. 60). . . . . 10. soltaui Casey (p. 25)

10. Metasternum with a common or two triangular discal areas that are smooth or minutely punctured; punctures elsewhere small or large and dish-like with a small, deep puncture inside the leading edge (figs. 55, 56, 57). 11

Metasternum coarsely, rather uniformly punctate throughout; punctures large and shallow, without small punctures inside their leading edge (figs. 52, 53). 13

11. Metasternum with a strongly impressed, longitudinal, broad channel; triangular, minutely punctured discal areas elevated and irregularly oval (fig. 57). . . . . 7. pluricostatus Leconte (p. 20)

Metasternum without strongly impressed, longitudinal, broad channel; triangular, minutely punctured discal areas fused or not elevated (figs. 55, 56). 12

12. Metasternum with no coarse punctures along the longitudinal midline, or with punctures along the longitudinal midline and on the front 0.3 that are not significantly larger than the punctures on the prosternum and that are separated by two to three times their diameters (fig. 55). . . . . 5. alternatus (Say) (p. 16)

Metasternum with coarse, crateriform punctures with small deep punctures inside their leading edge, along the longitudinal midline and on the front 0.3 (fig. 56). . . . . 6. nodatus Leconte (p. 18)

13. Lateral edges of pronotum straight and strongly convergent towards the front, and not reflexed in hind 0.5 (fig. 39). . . . . 2. deflectus n. sp. (p. 12)

Lateral edges of pronotum arcuate or feebly angulate at midpoints, and distinctly reflexed in hind 0.5 (fig. 40). . . . . 3. flohri Lewis (p. 14)

1. Onthophilus julii Lewis

Figures 20, 31, 38, 51, Map 2

Onthophilus julii Lewis, 1892: 124. TYPE. Holotype, female, from Mexico: Amecameca. Sacromonte, X.1891, collected by Julius Flohr from under decaying plants, alt. 8,300 ft (BMNH, London), not seen.

DIAGNOSIS. This species is readily distinguished from all other New World species of Onthophilus by the greatly interrupted elytral costae.

Elytral costae one, three and five are low and interrupted five times. Elytral costae two and four and the internal subhumeral costa are much higher and are interrupted three times. The general outline of the body and the punctation, especially on the meso and metasternum, suggest that this species is most closely allied to flohri, deflectus and intermixtus.

FEMALES. Length: 2.4 mm; width: 2.0 mm. Black with brassy tinge on head, pronotum and elytra. Head with VFC strong and complete. LFC strong and curved inward; carinae meeting above clypeus, forming a short single carina. Punctures on vertex, frons and genae large, round to irregular, and contiguous; on clypeus and vertices of LFC much smaller. Labrum with setiferous punctures in lateral 0.2; front margin straight. Pronotum transverse. Lateral margin broadly, obtusely angulate, somewhat rounded; lateral bead weak but distinct; surface along lateral edge reflexed. Disk 6-costate. PC 1 strong, very short and slightly curved inward. PC 2 strong, reaching from front 0.3 to just before the hind margin and curved gently outward. PC 3 strong; reaching from front margin to hind 0.1, but may be completely interrupted in the middle third of its length; curved slightly outward. Punctures large, round to irregular, contiguous, except smaller along hind margin; vertices of elevations with double row of minute punctures. Surface between PC 1 and PC 2 strongly concave, forming a broad trench that curves to the front angle; trench deepest just behind front angle. Elytron wider than pronotum. EC 1, EC 3 and EC 5 much lower than EC 2, EC 4 and ISC; interrupted five times; elongate tubercles more prominent in hind 0.3. EC 2, EC 4 and ISC very prominent; interrupted three times; tubercles behind front margin longest. ESC low and interrupted only once in the middle. SC very much attenuated in front 0.3. All costae with two rows of irregular punctures along their base; punctures prominent between tubercles. Interspaces between costae with clear stria that is bordered by two low carinae; strial punctures small and round, deepest at front margin, with two small lateral tubercles that interrupt the low carinae. Surface depressed behind front margin, forming shallow, transverse trench in front of costae. Propygidium with PMC strong; slightly abbreviated in front and behind. PLC strong, about 0.3 times as long as PMC. Punctures large, shallow, irregular and contiguous; on vertices of elevations very fine. Pygidium with LC strong, bifurcating in the middle of the pygidium, arms reaching hind 0.2. TC strong and straight; intersecting LC in front 0.2. Surface depressed before and behind TC. Punctures similar to those on the propygidium, except smaller and more pronounced on outer margins. Prosternum slightly concave between procoxae, convex before. Hind margin broadly, roundly emarginate. Punctures coarse, irregular, shallow and contiguous; about 0.5 times as large and more rounded on prosternal lobe. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctures similar to those on the prosternum. Metasternum separated from mesosternum by a suture which is irregular due to the punctures encroaching on it. Median longitudinal suture fine and obscured in part by punctures. Surface slightly depressed behind the front margin and along the median longitudinal suture; elevated triangular area between meso- and metacoxae. Punctures intermixed large and small, irregular and contiguous, except small on triangular area. First abdominal sternum punctate throughout; punctures similar to those on prosternum. Surface strongly reflexed behind front margin. Protibia slightly expanded distad, with eight short spicules each on a weakly elevated base.

MALE. Unknown.

SPECIMENS. Mexico. Oaxaca. km 154 on Route 175 south of Oaxaca,

8,000 ft, 2-3.VI.1971, H.F. Howden, 1 female. 20 km n. Oaxaca, 9,500 ft, 7.VI.1971, S. Peck, under carrion, 1 female.

REMARKS. I have seen only two specimens of this species, both females. The variation between these two specimens from Oaxaca is very slight. In specimen collected south of Oaxaca both PC 3 carinae are completely obsolete in the middle 0.3, but no other significant differences were detected. P.M. Hammond kindly compared my specimens with the holotype, which is a little smaller and the elytral costae are not quite so raised.

2. Onthophilus deflectus new species

Figures 11, 39, 52, Map 1

Onthophilus deflectus n. sp. TYPE. Holotype, male, Trelease Woods, Urbana, Ill., 28.IV.1951, R.K. Benjamin, (FMNH, Chicago), collected on dead Polypore. Allotype, female, with the same data as the type, (FMNH, Chicago). Paratypes, all material listed in the section on specimens examined.

DIAGNOSIS. The densely punctate meso- and metasternum separates this species from other species, with the exception of flohri, in which the major elytral costae are unequally developed. This species may be distinguished from flohri, which it resembles closely, by the following characters. The lateral pronotal edges of deflectus are nearly straight and strongly convergent in the hind 0.5; the front angles of the pronotum are broadly round; and the meso- and metasternum are convex. The lateral pronotal edges of flohri are arcuate or weakly, broadly angulate and subparallel in the hind 0.5; the front angles of the pronotum are not broadly round; the meso- and metasternum are concave in the males and flat or weakly concave in the females. In its general outline and punctation deflectus also resembles intermixtus but may be separated from the latter by the almost equally well developed elytral costae, smoothly arcuate lateral edge of the pronotum, and the long pronotal costa one, of intermixtus.

MALES. Length: 1.8 to 2.0 mm; width: 1.6 to 1.8 mm. Head with VFC strong. LFC strong and meeting just above clypeus. Punctures on frons, vertex and genae large, roundish, deep and contiguous; punctures much smaller on clypeus and on the vertices of elevations. Labrum with setiferous punctures in lateral 0.2. Pronotum 0.5 times as long as wide. Lateral margins nearly straight in hind 0.5 and strongly convergent frontwards; lateral bead poorly developed; hind angles not reflexed, surface smoothly concave to lateral edges; front angles broadly rounded. Disk 6-costate. PC 1 short and straight; reaching from just before the hind margin to front 0.5. PC 2 long and straight; reaching from the hind margin to just before the front margin. PC 3 long and straight; reaching from the front margin to hind 0.1. Surface not deeply concave between PC 1 and PC 2. Punctures between PC 1 and lateral edge and along hind margin large, round, and contiguous; punctures between costae large, elongate and contiguous, with interspaces arranged in strigose pattern; punctures on vertices of elevations minute and sparse. Elytron wider than pronotum. EC 1, EC 3, EC 5 and ESC much lower in the front 0.75 than EC 2, EC 4 and ISC. ISC, EC 2, EC 4 and SC with a clear row of large quadrate punctures along their bases. EC 1 and EC 3 abbreviated before front margin. SC strongly attenuated in front 0.2. Vertices of costae with two rows of minute punctures. Spaces between costae with strong stria bordered by two low carinae; strial punc-

tures strong, oval and deep with small but clear tubercles on their lateral edges that interrupt the low carinae. Surface with slight transverse depression near the middle running from ISC to EC 3. Propygidium with PMC strong; reaching from front 0.3 to hind 0.1. PLC short, reduced to round tubercle. Punctures large, irregular deep and contiguous. Vertices of elevations with minute punctures. Pygidium with LC strong; reaching from front margin to hind 0.1. TC strong, obtuse V-shaped, meeting LC in front 0.3. Punctures similar tothose on the propygidium. Prosternum flat between procoxae, convex in front. Hind margin broadly, roundly, shallowly emarginate. Punctures round, large and small intermixed, and contiguous; unctures smaller on prosternal lobe. Mesosternum short and transverse. Front margin lobed to fit the prosternal emargination. Punctures similar to those on the prosternum. Metasternum separated from the mesosternum by a fine suture. Median longitudinal suture distinct. Surface with a broad, oval discal elevation between meso- and metasternum. Punctures round to irregular, larger than on mesosternum and contiguous; punctures slightly smaller on elevations, with minute punctures on interstices. First abdominal sternum punctate throughout; punctures similar to those on prosternum. Protibia with 12-14 small spicules on only slightly elevated bases. Male genitalia shown in fig. 11.

FEMALES. Length: 1.9 to 2.2 mm; width: 1.6 to 2.0 mm. Very similar to males. They can usually be distinguished from males by the metasternum, which is in females only very slightly depressed along the longitudinal median suture.

SPECIMENS. CANADA: ONTARIO. Essex Co., Lasalle, 19-20.V. 1967, K. Stephan, 1 male, 3 females. UNITED STATES: ALABAMA. Jackson Co., Scottsboro, 4-8.IV.1967, S. Peck, forest litter, 1 female. ILLINOIS. Cook Co., Joliet, 18.IV.1927, O. Park, cow dung, 1. Urbana, Trelease Woods, 17.III.1944, W.E. Snow, ex tree hole, 1 female; 28.IV. 1951, R.K. Benjamin, from dead Polypore, 1 male, 3 females. INDIANA. Porter Co., 1 mi. S.W. of McCool, 4.X.1952, H.S. Dybas, 1 female, berlese leaf litter. MARYLAND. Takoma Pk., 16.V.1943, E.S. Ross, 2 males. MICHIGAN. Berrien Co., Lakeside, Warren Woods, 25.VI.1966, W. Suter, buttress debris beech, 1 male. MISSISSIPPI. Meridian, 8.II., H. Soltau, 1. MISSOURI. Boonville, 4.V.1964, G.G. Kennon, ex mouse nest under split oak log, 1 male, 1 female. NEBRASKA. F.C. Bowditch, 1. NORTH CAROLINA. Black Mts., VI.1902, Van Dyke, 1. Round Knob, 25. VI., Hubbard and Schwartz, 17. SOUTH CAROLINA. Clemson, 28.II.1962, J.A. Payne, chicken decay, 1; 27.I.1967, J.A. Payne, dead pig remains, 6. TENNESSEE. Blount Co., Great Smoky Mts. Nat. Pk., Cedar Cove, 8.VI. 1960, W. Suter and J. Wagner, alt. 1700 ft, leaf litter, 1. Specimens are in the following collections: Cal. Acad., San Francisco; FMNH, Chicago; USNM, Washington; Howden, Ottawa.

REMARKS. This species is named deflectus because unlike any other species, the lateral edge of the pronotum is not reflexed in the hind 0.5. The hind angles of the pronotum appear to bend down.

Most of the specimens of this species that I have seen are quite uniform in appearance, except those from Black Mountain and Round Knob, North Carolina and the specimen from Nebraska. The PC 3 costae of these specimens may be weakly to strongly, or not at all attenuated at their mid-points, and the EC 2 costa is weakly to rather strongly attenuated in the front 0.3. The strial puncture in stria 3 at this point is sometimes strong and reinforces the appearance that there is a transverse fossa across the elytron in the front 0.3. There is a spectrum of variability from specimens in which only the EC

2 is slightly attenuated to specimens in which the PC 3 is virtually interrupted and the EC 2 is strongly attenuated. No differences were noted in the male genitalia of the specimens. At this time, I would like only to note that this variability exists. Further studies and collecting will determine whether these forms should receive formal recognition as subspecies or whether they should be elevated to specific status.

3. Onthophilus flohri Lewis

Figures 6, 9, 12, 21, 32, 40, 53, Map 2

Onthophilus flohri Lewis, 1888: 235. TYPE. Holotype, sex unknown, labelled "type", Mexico. Durango. 8.VIII.1887, J. Flohr, (BMNH, London), not seen.

DIAGNOSIS. O. flohri resembles deflectus and intermixtus in general outline and the densely punctate meso- and metasternum. Characters that are useful for separating flohri from the former, are discussed in the diagnosis for deflectus. Intermixtus has almost equally well developed elytral costae and the pronotal costa one is long. In flohri, elytral costae one, three and five are much lower than elytra costae two and four, and the pronotal costa one is short. This species is readily distinguished from other species with unequally well developed elytral costae by the densely punctate meso- and metasternum.

MALES. Length: 2.0 to 2.5 mm; width: 1.6 to 1.8 mm. Head with VFC strong, reaching occipital carina. LFC strong above antennal pit, becoming obsolete above clypeus; curved inward slightly. Punctures large, shallow, irregular, and confluent on frons and genae; smaller and elongate above antennal pit; interstices arranged in strigose pattern; smaller and rounded along front margin of clypeus; vertices of elevations with small, round punctures. Labrum with setiferous punctures in lateral 0.2; front margin arcuate. Pronotum transverse, 0.50 as long as wide. Lateral margin arcuate, or weakly angulate at mid-point; slightly reflexed. Front margin slightly emarginate; front angles obtuse. Disk 6-costate. PC 1 short, straight; reaching from front 0.5, hind 0.10 or 0.05. PC 2 curved inward; abbreviated only slightly in front and behind. PC 3 straight; abbreviated behind, reaching from front margin to hind 0.20. PC 2 and PC 3 convergent towards the front. The two PC 3 almost parallel. Punctures at edges small and round; between costae elongate, interstices arranged in strigose pattern. Elytron wider than pronotum. ESC, ISC, EC 2, EC 4, and SC abruptly elevated and prominent; EC 1, EC 3 and EC 5 much lower and abbreviated just behind front margin. All costae abbreviated just before hind margin. SC attenuated in front 0.3; EC 1 slightly attenuated in the middle. All costae with a row of minute punctures on each side just below the vertex; EC 2, EC 4, SC and ISC with two basal rows of large quadrate punctures along each side. Spaces between costae with a strong stria bordered on each side by a low carina; strial punctures oval and deep, deepest in front, with a clear tubercle on each side that interrupts the carinae. Propygidium with front margin reflexed. PMC strong; reaching from just behind front margin to hind 0.2 to 0.1. PLC 0.5 times as long as PMC. Punctures large, round and separated by 0.5 times their diameters; vertices of elevations with minute punctures. Pygidium with LC strong; reaching from front margin to hind 0.4 to 0.3. TC strong, obtuse V-shaped, meeting TC in front 0.35. Punctures similar to those on propygidium. Prosternum with distinct depression between procoxae. Hind margin obtusely, roundly emarginate; some-

what sinuous. Punctures large, round, separated by their diameters; much smaller punctures between larger punctures, more dense towards the lateral margin. Prosternal lobe with punctures much smaller. Emargination present between prosternal lobe and proepisternum. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctures smaller and sparser than those on prosternum. Metasternum separated from mesosternum by an indistinct suture. Median longitudinal suture very fine and indistinct. Surface strongly depressed in the central area. Punctures large, round, separated by their diameters; punctures on discal area and along midline 0.50 times as large. First abdominal sternum punctate throughout with punctures similar to those on metasternum, but becoming smaller towards the hind margin. Protibia with eight weak spicules each on a slightly elevated base. Male genitalia illustrated in fig. 12.

FEMALES. Length: 2.6 to 2.8 mm; width: 1.6 to 2.1 mm. The females are very similar to the males. The metasternum of females is flat or only weakly depressed.

SPECIMENS. MEXICO: Durango. El Salto, 5.VI.1937, E.S. Ross, 44, (Cal. Acad.); 10 mi. W. El Salto, 16.VI.-12.VII.1964, H.F. Howden, 317, (CNC, Howden); 11-15.VII.1964, 9000 ft, J.E.H. Martin, 18, (CNC); 1.VII.1964, Linquist, oak, fir duff, dung, 7 (CNC); 11 mi. W. El Salto, 14-17.VI.1964, S. Peck, dung and carrion, 27, (CNC).

REMARKS. This species is at present known only from El Salto, Durango and has been collected in great numbers in baited traps. The variability expressed is quite low. The PC 1 costa of the males is slightly variable in length, and some males are slightly, but noticeably, smaller than most. The hind wing of at least the females is very much reduced. P.M. Hammond has kindly compared some of my specimens with the type.

4. Onthophilus intermixtus new species

Figures 14, 41, 54, Map 4

Onthophilus intermixtus n. sp. TYPE. Holotype, male, ARIZ. Graham Co. Pinaleno Mts. Wet Cn. 6100 ft, 29.VII.1969, A. Smetana, (CNC, Ottawa). Paratype, 1 male with the same data as the holotype (Howden, Ottawa).

DIAGNOSIS. This species resembles most closely flohri and deflectus in its general outline and punctation. It may be distinguished from them most readily by the almost equally well developed elytral costae. Other characters that are useful in separating these species are included under the specific description of deflectus. Although intermixtus has almost equally well developed elytral costae, it differs from those species in which the elytral costae are equally well developed in many significant ways. The dense, round to irregular punctation of the meso- and metasternum will immediately separate it from those species. The elytra are more convex, more elongate and the elytral costae are narrower and more sharply elevated than in the other two species.

MALES. Length: 2.5 mm; width: 1.8 mm. Head with VFC strong and complete. LFC strong, sharply elevated and meeting above clypeus. Punctures on vertex large and irregular, yielding strigose pattern; on frons and genae large, round to irregular, shallow and contiguous; on vertices of elevations small to minute. Labrum with front margin weakly arcuate; setiferous puncture in lateral 0.2; very short setae interspersed irregularly in front 0.5, separated by 3.0 to 5.0 times their length. Pronotum 0.5 times as long

as wide. Lateral margin smoothly arcuate; lateral bead strongly developed; surface along lateral edge reflexed from hind angles to front margin. Disk 6-costate. PC 1 long, straight and well developed; reaching from front 0.25 to hind margin. PC 2 strong, curved inward in front 0.25, straight in hind 0.75; reaching from just before front margin to hind margin. PC 3 strong and straight; reaching from front margin to just before hind margin. Surface smoothly convex between costae. Punctures large, round and shallow between lateral edge and PC 1; elongate, with interstices arranged in strigose pattern between costae, becoming sparser towards the middle; small to minute on vertices of elevations. Elytron wider than pronotum. EC 3, EC 5 and SC slightly lower than other costae in front 0.3. All costae with two rows of minute punctures just below the vertex; short yellow setae arising from them in the hind 0.5. All costae with a row of small quadrate punctures, which form a fine stria along the base, cutting off a fine and irregular carina. EC 3 slightly attenuated just before the front margin. Spaces between costae with a strong stria between two low carinae; strial punctures strong, oval and deep, with clear tubercles on their lateral edge, that interrupt the low carinae. Propygidium with PMC strong; reaching from front 0.1 to hind 0.1. PLC strong, 0.3 times as long as PMC. Punctures large, deep, irregular and contiguous; smaller on vertices of PLC. Pygidium with LC strong, complete from front to hind margin. TC very obtuse V-shaped, indistinct with punctures encroaching on its course, meeting LC in front 0.25. Punctures similar to those on propygidium, except smaller on two indistinct lateral tubercles and much smaller on vertex of LC. Prosternum flat between procoxae, convex in front. Hind margin broadly, roundly, shallowly emarginate. Punctures large, round, deep and separated by 0.5 times their diameters, with much smaller punctures on the interstices; punctures smaller on prosternal lobe. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctures similar to those on prosternum, but slightly smaller. Metasternum separated from mesosternum by a fine suture. Median longitudinal suture fine and distinct; surface weakly concave along it. Punctures intermingled large and medium sized, round, deep and nearly contiguous, with small punctures on interstices; small punctures dense on small oval area behind mesocoxa. First abdominal sternum with punctures along the front margin similar to those on metasternum, becoming progressively smaller towards the hind margin. Protibia with six small spicules on elevated bases in apical 0.5. Male genitalia illustrated in fig. 14.

FEMALE. Unknown.

SPECIMENS. This species is known only from the type material.

REMARKS. This species is named intermixtus because it apparently shares characters with both the flohri group and the lecontei group. It resembles flohri in most respects but the elytral costae of intermixtus are equally well developed and in this character it resembles the lecontei group.

5. Onthophilus alternatus (Say)

Figures 1, 2, 3, 4, 5, 7, 8, 10, 22, 33, 42, 55, 64, Map 3

Hister alternatus Say, 1825: 46. TYPE. Neotype here designated, female, bearing the following labels -- "orange", "O. alternatus (Say) Er.", red "MCZ TYPE 32249", red "NEOTYPE Helava '75". (Say stated that this species belonged in the genus Onthophilus Leach.)

Onthophilus alternatus (Say) Leconte, 1845: 52. Marseul, 1856: 558. Horn,

1873: 303.

DIAGNOSIS. O. alternatus is very similar to nodatus and pluricostatus in its general outline, in the shape and disposition of its pronotal costae and in the sculpture of its elytra. This species is most readily distinguished from the latter two species by the sparse punctation of the metasternum and by the shape of the punctures. Male specimens of alternatus have no large punctures along the longitudinal midline, only very fine punctures; females have few large punctures along the midline and have two large oval-triangular discal areas that are punctulate. The metasternal punctures on the central area are not ocellate in alternatus, but rather small and deep, with an abrupt leading edge and a less abrupt and fan-like trailing edge. If the ventral surface is not visible, alternatus may be distinguished with some confidence by the bituberculate verto-frontal carina and the fine, deep punctation of the pygidium.

MALES. Length: 1.6 to 1.9 mm; width: 1.4 to 1.7 mm. Head with VFC bituberculate. LFC strong, curved inwards; the two LFC meeting above the clypeus. Punctures on frons and genae small, deep and round; separated by 3.0 to 4.0 times their diameters; punctures much smaller, shallower and denser on vertices of elevations and above antennal sockets. Labrum with setiferous punctures in lateral 0.25. Pronotum 0.55 times as long as wide. Lateral margin feebly angulate at midpoint; lateral edge reflexed; lateral bead not prominent. Disk 6-costate. PC 1 slightly sinuous, strong; complete from front 0.3 to hind margin. PC 2 subsinuous, strong; complete from front margin to just before hind margin. PC 3 straight, strong; complete from front margin to hind 0.2. Surface much higher between inner four costae, than between PC 2 and lateral margin. Punctures, except on costae, small, deep, slightly elongate and separated by their diameters; punctures on vertices of elevations minute. Elytron wider than pronotum. ESC, ISC, EC 2, and EC 4 much higher and more pronounced than EC 1, EC 3, EC 5 and SC. EC 1 interrupted in front 0.3; EC 3 interrupted before front margin by a short transverse fossa between stria three and stria four; SC attenuated just behind the scutellum. Spaces between costae with a strong stria bordered on each side by a low carina; strial punctures deep and oval, especially deep just behind the front margin and in the front 0.3 of stria one to stria four, these giving the effect of a transverse depression; strial punctures with a tubercle on each side that interrupts the carina. All costae with a row of minute punctures on each side below the vertex. Propygidium with front margin strongly reflexed. PMC strong, complete from front 0.2 to hind 0.1. PLC 0.5 times as long as PMC. Punctures small, deep, round and separated by 2.0 to 3.0 times their diameters; punctures on vertices of elevations minute. Pygidium with front margin slightly reflexed. LC obsolete except in hind 0.2 or 0.1. TC strong and shaped like two contiguous shallow U's. Punctures similar to those on propygidium. Prosternum slightly depressed or flat between procoxae. Hind margin broadly, roundly emarginate. Punctures small, deep, round and separated by 2.0 to 3.0 times their diameters; prosternal lobe and interstices of punctures punctulate. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctured like prosternum. Metasternum separated from mesosternum by a fine, indistinct suture. Median longitudinal suture a fine, distinct, impressed line. Surface slightly to rather strongly depressed in front 0.5. Punctures along front margin small, deep and round, spaced irregularly; punctures along hind margin and on lateral areas large, irregular and sometimes indistinct, shallow and dish-like, with small, deep, round punctures near the leading edge. Central areas and interstices of punctures punctulate.

First abdominal sternum with front margin reflexed. A single row of punctures along front margin that are like those on the hind area of metasternum; punctures dense and much smaller on lateral areas; punctulate on central area. Protibia with seven to eight spicules, each on a weakly elevated base. Male genitalia illustrated in fig. 10.

FEMALES. Length: 2.0 to 2.5 mm; width: 1.6 to 2.0 mm. The females are very similar to males, except that the metasternum is not depressed and there is a double row of punctures along the longitudinal midline, leaving two large oval-triangular, punctulate, discal areas. The pygidial carina LC is longer; it is obsolete except in the hind 0.4 or 0.5.

SPECIMENS. UNITED STATES: ALABAMA. Seale, 21.III.1954, H.F. Howden, 9. FLORIDA. Clarksville, 21.III.1954, H.F. Howden, 20. DeFuniak Spr., 21.III.1954, H.F. Howden, 5. Levy Co., P. Laurent, 1. Mossy Head, 21.III.1954, H.F. Howden, ex skunk dung, 1 female. LOUISIANA. 10 mi. S.W. Alexandria, 1.IV.1960, J.G. Chillcott, 1 male, 4 females. NORTH CAROLINA. Raleigh, 18.X.1952, H. & A. Howden, ex Rhizopogon piceus, 25. Southern Pines, 6.X.1949, H. & A. Howden, ex rotten watermelon rind, 14. SOUTH CAROLINA. Columbia, 3.III.1932, O.L. Cartwright, 1. Windsor, XI.1933, E.S. Ross, ex dung, 31. Specimens are in the following collections: Cal. Acad., San Francisco; USNM, Washington; FMNH, Chicago; Howden, Ottawa; CNC, Ottawa; AMNH, New York; MCZ, Cambridge; ANSP, Philadelphia.

REMARKS. There is not a great deal of variability between the specimens examined. The pygidial carina LC is somewhat variable in length, both in males and females. Also the metasternal punctation is reduced in some males; the punctures are smaller and more irregular, often fused together behind the mesocoxae.

Say described alternatus from the Melsheimer collection under the name Hister alternatus, but stated that this species belonged to the genus Onthophilus Leach. It is very difficult to determine from Say's description to which species this description corresponds, and unfortunately Say's types, if extant in the Melsheimer collection, were not labelled. Leconte redescribed alternatus in 1845, but did not provide any useful diagnostic characters to separate alternatus from nodatus and pluricostatus which he described at the same time. However, Leconte did send a Zimmerman specimen from Georgia to Marseul, who redescribed alternatus in 1856. In the key to the species of Onthophilus, Marseul described the metasternum as "imponctué et impressioné au milieu" and in the description he stated that the metasternum is "fovéolé au milieu finement pointillé et entouré de quelque gros points épars". For these reasons, I have decided to attach the name alternatus to the species in which the males have no large punctures along the longitudinal midline, and in which the females have two large oval-triangular, punctulate discal areas. Although the distribution of this species appears to be centered in the southeastern states, and it may be unlikely that Say had a specimen which corresponds to my useage, I have decided to follow the useage of Leconte and Marseul, and have chosen a Leconte specimen as neotype.

6. Onthophilus nodatus Leconte

Figures 16, 23, 34, 43, 56, Map 2

Onthophilus nodatus Leconte, 1845: 53. TYPE. Holotype, (MNHN, Paris) not seen. Marseul, 1856: 556. Horn, 1873: 303.

DIAGNOSIS. O. nodatus is very nearly allied with alternatus and pluricostatus. This species may be separated from the former by the characters given in the diagnosis for alternatus. O. nodatus may be distinguished from pluricostatus by the following characters. The metasternum of pluricostatus is strongly depressed along the longitudinal midline, forming a broad, rounded trench from the front to the hind margin. This trench is stronger in the males than in females. The metasternum of nodatus is not depressed along the midline, although the large crateriform punctures along the midline sometimes give that impression. The tubercles on each side of the strial punctures are much stronger and clearer in nodatus, especially in striae three, four and five, than the tubercles in pluricostatus. The pronotal costae three of nodatus are, in general, parallel in the front 0.5 and are closer to each other than to pronotal costae two. The pronotal costae three of pluricostatus are divergent in the front 0.5 and are closer to pronotal costae two than to each other. The lateral margin of the pronotum of nodatus is more strongly reflexed than that of pluricostatus.

MALES. Length: 2.3 to 2.6 mm; width: 1.8 to 2.3 mm. Head with VFC strong and entire, reaching from occipital carina to frons between antennae. LFC strong, the two convergent, meeting above clypeus forming a short single carina. Punctures large, round, deep and separated by their diameters; interspaces of large punctures and vertices of elevations with minute punctures. Labrum with small, shallow punctures; setiferous punctures in lateral 0.25. Pronotum transverse, 0.5 times as long as wide. Lateral margins angulate in middle and very strongly reflexed; lateral bead prominent. Front margin weakly emarginate; front angles obtuse; front margin strongly reflexed from front angles to PC 2. Disk 6-costate. PC 1 long, straight or curved inwards; reaching from front 0.25 to hind margin. PC 2 subsinuate; reaching from front margin to just before hind margin. PC 3 curved feebly outward; reaching from front margin to slightly before hind margin. Surface between the four median costae higher than between PC 2 and lateral margin. Punctures medium, oval or round and deep; separated by their diameters. Elytron wider than pronotum. ESC, ISC, EC 2, EC 4, and SC abrupt and more strongly developed than EC 1, EC 3, and EC 5. EC 1 interrupted in front 0.3-0.5; EC 3 interrupted before front margin by a short transverse fossa between stria three and four, and interrupted in front 0.5; SC attenuated in front 0.2. All costae with a row of minute punctures on each side just below vertex. Spaces between costae with a strong stria bordered on each side by a low carina; strial punctures large, oval and deep; strial punctures strongest just behind front margin and in the front third of stria one to stria four; strial punctures with very strong tubercles on each side that interrupt the low carinae. EC 1, EC 2 and EC 3 attenuated before hind margin. Propygidium with front margin strongly beaded and reflexed. PMC strong; reaching from front 0.2 to hind 0.2. PLC slightly shorter than PMC. Punctures large, round and deep; separated by their diameters; vertices of elevations with minute punctures. Pygidium as long as wide. LC briefly interrupted behind transverse carina. TC bisinuate; with two short branches extending backwards in lateral 0.25 that are sometimes joined to LC. Punctures like those on propygidium. Prosternum flat between procoxae, strongly convex and higher in front. Hind margin broadly, roundly emarginate. Punctures large, round and deep; separated by their diameters; prosternal lobe with small, round, deep punctures. Mesosternum transverse, short. Front margin lobed to fit prosternal emargination. Punctures large, round and deep and contiguous. Metasternum separated from mesosternum by a fine suture. Median longitudinal suture fine. Surface flat or slightly

depressed. Punctures on narrow, triangular discal area minute, round and shallow; punctures elsewhere very large, shallow dish-like depressions with large, deep, round punctures within. First abdominal sternum with a row of large punctures like those on the hind margin of the metasternum, behind the front margin, becoming smaller and denser on the lateral areas; central area punctulate. Protibia with seven to eight spicules, the two most distad on weakly elevated bases. Male genitalia illustrated in Fig. 16.

FEMALES. Length: 2.6 to 3.0 mm; width: 2.3 to 2.5 mm. The females are very similar to males. The metasternum is slightly convex and the metasternal punctures are generally larger and are denser along the midline.

SPECIMENS. UNITED STATES: ALABAMA. 17 mi. N. Abbeville, 22.III.1954, H.F. Howden, ex malt trap, 1. FLORIDA. 2 mi. W. Archer, 24.III.1953, Howden & Dozier, ex propionic acid trap, 1. St. Augustine, 3. GEORGIA. 10 mi. N. Ft. Valley, Rt. 341, 17.III.1956, Howden & Howell, ex malt, 3. Tifon, 6.X.1968, J.A. Payne, ex gopher tortoise dung trap outside burrow, 1. NORTH CAROLINA. Southern Pines, 9.II.1952, H. & A. Howden, 1. OKLAHOMA. Payne Co., 20.III.1926, W.J. Brown, 1. SOUTH CAROLINA. Florence, 18.II.1938, 2. TEXAS. Nacogdoches, 14.V.1974, V. Nealis, ex human dung trap, pine-oak, 4. Specimens are in the following collections: FMNH, Chicago; USNM, Washington; CNC, Ottawa; Howden, Ottawa; MCZ, Cambridge.

REMARKS. There is very little variability between the specimens examined of this species, other than that already noted. Marseul's description of this species in 1856 corresponds closely to the specimens labelled O. nodatus in the Leconte Collection.

7. Onthophilus pluricostatus Leconte

Figures 13, 24, 35, 44, 57, Map 5

Onthophilus pluricostatus Leconte, 1845: 51. TYPE. Lectotype, here designated, sex not determined, bearing the following labels -- "orange", "937", "O. pluricostatus", red "MCZ TYPE 32251", red "lectotype Helava '75". Marseul, 1856: 565. Horn, 1873: 303.

DIAGNOSIS. This species is very closely allied with alternatus and nodatus. O. pluricostatus may be distinguished from these species by the broad, rounded, trench-like depression along the longitudinal midline of the metasternum. Further characters that separate this species from the latter two are dealt with under the diagnoses for alternatus and nodatus.

MALES. Length: 2.3 to 2.5 mm; width: 1.7 to 2.1 mm. Head with VFC entire. LFC strong, meeting above clypeus, and forming a short, single carina. Punctures large, round and deep; separated by their diameters on frons, genae and vertex; smaller above antennae; vertices of elevations with minute punctures. Labrum with small, shallow and round punctures; setiferous punctures in lateral 0.25. Pronotum 0.5 times as long as wide. Lateral margin strongly angulate at mid-point, sides in hind 0.5 parallel and convergent in front 0.5; lateral edges strongly reflexed; lateral bead indistinct. Front margin reflexed from front angles to PC 2; front angles 90°. Disk 6-costate. PC 1 strong, slightly curved outwards; complete from front 0.25-0.3 to hind margin. PC 2 sinuous; complete from front to hind margin. PC 3 straight, slightly curved outward in hind 0.1; complete from front margin to just before hind margin. Surface of pronotum elevated between four

median costae. Punctures medium, round and deep, separated by their diameters; sparser and slightly elongate between the PC 3; denser and slightly larger along lateral margin. Elytron wider in front than pronotum. ESC, ISC, EC 2, EC 4 and SC more abrupt and higher than EC 1, EC 3 and EC 5. EC 1 weakly attenuated in front 0.35 to 0.5; EC 3 interrupted before front margin by a short, transverse fossa between stria three and four; SC attenuated behind front margin. All costae with a row of very minute punctures on each side just below the vertex. All costae weakly attenuated before hind margin. Spaces between costae with a strong stria bordered on each side by a low carina; strial punctures large, oval and deep, deepest just behind front margin, and with small tubercles on each side; tubercles clearest in stria one and two, and interrupt the low carinae. Propygidium with front margin smoothly arcuate and strongly reflexed. PMC strong and complete from front 0.2 to 0.25 to hind 0.1. PLC 0.5 times as long as PMC. Punctures medium, round and deep; separated by their diameters. Pygidium with front margin slightly reflexed. TC very obtuse V-shaped. LC complete from front to hind margin except sometimes briefly interrupted just behind TC. Punctures similar to those on propygidium. Prosternum flat between procoxae, convex in front. Hind margin roundly, quite deeply emarginate. Punctures medium, round, deep and separated by 1.0 to 2.0 times their diameters; punctures on prosternal lobe much smaller. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctures much larger than those on prosternum; dish-like with medium, round and deep punctures in their centers, and nearly contiguous. Metasternum separated from mesosternum by a suture and an irregular impunctate line. Median longitudinal suture fine. Surface with broad, rounded, trench-like, longitudinal depression along the midline from the front to the hind margin. Punctures on two triangular, somewhat oval, weakly elevated discal areas small, round and shallow; punctures in front, behind and on lateral areas large, irregular, dish-like with medium, round, deep punctures inside them, and contiguous; punctures in depression smaller. First abdominal sternum with punctures along front margin like those on the lateral areas of the metasternum, except fan-like at their trailing edges; punctures smaller on lateral areas, becoming much smaller and sparser on central area. Protibia with eight small spicules, each on a weakly elevated base. Male genitalia illustrated in fig. 13 .

FEMALES. Length: 2.3 to 2.7 mm; width: 2.1 to 2.3 mm. The females are very similar to the males in most respects, except that the median depression of the metasternum is not well developed and clear in some specimens. These females may be identified with some confidence by the complete VFC and the carinae of the pygidium.

SPECIMENS. UNITED STATES: ALABAMA. Mobile, 24. Springhill, 24.XI.1918, H.P. Loding, 1. D.C., 1. GEORGIA. 5 mi. W. Toccoa, 3. IX.1967, J.M. & B.A. Campbell, under dog carcass, 5. KENTUCKY. Slade, 25.VIII.1967, J.M. & B.A. Campbell, 1. MARYLAND. Oakland, Hubbard & Schwarz, 1. MASSACHUSETTS. Framingham, 30-31.VII., C.A. Frost, ex fungus, 1. Natick, 13.IX.1913, C.A. Frost, sweeping in woods, 1. Springfield, 1.VIII.1927, D.H. Blake, under Lactarius, 1; 1954, Chapin, 1. MICHIGAN. Detroit, Hubbard & Schwarz, 1. NEW JERSEY. Lakehurst, 16.VIII.1912, 1. NEW YORK. Peck, 1. NORTH CAROLINA. Pisgah Forest, Looking Glass Mt., 21, 27.VIII.1940, O.L. Cartwright, 2; Pisgah Forest, 26.VIII.1941, O.L. Cartwright, 16. PENNSYLVANIA. Jefferson Co., 10.IX.1950, O.L. Cartwright, 1. SOUTH CAROLINA. Mountain Rest, 7.IX.1944, O.L. Cartwright, under cow dung, 1. Oconee

Co., Fish Hatchery, 3.IX.1935, 1; CCC Camp F2, 29.VIII.1937, 15.VIII.1947, O.L. Cartwright, 3. Sassafras Mtn, Rocky Bottom, 4.IX.1934, O.L. Cartwright, 1. TENNESSEE. Burrville, 16.X.1954, H.F. Howden, ex malt, 3. Chilhowee Mts., 3.X.1953, H. & A. Howden, ex malt and propionic acid trap, 8. Great Smokey Mt. Nat. Pk., 6.VIII.1955, H. & A. Howden, ex malt, 1. VIRGINIA. Church Falls, 19.VII.1919, E.A. Chapin, ex Lactarius piperans, 1. Lee Co., Jone's Cove, Hubbard & Schwarz, 2. Specimens are in the following collections: FMNH, Chicago; USNM, Washington; CNC, Ottawa; Howden, Ottawa; MCZ, Cambridge; AMNH, New York; O.L. Cartwright.

REMARKS. There is little variability between the specimens examined of this species, other than for the depth and density of punctation of the longitudinal trench of the metasternum. The only specimen in the Leconte Collection identified as O. pluricostatus is not in very good condition, but appears to fit Marseul's description (1856) and that of Leconte (1845), and was therefore chosen as lectotype.

8. Onthophilus wenzeli new species

Figures 25, 45, 58, Map 3

Onthophilus wenzeli n. sp. TYPE. Holotype, female, Nebraska (salt basin), 27.X.1923, Owen Bryant, (USNM, Washington).

DIAGNOSIS. This species may be distinguished from other species with equally well developed elytral costae, by the well developed pronotal costae PC 2 and PC 3, and by the fact that the pronotal costa PC 1 is not strongly and entirely undercut along its inner edge. The pronotal costae of intermixtus are well developed, but it is smaller in size and the meso- and metasternum are densely punctate. The metasternum of wenzeli has two large discal areas that are punctulate.

FEMALES. Length: 3.4 mm; width: 2.4 mm. Head with VFC reduced to a tubercle between antennae. LFC strong at antennae; attenuated in the middle; meeting above clypeus, forming an elevation that reaches the clypeal margin. Punctures round and irregular in size; much finer and denser above antennae and on vertices of elevations. Labrum finely punctate; setiferous punctures in lateral 0.25. Pronotum 0.50 times as long as wide. Lateral margins strongly angulate and reflexed; parallel in hind 0.50, convergent in front 0.50; lateral bead prominent; front angles acute. Disk 6-costate. PC 1 long and straight; reaching from front 0.3 to hind margin. PC 2 subsinuate and entire from front to hind margin. PC 3 slightly curved inward; reaching from front margin to slightly before hind margin. PC 2 and PC 3 closer together than the two PC 3. Surface between PC 1 and PC 2 depressed. Punctures medium size; separated by their diameters; slightly elongate on disk, rounder along lateral bead. Elytron broader than pronotum, narrower behind. All elytral costae equally strong and entire. SC attenuated before front margin. Costae with two rows of minute punctures on vertices. Interspaces between with strong stria bordered by two low carinae; strial punctures strong, more prominent towards front margin. EC 1 slightly attenuated in front 0.30 to 0.45. ESC strongly sinuate; punctate in hind 0.75. Propygidium with PMC strong in hind 0.75. PLC 0.65 times as long; vertex smoothly, broadly rounded. Punctures medium sized and deep along front margin, becoming smaller to minute and sparser towards hind margin and along vertices of elevations. Pygidium with weak, bisinuate TC in front 0.30. Surface depressed between front margin and TC. Punctures medium size,

round, separated by their diameters along front margin and on discal area, becoming small to minute along lateral margins and on vertex of TC. Prosternum slightly depressed between procoxae. Hind margin deeply, sinuously emarginate. Punctures medium size, round and separated by their diameters, with minute punctures on interspaces and on prosternal lobe. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination; strong, bisinuous. Metasternum separated from mesosternum by clear suture. Median longitudinal suture faint. Surface depressed along midline in front 0.10. Punctures along midline and front margin dish-like with medium size, round, deep punctures inside front edge; separated by their diameters; behind mesocoxae and lateral areas irregular and confluent; on interspaces and on two large triangular discal areas minute. First abdominal sternum with punctures similar to those on front 0.2 of metasternum along front edge and lateral areas; large semicircular median area that is punctulate. Protibia with fifteen slender spicules, each on a weakly elevated base.

MALES. Unknown.

SPECIMENS. Known only from the holotype.

REMARKS. The pronotum of this species is very similar to that found in the alternatus group. The lateral edge is strongly reflexed and the surface is depressed between PC 1 and PC 2, and the pronotal costae are very strongly developed. At present the range of this species is restricted but further investigations of small mammal burrows will undoubtedly reveal that it has a much wider range. This species is named for R.L. Wenzel in recognition of his assistance to me and other students of the Histeridae.

9. Onthophilus cynomysi new species

Figures 15, 26, 37, 46, 59, Map 3

Onthophilus cynomysi n. sp. TYPE. Holotype, male, Oklahoma, Grady Co., 4 mi. N. Blanchard, 17.VIII.1953, M.J. Wilcomb, (FMNH, Chicago). Allotype, female, with the same data as the holotype, (FMNH, Chicago). Paratypes, 5 males and 5 females with the same data as the holotype, (FMNH, Chicago; Howden, Ottawa).

DIAGNOSIS. This species resembles wenzeli, lecontei and soltaui in general outline. All four species have distinct pronotal costae two and pronotal costae three. The pronotal costa one in cynomysi is undercut along the entire length of the inner edge, while it is undercut only in the hind 0.2 in wenzeli. The pronotal costae two of cynomysi are convergent behind while they are straight or divergent behind in the other three species. The strongly and abruptly depressed surface between pronotal costa one and the lateral margin of cynomysi serves to separate this species from lecontei and soltaui.

MALES. Length: 2.5 to 3.1 mm; width: 2.1 to 2.5 mm. Head with VFC short, indistinct; often obscured by encroaching punctures. LFC meeting above clypeus; attenuated above clypeus, often indistinct. Surface depressed between the two LFC. Punctures round, medium sized, and separated by 0.5 to 1.0 times their diameters, except finer and setiferous on the vertices of the elevations. Labrum with two setiferous punctures in lateral 0.25, the setae long and prominent; the rest of the surface with much shorter setae that are separated by their lengths. Pronotum transverse, 0.5 times as long as wide. Lateral margin broadly angulate at midpoint; lateral bead prominent with inner groove. Front margin shallowly, roundly, emarginate; front angles slightly obtuse. Disk 6-costate. PC 1 slightly subsinuous; reaching from front 0.25 to hind margin; surface along outer edge smoothly, quite abruptly

depressed, then abruptly reflexed along lateral margin; inner edge strongly undercut along its entire length; surface between PC 1 and PC 2 depressed, forming a shallow trench that narrows strongly towards the front. PC 2 subsinuous; reaching from front 0.1 to just before hind margin; attenuated in front 0.5, higher and broader behind; obscured in front and behind by punctures. PC 3 curved weakly outward; reaching from just behind front margin to hind 0.25; obscured before and behind by punctures; the two PC 3 convergent behind. Punctures medium sized and separated by their diameters; round to oval on lateral and hind areas, more elongate in trench and on central areas. Elytron wider than pronotum. All costae equally well developed. SC slightly attenuated in front 0.3; two confluent and irregular rows of punctures just below the vertex, that are more prominent in hind 0.5. All other costae with two rows of minute punctures that bear short setae in hind 0.5. Interspaces between costae with a strong stria that is bordered by two low carinae; strial punctures much deeper at front margin. Propygidium with PMC broad, rounded, strongest just before hind margin; surface depressed behind hind end of PMC. PLC indistinct, broad swelling. Punctures medium size, deep, round and separated by their diameters, except on vertex of median elevation, punctures about 0.5 as large and elongate. Pygidium surface without carinae. Front margin reflexed; discal area convex. Punctate throughout; punctures similar to those on propygidium. Prosternum generally convex, with slight concavity between procoxae. Hind margin with deep, cuspidal emargination. Punctures round, medium size, deep and separated by 0.5 to 1.0 times their diameters. Mesosternum short and transverse. Front margin with a cusp to fit prosternal emargination. Punctures twice as large as those on prosternum, contiguous or separated by 0.5 times their diameters. Metasternum separated from mesosternum by clear suture. Median longitudinal suture fine and clear. Median area weakly concave. Punctures along front, hind and lateral margins like those on mesosternum; becoming finer on median discal areas. First abdominal sternum with punctures along front margin and on lateral areas similar to those on front third of metasternum; semicircular central area punctulate. Protibia with a row of ten to twelve spicules, on elevated bases. Male genitalia illustrated in fig. 15.

FEMALES. Length: 3.0 to 3.6 mm; width: 2.5 to 3.0 mm. Except for sexual characters the females differ very little from the males. On the average females are slightly larger than males; the outer edge of the lateral pronotal trench reaches the front 0.3; the metasternum is not depressed along the midline and the protibial spicules are stronger.

SPECIMENS. This species is known only from the type material.

REMARKS. There is very little variability within this species. The facial carina, pronotal costae and the PMC of the propygidium are less distinct in some specimens than in others. The protibial spicules are broken or worn on older specimens.

Virtually nothing is known about the biology or habits of this species. All the material seen was collected by M.J. Wilcomb during his study of prairie dog burrows. The conditioned soil was scraped from the tunnels and small arthropods were extracted with Berlese funnels. The name cynomysi does not mean to imply that this species is characteristic of, or confined to Cynomys burrows, but merely that this is the niche from which it was taken.

10. Onthophilus soltaui Casey

Figures 27, 47, 60, Map 1

Onthophilus soltaui Casey, 1893: 557. TYPE. Holotype, sex undetermined, bearing the following labels -- "Col.", "Denver 10/1890", "Casey bequest 1925", "soltaui Csy", red "TYPE USNM 38463", (USNM, Washington), not seen.

DIAGNOSIS. This species is very similar to lecontei and cynomysi. Characters that separate soltaui from them are dealt with in the diagnoses for lecontei and cynomysi.

FEMALES. Length: 3.5 mm; width: 2.5 mm. Head with VFC faintly indicated. LFC faint, barely discernable above clypeus. Punctures between the two LFC, and between LFC and lateral margin, large, round, shallow and separated by 0.5 to 1.0 times their diameters; above clypeus, on vertex, and on vertices of elevations strong, fine and dense. Labrum with setiferous puncture in lateral 0.25; shorter setae along front 0.5 separated by their lengths. Pronotum 0.6 times as long as wide. Lateral margins straight and subparallel to middle, then abruptly angulate, strongly convergent to front angles; lateral bead prominent, abruptly reflexed; front angles slightly obtuse, scarcely rounded. Disk 6-costate. PC 1 prominent and smoothly arcuate outwards; reaching from front 0.25 to hind margin; outer edge indistinct, not abrupt, surface smoothly continuous from vertex of PC 1 to lateral bead; inner edge very abrupt, deeply undercut and shining; surface between PC1 and PC 2 depressed, forming a broad trench. PC 2 straight and faint; reaching from front 0.25 to hind 0.25. PC 3 faint; weakly curved inward in front 0.1, then straight; reaching from front margin to hind 0.3. Punctures large, shallow and separated by approximately their diameters; round between median costae; elongate between PC 1 and PC 2 forming strigose pattern; less dense to lacking along lateral margin. Elytron wider at base than pronotum. Costae strong and even. SC attenuated in front 0.3. Vertices of costae with double row of fine setiferous punctures. Interspaces between costae with two fine, lateral carinae bordering a clear stria; strial punctures shallow, strongest at front margin. External subhumeral stria more coarsely punctate; area between it and lateral side coarsely punctate. Marginal stria indistinctly defined. Propygidium with PMC complete from front 0.2 to hind margin; indistinct in front; forming distinct tuberculate elevation behind. PLC indistinct. Punctures medium, round, shallow and separated by 1.0 to 1.5 times their diameters; punctures more distinct along their front edges. Pygidium with surface strongly convex. Front edge reflexed with distinct depression in front angles. Punctures similar to those on propygidium, but separated by 0.25 to 1.0 times their diameters; denser along hind margin. Prosternum strongly convex before procoxae, flat behind. Hind margin quite deeply, obtusely emarginate. Punctures medium, round, shallow and separated by their diameters; interspaces, hind margin and lateral margin behind procoxae with minute, round punctures. Prosternal lobe with small and minute punctures densest along midline, becoming sparser laterally. Mesosternum short and transverse. Front margin bisinuate; somewhat cuspid lobe fitting into prosternal emargination. Punctures medium, round, shallow and separated by 0.5 times their diameters. Metasternum separated from mesosternum by a clear suture. Median longitudinal suture fine. Punctures in front 0.3 and along hind margin large, round, shallow and separated by 0.5 times their diameters; becoming irregular and contiguous along lateral margin; interspaces and central areas with dense, minute punctures. First abdominal

sternum covered throughout with punctures similar to those on front 0.3 of the metasternum. Protibia with nine spicules mounted on elevated bases.

MALES. Unknown.

SPECIMENS. UNITED STATES. COLORADO. Denver, X.1890, H. Soltau, 1 female, (USNM, Washington).

REMARKS. Although soltaui is very similar to cynomysi and lecontei there appear to be sufficient differences to retain it as a good species. Since soltaui is known from only two specimens the ultimate decision as to whether these differences are species differences, or merely represent extremes of a clinal variation, must be reserved until more material has been collected. S. Peck has kindly compared my specimen with the type. No significant differences were perceived.

11. Onthophilus lecontei Horn

Figures 17, 28, 48, 61, Map 4

Onthophilus lecontei Horn, 1870: 138. TYPE. Holotype, sex undetermined, bearing the following labels -- "Ca.", red "HOLOTYPE 3237", "Onthophilus lecontei Horn", type locality Fort Tejon, California, (MCZ, Cambridge).

DIAGNOSIS. O. lecontei is very similar in its general outline to soltaui, wenzeli and cynomysi. For characters that separate the last two from lecontei refer to the diagnoses for these two species. O. lecontei may be separated from soltaui by the characters given in the key. There are other comparative characters which separate these species. The lateral bead is not as robust in soltaui, the lateral margin is more strongly reflexed, PC 1 is more strongly undercut before the hind margin, the trench between PC 1 and PC 2 is deeper, and the sutural costa has an irregular double row of small punctures separating it from the suture. These punctures are less dense and often quite indistinct in lecontei.

MALES. Length: 2.5 to 3.0 mm; width: 1.9 to 2.1 mm. Head with VFC small, low tubercle. LFC attenuated before clypeus; the LFC convergent but not meeting. Surface between antennae to occipital carina depressed; clypeo-frontal surface elevated along midline. Punctures large, round and contiguous in frontal area and on genae; punctures much smaller on vertex and clypeo-frontal elevation. Labrum with setiferous punctures in lateral 0.25. Pronotum 0.5 times as long as wide. Lateral margin smoothly arcuate or with slight angles at midpoint; lateral bead very strong with inner depression deep and extending along front margin. Front margin smooth, deep, round emargination; front angles 90°. Disk 6-costate. PC 1 slightly curved outward; reaching from front 0.25 to hind margin; outer edge indistinct, not abrupt, surface continuous from vertex to lateral margin; inner edge abrupt, strongly undercut along its entire length; surface between PC 1 and PC 2 depressed, forming a shallow trench that reaches the front angles. PC 2 very weakly subsinuate; attenuated before hind and front margin. PC 3 straight; attenuated before hind margin; strongest at front margin. Punctures medium, round along lateral edge and between PC 2 and PC 3; more elongate in depression between PC 1 and PC 2 and between the two PC 3; punctures encroaching on PC 2 and PC 3 in hind 0.25. Elytron wider than pronotum. All costae equally well developed and entire. SC attenuated in front 0.2. All costae with a row of minute punctures on each side just below the vertex, that bear minute setae in the hind 0.3. Spaces between costae with a strong stria that is bordered on each side by a low carina; strial punctures oval and

deep, with small tubercle on each side that interrupts the carinae; first puncture behind the front margin especially deep; punctures in the mid-section of stria one, two and three slightly deeper; minute punctures between costae and carinae. Propygidium with lateral margin angulate in front 0.2. PMC indistinct; reaching from front margin to hind 0.3; higher and broader in hind 0.5. Surface weakly depressed behind PMC. Punctures medium size, and elongate; interstices arranged in strigose pattern. Pygidium with no carinae; surface convex with transverse depression behind front margin. Punctures medium, round and separated by their diameters; becoming finer towards hind margin. Prosternum weakly depressed between procoxae, convex in front. Hind margin with obtuse, somewhat rounded, deep emargination. Punctures medium, round and separated by 1.0 to 2.0 times their diameters; much smaller punctures on interspaces. Prosternal lobe with small punctures; surface strigulate. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Punctures similar to those on prosternum with at least two complete rows across. Metasternum separated from mesosternum by a fine suture. Median longitudinal suture very fine. Surface distinctly concave behind front margin. Large dish-like punctures with small deep punctures inside their leading edge, in front 0.5, along midline, along hind margin and on lateral areas; interspaces of large punctures and discal areas with minute punctures. First abdominal sternum with large punctures along front margin and on lateral areas; large semicircular median area punctulate. Protibia with six to eight strong spicules each on an elevated base. Male genitalia illustrated in fig. 17.

FEMALES. Length: 3.2 to 3.7 mm; width: 2.4 to 2.7 mm. The females differ from males very little except for sexual characters. They are on the average larger, the metasternum is not depressed and the protibial spicules are slightly stronger.

SPECIMENS. UNITED STATES. CALIFORNIA. Atascadero, 8.II.1940, E.S. Ross, ex gopher burrow, 1 male, 1 female. Contra Costa Co., Danville, 5-8.XII.1951, F.X. Williams, ex Vespula pennsylvanica nest or debris, 1 male, 1 female; 9.II.1952, 28-30.III.1952, 17.IV.1952, F.X. Williams, ex gopher burrow, 15. Monterey Co., Carmel, 5.III.1914, 27.II.1915, 19.III.1915, 4.II.1917, S.L. Slevin, 4; Monterey, 20.XI.1925, S.L. Slevin, 1. Pasadena, XII, A. Fenyes Coll., 1 male, 1 female; II, A. Fenyes Coll., 1 female. Salada Beach, 21.IV.1928, F.E. Blaisdell, 1 male. San Diego Co., Poway, F.E. Blaisdell, 2. Santa Barbara, 22.XII.1928, F.E. Blaisdell, 1 female. Santa Cruz, 21.V.1921, S.L. Slevin, on dandelion, 1 male. Tracy, 5.III.1939, 1 female. (Cal. Acad., San Francisco; Howden, Ottawa)

REMARKS. There is not very much variation expressed in the specimens of this species. The trench between PC 1 and PC 2 is less well developed and the lateral margin is weakly angulate in some specimens. These differences do not appear to be clinal, but are expressed irregularly throughout the known range. O. lecontei has been recorded only from the coastal areas of California, and is apparently well isolated today from other related species.

12. Onthophilus thomomysi new species

Figures 18, 29, 36, 49, 62, Map 4

Onthophilus thomomysi n. sp. TYPE. Holotype, male, MEXICO. Durango. 10 mi. W. El Salto, 4.VI.1964, H.F. Howden, ex Thomomys burrow,

(CNC, Ottawa). Allotype, female, with the same data as holotype, (CNC, Ottawa). Paratypes, 11 males and 7 females with the same data as holotype, (CNC, Ottawa; Howden, Ottawa).

DIAGNOSIS. This species may be distinguished from the other species with equally well developed elytral costae, except kirni, by the absent or almost indistinguishable pronotal costae PC 2 and PC 3. For characters that separate thomomysi from kirni, refer to the diagnosis for the latter. Some specimens of thomomysi may be confused with very worn specimens of lecontei in which the pronotal costae PC 2 and PC 3 may be very low. These species may be separated by the pronotal punctures. The punctures of thomomysi are small, round and separated by several times their diameters. The punctures of lecontei are medium sized, oval and separated by their diameters.

MALES. Length: 3.2 to 3.4 mm; width: 2.6 to 2.7 mm. Head with VFC and LFC obsolete; indicated by broad, rounded elevations. Punctures on frons, vertex and above antennal sockets small, round and separated by several times their diameters; larger and sparser on genae. Labrum with setiferous punctures in lateral 0.25; surface densely punctulate. Pronotum 0.5 times as long as wide. Lateral margin weakly, broadly angulate; lateral bead prominent, with shallow inner groove, strongest in hind 0.5. Front margin deeply roundly emarginate; front angles 90 . Disk 2-costate. PC 1 strong, arcuate outward; reaching from front 0.25 to hind margin; outer edge smoothly continuous with surface between it and lateral margin; inner edge abrupt, strongly undercut and shining; surface mesad of PC 1 depressed, forming a shallow trench that runs the length of PC 1 and curves to the front angles. PC 2 and PC 3 entirely absent or sometimes faintly indicated by more shining and very weakly elevated areas. Punctures round, small on disk, larger along lateral margin, in lateral trench and along the hind margin; separated by two or more times their diameters. Elytron wider than pronotum. All costae equally well developed. SC attenuated in front 0.1. EC 3 slightly lower just behind front margin. All costae with two irregular rows of minute punctures, one on each side just below the vertex, that bear short setae in the hind 0.4. Spaces between costae with two low carinae and a strong, clear stria between them; strial punctures oval, deep and with small lateral tubercles that interrupt the carinae; strial punctures much stronger and deeper at the front margin, and slightly deeper in the midsection of stria one and stria two. Propygidium with lateral margin obtusely angulate in front 0.3. PMC and PLC faint, broad and low; more prominent in hind 0.6. Punctures along front margin small, round and separated by 2.0 to 5.0 times their diameters, gradually becoming smaller and sparser, almost absent from middle to hind margin. Pygidium with TC faint, broad, low and sinuate, its midpoint almost reaching front margin, its lateral ends in front 0.25. Punctures throughout small and round; separated by 2.0 to 4.0 times their diameters. Prosternum depressed between procoxae. Hind margin with deep, cuspid emargination. Punctures small, round and sparse; punctulate in front of hind margin. Prosternal lobe impunctate. Mesosternum short and transverse. Front margin lobed to fit prosternal emargination. Two transverse rows of small, round punctures separated by 2.0 times their diameters. Metasternum separated from mesosternum by a fine suture. Median longitudinal suture fine. Midline and large discal areas punctulate. Punctures in front and hind 0.3 small and round, separated by 2.0 to 4.0 times their diameters; punctures in lateral 0.5 large, shallow, somewhat irregular and dish-like, with small deep punctures within their front edges, confluent to separated by their diameters. Surface depressed behind front margin.

First abdominal sternum with punctures along front margin and on lateral areas similar to those along front margin of metasternum; large, semicircular central area that is punctulate. Protibia with eight spicules each on an elevated base. Male genitalia illustrated in fig. 18.

FEMALES. Length: 3.5 to 3.6 mm; width: 2.7 to 2.8 mm. The females are very similar to the males. The metasternum is not depressed and there are two rows of punctures similar to those along the front margin, along the longitudinal midline.

SPECIMENS. Type series. NEW MEXICO. Engle, 1 (MCZ, Cambridge).

REMARKS. Very little variability was noted, other than for the slight differences in the development of the pronotal costae. All specimens were heavily covered by a hard accretion of waxy exudate and adhered soil particles.

As with cynomysi, the name thomomysi does not intend to imply that this species is characteristic of, or confined to the burrows of Thomomys, but it is proposed merely to indicate the niche from which this species was first collected.

13. Onthophilus kirni Ross

Figures 19, 30, 50, 63, Map 1

Onthophilus kirni Ross, 1944b: 115. TYPE. Holotype and allotype, Texas, seven and one-half miles S.E. Somerset, 18.II.1943, A.J. Kirn, collected in a bait trap in a Geomys burrow, (Cal. Acad., San Francisco). Not seen. Paratypes, numerous males and females collected at the above locality in baited traps and by excavating Geomys burrows by A.J. Kirn and E.S. Ross, (deposited in numerous collections).

DIAGNOSIS: The males and females of this species can be readily distinguished from other species in which the elytral costae are equally well developed by the following combination of characters. The pronotal costae PC 2 and PC 3 are entirely obsolete. The third elytral costa is abbreviated in front by a short, deep, transverse trench that joins stria three and stria four. The metasternum is densely and finely punctate.

MALES. Length: 2.8 to 3.0 mm; width: 1.9 to 2.2 mm. Head with VFC and LFC poorly indicated by broad, low elevations. Punctures round, medium sized, slightly larger on frons and genae than on vertex, and separated by 0.5 to 1.0 times their diameters. Labrum with setiferous punctures along front margin; one long seta in lateral 0.25; other setae much shorter and separated by approximately their lengths. Pronotum 0.75 times as long as wide. Lateral margin very broadly, obtusely angulate, somewhat rounded; lateral bead prominent with a deep inner groove along the entire length of side, deepest at front angles. Front margin shallowly, roundly emarginate; front angles almost 90°. Disk with two broad trenches in lateral 0.25; trenches shallow, broader at their hind end, narrowing towards the front, reaching front 0.3; inner edge poorly indicated; outer edge equivalent to PC 1, abrupt, undercut, deepest at the hind margin, curved and shining. Punctures medium sized and separated by 0.5 to 1.0 times their diameters; round and densest between lateral margin and trench; elongate in trench and along longitudinal midline. Elytron with all costae approximately equally well developed, broad and low; EC 3 abbreviated before front margin by a short, deep, transverse fossa that joins stria three and stria four; EC 2 and EC 4 slightly broader and higher at front margin than other costae; SC slightly lower than other costae, separated from suture by a well defined, irregular

row of small punctures; all costae with a double row of minute punctures that are indistinct in the front 0.5 and have minute yellow setae in the hind 0.3. Interspaces between costae with two lower carinae that border a clear stria; strial punctures not distinct except along front margin and in hind 0.3. Propygidium with front margin reflexed. PMC reaching from front margin to just before hind margin; tear-shaped, narrow and low in front, broader and higher behind. PLC low and indistinct. Punctures oval and medium sized, separated by 0.5 to 1.0 times their diameters; leading edge of punctures better defined than trailing edge; punctures finer and sparser on vertex of PMC. Pygidium as long as wide. Surface convex; front edge most abrupt, forming a broad, transverse channel just behind the front margin. Punctures round and the same size as those on the propygidium; deeper and larger in the transverse channel. Prosternum very slightly concave between procoxae. Hind margin roundly emarginate. Punctures similar to those on the head, but with minute yellow setae arising from them in the hind 0.5; punctures on prosternal lobe smaller. Mesosternum short and transverse. Front margin lobed to fit the prosternal emargination. Punctures similar to those on hind 0.5 of prosternum. Metasternum separated from mesosternum by a clearly defined suture. Median longitudinal suture strong and fine. Surface shallowly depressed behind front margin. Punctures on the central area like those on hind 0.5 of prosternum; larger and very irregular on lateral 0.25. First abdominal sternum punctate throughout with punctures similar to those on the central area of metasternum. Protibia with eight spicules, each on an elevated base. Male genitalia illustrated in fig. 19.

FEMALES. Length: 3.0 to 3.6 mm; width: 2.4 to 2.6 mm. The females are very similar to the males, except that the metasternum is not depressed, and the protibial denticules are larger, more numerous and extend almost to the base.

SPECIMENS. I have seen a series of forty paratypes from California Academy of Sciences, San Francisco.

REMARKS. E.S. Ross and A.J. Kirn encountered kirni in large numbers in the nesting chambers of Geomys breviceps attwateri. As many as nineteen were found in one nest. In total they collected 115 specimens by digging out burrows and by bait traps (Ross, 1944a, b).

14. Onthophilus giganteus new species

Figures 65, 66, 67, 68, Map 5

Onthophilus giganteus n. sp. TYPE. Holotype, male, FLORIDA. Alachua Co. 1 mi. W. Archer, 15-19.I.1976, J.R. Diley, ex malt trap (FDACS, Gainesville).

DIAGNOSIS. This species may be separated from all other species by the following combination of characters: size over 4 mm; very strongly broadened front ends of elytral costae EC 2 and EC 4; very large and deep strial punctures just behind the front margin of the elytra.

MALES. Length: 5.6 mm; width: 4.1 mm. Head with VFC well developed, reaching from occipital carina to frons between antennae. LFC present near antennal sockets, obsolete elsewhere. Punctures minute, deep, separated by several times their diameters; denser on vertex and above clypeus. Labrum with minute, dense punctures; setiferous punctures in lateral 0.25. Pronotum transverse, 0.5 times as long as wide. Lateral margin arcuate, very strongly reflexed; lateral bead prominent. Front margin broadly, roundly emarginate; reflexed from front angles to PC 2. Disk

6-costate. PC 1 long, strongly angulate in front 0.2; reaching from front 0.2 to hind margin. PC 2 sinuate, broader behind; reaching from front margin to just before hind margin. PC 3 weakly indicated by broad elevations, slightly curved outward; reaching from front margin to hind 0.2. Surface very convex, very deeply depressed between PC 1 and PC 2; depression broad behind, narrowing towards front margin. Punctures on disk small to minute intermixed, sparser on costae and along lateral margin, depression impunctate. Elytron wider than pronotum. EC 2 and EC 4 slightly higher, much more robust at front margin than ESC, ISC, EC 1, EC 3, EC 5 and SC. EC 3 interrupted before front margin by short, deep, transverse fossa between EC 2 and EC 4; SC attenuated in front 0.5. Strial punctures oval, deeper, more pronounced towards hind margin; stria two, three, four and five with extremely large, deep punctures just behind front margin. Punctures on vertices of costae minute, oval, sparse. Propygidium with PMC strong, tear-shaped; reaching from front 0.5 to hind margin. PLC as long as, and converging towards PMC behind. Punctures medium, round, deep, separated by 2 to 3 times their diameters; contiguous just behind front margin; punctures on vertices of elevations minute. Pygidium with LC obsolete in middle 0.3; strong in hind 0.3; low, bicarinate in front 0.3. TC indicated by broad, low elevations. Punctures similar to those on propygidium. Prosternum slightly depressed between procoxae. Hind margin broadly, roundly emarginate. Punctures similar to those on propygidium, denser along lateral margin and behind; interstices of large punctures and prosternal lobe punctulate. Mesosternum short, transverse. Front margin lobed to fit prosternal emargination. Punctures slightly larger than those on prosternum; contiguous or fused laterally. Metasternum separated from mesosternum by a fine, distinct suture. Median longitudinal suture fine, distinctly impressed. Surface with broad, median depression in front 0.3. Punctures along hind margin like those on mesosternum; laterally large, irregular, shallow, confluent; fused into broad, deep, punctate fossa along inner margin of lateral metasternal stria; punctures on disk and interstices of large punctures sparse and minute. First abdominal sternum with front margin reflexed. Punctures medium, deep, sparse behind front margin; forming short fossa behind metacoxae; large, shallow, irregular, contiguous laterally; minute elsewhere. Protibia with fourteen spicules, each on a weakly elevated base; apical three contiguous. Male genitalia illustrated in fig. 68.

FEMALES. Unknown.

SPECIMENS. This species is known only from the holotype.

REMARKS. O. giganteus is by far the largest species of Onthophilus yet described. It is nearly 1.5 mm longer than the next largest and nearly four times longer than the smallest. Apparently it belongs near nodatus, but the elytral costae are not as unequally developed.

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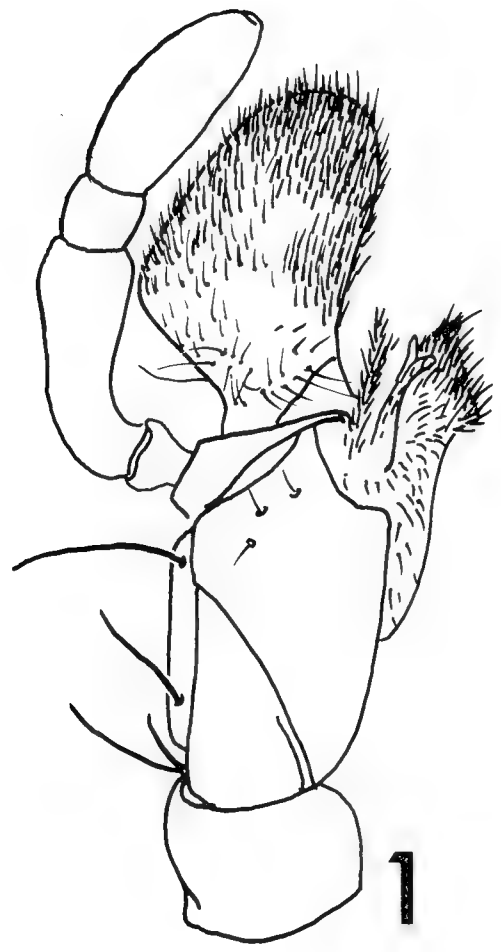
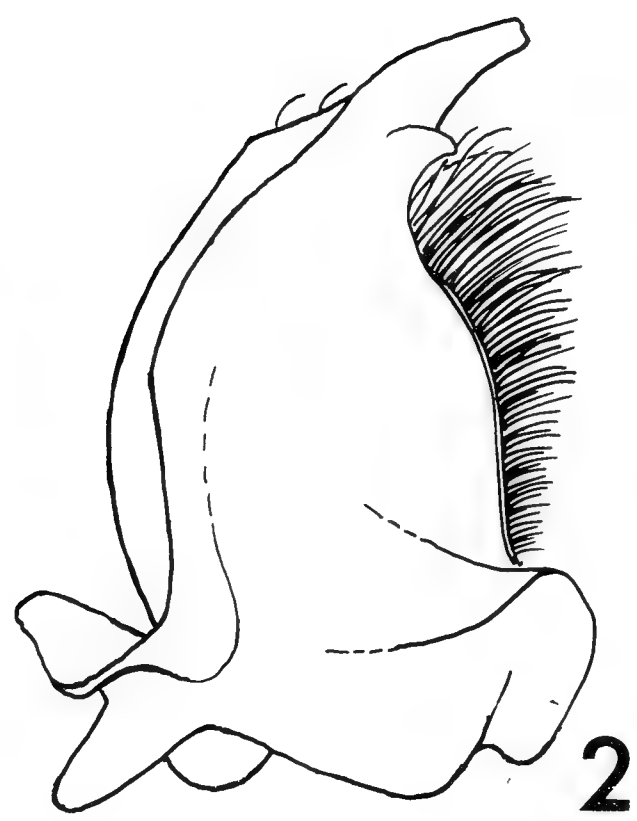
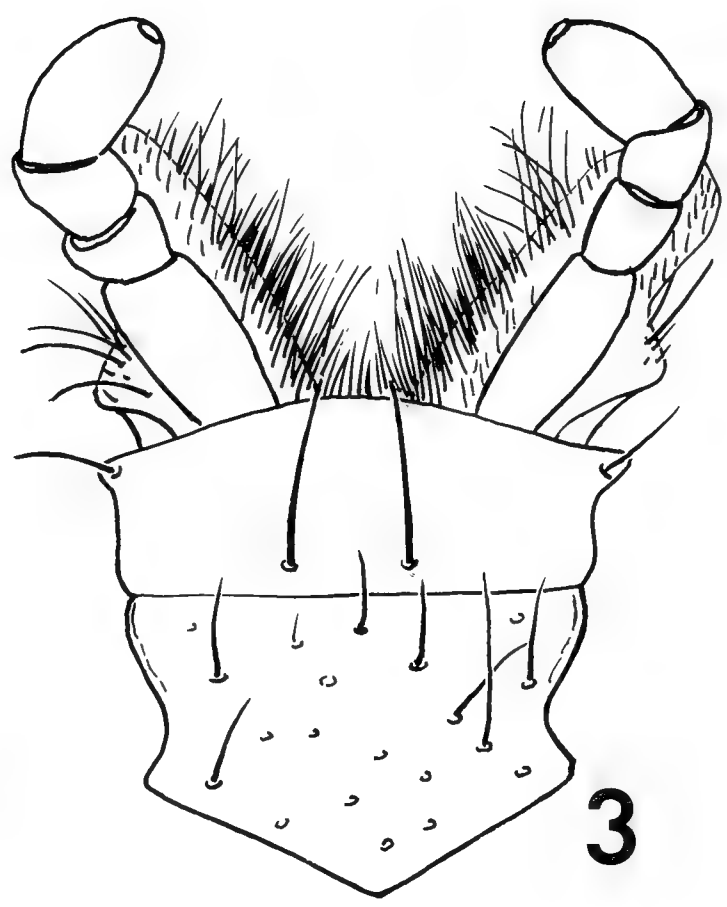
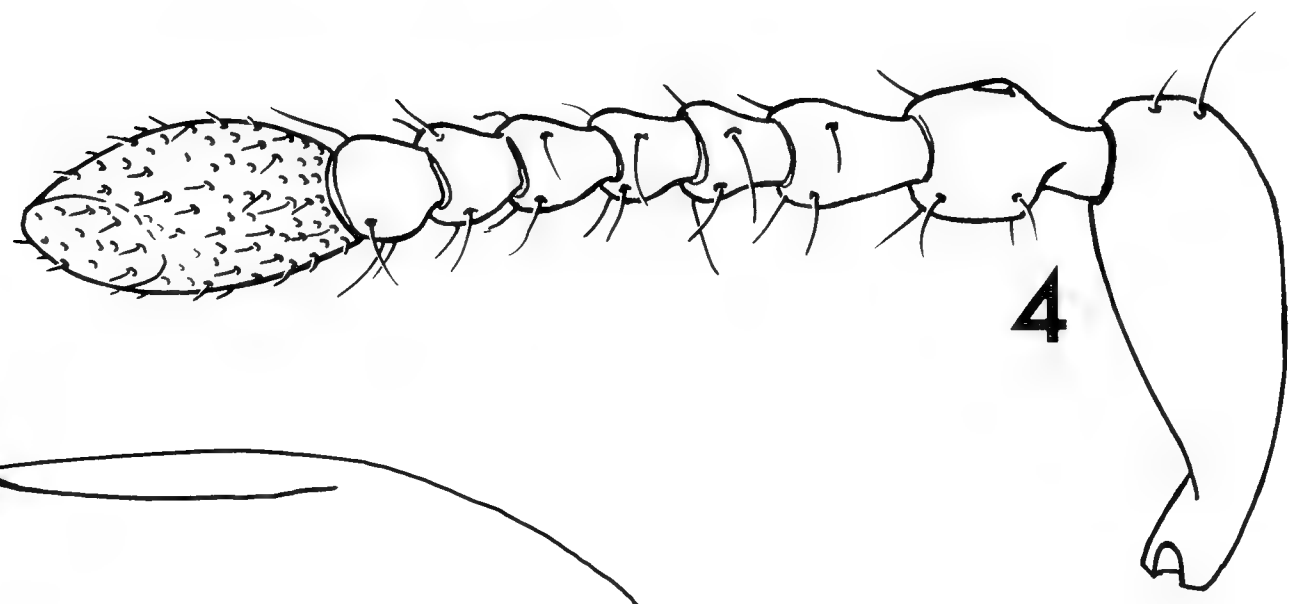
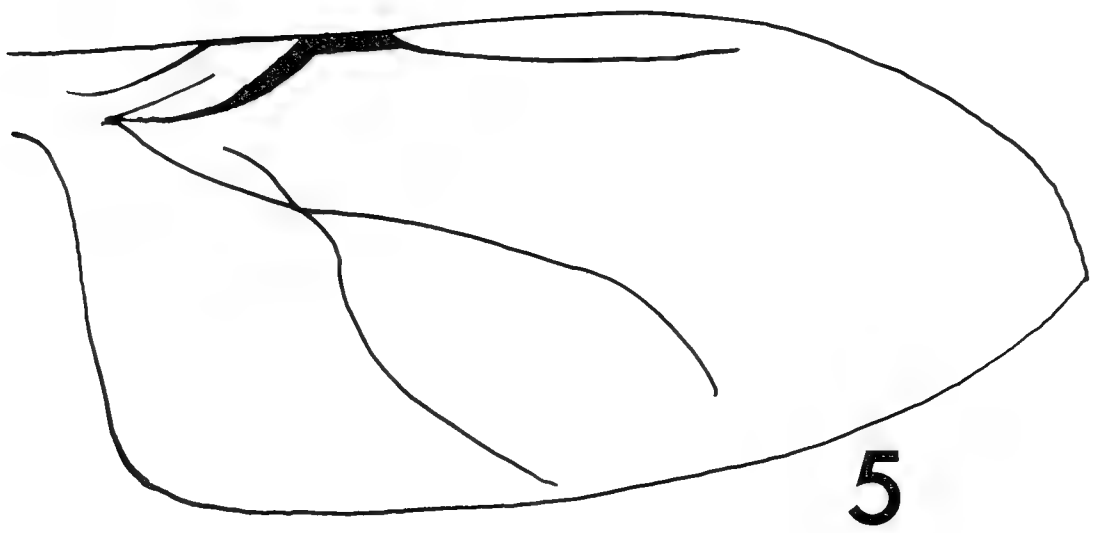
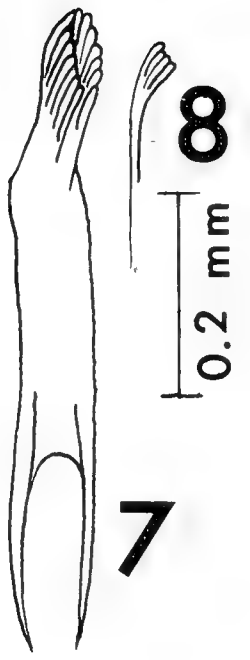


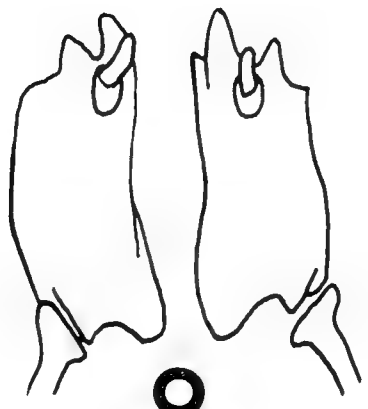








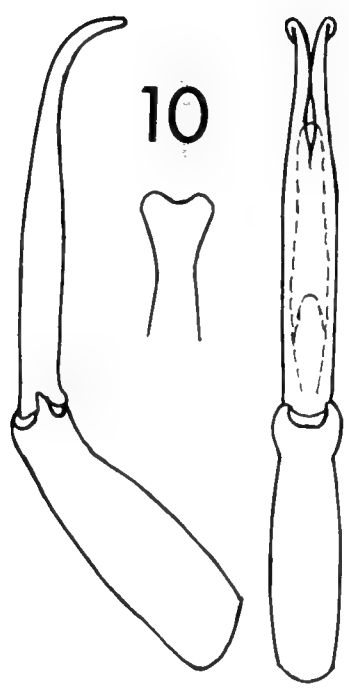


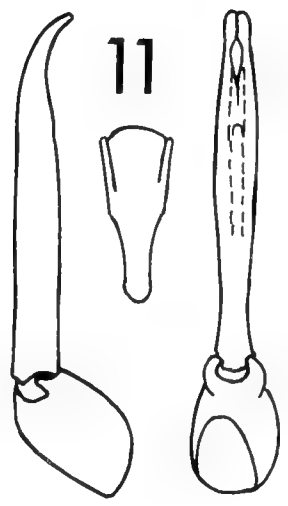


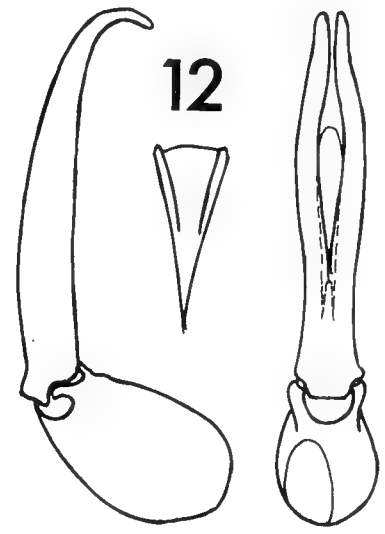
0.2 mm

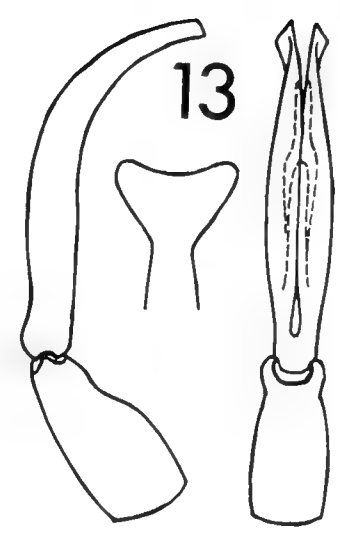
1.0 mm

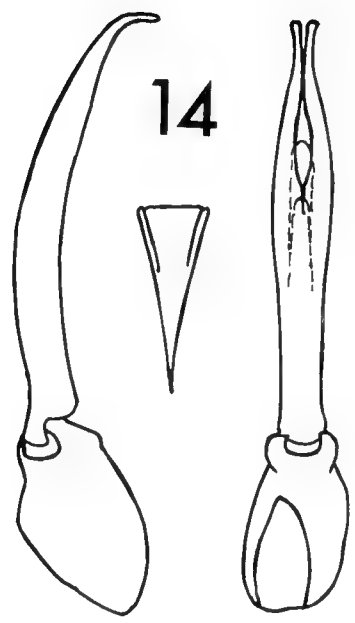
Figs. 1-9. Onthophilus spp. 1-5. alternatus, male. 1. anterior view of left maxilla; 2. anterior view of left mandible; 3. ventral view of labium; 4. antenna; 5. right hind wing; 6. flohri, female right hind wing; 7-8. alternatus, male. 7. penis; 8. median lobe of penis; 9. flohri, female styli of ovipositor.

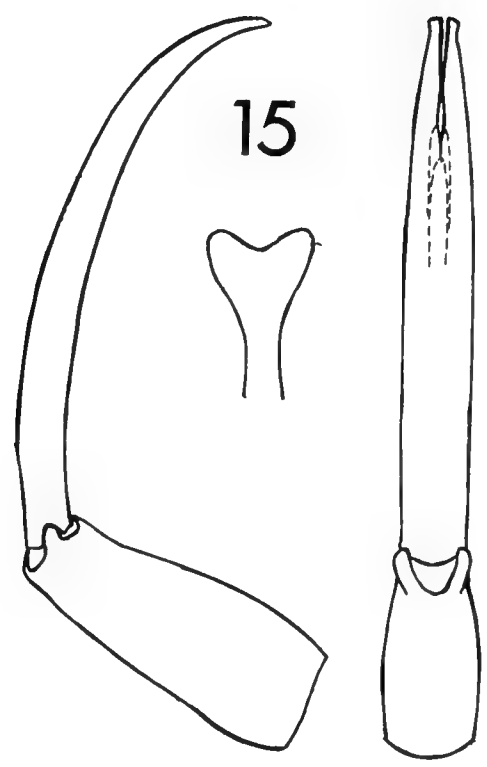


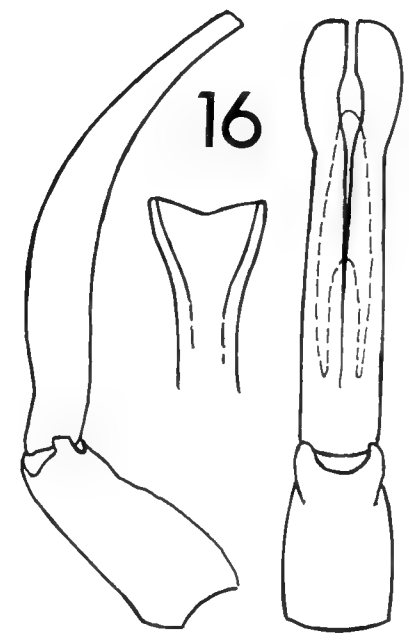


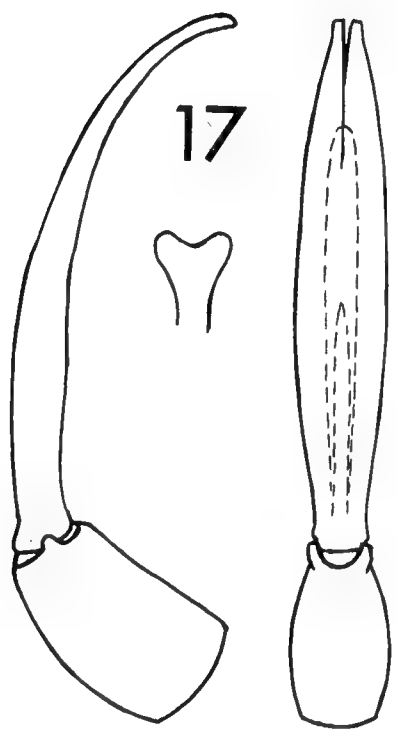


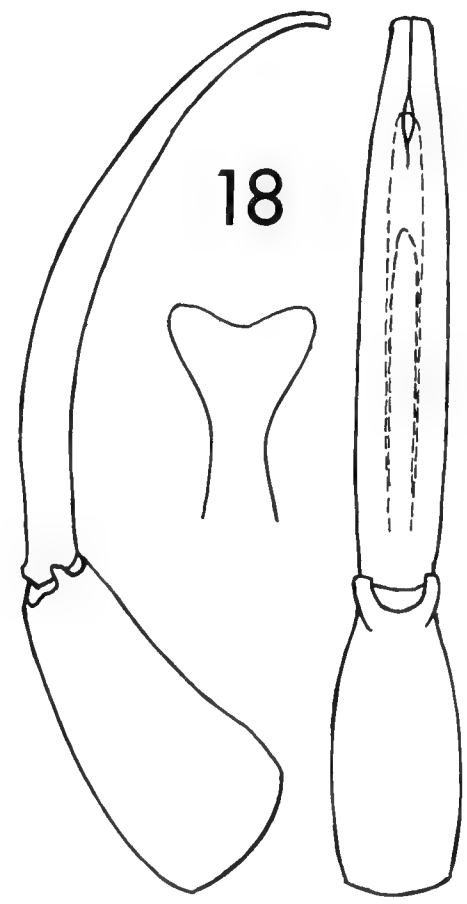


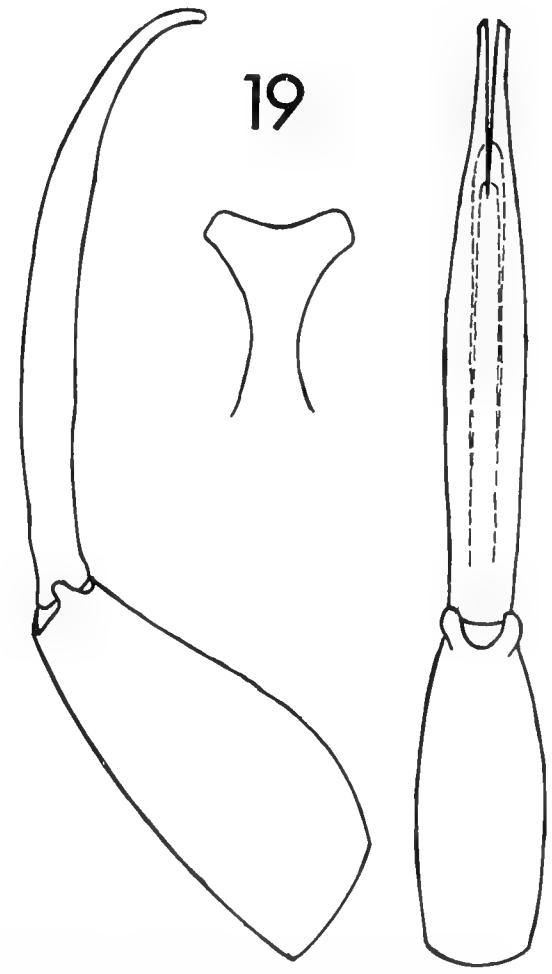


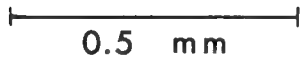












Figs. 10-19. Onthophilus spp. male genitalia (lateral view of aedeagus, ventral view of 9th sternite, dorsal view of aedeagus). 10. alternatus; 11. deflectus new species; 12. flohri; 13. pluricostatus; 14. intermixtus new species; 15. cynomysi new species; 16. nodatus; 17. lecontei; 18. thomomysi new species; 19. kirni.

Figs. 20-28. Onthophilus spp., anterior view of head. 20. julii; 21. flohri; 22. alternatus; 23. nodatus; 24. pluricostatus; 25. wenzeli new species; 26. cynomysi new species; 27. soltaui; 28. lecontei.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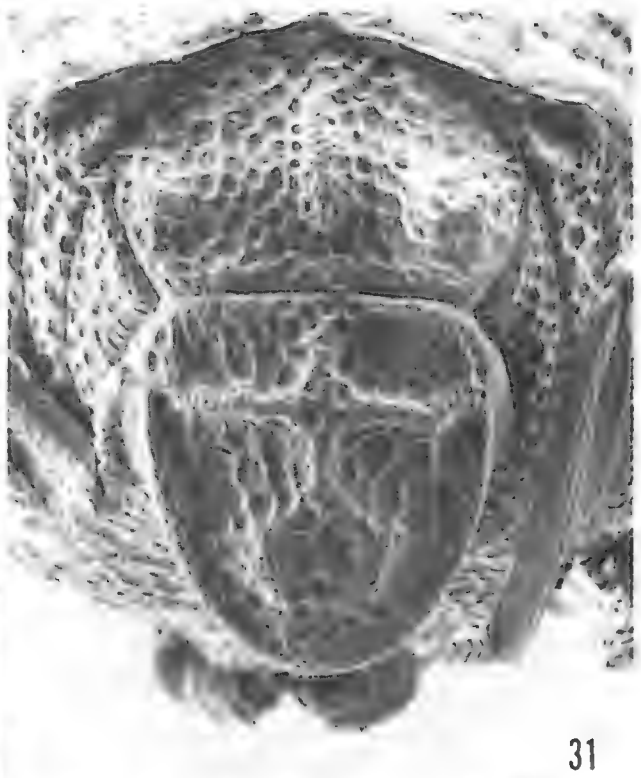
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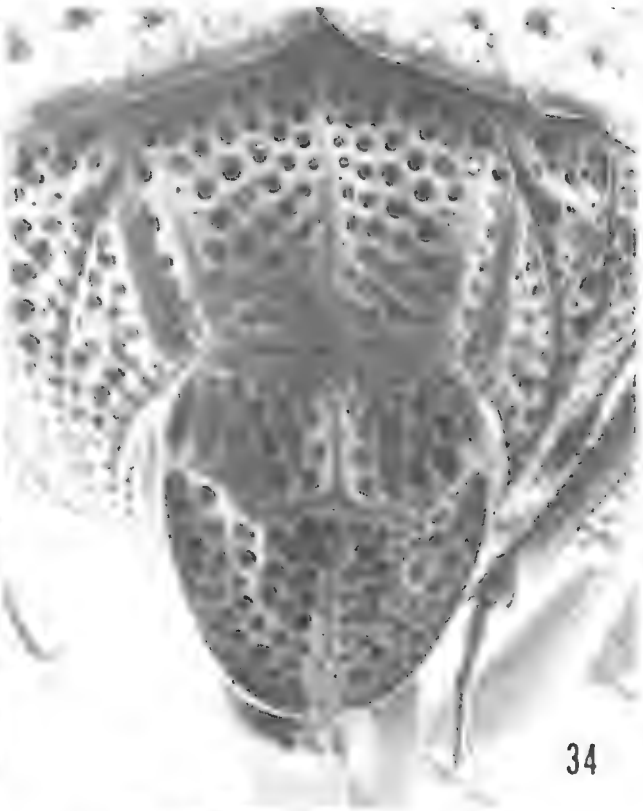
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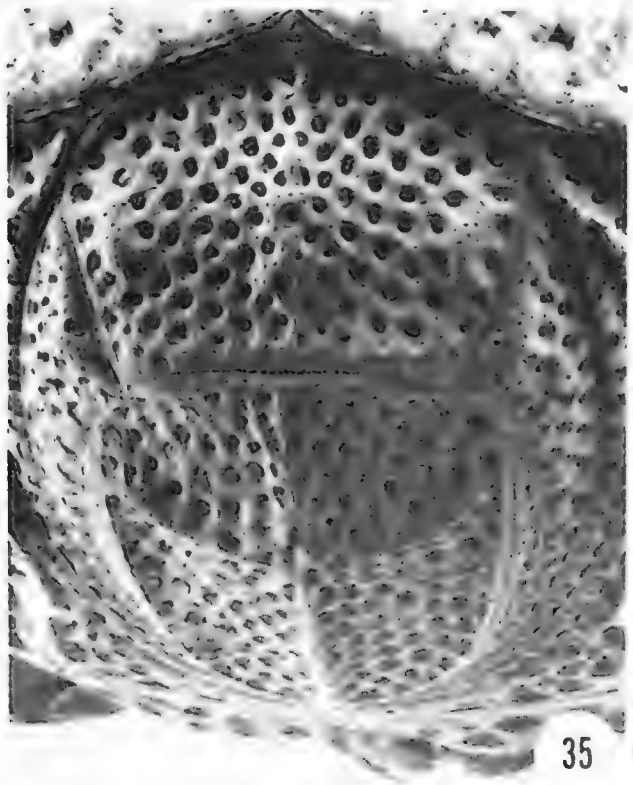
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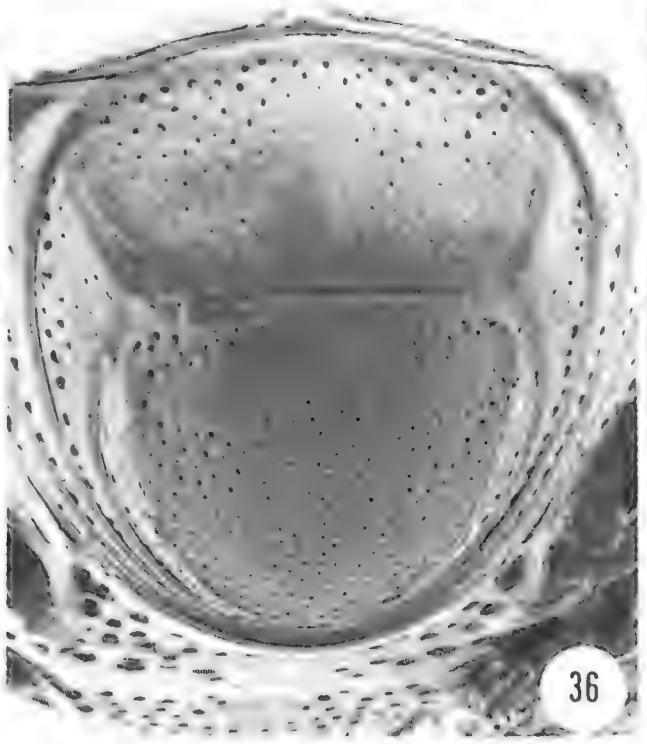
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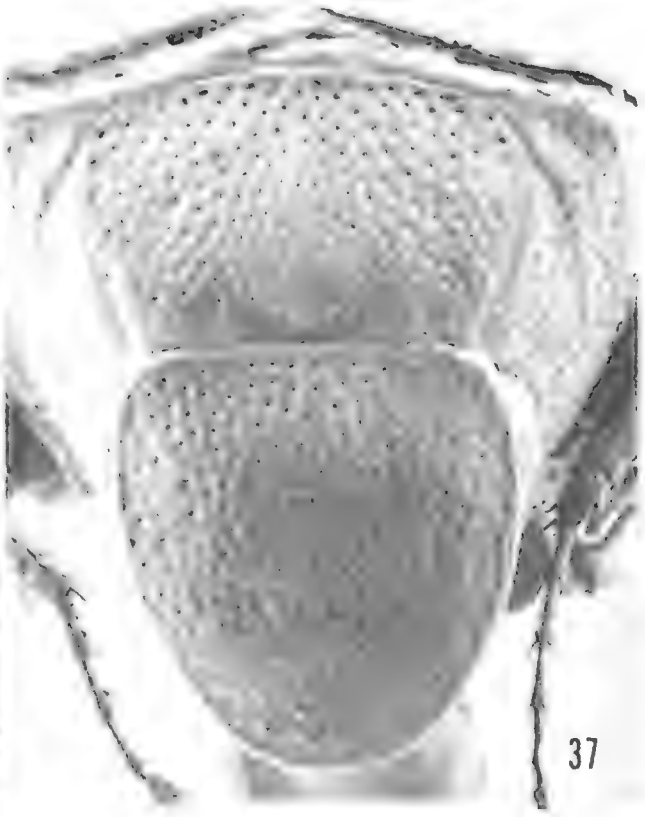
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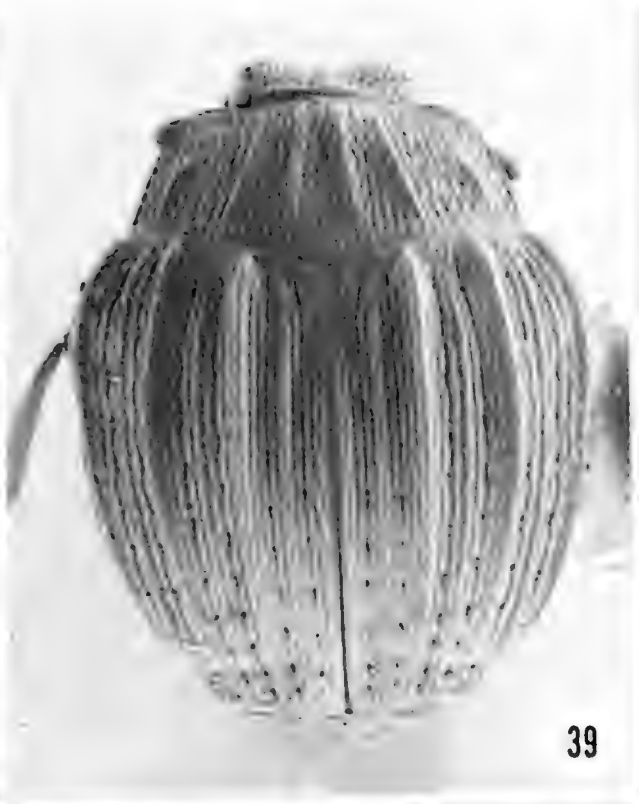
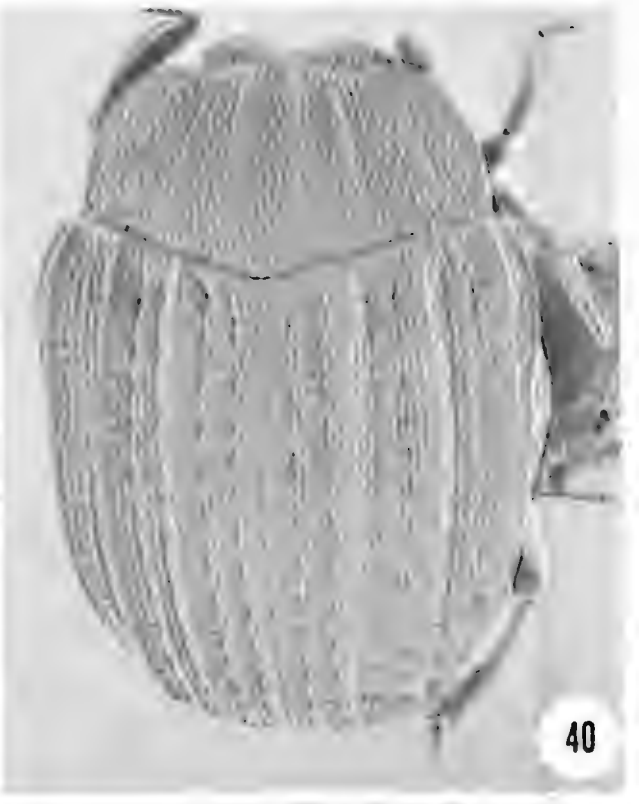
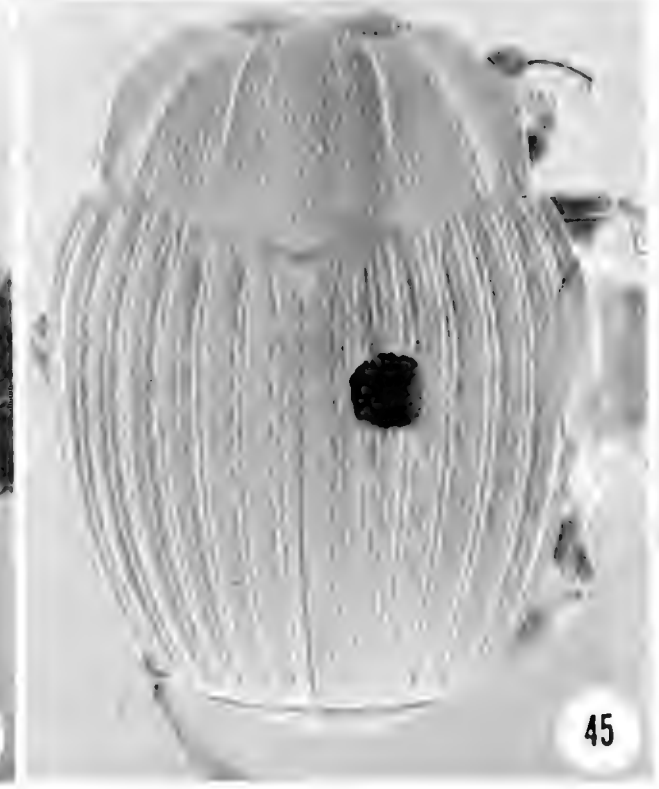
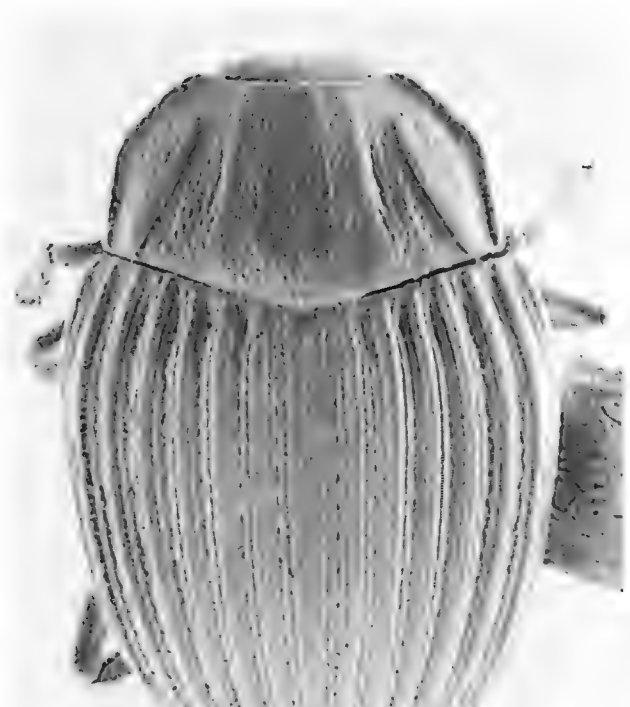
Figs. 29-37. Onthophilus spp. 29-30. anterior view of head. 29. thomomysi new species; 30. kirni. 31-37. posterior view of propygidium and pygidium. 31. julii; 32. flohri; 33. alternatus; 34. nodatus; 35. pluricostatus; 36. thomomysi new species; 37. cynomysi new species.







Figs. 38-46. Onthophilus spp., dorsal view. 38. julii; 39. deflectus new species; 40. flohri; 41. intermixtus new species; 42. alternatus; 43. nodatus; 44. pluricostatus; 45. wenzeli new species; 46. cynomysi new species.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Figs. 47-55. Onthophilus spp. 47-50. dorsal view. 47. soltaui; 48. lecontei; 49. thomomysi new species; 50. kirni; 51-55. ventral view. 51. julii; 52. deflectus new species; 53. flohri; 54. intermixtus new species; 55. alternatus.


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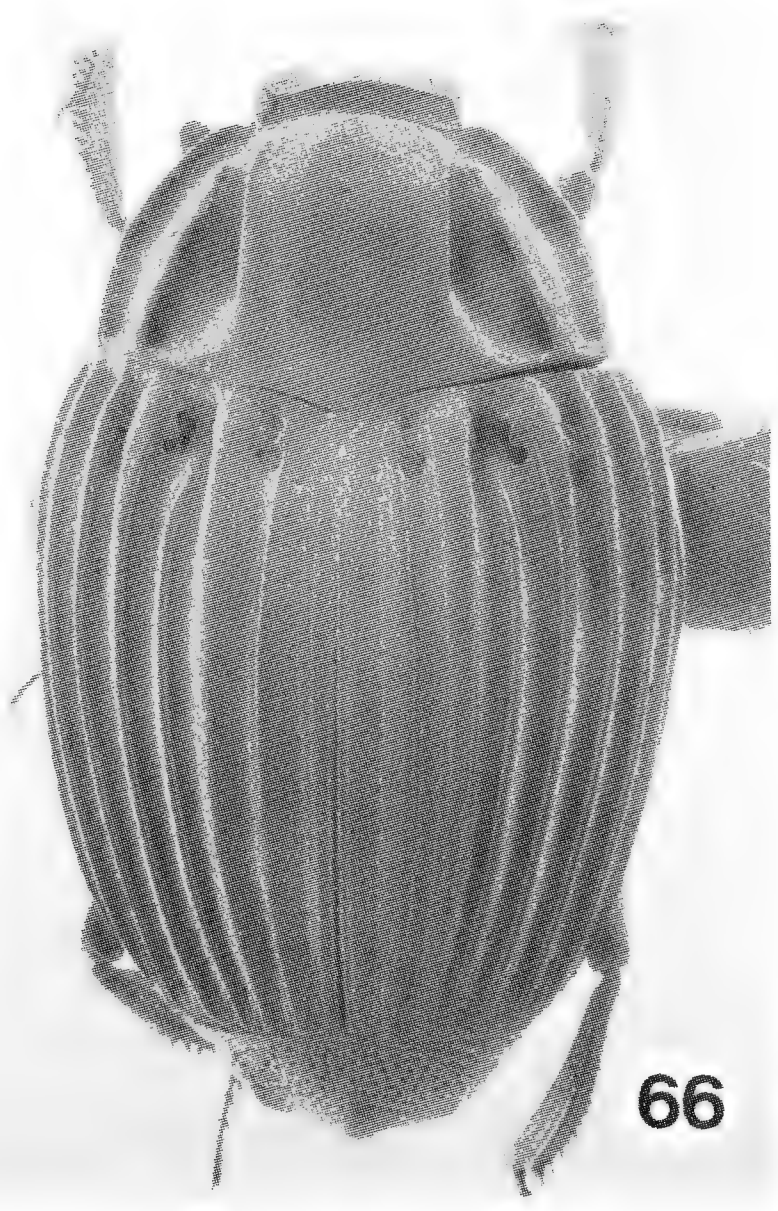
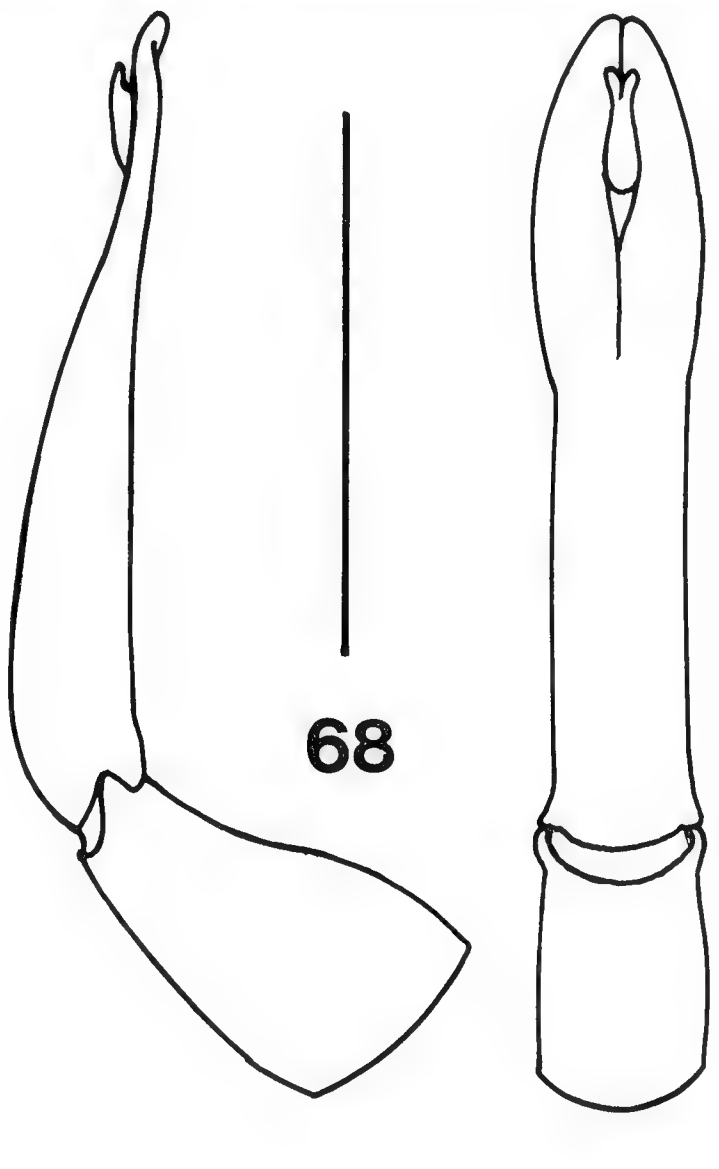
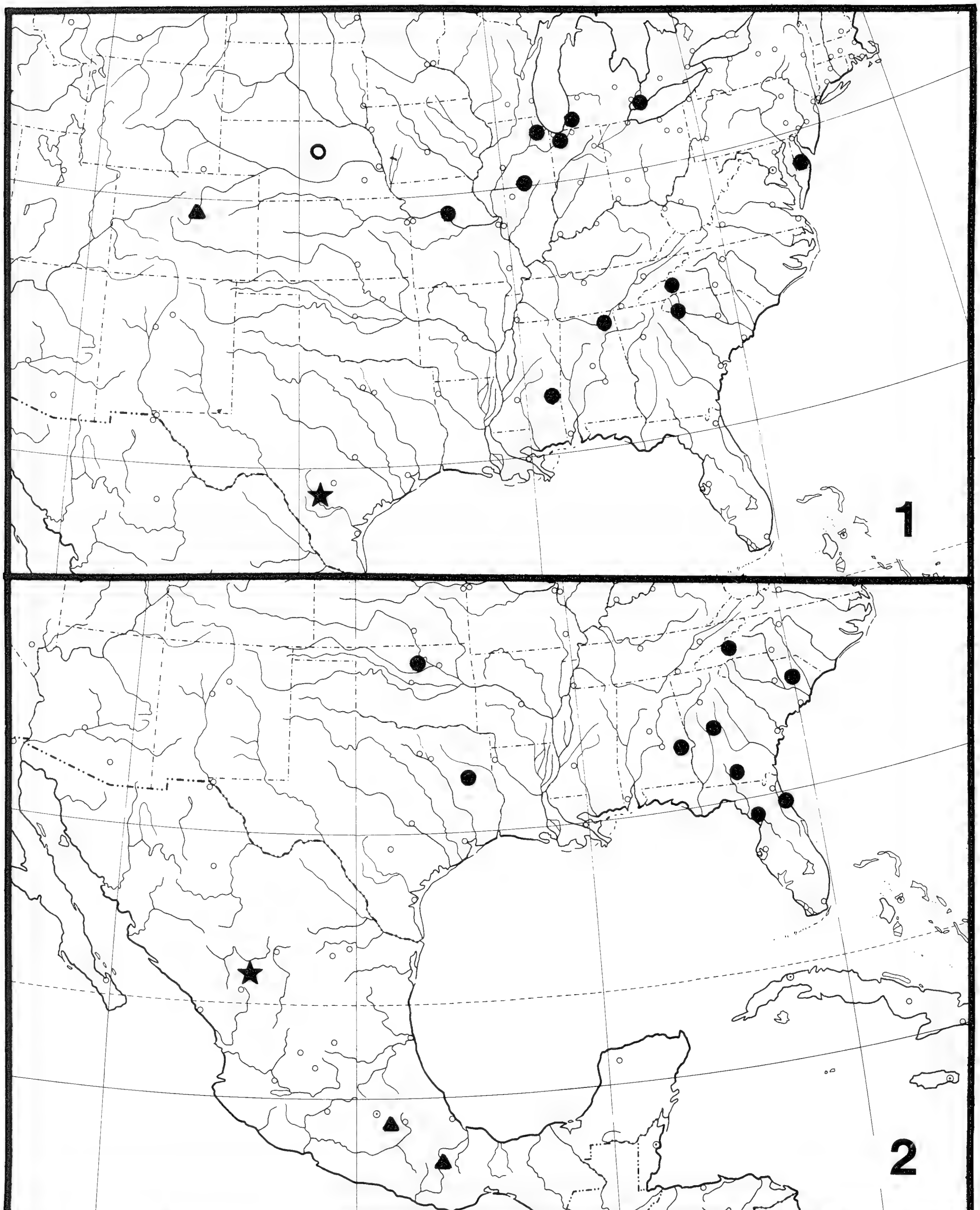
Figs. 56-64. Onthophilus spp. 56-63. ventral view. 56. nodatus; 57. pluricostatus; 58. wenzeli new species; 59. cynomysi new species; 60. soltaui; 61. lecontei; 62. thomomysi new species; 63. kirni; 64. alternatus, male protibia.

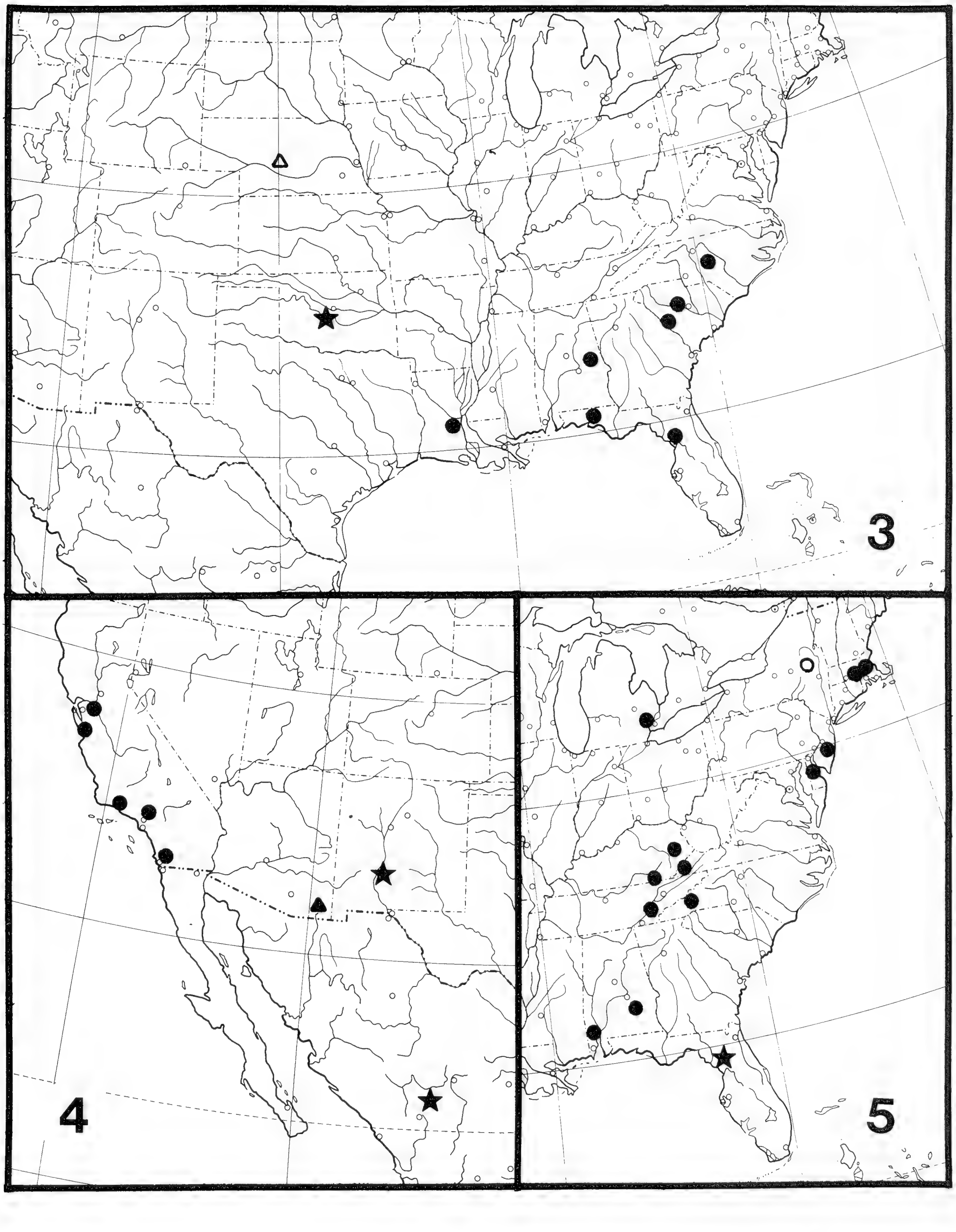




Figs. 65-68. Onthophilus giganteus new species. 65. anterior view of head; 66. dorsal view; 67. ventral view; 68. male genitalia (lateral view, dorsal view).



Map 1-2. Distribution of Onthophilus spp.: 1. deflectus new species (●) (○- state record); soltaui (▲); kirni (★). 2. nodatus (●); julii (▲); flohri (★).



Map 3-5. Distribution of Onthophilus spp.: 3. alternatus (●); wenzeli new species (△- state record); cynomysi new species (★).
4. lecontei (●); intermixtus new species (▲); thomomysi new species (★).
5. pluricostatus (●) (○ - state record); giganteus new species (★).

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MEDICAL ENTOMOLOGY STUDIES - XI.

THE SUBGENUS *STEGOMYIA* OF *AEDES* IN THE ORIENTAL REGION WITH KEYS TO THE SPECIES (DIPTERA: CULICIDAE).

by

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CONTENTS

MEDICAL ENTOMOLOGY STUDIES - XI.

THE SUBGENUS *STEGOMYIA* OF *AEDES* IN THE ORIENTAL REGION WITH KEYS TO THE SPECIES (DIPTERA: CULICIDAE).[1]

by

Yiau-Min Huang[2]

ABSTRACT

The subgenus *Stegomyia* Theobald of the genus *Aedes* Meigen and the 5 species groups recognized in the Oriental region are characterized. The taxonomy, medical importance, immature habitats and distribution of the species of the region are discussed and summarized. Keys and illustrations are provided for the identification of adults (males and females), male terminalia, pupae and 4th stage larvae of the 5 species groups and 37 species and subspecies known to occur in this region. In addition, the detailed description of the male, female, pupa and larva of *Aedes aegypti* (Linnaeus) and a redescription of the male terminalia of *Aedes platylepidus* Knight and Hull are given.

INTRODUCTION

The subgenus *Stegomyia* Theobald is medically very important since it includes vectors of human filariasis and a number of virus diseases. It is one of the most dominant subgenera of the genus *Aedes* Meigen in the Oriental region, as indicated by the number of species groups and species. At present, 37 species and subspecies of this subgenus are recognized in this region.

The subgenus *Stegomyia* has not been properly defined since Edwards' (1932) classification and this has resulted in the incorrect assignment of some species to it and exclusion of others. As there is no comprehensive review of the subgenus of this area, this paper is intended to clarify some of these taxonomic problems and also provide a guide for the identification of the species occurring in the Oriental region.

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The subgeneric characters of *Stegomyia* and its affinities to other aedine subgenera and the classification of the species groups are discussed. The 5 species groups of this subgenus, known as the *aegypti, albolineatus, edwardsi, scutellaris* and *w-albus* groups, occurring in the Oriental region are also characterized. These 5 species groups with their constituent subgroups and 37 species and subspecies recognized here are outlined in Table 1. The role of members of the subgenus in the transmission of pathogens is presented in Table 2. Keys and illustrations for the identification of adults (males and females), male terminalia, pupae and 4th stage larvae of the 5 species groups and 37 species and subspecies of this region are provided. However, the full illustrations of those species which were published previously by Huang (1972, 1977a, 1978a, 1978b) will not be included. Data on the present status, geographical distribution and immature habitats of the species are summarized in Appendices I, II, and III.

Aedes aegypti (Linnaeus) is the type-species of the subgenus *Stegomyia*. It is one of the most variable of all species of mosquitoes with respect to its coloration (scale pattern). Mattingly (1957) recognized 3 forms of *aegypti:* (1) *aegypti* sensu strictu, the type form, (2) *aegypti* subspecies *formosus* (Walker), (3) *aegypti* variety *queenslandensis* (Theobald) and gave a provisional diagnosis for each. Both the "type form" and "variety *queenslandensis*" occur in the Oriental region. It is interesting to note that these 2 forms appear to exist sympatrically throughout this region, but "variety *queenslandensis*" occurs at a very low frequency. For this reason, I believe that these "forms" of *aegypti* in the Oriental region are not discrete entities, and therefore consider that "variety *queenslandensis*" is an infraspecific variation. The detailed description of the male, female, pupa and larva of this species is given in Appendix IV. Another form of *aegypti,* "subspecies *formosus*", is known only from Africa and will not be discussed here.

Aedes platylepidus Knight and Hull, which was assigned by Reinert (1970) to the subgenus *Diceromyia* Theobald, is included here in the *albolineatus* group. This decision was reached after a careful study of the male terminalia of this species which agree well with the members of the *albolineatus* group, as demonstrated in this paper. The male terminalia of *platylepidus* are very similar to that of other members of the *albolineatus* group. Its closest allies within this group are *bambusicola* Knight and Rozeboom, *hoogstraali* Knight and Rozeboom and *impatibilis* (Walker), (see Figs. 12C, 16C, 19C). It should be noted that the description and the illustration of the male terminalia given by Reinert (1970: 13 and Fig. 10) are in error, particularly with regards to the basal mesal lobe (claspette) and is corrected in Appendix V (Fig. 24). Unfortunately, the larva and pupa of this species are unknown. The transfer of *platylepidus* from *Diceromyia* to *Stegomyia* may well receive further confirmation when the immature stages are known.

Aedes meronephada (Dyar and Shannon), was placed by Edwards (1929) in the subgenus *Stegomyia* and was assigned by Edwards (1932) to Group B (*w-albus* group), on the basis of the tarsal markings and the thoracic ornamentation. Huang (1978b) removed *Aedes meronephada* from Group B (*w-albus* group) and placed it in the subgenus *Diceromyia*. This conclusion was reached after a critical study and consideration of all known stages. Thus, *Aedes meronephada* is omitted from the key since it is not a *Stegomyia*.

Hairiness in *Stegomyia* larvae was first reported by Rosen and Rozeboom (1954) in members of the *scutellaris* group in the South Pacific. In Singapore, Colless (1956) observed that larvae of *Ae. albopictus* (Skuse) (also a member of the *scutellaris* group) collected from tree holes, frequently had many of the

body setae longer, stouter and more branched than usual. The hairiness factor was shown to be associated with the presence of debris in the tree holes utilized as larval habitats.

This study was based primarily on specimens accumulated by the Southeast Asia Mosquito Project (SEAMP) and its successor, the Medical Entomology Project (MEP), Department of Entomology, Smithsonian Institution. Additional material was borrowed from the following institutions: Bernice P. Bishop Museum; United States National Museum; Field Museum of Natural History, Chicago; University of Utah; Cornell University; Johns Hopkins School of Hygiene and Public Health; California Academy of Sciences; Academy of Natural Sciences, Philadelphia; Medical Zoology Laboratory, Institute for Infectious Disease, University of Tokyo; British Museum (Natural History) and the Instituut voor Tropische Hygiene, Amsterdam.

All the type-specimens of the included species which are in the British Museum (Natural History), the United States National Museum and the Medical Zoology Laboratory, Institute for Infectious Diseases, University of Tokyo, have been studied.

It has been necessary to rely upon available literature both for information regarding those species recorded from the Oriental region and for information regarding medical significance.

The nomenclature chosen for the chaetotaxy of the larva and pupa and the terminology for the structural parts of the adult used in this paper largely follows that of Belkin (1962) and Huang (1972, 1977a).

Abbreviations cited for the references to the literature conform to the BIOSIS List of Serials, Biosciences Information Service of Biological Abstracts, Philadelphia, 1974.

The information on the immature habitats is entirely based on data accompanying specimens which I have examined.

The term "Oriental region" as used here encompasses both the Oriental and Indomalayan areas of Belkin (1962). It comprises the following area: the Ryukyu islands (Amami, Okinawa, Miyako, Ishigaki, Iriomote), Taiwan, the Pescadores, Hainan, China (south of the Yangtze Kiang), the Philippines, Vietnam, Indonesia (the eastern boundary is essentially that of Lee 1944), Laos, Cambodia, Thailand, Malaysia, the Andaman islands, the Nicobar islands, Burma and Assam, Bangladesh, Bhutan, Nepal, India (south of the Himalayas), Sri Lanka, southeastern part of Pakistan, the Laccadive islands, the Maldive islands and the Chagos islands. This area falls approximately within 11 degrees south to 30 degrees north latitude and 65 to 130 degrees east longitude (Map 1).

SUBGENUS *STEGOMYIA* THEOBALD

Stegomyia Theobald 1901a (June 1), in Howard 1901: 235; Theobald 1901b (July 15): 235; Theobald 1901c (Sept.): 4, App. ii; Theobald 1901d (Nov. 23): 283. Type-species: *Culex aegypti* Linnaeus 1762 (see Mattingly, Stone and Knight 1962).

Scutomyia Theobald 1904: 77. Type-species: *S. albolineatus* Theobald 1904, Ampang Jungle, near Kuala Lumpur, Selangor, Malaya; monobasic.

Quasistegomyia Theobald 1906: 69. Type-species: *Q. unilineatus* Theobald 1906, Bahr-el-Ghazal, Sudan; monobasic.

Pseudostegomyia Ludlow 1908: 10. Type-species: *Stegomyia gardnerii* Ludlow 1905, Bulacao, Mindoro Island, Philippines; monobasic. - Apparently an

error for *Quasistegomyia* Theobald 1906 (see Theobald 1910: 135). For complete synonymy, see Knight and Stone (1977: 154).

CHARACTERISTICS.

The subgenus *Stegomyia* is characterized by the following combination of characters: ADULT (both sexes). *Head*. Vertex with largely broad and flat decumbent scales, erect forked scales not numerous, restricted to occiput; ♂ palpus not very short, more than 0.5 length of proboscis, 5-segmented, segments 4, 5 subequal, slender and with only a few short setae, total length of apical 2 segments not very short, at least 0.4 length of the remaining segments; in ♀ about 0.14-0.25 length of proboscis, 4- or sometimes 5-segmented, when present segment 5 minute. *Thorax*. Acrostichal bristles absent; spiracular bristles absent; postspiracular bristles present; scutellum with broad scales on all lobes; postnotum bare. *Wing*. With narrow scales on all veins. *Legs*. Hindtarsus with basal white band at least on tarsomere 1. *Male Terminalia*. Proctiger without cercal setae; aedeagus strongly toothed; claspette well developed, with numerous setae; distimere usually simple, elongate, or sometimes distimere complex, expanded at base apically forked, spiniform present. *Female Terminalia*. Insula longer than broad, with minute setae and 3-10 larger setae on apical 0.25-0.50; cerci short and broad; 3 spermathecae, one larger than the other 2. PUPA. Subgeneric characters not evident, see under groups. LARVA. *Head*. Seta 4-C well developed, branched, closer to 6-C than 5-C, cephalad and mesad of 6-C; 4, 6-C cephalad of antennal base; 6-C cephalad of 5, 7-C. *Abdomen*. Seta 12-I not developed; 2-VIII distant from 1-VIII; comb scales in a single row; ventral brush with 4, 5 pairs of setae on grid; without precratal tufts. This combination of characters differs from that of all other subgenera of *Aedes*.

SYSTEMATICS.

Edwards (1932) divided the subgenus *Stegomyia* into 4 groups which he designated A, B, C, and D. Knight and Rozeboom (1946) removed *Aedes albolineatus* (Theobald) from Group C and defined a 5th group for that species and its relatives which later was designated Group E (*albolineatus* group) by Knight and Hurlbut (1949). Bohart 1956 (1957) added Group F (*pandani* group) and Group G (*maehleri* group). Belkin (1962) removed *Aedes edwardsi* (Barraud) from Group B and defined a new group (*edwardsi* group) for it and its relatives. Huang (1972) redefined Group C (*scutellaris* group) and subdivided the *scutellaris* group into 2 subgroups known as the *albopictus* and *scutellaris* subgroups. Later, Huang (1977a) redefined Group B (*w-albus* group) and subdivided the *w-albus* group into 4 subgroups known as the *annandalei*, *desmotes*, *mediopunctatus* and *w-albus* subgroups. Huang (1977b) removed Group D (*vittatus* group), a monotypic species group, (*Aedes vittatus* (Bigot)), from the subgenus *Stegomyia* and placed it in the subgenus *Aedimorphus* Theobald of the genus *Aedes*. Thus, the subgenus *Stegomyia* now consists of the following 7 groups: Group A (*aegypti* group), Group B (*w-albus* group), Group C (*scutellaris* group), Group E (*albolineatus* group), Group F (*pandani* group), Group G (*maehleri* group), and Group H (*edwardsi* group).

Of the 7 recognized groups of *Stegomyia* mentioned above, 5 are represented in the Oriental region. Only Groups F and G do not occur in the Oriental region. These 5 groups with their constituent subgroups, 37 species and subspecies are indicated in Table 1.

TABLE 1. Classification of the subgenus *Stegomyia* in the Oriental region.

GROUP	SUBGROUP	SPECIES AND SUBSPECIES
1. *aegypti*		1. *aegypti* (Linnaeus)
2. *albolineatus*		2. *albolineatus* (Theobald) 3. *arboricola* Knight and Rozeboom 4. *bambusicola* Knight and Rozeboom 5. *boharti* Knight and Rozeboom 6. *hoogstraali* Knight and Rozeboom 7. *impatibilis* (Walker) 8. *laffooni* Knight and Rozeboom 9. *platylepidus* Knight and Hull 10. *pseudalbolineatus* Brug
3. *edwardsi*		11. *edwardsi* (Barraud) 12. *seampi* Huang
4. *scutellaris*	*albopictus*	13. *albopictus* (Skuse) 14. *downsi* Bohart and Ingram 15. *novalbopictus* Barraud 16. *patriciae* Mattingly 17. *pseudalbopictus* (Borel) 18. *seatoi* Huang 19. *subalbopictus* Barraud 20. *unilineatus* (Theobald)
	scutellaris	21. *alcasidi* Huang 22. *alorensis* Bonne-Wepster 23. *andrewsi* Edwards 24. *krombeini* Huang 25. *malayensis* Colless 26. *paullusi* Stone and Farner 27. *riversi* Bohart and Ingram
5. *w-albus*	*annandalei*	28. *annandalei* (Theobald) 29. *craggi* (Barraud)
	desmotes	30. *desmotes* (Giles) 31. *malikuli* Huang
	mediopunctatus	32. *mediopunctatus* (Theobald) 33. *perplexus* (Leicester) 34. *rhungkiangensis* Chang and Chang
	w-albus	35. *gardnerii gardnerii* (Ludlow) 36. *gardnerii imitator* (Leicester) 37. *w-albus* (Theobald)

In the identification of the species of the subgenus *Stegomyia*, the adult stages appear to be more useful than the immature stages. However, it must be remembered that specific differences between the members of this subgenus tend to be very slight. Some members are highly variable in both adult ornamentation and in the immature stages. Although the males of all species can be recognized on the basis of morphological features, the females and the immatures are extremely difficult or impossible to distinguish in many instances. The male terminalia of all species are distinct and the most diagnostic feature of all is the claspette of the basimere. In dealing with these, special preparations must be made and care taken to study both lateral and mesal views of the dissected claspette as well as undissected aspects.

AFFINITY.

The subgenus *Stegomyia* possesses some rather important basic characters, as follows, in common with the subgenera *Aedimorphus* Theobald, *Alanstonea* Mattingly, *Ayurakitia* Thurman and *Diceromyia* Theobald of the genus *Aedes* in the Oriental region: *Adult*. Male palpus 5-segmented; proctiger without cercal setae; aedeagus with conspicuous teeth; claspette developed; distimere with one or more spiniforms; *Larva*. Seta 12-I not developed; pecten teeth present. These shared characters indicate the affinity of *Stegomyia* to the above 4 subgenera. Of these 4 subgenera, *Stegomyia* shares more important characters in both adult and immature stages with *Diceromyia* than with any other subgenus, suggesting the strongest affinities with that subgenus. However, it differs from *Diceromyia* in the development of the male palpus and in the position of seta 4-C of the larva. The male palpus of *Stegomyia* has the total length of the apical 2 segments not very short, at least 0.4 the length of the remaining segments while in *Diceromyia*, the total length of the apical 2 segments is very short, at most 0.3 the length of the remaining segments, or segment 5 is much shorter than segment 4. The larva of *Stegomyia* has seta 4-C cephalomesad of 6-C while in *Diceromyia*, seta 4-C is caudomesad of 6-C.

DESCRIPTIONS OF THE GROUPS OCCURRING IN THE ORIENTAL REGION.

aegypti group

ADULT. *Head*. Palpi with white scales. *Thorax*. Dorsocentral bristles present; scutum with a lateral crescent-shaped white marking on anterior half of scutum; subspiracular area with broad white scales; postspiracular area without scales; paratergite with broad white scales; scutellum with broad white scales on all lobes. *Legs*. Hindtarsus with a basal white band on tarsomeres 1-4, tarsomere 5 all white. *Male Terminalia*. Apical margin of tergum IX with middle part deeply concave; paraproct with sternal arm, without apical lobed process; distimere simple, elongate, with an apical spiniform process; aedeagus strongly toothed. *Female Terminalia*. Apical margin of sternum VIII with a deep U-shaped notch at middle.

PUPA. *Paddle*. Margins with distinct denticles; seta 1-P single.

LARVA. Comb scales in a single row, not arising from a sclerotized plate; marginal spicules of anal segment very small and inconspicuous; ventral brush with 5 pairs of setae.

albolineatus group

ADULT. *Head*. Palpi without white scales. *Thorax*. Dorsocentral bristles present or absent; scutum with, or without, a long median longitudinal, white stripe of narrow scales extending from anterior margin to at least the level of wing root; subspiracular and postspiracular areas without scales; paratergite bare; scutellum with broad scales on all lobes. *Legs*. Hindtarsus with basal white band at least on tarsomere 1. *Male Terminalia*. Apical margin of tergum IX with middle part shallowly concave, flat, or slightly produced; paraproct without sternal arm, with or without apical lobed process; distimere simple, elongate, with a submedian or subbasal spiniform process; aedeagus with several lateral distal teeth. *Female Terminalia*. Apical margin of sternum VIII with middle part shallowly concave, or apical margin of sternum VIII with a deep U-shaped notch at middle.

PUPA. *Paddle*. Margins without fringe of very long hair-like spicules, or distinct denticles, at most with slight spicules; seta 1-P branched.

LARVA. Comb scales in a single row, arising or not arising from a sclerotized plate; marginal spicules of anal segment very small and inconspicuous, or very long, spine-like and conspicuous; ventral brush with 5 pairs of setae.

edwardsi group

ADULT. *Head*. Palpi with white scales. *Thorax*. Dorsocentral bristles present; scutum with a distinct, small, median oval white spot of narrow scales on anterior 0.33 of scutum; subspiracular area with or without scales; postspiracular area without scales; paratergite with broad white scales; scutellum with broad white scales on all lobes. *Legs*. Hindtarsus with a basal white band on tarsomeres 1-4, tarsomere 5 all white. *Male Terminalia*. Apical margin of tergum IX with middle part produced into a large lobe; paraproct without sternal arm, without apical lobed process; distimere simple, elongate, with an apical spiniform process; aedeagus apically widened, with 6 or 7 apical teeth on each side. *Female Terminalia*. Apical margin of sternum VIII with a deep, U-shaped notch at middle.

PUPA. *Paddle*. Margins with fringe of very long hair-like spicules; seta 1-P single.

LARVA. Comb scales in a single row, arising from a sclerotized plate; marginal spicules of anal segment very long, spine-like and conspicuous; ventral brush with 4 pairs of setae.

scutellaris group

ADULT. *Head*. Palpi with white scales. *Thorax*. Dorsocentral bristles present; scutum with a long, median longitudinal white stripe of narrow scales extending from anterior margin to about the level of wing root; subspiracular and postspiracular areas with or without scales; paratergite with broad white scales; scutellum with broad white scales on all lobes. *Legs*. Hindtarsus with a basal white band on tarsomeres 1-4, tarsomere 5 all white. *Male Terminalia*. Apical margin of tergum IX with middle part rounded, truncated, or produced into a large lobe or a median projection; paraproct without sternal arm, without apical lobed process; distimere simple, elongate, with an apical or a subapical

spiniform process; aedeagus with a distinct sclerotized, lateral toothed plate on each side. *Female Terminalia*. Apical margin of sternum VIII with a deep U-shaped notch at middle.

PUPA. *Paddle*. Margins with fringe of very long hair-like spicules; seta 1-P single.

LARVA. Comb scales in a single row, not arising from a sclerotized plate; marginal spicules of anal segment very small and inconspicuous; ventral brush with 4 pairs of setae.

w-albus group

ADULT. *Head*. Palpi with white scales. *Thorax*. Dorsocentral bristles absent; scutal markings varied; subspiracular and postspiracular areas with broad white scales; paratergite with broad white scales; scutellum with broad white scales at least on one lobe. *Legs*. Hindtarsus with a basal white band on tarsomeres 1, 2, tarsomere 3 with or without a basal white band. *Male Terminalia*. Apical margin of tergum IX with middle part concave, nearly flat, or produced into a large lobe; paraproct with or without sternal arm, without apical lobed process; distimere simple, elongate, with an apical or a subapical spiniform process, or distimere complex, expanded at base and apically forked, with spiniform process; aedeagus with a distinct, sclerotized, lateral toothed plate on each side. *Female Terminalia*. Apical margin of sternum VIII with a deep U-shaped notch at middle.

PUPA. *Paddle*. Margins with fringe of very long hair-like spicules; seta 1-P single.

LARVA. Comb scales in a single row, arising or not arising from a sclerotized plate; marginal spicules of anal segment very small and inconspicuous, or very long, stout and conspicuous; ventral brush with 4 pairs of setae.

DISTRIBUTION.

Stegomyia is confined to the Old World, except for *Aedes aegypti* which has been introduced through commerce into the New World. This subgenus occurs chiefly in the tropical and subtropical zones throughout the Old World but is also represented in the southern part of the Palearctic.

Members of the Oriental *Stegomyia* are distributed mainly in the Oriental region, with extensions into the southern part of the Palearctic area in the north, the Papuan, Western Pacific islands and South Pacific areas in the east and the Ethiopian area in the west. *Aedes albopictus* (Skuse) is also known in the Hawaiian islands (where it has been introduced) and Malagasy. In *Stegomyia*, it appears that there are several widely distributed dominant species and a number of specialized endemic species. The distribution records are given in Appendix II.

BIONOMICS.

The immature stages have been found mainly in tree holes, bamboo stumps, artificial containers (tin can, water jar, water bucket, broken bottle and tire), stump holes (palm stumps, banana stumps and coconut stumps), bamboo internodes, coconut shells (coconut halves, coconut husks and coconut spathes), bamboo cups (bamboo pots), rock holes, plant axils (*Pandanus*, banana, nipa palm, sago palm, taro and *Colocasia*), log holes, split bamboos, cut bamboos, fallen leaves (fallen abaca leaf), palm fronds (coconut fronds), rock pools, footprints, wheel ruts, root holes and shelf fungus - a wide variety of natural and

artificial container habitats. Females of 14 species and one subspecies (*aegypti, boharti, albopictus, downsi, seatoi, krombeini, malayensis, riversi, annandalei, craggi, desmotes, mediopunctatus, perplexus, w-albus* and *gardnerii imitator*) are known to bite man. The immature habitats are summarized in Appendix III.

MEDICAL IMPORTANCE.

Stegomyia is one of the most important subgenera of mosquitoes from the standpoint of the transmission of pathogens. *Aedes aegypti* is the principal vector of urban yellow fever virus in the African, Central and South American tropics. This species is likewise the primary vector of dengue viruses through most of the tropical world. It has also been shown to be a vector of Chikungunya virus in Southern Province, Tanganyika Territory [Tanzania] (Lumsden 1955) and Venezuelan equine encephalitis virus in Colombia (Sanmartin-Barberi et al. 1955) and is a known vector of other viruses. Some members of the *aegypti* group are efficient vectors of yellow fever virus in Africa (Gillett 1972). *Aedes scutellaris* (Walker) from New Guinea has been incriminated as a vector of dengue virus (Mackerras 1946). In addition to viruses, some members of the *scutellaris* group are also efficient vectors of subperiodic filaria in the South Pacific (Sasa 1976).

Both *Aedes aegypti* and *albopictus* are important vectors of dengue viruses in Southeast Asia and have been incriminated in the transmission of dengue virus during outbreaks of haemorrhagic fever in Singapore (Chan, Ho and Chan 1971) and Koi Samui Island, Thailand (Gould et al. 1968). *Aedes albopictus* from India can transmit Chikungunya virus in the laboratory (Rao et al. 1964). The larvae of *Dirofilaria immitis* have been found in wild-caught *albopictus* in Nagasaki, Japan (Suenaga and Itoh 1973) and 3rd stage larvae of *Dirofilaria* sp. have been found in wild-caught *albopictus* in Thailand (Harinasuta et al. 1970). Several viruses have been isolated from wild-caught *aegypti* and *albopictus* from the Oriental region. Table 2 shows briefly what is known in this regard.

TABLE 2. Isolation of pathogens of actual or potential medical significance from *Aedes (Stegomyia)* species in the Oriental region.

Species	Pathogen	Location	Comments	Reference
aegypti	Chikungunya virus	South India	111 isolations August-December, 1964	Myers et al. 1965
	Chikungunya virus	Nagpur City, India	5 isolations 1965	Rodrigues et al. 1972
	Chikungunya virus	Bangkok, Thailand	7 isolations from 150 pools, 1962	Halstead et al. 1969
	Dengue 1 and Dengue 4 viruses	Vellore, India	3 isolations Dengue 1 and 2 Dengue 4 from 77 pools, September-December, 1961	Carey et al. 1964

TABLE 2 (Continued).

Species	Pathogen	Location	Comments	Reference
aegypti	Dengue 4 virus	Nagpur City, India	9 isolations 1965	Rodrigues et al. 1972
	Dengue 1 and Dengue 3 viruses	Ajmer City, India	isolations September 1969	Ghosh et al. 1974
	Dengue 1 and Dengue 2 viruses	Bangalore City, India	32 isolations of both viruses, Dengue 2 more plentiful	George and Soman 1975
	Dengue 1 virus	Peninsular Malaysia		Rudnick (pers. commun.) 1975
	Dengue 3 virus	Manila, Philippines	1 isolation 1956	Hammon, Rudnick and Sather 1960
	Dengue virus	Singapore		Lim, Rudnick and Chan 1961
	Dengue 2 virus	Singapore	1 isolation 1966	Chan, Ho and Chan 1971
	Dengue 2 virus	Bangkok, Thailand	3 isolations 1958	Hammon, Rudnick and Sather 1960
	Dengue 2 virus	Koh Samui Island, Thailand	8 isolations from 27 pools July-September 1966	Gould et al. 1968
	Dengue 1-4 viruses	Bangkok, Thailand	5 isolations Dengue 1, 6 Dengue 2, 8 Dengue 3 and 1 Dengue 4 from 150 pools, 1966; 1 isolation Dengue 1, 2 Dengue 2 and 1 Dengue 4 from 90 pools, 1963	Halstead et al. 1969

TABLE 2 (Continued).

Species	Pathogen	Location	Comments	Reference
aegypti	Dengue 4 virus	Koh Samui Island, Thailand	25 isolations from 88 pools May-November 1968	Smith et al. 1971
	Dengue 2 virus	Saigon, Vietnam	1 isolation November 1963	Halstead et al. 1965
	Dengue 1-4 viruses	Saigon area, Vietnam	30 dengue isolations of all strains from 1,892 pools May-December 1967	Russell, Quy et al. 1969
	Dengue 3 virus	Rangoon, Burma	1 isolation July 1969	MI-MI-KHIN and KHIN-AYE-THAN 1976
	Zika virus	Bentong, Malaysia	1 isolation July 1966	Marchette, Garcia and Rudnick 1969
albopictus	Dengue 2 virus	Singapore	1 isolation November 1960	Rudnick and Chan 1965
	Dengue 1 and Dengue 2 viruses	Singapore	1 isolation Dengue 1 and 4 isolations Dengue 2 from pools April-October 1966	Chan, Ho and Chan 1971
	Dengue 2 virus	Koh Samui Island, Thailand	4 isolations from 141 pools July-September 1966	Gould et al. 1968
	Dengue 4 virus	Koh Samui Island, Thailand	10 isolations from 897 pools August-December 1967	Russell, Gould et al. 1969
	Dengue 4 virus	Koh Samui Island, Thailand	38 isolations from 1,829 pools May-November 1968	Smith et al. 1971
	Reovirus 3	Peninsular Malaysia	2 isolations 1974	Rudnick (pers.) commun.) 1975

TABLE 2 (Continued).

Species	Pathogen	Location	Comments	Reference
albopictus	Tembusu virus	Peninsular Malaysia	1 isolation 1974	Rudnick (pers. commun.) 1975
	Dirofilaria immitis	Nagasaki, Japan	3.2% of field dissected adults in urban areas with filarial larvae and 5.5% in rural areas with filarial larvae	Suenaga and Itoh 1973
	Dirofilaria sp.	Sangkhlaburi District, Kanchanaburi Prov., Thailand	2/571 dissected with stage 3 filarial larvae	Harinasuta et al. 1970

KEYS TO THE GROUPS, SUBGROUPS AND SPECIES OF THE SUBGENUS *STEGOMYIA*

ADULTS (MALES AND FEMALES)

1. Palpi with white scales (Fig. 1A). 2
   Palpi without white scales (Fig. 6A).
   ALBOLINEATUS GROUP (p. 13)

2(1). Dorsocentral bristles present (Fig. 1A). 3
   Dorsocentral bristles absent (Huang 1977a, Fig. 25A).
   W-ALBUS GROUP (p. 15)

3(2). Scutum with lyre-shaped white markings (Fig. 1A).
   AEGYPTI GROUP
   aegypti (p. 41)
   Scutum without lyre-shaped white markings. 4

4(3). Scutum with a long median longitudinal white stripe of narrow scales extending from anterior margin to about level of wing root (Fig. 25A). . . . . *SCUTELLARIS* GROUP (p. 14)
   Scutum with a distinct, small, median oval white spot of narrow scales on anterior 0.33 of scutum (Huang 1977a, Fig. 1A).
   EDWARDSI GROUP (p. 13)

THE *ALBOLINEATUS* GROUP

1. Scutum with a median longitudinal white stripe. 2
   Scutum without a median longitudinal white stripe.
   platylepidus (p. 44)

2(1). Scutellum with broad white scales on midlobe and with broad dark scales on lateral lobe (Fig. 6A). 3
   Scutellum with broad white scales on all lobes (Fig. 20A). 6

3(2). Median scutal stripe extending posteriorly to the scutellum (Fig. 18C). 4
   Median scutal stripe extending posteriorly only to the level of wing root (Fig. 6A). 5

4(3). Hindtarsomere 3 with white basal band (Fig. 18A). . . . *hoogstraali*
   Hindtarsomere 3 entirely dark (Fig. 18B). . . . . *impatibilis*

5(3). Posterior pronotum with narrow dark scales only. . . . *albolineatus*
   Posterior pronotum with narrow dark scales dorsally and broad white scales ventrally. . . . . *boharti*

6(2). Median scutal stripe extending posteriorly to the prescutellar area (Fig. 20A). . . . . *bambusicola*
   Median scutal stripe extending posteriorly only to the level of wing root (Fig. 20B). 7

7(6). Scutum with a patch of broad white scales on lateral margin just before the level of wing root (Fig. 20C). 8
   Scutum without a patch of broad white scales on lateral margin just before the level of wing root. . . . . *arboricola*

8(7). Male hindtarsomere 2 with at least basal 0.25 white band; female hindtarsomere 3 with at most basal 0.5 white dorsally (Fig. 23A).
   laffooni
   Male hindtarsomere 2 with at most basal 0.2 white band; female hindtarsomere 3 with at least basal 0.87 white dorsally (Fig. 23B).
   pseudalbolineatus

THE *EDWARDSI* GROUP

Posterior pronotum without narrow dark scales on upper portion; lower mesepimeron with bristles (Huang 1977a, Fig. 4C).
edwardsi
Posterior pronotum with narrow dark scales on upper portion; lower mesepimeron without bristles (Huang 1977a, Fig. 4F). . *seampi**

*The male of *seampi* is unknown.

THE *SCUTELLARIS* GROUP

1. Supraalar white line incomplete, not clearly defined and with only narrow scales over wing root (Fig. 30A). 2
Supraalar white line complete and well developed, with broad flat scales over wing root and toward scutellum (Fig. 30B). 9

2(1). Scutum with patch of broad flat white scales on lateral margin just before level of wing root (Fig. 30C). 3
Scutum without such patch. 5

3(2). Scutum with a small patch of white scales on scutal angle area; midfemur with some pale scales scattered on anterior surface (Huang 1972, Figs. 15A, 15C, 15D). 4
Scutum without such a white patch on scutal angle area; midfemur without such scales (Huang 1972, Figs. 1A, 1D, 1E). . . *albopictus*

4(3). Tergum I with a large median patch of white scales; midfemur without a large white spot on anterior surface (Huang 1972, Figs. 15A, 15D). . . . . *seatoi*
Tergum I without median patch of white scales; midfemur with a large, white spot on anterior surface (Fig. 25B). . . . . *unilineatus*

5(2). Scutum with patch of narrow curved yellowish scales on lateral margin just before level of wing root. 6
Scutum with patch of narrow curved white scales on lateral margin just before level of wing root (Fig. 30D). 8

6(5). Fore- and midfemora with some pale scales scattered on anterior surface. . . . . *novalbopictus**
Fore- and midfemora without such scales. 7

7(6). Subspiracular area with scales; hindtarsomere 4 with at most basal 0.66-0.75 white banded (Huang 1972, Fig. 20M). . . . . *patriciae*
Subspiracular area without scales; hindtarsomere 4 with basal 0.83-0.90 white banded (Huang 1972, Fig. 20N). . . . . *downsi*

8(5). Scutum with patch of broad dark scales on each side of prescutellar space between prescutellar white line and postdorsocentral white line; postspiracular area with scales (Fig. 31A).
pseudalbopictus
Scutum without such patch of scales; postspiracular area without scales (Fig. 31B). . . . . *subalbopictus*

9(1). Abdomen with lunate, lateral, white spots only; wing without a minute basal spot of white scales on costa (Huang 1972, Fig. 20D).
andrewsi

*The female of *novalbopictus* is unknown.

Abdomen with some complete pale bands or with indications of such bands on terga; wing with a minute basal spot of white scales on costa. 10

10(9). Midfemur with a median white line on anterior surface (Huang 1972, Fig. 20K). 11
Midfemur without such line. 12

11(10). Scutum with a few narrow white scales on lateral prescutal area and on scutal angle area (Huang 1972, Fig. 20J). . . . . *paullusi*
Scutum without any narrow white scales in these positions. *alorensis*

12(10). Hindtarsomere 3 with basal 0.4 white; hindtarsomere 4 with at most basal 0.66 white. 13
Hindtarsomere 3 with basal 0.5 white; hindtarsomere 4 with basal 0.75 white (Huang 1972, Fig. 21E). . . . . *alcasidi*

13(12). Hindtarsomere 1 with at least basal 0.25 white; hindtarsomere 2 with basal 0.33 white. 14
Hindtarsomere 1 with basal 0.20 white; hindtarsomere 2 with basal 0.25 white (Huang 1972, Fig. 31E). . . . . *riversi*

14(13). Hindtarsomere 1 with basal 0.25 white; hindtarsomere 4 with basal 0.66 white (Huang 1972, Fig. 31D). . . . . *malayensis*
Hindtarsomere 1 with basal 0.33 white; hindtarsomere 4 with basal 0.60 white. . . . . *krombeini*

THE *W-ALBUS* GROUP*

1. Tibiae with white band (Huang 1977a, Fig. 21A). (*desmotes* subgroup) *desmotes*
Tibiae without white band. 2

2(1). Scutellum with broad dark scales on midlobe and with broad white scales on lateral lobe (Huang 1977a, Figs. 9B, 9D). (*annandalei* subgroup) 3
Scutellum with broad white scales on midlobe and with broad dark, or white, or both on lateral lobe. 4

3(2). Scutum with a large median oval white patch, extending from anterior margin, narrows slightly posteriorly, to about the middle of the scutum; scutal patch posteriorly blunt (Huang 1977a, Fig. 9B). *annandalei*
Scutum with a large median triangular white patch, extending from anterior margin and about anterior half of the lateral prescutal area, narrows posteriorly, to the middle of the scutum; scutal patch posteriorly pointed (Huang 1977a, Fig. 9D). . . . . *craggi*

*_____
Aedes rhungkiangensis is not included.

4(2). Scutum with a broad median longitudinal white stripe, extending from anterior margin, tapering posteriorly, to the prescutellar area and forking at the beginning of prescutellar space; midfemur without a median white spot on anterior surface (Huang 1977a, Fig. 25A).
(*mediopunctatus* subgroup)
*malikuli**
mediopunctatus
perplexus

Scutum without such a median longitudinal white stripe; midfemur with a median white spot on anterior surface (Huang 1977a, Fig. 21B).
(*w-albus* subgroup) 5

5(4). Scutum with a broad longitudinal white stripe on each side of midline, extending from anterior margin to the middle of the scutum and fusing with the antealar white patch (Huang 1977a, Fig. 17D).
gardnerii gardnerii

Scutum with a large median white patch, or 2 lateral white patches, on anterior 0.33 of scutum. 6

6(5). Scutal median white patch broader than long, with narrow white scales reaching from anterior margin to the lateral prescutal area on each side; antealar white patch with narrow white scales mainly and with some broad white scales on the lateral margin just before the level of the wing root (Huang 1977a, Figs. 32B, 32A).
gardnerii imitator

Scutal median white patch rather narrow and long; antealar white patch with all narrow white scales (Huang 1977a, Figs. 32D, 32C).
w-albus

MALE TERMINALIA

1. Paraproct with sternal arm (Fig. 1C). 2
Paraproct without sternal arm. 3

2(1). Apical margin of tergum IX with middle part deeply concave (Figs. 1D, 2C). . . . . *AEGYPTI* GROUP
aegypti (p. 41)

Apical margin of tergum IX with middle part nearly flat (Huang 1977a, Fig. 14C). . . . . *W-ALBUS* GROUP
(*desmotes* subgroup)
desmotes

3(1). Distimere simple, elongate, with a spiniform process. 4

Distimere complex, expanded at base and apically forked, with spiniforms processes (Huang 1977a, Figs. 19C, 21C, 25C).
W-ALBUS GROUP
(*mediopunctatus* subgroup) (p. 20)

*The female of *malikuli* is unknown.

4(3). Spiniform of distimere process submedial or subbasal (Figs. 6C, 12C). . . . . *ALBOLINEATUS* GROUP (p. 17)
Spiniform of distimere process at apex or subapical. 5

5(4). Apical margin of tergum IX with middle part concave (Huang 1977a, Figs. 6C, 11C). . . . . *W-ALBUS* GROUP (*annandalei* subgroup) (p. 20)
Apical margin of tergum IX with middle part rounded, truncated, or produced into a large lobe, or a median projection. 6

6(5). Aedeagus apically widened, with 6 or 7 apical teeth on each side (Huang 1977a, Fig. 1B). . . . . *EDWARDSI* GROUP* *edwardsi*
Aedeagus with a distinct sclerotized lateral toothed plate on each side. 7

7(6). Spiniform of distimere long, at least 0.28 length of distimere; apical margin of tergum IX with large median lobe (Huang 1977a, Figs. 29C, 33C). . . . . *W-ALBUS* GROUP (*w-albus* subgroup) (p. 20)
Spiniform of distimere rather short, at most, 0.25 length of distimere, or apical margin of tergum IX without large median lobe (Figs. 25D, 27C). . . . . *SCUTELLARIS* GROUP (p. 18)

THE *ALBOLINEATUS* GROUP

1. Paraproct with apical lobed process. 2
Paraproct without apical lobed process. 8

2(1). Spiniform of distimere process before middle, at most, at about basal 0.33. 3
Spiniform of distimere process at middle, or beyond middle. . . . 4

3(2). Apical margin of tergum IX with middle part concave; basimere long, about 3.0 as long as wide, with numerous short, apically curved setae along mesal side of dorsal surface (Fig. 16C). *hoogstraali*
Apical margin of tergum IX with middle part nearly flat; basimere rather short and broad, about 2.2 as long as wide, with some long, stout, apically curved setae along mesad side of dorsal surface (Fig. 19C). . . . . *impatibilis*

4(2). Lateral plate of aedeagus with less than 10 apical teeth (Figs. 6B, 6C). . . . . *albolineatus*
Lateral plate of aedeagus with more than 10 apical teeth. 5

5(4). Claspette with 3 short, stout, spine-like setae and several shorter setae on distal part (Fig. 14C). . . . . *boharti*

*The male of *seampi* is unknown.

Claspette with 3-5 rather long, stout, spine-like setae and several long setae with slender curved tips on distal part. 6

6(5). Claspette with 3, 4 stout, spine-like setae and several long setae with slender curved tips on distal part; apical margin of tergum IX with middle concave (Fig. 10C). . . . . *arboricola*
Claspette with 4, 5 stout, spine-like setae and several long, stout setae with slender curved tips on distal part; apical margin of tergum IX with middle flat (Figs. 21C, 23C, 23D). 7

7(6). The apices of the strongest spine-like setae of claspette reaching to the level of apex of basimere (Fig. 21C). . . . . *laffooni*
The apices of the strongest spine-like setae of claspette not reaching to the level of apex of basimere (Fig. 23D). . . . *pseudalbolineatus*

8(1). Spiniform of distimere process subbasal (Fig. 12C). *bambusicola*
Spiniform of distimere process submedial (Fig. 24C). *platylepidus* (p. 44)

THE *SCUTELLARIS* GROUP

1. Apical margin of tergum IX with a median lobe or projection. . . . 2
Apical margin of tergum IX with middle broadly rounded or truncated. 8

2(1). Apical margin of tergum IX with conspicuous horn-like median projection (Huang 1972, Fig. 2C). . . . . *albopictus*
Apical margin of tergum IX with middle part produced into a lobe. . 3

3(2). Apical margin of tergum IX with middle part produced into large lobe with apex serrated (Huang 1972, Fig. 4C). . . . . *downsi*
Apex of lobe not serrated. 4

4(3). Claspette long, slender, reaching to about 0.75 of basimere, expanded portion facing mesad (Fig. 25D; Huang 1972, (Fig. 16C). 5
Claspette large, broad, reaching to about 0.5 of basimere, expanded portion horizontal in position (Huang 1972, Figs. 9C, 11C, 18C). 6

5(4). Apical margin of tergum IX with large median lobe; claspette with numerous setae and several widened specialized curved ones on mesal side of slightly expanded distal part, without any setae on basal 0.4 area (Huang 1972, Fig. 16C). . . . . *seatoi*
Apical margin of tergum IX with rounded median lobe; claspette with numerous setae and several stouter widened ones on distal part, with a small, mesally directed projection on basal 0.4 bearing one large seta and with 3 smaller setae near to it (Figs. 25D, 25C). *unilineatus*

6(4). Specialized setae on sternal side of expanded portion of claspette spine-like, curved with sharply pointed tips and varying length (Huang 1972, Figs. 8C, 9C). . . . . *novalbopictus*
These specialized setae blade-like or clubbed, without sharply pointed tip (Huang 1972, Figs. 11C, 18C). 7

7(6). Claspette with broad stem and lateral distal angle turned through 90° in lateral aspect (dissected) (Huang 1972, Fig. 18C). *subalbopictus*
Claspette with narrower stem and without a 90° lateral distal angle (Huang 1972, Fig. 11C). . . . . *patriciae*

8(1). Claspette complex with numerous setae on expanded distal part, each seta on distinct cone, a tergal mesal finger-like process bearing 6 modified setae at tip (Huang 1972, Fig. 24B). . . *alorensis*

9(8). Claspette truncate, with a distinct oval face at apex; with numerous setae and several long, stout ones on tergal side and with 4 spine-like setae on sternal side of oval face; apical margin of tergum IX with middle truncated (Huang 1972, Fig. 29C). . . . . *paullusi*
Claspette with apex more or less cylindrical. 10

10(9). Claspette long, slender, reaching to 0.7 of basimere, with one widened specialized spine-like seta and numerous setae distal to it (Huang 1972, Fig. 13C). . . . . *pseudalbopictus*
Claspette rather short, with several widened specialized setae and numerous unmodified setae. 11

11(10). Claspette with distal expanded part rectangular in lateral aspect (dissected), sternal and tergal sides more or less parallel, apicosternal angle present (Fig. 27C). 12
Claspette with distal expanded part subtriangular in shape in lateral aspect (dissected), sternal and tergal sides not parallel but tapering, without apicosternal angle. 13

12(11). Apicotergal area of claspette with several distinctly long and stout setae (Huang 1972, Fig. 24A). . . . . *andrewsi*
Apicotergal area without any such setae (Fig. 27C). *krombeini*

13(11). Apicotergal area of claspette with several distinctly long setae (Huang 1972, Figs. 22C, 26C). . . . . *alcasidi*
Apicotergal area without any such setae. 14

14(13). Claspette with 7-10 modified setae forming a prominant row at center of sternal side and occupying about 0.5 of it (Huang 1972, Figs. 26D, 27C). . . . . *malayensis*
Claspette with 6-8 modified setae at center of sternal side, closer to sternal angle area than to apicotergal angle area and occupying about 0.4 of it (Huang 1972, Figs. 26A, 26B). . . . . *riversi*

THE *W-ALBUS* GROUP

annandalei subgroup

Claspette short and broad, with 3 widened, leaf-like setae on tergal side and with 2 stout, spine-like setae on sternal side of expanded distal part, with several slender setae scattered in-between (Huang 1977a, Figs. 6C, 10B). . . . . *annandalei*

Claspette longer and narrower, reaching to 0.75 of basimere, with 3 widened specialized setae on dorsal basal part and with numerous long setae ventral and distal to it (Huang 1977a, Figs. 11C, 10D). *craggi*

mediopunctatus subgroup*

1. Claspette simple, with numerous long setae on the slightly expanded distal part and with few shorter ones on sternal side (Huang 1977a, Fig. 19C). . . . . *malikuli*

   Claspette large and bilobed, with numerous setae and with a distinct stout spine-like seta on apicosternal angle of expanded distal part. 2

2(1). Claspette with several distinctly long and stout setae on tergal portion of expanded distal part (Huang 1977a, Figs. 21C, 21D). *mediopunctatus*

   Claspette without several distinctly long and stout setae on tergal portion of expanded distal part (Huang 1977a, Fig. 25C). *perplexus*

w-albus subgroup

Claspette with numerous setae on the expanded distal part and occupying about 0.5 of it (Huang 1977a, Fig. 29C). . *gardnerii gardnerii gardnerii imitator*

Claspette with numerous stouter, widened setae on the expanded distal part and occupying 0.67 or more of it (Huang 1977a, Fig. 33C). *w-albus*

PUPAE**

1. Paddle margins without fringe of very long hair-like spicules (Figs. 2A, 7A). 2

   Paddle margins with fringe of very long hair-like spicules (Fig. 27A). 3

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*_Aedes rhungkiangensis_ is not included.

**The pupa of _rhungkiangensis_ is unknown.

2(1). Paddle margins with distinct denticles; seta 1-P single (Fig. 2A). *AEGYPTI* GROUP
aegypti (p. 41)

Paddle margins without distinct denticles, at most with slight spicules seta 1-P branched (Figs. 7A, 10A, 12A, 14A, 16A, 19A, 21A) *ALBOLINEATUS* GROUP (p. 21)

3(1). Seta 2-IV, V directly anteriad of 1-IV, V; seta 5-C strong, usually double. . . . . *EDWARDSI* GROUP*

Seta 2-IV, V laterad of, or mesad of 1-IV, V. 4

4(3). Seta 2-IV, V laterad of 1-IV, V. 5

Seta 2-IV, V mesad of 1-IV, V (Fig. 27A; Huang 1977a, Figs. 29A, 33A). . . . . *SCUTELLARIS* GROUP (p. 22)
W-ALBUS GROUP
(*w-albus* subgroup)

5(4). Seta 2-IV, V laterad of 3-IV, V; seta 1-II usually with 3-6 branches, not dendritic (Huang 1977a, Fig. 14A). . . . . *W-ALBUS* GROUP
(*desmotes* subgroup)
desmotes

Seta 2-IV, V mesad of 3-IV, V; seta 1-II usually well developed, with many dendritic branches. 6

6(5). Male genital lobe short and broad, about as long as wide (Huang 1977a, Figs. 19A, 22A, 26A). . . . . *W-ALBUS* GROUP
(*mediopunctatus* subgroup)
malikuli
mediopunctatus
perplexus

Male genital lobe long and broad, slightly longer than wide (Huang 1977a, Figs. 6A, 11A). . . . . *W-ALBUS* GROUP
(*annandalei* subgroup) (p. 23)

THE *ALBOLINEATUS* GROUP**

1. Seta 5-C short, about length of 4-C (Figs. 12B, 16B, 19B). 2

Seta 5-C strongly developed, very long, much longer than 4-C. . . 3

2(1). Seta 9-VII single, small and slender, about same magnitude as 9-VI; 1-P well developed, with at least 9 branches (Fig. 12A).
bambusicola

Seta 9-VII single or branched, much longer and stouter than 9-VI; 1-P with at most 5 branches (Figs. 16A, 19A). . . . . *hoogstraali*
impatibilis

3(1). Seta 5-VI usually single (1, 2), short, not reaching beyond posterior margin of following segment (Figs. 7A, 14A). 4

*Known from unpublished material from Andaman islands.
**The pupae of *platylepidus* and *pseudalbolineatus* are unknown.

Seta 5-VI single or double, or 2, 3 forked, usually long, reaching beyond posterior margin of following segment. 5

4(3). Seta 9-VII usually with 2, 3 branches; 6-VII usually single or double and smaller than 9-VII (Fig. 7A). . . . . *albolineatus*
Seta 9-VII usually with 3-5 branches; 6-VII usually with 2-6 branches (Fig. 14A). . . . . *boharti*

5(3). Seta 9-VIII usually with 17 (14-21) branches (Fig. 21A). . . *laffooni*
Seta 9-VIII usually with 13 (11-16) branches (Fig. 10A). . *arboricola*

THE *SCUTELLARIS* GROUP*
THE *W-ALBUS* GROUP
w-albus subgroup

1. Seta 9-III-V strongly developed, thickened, much stouter than 9-II (Huang 1972, Fig. 16A; Huang 1977a, Fig. 33A). 2
Seta 9-III-V not strongly developed, slender, about same magnitude as 9-II. 3

2(1). Seta 1-II usually with 8-10 branches (Huang 1972, Fig. 16A). *seatoi*
Seta 1-II usually with 2, 3 branches (Huang 1977a, Fig. 33A). *w-albus*

3(1). Seta 9-VI much stouter than 9-V, at least 2.0 length of 9-V (Fig. 27A; Huang 1972, Figs. 4A, 18A). 4
Seta 9-VI about as thick as 9-V, less than 2.0 length of 9-V. 6

4(3). Seta 9-VI usually single and barbed; 9-VII usually single and barbed or with 2 apical branches; 9-VIII usually with 2 main stems (1, 2) reaching beyond fringe of paddle, each stem with lateral branches of varying length (Huang 1972, Fig. 4A). . . . . *downsi*
Seta 9-VI single and simple (Fig. 27A; Huang 1972, Fig. 18A). . . . 5

5(4). Seta 9-VIII usually with 2 main stems, barbed, not reaching beyond fringe of paddle (Huang 1972, Fig. 18A). . . . . *subalbopictus*
Seta 9-VIII usually with single main stem (1, 2) reaching beyond fringe of paddle, with lateral branches of varying length (Fig. 27A). *krombeini*

6(3). Seta 9-VII single, stout and barbed or split at apex. 7
Seta 9-VII single, simple. 9

7(6). Seta 6-C much shorter than 7-C (Huang 1972, Fig. 9B). *novalbopictus*
Seta 6-C about length of 7-C. 8

*The pupa of *unilineatus* is not included. The pupae of *alorensis* and *andrewsi* are unknown.

8(7). Seta 6-C much stouter than 7-C and usually slightly longer; 1-II usually with 10, 11 branches arising from a common stem at base; 9-VIII usually with 2 main stems, reaching beyond fringe of paddle, each stem with lateral branches of varying length; paddle margins fringed close to base, on more than apical 0.75 of paddle (Huang 1972, Figs. 29B, 29A). . . . . *paullusi*

Seta 6-C usually about length of 7-C; 1-II branched, without a common stem at base; paddle margins with fringe on less than apical 0.75 of paddle (Huang 1972, Figs. 22B, 22A). . . . *alcasidi* (in part)

9(6). Seta 9-VIII usually with 2 (1, 2) branches, each barbed, not reaching beyond fringe of paddle (Huang 1972, Fig. 11A). . . . . *patriciae*

Seta 9-VIII reaching beyond fringe of paddle. 10

10(9). Seta 6-C about 0.5 length of 7-C. 11

Seta 6-C about 0.75-1.00 length of 7-C. 13

11(10). Seta 9-VIII with 2 branches (Huang 1972, Fig. 13A). *pseudalbopictus*

Seta 9-VIII usually single (1, 2). 12

12(11). Male genital lobe short and broad, about as long as wide (Huang 1972, Fig. 2A). . . . . *albopictus*

Male genital lobe long and broad, longer than wide (Huang 1977a, Fig. 29A). . . . . *gardnerii gardnerii gardnerii imitator*

13(10). Seta 6-C about 0.75 length of 7-C. 14

Seta 6-C about 1.0 length of 7-C (Huang 1972, Fig. 22B). *alcasidi* (in part)

14(13). Seta 9-VIII usually with single main stem (1, 2), with lateral branches of varying length; 1-II with many primary and secondary branches (Huang 1972, Fig. 27A). . . . . *malayensis*

Seta 9-VIII usually with 2 branches (1, 2), barbed; 1-II with very few secondary branches (Huang 1972, Fig. 32A). . . . . *riversi*

annandalei subgroup

Male genital lobe with a triangular-shaped fold on ventral side (Huang 1977a, Fig. 11A). . . . . *craggi*

Male genital lobe without a triangular-shaped fold on ventral side (Huang 1977a, Fig. 6A). . . . . *annandalei*

FOURTH STAGE LARVAE*

1. Ventral brush with 5 pairs of setae (Figs. 3C, 8C). 2

Ventral brush with 4 pairs of setae (Fig. 28C). 3

**Aedes rhungkiangensis* is not included.

2(1). Comb scale with very strong basal denticles (Fig. 3C).
AEGYPTI GROUP
aegypti (p. 41)

Comb scale without very strong basal denticles (Figs. 8C, 11C, 13C, 15C, 17C, 22C). . . . . *ALBOLINEATUS* GROUP (p. 25)

3(1). Marginal spicules of anal segment well developed and conspicuous. . 4

Marginal spicules of anal segment not well developed, very small and inconspicuous. 6

4(3). Seta 1-S inserted at level of, or before last pecten tooth. 5

Seta 1-S inserted beyond last pecten tooth (Huang 1977a, Figs. 20C, 23C, 27C). . . . . *W-ALBUS* GROUP
(*mediopunctatus* subgroup)
malikuli
mediopunctatus
perplexus

5(4). Marginal spicules of anal segment very long, spine-like.
EDWARDSI GROUP*

Marginal spicules of anal segment stout, rather short and bluntly rounded at apex (Huang 1977a, Figs. 7C, 12C).
W-ALBUS GROUP
(*annandalei* subgroup)
annandalei
craggi

6(3). Comb scales in a single row, arising from a sclerotized plate (Huang 1977a, Fig. 15C) . . . . . *W-ALBUS* GROUP
(*desmotes* subgroup)
desmotes

Comb scales in a single row, not arising from a sclerotized plate. . 7

7(6). Ventral brush with 4d-X well developed, single or branched and with bars (Fig. 28C; Huang 1977a, Fig. 34C).
SCUTELLARIS GROUP (p. 25)
W-ALBUS GROUP
(*w-albus* subgroup)
w-albus

Ventral brush with 4d-X not well developed, single, very small, much smaller than 4a, b, c-X and without bars (Huang 1977a, Fig. 30C). . . . . *W-ALBUS* GROUP
(*w-albus* subgroup)
gardnerii gardnerii
gardnerii imitator

*Known from unpublished material from Andaman islands.

THE *ALBOLINEATUS* GROUP*

1. Marginal spicules of anal segment small and inconspicuous (Figs. 13C, 17C). 2
Marginal spicules of anal segment well developed, very long and conspicuous (Figs. 8C, 11C, 15C, 22C). 3

2(1). Comb scales in a single row, arising from a sclerotized plate (Fig. 13C). . . . . *bambusicola*
Comb scales in a single row, not arising from a sclerotized plate (Fig. 17C). . . . . *hoogstraali*

3(1). Seta 5-P long, about 1.0 length of 7-P (Fig. 8B). . . . *albolineatus*
Seta 5-P short, much shorter than 7-P (Figs. 11B, 15B. 22 B). . . 4

4(3). Comb scale with free portion widened at base and sharply pointed at apex, with fine denticles on basal portion of apical spine (Fig. 15C). . . . . *boharti*
Comb scale with free portion rather slender and long, about 2.0 length of attached portion, without fine denticles on basal portion of apical spine (Figs. 11C, 22C). 5

5(4). Comb scales in a single row, arising from a sclerotized plate (Fig. 11C). . . . . *arboricola*
Comb scales in a single row, not arising from a sclerotized plate (Fig. 22C). . . . . *laffooni*

THE *SCUTELLARIS* GROUP**
THE *W-ALBUS* GROUP
w-albus subgroup

1. Comb scale with prominent denticles at base of apical spine; seta 2-VII usually with 6 (5-8) branches (Fig. 31C). . . . . *seatoi*
Comb scale without such denticles. 2

2(1). Siphon with acus; pecten teeth 3-6, each tooth short and stout; usually with 3, 4 basal denticles (Huang 1972, Fig. 14C). *pseudalbopictus*
Siphon without acus; pecten tooth long, at least 4.0 as long as wide. 3

3(2). Anal segment with complete saddle (Huang 1972, Figs. 10C, 19C). . 4
Anal segment with incomplete saddle. 5

*The larvae of *impatibilis* and *platylepidus* are unknown. The larva of *pseudalbolineatus* is not included.

**The larva of *unilineatus* is not included. The larvae of *alorensis* and *andrewsi* are unknown.

4(3). Seta 2-X 2-branched; pecten tooth usually with 3 (2, 3) basal denticles; 1-S inserted beyond last pecten tooth and ventrad of teeth (Huang 1972, Fig. 10C). . . . . *novalbopictus*

Seta 2-X usually single, when 2-branched one much smaller than the other; pecten tooth usually with 2 (2, 3) basal denticles; 1-S inserted well beyond last pecten tooth and in line with teeth (Huang 1972, Fig. 19C). . . . . *subalbopictus*

5(3). Siphon short, 1.7 as long as wide at middle (Huang 1977a, Fig. 34C). . . . . *W-ALBUS* GROUP (*w-albus* subgroup) *w-albus*

Siphon about 2.0-2.5 as long as wide at middle. 6

6(5). Seta 2-X 3-branched; 2-VII usually with 3 (2, 3) branches; pecten tooth with one large and occasionally 1, 2 very small basal denticles (Huang 1972, Fig. 30C). . . . . *paullusi*

Seta 2-X 2-branched. 7

7(6). Seta 1-VII usually with 4 (3, 4) branches, short, less than 2.0 length of 5-VII. 8

Seta 1-VII usually with 2 (2, 3) branches, long, at least 2.5 length of 5-VII. 10

8(7). Seta 2-VII with 3, 4 branches. 9

Seta 2-VII usually single (1, 2) (Huang 1972, Fig. 3C). . . *albopictus*

9(8). Comb scale with free portion widened at base and sharply pointed at tip (Fig. 31D). . . . . *downsi*

Comb scale with free portion rather slender, nearly parallel-sided from base and at least length of attached portion (Fig. 31E). *patriciae*

10(7). Seta 1-VII with 2, 3 branches; siphon about 2.0 as long as wide; pecten teeth 10-21, closely arranged in a line; 1-S usually inserted beyond middle of siphon; comb scale sometimes with apical spine split at tip (Huang 1972, Fig. 33C). . . . . *riversi*

Seta 1-VII usually with 2 long branches (2, 3), when 3-branched then one much smaller than other 2; siphon about 2.5 as long as wide; pecten teeth 10-19; 1-S inserted at middle or before middle of siphon. 11

11(10). Seta 1-S usually inserted at middle of siphon; pecten teeth 10-14, each with 2-4 basal denticles (Huang 1972, Fig. 28C). . . . *malayensis*

Seta 1-S usually inserted before middle of siphon. 12

12(11). Pecten tooth with one large and 1-3 small basal denticles (Fig. 31F). *alcasidi*

Pecten tooth with 1-3 basal denticles (Fig. 28C). . . . . *krombeini*

NOMEN DUBIUM

Aedes rimandoi Basio. Philippines. 1971a: 52 (♂*, ♀). Type-locality: U. P. College of Forestry Campus, Los Banos, Laguna, Luzon, Philippines (NE).

TAXONOMIC DISCUSSION. According to Basio (1971a: 53), the original description was based on 2♂, 1♀ and the type of *rimandoi* was deposited in the "RGB", Ruben G. Basio Mosquito Collection, Manila, Philippines (Basio 1971b: 31). However, numerous enquiries addressed to several persons in Manila, Philippines have failed to show that any type-material is still in existence. Based on the original description, *rimandoi* is unrecognizable and should be considered a *nomen dubium*.

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APPENDIX I. PRESENT STATUS OF THE SPECIES OF *AEDES (STEGOMYIA)* IN THE ORIENTAL REGION

SPECIES	STAGES					BIONOMICS
	A ♂	A ♀	P	L	E	
1. *aegypti*	X*	X*	X*	X*	X*	Immature habitats known, female bites man
2. *albolineatus*	X*	X*	X*	X*	-	Immature habitats known
3. *arboricola*	X*	X	X*	X*	-	Immature habitats known
4. *bambusicola*	X*	X*	X*	X*	-	Immature habitats known
5. *boharti*	X*	X	X*	X*	-	Immature habitats known, female bites man
6. *hoogstraali*	X*	X*	X*	X*	-	Immature habitats known
7. *impatibilis*	X*	X*	X*	-	-	Immature habitats known
8. *laffooni*	X*	X*	X*	X*	-	Immature habitats known
9. *platylepidus*	X*	X*	-	-	-	Immature habitats known
10. *pseudalbolineatus*	X*	X*	-	X	-	Immature habitats known
11. *edwardsi*	X*	X*	-	-	-	Immature habitats known
12. *seampi*	-	X*	-	-	-	Unknown
13. *albopictus*	X*	X*	X*	X*	X*	Immature habitats known, female bites man
14. *downsi*	X*	X*	X*	X*	-	Immature habitats known, female bites man
15. *novalbopictus*	X*	-	X*	X*	-	Immature habitats known
16. *patriciae*	X*	X*	X*	X*	-	Immature habitats known
17. *pseudalbopictus*	X*	X*	X*	X*	X*	Immature habitats known
18. *seatoi*	X*	X	X*	X*	-	Immature habitats known, female bites man
19. *subalbopictus*	X*	X*	X*	X*	-	Immature habitats known
20. *unilineatus*	X*	X*	X*	X*	-	Immature habitats known
21. *alcasidi*	X*	X*	X*	X*	X*	Immature habitats known
22. *alorensis*	X*	X*	-	-	-	Unknown
23. *andrewsi*	X*	X*	-	-	-	Unknown
24. *krombeini*	X*	X*	X*	X*	-	Immature habitats known, female bites man
25. *malayensis*	X*	X*	X*	X*	-	Immature habitats known, female bites man
26. *paullusi*	X*	X*	X*	X*	-	Immature habitats known, female bites buffalo
27. *riversi*	X*	X*	X*	X*	-	Immature habitats known, female bites man
28. *annandalei*	X*	X*	X*	X*	X*	Immature habitats known, female bites man
29. *craggi*	X*	X*	X*	X*	-	Immature habitats known, female bites man
30. *desmotes*	X*	X*	X*	X*	X*	Immature habitats known, female bites man
31. *malikuli*	X*	-	X*	X*	-	Immature habitats known

APPENDIX I (Continued).

SPECIES	STAGES					BIONOMICS
	A		P	L	E	
	♂	♀				
32. *mediopunctatus*	X*	X*	X*	X*	-	Immature habitats known, female bites man
33. *perplexus*	X*	X*	X*	X*	X*	Immature habitats known, female bites man
34. *rhungkiangensis*	X*	X	-	X*	-	Unknown
35. *gardnerii gardnerii*	X*	X*	X*	X*	-	Immature habitats known
36. *gardnerii imitator*	X*	X*	X*	X	X*	Immature habitats known, female bites man
37. *w-albus*	X*	X*	X*	X*	-	Immature habitats known, female bites man

X* = Stage or sex described and illustrated.
\- = Stage or sex unknown.
X = Stage or sex described.

APPENDIX II. DISTRIBUTION LIST OF THE ORIENTAL SPECIES OF *AEDES (STEGOMYIA)*

SPECIES	ORIENTAL REGION																															
	Ryukyu Islands	Taiwan	China (S. of Yangtze Kiang)	Hong Kong	Hainan	Vietnam	Laos	Cambodia	Thailand	Burma	Assam (India)	Philippines	Sangi Islands, Taroena	Celebes, Kabaena	Sabah	Sarawak	Kalimantan, Tarakan	W. Malaysia	Poeloch Weh	Singapore	Sumatra	Nias	Java	Bali	Flores	Alor	Soemb	Christmas Island
1. aegypti	●	●				●	●	●	●	●	●	●		●	●		●	●		●	●		●					●
2. albolineatus		●			?	●		●	●		?	●		●	●	●	●	●			?		?				?	
3. arboricola												●																
4. bambusicola												●																
5. boharti												●			●													
6. hoogstraali												●																
7. impatibilis												●		●														
8. laffooni												●		●														
9. platylepidus												●																
10. pseudalbolineatus													?	●														
11. edwardsi						?																						
12. seampi																												
13. albopictus	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●		●	●	●	●	●	●			
14. downsi	●																											
15. novalbopictus									●																			
16. patriciae			?			●			●									●										
17. pseudalbopictus		?				●			●	●								●					●					
18. seatoi									●																			
19. subalbopictus					?																							
20. unilineatus																												
21. alcasidi		?										●			●													
22. alorensis																										●		
23. andrewsi																												●
24. krombeini																												
25. malayensis		●				●		●	●									●		●								
26. paullusi												●	●	●	●			●										
27. riversi	●																											
28. annandalei		●	?			●			●	●	●			●							?		●	●	●			
29. craggi									●		●																	
30. desmotes		●							●		●	●		●			●	●									?	
31. malikuli		●							●																			
32. mediopunctatus											●	●																
33. perplexus		?							●									●										
34. rhungkiangensis			?																									
35. gardnerii gardnerii												●		●	●												●	?
36. gardnerii imitator		?	●	●	●	●		●	●									●	?									
37. w-albus						●			●																			

● = Areas from which specimens were available for examination.

? = Species recorded from the area but have not been seen by the author.

APPENDIX II (Continued)

SPECIES	ORIENTAL REGION							OTHER AREAS																				
								Pale-arc-tic		W. Paci-fic Is.		Papuan						Malagasy				Pa-ci-fic Is.	S. Pa-ci-fic	Ethiopian				
	Andaman Islands	Nepal	Pakistan	Bangladesh	India	Sri Lanka	Chagos Islands	Japan	China (N. of Yangtze Kiang)	Bonin Islands	Mariana Islands	Morotai	Ceram	Ambon	Buru	Timor	New Guinea	Seychelles	Mauritius	La Reunion	Madagascar	Hawaiian Islands	Solomon Islands	Sudan	N. Rhodesia	Nigeria	Gold Coast	Transvaal
1. *aegypti*	●		●	●	●	●				●	●						●	●	●			●	●		●	●	●	●
2. *albolineatus*												●	?				●						●					
3. *arboricola*																												
4. *bambusicola*																												
5. *boharti*																												
6. *hoogstraali*																												
7. *impatibilis*																												
8. *laffooni*																												
9. *platylepidus*																												
10. *pseudalbolineatus*																												
11. *edwardsi*	●																											
12. *seampi*	●																											
13. *albopictus*		●	●	?	●	●	●	●	●	●	●		●			●	?	●	●	●	●	●						
14. *downsi*																												
15. *novalbopictus*					●																							
16. *patriciae*			?		●																							
17. *pseudalbopictus*					●																							
18. *seatoi*																												
19. *subalbopictus*					●																							
20. *unilineatus*			●		●																			●	●	●	●	●
21. *alcasidi*																												
22. *alorensis*																												
23. *andrewsi*																												
24. *krombeini*						●																						
25. *malayensis*																												
26. *paullusi*														●														
27. *riversi*								?																				
28. *annandalei*				?	●								?		?		?											
29. *craggi*					●																							
30. *desmotes*					●																							
31. *malikuli*																												
32. *mediopunctatus*					●	●																						
33. *perplexus*																												
34. *rhungkiangensis*																												
35. *gardnerii gardnerii*																												
36. *gardnerii imitator*	?	●			●																							
37. *w-albus*		?	●	?	●																							

● = Areas from which specimens were available for examination.

? = Species recorded from the area but have not been seen by the author.

APPENDIX III.
SUMMARY OF THE IMMATURE HABITATS OF THE SPECIES OF *AEDES (STEGOMYIA)* IN THE ORIENTAL REGION*

SPECIES \ IMMATURE HABITATS	Tree holes	Bamboo stumps	Artificial containers (tin can, water jar, water bucket, broken bottle, tire)	Stump holes (palm stumps, coconut stumps, banana stumps)	Bamboo internodes	Coconut shells (coconut halves, coconut husks, coconut spathes)	Bamboo cups (bamboo pots)	Rock holes	Plant axils (*Pandanus*; banana, nipa palm, sago palm, taro, *Colocasia*)	Log holes	Split bamboos	Cut bamboos	Fallen leaves (fallen abaca leaf)	Palm fronds (coconut fronds)	Rock pools	Footprints (wheel ruts)	Root holes	Shelf fungus
1. aegypti			●															
2. albolineatus	●	●	●			●		●	●				●					
3. arboricola	●																	
4. bambusicola		●																
5. boharti	●	●	●	●		●												
6. hoogstraali	●	●	●															
7. impatibilis	●																	
8. laffooni	●	●																
9. platylepidus	●	●				●				●								
10. pseudalbolineatus	●	●	●															
11. edwardsi	●																	
12. albopictus	●	●	●			●		●	●				●	●				
13. downsi	●	●	●						●			●						
14. novalbopictus	●				●													
15. patriciae	●			●														
16. pseudalbopictus	●	●	●		●	●	●				●							
17. seatoi		●	●	●			●											
18. subalbopictus	●	●			●													
19. unilineatus	●																	
20. alcasidi	●	●	●	●		●												●
21. krombeini	●	●	●	●	●					●					●	●	●	
22. malayensis	●	●	●			●	●	●							●			
23. paullusi	●	●	●			●		●		●			●	●				
24. riversi	●							●				●						
25. annandalei		●			●		●					●						
26. craggi	●	●		●							●							
27. desmotes		●			●						●							
28. malikuli	●	●			●													
29. mediopunctatus		●							●			●						
30. perplexus	●	●		●	●		●			●	●							
31. gardnerii gardnerii	●	●																
32. gardnerii imitator	●	●		●			●			●								
33. w-albus	●																	

*Immature habitats are unknown for the following species: *seampi, alorensis, andrewsi* and *rhungkiangensis*.

APPENDIX IV. *Aedes (Stegomyia) aegypti* (Linnaeus)

Type species: *Aedes (Stegomyia) aegypti* (Linnaeus)
(Figs. 1, 2, 3, 4, 5)

Culex aegypti Linnaeus 1762: 470 (A).
Culex argenteus Poiret 1787: 245 (♀).
Culex fasciatus Fabricius 1805: 36 (A).
Culex calopus Meigen 1818: 3 (♂, ♀).
Stegomyia fasciata var. *queenslandensis* Theobald 1901d: 297 (♀).
Stegomyia fasciata persistans Banks 1906: 996 (♂, ♀).
Duttonia alboannulis Ludlow 1911: 132 (♀).
For complete synonymy, see Knight and Stone (1977).
Aedes (Stegomyia) aegypti (Linnaeus), Dyar 1920a, 1920b: 181, 204 (taxonomy); Edwards 1932: 161 (systematics); Barraud 1934: 221 (♂*, ♀, L*, variations); Bohart and Ingram 1946: 6, 11, 22, 27, 37, 66 (♂*, ♀*, P*, L*, bionomics, Pacific distribution); Knight and Hull 1952: 167 (♂, ♀, L*); Bonne-Wepster 1954: 75 (♂, ♀*, L*); Mattingly 1957: 392 (taxonomy, bionomics); Belkin 1962: 441 (♂*, ♀, P*, L*); Mattingly 1965: 23 (♂*, ♀*, P*, L*; Neotype designated).
Aedes (Stegomyia) fasciatus (Fabricius), Bonne-Wepster and Brug 1932: 47 (♂*, ♀, L*, biology).
Aedes (Stegomyia) argenteus of authors.
Stegomyia fasciata of authors.
Aedes calopus of authors.
Stegomyia calopus of authors.

MALE (Fig. 1A). *Head*. Proboscis dark scaled, without pale scales on ventral side, longer than forefemur; palpus 5-segmented, as long as proboscis, dark, with a white basal band on each of segments 2-5; those on segments 4, 5 dorsally incomplete; segments 4, 5 subequal, slender, upturned, and with only a few short setae; antenna plumose, shorter than proboscis; torus covered with white scales except on dorsal and ventral sides; clypeus bare; erect forked scales pale, not numerous, restricted to occiput; vertex with a median stripe of broad white scales, with broad dark ones on each side interrupted by a lateral stripe of broad white scales followed ventrally by a patch of broad white scales. *Thorax*. Scutum with narrow dark scales and a distinct, small, median white spot of narrow scales on anterior border; a narrow submedian longitudinal stripe of narrow pale yellowish scales on each side of midline, submedian stripes reach to anterior 0.66 of scutum; a few narrow white scales on the posterior portion of midline forming a short median white stripe just in front of prescutellar space; on each side a narrow prescutellar white line present; broad curved lateral prescutal and posterior fossal lines of crescent-shaped silvery white scales followed by a narrow line of narrow white scales reaching to the posterior margin of scutum; a patch of broad white scales on lateral margin just in front of wing root and a few narrow curved pale scales over wing root; acrostichal bristles absent; dorsocentral bristles present; scutellum with broad white scales on all lobes and with a few broad dark scales at apex of midlobe; anterior pronotum with broad white scales; posterior pronotum with a patch of broad white scales and some dark and pale narrow scales dorsally; paratergite with broad white scales; postspiracular area without scales; patches of broad white scales on propleuron, on the subspiracular and hypostigial areas, on prealar, on the

upper and lower portions of sternopleuron, and the mesepimeron; upper sternopleural scale patch not reaching to anterior corner of sternopleuron; upper mesepimeral scale patch not connecting with lower mesepimeral scale patch; lower mesepimeron without bristles; metameron bare. *Wing*. With dark scales on all veins except for a minute basal spot of white scales on costa; cell R_2 1.5 length of R_{2+3}. *Halter*. With dark scales. *Legs*. Coxae with patches of white scales; knee spots present on all femora; fore- and midfemora with a narrow white longitudinal stripe on ventral half of anterior surface; hindfemur anteriorly with a broad, white, longitudinal stripe which widens at base and is separated from apical white scale patch; all tibiae dark anteriorly; fore- and midtarsi with a basal white band on tarsomeres 1, 2; hindtarsus with a basal white band on tarsomeres 1-4, the ratio of length of white band to the total length of tarsomere is 0.33, 0.33, 0.33 and 0.75; tarsomere 5 all white; foreleg with tarsal claws unequal, the larger one toothed, the smaller one simple; midleg with tarsal claws unequal, both simple; hindleg with tarsal claws equal, simple. *Abdomen*. Segment I with white scales on laterotergite and a large, median, pale patch; terga II-VIII with basolateral white spots; terga III-VI each with a basal pale band which does not connect with the basolateral white spots; sterna I-III largely covered with pale scales; sterna IV-VI each with a basal pale band and lateral white spots which do not connect with the basal bands. *Terminalia* (Figs. 1B, 1C, 1D, 2C). Basimere about 2.2 as long as wide, scales restricted to lateral and ventral areas, with a few setae on basomesal area of dorsal surface, mesal surface membranous; claspette large, oval, lobelike, with numerous setae and with several widened specialized setae, of which 3 or 4 of these setae bent at tip, on mesal side of expanded distal part; distimere simple, elongate, about 0.63 length of basimere, apical 0.28 rather narrow and curved, with a short spiniform process at apex and with a few setae on apical 0.25; aedeagus strongly toothed; paraprocts with sternal arms; cercal setae absent; apical margin of tergum IX deeply concave medially and with 3 setae on each lateral lobe; sternum IX without bristles.

FEMALE. Essentially as in the male, differing in the following respects: *Head*. Palpus about 0.2 length of proboscis, with white scales on apical half, 4-segmented, or sometimes 5-segmented, when present segment 5 minute; clypeus with lateral white scale patches. *Wing*. Cell R_2 about 2.0 length of R_{2+3}. *Legs*. Hindtarsomere 4 with basal 0.4 white band; fore- and midlegs with tarsal claws equal, all toothed. *Abdomen*. Terga II-VI each with a basal white band and basolateral white spots which do not connect with the basal bands; tergum VII with lateral white spots only; a row of small white scales along posterior border on II-VII; segment VIII largely retracted. *Terminalia* (Figs. 4, 5). Apical margin of sternum VIII with a deep U-shaped notch at middle and with conspicuous rounded lateral lobes; insula longer than broad, with minute setae and with 5 larger setae on apical 0.25; apical margin of tergum IX with well developed lateral lobes, each with 5 or 6 setae; apical margin of postgenital plate with a shallow notch; cerci short and broad; 3 spermathecae, one larger than the other 2.

PUPA (Figs. 2A, 2B). *Cephalothorax*. Trumpet short, about 2.0 as long as wide at the middle; setae 1,3-C usually single (1,2), longer than 2-C, 2-C usually double (1,2), 4-C usually single (1,2), 5-C usually with 2,3 branches, 6-C single, longer than 7-C, 7-C usually double (1,2), 8-C usually double (2,3), 9-C single, 10-C 2-branched, mesad and caudad of 11-C, 11-C single, stout, 12-C usually single (1-3). *Abdomen*. Seta 1-I well developed, with more than 10 branches, dendritic, 2-I single, 3-I single, long, 2,3-I widely separated, distance between them about 1.5 of the distance between 4, 5-I; seta 1-II usually

with 3 branches (2-4); 3-II, III usually single (1, 2), shorter than segment III; 1-III usually double (1-3); 1-IV usually double (1, 2); 2-IV, V slightly mesad of 1-IV, V; 5-IV-VI usually single (1, 2), short, not reaching beyond posterior margin of following segment; seta 9-I-VI small, single, simple, sometimes 9-VI double; 9-VII usually single (1, 2) and barbed; 9-VII, VIII much longer and stouter than preceeding ones; 9-VIII usually with 5 branches (3-7) and barbed. *Paddle*. Margins with distinct denticles, without fringe of very long hair-like spicules; apex rounded; seta 1-P single. Male genital lobe short and broad, much shorter than wide.

LARVA (Fig. 3). *Head*. Antenna 0.5 length of head, without spicules; seta 1-A inserted slightly before middle of shaft, single, small, spine-like; inner mouth brushes pectinate at tip; seta 4-C well developed, usually with 5 branches (4-7), closer to 6-C than 5-C, cephalad and mesad of 6-C, 5-C usually single, long, 6-C usually single, 7-C usually single, rarely double, 8-10, 13-C single, 11-C usually with 3 branches (2, 3), 12-C usually double (2, 3), 14, 15-C usually with 2, 3 branches; mentum usually with 12 (10-14) teeth on each side. *Thorax*. Setae 1, 7, 14-P usually with 3 branches (2, 3), 2, 6-P single, 3-P double, 4, 9, 11-P usually single (1, 2), 5-P usually double; 5, 7-M single, 6-M usually 3-branched, 8-M usually with 4 branches (3, 4), 9-M usually 2-branched (2, 3), 10, 12-M single, long, stout and barbed, 11-M single, small; 7-T usually with 4 branches (4, 5), 9-T usually 2-branched, 10, 11-T similar to those on mesothorax, 12-T much reduced; basal spine of meso- and metapleural seta long, stout, pointed at tip and apically hooked. *Abdomen*. Seta 6-I-III usually with 3 branches (2-4), 7-I single; 7-II usually double (2, 3); 6-IV, V usually double (2, 3); 6-VI usually single (1, 2); 1-VII usually double (1-3), 2-VII single; 2-VIII distant from 1-VIII, 1, 5-VIII usually with 3, 4 branches, 3-VIII usually with 6 branches (5-7), 2, 4-VIII single; comb of 8 (6-12) scales in a row, each scale with very strong denticles at the base of the apical spine; anal segment with saddle incomplete, marginal spicules very small and inconspicuous; seta 1-X usually double (1, 2), short, 2-X usually with 3 branches (2, 3), 3-X usually single (1, 2); ventral brush with 5 pairs of setae on grid, each seta usually 2-branched (2, 3), sometimes 4e-X single; no precratal tufts; anal papillae about 2.5-3.0 length of saddle, sausage-like. *Siphon*. About 1.8-2.5 as long as wide, acus absent; pecten teeth usually 8-20, evenly spaced, or sometimes with the last pecten tooth widely spaced, each tooth with 1-4 basal denticles; seta 1-S with 3, 4 branches, usually inserted beyond last tooth and beyond middle of siphon.

MATERIAL EXAMINED. More than 1,070 adults (♂ and ♀), 390 individual rearings (291 l, 390 p), 43 ♂ terminalia, 25 ♀ terminalia, 210 whole larvae from the Oriental region.

REMARKS. Adult specimens of "variety *queenslandensis*" have more pale scales present on the vertex, thorax and abdomen than that of typical *aegypti*. The range of scaling varies from that almost referable to typical *aegypti* to complete covering of the vertex and abdomen with white scales. The main character used to identify "variety *queenslandensis*" is the white scales present on at least the first and 2nd abdominal tergite. Typical *aegypti* has white scales present on the first abdominal tergite.

APPENDIX V.

Aedes (Stegomyia) platylepidus Knight and Hull
(Fig. 24)

Aedes (?) *platylepidus* Knight and Hull 1951: 201 (♀).
Aedes (Diceromyia) platylepidus Knight and Hull, Mattingly 1959: 43 (♀); Reinert 1970: 12 (♂*, ♀*).

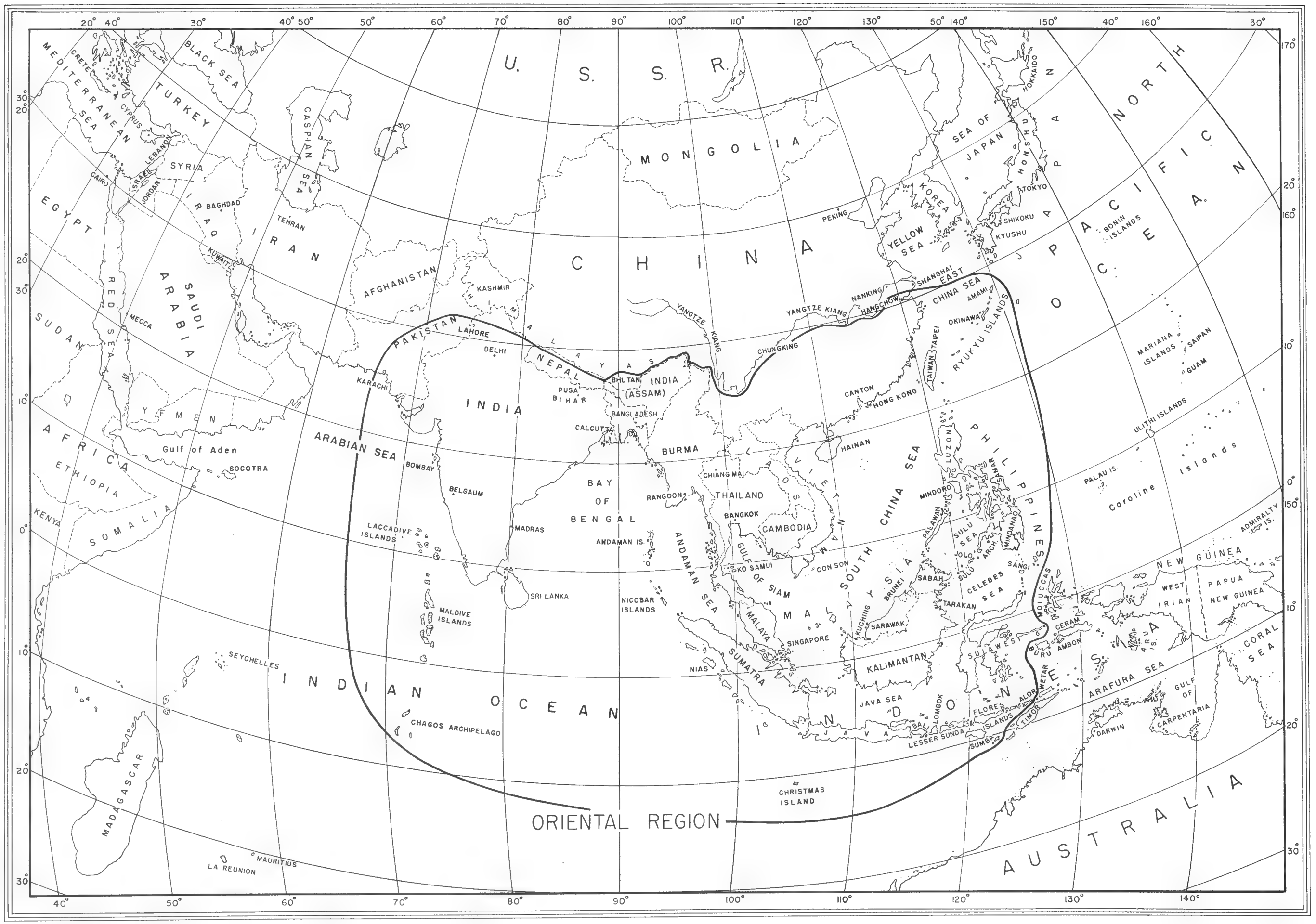
MALE. *Terminalia*. (Figs. 24A, 24B, 24C). Basimere short and broad, about 2.0 as long as wide, scales restricted to lateral and ventral areas, with several irregular rows of stout, flattened, long setae along mesal side of dorsal surface, with several short setae scattered on lateral half of dorsal surface; claspette with 5 stout, spine-like setae and several long, stout setae with slender curved tips on distal part; distimere simple, elongate, about 0.8 length of basimere, tapering to a blunt apical point, with a long, stout, spiniform process at basal 0.4, apex of the spiniform blunt and mesally curved; aedeagus with several apical teeth on each side; paraproct long, without apical lobe-like process; cercal setae absent; apical margin of tergum IX flat at middle, with 5 setae on each side.

REMARKS. The above description was based on the only known terminalia, (slide #68/1142 from adult #2252, Isabella, Basilon Is., Philippine Is., 27 Sept. 1945) in USNM, which was used by Reinert (1970) in his original description of ♂ *platylepidus*. Figure 24C was drawn from the original undissected view of the ♂ terminalia.

In order to give a correct and detailed description of the ♂ terminalia, I have dissected the claspette and remounted the terminalia.

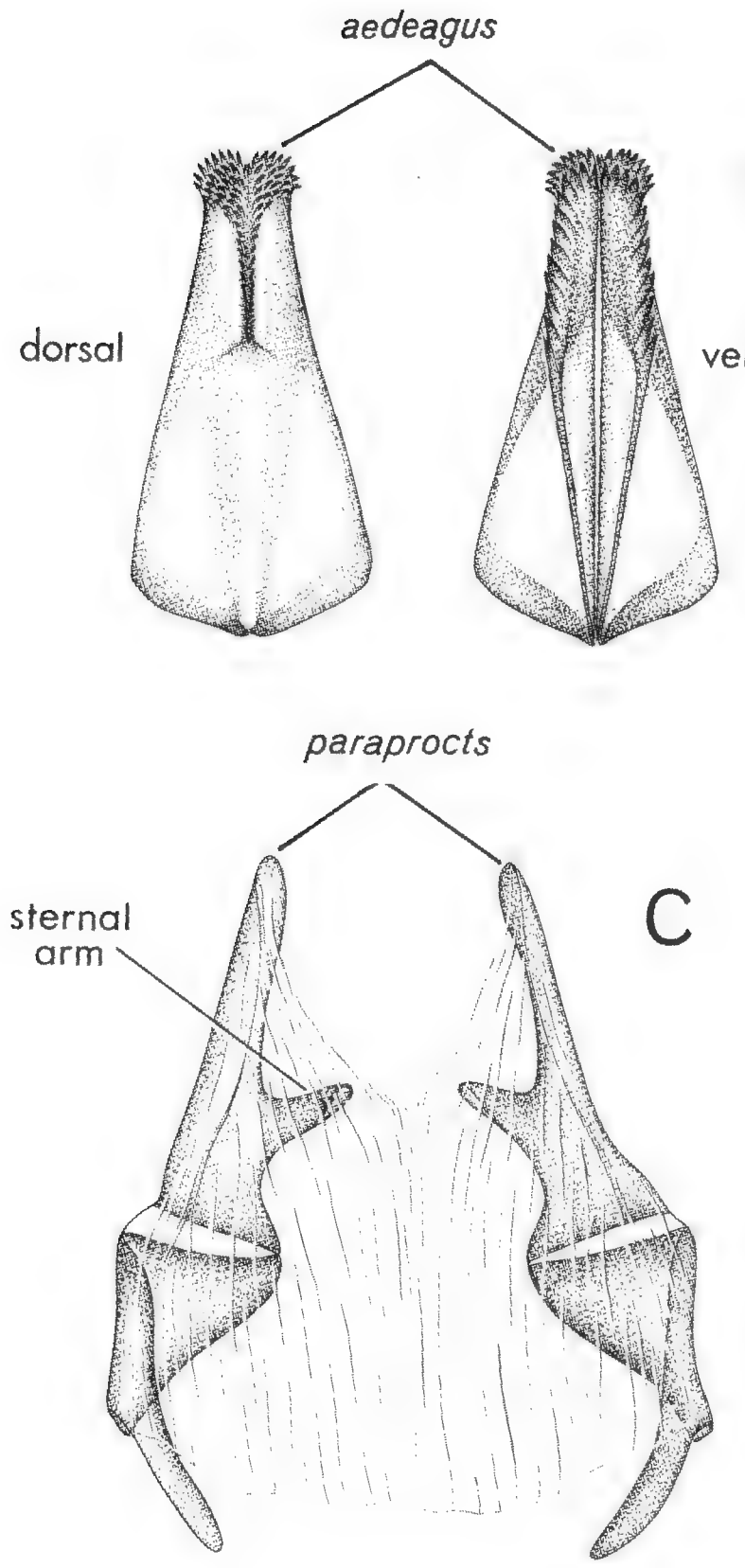
MATERIAL EXAMINED: 1♂, 2♀, 1♂ terminalia, 1♀ terminalia.

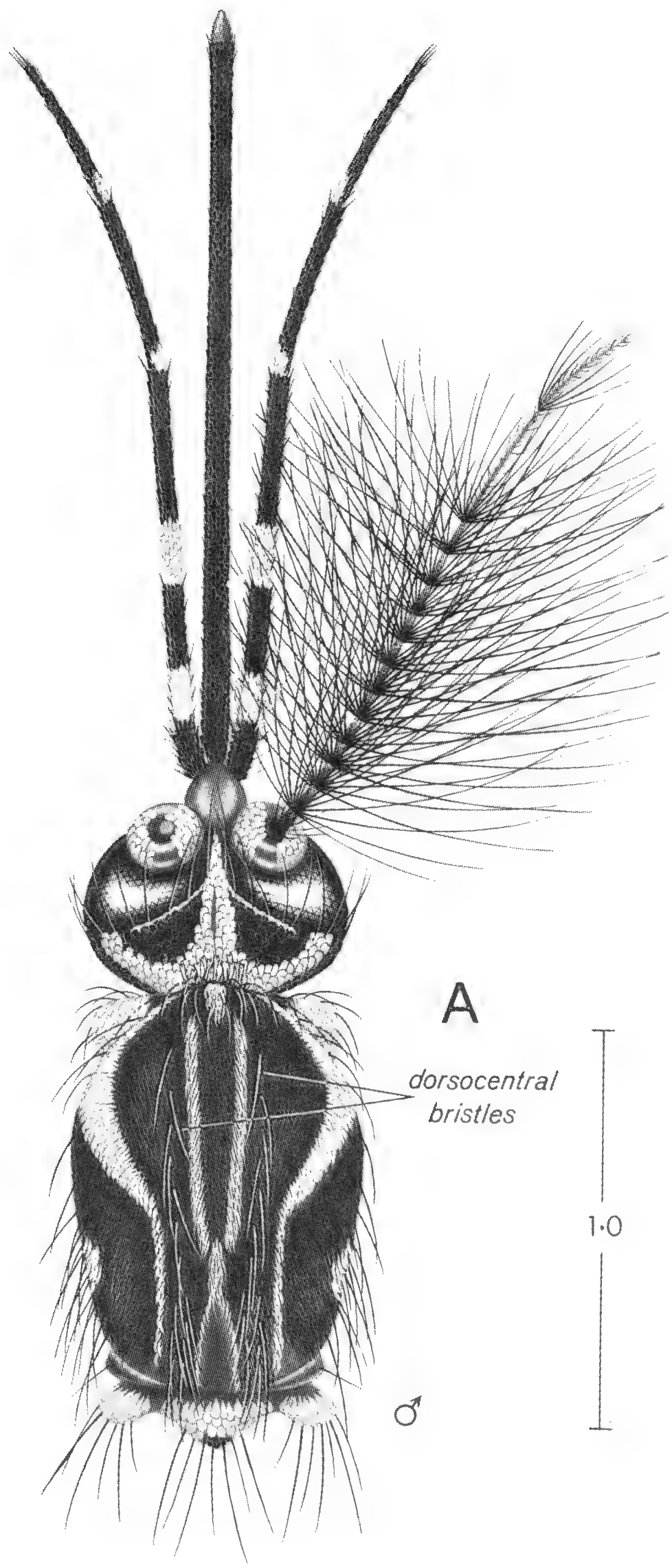
MAP I

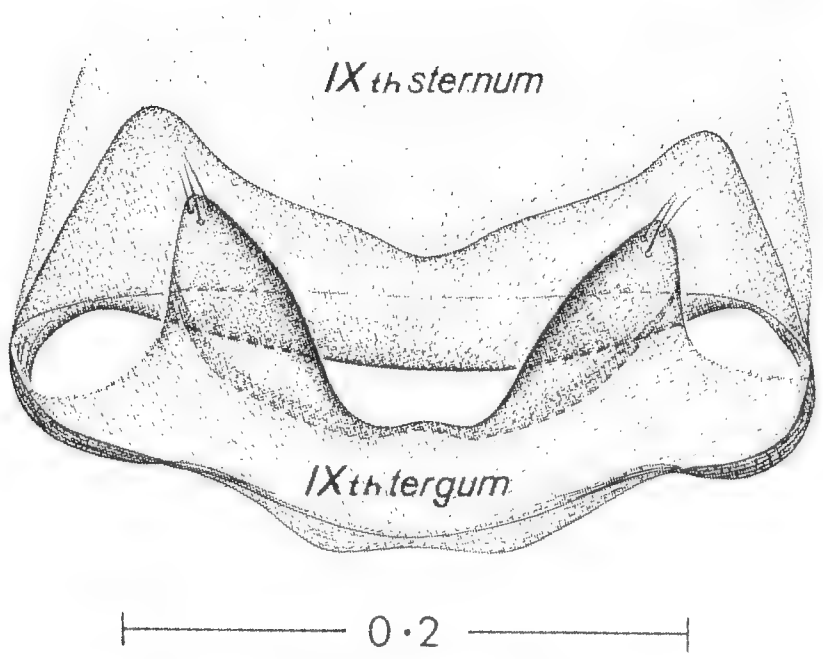

U. S. S. R.
MONGOLIA
CHINA
NORTH PACIFIC OCEAN
INDIAN OCEAN
AUSTRALIA
TURKEY
BLACK SEA
MEDITERRANEAN SEA
CRETE
CYPRUS
SYRIA
LEBANON
ISRAEL
JORDAN
CAIRO
EGYPT
IRAQ
BAGHDAD
IRAN
TEHRAN
CASPIAN SEA
KUWAIT
SAUDI ARABIA
MECCA
RED SEA
SUDAN
YEMEN
Gulf of Aden
SOCOTRA
AFRICA
ETHIOPIA
SOMALIA
KENYA
AFGHANISTAN
KASHMIR
PAKISTAN
LAHORE
DELHI
KARACHI
NEPAL
BHUTAN
INDIA (ASSAM)
PUSA BIHAR
BANGLADESH
CALCUTTA
BURMA
ARABIAN SEA
BOMBAY
BELGAUM
BAY OF BENGAL
MADRAS
RANGOON
THAILAND
BANGKOK
CAMBODIA
LACCADIVE ISLANDS
ANDAMAN IS.
NICOBAR ISLANDS
SRI LANKA
MALDIVE ISLANDS
SEYCHELLES
CHAGOS ARCHIPELAGO
MADAGASCAR
MAURITIUS
LA REUNION
CHRISTMAS ISLAND
ANDAMAN SEA
GULF OF SIAM
KO SAMUI
CON SON
VIETNAM
MALAYSIA
SINGAPORE
SUMATRA
NIAS
KALIMANTAN
JAVA SEA
JAVA
BALI
LOMBOK
FLORES
LESSER SUNDA ISLANDS
SUMBA
TIMOR
ALOR
WETAR
MOLUCCAS
CERAM
BURU
AMBON
SULAWESI
CELEBES SEA
TARAKAN SEA
SULU SEA
SULU ARCH.
JOLO
PALAWAN
MINDORO
LUZON
HAINAN
SOUTH CHINA SEA
PHILIPPINES
MINDANAO
SANGI
SABAH
BRUNEI
SARAWAK
KUCHING
NEW GUINEA
WEST IRIAN
PAPUA NEW GUINEA
ARAFURA SEA
GULF OF CARPENTARIA
DARWIN
CORAL SEA
ADMIRALTY IS.
PALAU IS.
Caroline Islands
ULITHI ISLANDS
MARIANA ISLANDS
SAIPAN
GUAM
BONIN ISLANDS
HOKKAIDO
HONSHU
SHIKOKU
KYUSHU
TOKYO
SEA OF JAPAN
KOREA
YELLOW SEA
PEKING
SHANGHAI
NANKING
HANGCHOW
EAST CHINA SEA
YANGTZE KIANG
CHUNGKING
AMAMI
OKINAWA
RYUKYU ISLANDS
TAIWAN
TAIPEI
CANTON
HONG KONG
ORIENTAL REGION

LIST OF FIGURES

Fig. 1



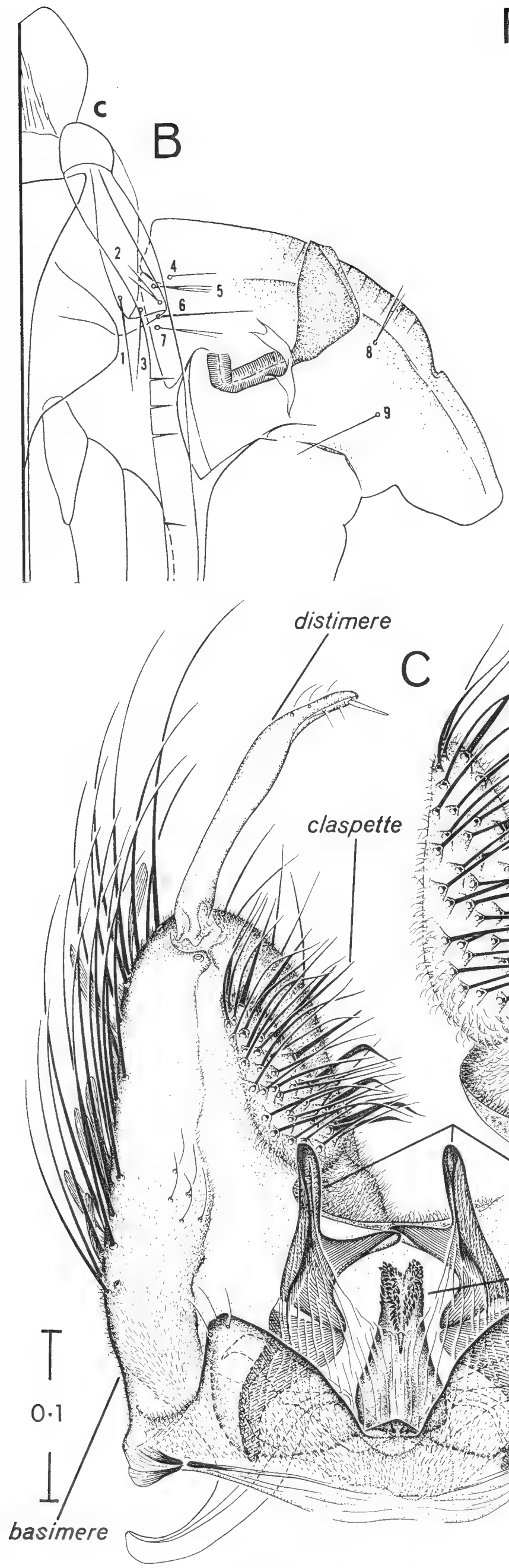


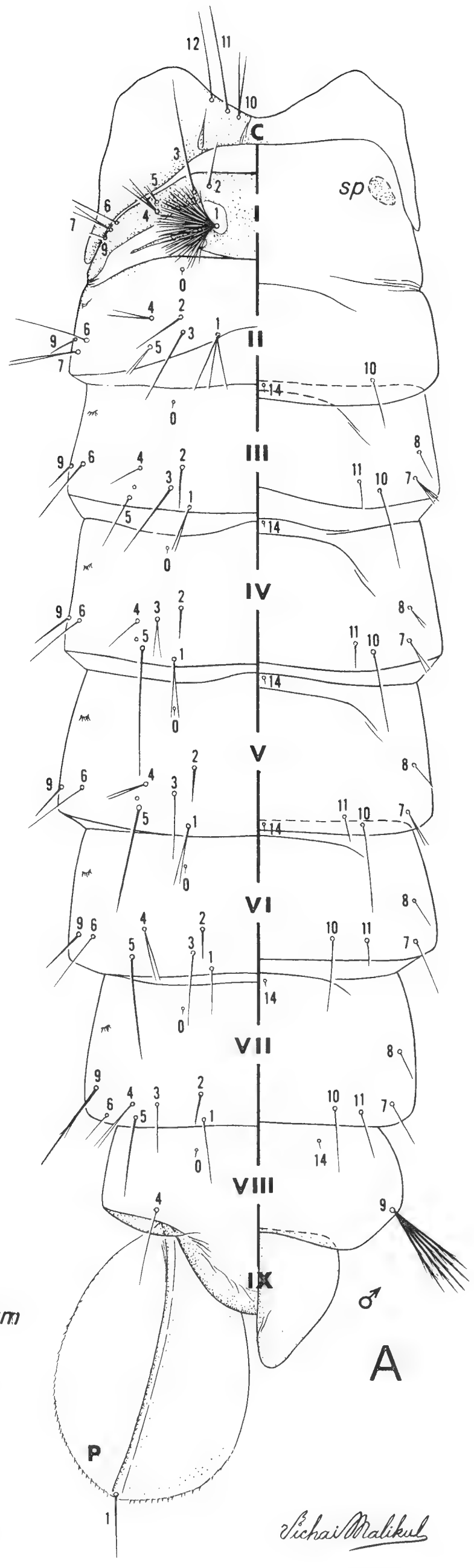


Aedes (Stegomyia) aegypti (Linnaeus)

Sichai Malikul

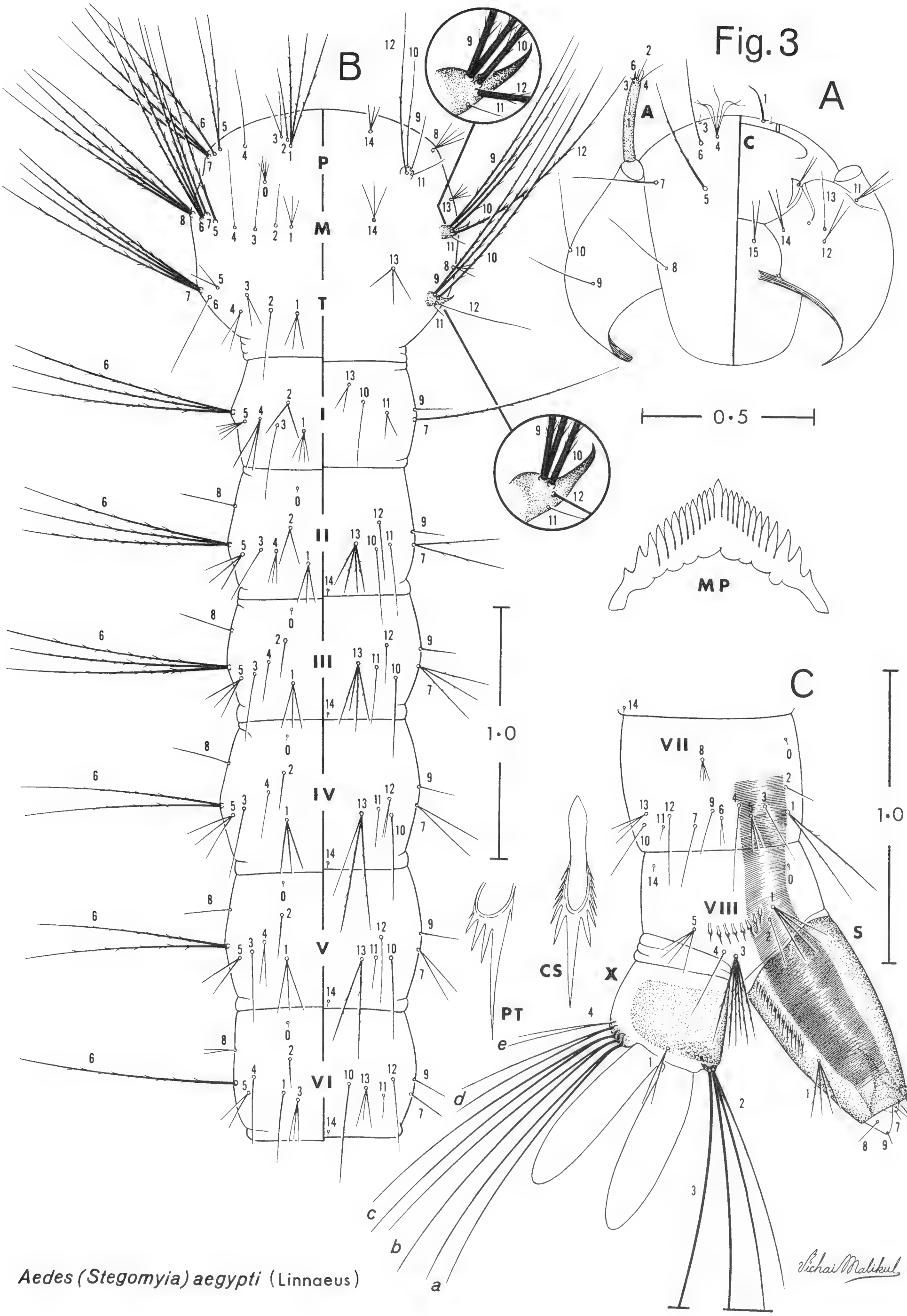
Fig. 2





Aedes (Stegomyia) aegypti (Linnaeus)

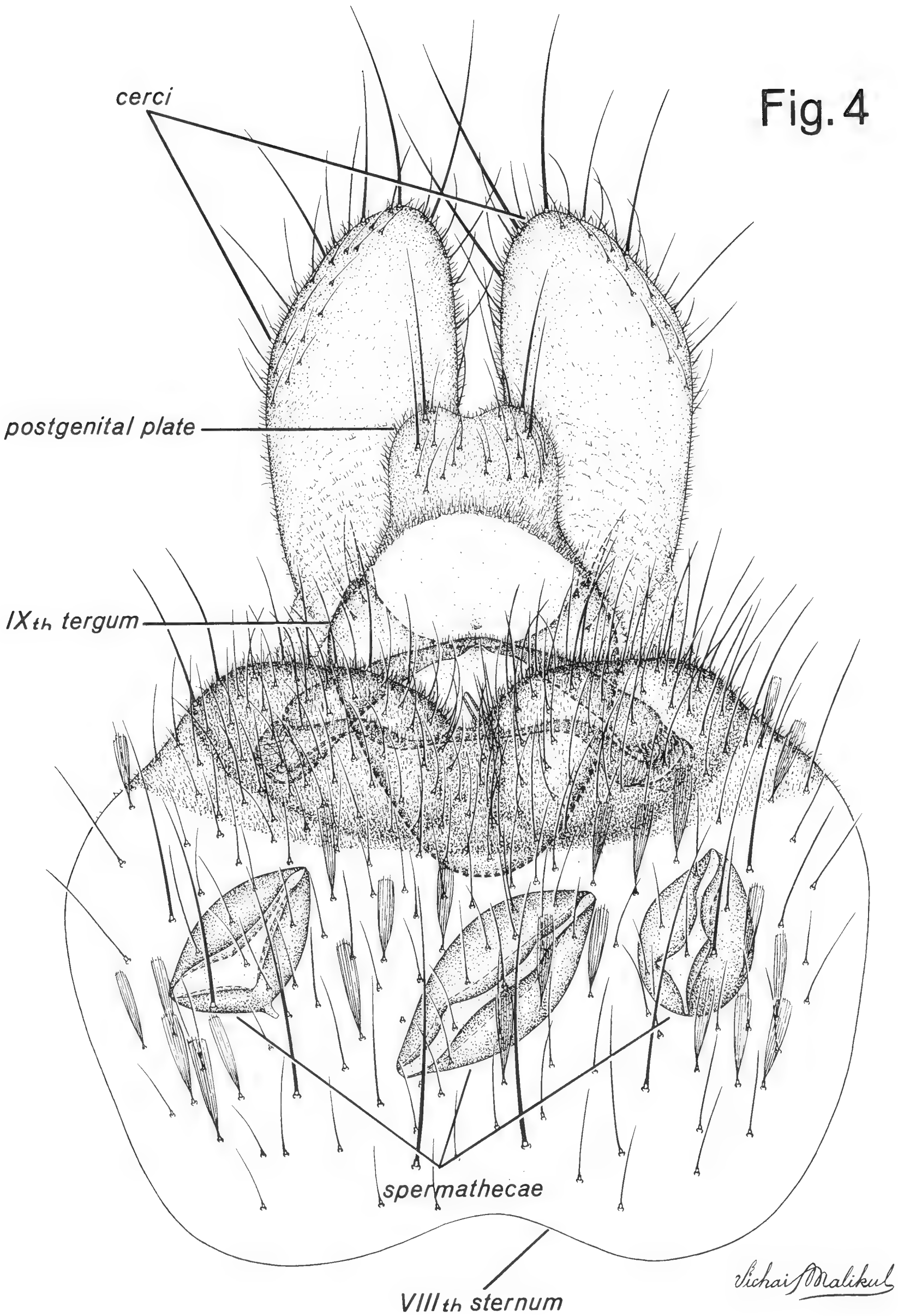
Fig. 3



Aedes (Stegomyia) aegypti (Linnaeus)

Sichai Malikul

Fig. 4



Sichai Malikul

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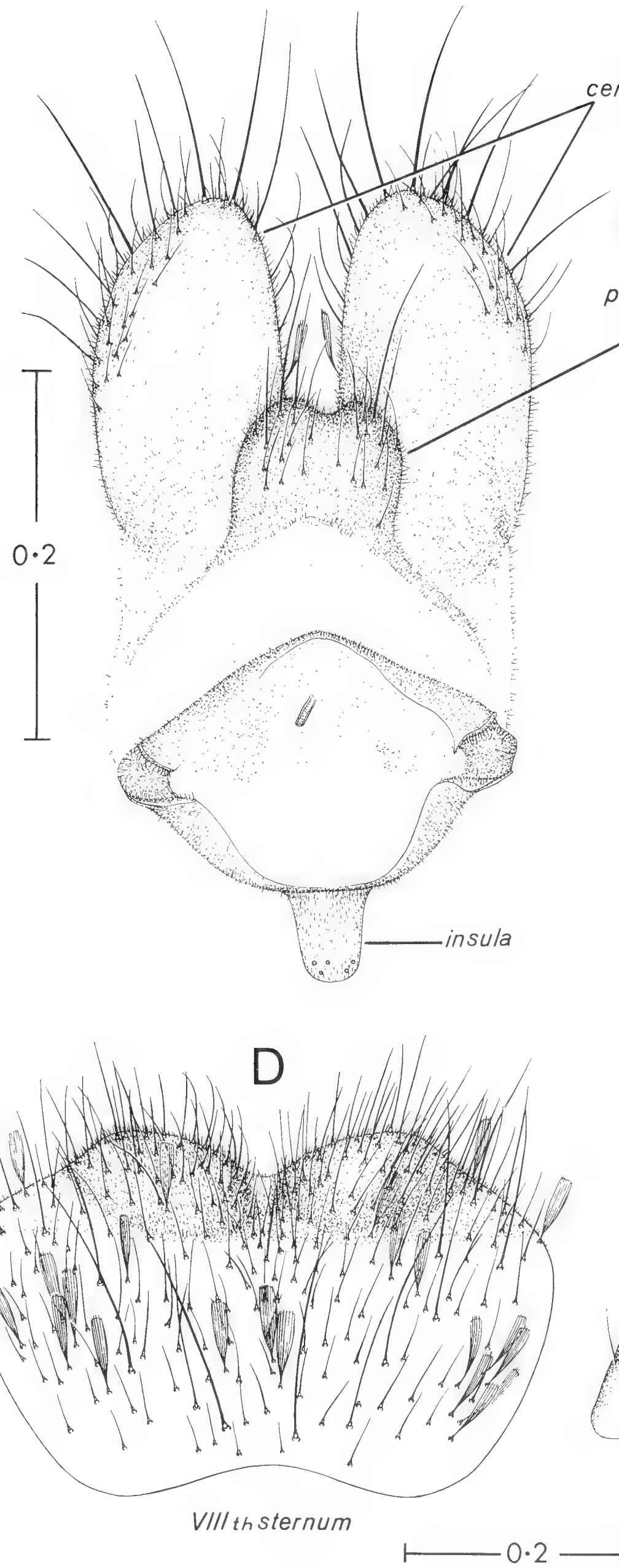
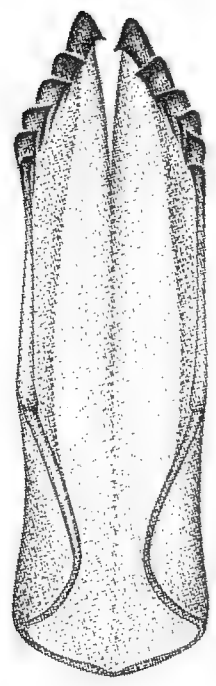
Aedes (Stegomyia) aegypti (Linnaeus)

Fig. 5



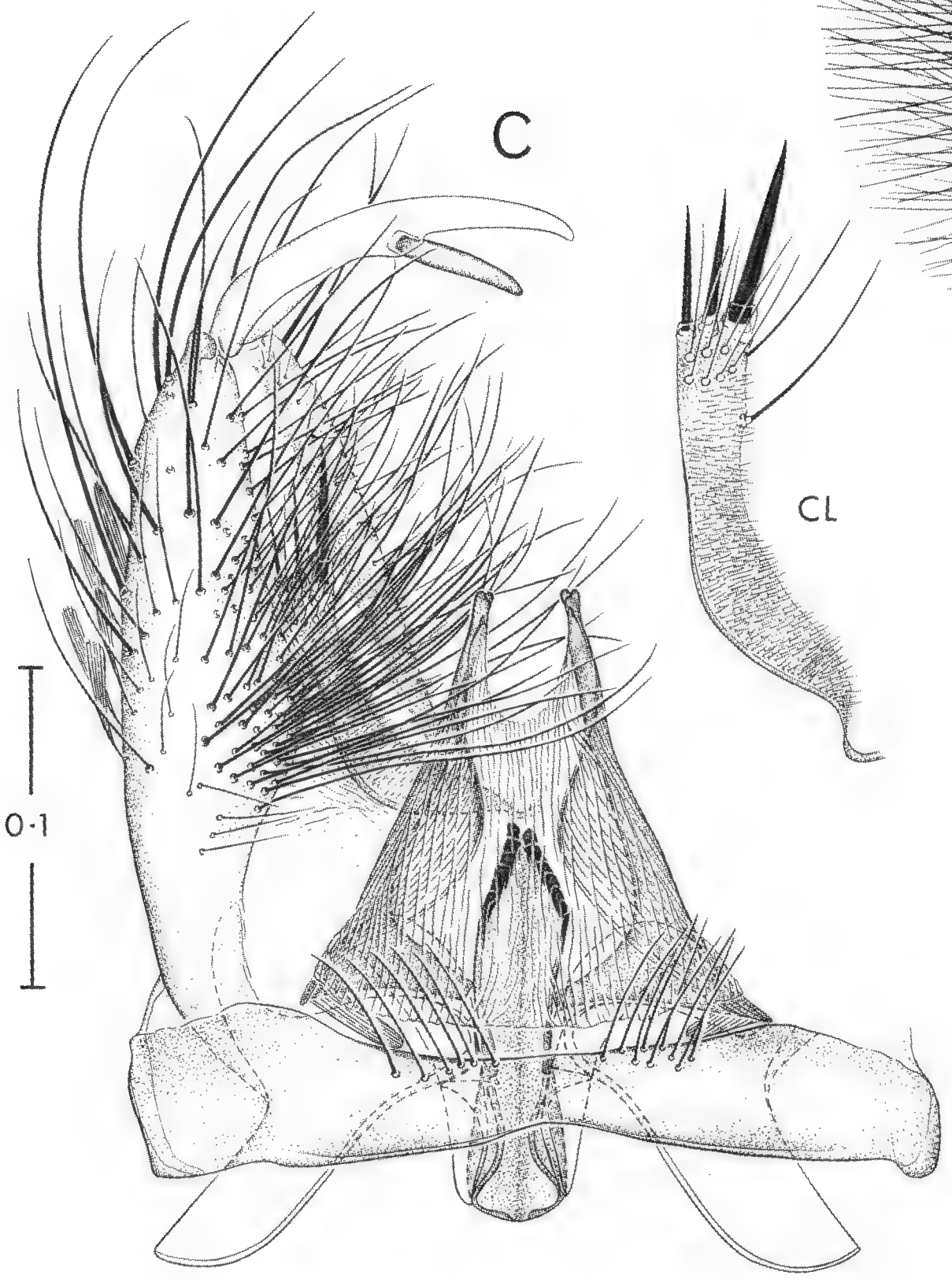
Aedes (Stegomyia) aegypti (Linnaeus)

Fig. 6



B

aedeagus



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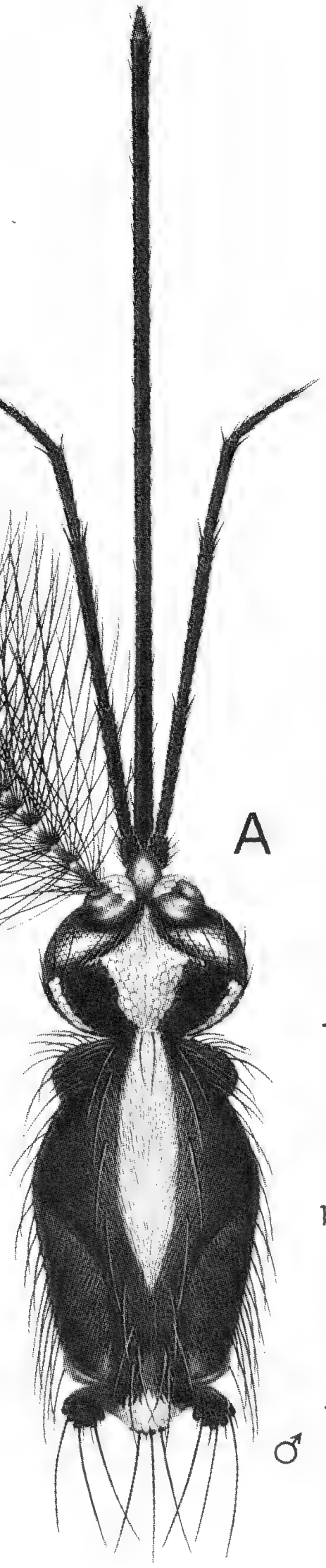

A

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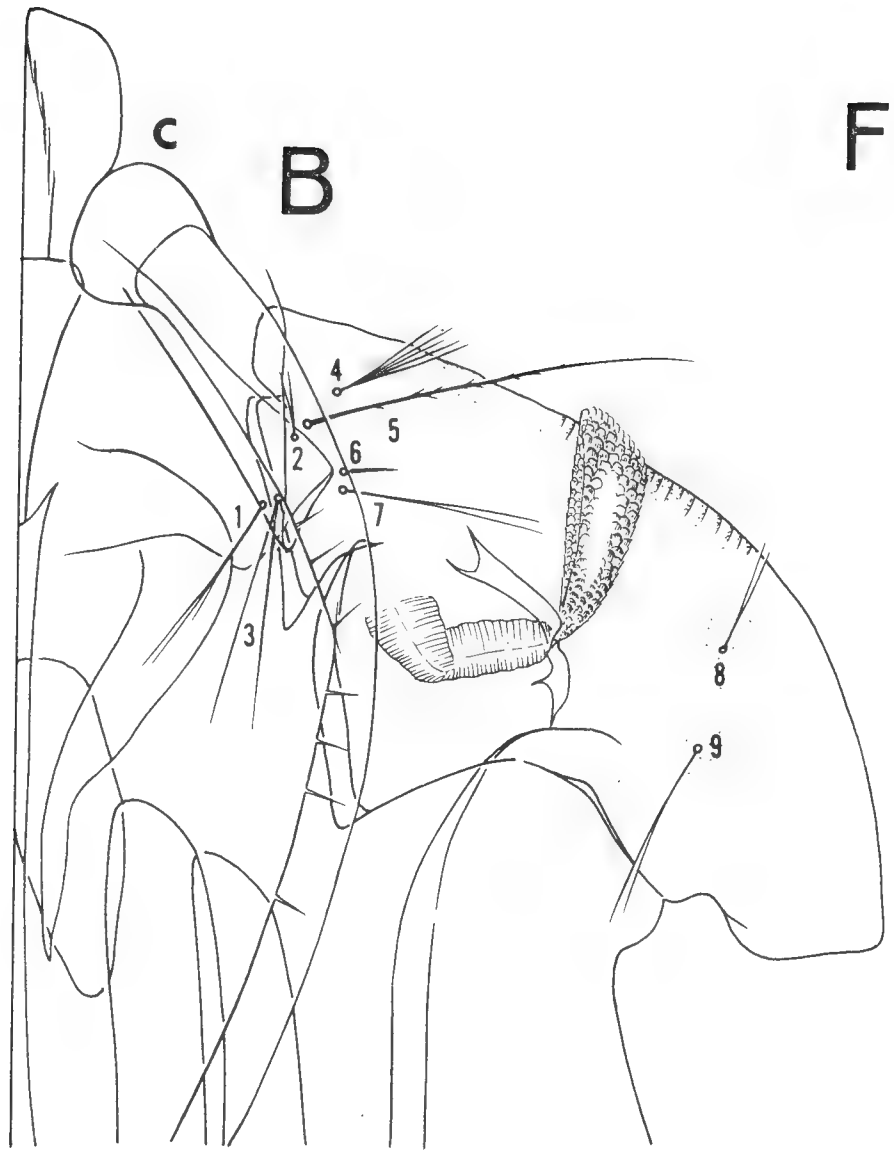
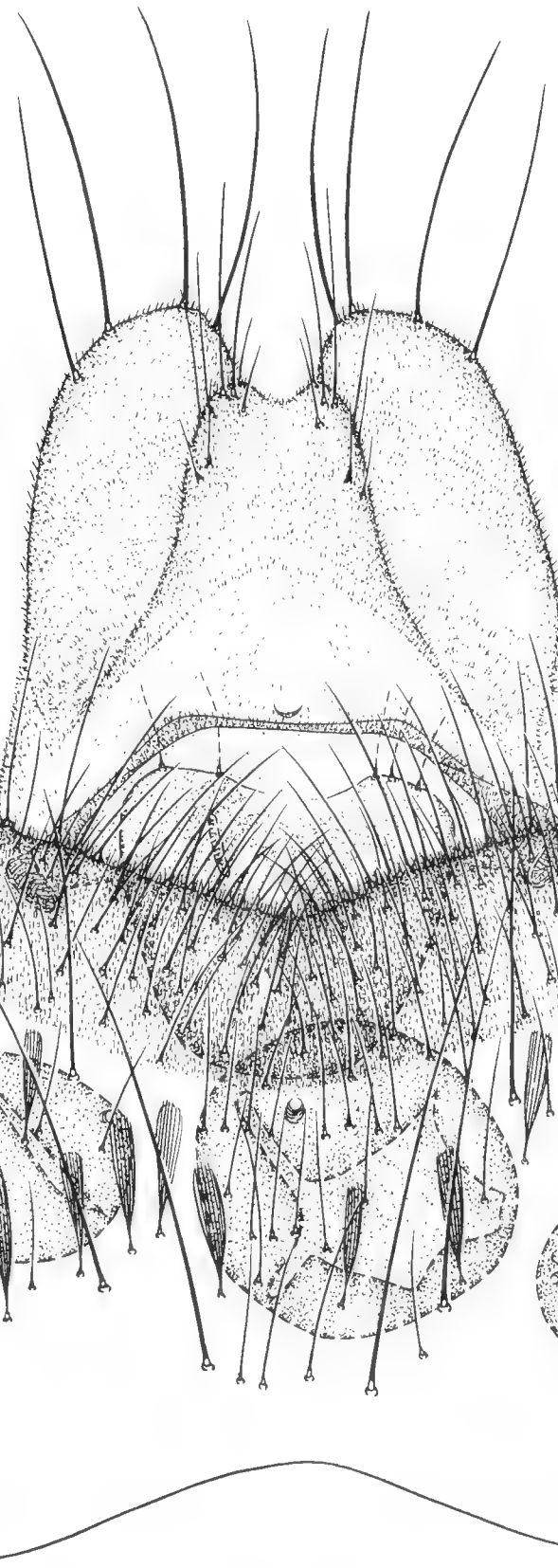
♂

Aedes (Stegomyia) albolineatus (Theobald)

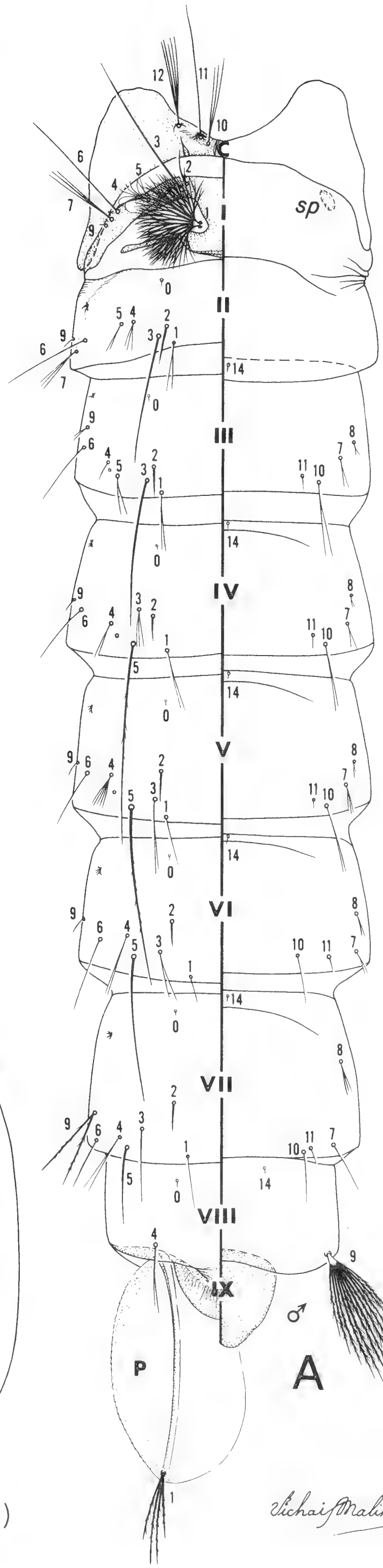
Sichai Bhalikul

Fig. 7



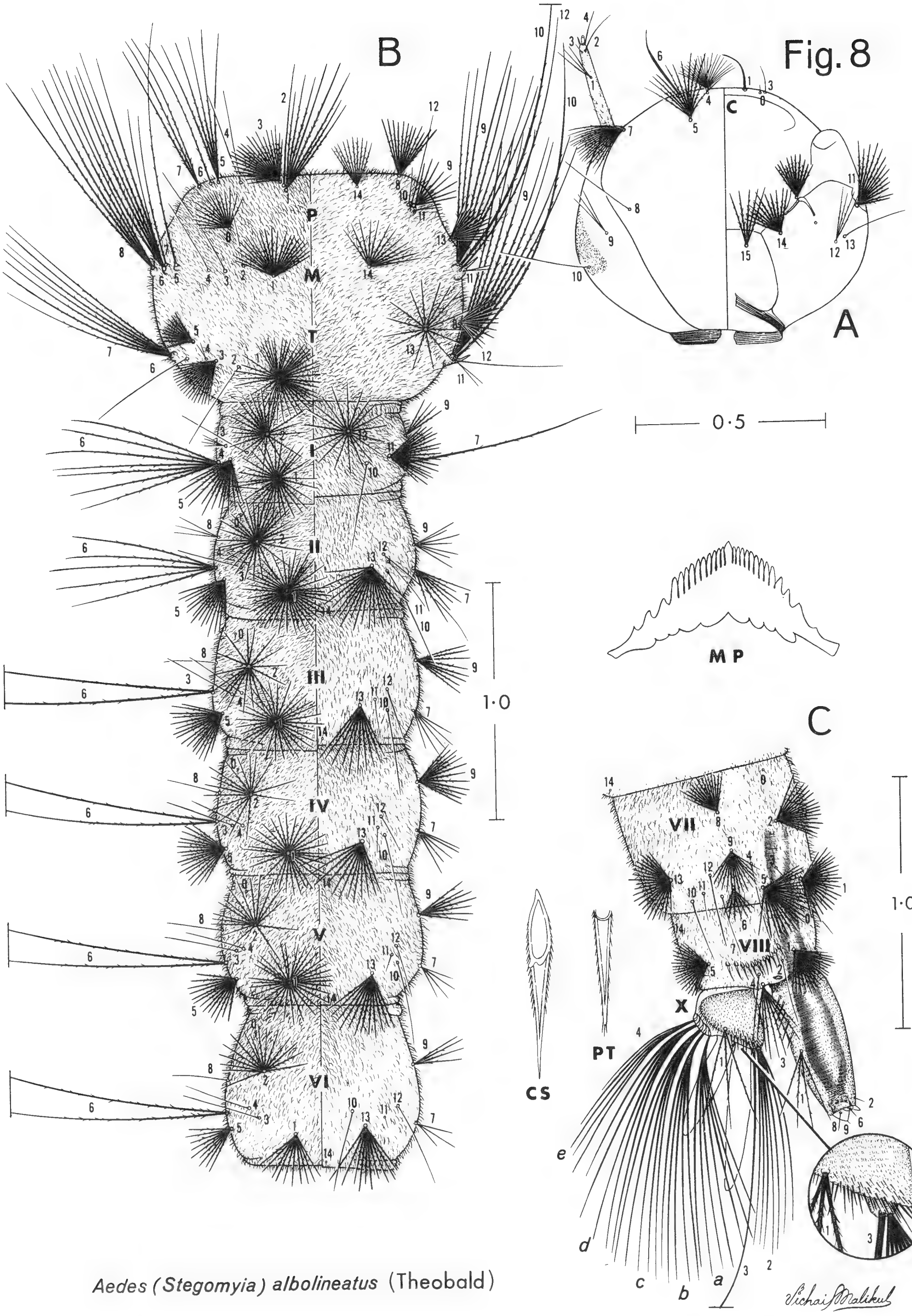


Aedes (Stegomyia) albolineatus (Theobald)



Vichai Malikul

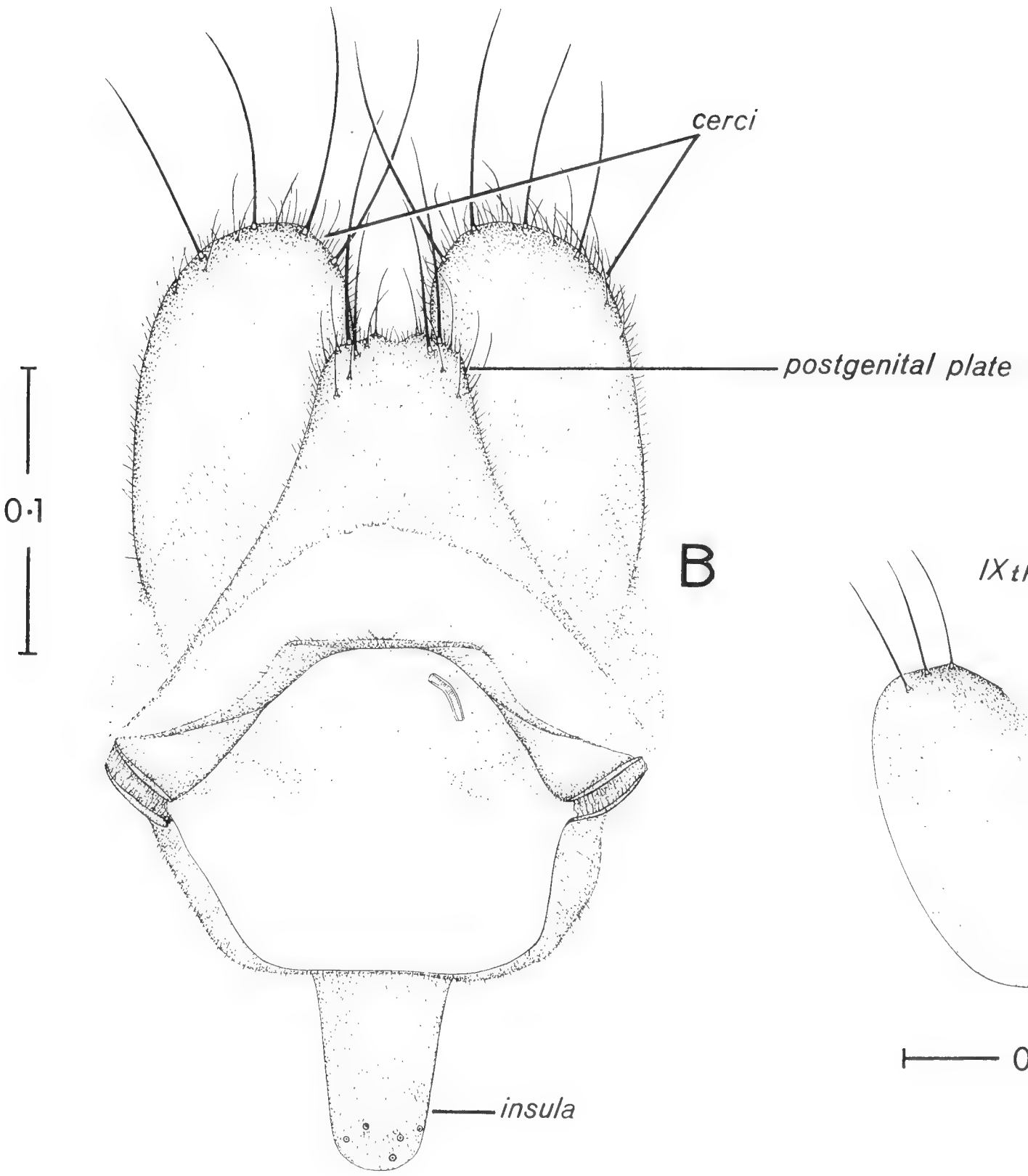
Fig. 8

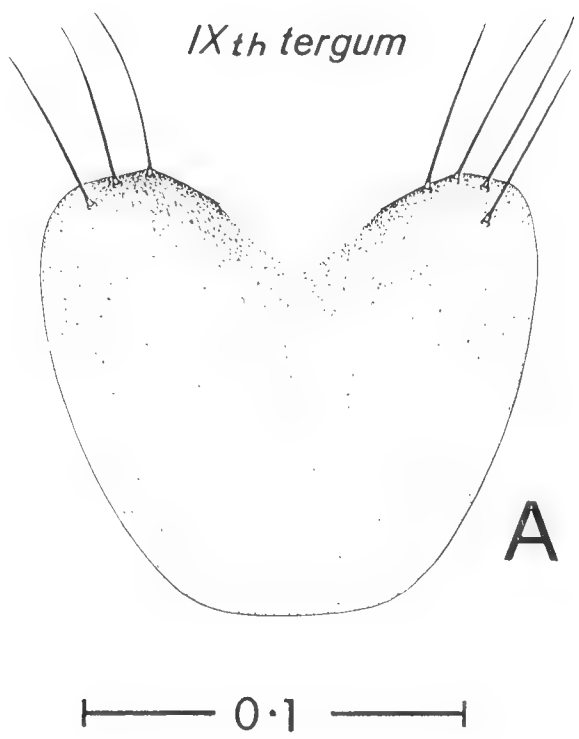


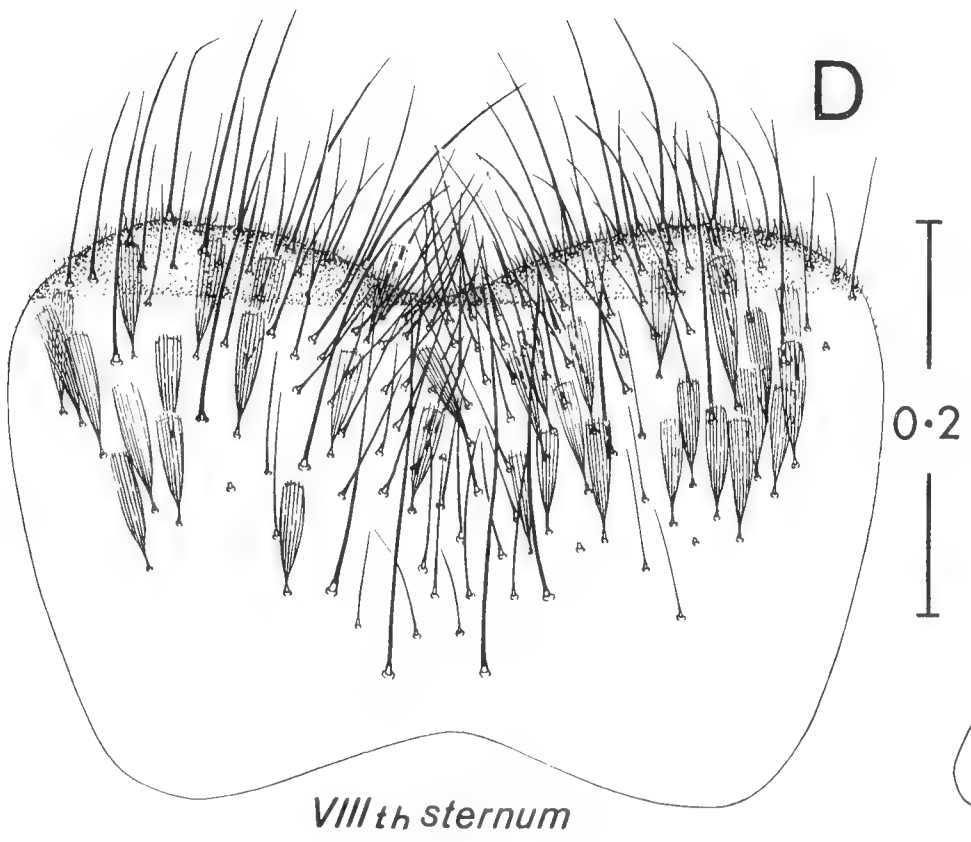
Aedes (Stegomyia) albolineatus (Theobald)

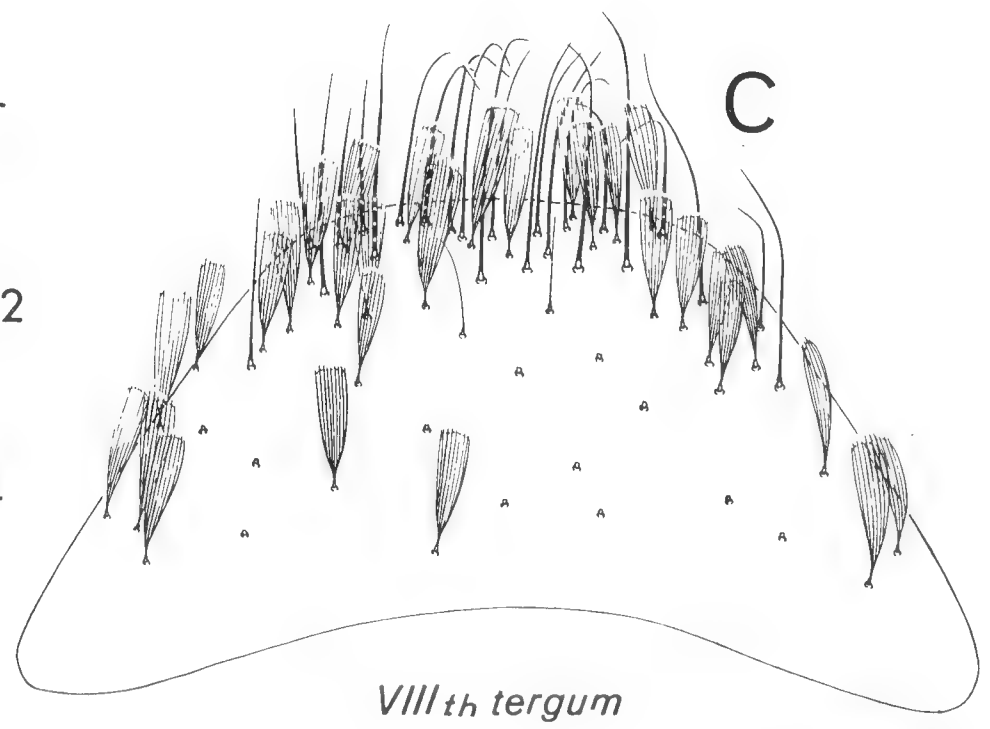
Vichai Malikul

Fig. 9



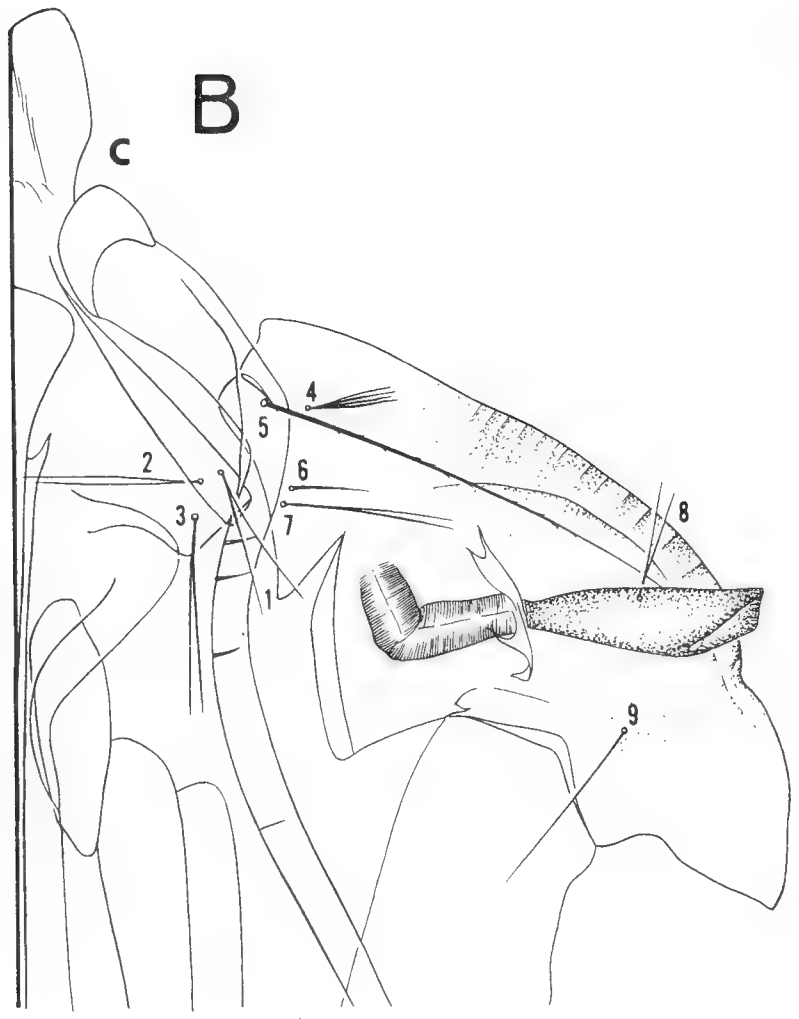


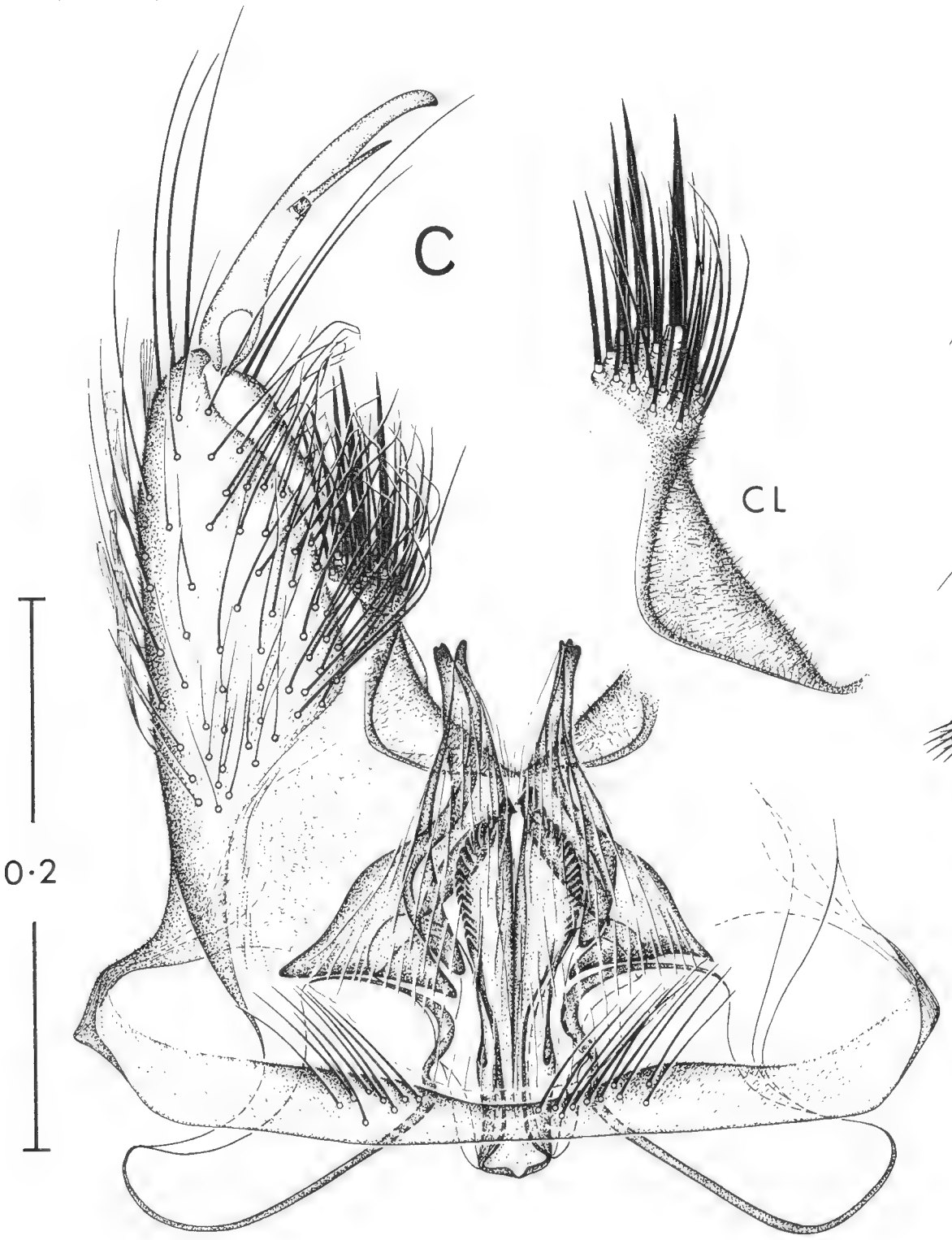


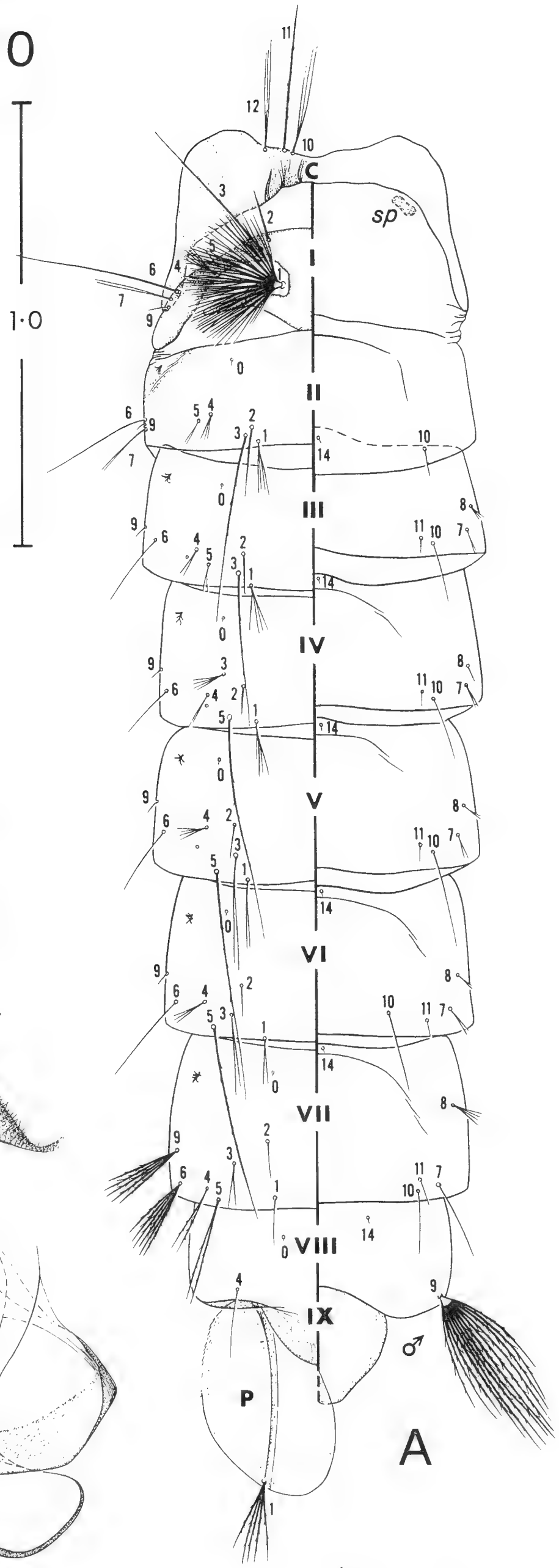


Aedes (Stegomyia) albolineatus (Theobald)

Fig.10



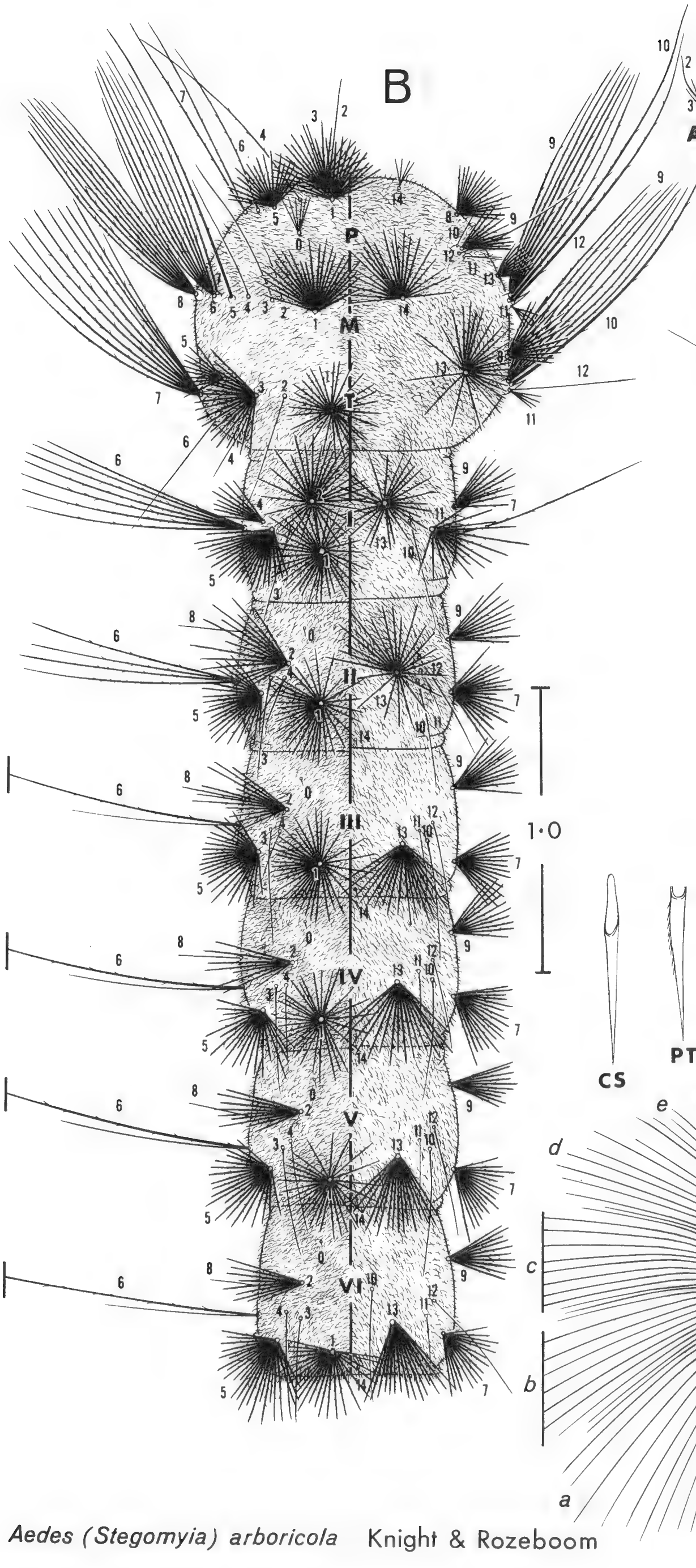


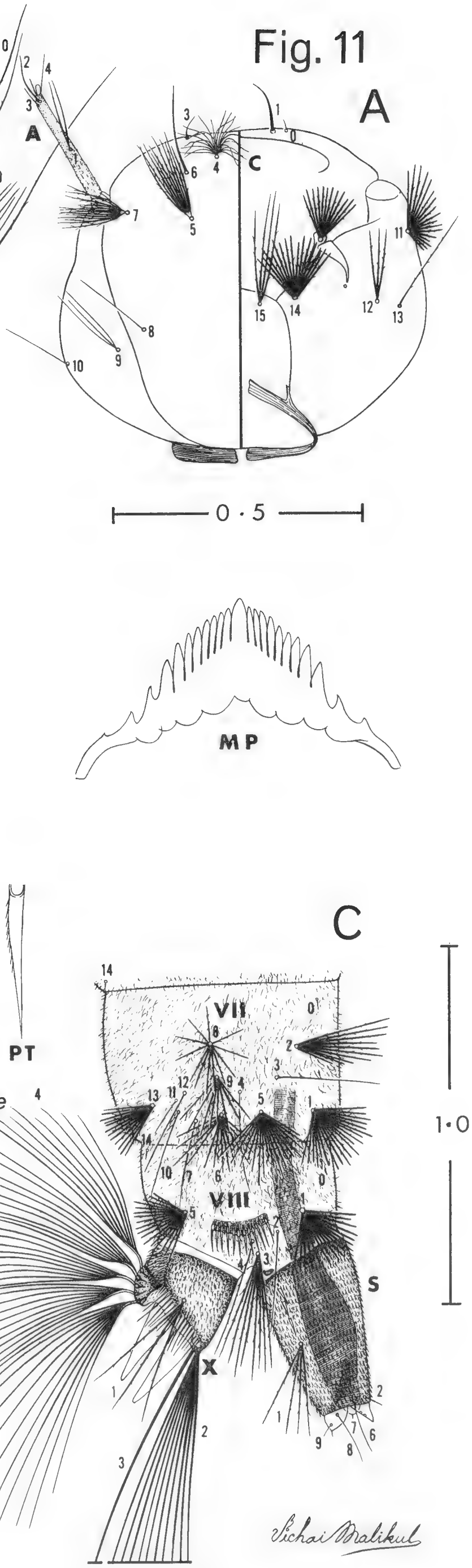


Aedes (Stegomyia) arboricola Knight & Rozeboom

Sichai Malikul

Fig. 11

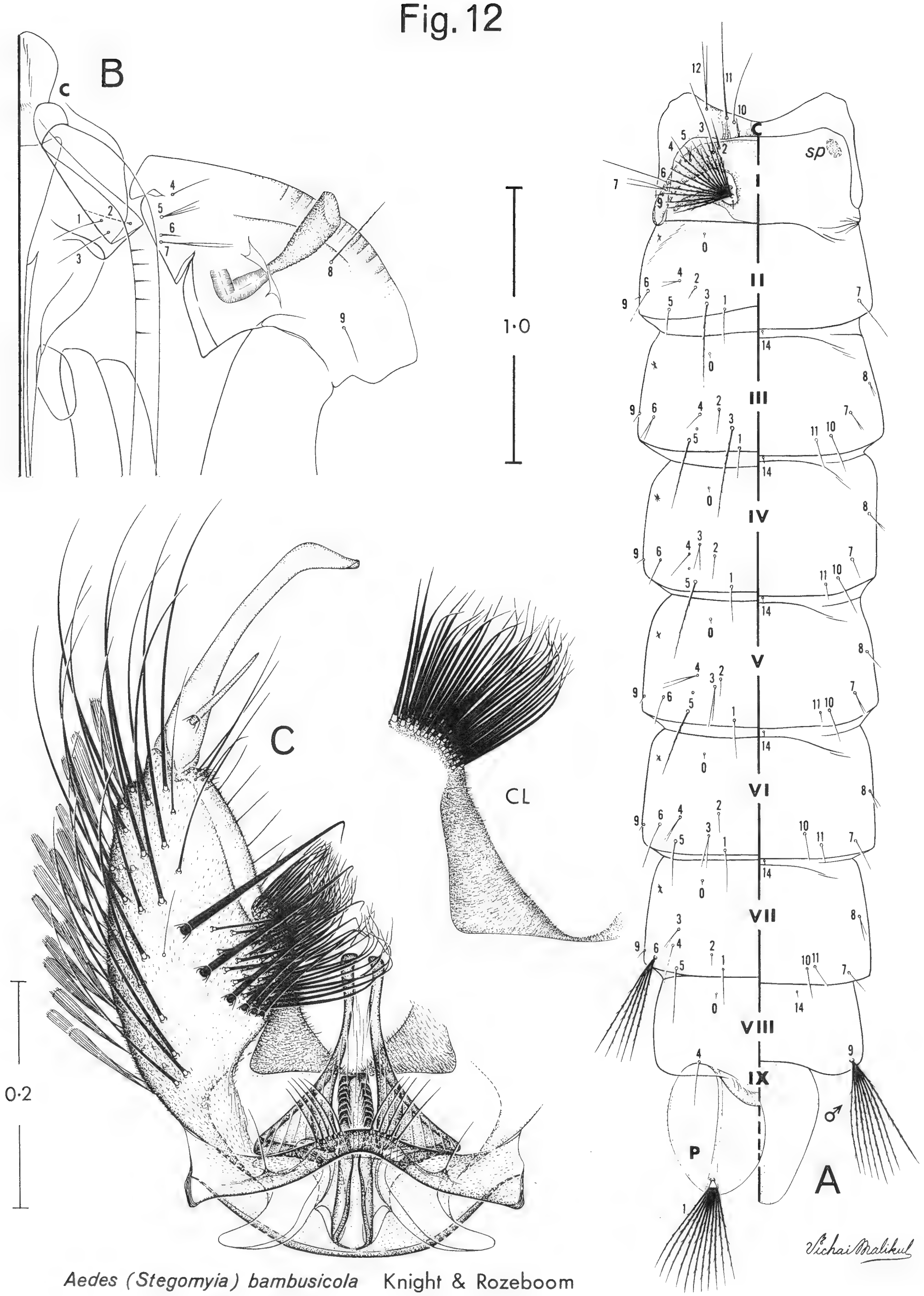




Aedes (Stegomyia) arboricola Knight & Rozeboom

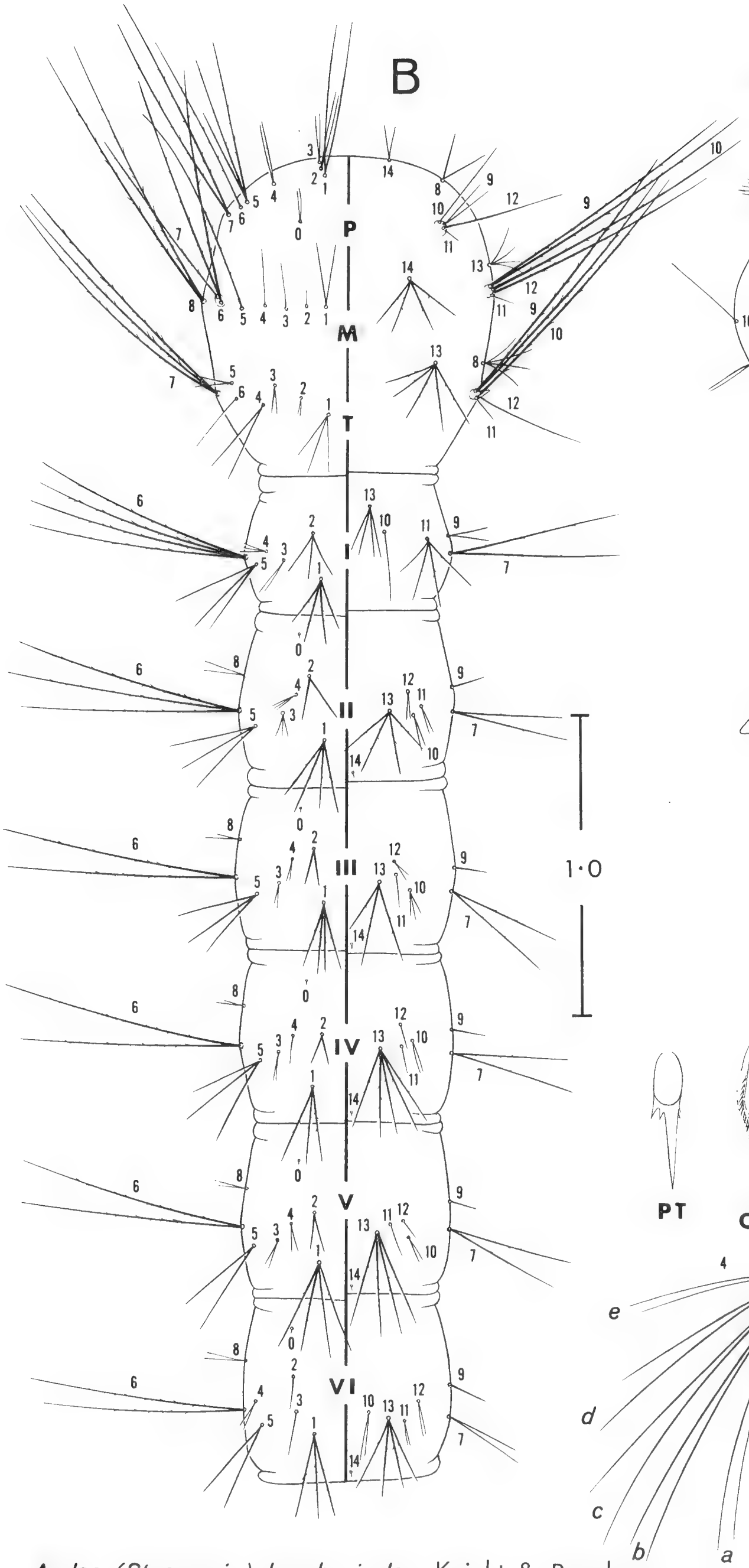
Sichai Malikul

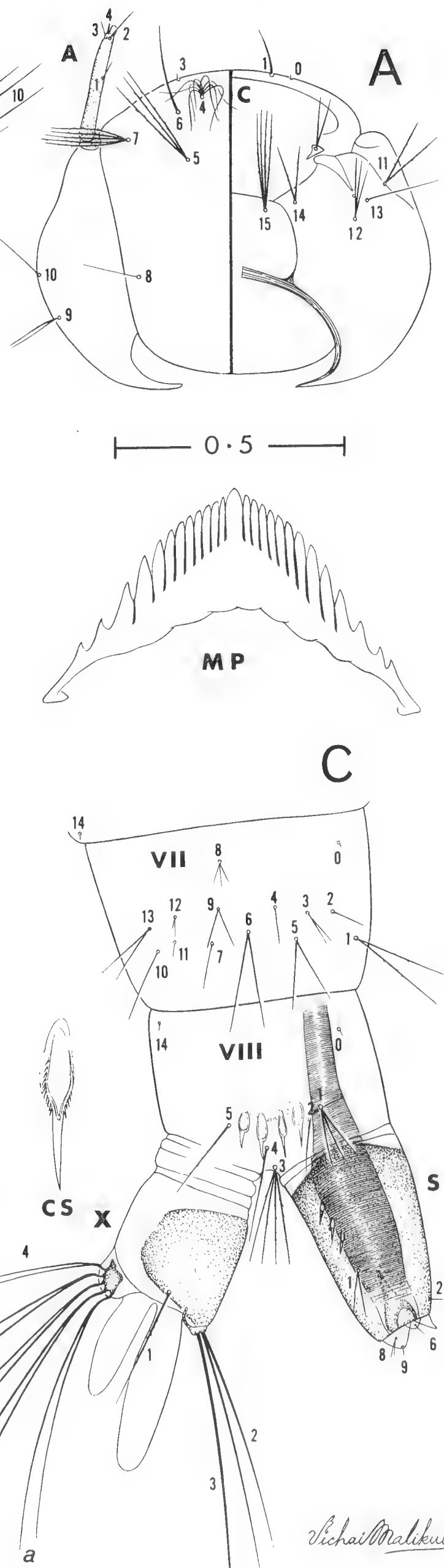
Fig. 12



Aedes (Stegomyia) bambusicola Knight & Rozeboom

Fig. 13

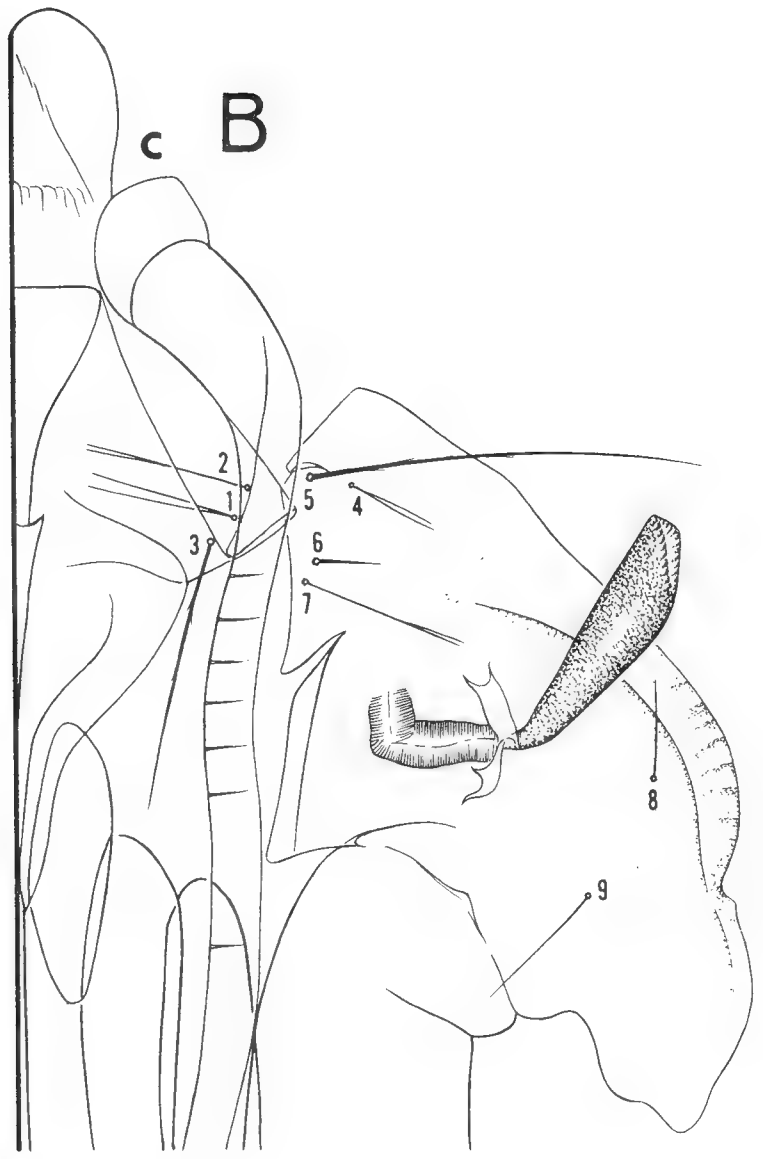


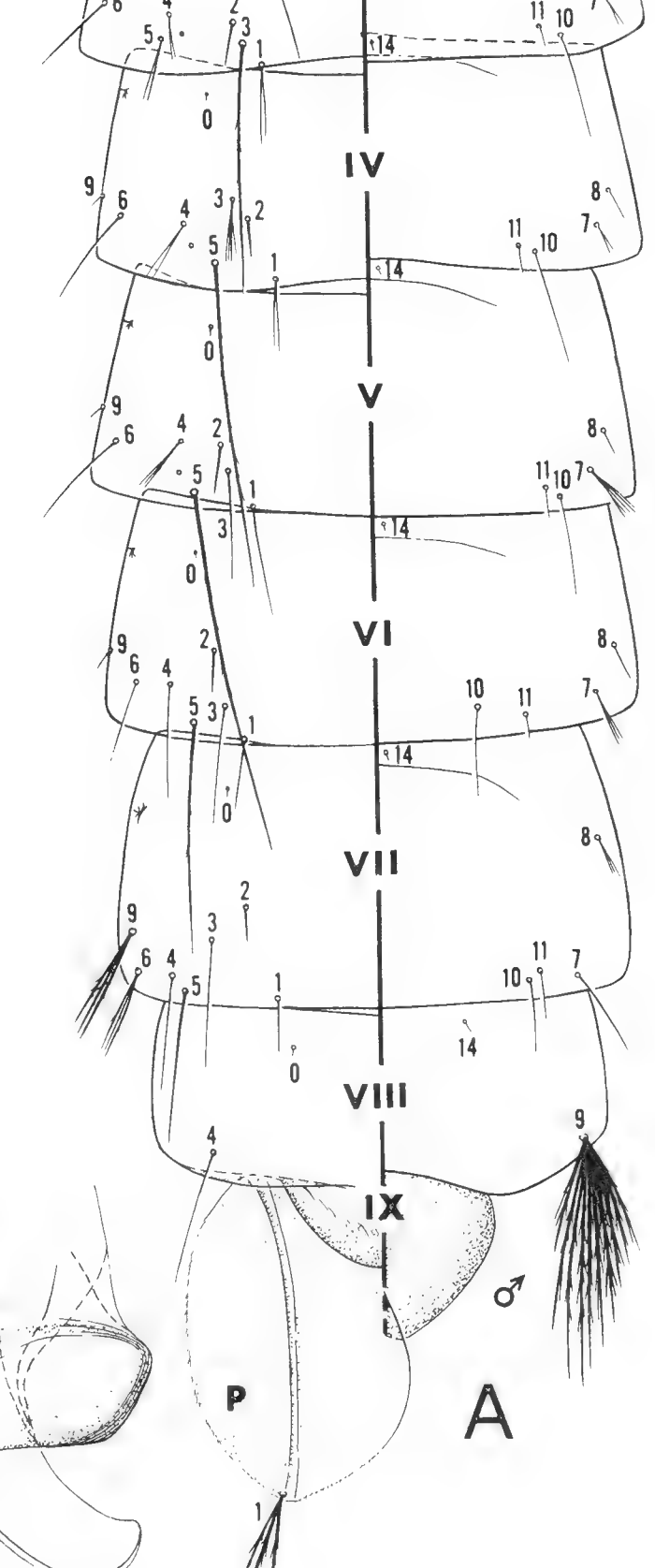


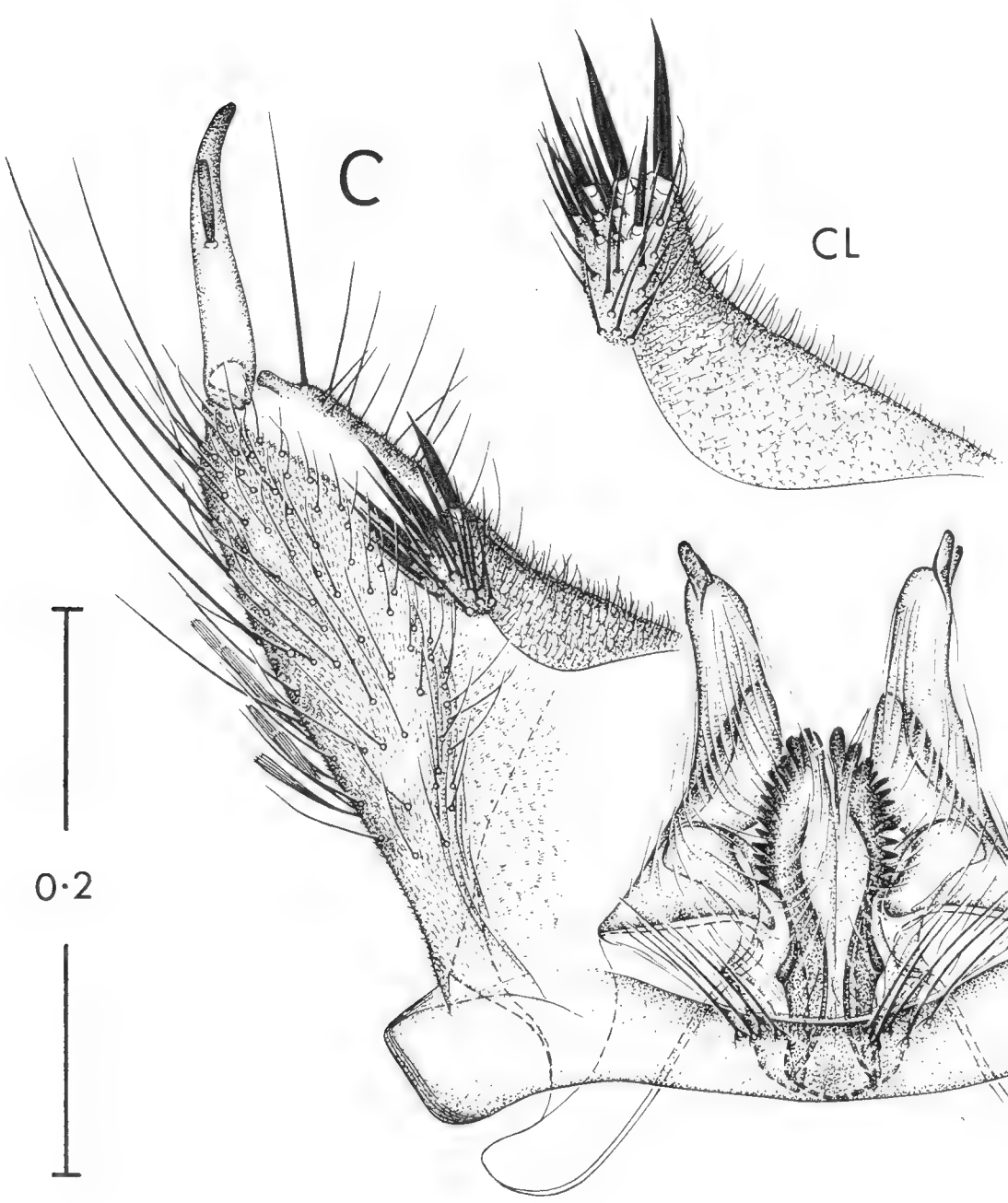
Aedes (Stegomyia) bambusicola Knight & Rozeboom

Sichai Malikul

Fig. 14



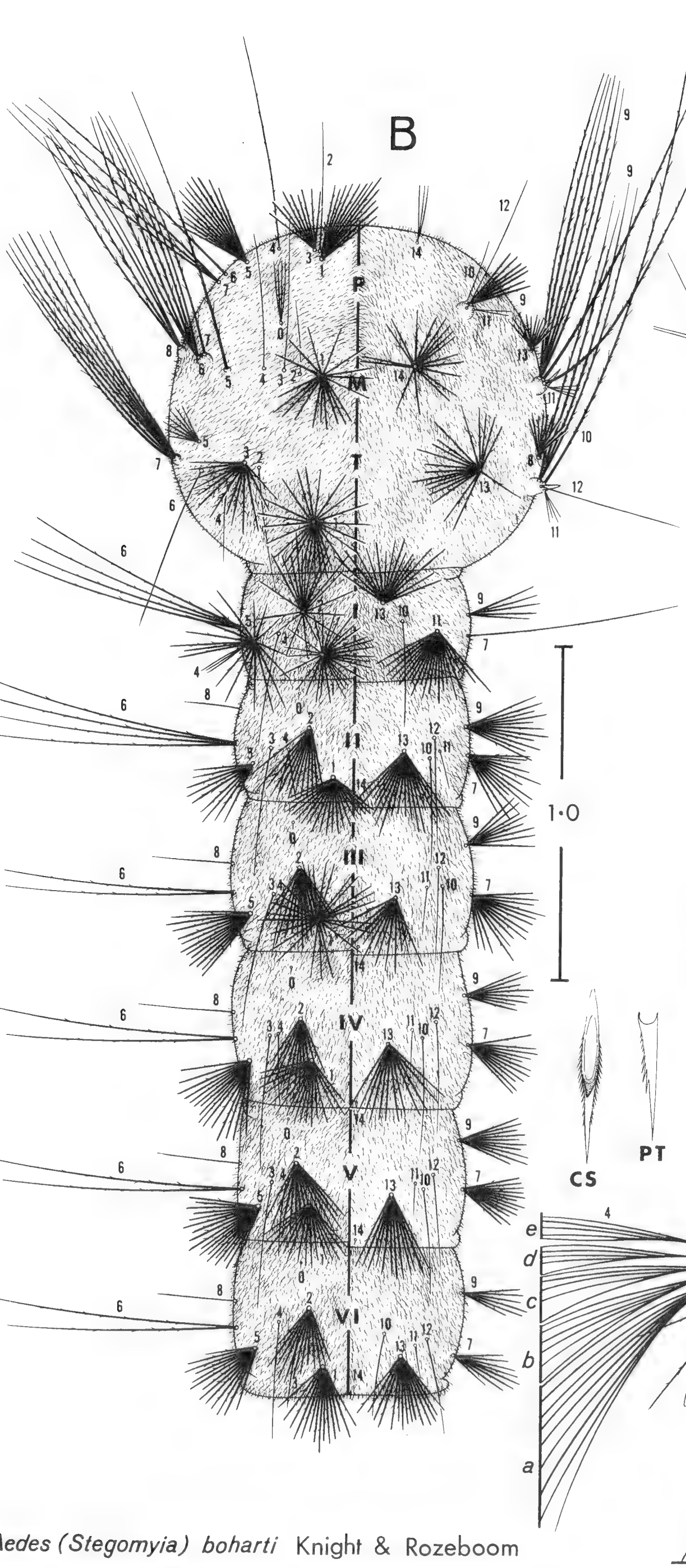


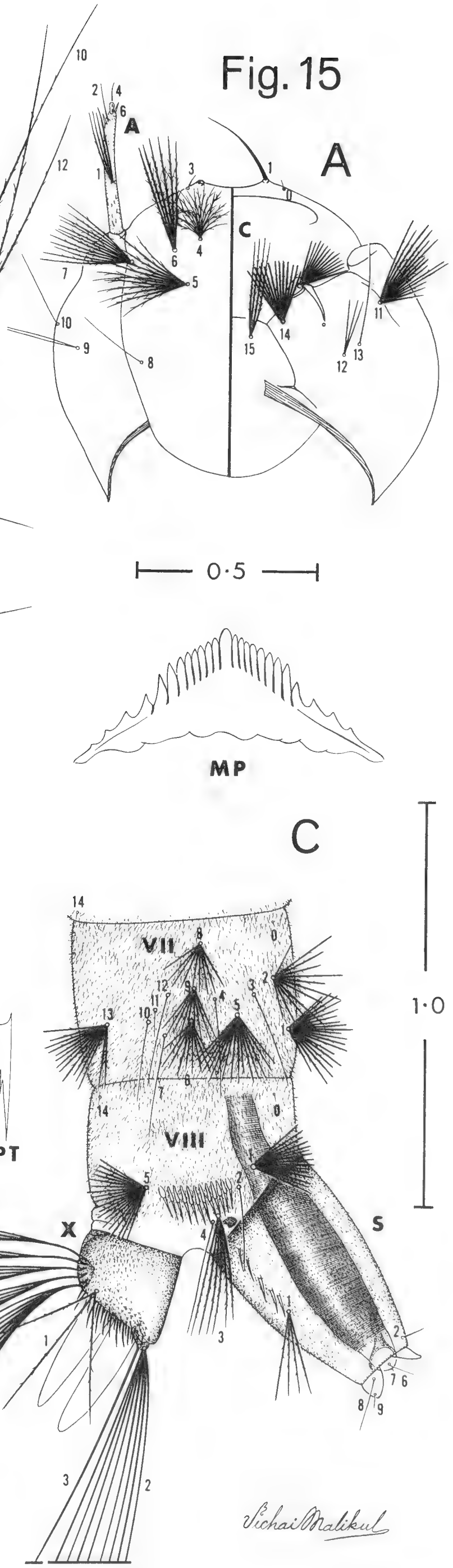


Aedes (Stegomyia) boharti Knight & Rozeboom

Michail Malikul

Fig. 15

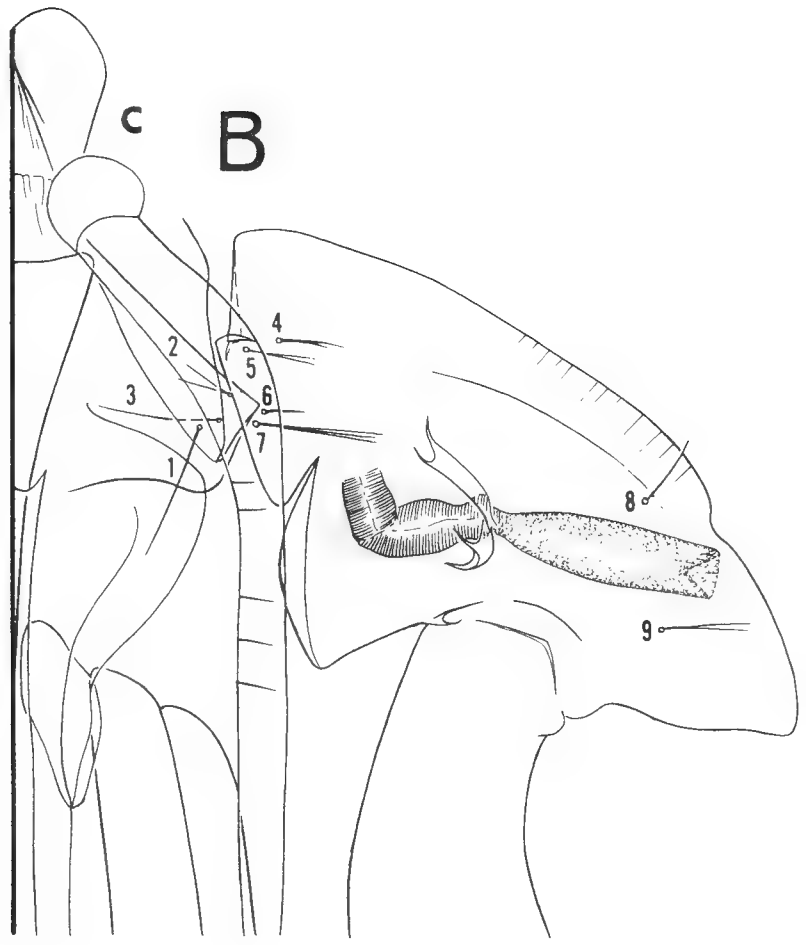


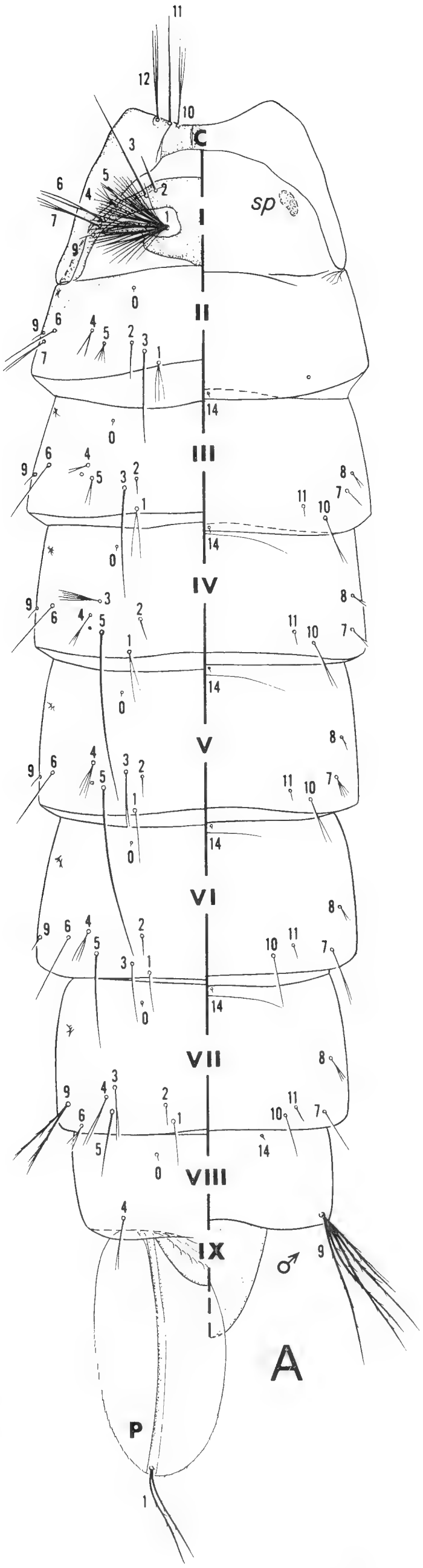


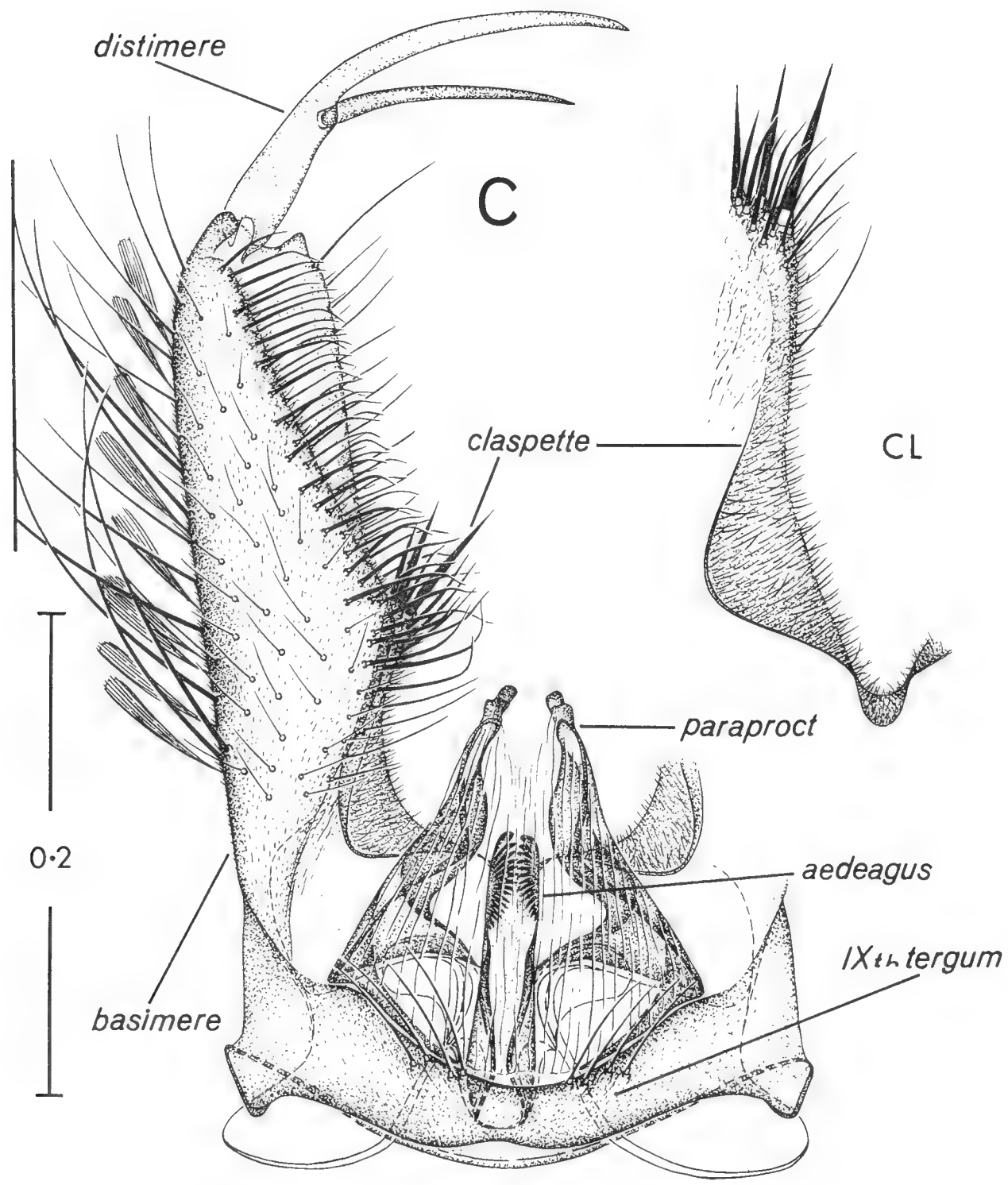
Aedes (Stegomyia) boharti Knight & Rozeboom

Sichai Malikul

Fig. 16



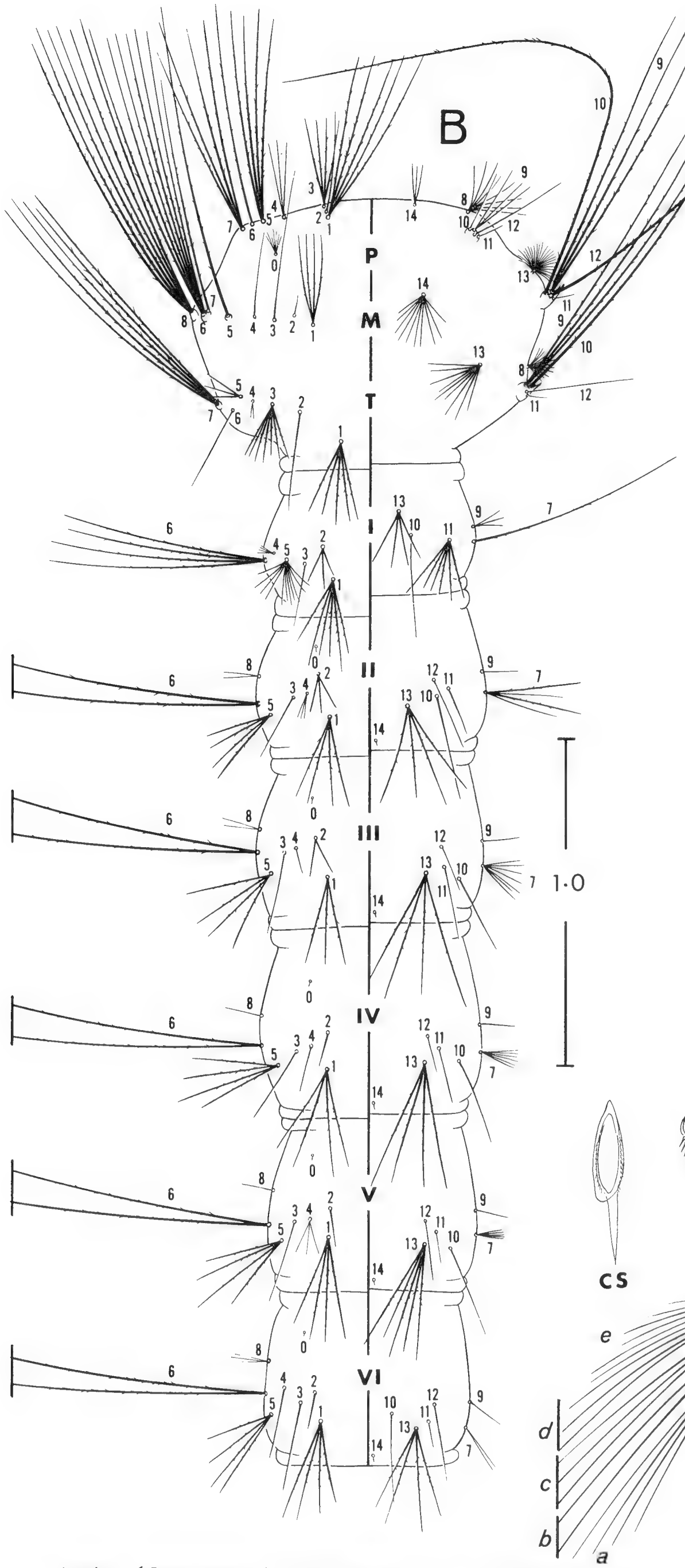


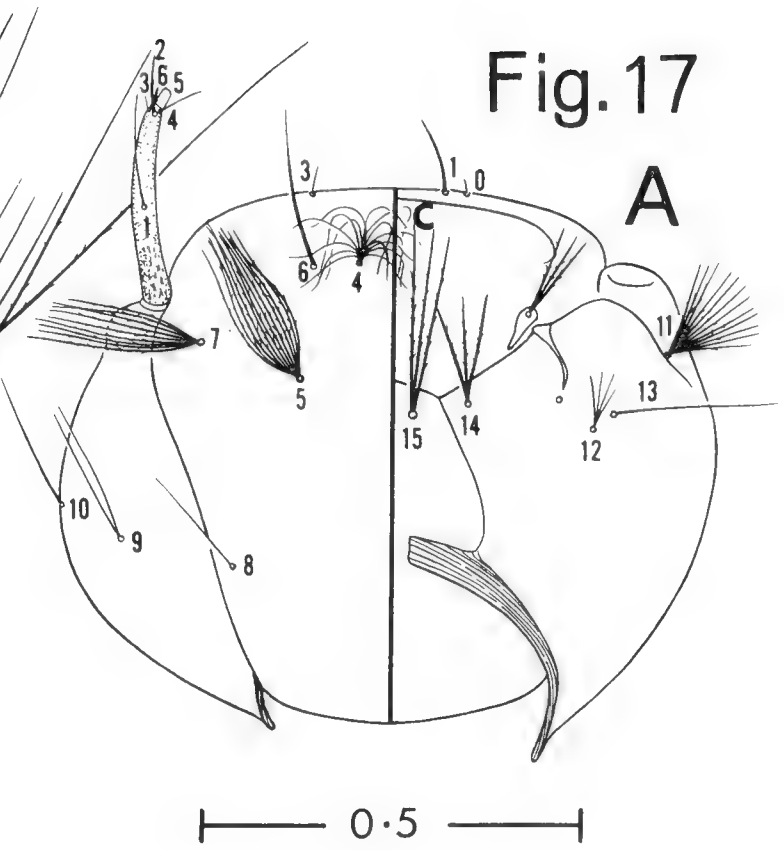


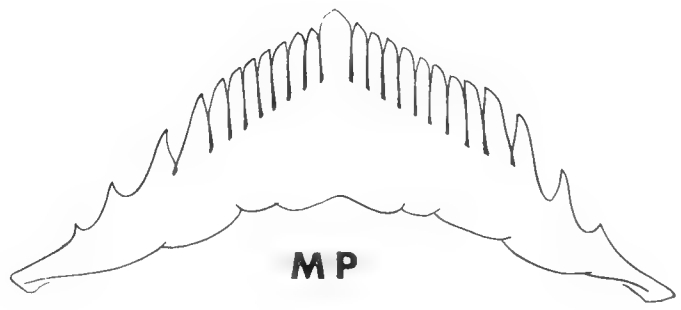
Aedes (Stegomyia) hoogstraali Knight & Rozeboom

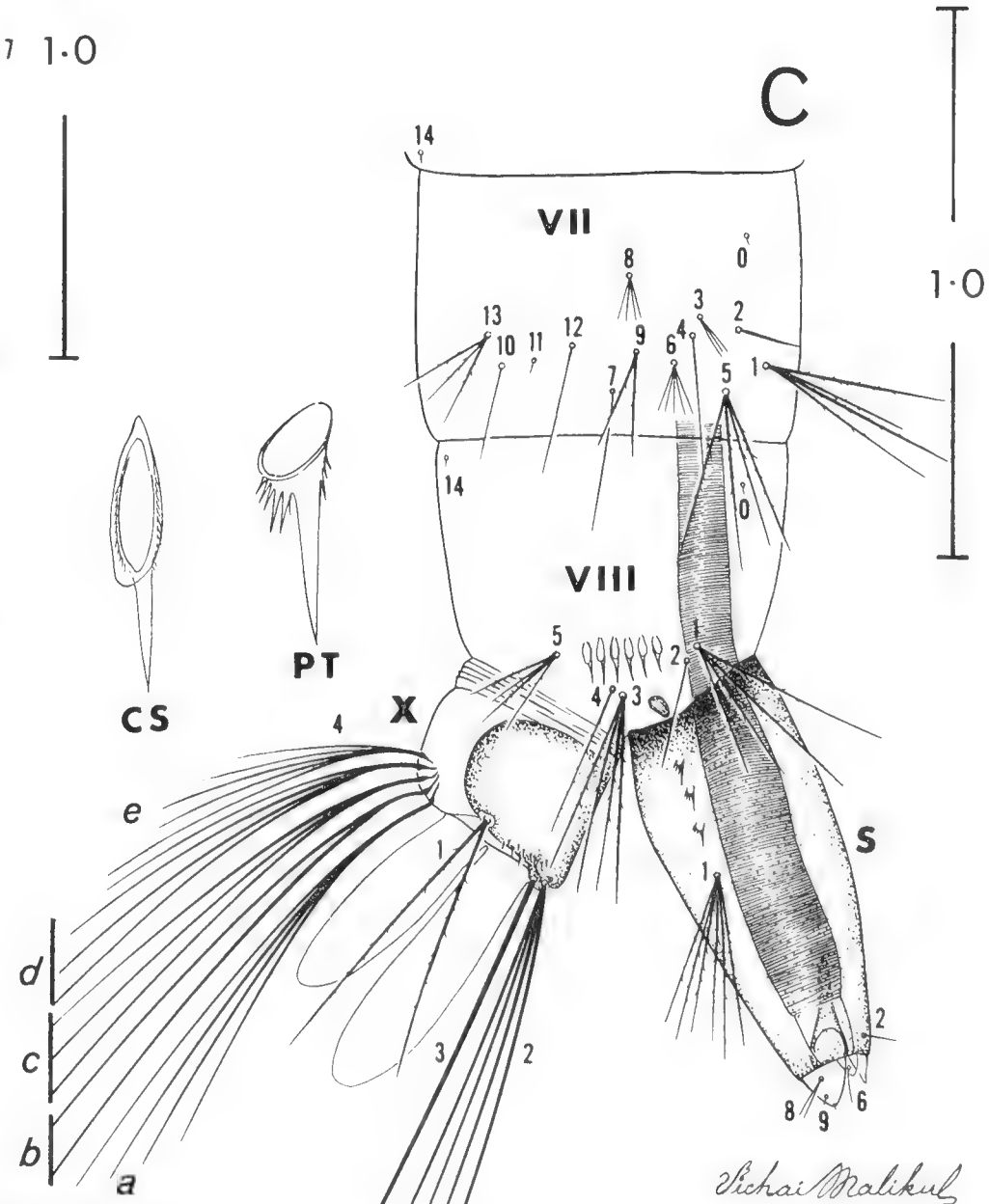
Vichai Malikul

Fig. 17



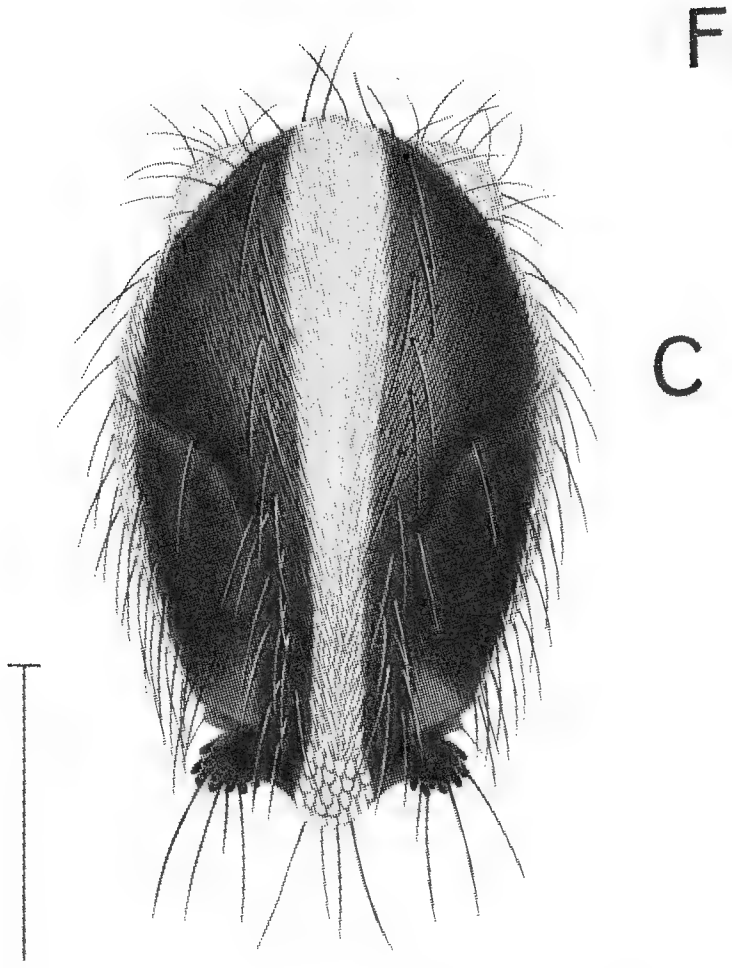






Aedes (Stegomyia) hoogstraali Knight & Rozeboom

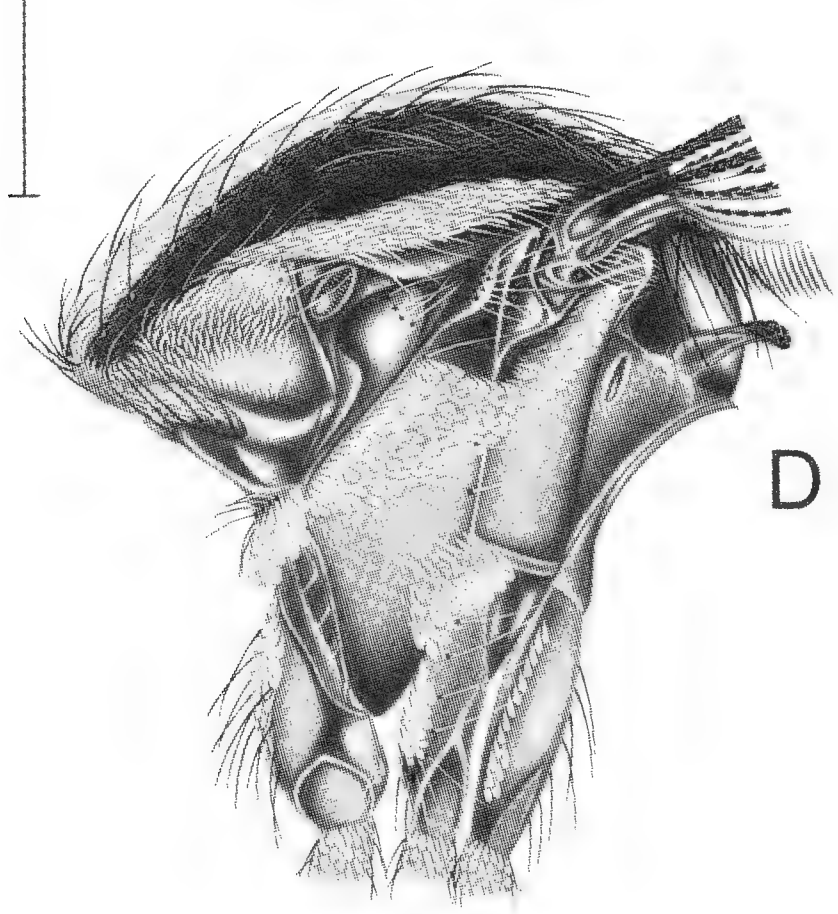
Fig.18



C

1·0

impatibilis



D

impatibilis hindleg ♂

B

hoogstraali hindleg ♂

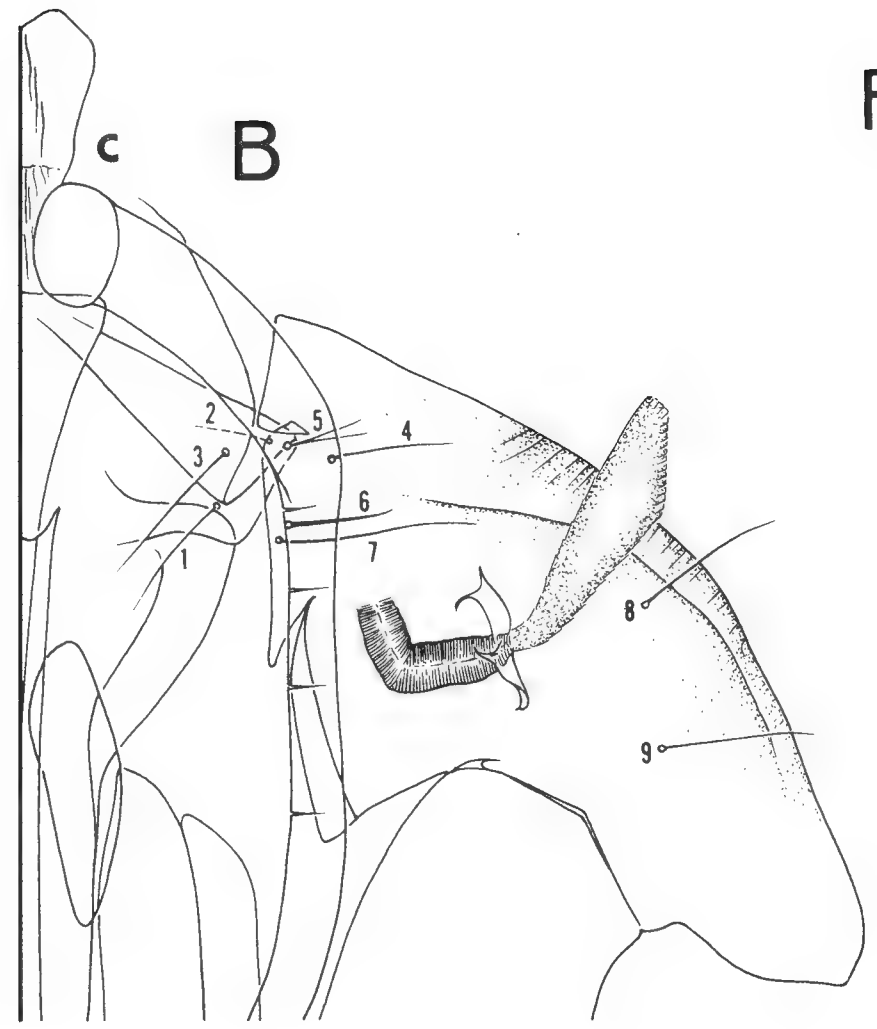
A

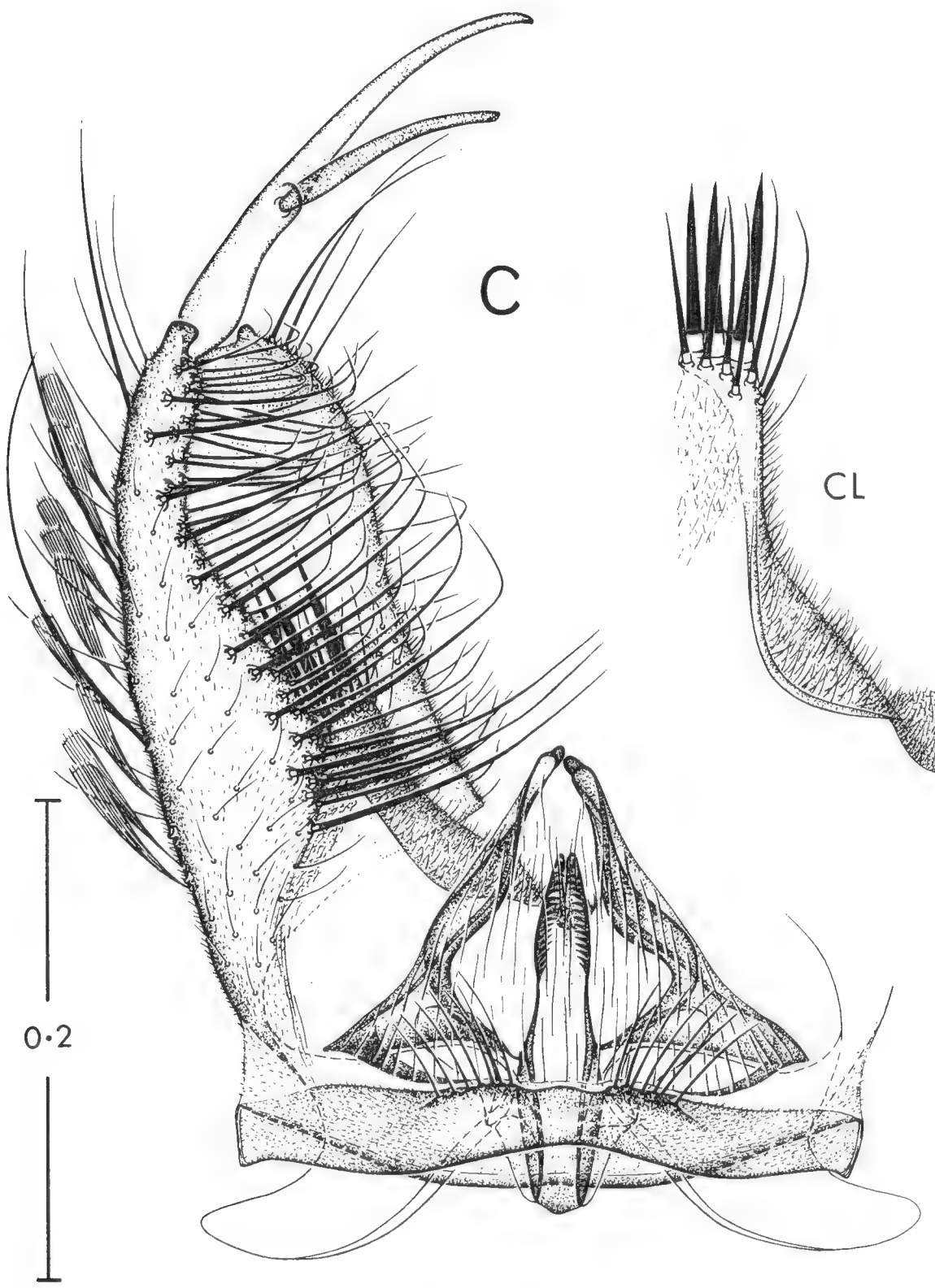
1·0

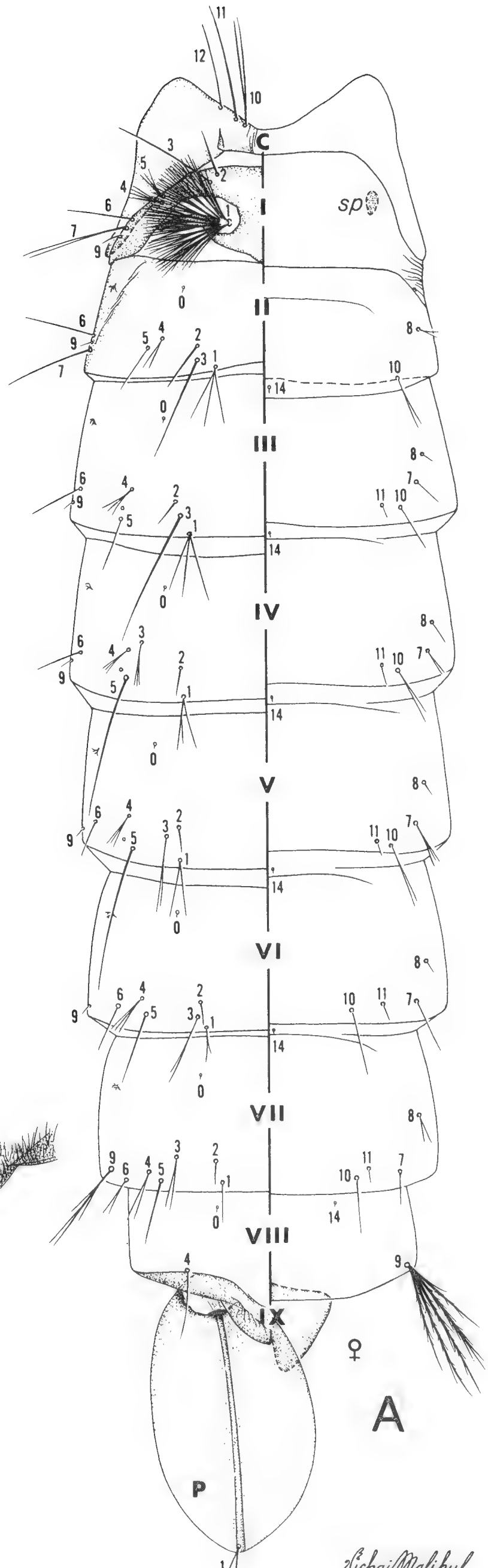
Aedes (Stegomyia) impatibilis (Walker)

Vichai Malikul

Fig.19

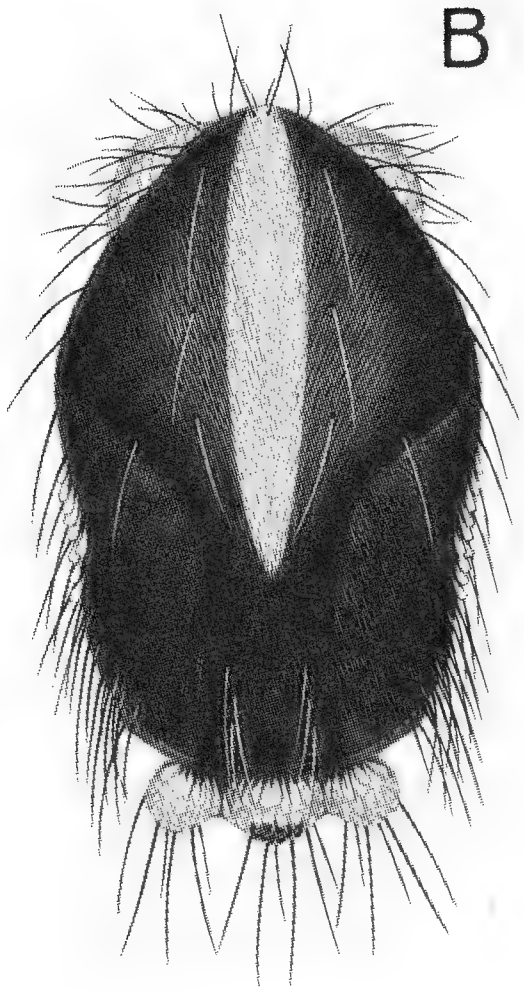


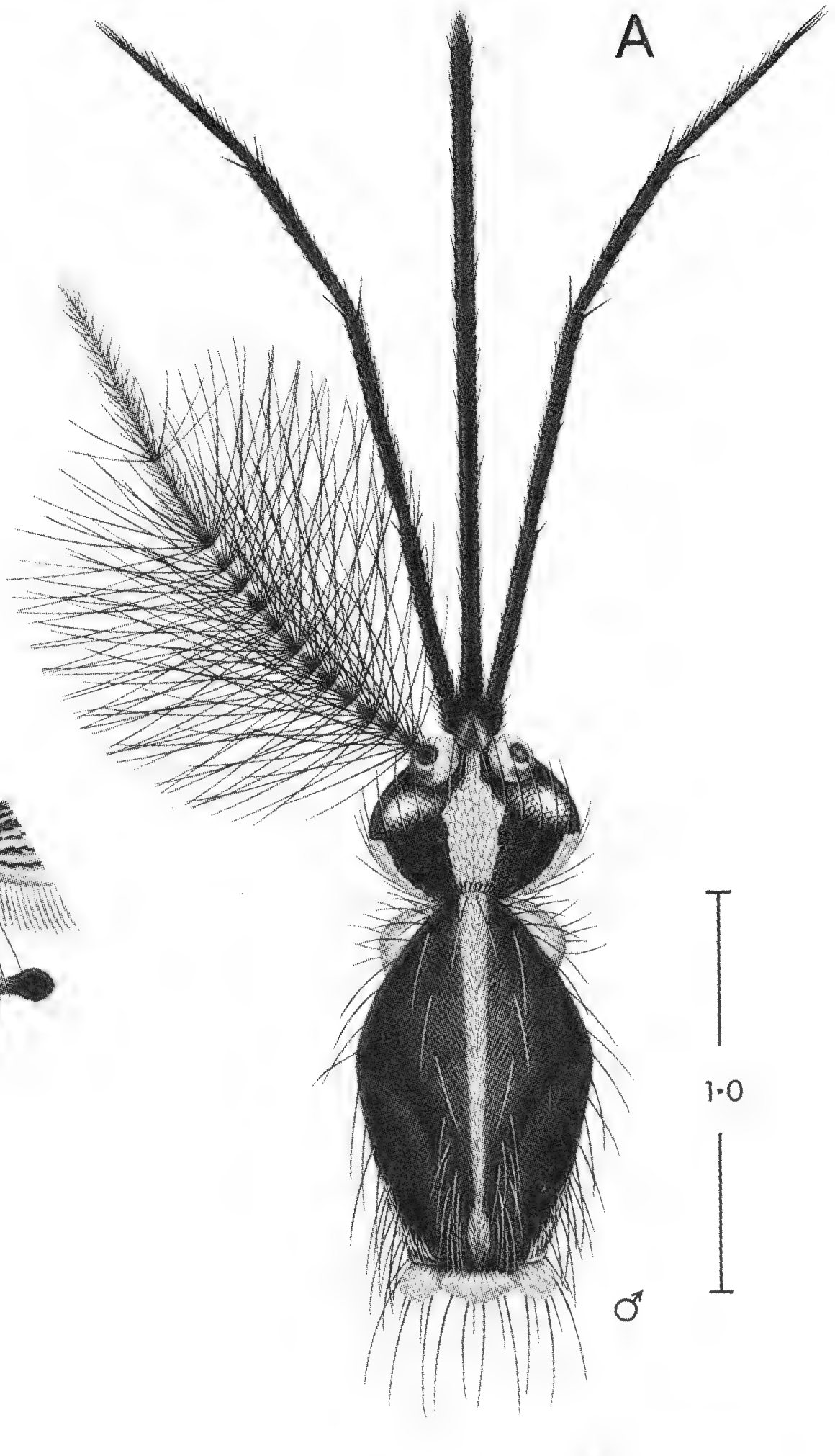


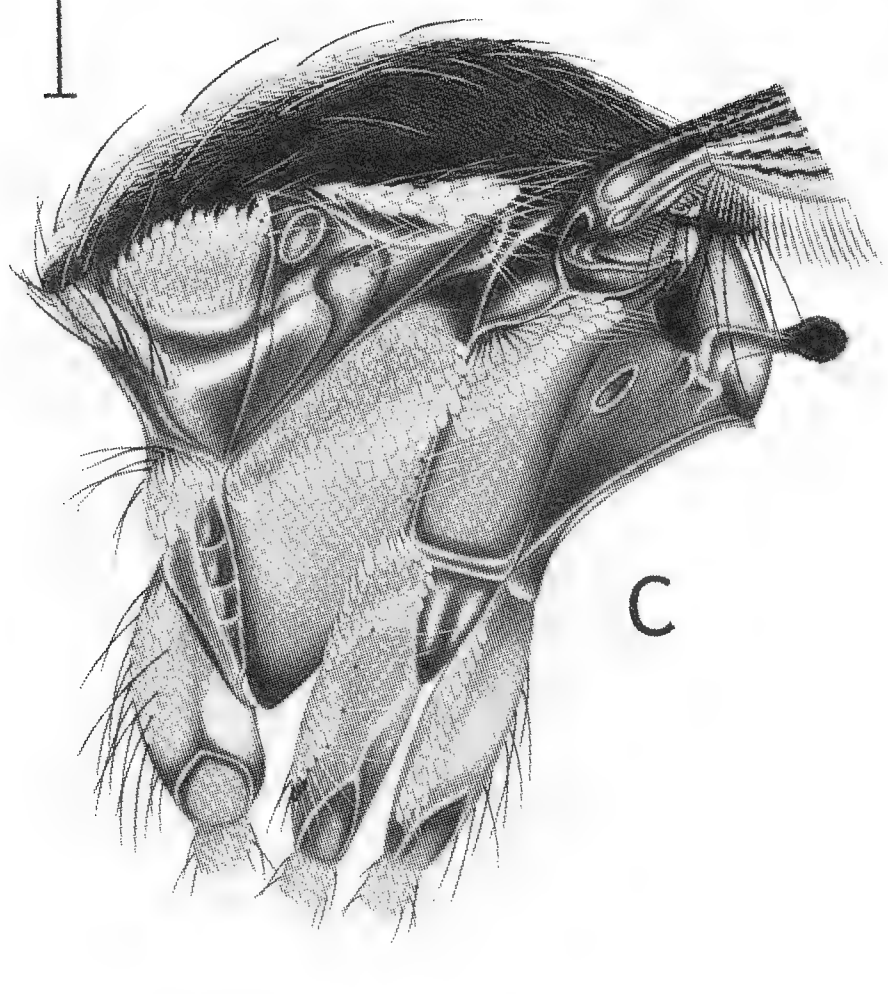


Aedes (Stegomyia) impatibilis (Walker)

Fig. 20





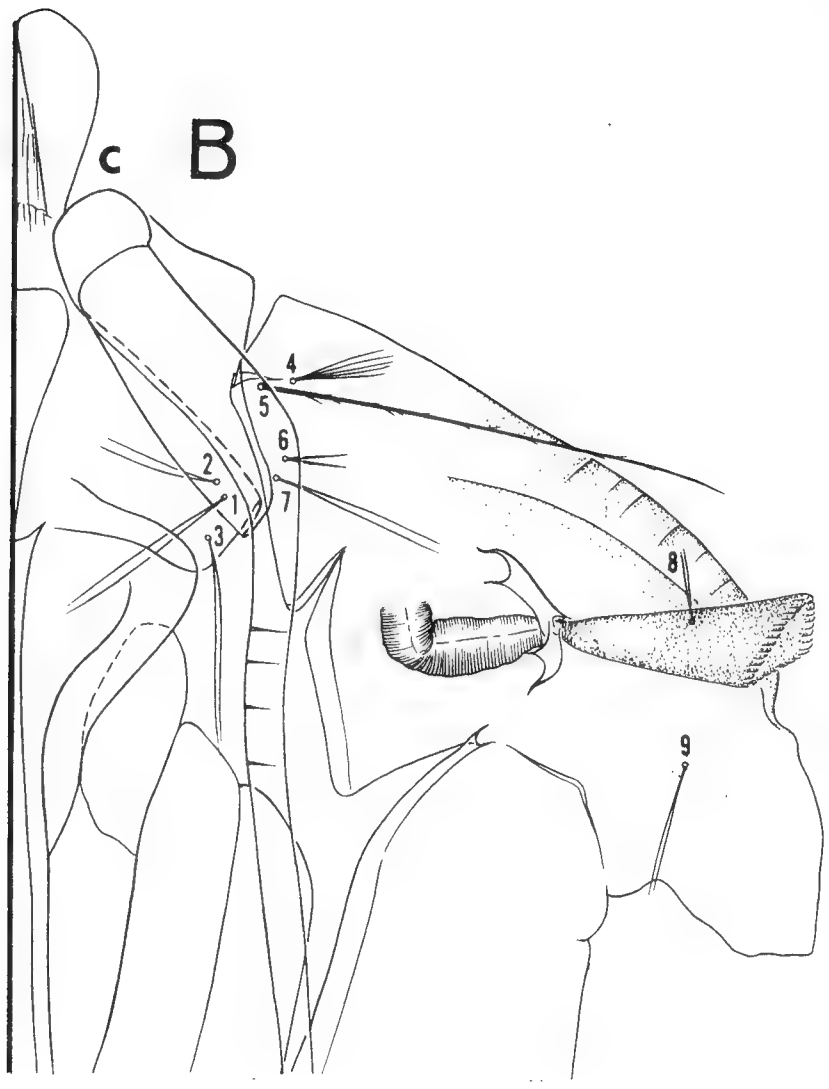


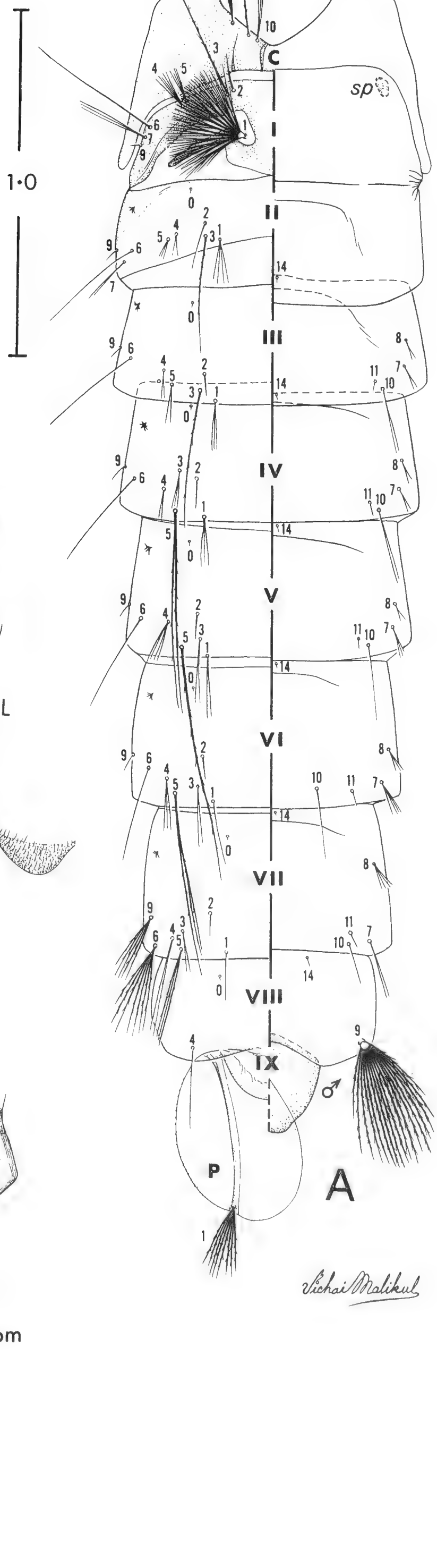
Sichai Malikul

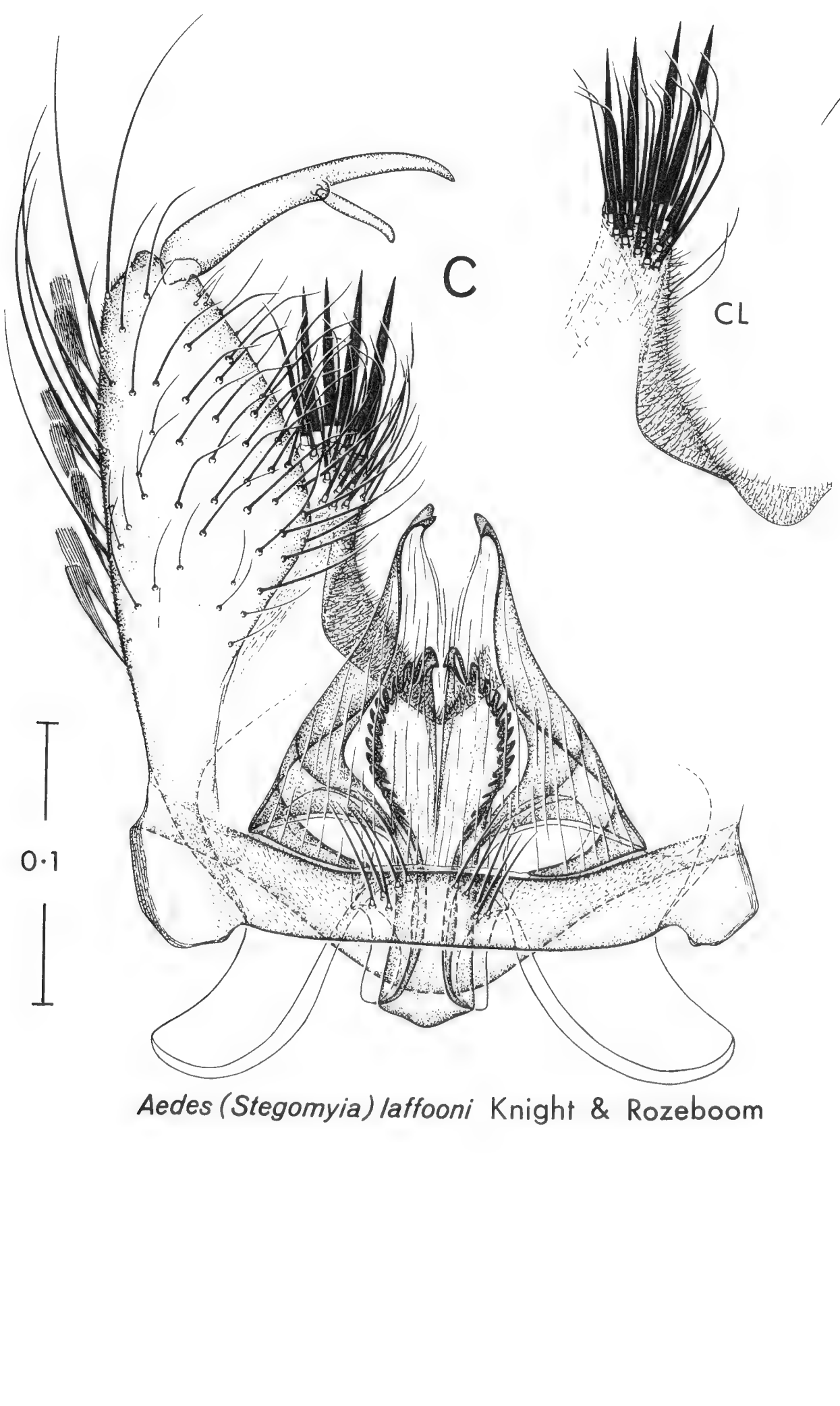
Aedes (Stegomyia) laffooni Knight & Rozeboom

Aedes (Stegomyia) bambusicola Knight & Rozeboom

Fig. 21



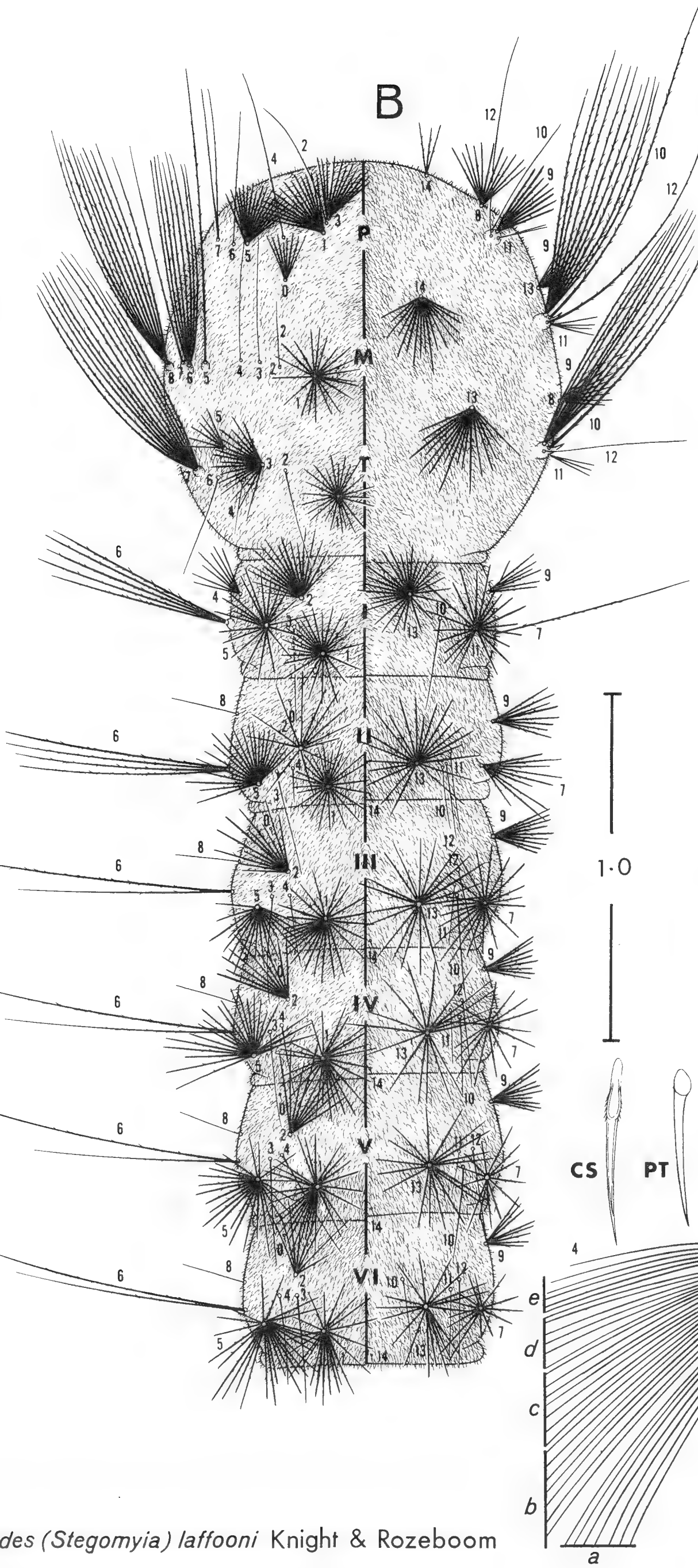


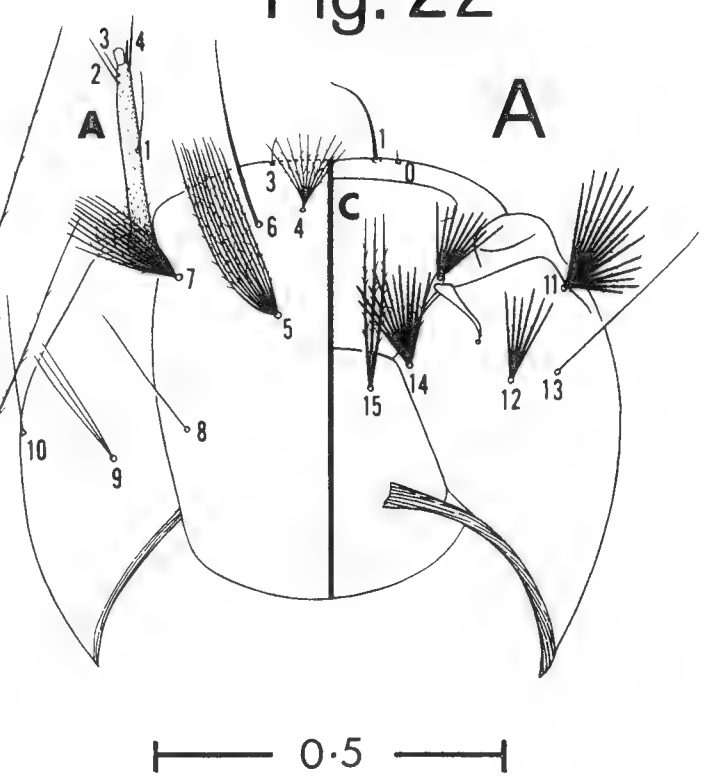


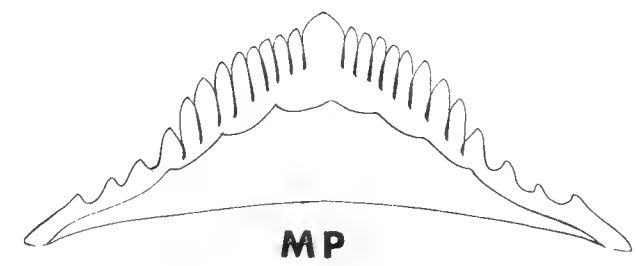
Aedes (Stegomyia) laffooni Knight & Rozeboom

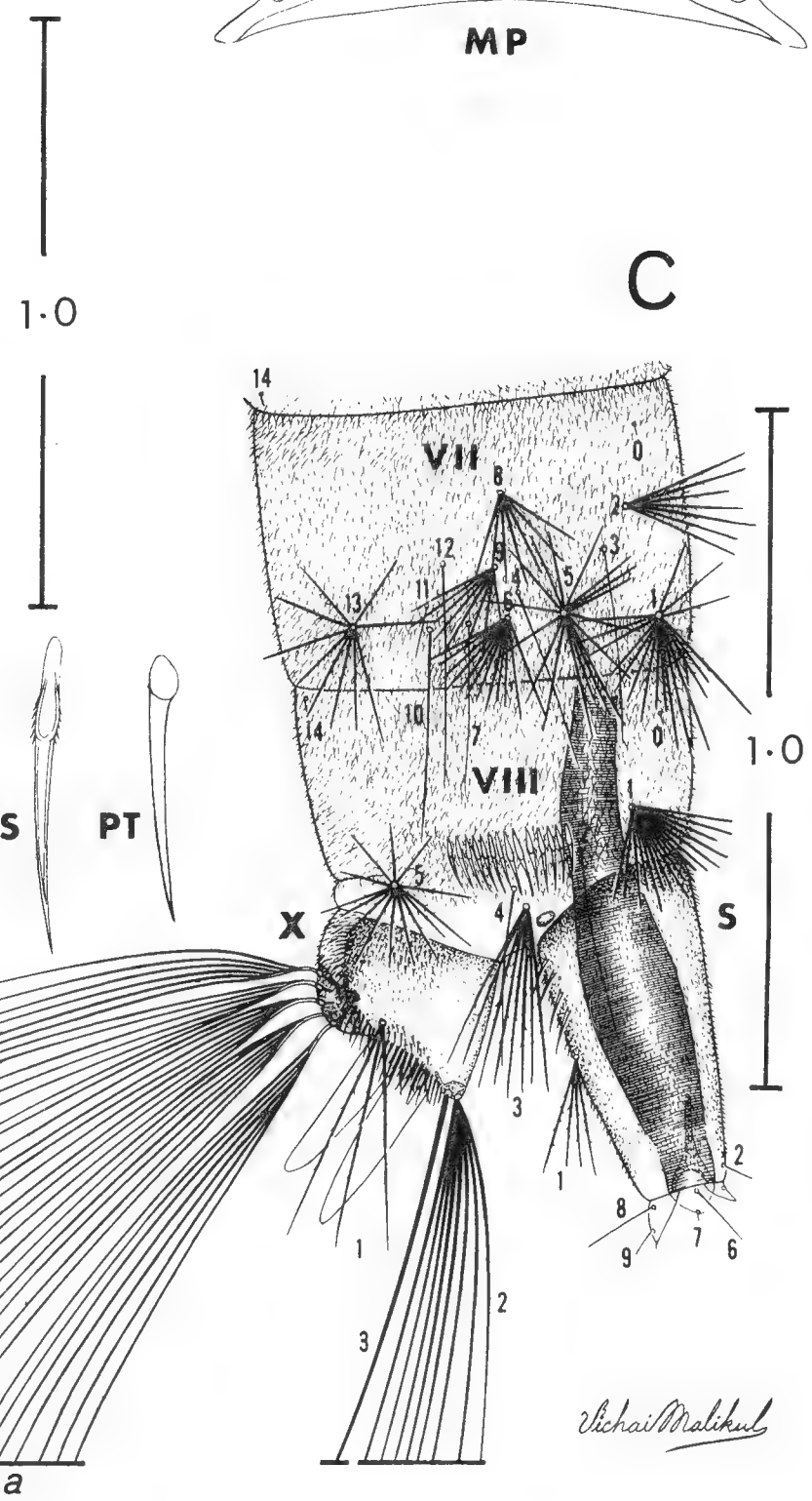
Vichai Malikul

Fig. 22









Aedes (Stegomyia) laffooni Knight & Rozeboom

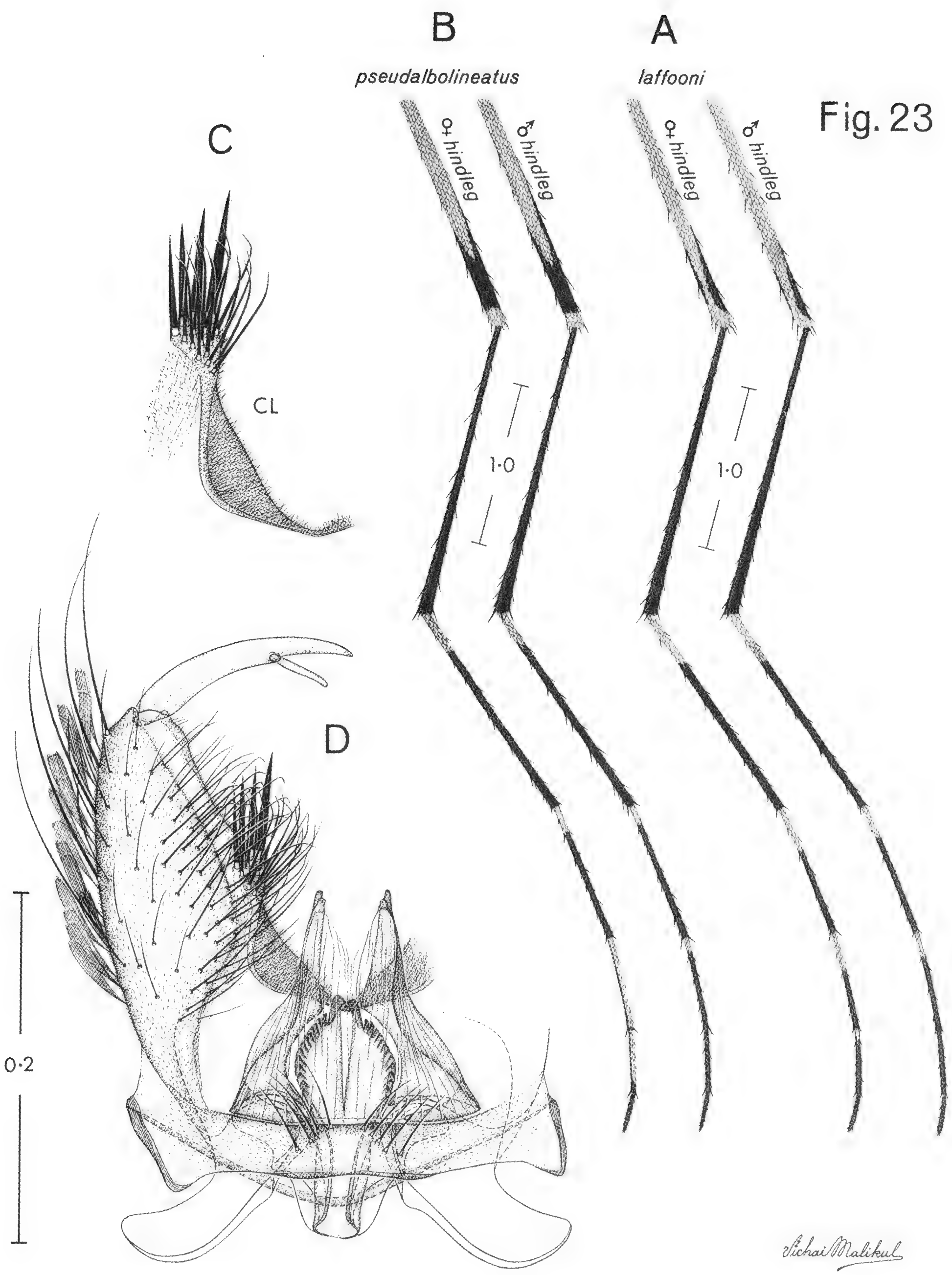
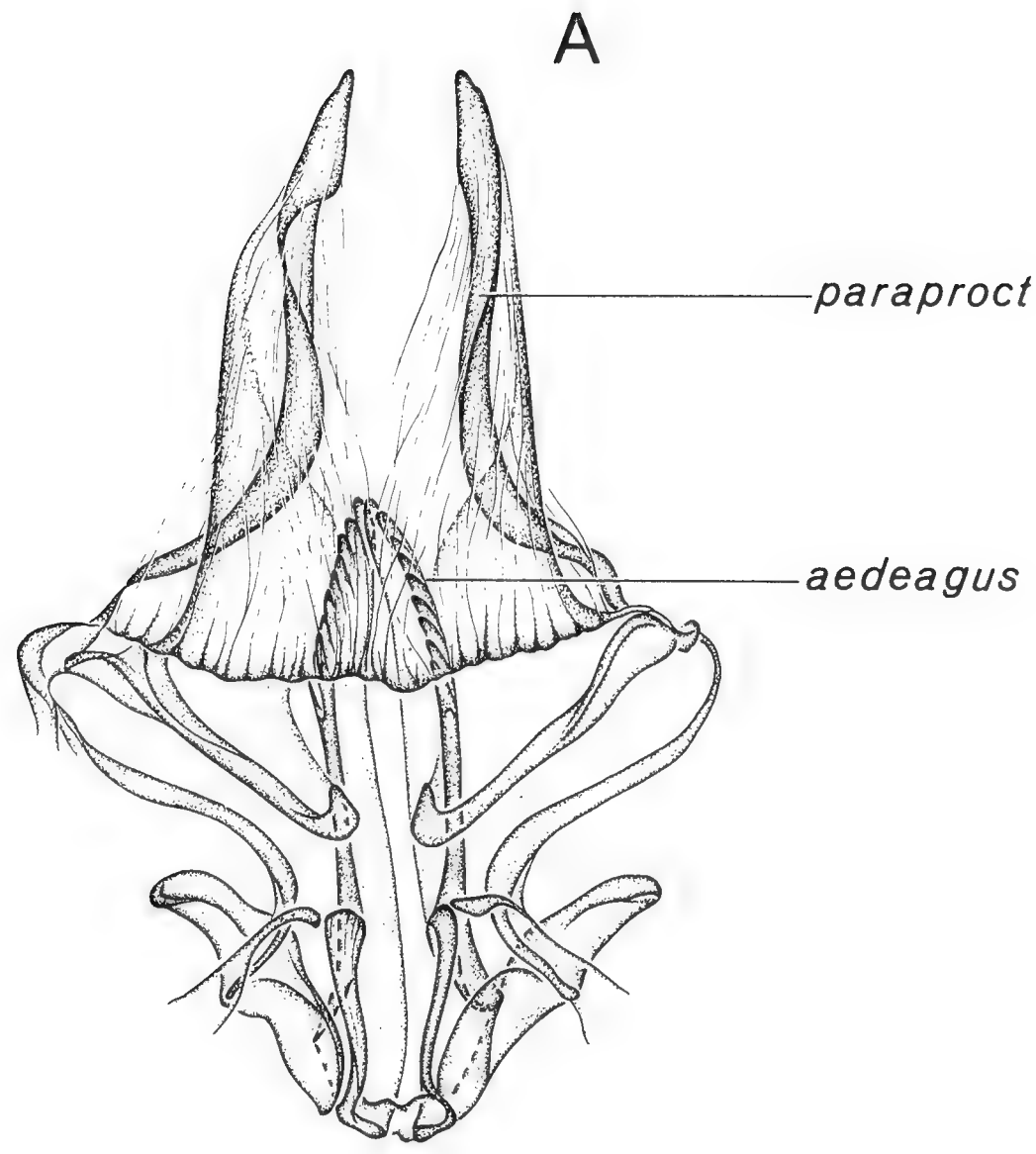


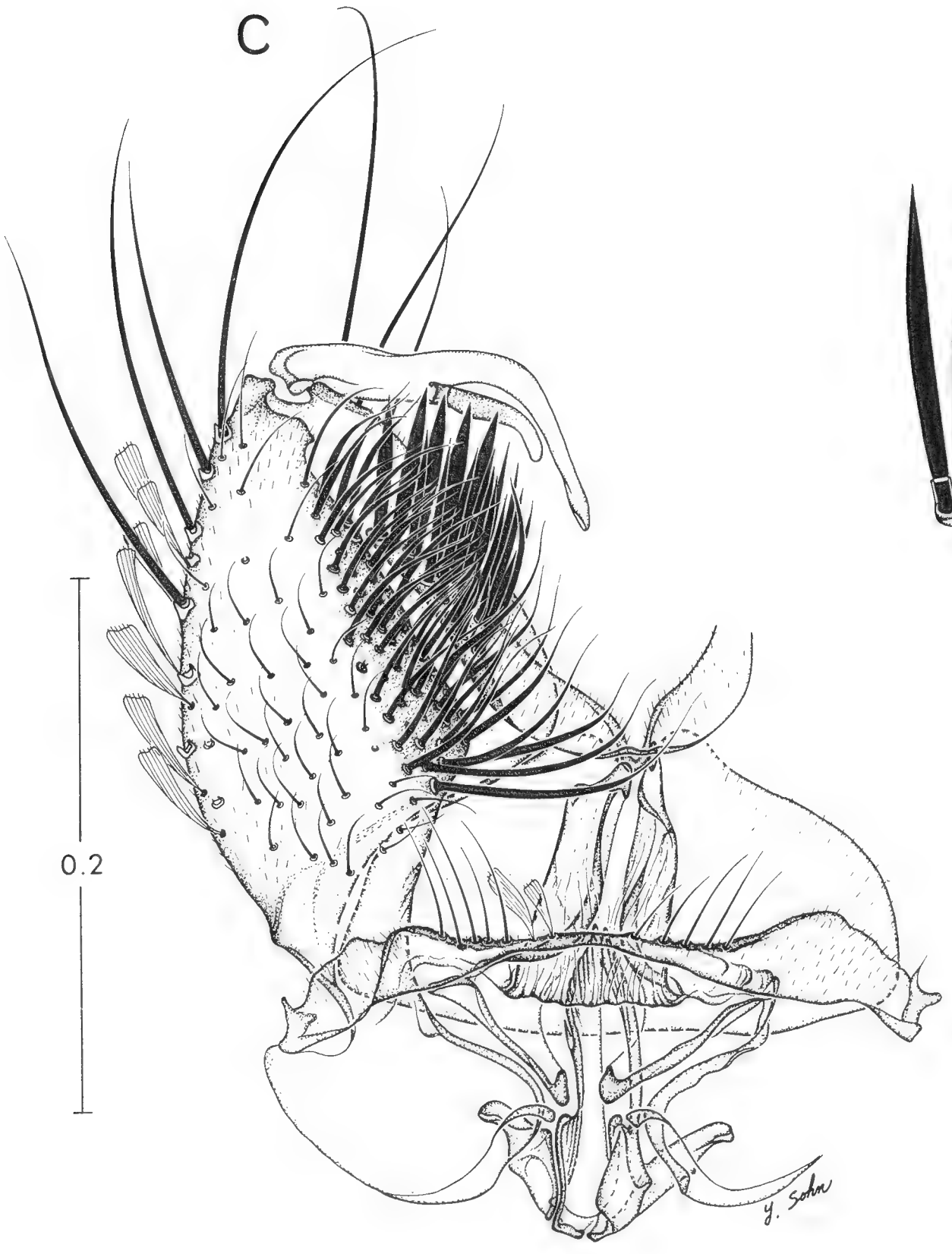
Fig. 23

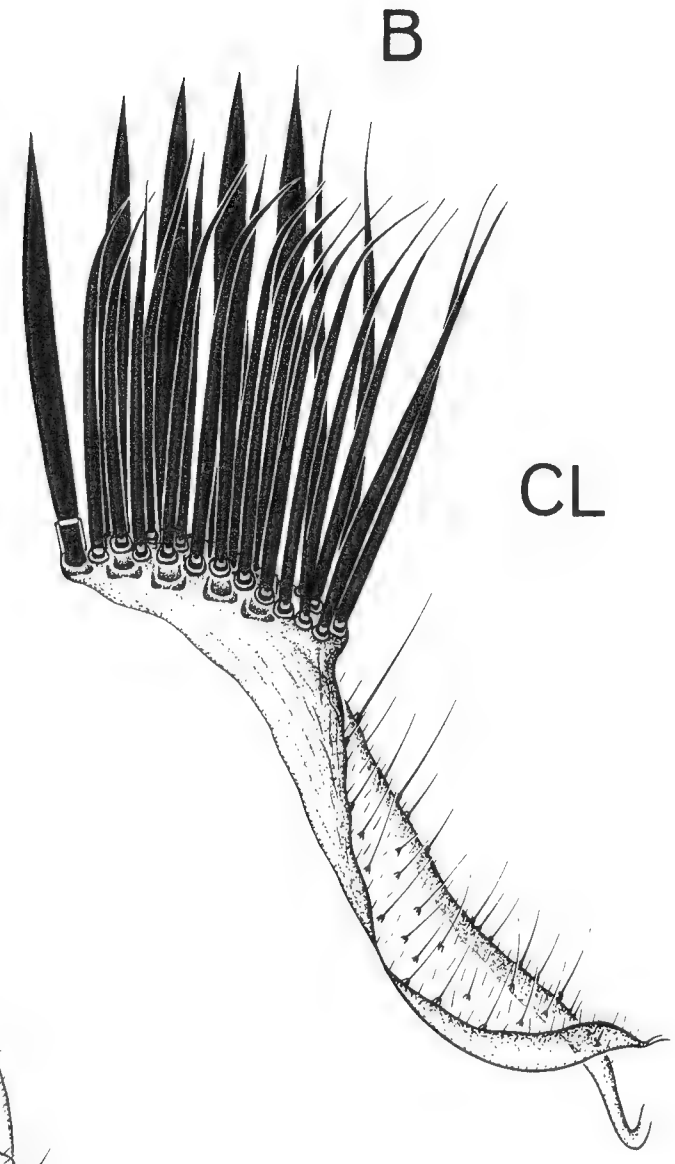
Aedes (Stegomyia) pseudalbolineatus Brug

Sichai Malikul

Fig. 24

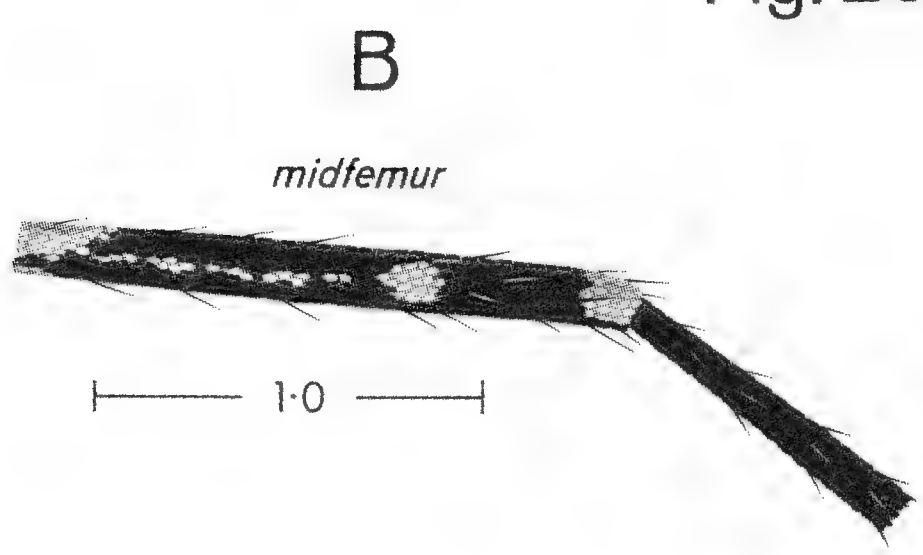


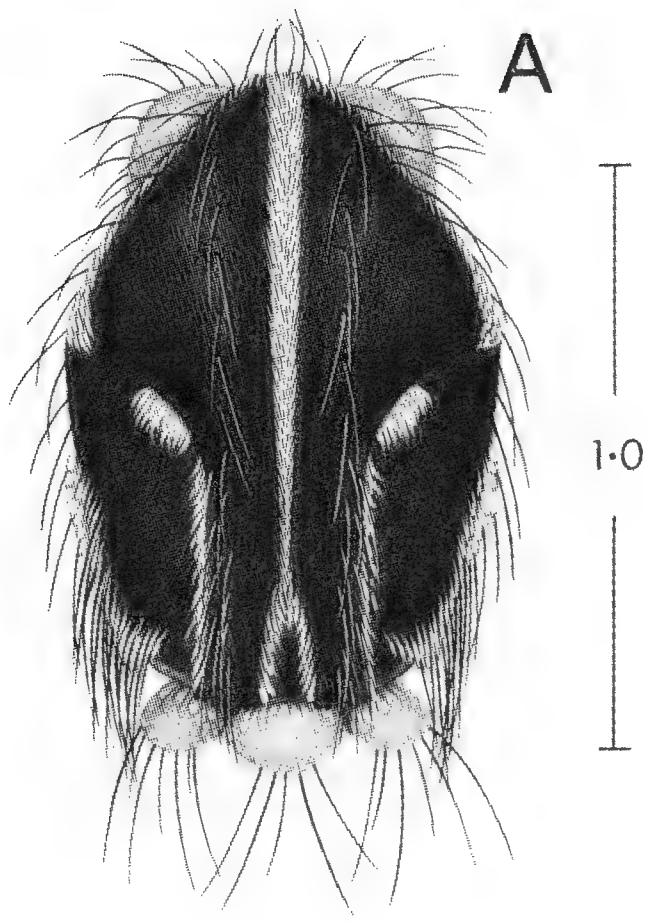


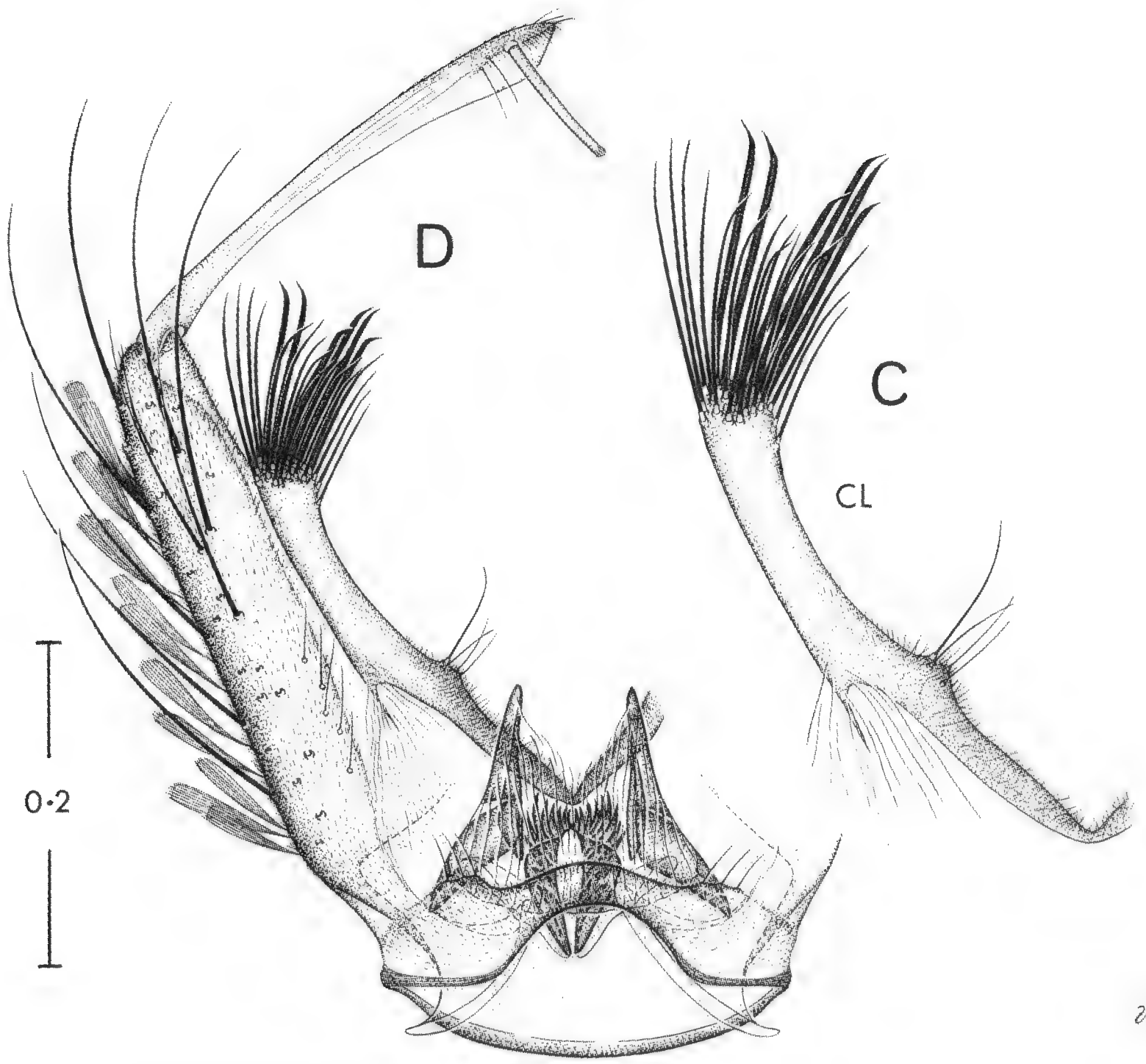


Aedes (Stegomyia) platylepidus Knight & Hull

Fig. 25



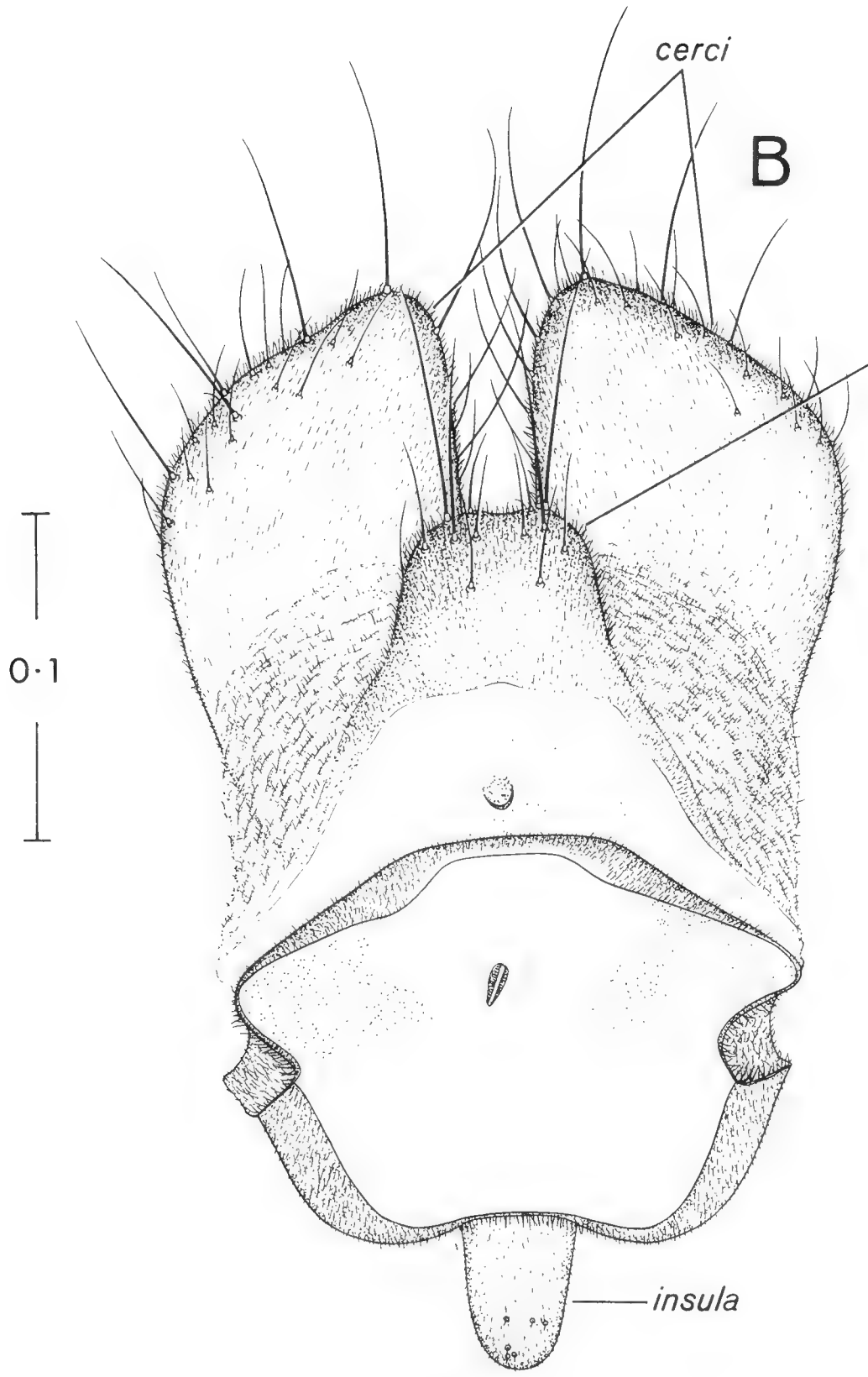


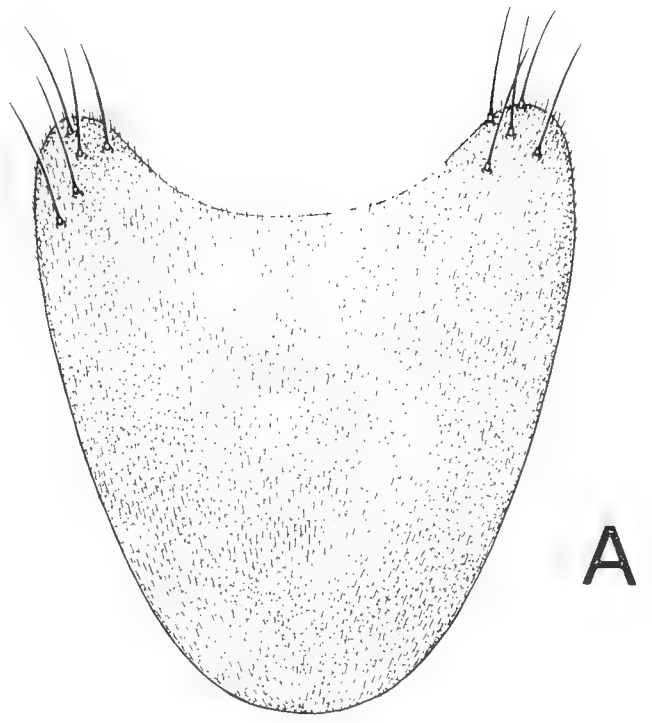


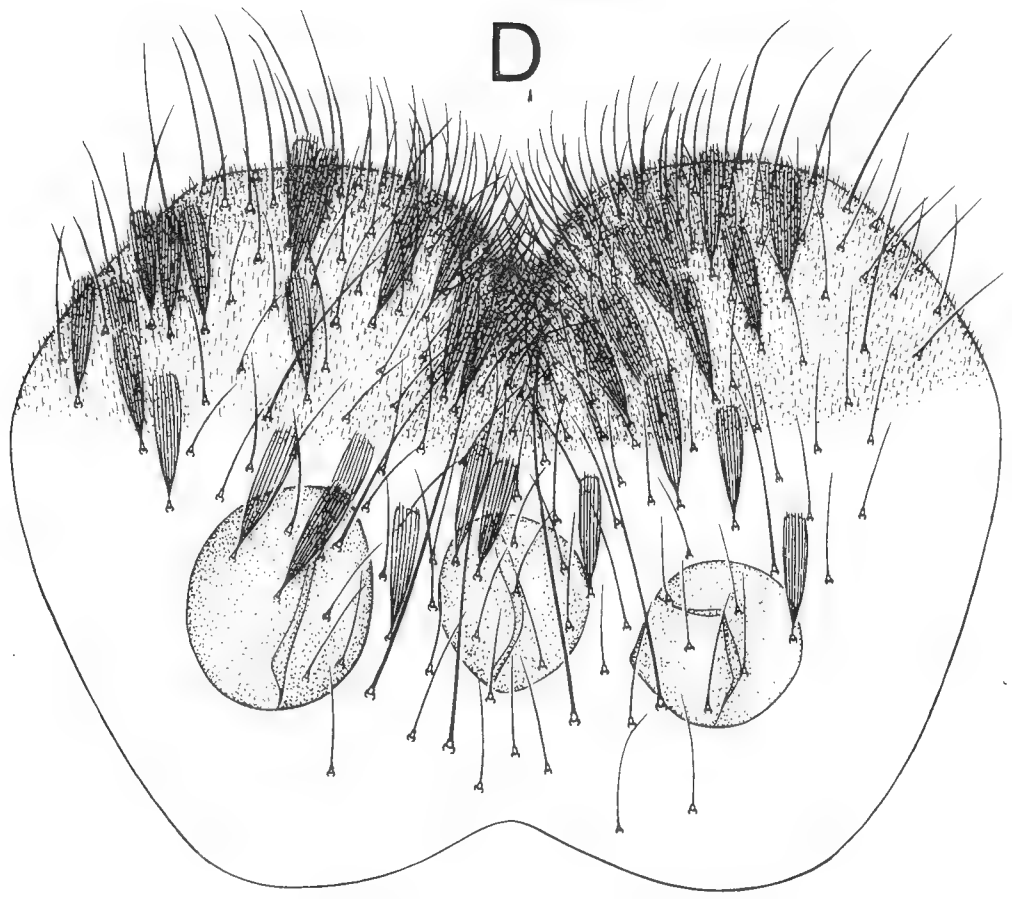
Aedes (Stegomyia) unilineatus (Theobald)

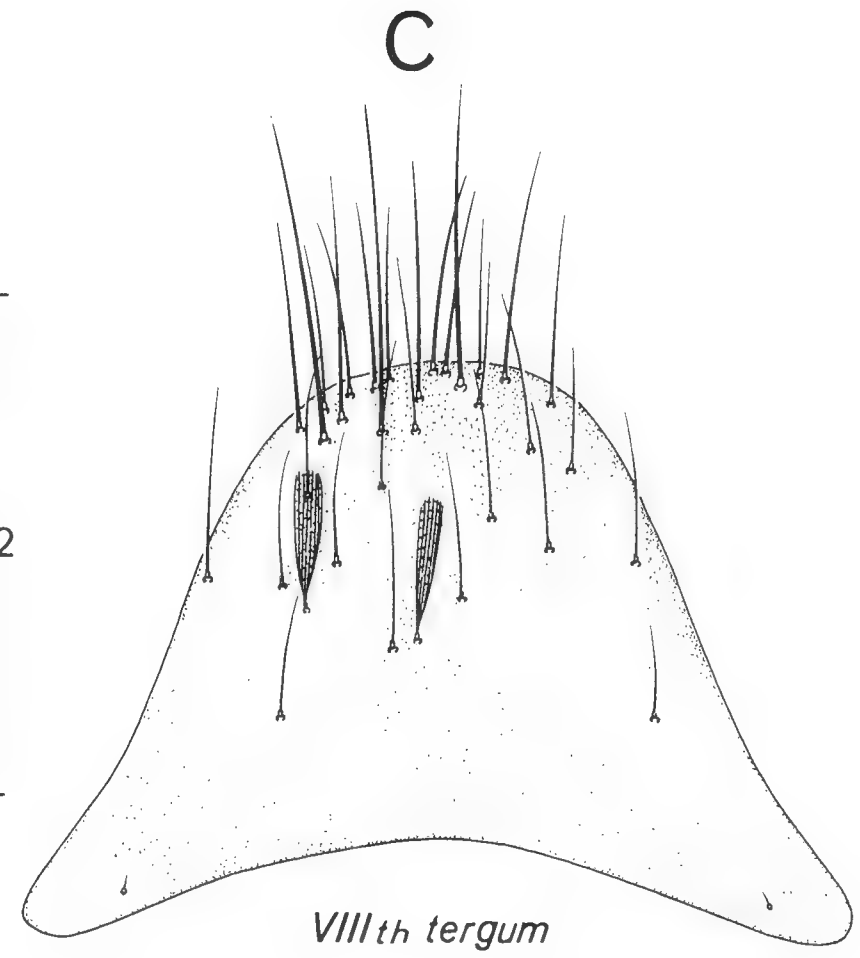
Vichai Malikul

Fig. 26





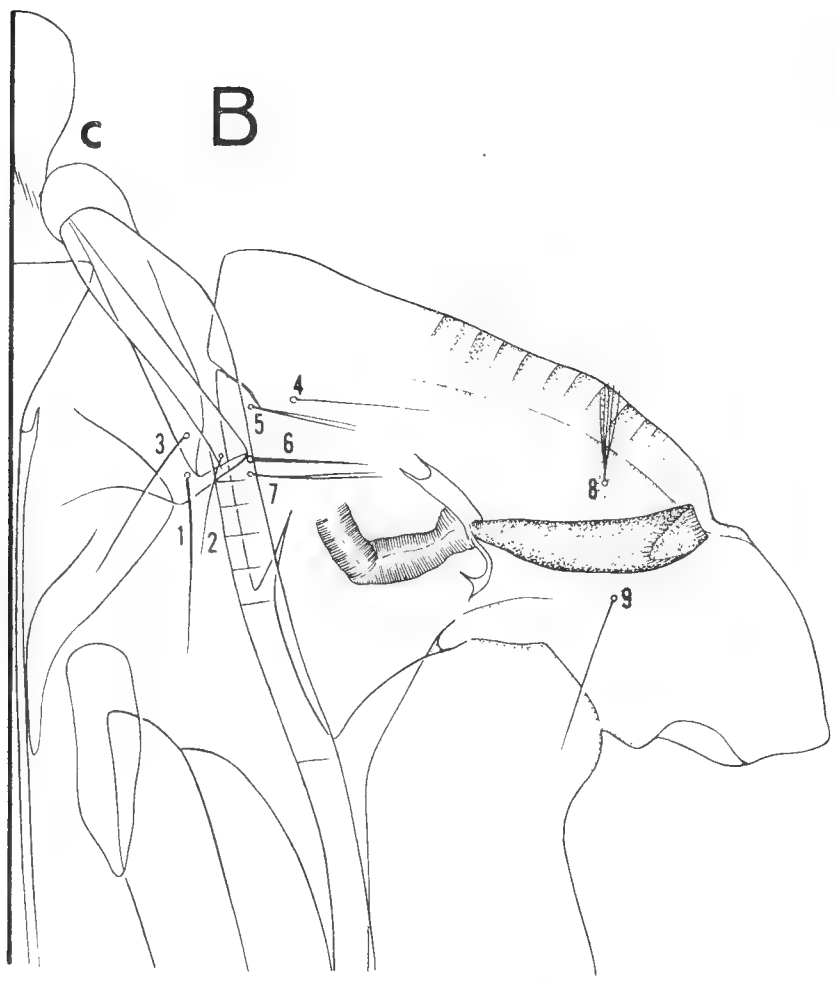


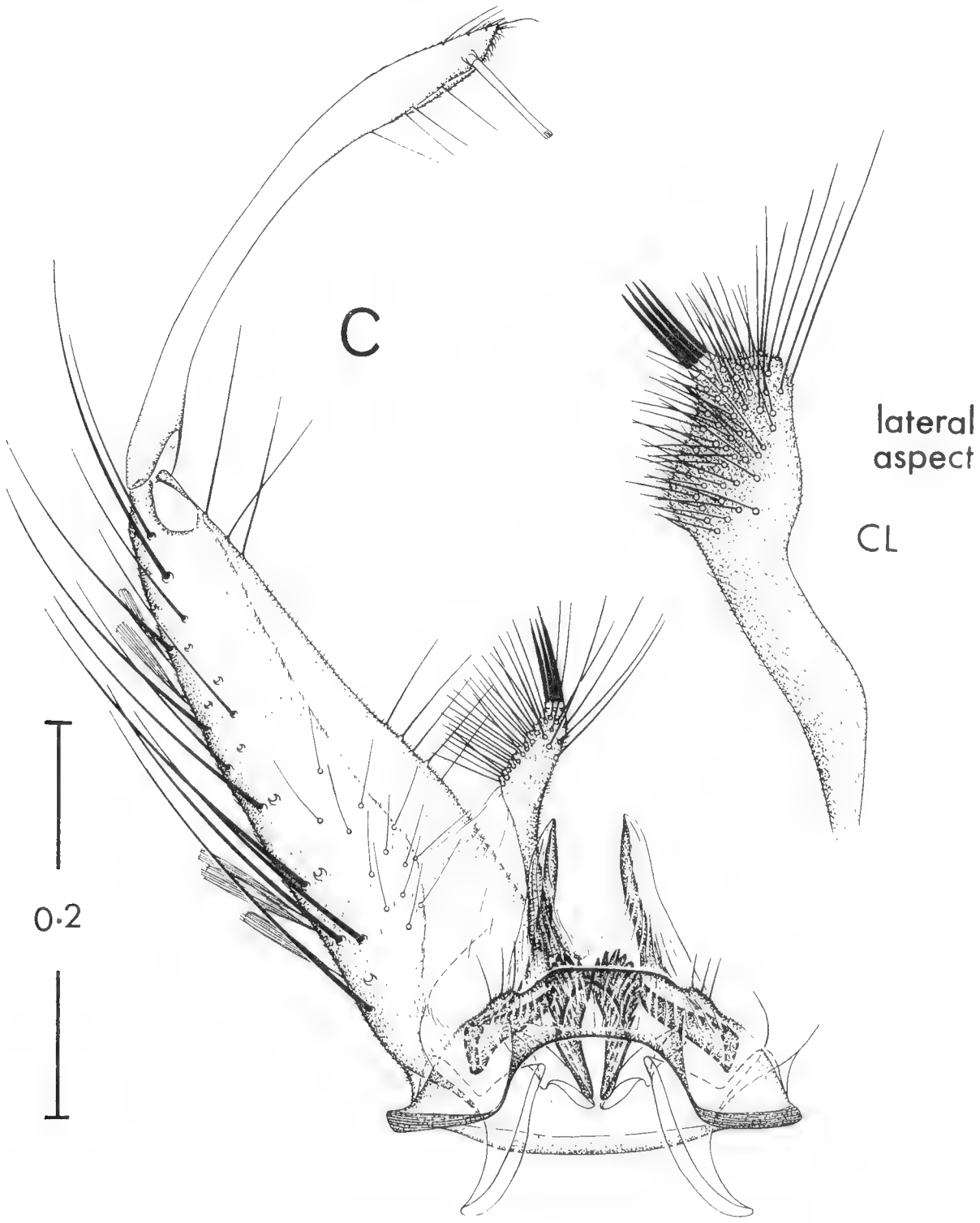


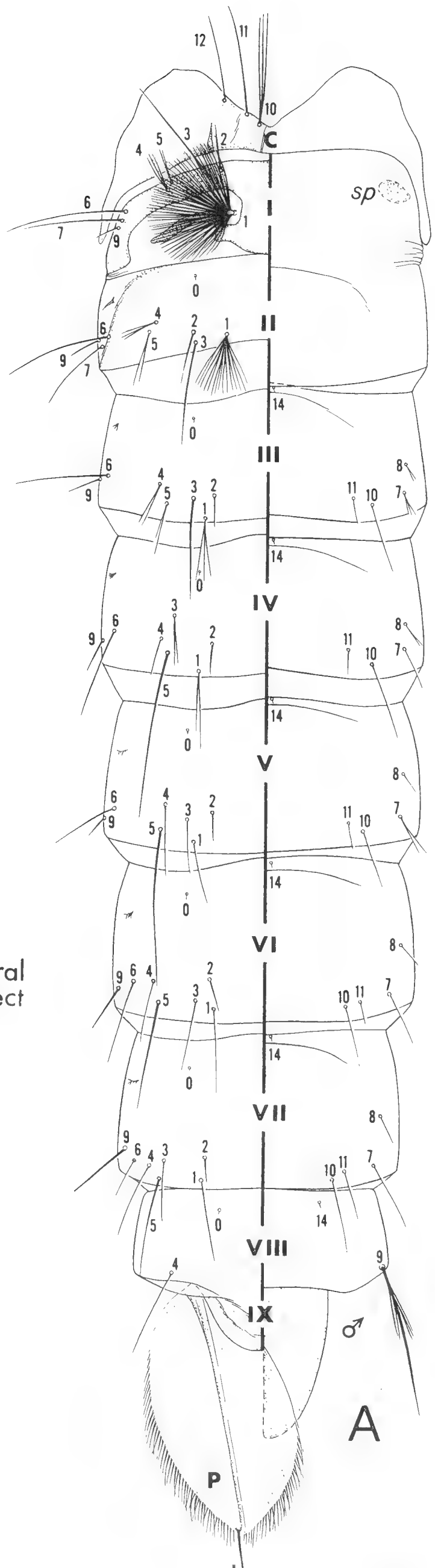
Aedes (Stegomyia) unilineatus (Theobald)

Vichai Malikul

Fig. 27



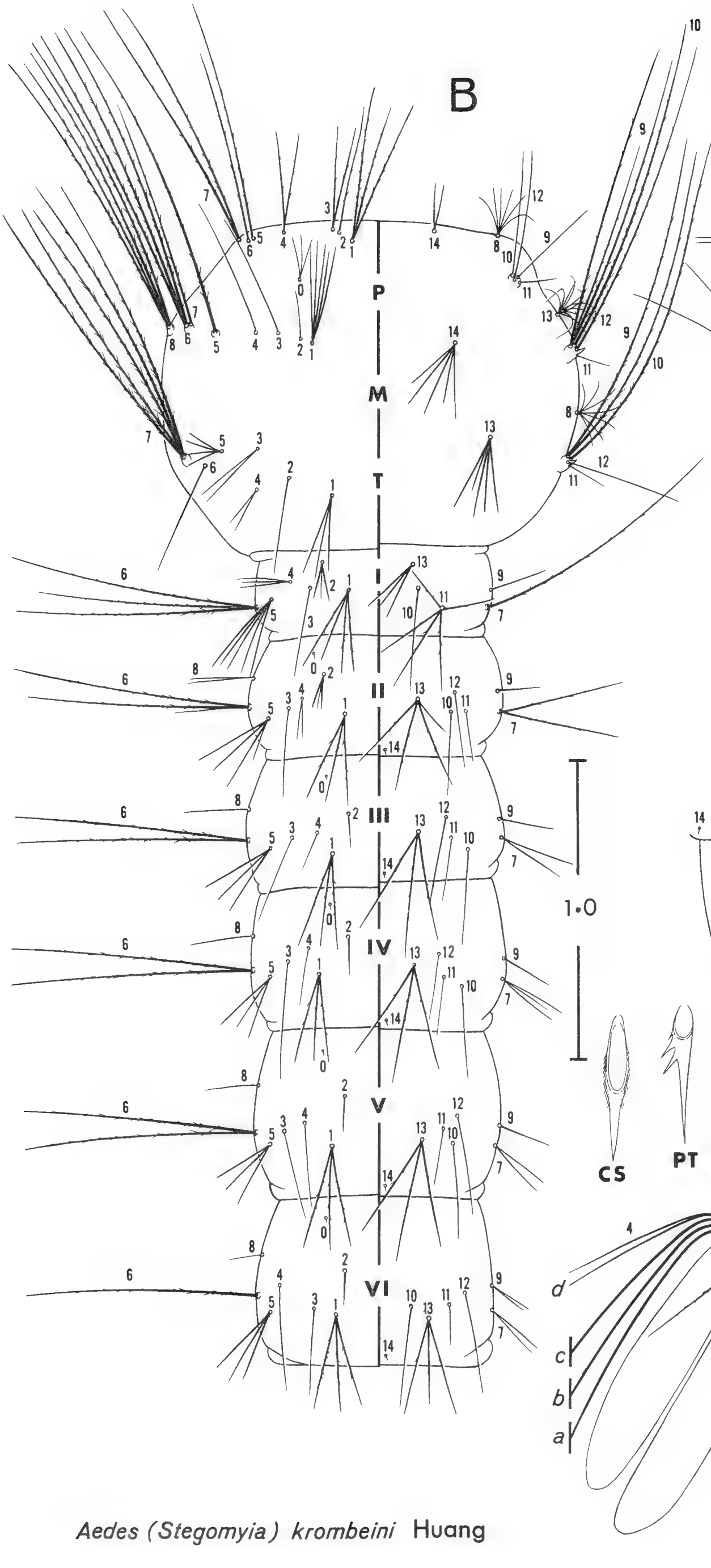


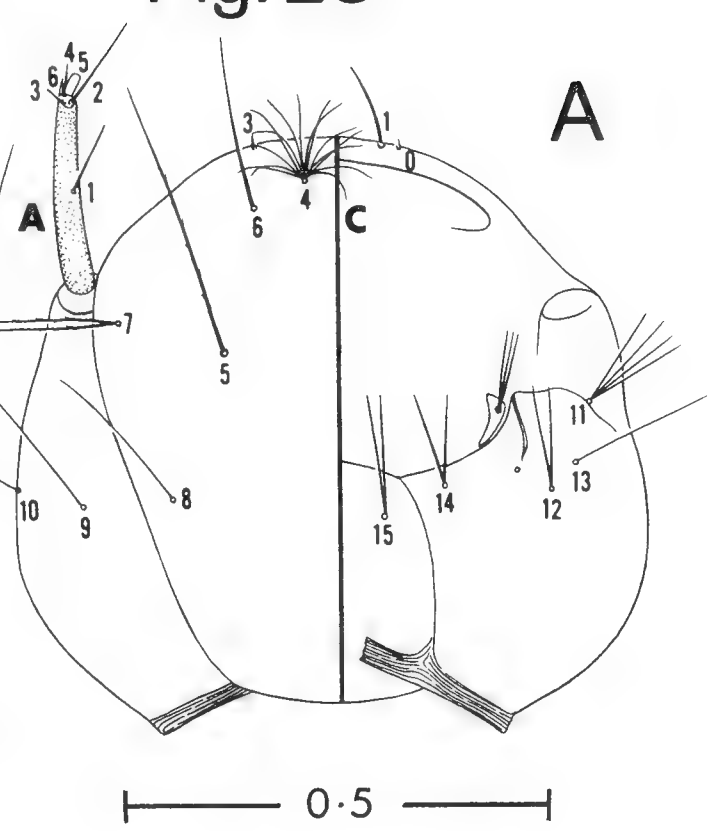


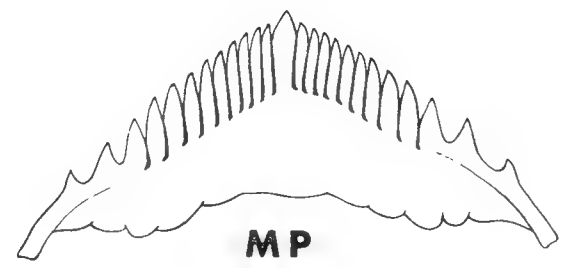
Aedes (Stegomyia) krombeini Huang

Sichai Malikul

Fig. 28







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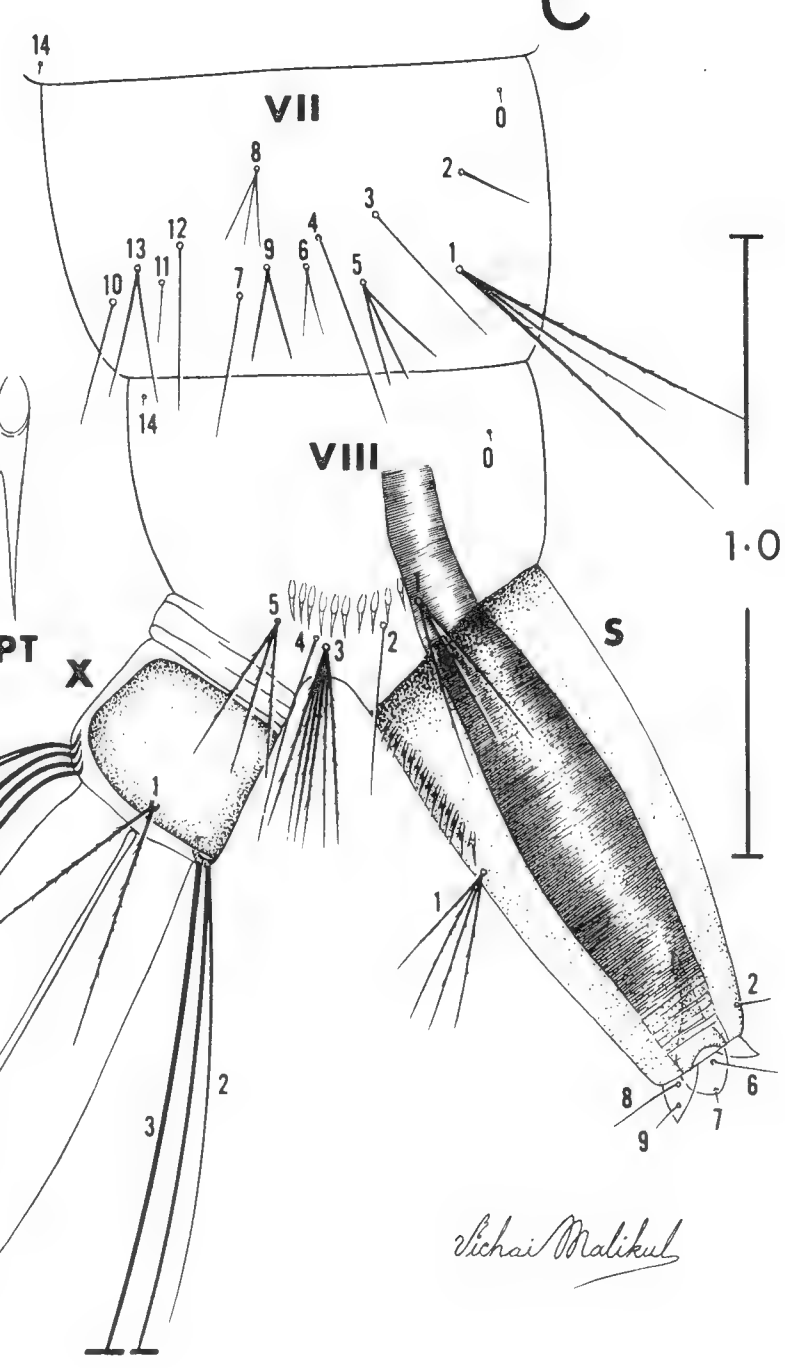
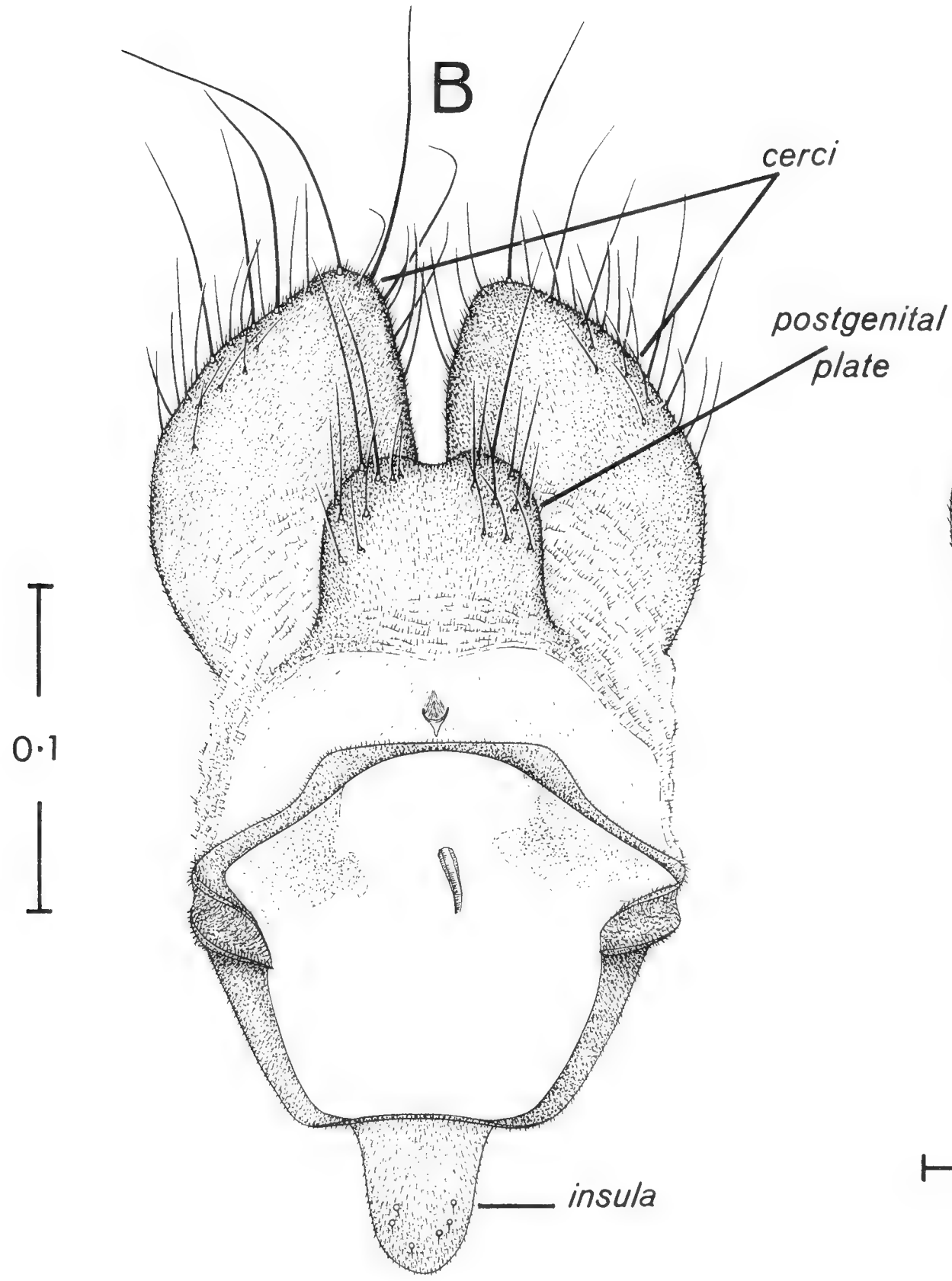
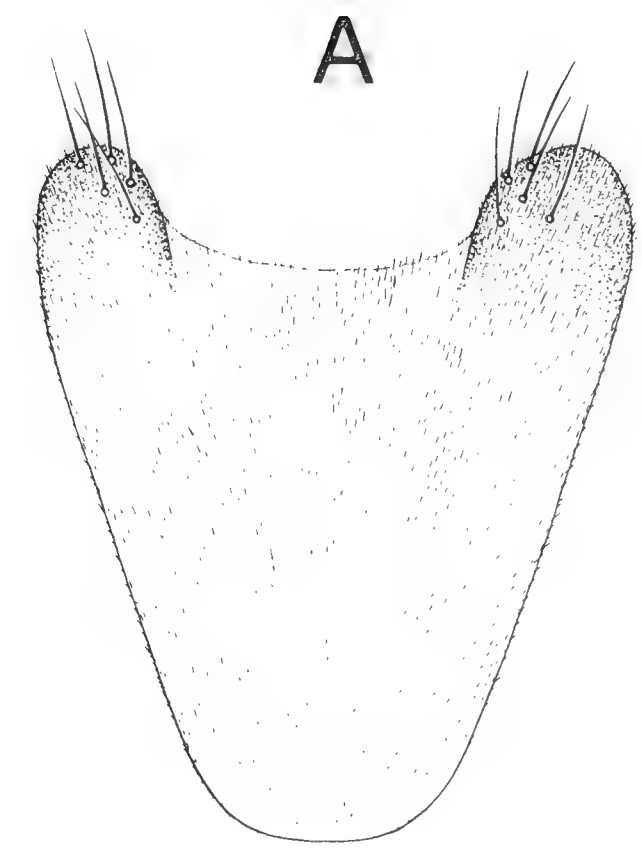


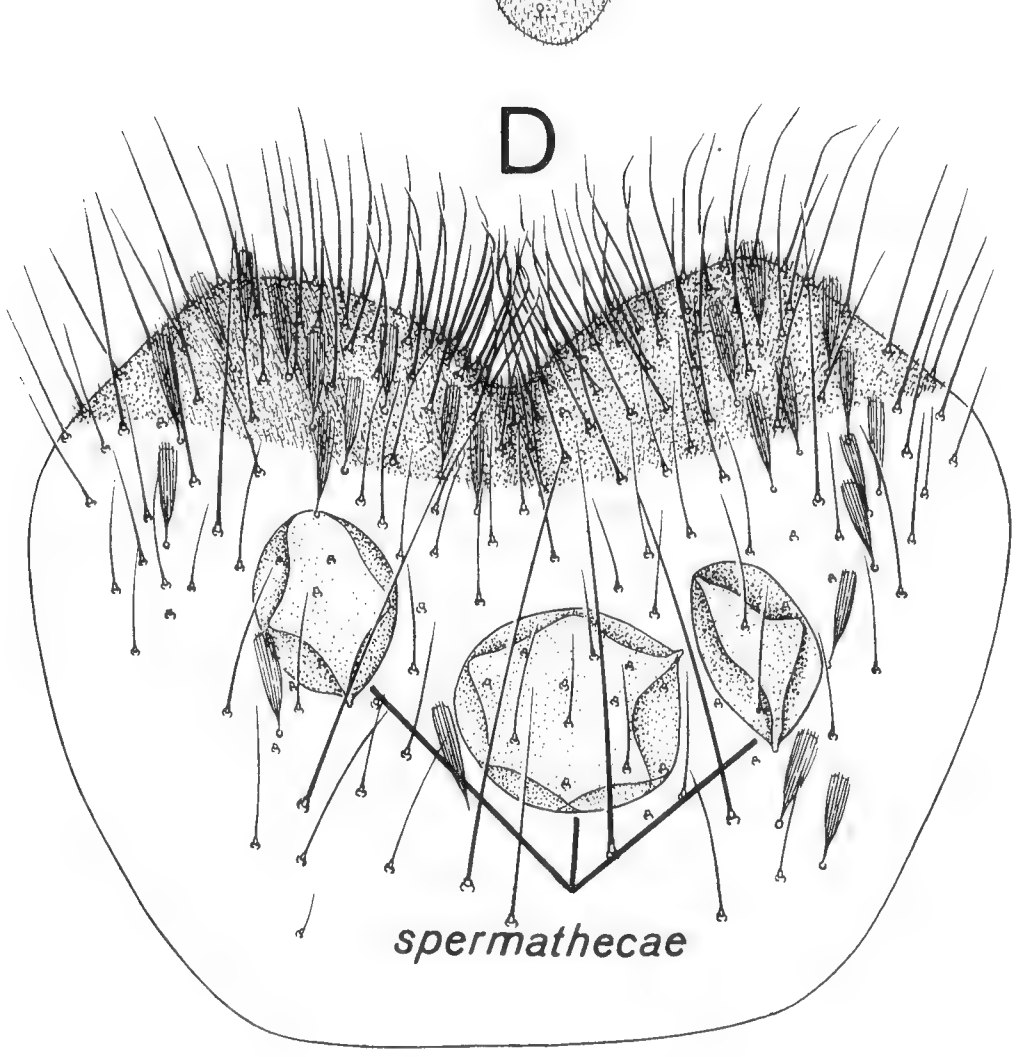
Vichai Malikul

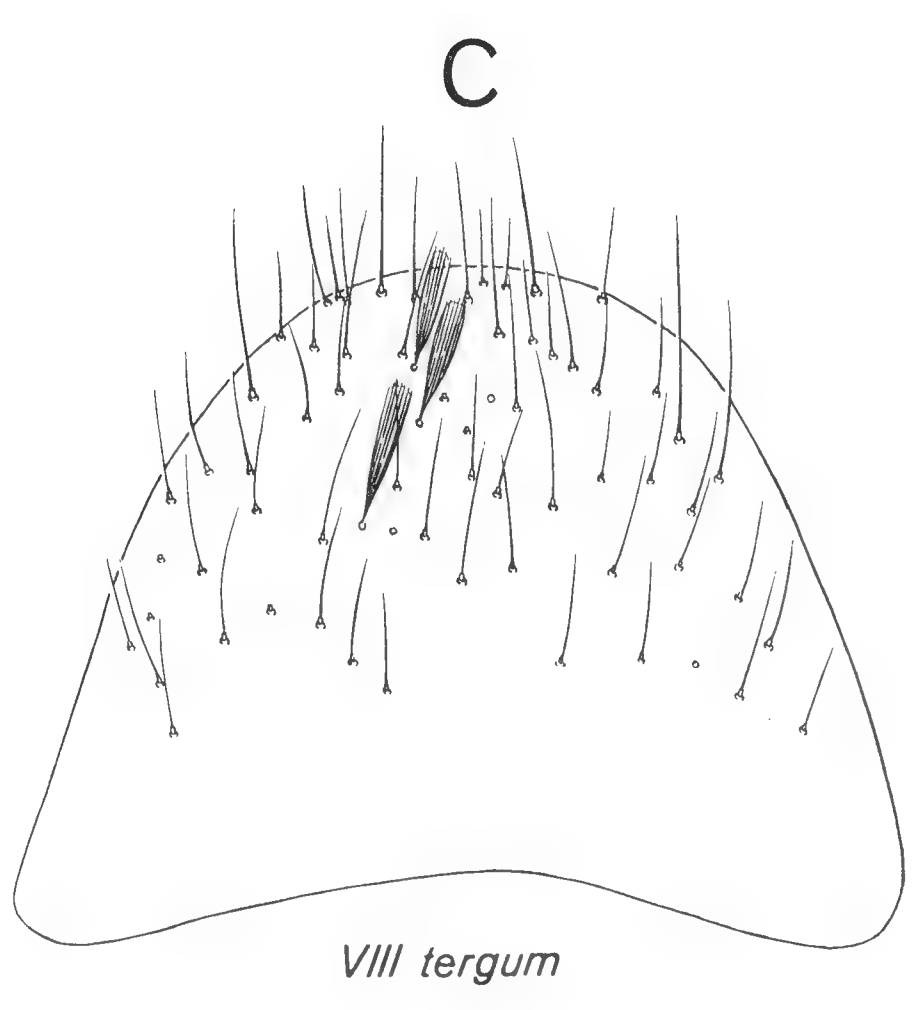
Aedes (Stegomyia) krombeini Huang

Fig. 29





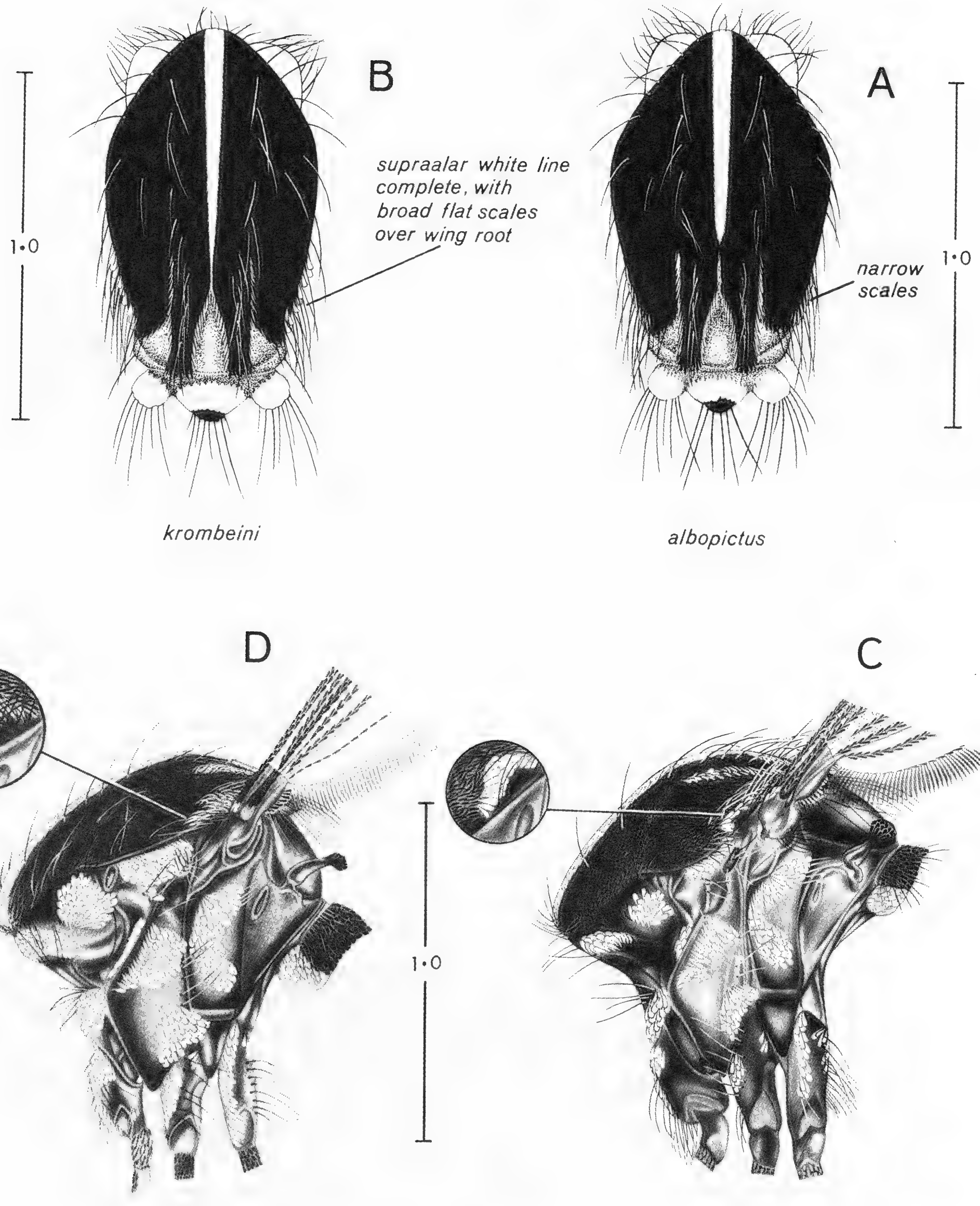




Richai Malikul

Aedes (Stegomyia) krombeini Huang

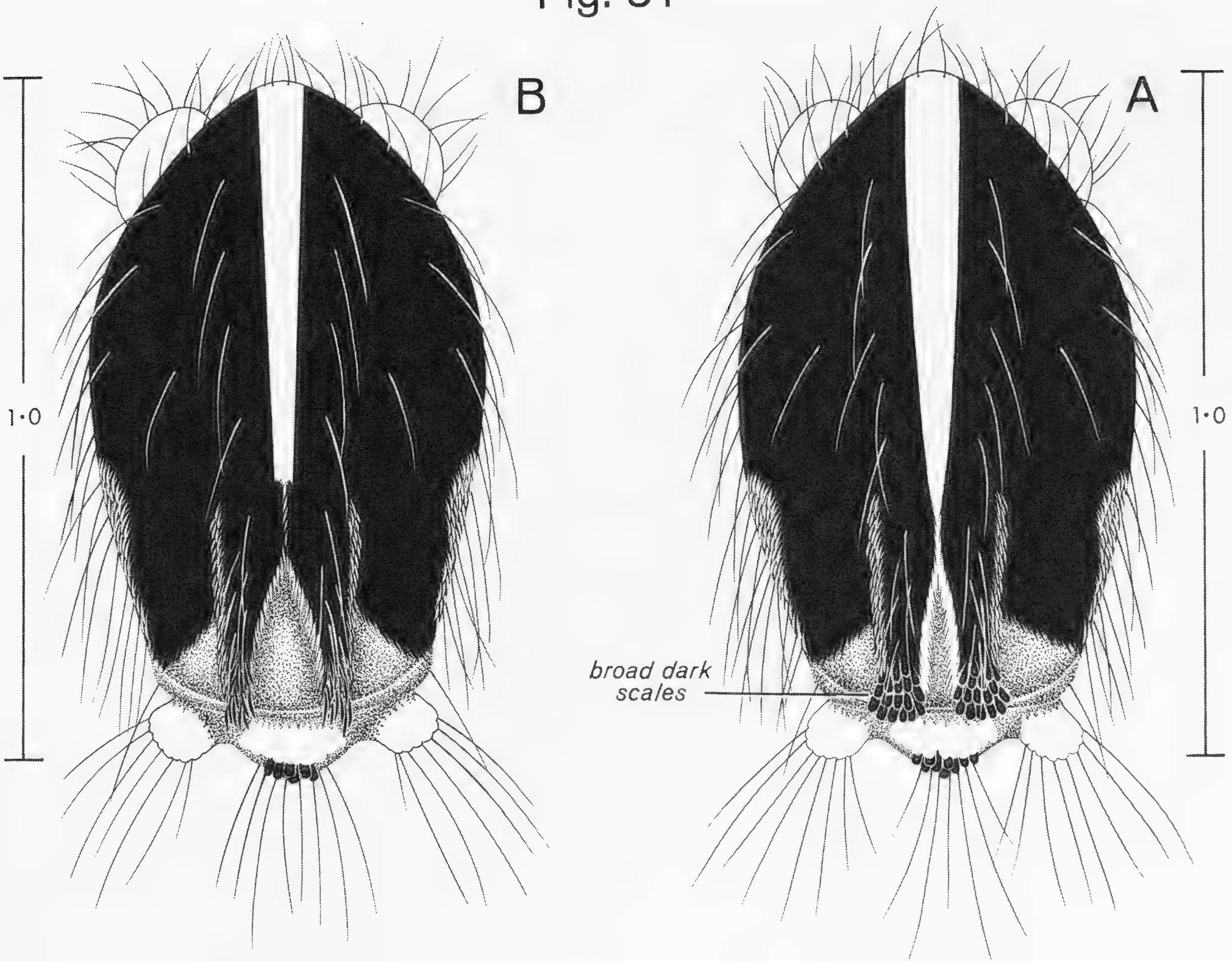
Fig. 30



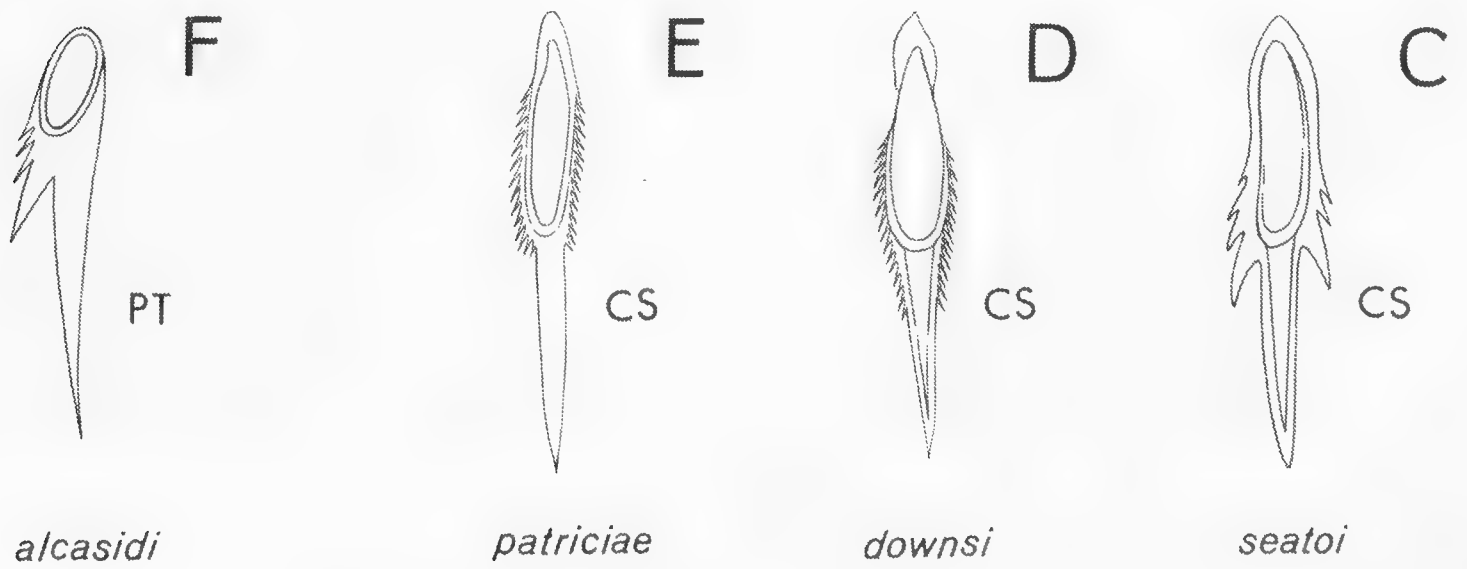
Pichai Malikul

Fig. 31

subalbopictus



pseudalbopictus



alcasidi *patriciae* *downsi* *seatoi*

Sichai Malikul

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Names of valid taxa are set in roman type; synonyms are in italicized type. Italicized numerals refer to the principal text references. Roman numerals refer to secondary text references; the suffix "k" indicates mention in a key and the suffix "t" indicates mention in a table. Roman numerals in parentheses without a suffix refer to the figures.

Contributions
of the
American Entomological Institute

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MOSQUITO STUDIES (Diptera, Culicidae) XXXIV.

A revision of the Albimanus Section of the subgenus Nyssorhynchus of Anopheles

By

Michael E. Faran

CONTENTS

MOSQUITO STUDIES (Diptera, Culicidae)

XXXIV. A REVISION OF THE ALBIMANUS SECTION OF THE SUBGENUS *NYSSORHYNCHUS* OF *ANOPHELES*[1]

By

Michael E. Faran[2]

INTRODUCTION

Zavortink (1973:4), when he was reviewing the subgenus *Kerteszia* of *Anopheles*, stated, ". . . the systematics of *Nyssorhynchus* are too poorly known and hopelessly confused." In 1942, L. E. Rozeboom (1942b) used only one couplet in a key to the adult females for 9 different species in the Albimanus Section. The reason for this, as the pioneering work of W. H. W. Komp (1942:25-26) and Rozeboom recognized, is that many of the characters that have been used to distinguish the adult females in the Albimanus Section are extremely variable and unreliable for species identification. On the basis of one character alone it is often impossible to identify with any confidence an adult female as belonging to a particular species in this section, which includes several important vectors of malaria. The purpose of this revision is (1) to describe and illustrate, in detail, all the currently known species in the Albimanus Section, (2) to reconcile some of the systematic problems that have resulted in this aura of confusion and (3) to develop effective keys that use more than one character, when possible, for all stages of the life cycle for the species in this section.

I am subdividing the subgenus *Nyssorhynchus* into 2 sections, the Albimanus Section and the Argyritarsis Section. These sections are very closely allied and form a tight, well-defined unit. The entire subgenus is restricted to the Neotropics except for *albimanus* which extends into the Nearctic. The Albimanus Section is distinguished from the Argyritarsis Section in the adults primarily by the basal dark band on hindtarsal segment 5, and in the male genitalia by the variously developed fused ventral claspette. Only on the basis of these 2 characters can these sections be readily differentiated. The *Myzorhynchella* group has been excluded from consideration because of the paucity of material available for study and because of its uncertain taxonomic position.

In the present revision 14 species are recognized in the Albimanus Section. The nominal species *sanctielii* is not included because of the lack of material. *An. gorgasi*

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[1] This research was supported by the Medical Entomology Project, Smithsonian Institution, U. S. Army Medical Research and Development Command Research Contract DAMD-17-74C-4086; the Mosquitoes of Middle America project, University of California, Los Angeles, supported by U. S. Army Medical Research and Development Command Research Contract DA-49-193-MD-2478 and U. S. Public Health Service Research Grant AI-04379; and U. S. Public Health Service Predoctoral Trainee Grant 5T01 AI00070-14.

[2] Captain, Medical Service Corps, U. S. Army, Department of Entomology, Walter Reed Army Institute of Research, Washington, DC 20012.

is removed from synonymy with *albimanus* and relegated to status of a *nomen dubium* as is *evansi* which was formerly considered to be the senior synonym of *strodei.* The synonymy of *metcalfi* is changed from *oswaldoi* to that of *noroestensis. An. triannulatus* is treated as a single, although variable, form, *not* as being composed of 2 separate subspecies, *t. triannulatus* and *t. davisi* (or *t. bachmanni*).

An attempt has been made to assemble the species into distinct monophyletic groups on the basis of correlated characters in the adults and immatures. The character state, ancestral or derived, of the taxonomically important features has been determined whenever possible and evolutionary trends stated in formulating the phylogenetic relationships within the section. I am dividing the section into 2 groups, the monotypic Albimanus Group and the Oswaldoi Group. *An. albimanus* is the least derived species in the section, possessing several ancestral features which it shares with some of the ancestral species in the Argyritarsis Section. *An. albimanus* is easily differentiated from the Oswaldoi Group by several correlated unique features in the adult, male genitalia and larva.

I am separating the Oswaldoi Group into 2 subgroups, the monotypic Triannulatus Subgroup and the Oswaldoi Subgroup composed of 12 species, further separated into the Oswaldoi Complex and the Strodei Complex.

The Oswaldoi Complex consists of 9 species. Within the complex, 2 separate phyletic lines are discernible on the basis of the structure of the ventral claspette of the male genitalia. One line is composed of *oswaldoi, galvaoi, noroestensis, aquasalis, ininii* and possibly the relict *anomalophyllus,* and the other by *rangeli, trinkae* and *nuneztovari.*

The Strodei Complex contains *strodei, rondoni* and *benarrochi. An. strodei* and *rondoni* are very closely related, but their relationship to *benarrochi* is difficult to determine as *benarrochi* is the most derived species in the section. *An. benarrochi* has been placed in the Strodei Complex only because of the similarity of its male genitalia with those of *strodei* and *rondoni.*

The larvae and pupae of the Albimanus Section occur primarily in ground water habitats. All the species breed in fresh water, except for *aquasalis* and often *albimanus* which are often found in brackish water. The females feed predominantly on large mammals. The adults are active either crepuscularly or nocturnally; *triannulatus* is the only species reported to bite occasionally during the day.

Two species, *albimanus* and *aquasalis,* are major vectors of malaria in Central and South America and the islands of the Caribbean. *An. nuneztovari* is the primary vector of malaria in western Venezuela and northern Colombia and possibly a vector in Suriname. *An. triannulatus, strodei* and *norestensis* have been implicated in the transmission of malaria, since they have been found naturally infected. *An. rangeli* has been suspected of transmitting malaria in Ecuador. Two viruses, Venezuelan Encephalitis virus and Tlacotalpan virus, have been isolated from *aquasalis* and *albimanus* respectively. Nothing is known about the medical importance of the remaining species.

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MATERIAL AND METHODS

MATERIALS. This taxonomic revision is based on a study of 14,792 specimens: 2816 males, 774 male genitalia, 6078 females, 2088 pupae and 3036 larvae, including 1682 individual rearings (755 larval, 741 pupal, 186 incomplete) and 30 progeny rearings. Individually reared specimens were available for 11 of the 14 species (all but *benarrochi, galvaoi* and *rondoni*); progeny rearings were available for 5 species (*benarrochi, oswaldoi, rangeli, triannulatus* and *trinkae*). Except for *galvaoi* and *rondoni*, larvae and pupae of all species were available for study. For 2 of the medically more important species (*albimanus* and *aquasalis*), abundant individually reared material from almost their entire geographic range was examined, permitting the analysis of intra- and interpopulational variation(s) within these 2 species.

The majority of the material for the present study was collected (or otherwise acquired) by the project "Mosquitoes of Middle America" (MOMA); this material has recently been transferred from the University of California at Los Angeles to the "Medical Entomology Project" (MEP) at the U. S. National Museum of Natural History [USNM]. In the Distribution section for each species, the specimens listed are all deposited at the USNM, unless otherwise noted by the presence of the abbreviation for the depository in brackets. In order to conserve space, specimens from the MOMA collection for which collection data have been published are listed only by code and collection number under the correct locality (example: "Humazones, HON 59"). All other specimens are listed individually by number and type, along with locality, date and collector. Most collection localities are not given in detail, but only by the nearest town. The number and types of specimens are summarized and listed directly after the country or major political division. The collection records of the

"Mosquitoes of Middle America" project have been published in the following series of papers: Belkin, Heinemann and Page 1970; Belkin and Heinemann 1973, 1975a, 1975b, 1976a, 1976b, 1976c; Heinemann and Belkin 1977a, 1977b, 1977c, 1978a, 1978b, 1978c, 1979. These papers should be consulted for complete data for the following codes: ANT, BAH, BH, BRA, BRB, CAY, COL, COM, CR, CUB, DOM, ECU, FWI, FWIM, FG, FGC, GG, GR, GRR, GUA, GUY, HAC, HAR, HAT, HON, JA, LAR, LU, MAR, MEX, MNT, MX, NI, NIC, NVS, PA, PER, PR, PRA, PRX, RDO, SAL, SUR, VI, VZ.

The only other major sources of material were the USNM and the School of Public Health, Johns Hopkins University. Additional individually reared material collected by John F. Reinert and Donald R. Roberts from Para, Brazil has been particularly important in this study since it included the only specimens of *ininii*. Other sources of material include collections by A. Gabaldon, P. Cova Garvia, J. B. Kitzmiller, R. F. Darsie, Jr., R. S. Panday, W. H. W. Komp, F. M. Root and L. E. Rozeboom. Material was also borrowed from Paul H. Arnaud, California Academy of Sciences, San Francisco [CAS]; A. Ralph Barr, University of California, Los Angeles [UCLA]; Margaret Thayer, Museum of Comparative Zoology, Harvard University, Cambridge [MCZ]; Henry S. Dybas, Field Museum of Natural History, Chicago [FMNH]; Peter F. Mattingly and Graham B. White, British Museum (Natural History), London [BM]; L. L. Pechuman, Cornell University, Ithaca [CU]; Selwyn S. Roback, Academy of Natural Sciences, Philadelphia [ANS]; Milan Trpis, Johns Hopkins University, Baltimore [JH]; and Pedro W. Wygodzinsky, American Museum of Natural History, New York [AMNH]. Recently, valuable material was collected and field observations made by John N. Belkin, J. Hal Arnell, Thomas E. Rogers, Kenneth J. Linthicum and myself in the state of Sao Paulo, Brazil, January to March 1975, and by John N. Belkin, George K. Bryce and myself in the state of Rio de Janeiro, December 1975 to March 1976; the data for these collections are given in Heinemann and Belkin 1979. I have examined the types of *davisi, anomalophyllus, emilianus, dunhami, galvaoi* (paratype), *goeldii, gorgasi, metcalfi* and *strodei* [USNM]. J. N. Belkin has examined the types of *galvaoi, noroestensis, rondoni, cuyabensis, albimanus* and *albipes.*

TAXONOMIC PROCEDURES. The methods and techniques utilized in this study are essentially those of comparative morphological taxonomy as described by Belkin, Schick, Galindo and Aitken (1965:10; 1967:10-11). An attempt has been made to assemble the species described here into separate monophyletic taxa. In almost all cases this was done on the basis of the correlation of several derived features in the larva, adult and male genitalia. The determination of the character states, derived (apomorph) or ancestral (plesiomorph), was accomplished using the methods previously described and discussed by Mayr (1969:181-257) and Hennig (1966). Bionomics and distributional data also were employed as taxonomic characters in an attempt to explore evolutionary trends within the section.

DESCRIPTIONS. The terminology, abbreviations and form of presentation are essentially those of Belkin (1962) with the modifications of Belkin (1968a:49). The descriptions are all composites based on as many specimens as were available. In most cases the chaetotaxy of the immatures was based on at least 10 individuals, unless otherwise stated, and is listed as 2 sets of figures for all the setae that are considered to be taxonomically important. The first set of numbers after the hair is the modal condition, representing the frequency of at least 75% of the observations. The set of numbers following the modal condition is the entire range of all observations. A few special terms are used for the wing spots and the male genitalia. These terms are discussed in the chapter on Taxonomic Characters. Most measurements were

made from slides with the aid of a calibrated ocular micrometer in the eyepiece of a compound microscope, except for a few of the adults in which measurements were made in a similar fashion with a stereoscopic dissecting microscope. Intra- and interpopulational variations and any anomalous forms are analyzed in the Discussion sections.

SYSTEMATICS. The taxonomic history, when pertinent, and systematics are discussed for each species. This includes affinities, evolutionary trends, possible centers of origin, intrapopulational and geographical variations, and any other information relevant to the systematics of the species. In the discussions under the groups, subgroups and complexes particular attention has been given to the interrelationships of the species within each taxon and the taxon's relationships with other related taxa.

BIONOMICS. Much of the information regarding the bionomics of the species for which there was adequate material collected by the project "Mosquitoes of Middle America" was extracted from the field collection data forms on file at UCLA. Most of this data has since been published in the "Collection records of the project 'Mosquitoes of Middle America' " series (see p 4). The data from the collection forms are combined with information condensed from the literature about the natural history of each species.

MEDICAL IMPORTANCE. A brief summary of the medical importance of each species is included following the bionomics. This section is only a summary and does not in any way attempt to be an inclusive discussion of the literature on this subject. It pertains primarily to malaria and what is known concerning the vector capacity of each species.

DISTRIBUTION. The known distribution is given for each species followed by a list of the material examined (see p 3-4). In the "Table of Distributions," under each species for the different countries, a solid circle is used to indicate that a specimen (or specimens) of that species was examined from that locality. A starred circle indicates a distribution record taken from what is believed to be a reliable reference. The distribution for each species is outlined in figures 1-3. On the figures, a solid line broken by a dotted line implies uncertainty regarding the distribution of that particular species within the area bordered by the dotted line.

TAXONOMIC HISTORY

Several good reviews have been published on the taxonomic history of the Albimanus Section, previously referred to as "Tarsimaculatus Series," "Tarsimaculatus Complex," "Albimanus Series" or "Albimanus Group" (Root 1926b; Lima 1928; Gabaldon 1940; Rozeboom and Gabaldon 1941; Komp 1941b; Galvao and Lane 1938; Galvao 1940, 1943; Floch and Abonnenc 1943a; Causey, Deane and Deane 1945; Bejarano 1957). For this reason I will only briefly summarize the history of this group, indicating some of the major taxonomic problems which have led to considerable confusion. Most of the problems relating to a particular species will be dealt with in the Discussion section for the species concerned. The single most perplexing problem in the past regarding the species in the Albimanus Section has resulted from the use of the name "*tarsimaculatus*." This one taxonomically invalid name has hindered the understanding of this group of mosquitoes more than any other factor. The taxonomic history of the Albimanus Section is, in many ways, the history of "*tarsimaculatus*."

The oldest species in the subgenus *Nyssorhynchus* is *albimanus*, which was describ-

ed by C. R. W. Wiedemann in 1820. A few years later, J. B. Robineau-Desvoidy (1827) described *argyritarsis*, the first species now recognized in the other major section of *Nyssorhynchus* bearing its name. Theobald (1901) described *albipes* as a variety of *argyrotarsis* [*sic*] which, he stated, differed from *argyrotarsis* only by the presence of a black basal band on the last hindtarsal segment. The type locality was not specified. Theobald (1903:110-113) raised *albipes* to specific rank, placing it in his new genus *Cellia*, which included New World as well as Old World species of *Anopheles*. Shortly afterward, Goeldi (1905), after studying material in Para, Brazil, proposed the name *tarsimaculata* as an emendation for Theobald's *albipes* in order to avoid confusion with the name *albitarsis*. Coquillett (1906:8, 13) synonymized *albipes* with *albimanus*. Dyar and Knab (1906b:160-161) also correctly synonymized *albipes* with *albimanus* and recognized that *tarsimaculatus* was proposed as a substitute for *albipes*. However, they mistakenly concluded that since the material Goeldi examined was not *albimanus* or *argyritarsis*, Goeldi's name *tarsimaculata* was available for the specimens they had examined from Sao Paulo and Manaus, Brazil, and Trinidad. In 1907, Dyar and Knab described a new species, *gorgasi*, based on a badly damaged, mutant specimen collected by A. H. Jennings on the Pacific side of the Panama Canal Zone. The same year Theobald (1907:106-109) synonymized *cubensis* Agramonte 1900, *albipes* and *tarsimaculata* with *albimana*. Theobald (1910:69) in a footnote stated, "All the long series [of *tarsimaculatus*] sent me by Professor Goeldi from Para are the same as those received from many other places, and are undoubtedly *albimana*." Knab (1913), like Theobald, synonymized *albipes* and *cubensis* with *albimanus*; however, he synonymized *gorgasi* with *tarsimaculata*. In their fourth volume of "The mosquitoes of North and Central America and the West Indies," Howard, Dyar and Knab (1917:975-979) interpreted *tarsimaculata* as being a valid species even though they realized Goeldi had not proposed a new species and stated, "There is therefore no original description, but the species is figured and with a discussion the new name is published. We have therefore felt justified in recognizing Goeldi's name as the first valid name for the species before us." They also recognized 2 other species in *Nyssorhynchus, albimanus* and *argyritarsis*.

Subsequently, after Howard, Dyar and Knab accepted *tarsimaculatus* as being valid, almost all the species in the Albimanus Section have at some time been designated as *tarsimaculatus* or as synonyms of *tarsimaculatus*. Root (1924b:460-462) studied the male genitalia of "*oswaldoi*," *tarsimaculata* and *albimanus*. He stated that *tarsimaculata* is easily distinguished from *albimanus*; however, he could not find any genitalic differences between *tarsimaculata* and *oswaldoi*, so he "relegated" the name *oswaldoi* as a synonym of *tarsimaculata*. Root (1926b) described *strodei* and listed *albimanus, tarsimaculatus, bachmanni,* and tentatively *rondoni, triannulatus* and *cuyabensis*, plus a number of other species in the Argyritarsis Section, in the subgenus *Nyssorhynchus*. Concerning *tarsimaculatus,* Root stated that the range of variation in the black area on the second hindtarsal segment is continuous, ranging from 8 to 35%, and the larvae, pupae and male genitalia of the *Cellia oswaldoi* type of the Brazilians, "seem to be quite identical with those of normal *tarsimaculatus*." Therefore he saw no reason for retaining the name *oswaldoi*.

Christophers (1924:38-41) recognized *albimanus* and 5 different varieties of the species *tarsimaculatus* which included *oswaldoi, rondoni, cuyabensis, triannulatus* and a Bonne variety from Surinam (Bonne 1923, and Bonne and Bonne-Wepster 1925, recognized 2 types of *tarsimaculatus,* one on the coast and one in the interior). Dyar (1928:434-446) in his monograph "The Mosquitoes of the Americas," as did Root, considered *oswaldoi* a synonym of *tarsimaculatus*, listing 15 "species" in *Nys-*

sorhynchus of which 7, *albimanus, bachmanni, rondoni, cuyabensis, triannulatus, evansi* and *tarsimaculatus*, are now included in the Albimanus Section. Later Curry (1932) described 2 more varieties of *tarsimaculatus*, var. *aquasalis* and var. *aquacaelestis.* Curry recognized, however, that his *aquacaelestis* could be synonymous with *oswaldoi* or possibly a valid species, and not merely a variety of *tarsimaculatus.*

To unnecessarily complicate matters, Townsend (1933a:102) stated that the *tarsimaculata* of Howard, Dyar and Knab 1917 was not the *tarsimaculata* of Goeldi 1905, and proposed *gorgasi* as an available name for the former species. In another paper Townsend (1933b) stated, "It seems strange that the name *tarsimaculatus* was ever adopted from Goeldi by Howard, Dyar and Knab." Unfortunately, as Komp (1941b: 793) stated, "He [Townsend] plunged the subject into confusion by making several unwarrantable assumptions." Townsend believed that *albitarsis* and *albimanus* (the *tarsimaculatus* that Townsend thought Goeldi examined) were both present in Belem during the time Goeldi collected there, and later these 2 species were replaced by *gorgasi* of Townsend and *An. (Nys.) darlingi* Root 1926. Townsend called specimens he collected at Rio Tapajos, Boa Vista, Para, Brazil *gorgasi*. Some of this latter material was identified as *goeldii* by Rozeboom and Gabaldon (1941:97). When Komp (1941b) examined mounts of the male genitalia from Boa Vista labelled by Townsend *tarsimaculatus* Goeldi, he discovered some of them to be *triannulatus*.

In 1937 Galvao and Lane revalidated *oswaldoi* and stated that *tarsimaculatus* of Root 1926 is really a variety of *oswaldoi* which they called *oswaldoi* var. *metcalfi. An. metcalfi* was based principally on a description of an egg by Root (1926b:700). Galvao and Lane, at a meeting of the Sociedade de Biologia de Sao Paulo, 15 September 1937, described the varieties *metcalfi* and *noroestensis*, but their published descriptions did not appear until later (Galvao and Lane 1938:169-178). At this meeting they also stated that they recognized *tarsimaculatus* Goeldi 1905 as being valid because of Article 21 of the International Code of Zoological Nomenclature which stated, "The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description." So by 1937, Galvao and Lane recognized *tarsimaculatus* separately from *oswaldoi,* the latter composed of 3 varieties, *oswaldoi, metcalfi* and *noroestensis.* Lane (1939:27-29), in his "Catalogo das mosquitos neotropicos," listed *gorgasi, evansi, aquasalis* and *aquacaelestis* as synonyms of *tarsimaculatus*.

Three years later Rozeboom and Gabaldon (1941:96) stated, ". . . we do not see how Article 21 applies to this [*tarsimaculatus*] case. Goeldi did not realize that he was dealing with a new species, as he proposed '*tarsimaculata*' simply because *albipes* has the same meaning that *albitarsis* has and might lead to confusion. Therefore, Goeldi proposed his name illegally, for Article 32 of the International Rules states, 'A generic or specific name, once published, cannot be rejected, even by its author, because of inappropriateness.' " Komp (1941b:793) was in agreement with the latter authors and proposed a new species, *emilianus* from Belem, Para, in order to "obviate further difficulties in the nomenclature of the species in this group. . . ." *An. emilianus* was supposedly the species Goeldi worked with in 1905. One year later, Galvao and Damasceno (1942), for exactly the same reasons as given by Komp, synonymized *emilianus* with *tarsimaculatus.* Since then *tarsimaculatus* (=*aquasalis*) has continued to be used as recently as 1958 (Rachou 1958; Andrade 1958a, b) and possibly even more recently in Brazil.

Regarding the higher classification of the group, Theobald described the genus *La-*

verania in 1902 with the type *argyrotarsis* [*sic*]. At the time Theobald (1902) described *Laverania* he also described the genus *Cellia*, with *pharoensis* as type species. *Cellia* included also *pulcherrimus, squamosus* and *bigotii*. The same year Blanchard (1902) proposed *Nyssorhynchus* as a replacement for *Laverania* Theobald 1902, because the name was preoccupied by *Laverania* Grassi and Feletti 1890. In 1903, in Volume 3 of his "Monograph of the Culicidae of the World," Theobald catalogued the species *argyrotarsis* and *albipes* in *Cellia*, even though he synonymized *Laverania* with *Nyssorhynchus*. By 1910, in Volume 5, Theobald included *argyrotarsis* and *albimana* of *Nyssorhynchus* in the genus *Cellia*, along with several Old World species. Unfortunately Theobald based his classification on the adult scalation patterns. Knab (1913:34), criticizing the classification of *Anopheles,* wrote, ". . . the subject [*Anopheles*] was made needlessly difficult by hasty work and by the sub-division of the old genus *Anopheles* into numerous ill-defined and fancifully differentiated genera."

Christophers (1915) studied the male genitalia of *Anopheles* and stated that although he was not at that time concerned with nomenclature, generic subdivision of anophelines would include the following 3 amended genera, *Anopheles, Myzomyia* and *Nyssorhynchus*. Root (1923:266) agreed in general with Christophers' classification but considered *Nyssorhynchus* to be of subgeneric rank. Lima (1928) followed Christophers' interpretation, but divided the genus *Nyssorhynchus* into 2 subgenera, *Nyssorhynchus* and *Kerteszia*; he further subdivided the subgenus *Nyssorhynchus* into 2 groups, Group A (in part Argyritarsis Section) and Group B which included 11 "species" now in the Albimanus Section. Edwards (1932:43-46) separated the subgenus *Nyssorhynchus* into 3 groups, Group A being *Nyssorhynchus* excluding *Myzorhynchella*, which was divided into 3 series, Argyritarsis, Tarsimaculatus and Rondoni. The Tarsimaculatus series included species with a basal dark band on the second and fifth hindtarsal segments, hindtarsal segments 3 and 4 being entirely white. The Rondoni series comprised those species which had dark bands on hindtarsal segments 3 and 4 in addition to hindtarsal segments 2 and 5.

It was not until 1940 that Gabaldon divided the Tarsimaculatus series of Edwards, which he called the Albimanus Series, into 3 subseries based on the presence or absence of setae on the ventral claspette of the male genitalia. These subseries were the monotypic Albimanus Subseries, the Triannulatus Subseries (*triannulatus* and *strodei*) and the Oswaldoi Subseries (*oswaldoi, aquasalis, anomalophyllus* and *nuneztovari*). By 1952 (Gabaldon and Cova Garcia 1952:178), *benarrochi* and *rondoni* had been added to the Triannulatus Subseries, and *galvaoi, ininii, konderi, noroestensis, rangeli* and *sanctielii* had been placed in the Oswaldoi Subseries.

In another interpretation of the phylogenetic relationships within the subgenus, Galvao (1943:141-142) divided *Nyssorhynchus* into 2 series, the Argyritarsis Series and the Tarsimaculatus Series corresponding to Lima's Groups A and B respectively. He further separated the Tarsimaculatus Series into a monotypic group, *albimanus*, and 3 complexes: the *tarsimaculatus* Complex (*tarsimaculatus, oswaldoi, aquasalis, anomalophyllus, noroestensis, rangeli* and *nuneztovari*), the *rondoni* Complex (*rondoni* and *strodei* including subspecies *albertoi, arthuri, artigasi* and *lloydi*) and the *triannulatus* Complex (*triannulatus triannulatus, t. davisi, t. chagasi* and *benarrochi*).

In 1949 Levi-Castillo divided the subgenus *Nyssorhynchus* into the Albimanus Group and the Argyritarsis Group. The Albimanus Group was divided into 3 series, Albimanus, Oswaldoi and Triannulatus which corresponded to the subseries of Gabaldon. However, in addition to *strodei, triannulatus, rondoni* and *benarrochi,* Levi-Castillo also included *galvaoi* and *nuneztovari* in the Triannulatus Series. Until the

present revision no other major changes have been made in the higher classification of the Albimanus Section.

TAXONOMIC CHARACTERS

I have attempted, whenever possible, to determine the character state, whether ancestral (plesiomorph *sensu* Hennig 1966) or derived (apomorph *sensu* Hennig 1966), of the taxonomically important characters, in order to facilitate the hypothesis of the probable phylogenetic relationships among the species within the Albimanus Section (fig. 4). In some cases it has been very difficult to ascertain the character state of certain features because of the tremendous number of similarities among the species resulting from convergent and parallel evolution, and/or secondary loss of morphological traits.

When possible, I have stated evolutionary trends which may have taken place within the section, regarding individual characters in the adult, male genitalia, pupa and larva. In developing and interpreting the proposed phylogeny of the Albimanus Section I have relied on the correlation of as many derived characters as possible in all the life stages. Ancestral characters, along with certain derived features, were important in determining the phylogenetic relationships of the 2 more ancestral monotypic taxa, the Albimanus Group and the Triannulatus Subgroup.

The most reliable characters for species identification are in the male genitalia and the larva. The external morphology of the adult and pupa, particularly in the case of the Oswaldoi Subgroup, is very similar interspecifically, and usually quite variable intraspecifically. For this reason, the keys for the adults and pupae are not always entirely reliable when used by themselves. It is *highly* recommended that one refer to the species descriptions and discussions when attempting to identify any species in this subgroup, and that one correlate those data with the information given on the bionomics and distribution. As has been emphasized by Belkin (1962), it is best to examine more than one specimen. And to be certain of an identification, the immatures should be individually reared and slides prepared of their exuviae and of the genitalia of the corresponding males to permit the correlation of characters in the different life stages. Where morphologically similar species occur sympatrically it is doubly important to use more than one developmental stage. Lastly, it must be emphasized that not all the populations from every locality where each species exists were examined. Thus, the range of variation reported is conservative, may not be inclusive and may be exceeded in some individuals. Also, as indicated by Arnell (1973: 5), the illustrations of the larvae and pupae show only the modal condition of the setal branching and cannot represent the range of variation which occurs in a species.

ADULTS

The important characters for differentiating the females are seen in the (1) penultimate segment [4] of the palpus, (2) presence or absence of scales on the mesepimeron, (3) banding pattern of the legs, (4) relative length of wingspots and (5) dark caudolateral scale tufts of the abdomen.

HEAD. The only character which varies appreciably among the species is the light color of the scales vesting the penultimate segment of the palpus and, to a much lesser extent, the erect scales on the vertex. The trend in the scale pattern of the fourth palpal segment appears to be a shift from predominantly dark in the ancestral condition to mostly light in the derived. In the Albimanus Group palpal segment 4 is dark

or almost completely dark; whereas, throughout the Oswaldoi Subgroup this segment is conspicuously light, at least mediolaterally. The Triannulatus Subgroup has an appreciable amount of light scaling on palpal segment 4 but generally less than in the Oswaldoi Subgroup.

THORAX. Very few differences are found in the thorax. Primitively, there was probably an upper mesepimeral patch of light scales which has been lost in all species except *rangeli*, and occasionally *trinkae* and *noroestensis*. The premise of the antiquity of these scales is based on an out-group comparison, the fact that several species in the Argyritarsis Section also possess upper mesepimeral scales. *An. triannulatus* is distinguished by the key feature, a patch of light scales on the anterior mesepimeron, rather than on the upper mesepimeron. This character is present only in one other species in *Nyssorhynchus, darlingi* of the Argyritarsis Section.

LEGS. The hindtarsus was consistently studied in the past with little regard for the banding patterns of the fore- and midtarsus. In the fore- and midtarsus, as in the hindtarsus, there seems to have been a trend toward the development of a larger and more extensive light apical band. In *albimanus* foretarsal segments 4 and 5 are almost completely dark. In *triannulatus* foretarsal segment 5 is all dark, but foretarsal segment 4 has a large apical light band. Throughout the Oswaldoi Subgroup the apical light band varies in size, but is usually present on foretarsal segments 1, 2, 3 and 5, with segment 4 being largely dark. The extreme condition in seen in *ininii* where all the foretarsal segments are largely light, with dark scales occasionally present only as a narrow dorsobasal stripe. The midtarsal segments are usually similarly banded; however, the light apical band is much less conspicuous, smaller and usually cream or golden, rarely white. There is no apical light band on midtarsal segments 3 or 4 in *albimanus*. Midtarsal segment 4 of the Oswaldoi Subgroup is usually all dark or with a rather inconspicuous apical light band, except in *ininii* where a distinct apical light band is present. Primitively the second hindtarsal segment probably possessed a large basal dark band, 0.5 or more the length of the segment. In all taxa above the species level, there is at least one species that retains this character. There has been an independent reduction in the size of the dark basal band in the Oswaldoi and Strodei Complexes, the band being smallest in *oswaldoi* and *ininii*. In other species, such as *rondoni* and *aquasalis*, the large dark basal band of hindtarsal segment 2 may be independently derived.

WING. The terminology used for the wing spots is modified from Zavortink (1973: fig. 5). The trend has been for the reduction in size of the dark spots along the costal vein and corresponding spots on the more posterior veins. The basal dark spot of the costal vein is moderately large in *albimanus* and large in *triannulatus*. In the Oswaldoi Subgroup it is small, usually less than the length of the humeral light spot, except in *nuneztovari* and some *trinkae*, where it is large and may be independently derived. In general the wings are very similar throughout the Oswaldoi Subgroup except for *rangeli* and *rondoni*. In *rangeli* there has been a very definite increase in the size of the light spots of veins C, R, Rs, R_1, R_2 and R_{4+5}. In *rondoni* the opposite has occurred and the dark spots are much more extensive. The subbasal, presectoral and sectoral dark spots on vein C usually are fused into a very long, single dark spot. Correspondingly, the dark spots on the posterior veins are in general very large. The preapical dark spot of vein M in *rondoni* extends unbroken onto vein M_{1+2}.

ABDOMEN. I believe that the dark caudolateral scale tufts were primitively present on segments II-VII. In *albimanus* the scale tufts are absent on II.

MALE GENITALIA. The male genitalia offer the best and most easily identifiable

group characters. In the Albimanus Section, the male genitalia are complex and highly derived with respect to other anopheline groups. The terms dorsal and ventral in this study refer to the orientation of structures of the male genitalia prior to rotation, that is, the morphological tergal and sternal surfaces respectively.

The subgenus *Nyssorhynchus* is characterized by the fusion of the ventral claspettes to form a single median structure, and by the single parabasal spine on the sidepiece. The male genitalia of the Albimanus Section have been studied extensively by previous workers and have been regarded as being of primary importance in species identification. Characters and structures seldom examined in the past are sternite IX, the relative length of the parabasal spines, the setal pattern of the sidepiece, and features of the dorsal claspette. There are no good group characters on segment VIII.

Sternite IX. In ventral aspect, the sternite appears short and subrectangular in the Albimanus Group and moderately long to long and subtrapezoidal to subtriangular in the Oswaldoi Group. Along the anterior margin there is an apodeme (anterior apodeme) which is very short and inconspicuous in the Albimanus Group and moderately narrow and subrectangular, to broad and subtriangular in the Oswaldoi Group.

Sidepiece. There is a trend for a relative shortening of the parabasal spine in several species within the Oswaldoi Complex. The parabasal spine and tubercle are, in general, longer in *albimanus, triannulatus* and the Strodei Complex, and shorter in the Oswaldoi Complex.

Dorsal Claspette. Although not important as a section feature, the morphology of the dorsal claspette may aid in identification of species within the section and should be used in correlation with other characters of specific value.

Ventral Claspette. The fused ventral claspette best delimits the taxa within the section and has been used most often to divide the section into different groups (Gabaldon 1940; Galvao 1943; Levi-Castillo 1949). The various components of the ventral claspette, the (1) basal lobules, (2) preapical plate (Gabaldon 1940), (3) refringent structure (Gabaldon 1940), (4) mesal cleft, (5) membranous area and (6) median sulcus, are illustrated in figure 10. The trend has been for the acquisition of setae on the ventral claspette; this appears to have occurred in a more or less stepwise fashion. The ancestral condition is represented in *albimanus, triannulatus* and all members of the Argyritarsis Section, by the complete absence of setae. In the Strodei Complex setae are present; however, they do not extend to the apex. The most derived condition is represented by the species comprising the Oswaldoi Complex (except *ininii*) in which setae are continuous on the lateral and ventral surfaces, extending to or nearly to the apex. The preapical plate has also tended to increase in size from an inconspicuous spot in the Albimanus Group to a very large, heavily sclerotized plate in some species in the Oswaldoi Complex.

Phallosome. Primitively the phallosome in the Albimanus Section probably had a pair of large, serrated leaflets as seen in several species in the Argyritarsis Section. These leaflets have been lost except in *anomalophyllus*, a relict species in the Oswaldoi Complex. Remnants of the leaflets are still present in many of the species in the latter complex as unserrated, membranous, basolateral expansions at the apex of the aedeagus. Whenever width of aedeagus is used, this refers to width of aedeagus at base of apex (subapex where lateral sclerotizations extend ventromedially to form an incomplete tube, fig. 10). Length of apex of aedeagus refers to distance from subapical, collarlike, subtriangular, lateral sclerotizations to apex of aedeagus (fig. 10).

PUPAE

As in several other groups of mosquitoes, the pupae in the Albimanus Section are remarkably similar. They exhibit few features that vary consistently throughout the group, and are of phylogenetic importance only when correlated with the significant group characters in the other life stages. For this reason I have not included them in the descriptions of the groups, subgroups and complexes except for the monotypic taxa. The only group trends that are apparent occur in the trumpet and "caudolateral spines" (hair 9-II-VIII). In the ancestral condition of the trumpet, the pinna is long, usually greater than 3.0 length of the meatus. The pinna is proportionately long in *triannulatus, benarrochi, strodei, rangeli, trinkae* and *ininii*. The pinna is highly derived and shortest in 2 species in the Oswaldoi Complex, *oswaldoi* and *nuneztovari*. Likewise, hairs 9-II-VIII are shorter in the more derived state. Hairs 9-VII,VIII are 0.5 or less the length of the corresponding abdominal segment in *oswaldoi, anomalophyllus, benarrochi, noroestensis* and *nuneztovari*; in the other species, these hairs are at least 0.5 the length of the segment. There is also a correlation between the short pinna and the short caudolateral spines in *oswaldoi* and *nuneztovari.* The shape of the pinna is described in lateral aspect (as in figs. 8, 25) from dissected pupal exuviae mounted on microscope slides (Belkin 1962:77). In living specimens when the trumpet is open at the water surface, the margins of the meatal cleft are widely separated. This separation is much wider apically in some species than in others; the wider this opening is, the narrower the sides of the pinna appear to be, so that in lateral view on a microscope slide the pinna may appear to be tapered toward the apex.

CHAETOTAXY. The chaetotaxy is of little phylogenetic value, but is important for species differentiation. On the cephalothorax, the relative lengths of the individual branches of hair 7-C are significant, since in many species one branch is considerably longer than the other(s). The relative lengths of hairs 10-12-C are also of specific value. In most species 10-C is subequal to 11-C, whereas in *triannulatus* 10-C is much shorter than 11-C. On the abdomen, the length of hair 2-I, the number and the point of origin of branches, correlated with the relative length of hair 3-I, are important distinguishing characters in some species. The relative lengths of hairs 6,7,9-I and 6,7-II are good secondary key characters. Also the derived feature, insertion of hair 3-II very near the caudal margin of the segment adjacent to hair 1-II, is diagnostic for *benarrochi.*

PADDLE. The shape of the paddle and/or the relative length of the buttress do not show any phyletic relationships. The length of hairs 1,2-P and the distance the marginal fringe of spicules extends along the inner margin of the paddle are secondary diagnostic characters in some species.

TERMINAL SEGMENTS. The male genital lobe and its apical mammilliform protuberance are more strongly developed in some species, but show no phylogenetic relationships.

FOURTH INSTAR LARVAE

Many characters in the larvae of the Albimanus Section correlate with characters in the adult and the male genitalia to clearly define the separate taxa. The chaetotaxy is very important for species identification; therefore I have included in the species descriptions the mode (at least 75% of the observations) and range for all the setae of taxonomic significance. It is important to consider the amount of intraspecific variation in larval "hairiness" when examining any of the species in the section.

HEAD. In the ancestral condition, the clypeal hairs (2,3-C) are widely spaced, with short to minute barbs, occasionally appearing as simple spiniform hairs (hair 3-C in this condition is shorter than 2-C). In the derived state the inner clypeals (2-C) may be (1) closely approximated, (2) of subequal length and/or (3) with long, simple or dendritic branches. The relationship between the approximation of the inner clypeal hairs (2-C) and the outer clypeal hairs (3-C) is given by the **clypeal index**, which is the distance between the inner and outer clypeals on one side divided by the distance separating the inner clypeals. *An. anomalophyllus* in the Oswaldoi Complex, and *strodei* and reportedly *rondoni* in the Strodei Complex, are characterized by approximated inner clypeals. This character has supposedly evolved independently in the 2 complexes. In the Oswaldoi Subgroup, for some species, the trend has been toward more extensive branching of the clypeal hairs along with longer branches, so that either or both the inner and outer clypeals may be plumose. The most derived condition is found in *oswaldoi*, where the clypeal branching is often dendritic. Hair 4-C is long in the Albimanus Group and short throughout the Oswaldoi Group except in *nuneztovari* and *trinkae*, where it is strongly developed. Hairs 8,9-C do not show any phylogenetic relationships; however, they are important to characterize species, being strongly developed in some species and more weakly developed in others. The collar tends to be wider, dorsomedially, in the more derived species than in the more ancestral, and is of group importance, although this character is highly variable.

ANTENNA. Hair 1-A in the ancestral condition is small; it is large and independently derived in *benarrochi* and *ininii*.

THORAX. Primitively, hair 1-P was plumose and multibranched; this condition is found only in the monotypic Albimanus Group. The trend has been toward the development of palmate hairs with fewer, broader, lanceolate leaflets. Hair 1-P in *triannulatus* may represent the intermediate condition with numerous, weakly lanceolate branches. The branching of hair 2-P and the presence or absence of a common sclerotized tubercle for hairs 1,2-P or 1-3-P show some group relationships. However, these characters are unreliable because of considerable intraspecific variation. The length of the dorsoventrally flattened shaft, and the number and length of the branches of hair 14-P are characteristic, to some extent, of *triannulatus* and some species in the Oswaldoi Group.

ABDOMEN. Derived group characters include the following: (1) small, usually numerously branched hair 13-I-IV in Oswaldoi Subgroup, with *triannulatus* somewhat intermediate between Albimanus Group and Oswaldoi Subgroup and (2) large, 5-7 branched hair 11-I in *triannulatus*. Important characters for species identification within the Oswaldoi Group include (1) location and size of hair 5-I,II, (2) size and branching of hairs 0-II and 13-IV and (3) width of palmate hair 1-II-VII.

SPIRACULAR LOBE. In the ancestral condition the lateral arms of the spiracular apparatus were moderately short. There has been an independent increase in the size of the arms in the Triannulatus Subgroup and to a lesser degree in *ininii* of the Oswaldoi Subgroup. The dentition of the pecten, although not of group importance, is of value as a secondary key character in species diagnosis within the Oswaldoi Group.

ANAL SEGMENT. In the Section there appears to be a trend in the migration of the point of insertion of hair 1-X from a dorsal position, within the saddle, to a position on or near the ventral margin of the saddle. In the most derived case (*oswaldoi*), hair 1-X is not inserted on the saddle at all, but ventrad of it. Hair 1-X is moderately long to long in all species except *benarrochi*. The anal gills are short in *aquasalis* and sometimes in *albimanus*; in all other species they are moderately long to very long.

SYSTEMATICS

The nominal species *sanctielii* Senevet and Abonnenc 1938 is not included in this revision because of the lack of material.

I no longer consider the nominal species *gorgasi* as a synonym of *albimanus* but as a *nomen dubium*. After examination of the damaged adult female holotype of *gorgasi*, collected by A. H. Jennings at La Boca, Panama Canal Zone, I have concluded that this specimen is probably not a mutant of *albimanus*. Contrary to the condition in *albimanus*, this specimen possesses dark caudolateral scale tufts on abdominal segments II-VII, and the penultimate segment of the palpus appears to have been white. It lacks upper mesepimeral scales and is too large to be considered *triannulatus*. Hindtarsal segment 2 of this female is brown in about 0.5, and segment 3 has a brown spot slightly less than half the length of the segment. This anomalous specimen most likely belongs to either *strodei, oswaldoi* or *aquasalis*. Previous workers (Rozeboom 1941; Curry 1932) have rejected *aquasalis* since it is very rarely ever collected on the Pacific side of Panama, even though it is probably the most likely candidate based on morphological characters. In any case, *gorgasi* is not easily recognizable as any species, since mutations of the sort found in *gorgasi* are now known to occur in many different species in this section.

I am dividing the Albimanus Section, composed of those species in the subgenus *Nyssorhynchus* characterized by the presence of a basal dark band on hindtarsal segment 5, into 2 clearly defined groups: a monotypic Albimanus Group and the Oswaldoi Group consisting of 13 species. The 2 groups are easily separated on the basis of 9 correlated characters in the adults, male genitalia and larvae. *An. albimanus* is the least derived species in the Albimanus Section and retains many ancestral characters that it shares with several species in the Argyritarsis Section. The **Albimanus Group** is characterized, primarily, in the **female** by (1) dark palpal segment 4, (2) absence of dark caudolateral scale tufts on the second abdominal segment and (3) predominantly dark foretarsal segment 5; in the **male genitalia** by (1) short sternite IX, (2) ventral claspette completely without setae and with the ventral surface produced into 2 large, inflated, ovoid, bulbous lobes and (3) very small circular to oval, weakly sclerotized preapical plate; and in the **larva** by (1) hair 1-P plumose with filiform branches, (2) hair 9-P,T pectinate and (3) hair 13-I,III, IV moderately large, with few branches. Most of these characters that distinguish the Albimanus Group from the Oswaldoi Group are ancestral, and are found nowhere else in the section. Exceptions are the 2 derived features, the short ninth sternite in the male genitalia and the pectinate hair 9-P,T in the larva.

I believe that the evolutionary lineage which has resulted in *albimanus* separated from the main phyletic line of the Albimanus Section very early in the evolution of the section. *An. albimanus* retains many characters shared by relict species in the Argyritarsis Section, which indicates that it diverged from the *Nyssorhynchus* phylogenetic tree soon after the separation of the 2 sections, Albimanus and Argyritarsis. It is even possible that the Albimanus Section is of polyphyletic origin, although not very probable for the reasons enumerated below. The principal character, the dark basal band on hindtarsal segment 5, separating the Albimanus Section from the Argyritarsis Section, is extremely stable throughtout the Albimanus Section. K. L. Linthicum (personal communication; who is presently revising the Argyritarsis Section) states that he has never observed any specimen in the Argyritarsis Section with a dark band present on hindtarsal segment 5. Conversely, I have never observed a speci-

men in the Albimanus Section with the dark fifth hindtarsal band completely absent, although it is sometimes considerably reduced. Parallel evolution and the very close phylogenetic relationship of the Albimanus and Argyritarsis Sections may help to explain the absence of other consistent characters distinguishing the 2 taxa. For example, in both sections there has been a tendency for some members to independently lose the apical leaflets on the phallosome of the male genitalia and for the larval hair 1-P,I to become palmate. The divergence within the subgenus *Nyssorhynchus* is probably of very recent origin.

The **Oswaldoi Group** is characterized in the **female** by (1) palpal segment 4 light, (2) presence of dark caudolateral scale tufts on abdominal segment II and (3) foretarsal segment 5 usually about 0.5 to completely light (except in *triannulatus* and some *strodei*); in the **male genitalia** by (1) moderately long to long, subtriangular to subtrapezoidal sternite IX, (2) presence of setae on the ventral claspette or, if bare, apex expanded laterally into large auriculate lobe and (3) absence of bare, ventral, inflated, ovoid lobes on the ventral claspette; and in the **larva** by (1) hair 1-P palmate, (2) hair 9-P,T long and single and (3) hair 13-I,III,IV small to moderate or, if large, hair 11-I large and 5-7 branched.

I am dividing the Oswaldoi Group into 2 subgroups: the monotypic **Triannulatus Subgroup** and the Oswaldoi Subgroup. I have separated *triannulatus* from *strodei* and *rondoni*, as did Galvao (1943), since it differs from all species in the Oswaldoi Subgroup by several correlated characters in all stages except the pupa. The **adults** of *triannulatus* are unique in possessing a patch of white scales on the anterior mesepimeron. Several reliable characters in the **larva**, particularly the length of the lateral arms of the spiracular apparatus and the development of hairs 1,14-P, 11-I, 13-I,III, IV, clearly separate *triannulatus* from the Oswaldoi Subgroup. The ventral claspette of the **male genitalia** of *triannulatus* lacks setae, as in *albimanus*, and the apex is expanded laterally into a pair of large auriculate lobes. The reason for including *triannulatus* in the Oswaldoi Group is on the basis of (1) presence of caudolateral tufts on the second segment of the abdomen in the adult, (2) more or less lightly colored palpal segment 4 in the female, (3) hair 1-P palmate in the larva, (4) the intermediate character of hair 13-IV in the larva and (5) overall general similarity of the male genitalia, particularly with the Strodei Complex.

The **Oswaldoi Subgroup** is characterized in the **female** by (1) predominantly white palpal segment 4, (2) absence of anterior mesepimeral scales, (3) absence of a large, apical, white band on foretarsal segment 4, except for some *nuneztovari, trinkae* and *ininii* and (4) foretarsal segment 5 about 0.5 to completely light, except in some *strodei*; in the **male genitalia** by the presence of setae at least on the basal lobules of the ventral claspette; and in the **larva** by (1) palmate hair 1-P usually with fewer than 16 leaflets, (2) 14-P with a short to moderately short shaft, (3) 11-I moderately large, 2-4 branched, (4) 13-I small to moderately large, usually more than 3 branched, (5) 13-III small, with numerous branches and (6) lateral arms of the spiracular apparatus short to moderately long, except in *ininii.*

The Oswaldoi Subgroup is an assemblage of closely related species, which I believe is composed of 2 major phyletic lines: the **Strodei Complex** and the Oswaldoi Complex. As indicated above, on the basis of the **male genitalia**, the Strodei Complex is more closely allied to the Triannulatus Subgroup than is the Oswaldoi Complex. The apex of the ventral claspette is expanded laterally, and the sidepiece possesses a long parabasal spine and tubercle as in *triannulatus*. Setae are present on the ventral claspette but do not extend to the apex. Within the Strodei Complex, 2 of the species, *rondoni* and *strodei*, are very closely related and represent one clearly defined line;

benarrochi, a highly derived species, represents the other. *An. rondoni* appears to be a very recent species that may have evolved from an isolated gravid female or an anomalous population of *strodei*, later becoming reproductively isolated. The relationship of *benarrochi* to *strodei* is more difficult to understand, since *benarrochi* is the most highly derived species in the Oswaldoi Subgroup, possessing several unique characters; only on the basis of the male genitalia is it possible to see its relationship with *rondoni* and *strodei*.

The **Oswaldoi Complex** is characterized in the **male genitalia** by (1) setae on the lateral margins of the ventral claspette extending to or nearly to the apex (except in *ininii*), (2) apex of the ventral claspette not expanded into a pair of lateral lobes and (3) usually moderately short parabasal spine and tubercle. The Oswaldoi Complex is composed, I believe, of 2 separate monophyletic lines in addition to one relict species, *anomalophyllus*. *An. nuneztovari, trinkae* and *rangeli* compose one phyletic line, and *oswaldoi, galvaoi, aquasalis, noroestensis* and *ininii* form the other clearly defined line, as based on the male genitalia, larvae and adults. Within each phyletic line of the Oswaldoi Complex the male genitalia are clearly distinct. Also, in the *oswaldoi* phyletic line, there is a tendency in the larvae for the acquisition of long branches on the clypeal hairs as observed in *oswaldoi* and *aquasalis*. The relationship of *anomalophyllus* to the rest of the species in the complex is unclear. *An. anomalophyllus* retains a pair of strongly developed serrated leaflets at the apex of the aedeagus. Also, it shares with the Strodei Complex several larval characters such as the closely approximated inner clypeals. It may possibly be that *anomalophyllus* represents an annectent species between the Oswaldoi Complex and Strodei Complex. Within the complex several other species, *nuneztovari, rangeli, ininii* and (rarely) *oswaldoi*, often have remnants of aedeagal leaflets evident as very small, membranous, pointed projections.

BIONOMICS

The immature stages of the Albimanus Section are found predominantly in ground water. They occur in a variety of habitats, such as ponds, lakes, stream and river margins, canals, seepage and drainage areas, ditches, flooded meadows or pastures, reservoirs, swamps, ground pools, borrow pits, and animal and vehicle tracks. *An. albimanus*, although usually collected from ground pools of various sorts and stream margins, has been found also in crab holes, tree holes, large artificial containers and brackish swamps. *An. aquasalis* is the only species primarily restricted to the coast and preferentially occurs in brackish water such as in mangrove swamps and coastal ground pools. However, *aquasalis* is capable of breeding in fresh water, and often is collected several kilometers from the coast. *An. anomalophyllus* may be restricted to stream margins in Costa Rica and northern Panama. *An. triannulatus* and *ininii* are found commonly in lakes, ponds or large ground pools. *An. triannulatus* is the only species clearly shown to be often closely associated with a specific plant; it is usually collected in or between the rosette crowns of *Pistia* sp. Some species are fairly habitat specific. *An. oswaldoi, ininii* and *triannulatus* adults are usually collected in the interior of forests, although the larvae may be collected from ground pools in interspersed secondary growth areas. *An. noroestensis* is usually collected in drier regions than the forest species, in cultivated areas or areas of secondary vegetation.

Regarding altitudinal distribution, *strodei* breeds at the highest elevations for any species in the Albimanus Section (1600m), although it also occurs at lower elevations.

An. rangeli, and to a lesser extent *benarrochi*, are principally found at intermediate elevations (200-1000m) such as in the upper Amazon and the llano plateau region of Colombia extending south into Mato Grosso and Bolivia. *An. albimanus* and *aquasalis*, on the other hand, normally breed on or near the coast in wet areas, usually at elevations less than 400m. *An. nuneztovari* is found at low elevations usually in or at the margins of forests. *An. trinkae* breeds in habitats similar to those of *rangeli*, often in areas of secondary growth at intermediate elevations. *An. rondoni* breeds in ditches, puddles, flooded meadows, etc., in southern Brazil and northern Argentina, and is never found farther north than the southern margin of the upper Amazon. *An. ininii* has been collected only in French Guiana and in Para, Brazil in the interior of the forest.

Host preference studies for several species indicate that these mosquitoes feed predominantly on large mammals such as dogs, cats, cattle, pigs, goats, donkeys and man, although some do feed on fowl. In all known cases, the species feed readily on man when given the opportunity; however, *anomalophyllus, ininii, trinkae* and *galvaoi* have not been studied in this respect. The adults are active either crepuscularly or nocturnally, except *triannulatus* which is somewhat diurnal (Rozeboom 1935:527). Most of the species are predominantly exophilic and zoophilic and become a serious health or pest problem only when occurring in high densities without abundant alternate hosts. However, during the peak seasons certain species, such as *albimanus, aquasalis, nuneztovari* and possibly *rondoni* and *strodei*, are commonly found inside houses. Marked capture and release studies indicate that *aquasalis* and *albimanus* are both strong fliers capable of migrating considerable distances. Flight ranges for the remaining species have not been studied in detail.

MEDICAL IMPORTANCE

An. albimanus is the major vector of malaria in coastal Central America and northern South America, extending to the Paria Peninsula in Venezuela and into the Greater Antilles. It does not seem to be predominantly anthropophilic or endophilic, but, because it occurs in such tremendous numbers during certain times of the year, it is the most common anopheline found inside houses feeding on man. *An. albimanus* has been found naturally infected with *Plasmodium* sp in nearly every country in which it is encountered.

An. aquasalis is a primary vector of malaria in the Lesser Antilles, and in Trinidad and Tobago. Along the coast of Brazil, the Guianas and possibly Venezuela, it is always a potential vector but usually only important when it occurs in large numbers. *An. aquasalis* feeds readily on man and is commonly collected in houses. In the past it has been an important vector of malaria in coastal Brazil.

An. nuneztovari is a primary vector of malaria in western Venezuela and northern Colombia, and is a probable vector in Suriname; in some areas where it occurs, spleen indices have been close to 100% (Gabaldon and Guerrero 1959). The vector potential of *nuneztovari* has been reported to depend on the density of the nearby vegetation surrounding regions of habitations, which may be correlated with the greater life expectancy and vector density in the forest (Hamon, Mouchet *et al.* 1970).

An. triannulatus has been implicated as a vector of malaria in Venezuela, and once was found to have a natural oocyst infection (Gabaldon and Cova Garcia 1946b). Several authors have succeeded in experimentally infecting *triannulatus* with *Plasmodium vivax* and *P. falciparum*; however, it is much more refractory to infection than is *albimanus*.

According to Correa (1938), *strodei* transmitted malaria at the Fazenda Santa Alice, Sao Paulo, Brazil. He reported a natural infection rate of 1.2%. Other Brazilian workers have experimentally infected *strodei* with *Plasmodium vivax*, although there have not been any other reports implicating *strodei* as a vector.

Very little is known regarding the vector potential of *rangeli*, *noroestensis, rondoni* and *oswaldoi. An. noroestensis* was found naturally infected once in Ribeira, Sao Paulo, Brazil by Correa and Ramos (1942b:385-386). Lucena (1940b) reported finding *oswaldoi* var. *metcalfi* naturally infected in Pontesinha, Brazil; however, Lucena may have been studing *aquasalis* rather than *noroestensis. An. oswaldoi* has been experimentally infected with *P. vivax* and *P. falciparum* (Fonseca and Fonseca 1942; Rozeboom 1942a). *An. rangeli* has been suspected of transmitting malaria in Ecuador (Forattini 1962), but it has never been shown to be naturally infected. *An. rondoni* was investigated in Jujuy, Argentina during the malaria season by Davis and Shannon (1928), and it was not found to be naturally infected nor was it possible to experimentally infect it with *P. falciparum, P. vivax* or *P. malariae* in 3 different experiments. Nevertheless, Shannon and Del Ponte (1927) stated that Davis was able to infect *rondoni* in other experiments. Nothing is known about the vector potential of *ininii, galvaoi, trinkae* or *anomalophyllus.*

Two viruses have been isolated from 2 species in the Albimanus Section. *An. aquasalis* was found naturally infected with Venezuelan Encephalitis virus (VE) during the 1962-1964 outbreaks in Venezuela (Sellers, Bergold *et al.* 1965). Tlacotalpan virus, in the Bunyamwera group, was isolated from *albimanus* in Tlacotalpan, Mexico (Scherer, Campillo-Sainz *et al.* 1967:79-91).

TAXONOMIC TREATMENT

ALBIMANUS SECTION

FEMALES (fig. 5). Small to large, wing 2.5-4.0 mm. Head, thorax, abdomen and legs predominantly dark scaled with distinct markings of light scales and pruinose integumentary patterns. **Head:** Integument light brown to dark brown, usually somewhat pruinose. Interocular space moderately wide, 2-7 ommatidial diameters. Vertex and occiput with many erect, moderately long to long, cuneate to lanceolate or weakly forked scales, white anteriorly on vertex, becoming progressively darker caudad and laterad on occiput and postgena. Vertex with a few decumbent light scales. Interorbital and upper orbital lines with white decumbent scales. Strong, long, curved, dark orbital setae present. Frontal tuft conspicuous, composed of 10-20 long, slender, white setiform scales. Clypeus prominent, bare, pruinose. Proboscis much longer than forefemur, entirely dark scaled; labella slightly lighter than labium; with 3-6 basal bristles. Palpus subequal in length to proboscis; predominantly dark scaled; appearing weakly metallic when viewed at an angle; with an apical light band on segments 2,3; band on 3 usually broader than that on 2; segment 4 either light or dark scaled, when light scaled, a basal and an apical dark, narrow band present, and occasionally a darker stripe on ventral surface; segment 5 white, occasionally with a small basal dark band; segments 2,3 with varying amounts of dorsal and dorsolateral speckling of light scales; segment 1 less than 0.1 of palpal length; segment 2 about 0.7-0.9 of segment 3; combined length of segments 4 and 5 slightly greater than length of segment 2 and less than that of segment 3; segments 1,2 and basal 0.3-0.5 of 3 with erect scales, progressively less outstanding from base of segment 1 to seg-

ment 3; remainder of palpus with decumbent scales. **Antenna**: 0.60-0.75 length of proboscis. Torus with dorsolateral row of light scales and a few short lateral and ventral setae. Lateral margin of proximal flagellar segments (1-5) with small, light scales; flagellar segment 1 subequal to combined length of segment 2 and 3, with long bristles on all surfaces except midventral, bristles most abundant on dorsolateral surface, and with long, oblanceolate to setiform, white scales on dorsomesal surface and shorter scales basally; segments 2-13 each with basal whorl of 6-10 long, curved bristles and with short, silver setae distally; segment 13 pointed at apex and slightly longer than 2-12. **Thorax**: Scutum small to large, length on midline 0.9-1.4 mm; integument generally pruinose; with 2 pairs of bare, light pruinose, longitudinal stripes, when viewed at an angle from the front as follows: (1) submedian stripe just laterad of acrostichal bristles, extending from scales of anterior promontory to about middle of scutum, becoming much less distinct in posterior half of scutum, (2) broad, subdorsal stripe laterad of posterior dorsocentral and lateral prescutellar bristles extending caudad from a pair of prominent, bare, nonpruinose rectangular or subtriangular areas at caudal margin of posterior fossa, ending at small nonpruinose area anterior to scutellum; acrostichal and posterior dorsocentral lines nonpruinose or distinctly less pruinose than remainder of scutum; fossal region slightly less pruinose than general surface of scutum. Scutum with small, lanceolate to obovate, silver or yellow to white, decumbent scales in (1) acrostichal line, extending from anterior promontory to prescutellar bare space, and anterior and posterior dorsocentral lines, the scales becoming less defined into distinct regions posteriorly, (2) fossal area and (3) supraalar and antealar areas; with elongate, narrow erect, lanceolate scales on median anterior promontory and along lateral margin of antealar area extending posteriorly onto supraalar area; humeral tuft with numerous moderately short to long, light scales above and numerous, short, obovate or cuneate, dark scales below. Scutum with numerous moderately long to long, dark setae on acrostichal line, dorsocentral line, posterior median scutal area and supraalar area; with scattered short, light to dark setae on fossa, antealar area and lateral prescutum. Parascutellum with a single long seta. Prescutellar bare space appearing dark from above, weakly pruinose, triangular or horseshoe shaped. Scutellum rounded, with obovate light scales, very long, dark setae and shorter, light setae along posterior border; posteromedian border usually with a few long, light setiform scales. Postnotum bare. Pleural integument dark, with gray or silver to reddish pruinose pattern. *Apn* reniform, with moderately long setae on dordal surface along ventral margin, and with a dorsal patch of erect, obovate, dark scales, usually with a few light scales; *ppl* with 2,3 (1-4) setae; *sp* with 1-9 short to moderately long setae and a few elongate light scales; *pra* with 4-10 light setae and a patch of elongate light scales; upper *stp* with 2-8 setae and a patch of 4-18 light scales; lower *stp* with 1-3 setae and 2-10 light scales oriented either in a horizontal arc or diagonal patch; upper *mep* with 3-10 setae in horizontal or diagonal row and occasionally 1-4 light scales; anterior *mep* bare or with a cream to white scale patch in *triannulatus*; remainder of pleuron without scales or setae. **Legs**: Forecoxa larger than mid- or hindcoxa. Integument of coxae and trochanters dark. Forecoxa with a row of long, strong, dark setae anteriorly and a cluster of 1-4 long, dark setae caudoventrally; a patch of light scales dorsolaterally; caudoventral surface with a row of light and dark scales, light scales usually somewhat cephalad of dark scales. Midcoxa laterally with 1-3 long, dark setae 0.3 from base; anteriorly with a small patch of short spiniform setae and a horizontal line of yellow to white scales; antero- and posteroapical borders with 1,2 long, dark setae and usually a light scale patch; anteroapically also with a row of short, dark setae. Hindcoxa with 1,2 long, dark setae and dorso-

caudally with a patch of light scales; posteroapical margin with moderately short setae, occasionally 1,2 long, dark setae and a row of light scales; anteroapical border with a long, curved, dark seta directed ventrad. Trochanter with short setae and yellow to white scales. Forefemur shorter than midfemur; latter subequal to hindfemur. Forefemur largely dark scaled, with a band of light scales at base; anterior surface mottled and occasionally with an indistinct, longitudinal streak of light scales; basal, dorsal and anterior surfaces speckled with light scales; distal 0.3-0.5 of dorsal, posterior and ventral surfaces with cream to yellow scales. Midfemur with basal light band followed by a narrow dark band; posterior surface light; anterior surface predominantly dark scaled, with a distal, variously shaped, light (anteroapical) spot just anterior and basad of distinct dorsal knee spot and with a longitudinal streak extending from near base to near anteroapical spot; apex with row of moderately strong setae. Hindfemur predominantly dark, with a basal light band, speckled with scales, and with a light spot of variable length in distal 0.25; knee spot present or absent; ventral surface light; apex with moderately long setae and whitish scales. Foretibia subequal to midtibia; hindtibia longest. Tibiae predominantly light on ventral and posterior surfaces; fore-, mid- and occasionally hindtibia with a yellowish longitudinal streak on anterior and dorsoanterior surfaces broadening at apex, occasionally appearing as speckling on foretibia; apices of tibiae yellow to white, usually light scaling weakly developed on foretibia, progressively more extensive on mid- and hindtibia; dorsal surface of apex with strongly developed apical spines. Hindtarsal segment 1 longer than hindtibia. Dorsal surface of fore- and midtarsal segment 1 predominantly dark, speckled with light scales, and with a light apical band usually less than 0.1 length of segment. Foretarsal segments 1 and 2 with double row of spiniform setae on plantar surface. Ventral surfaces of fore- and midtarsal segments 1,2 light; segments 3-5 often speckled with dark scales, varying from completely light to dark. Foretarsal segment 1 with an apical band, when present, white to golden; segment 2 with a narrow to wide, light scaled band in apical 0.15-0.95; segment 3 with a broad, light scaled band in apical 0.2-0.9; segment 4 from dark to predominantly light; segment 5 from dark to light. Midtarsal markings generally as in foretarsus except that ventral surface usually darker and apical light bands, when present, white to golden and usually darker than on foretarsus; dorsal surfaces of segments 2,3 from completely dark to light in apical 0.4; segment 4 usually dark, occasionally with apical light band (*ininii*); segment 5 from completely dark (*albimanus* and *triannulatus*) to completely light. Hindtarsal segment 1 predominantly dark with speckling of light scales on ventral surface and a longitudinal light streak on anterior surface, apex with or without yellow to white band; segment 2 with highly variable, white band in apical 0.10-0.95; segments 3,4 completely white or with dark basal band present on either one (mutants) or both segments (*rondoni*, mutants); segment 5 with white to pale yellow band in about apical 0.5. Pretarsi simple, claw of foreleg largest; claw of midleg larger than that of hindleg. **Wing** (fig. 5): As figured but extremely variable. Vein C with basal, humeral, subbasal, presectoral, sectoral, subcostal and preapical light scaled spots usually present; subbasal, presectoral and subcostal light spots sometimes absent. Integument of wing usually darkened in region of scales on C and R. Rs-R_{2+3} variable, more or less predominantly dark, with 3 or 4 dark spots and 2 or 3 light spots; with or without an extra subcostal light spot. R_2 with 2 light spots of varying lengths. R_3 usually with 3, occasionally only 2, light spots. R_{4+5} with 2 small to moderate size dark spots, one subcostal, the other preapical. M with or without sectoral dark spot of variable length and subcostal dark spot that may reach furcation. M_{1+2} with 2 dark spots and M_{3+4} with one dark spot. Base of Cu light with a small to medium sectoral

dark spot usually not reaching furcation. Cu_1 largely light, with 3 small, dark spots, 2 toward base in sectoral-subcostal region and one preapical. Cu_2 all light except for small to moderate preapical dark spot. Vein A largely light, with 2 dark spots, 1 subbasal and 1 subcostal. Apical light fringe spot conspicuous, small to large; fringe of remainder of wing largely dark with light areas where veins intersect wing margin except for R_1; usually additional moderately long, light fringe spot present between base of wing and A. **Haltere**: Stem pale; apex of knob with small patch of dark brown scales, surrounded by subapical light scales, particularly abundant laterally. **Abdomen**: Integument of tergites predominantly light to dark brown, with light mottling occasionally present on II-VII, when present usually more extensive on V-VII. Long setae present along lateral and apical margins of tergites I-VII; and short, scattered setae medially. Tergites II-VII with patches of light scales; patches triangular, with bases toward apex of segment on proximal segments, and subrectangular and longer on more distal segments. Caudolateral margins of tergites and sternites of segments II-VII (III-VII in *albimanus*) with conspicuous, outstanding, dark scale tufts. Sternite I with or without setae. Moderately long setae present on sternites II-VII in submedian row and along caudal border; sternite I usually with a few inconspicuous light scales; sternites II-VII with a submedian, longitudinal patch of light scales, followed posteriorly by tuft of dark scales which extend laterally along caudal border of sternite to meet caudolateral tufts of tergite.

FEMALE GENITALIA. Segment VIII: About as long as wide, slightly narrower than segment II-VII; with scattered moderately long, dark setae; tergite densely covered with light scales; sternite usually with median longitudinal tuft of dark scales along caudal border; remainder of sternite with light scales. **Tergite IX**: Ribbonlike dorsally, expanding laterally into curved plate projecting slightly ventromesad. **Tergite X**: With curved subtriangular lateral plates directly caudad of tergite IX, narrowing abruptly medially, and not continuous dorsally. Tergites IX and X densely covered with short, fine spicules. **Cercus**: Large, subcylindrical, curved dorsally; densely covered with lanceolate scales and moderately long, dark setae; scales darker at base, cream at apex. **Postgenital Plate**: Moderately long, subtriangular, rounded apically, covered with short fine spicules, with 2 long, strong, subapical setae. **Upper Vaginal Lip**: Strongly sclerotized. **Insula**: Discoid, without distinct margin, usually with 20 or more short spiniform setae originating from large conspicuous alveoli. **Atrial Plates**: Strongly sclerotized, triangular, laterally articulating with tergite IX. **Lower Vaginal Lip**: Membranous, spiculose. **Spermatheca**: One, spherical, strongly sclerotized, dotted with numerous small, circular, membranous regions.

MALES (fig. 5). Essentially similar to females except for sexual characters. Coloration and scale patterns as in females. **Head**: Clypeus smaller than in females. Proboscis longer than in females, usually apically retrorse, light reddish brown to dark brown. Palpus 5 segmented, subequal to or slightly longer than proboscis, segment 1 short, 0.06-0.08 of palpal length; segment 2 long, shorter than segment 3, 0.25-0.30 of palpal length; segment 3 long, 0.32-0.39 of palpal length; segments 4 and 5 moderately short, each 0.10-0.16 of palpal length; segments 1, 2 and 3 ankylosed; 3 expanded dorsoventrally at apex and with segments 4 and 5 forming a laterally compressed, dorsoventrally expanded, conspicuous club; palpus bent near apex of segment 3 so that segments 4 and 5 are directed anterolaterally; segments 1 and 2 with dark, erect scales, becoming decumbent toward apex of 2; apex of segments 2 and 3, and base of segment 3, each with a white band; segment 3 and occasionally 2 with a few dorsal, light scales; base and occasionally ventral surface and apex of segment 4 dark, remainder of lateral surface of segment 4 cream or white, somewhat darker in

albimanus; lateral surface of segment 5 dark in about basal 0.33 of segment and on ventral surface, remainder of segment 5 white; dorsal and ventral surfaces of apices of palpal segments 2 and 3 with numerous, long, apically directed setae. **Antenna**: Length 0.65-0.85 length of proboscis; segment 1 slightly longer than segments 2-11, with long, light scales on inner margin; segment 12 very long, about 0.20-0.25 of antennal length; segment 13 about 0.5 length of segment 12; flagellar whorls on segments 1-12 strongly developed, with numerous, long setae; setae on inner margins of whorls 1-5 occasionally white. **Legs**: Basal plantar surface of foretarsal segment 5 with about 6-9 short to moderately long, spiniform setae; setae longer toward apex; shorter spiniform setae medially between longer setae. Single claw on foreleg long, slightly curved, acuminate, with a blunt to acuminate submedian tooth and a curved, usually blunt, short to moderately short, external basal tooth. Mid- and hindleg with 2 claws; claws on midleg larger than on hindleg. Empodium spinulose, about 0.75 length of claw. **Wing**: Narrower than in female.

MALE GENITALIA. Segment VIII: Not retracted into segment VII; as narrow as or slightly narrower than segment VII; densely covered with lanceolate to truncate, obovate scales except on proximal border and with moderately long, dark setae scattered over surface. Tergite often with a median longitudinal patch of dark scales surrounded by light scales, and with long, dark setae along distal and lateral margins. Sternite covered with light scales, with or without median subtriangular, dark scale patch. **Segment IX**: Spiculose. Tergite small, membranous, without lateral lobes, articulated caudally with proctiger and laterally with sidepiece. Sternite well developed, sclerotized; narrowly subrectangular to broadly subtriangular, curved and tapered dorsolaterally, extending a short distance dorsad as a small, sclerotized, subrectangular lobe; articulating with proctiger and sidepiece; with ribbonlike to triangular, darker, sclerotized, nonspiculose, apodeme projecting along anteromedian border; apodeme occasionally with a median protuberance. **Sidepiece**: Sclerotized, spiculose, cylindrical to subconical, moderately narrow, curved mesally. Tergal surface with a submedian longitudinal row of 4-6 long (about 0.67 length of sidepiece), strong (tergomedial) bristles arising from large, conspicuous alveoli; basal 3 or 4 bristles separated from more apical bristles; rows of weaker moderately long setae, one row mesad, and usually one laterad, of long bristles. Tergolateral surface with large, spatulate scales extending onto sternal surface, usually darker laterally. Basal tergomesal margin with a single, large, very stout, blunt, retrorsely hooked, parabasal spine inserted on a moderately short to long, protruding tubercle, directed tergomesally. Basomesal margin of sidepiece cephalad of parabasal spine modified into a long (0.16-0.25 length of sidepiece), heavily sclerotized, blunt apodeme articulating mesally with basal piece of phallosome; apodeme equal to or slightly less than length of parabasal spine. Tergomesal surface of sidepiece with 2 long, apically flattened, blunt-hooked, accessory spines inserted on 2 adjacent, prominent tubercles that arise 0.40-0.52 from base of sidepiece; the more dorsal spine about 0.5 length of sidepiece; shorter more ventral spine 0.58-0.80 length of dorsal spine. Mesal surface with a long, curved, internal spine arising 0.45-0.60 from base, subequal in length to more ventral accessory spine. Apicomesal border usually with one long, subapical seta at base of clasper. Sternomesal and mesal margins with moderately short, weak setae. **Clasper**: Subequal in length to sidepiece, curved mesally, slender beyond base. Ventromesal margin with a row of about 10-14 short spinules, from near base to apex. Spiniform thin to thick, blunt to acuminate. Seta *b* weak, moderately short to moderately long; subequal to slightly longer than spiniform, arising from small crest immediately basolaterad of spiniform. **Claspette**: Divided into a dorsolateral claspette

and an apically fused, membranous, mesoventral claspette. **Dorsal Claspette:** Base continuous ventrally with phallosome and ventral claspette, and laterally with sidepiece; basal portion modified into sclerotized pedicel with a rounded semispherical base usually curved mesad, occasionally with a conspicuous internal apodeme; distally developed into 3 long, broad, membranous, lanceolate leaflets, longest about 0.3-0.5 length of claspette, each curving mesally, with a medial supporting rib; ventral leaflet subequal to middle leaflet; dorsal leaflet shortest, with a variously developed, mesally directed, basal projection (basomesal projection). **Ventral Claspette:** Highly variable, supported mesally by 2 sclerotized "rods" arising from a sclerotized bridge which extends mesad from sidepieces; basally produced into 2 small to large basal lobules interconnected by an inconspicuous spiculose membrane, area ventrad of membrane between 2 lobules referred to as mesal cleft; setae present or absent on basal lobules. A thickened rooflike refractile structure, known as refringent structure, extends across vertex of fusion of basal lobules and basad a short distance along inner margin of each lobule, occasionally with lateral extensions or arms. Fused apical portion of ventral claspette differentiated into (1) a hairless dorsal lobe which apposes the aedeagus (possibly to form the external gonopore) and (2) a variously shaped, ventral lobe with or without setae. Subapicomedial region of ventral claspette with a small to large, variously shaped, sclerotized, preapical plate. Area immediately basad of preapical plate transparent and membranous, in shape of an inverted U or V, basal margins being formed by refringent structure. **Phallosome:** Composed of a central aedeagus, a pair of parameres and a pair of basal pieces, all fused into one sclerotized structure. Sides and most of apex of aedeagus sclerotized; apex with or without leaflets; subapically with a pair of subtriangular, lateral sclerotizations extending ventromedially to form an incomplete tube; outer border of apex membranous; aedeagus weakly to moderately curved dorsally toward proctiger. Aedeagus basally contiguous with triangular, highly sclerotized parameres. Basal piece laterally connected to paramere by a narrow, sclerotized bridge. A dorsocaudal extension of basal piece articulates with dorsal claspette; a lateral arm of basal piece extending laterally, basad of sidepiece, and appearing to be attached to sidepiece by a tendinous apodeme. Phallosome usually equal to or longer than ventral claspette. **Proctiger:** Conical, apex hooked ventrally, spiculose, with sclerotized sides and triangular base, articulating laterally with sidepiece and tergite IX.

PUPAE. Cephalothorax: Weakly to strongly pigmented; often with longitudinal pigmented stripes on wing cases. Vertical plate about as long as wide, more sclerotized along anterior border, and produced apicomedially into small protuberance. Hairs 1-3-C 2,3 branched (1-4), moderately developed; 1,2-C adjacent. Hairs 4-7-C usually few branched, moderately to strongly developed; 4,5-C shorter than 6,7-C; 7-C laterad or caudolaterad of 6-C. Hair 8-C single (1-3 branched), moderately long, inserted near lateral ridge. Hair 9-C usually forked, weak, moderately long, inserted caudolaterad of trumpet base. **Trumpet:** Length and shape highly variable. Moderately to strongly pigmented. Inserted very close to wing base. Pinna angusticorn; strongly tuberculate, varying from short, flared and truncate to long, narrow and tapered; meatal cleft short to long. Tracheoid not developed. **Metanotum:** Hair 10-C single, shorter than or about equal to 11-C; 11-C multiple, branched or forked. Hair 12-C single or 2-4 forked, longer than 10,11-C. **Abdomen:** Float hair (1-I) dendritic, large. Hairs 2,3-I approximated, inserted cephalolaterad of the base of hair 1-I; 2-I multiple, moderately to strongly developed; 3-I 0.5 of to about equal to 2-I. Hair 4-I multiple, short, inserted caudolaterad of 2,3-I. Hair 5-I single or 2-4 forked, long, inserted laterad of 4-I. Hairs 6,9-I single or double, moderately long to long. Hair 7-I

2-7 forked, strongly developed. Hair 0-II-VII multiple, medium; 0-VIII 1-3 branched (1-4). Hair 1-II,III multiple, moderately large to large; 1-IV-VII single, very long, 1.0-2.0 length of segment. Hair 2-II,III multiple, moderately large, inserted cephalolateral of hair 1 of segment; 2-IV-VII usually 1-5 branched, inserted cephalolaterad or cephalomesad of hair 1 of segment. Hair 3-II,III 1-3 branched, inserted well cephalad of caudal margin of segment (except in *benarrochi*) and between hairs 1 and 2; 3-IV multiple, moderately developed; 3-V single or 1-5 forked; 3-VI single or forked, inserted on caudal margin of segment mesad of hair 1-VI; 3-VII branched or forked. Hair 4-II inserted cephalomesad of 5-II; 4-III-VII always inserted cephalad or cephalolaterad of hair 5 of segment; 4-II-IV branched, small to moderately long; 4-V-VII 1-7 forked, moderately long; 4-VIII forked, inserted cephalomesad of hair 9-VIII. Hair 5-II multiple, small to moderately large; 5-III-VII inserted on caudal margin of segment between hairs 1 and 9; 5-III,IV 1-13 branched, moderately large to large; 5-V-VII single, occasionally double or triple, about equal to length of segment. Hair 6-II 1-3 branched, moderately long to long, inserted immediately cephalad of hair 7-II; 6-III-VI 1-2 branched (1-6), moderately long; 6-VII single, moderately short. Hair 7-II 2-7 branched, equal to or shorter than 6-II; 7-III-VII inserted laterad of or arising from oblique sublateral ridge, caudad of hair 8 of segment; 7-III-V 1-7 branched, small to moderate; 7-VI,VII usually single (1-4 branched), moderately long to long. Hair 8-III-VII 1-7 branched, short, inserted mesad of oblique sublateral ridge. Hair 9-II-VIII (caudolateral spines) highly variable, spiniform, inserted on caudolateral margin of segment; 9-II minute, unpigmented; 9-III thin to bulletlike, minute to short, pigmented or unpigmented; 9-IV-VIII darkly pigmented; 9-IV short to medium, heavy, straight or slightly curved; 9-V-VIII moderately short to long, thin to thick, straight or curved. Hair 10-III-V,VII inserted mesad of hair 7 and very near caudal border of segment; 10-III single or 2-6 forked; 10-IV,V single, long; 10-VI absent; 10-VII single or double, moderately short to medium. Hair 11-III-VII single or occasionally double, small. Hair 14-III-VIII minute and inconspicuous, inserted submedially near anterior margin of segment. **Terminal Segments**: Hair 1-IX 1-3 branched, minute. Median caudal lobe short, dorsobasally covering genital and cercal lobes. Genital lobe of female covering about basal 0.75 of cercal lobes. Cercal lobe about 0.5 of segment VIII. Male genital lobe about as long as segment VIII and usually mammillated distally. **Paddle**: Elliptical or obovate, often distally truncate and emarginate, always longer than wide. Midrib moderately developed, not reaching apex. Buttress strongly developed, serrated distally. Outer margin distad of buttress with short, fine spicules; inner margin with or without very short spicules. Hair 1-P single or double, strong, moderately short; 2-P forked, subequal to 1-P.

LARVAE. Head: Ovoid, usually slightly longer than wide, widest at ocular bulge; light brown to black; with various patterns of pigmentation, from small patches to extensive mottling. Collar darker than rest of head, highly sclerotized, narrow to moderately wide. Mental plate with 3,4 teeth on each side of median tooth; median tooth varied from narrow to broad and from sharply pointed to blunt. Labial plate subtrapezoidal; maxillary suture not contiguous with posterior tentorial pit. Mouth brushes with numerous, simple filaments. Median labral plate bilobed and small. Mandible and maxilla normal. Hair 1-C strong, moderately long, curved ventromedially, arising from lateral lobes of median labral plate. Inner clypeal hairs (2-C) closely approximated or widely spaced, single and simple, barbed or plumose with branches short to long, occasionally dendritic. Outer clypeal hair (3-C) shorter than or about equal to 2-C. Posterior clypeal hair (4-C) 1-5 branched; 4-C simple, forked, branched or dendritic, inserted caudomesad of outer clypeal hairs. Hairs 5-7-C plu-

mose, long, with long branches; 5-C longest; 5,6-C usually extending beyond anterior margin of head; distance between hairs 5-C equal to or greater than distance between 5-C and 6-C. Hair 8-C branched, forked or dendritic, with 2-10 branches. Hair 9-C usually slightly longer than 8-C and occasionally with a few more branches. Hair 10-C 3 branched (2-4), small. Hair 11-C plumose, long, inserted basolaterad of antenna. Hair 12-C 2-6 branched, small to large. Hair 13-C 4-6 branched, inserted immediately caudad of 11-C, moderately long. Hair 14-C 2-5 branched, short, inserted caudoventrad of cibarial bar. Hair 15-C varied in length, inserted immediately mesad of maxillary suture. *Bmh* branched or dendritic, moderately short to moderately long. **Antenna**: Same color as or darker than head with a darker basal band, slightly tapering toward apex. About 0.5 length of head capsule, with spicules on mesal or ventral surfaces, spicules longer on mesal margin; dorsal surface occasionally with very short spicules. Hair 1-A 2-7 branched (2-10), small to large, inserted on dorsolateral surface about 0.25-0.33 from base. Hairs 2,3-A long, saberlike, usually serrated on basomesal margin; 2-A inserted dorsomesad of 3-A at apex of antenna. Hair 5-A short, spiniform, inserted at apex of antenna. Hair 6-A short, thick, blunt, peglike. **Thorax**: Uniformly pigmented and with a few small sclerotized plates dorsomedially on meso- and metathorax. Integument without spicules. Pro-, meso- and metathoracic pleural group hairs all arising from large common tubercles; tubercles laterally modified into a large spine. Submedian prothoracic group (1-3-P) with hair 1-P palmate with unserrated, narrow to broad, lanceolate leaflets or, in *albimanus*, plumose with filiform branches; 2-P plumose, moderately long, with an elongate dorsoventrally flattened shaft; 1,2-P with or without a common tubercle; 3-P single and simple, short. Hairs 4,5-P plumose, strongly developed, each arising from a separate tubercle; 4-P shorter than 5-P. Hair 6-P single and simple, long, arising from same large tubercle as 5-C. Hairs 7,8-P plumose, very long; 7-P inserted immediately ventrad of 6-P; 8-P arising from strong tubercle mesad of prothoracic pleural group (9-12-P). Hairs 9,10,12-P single and simple (except 9-P pectinate in *albimanus*), long; 9-P shorter than 10-P; 11-P forked at various distances from base, shortest of pleural group, about 0.4-0.6 length of 10-P; 12-P longest of pleural group. Hair 13-P with a highly variable number of branches, moderately large. Hair 14-P moderately large to large, 5-15 branched from short to long, dorsoventrally flattened stalk. Hair 1-M moderately long, strongly plumose, with an elongate, dorsoventrally flattened shaft, arising from fairly large tubercle. Hair 2-M single or forked, moderately short. Hairs 3,5-M single and simple, long. Hair 4-M branched or dendritic, short. Hair 6-M 2-4 forked near base, long. Hair 7-M 3-5 branched, moderately large. Hair 8-M moderately plumose with 25-30 branches, long, inserted in small tubercle. Hairs 9,10-M single, long; 10-M about 1.1-1.4 length of 9-M. Hair 12-M single, moderately short, about 0.33 length of 10-M. Hair 13-M multiple, small. Hair 14-M numerously branched or weakly pectinate, small. Hairs 1,2-T single; 1-T short; 2-T moderately short to moderately long; 1-T usually about 0.5 length of 2-T. Hair 3-T always palmate and either brushlike or with spreading leaflets, usually unpigmented. Hair 4-T 3,4 branched, very small. Hairs 5, 7,8-T strongly plumose, very long, arising from moderately developed tubercles. Hair 6-T 2,3 forked, moderately long. Hair 9-T single (except pectinate with 3-5 branches in *albimanus*), long; 10-T single, longer than 9-T. Hair 12-T 2,3 forked, moderately long. Hair 13-T 2,3 branched, large. **Abdomen**: Integument without spicules except on anal segment. Large, strongly sclerotized, median tergal plates present on anterior margins of segments I-VII. Usually small, median and submedian, sclerotized spots present immediately caudad of tergal plates; median spot larger than submedian spot, occasionally connected to plates. Chaetotaxy, in general, as in genus. Hair 0-II-VII

2-9 branched (1-12), moderately small to moderately large (0-II very small in *trinkae*). Hair 1-I-VII palmate, with unserrated, narrow to broad, lanceolate, blunt or pointed leaflets; 1-I 8-18 branched, unsclerotized or weakly sclerotized; 1-II-VII about 20-30 branched. Hair 5-II,III 3-12 branched, small to moderately large. Hairs 6-I-III and 7-I,II strongly plumose, very long. Hair 6-IV-VII single, very long. Hair 7-III-V 2-4 branched, moderately long. Hair 8-II-VI 2-4 branched, moderately small. Hair 9-I usually 3-7 branched, rarely 6-9 branched (*triannulatus*); 9-II-VII 6-13 branched, moderately large. Hair 11-I 2-5 branched (5-7 in *triannulatus*), large. Hair 13-I 4-10 branched (2-4 in *triannulatus, benarrochi* and *albimanus*); 13-II,III small to moderate (moderately large to large in *triannulatus* and *albimanus*); 13-IV 3-7 (2-8) branched (rarely 10-13 in *benarrochi*). **Segment VIII**: Hair 0-VIII 2-5 branched (rarely single in some *benarrochi*), very small. Hairs 1,4-VIII moderately long; 4-VIII always longer than 1-VIII. Hairs 2,3-VIII branched, large, highly variable. **Spiracular Lobe**: Pecten with 11-22 teeth, highly variable in length; teeth usually as follows beginning ventrally: (1) 1 long, (2) numerous, mixed short to moderate, (3) 1 long, (4) 4-6 short to moderate and (5) some combination of long and short, or with 2,3 long; teeth sabrelike, dorsally curved, serrated in basal half. Lateral arms of spiracular apparatus varied in length, extending or not extending to spiracular openings. Hair 2-S 5-9 branched, moderately small. Hair 6-S single or forked. Hairs 8,9-S small to moderately large, 3-7 branched (3-8), rarely 6-9 branched (*ininii*). **Anal Segment**: Saddle strongly sclerotized, extending about 0.5 around segment; light brown to brown. About caudal 0.6 of saddle and most of anal segment finely spiculose; caudal margin with thicker, stronger spicules. Hair 1-X single, strongly developed, as long as or longer than saddle; inserted on or not inserted on saddle. Hair 2-X strongly plumose, 15-20 branched, long. Hair 3-X 7-10 branched, longer than 2-X. Ventral brush with 8 pairs of long, strongly plumose hairs. Anal gills varying from less than length of saddle to greater than 2.0 length of saddle.

KEYS TO GROUPS AND SPECIES

FEMALES

(*3. **galvaoi*** and *7. **anomalophyllus*** not included)

1. Dark caudolateral scale tufts absent from abdominal segment II; palpal segment 4 all dark *or* yellow to golden brown on mediolateral surface, never white or cream; foretarsal segment 5 usually all dark (fig. 5) (**Albimanus Group**) . . . . . ***1. albimanus***

Dark caudolateral scale tufts present on abdominal segment II; palpal segment 4 with at least some white or cream on mediolateral surface; foretarsal segment 5 variable (**Oswaldoi Group**) 2

Oswaldoi Group

2(1). Anterior mesepimeron (*mep*) with a conspicuous patch of light scales; foretarsal segment 4 with a light band in apical 0.40-0.65; foretarsal segment 5 predominantly dark; hindtarsal segment 2 dark in basal 0.4-0.7; humeral light spot of vein C small, 0.5-1.3 length of basal dark spot; small species (fig. 7) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Anterior mesepimeron (*mep*) without a patch of light scales; foretarsal segment 4 predominantly dark, *or if* light in more than apical 0.3 *then* foretarsal segment 5 about 0.5 apically light *and/or* hindtarsal segment 2 less than 0.4 basally dark; humeral light spot of vein C small to large; moderately large to large species (**Oswaldoi Subgroup**) 3

Oswaldoi Subgroup

3(2). Hindtarsal segment 3 dark in basal 0.20-0.35; vein C predominantly dark, subbasal, presectoral and sectoral dark spots fused into one large spot; preapical dark spot of vein M extending uninterrupted onto vein M_{1+2} (fig. 7) . . . . . ***12. rondoni***

Hindtarsal segment 3 completely white; subbasal, presectoral and sectoral dark spots of vein C not fused into large spot; preapical dark spot of vein M not extending onto vein M_{1+2} 4

4(3). Hindtarsal segment 2 with basal dark band usually less than 0.25 length of segment; vein C humeral light spot greater than 1.5 length of basal dark spot 5

Hindtarsal segment 2 with basal dark band usually equal to or greater than 0.25 length of segment, *if* less than 0.25 *then* vein C humeral light spot less than 1.5 length of C basal dark spot 6

5(4). Foretarsal segment 4 all light to rarely more than 0.3 basally dark; midtarsal segment 4 with a light band in apical 0.15-0.25; foretarsal segments 3-5 predominantly cream to white, dark scales often present only on dorsobasal surface of segment; foretarsal segment 2 light in apical 0.35-0.55; foretarsal segment 3 light in apical 0.70-0.86 . . . . . ***6. ininii***

Foretarsal segment 4 all dark to at least 0.3 basally dark; midtarsal segment 4 all dark; dark basal bands on foretarsal segments 3-5 almost completely encircling each segment, dark scales occasionally absent from ventral surface; foretarsal segment 2 light in apical 0.20-0.45; foretarsal segment 3 light in apical 0.50-0.85 . . . . . ***2. oswaldoi***

6(4). Subcostal light spot of vein C usually greater than 0.5 (0.45-1.00) length of subcostal dark spot; upper mesepimeron (*mep*) often with 1-4 light, obovate scales; hindtarsal segment 2 usually dark in basal 0.25-0.35; humeral light spot of vein C usually large, 1.8-3.5 (1.0-3.7) length of basal dark spot (fig. 6) . . . . . ***8. rangeli***

Subcostal light spot of vein C almost always less than 0.5 length of subcostal dark spot; upper mesepimeron (*mep*) usually without light scales; hindtarsal segment 2 and humeral light spot of vein C variable . . . 7

7(6). Hindtarsal segment 2 dark in about basal half, 0.40-0.55 (0.3-0.6); light wing spots at least on veins C and R light cream to yellowish, not white . . . . . ***5. aquasalis*** ***13. benarrochi***

Hindtarsal segment 2 dark in less than basal 0.40, *or if* greater than 0.40 *then* light wing spots white, not light cream to yellowish 8

8(7). Vein C humeral light spot less than 2.0 length of basal dark spot . . . 9

Vein C humeral light spot equal to or greater than 2.0 length of basal dark spot 10

9(8). Light spots on wing usually very light, white or very light cream; vein C with humeral light spot 1.3-2.0 of basal dark spot (fig. 7) . ***9. trinkae***

Light spots on wing usually cream, at least on anterior veins; vein C with humeral light spot 0.7-1.3 (0.7-1.7) of basal dark spot (fig. 7) . . . . . ***10. nuneztovari***

10(8). Light scales on wing (at least anterior veins) and coxae (usually) gray to cream to yellow, not white; foretarsal segment 5 cream, gray or golden in apical 0.3-0.5 . . . . . ***4. noroestensis***

Light scales on wing and coxae usually white or very light cream; foretarsal segment 5 variously banded 11

11(10). Midtarsal segment 5 usually cream in less than apical 0.3; foretarsal segment 2 with a cream to white band in apical 0.25 (0.18-0.35), segment 5 usually golden to brown, occasionally differentiated into 0.5 dark, 0.5 light; vein C humeral light spot usually 2.0-4.0 (1.2-4.1) of basal dark spot (fig. 7) . . . . . ***11. strodei***

Midtarsal segment 5 cream in apical 0.3-0.7; foretarsal segment 2 with a cream to white band in apical 0.31-0.46, segment 5 cream to white in about apical 0.5; vein C humeral light spot 2.0-2.5 (1.3-4.0) of basal dark spot (fig. 7) . . . . . ***9. trinkae***

MALE GENITALIA

1. Ventral claspette without setae, apex rounded and not expanded laterally into large auriculate lobe; preapical plate of ventral claspette very small, weakly sclerotized; apex of aedeagus slightly broader than long; sternite IX short, subrectangular (fig. 8) (**Albimanus Group**) . . ***1. albimanus***

Ventral claspette with setae, *or if* without setae *then* apex expanded laterally into large auriculate lobe; preapical plate of ventral claspette and aedeagus variously developed; sternite IX moderately long to long, subtrapezoidal to subtriangular (**Oswaldoi Group**) 2

Oswaldoi Group

2(1). Ventral claspette without setae, apex expanded laterally into large, auriculate lobe, preapical plate small, oval and heavily sclerotized; apex of aedeagus about 1.5 as long as wide (fig. 31) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Ventral claspette with setae at least on basal lobules, apex with or without lateral expansion, preapical plate various; apex of aedeagus less than 1.5 as long as wide (**Oswaldoi Subgroup**) 3

Oswaldoi Subgroup

3(2). Ventral claspette with apex rugose or deeply striated, and moderately to strongly expanded laterally into rounded or pointed lobe, setae on lateral margins not extending toward apex as far as level of apical margin of preapical plate; apex of aedeagus without leaflets (**Strodei Complex**) . 4

Ventral claspette with apex neither rugose nor deeply striated nor laterally expanded, setae extending to apex or at least as far as level of apical margin of preapical plate; apex of aedeagus with or without leaflets (**Oswaldoi Complex**) 6

Strodei Complex

4(3). Ventral claspette small, about 0.33 length of sidepiece, apex moderately expanded laterally, apicolateral margins sharply angled and moderately pointed; basal lobule of ventral claspette small, narrow, curving mesad, with setae along basal margin short, about equal to or slightly longer than width of aedeagus; preapical plate of ventral claspette heavily sclerotized (fig. 29) . . . . . ***13. benarrochi***

Ventral claspette large, about 0.5 length of sidepiece, apex strongly expanded laterally, apicolateral margin produced into large, rounded lobe with basal and lateral margins convex and apical margin weakly concave; basal lobule of ventral claspette large, with setae along basal margin long, about 2.0-3.5 width of aedeagus; preapical plate of ventral claspette very weakly to moderately sclerotized 5

5(4). Ventral claspette with setae on lateral margins extending toward apex to base of apicolateral lobe, preapical plate weakly to moderately sclerotized and moderately well-defined (fig. 27) . . . . . ***11. strodei***

Ventral claspette with setae usually on basal lobule only, not extending to base of apicolateral lobe, preapical plate very weakly sclerotized and ill-defined (fig. 12) . . . . . .***12. rondoni***

Oswaldoi Complex

6(3). Apex of aedeagus with a pair of long, sclerotized, serrated leaflets about 0.4 length of aedeagus; ventral claspette with large basal lobule with setae along basal margin 1.5-2.0 width of aedeagus, preapical plate oval to semicircular and moderately sclerotized (fig. 19) . . ***7. anomalophyllus***

Apex of aedeagus without leaflets or occasionally with very small, membranous leaflets; ventral claspette with large or small basal lobule, preapical plate variously developed 7

7(6). Ventral claspette strongly conoid, with a very small median sulcus at apex, setae on lateral margins (exclusive of basal lobule) short and extending toward apex only as far as level of apical margin of preapical plate, setae along basal margin of basal lobule long about 2.0-3.0 width of aedeagus, preapical plate very large, crescent shaped and heavily sclerotized (fig. 17) . . . . . ***6. ininii***

Ventral claspette not strongly conoid, either truncate or with a moderately small to large median sulcus at apex, setae on lateral margins extending to or nearly to apex, setae along basal margin of basal lobule short to long, preapical plate small to large 8

8(7). Ventral claspette with a concentration of long setae about 1.5 width of aedeagus on basomesal margin of basal lobule and directed caudally into mesal cleft, wide at apex (width 0.4-0.5 length of claspette) with abruptly angled, rounded lateral margins, preapical plate small, oval and heavily sclerotized (fig. 21) . . . . . ***8. rangeli***

Ventral claspette without setae concentrated on basomesal margin of basal lobule, shape and preapical plate varied 9

9(8). Ventral claspette with apex moderately broad to broad, width at apex 0.4-0.6 length of claspette, lateral margins of claspette not tapering appreciably medially toward apex, lateral margins of apex abruptly angled, preapical plate moderately small and semicircular to oval. 10

Ventral claspette with apex moderately narrow to narrow, width at apex about 0.3 length of claspette, lateral margins of claspette tapering toward apex, lateral margins of apex evenly curved, preapical plate variously developed 11

10(9). Length of aedeagus 1.33-1.60 (1.31-1.89) length of ventral claspette; ventral claspette moderately short, 0.25-0.40 length of sidepiece, width of apex 0.50-0.60 (0.50-0.64) length of claspette (fig. 25) . . . . . ***10. nuneztovari***

Length of aedeagus 1.00-1.20 (1.00-1.33) length of ventral claspette; ventral claspette moderately long, 0.40-0.50 length of sidepiece, width of apex 0.43-0.50 (0.38-0.54) length of claspette (fig. 23) . . ***9. trinkae***

11(9). Aedeagus truncate at apex; preapical plate of ventral claspette large, semicircular to oval, heavily sclerotized (fig. 13). . . . . ***4. noroestensis***

Aedeagus rounded at apex; preapical plate of ventral claspette variously developed 12

12(11). Ventral claspette with setae along basal margin of basal lobule moderately short about equal to or slightly longer than width of aedeagus, setae usually not reflexed, preapical plate moderately small, circular to oval and weakly to moderately sclerotized (fig. 15) . . . . . ***5. aquasalis***
Ventral claspette with setae along basal margin of basal lobule long about 2.0 or more width of aedeagus, setae often reflexed caudally, preapical plate large and moderately to strongly sclerotized 13

13(12). Ventral claspette with setae along basal margin of basal lobules about 2.0 width of aedeagus, preapical plate large, usually crescent shaped and moderately to strongly sclerotized (fig. 10) . . . . . ***2. oswaldoi***
Ventral claspette with setae along basal margin of basal lobules very long about 3.0 width of aedeagus, preapical plate strongly sclerotized, large and circular to semicircular with small basolateral projections (fig. 12) . . . . . ***3. galvaoi***

PUPAE

(*3. **galvaoi***, *7. **anomalophyllus*** and *12. **rondoni*** not included)

1. Hair 9-VII long, usually more than 0.33 length of segment 2
Hair 9-VII short, less than or equal to 0.33 length of segment 9

2(1). Hair 9-V less than 2.3 length of 9-IV; 9-VI relatively short, 9-VII 1.4-2.0 length of 9-VI 3
Hair 9-V 2.3 or more length of 9-IV, rarely 2.0; 9-VI long, 9-VII 1.0-1.5 length of 9-VI 5

3(2). Hair 9-VII usually less than 0.5 length of segment (fig. 13) . . . . . ***4. noroestensis***
Hair 9-VII about 0.5 or more length of segment 4

4(3). Sum of branches of hairs 1-III, 5-III and 0-VI less than 18 (fig. 27) . . . . . ***11. strodei***
Sum of branches of hairs 1-III, 5-III and 0-VI greater than 20 (fig. 17) . . . . . ***6. ininii***

5(2). Pinna of trumpet very long, about 4.0-6.5 (3.4-8.0) length of meatus and narrow, not appearing to taper toward apex; hair 9-V-VIII very long, slender, acuminate; 9-III small, unpigmented, slightly longer than 9-II; 7-C with one branch very long, about 1.5-2.0 length of other branch(es); 6-I,II very long and 9-I subequal to 6-I; 3-I subequal to 2-I; 2-I 3-6 branched; size small (fig. 31) . . . . . ***14. triannulatus***
Pinna of trumpet usually equal to or less than 4.0 length of meatus and moderately wide, *if* longer than 4.0 *then* tapered *or* hair 9-V less than 2.3 length of 9-IV *or* 9-III about 2.0 length of 9-II; hair 9-V-VIII moderately slender to heavy; 9-III small to moderate, variously pigmented; 7-C variously developed; 6-I,II and 9-I short to long; 2,3-I variously developed; size moderately large to large 6

6(5). Hair 9-III strongly pigmented, heavy and usually thick, at least 2.0 length of 9-II; 6-II 2.0 or more length of 7-II; 2-I moderately developed, 3-5 branched (2-6), forked about 0.5 distance from base; 3-I subequal to 2-I (fig. 8) . . . . . ***1. albimanus***

Hair 9-III usually less than 2.0 length of 9-II, *if* longer *then* weakly to moderately pigmented and not thick and heavy; 2,3-I and 6-II varied 7

7(6). Hair 2-I moderately short, usually with 4-8 (2-10) branches arising near or at base (fig. 15) . . . . . ***5. aquasalis***

Hair 2-I moderately long to long, forked, branches arising at least 0.20 distad of base 8

8(7). Sum of branches of hairs 0-II and 0-III usually greater than 8 (8-14); 0-II moderate, usually 5-7 branched (4-7); 7-C with branches subequal or one branch slightly longer than other(s) (fig. 21) . . . . . ***8. rangeli***

Sum of branches of hairs 0-II and 0-III usually less than 8 (3-9); 0-II small, single to triple (1-4); 7-C with one branch about 1.5 length of other branch(es) (fig. 23) . . . . . ***9. trinkae***

9(1). Pinna of trumpet short, about 1.6-2.1 length of meatus, appearing apically flared in lateral aspect, meatal cleft appearing narrow and basally pointed; hair 6-II equal to or slightly longer than 7-II (fig. 10). . ***2. oswaldoi***

Pinna of trumpet moderately long to long, 3.0-5.5 length of meatus, not appearing apically flared in lateral aspect, meatal cleft moderately pointed to rounded at base; hair 6-II conspicuously longer than 7-II . . 10

10(9). Pinna of trumpet moderately long, 3.5-4.5 (3.0-4.8) length of meatus, appearing broad medially and tapered toward apex in lateral aspect; hair 10-C less than 0.5 length of 12-C; 6-I usually more than 2.0 length of 7-I (fig. 25) . . . . . ***10. nuneztovari***

Pinna of trumpet long, 4.5-5.1 (4.4-5.5) length of meatus, not appearing to taper toward apex in lateral aspect; hair 10-C more than 0.5 length of 12-C; 6-I about 1.5-2.0 length of 7-I (fig. 29) . . . . . ***13. benarrochi***

LARVAE

(*3. **galvaoi*** and *12. **rondoni*** not included)

1. Hair 1-P plumose, with filiform branches; 9-P,T pectinate, usually 4-6 branched (4-7); 13-I-IV moderately large to large; 4-C moderately long to long, usually extending to anterior margin of head capsule (fig. 9) **(Albimanus Group)** . . . . . ***1. albimanus***

Hair 1-P palmate; 9-P,T single; 13-I-IV small to large; 4-C short or long **(Oswaldoi Group)** 2

Oswaldoi Group

2(1). Hairs 2-C widely spaced, clypeal index about 1.0-2.0, single to plumose . 3

Hairs 2-C closely approximated, clypeal index about 2.5-4.0, single, and simple or barbed 11

3(2). Hair 11-I large, usually 5-7 branched (3-7); 13-I very large, usually 3 branched (2-4); lateral arm of spiracular apparatus long, directed laterally; 1-P with 15-20 (13-20) very narrow to narrow lanceolate leaflets (rarely filiform); 2-C single, and simple or barbed (fig. 32) (**Triannulatus Subgroup**) . . . . . ***14. triannulatus***

Hair 11-I moderately large, 2-4 branched; 13-I small to moderately large, usually more than 3 branched; lateral arm of spiracular apparatus very short to moderately long (except long in *ininii*); 1-P with usually 9-16 (8-18) narrow to broad lanceolate leaflets; 2-C single to plumose (**Oswaldoi Subgroup**) 4

Oswaldoi Subgroup

4(3). Hair 3-C, and usually 2-C, plumose in about apical half, with distinct, moderately long to long branches 5

Hairs 2,3-C single, and simple or barbed 7

5(4). Hair 1-A long, at least 2.0 width of antenna at point of insertion; 13-IV small, usually 10-13 branched (6-13); 1-X moderately short, as long as or slightly longer than saddle; 3-C with moderately long branches and 2-C barbed (fig. 30) . . . . . ***13. benarrochi***

Hair 1-A short to moderately short, always less than 2.0 width of antenna at point of insertion; 13-IV moderately large, usually 5-7 branched (3-8); 1-X longer than saddle; 2,3-C with branches subequal in length or branches of 3-C slightly longer than those of 2-C. 6

6(5). Hair 1-X inserted on saddle, on or near ventral margin; anal gills usually short, about 0.5 length of anal segment; 2,3-C with simple branches, rarely dendritic; lateral arm of spiracular apparatus very short; pecten with median teeth mixed medium and short (fig. 16) . . . ***5. aquasalis***

Hair 1-X not inserted on saddle; anal gills long, as long as or longer than anal segment; 2,3-C with usually dendritic branches; lateral arm of spiracular apparatus moderately long; pecten with median teeth mostly subequal (fig. 11). . . . . ***2. oswaldoi***

7(4). Hair 4-C single or forked, moderately long to long, usually extending to near or beyond base of 2-C, *if* moderately long (0.30-0.60 length of 3-C) *then* 13-V 4-6 branched (4-7) 8

Hair 4-C variously branched, short to moderately long, usually not extending to base of 2-C, *if* moderately long (0.30-0.45 length of 3-C) *then* 13-V almost always 3 branched (3-5) at least on one side of larva . . 9

8(7). Hair 0-II very short, about 0.5 or less length of leaflets of 1-II, inconspicuous, single to triple; 3-C 0.5-0.8 length of 2-C; 4-C long, 0.7-1.0 length of 3-C; 13-IV moderately large, 3,4 branched, 1.5-2.0 length of leaflets of 1-IV (fig. 24) . . . . . ***9. trinkae***

Hair 0-II moderately long, subequal to or longer than length of leaflets of 1-II, conspicuous, usually 5-8 branched (4-10); 3-C 0.76-0.90 length of 2-C; 4-C moderately long, 0.3-0.6 length of 3-C; 13-IV moderate, usually 4-6 branched (3-6), equal to or slightly longer than leaflets of 1-IV (fig. 26) . . . . . ***10. nuneztovari***

9(7). Hair 1-A long, about 2.0 width of antenna at point of insertion; lateral arm of spiracular apparatus long, directed laterally (fig. 18) . . . ***6. ininii***

Hair 1-A short, as long as or slightly longer than width of antenna at point of insertion; lateral arm of spiracular apparatus short to moderately short, directed caudolaterally 10

10(9). Hair 5-I short, inserted 0.75-1.00 its length from lateral margin of abdomen; 2-III relatively short, 1.5-2.0 length of leaflets of 1-III; 2,13-IV moderately short, slightly longer than leaflets of 1-IV (fig. 22) . . . . . .***8. rangeli***

Hair 5-I moderately short, inserted less than 0.75 its length from lateral margin of abdomen; 2-III longer than 2.0 length of leaflets of 1-III; 2,13-IV moderately long, about 1.5 length of leaflets of 1-IV (fig. 14) . . . . . .***4. noroestensis***

11(2). Hair 1-P with 13-17 narrow leaflets; 2-P 16-24 branched; 1-M 31-35 branched; 1,2-P rarely sharing common tubercle; 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation (fig. 28) . . . . . ***11. strodei***

Hair 1-P with 9-12 moderately broad to broad leaflets; 2-P usually 12-14 branched (12-17); 1-M usually 20-30 branched (20-32); 1,2-P arising from a common tubercle; 1-X inserted usually on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin (fig. 20) . . . . . ***7. anomalophyllus***

ALBIMANUS GROUP

1. Anopheles (Nys.) albimanus Wiedemann

Figs. 1, 4, 5, 8, 9

1820. *Anopheles albimanus* Wiedemann 1820:10. TYPE: *Holotype* female, Santo Domingo (Dominican Republic) [NMW]. Specimen in poor condition (abdomen and antennae missing, legs missing or incomplete except for complete left hindleg), with following labels, //[red square]//albimanus/det Wiedem//albimanus/Wied/St. Domingo// (Belkin 1968b:8).

1900. *Anopheles cubensis* Agramonte 1900:460-464. TYPE: *Syntypes* males and females, several localities in Cuba [LU]. Synonymy with *albimanus* by Theobald (1907:106-109).

1901. *Anopheles argyrotarsis* (!) *albipes* Theobald 1901:125-128. TYPE: *Lectotype* male with the following labels, //16.XII.99//8.2.00 Jamaica Dr. Grabham//Type//Anopheles argyritarsis var. albipes Theobald (Type)// [BM; designation of Belkin 1968b:8-9]. Originally described from unspecified number of males and females from Jamaica, Guyana, Rio de Janeiro, Antigua and India. Synonymy with *albimanus* by Coquillett (1906:8, 13).

1905. *Cellia tarsimaculata* Goeldi 1905:133. TYPE: Same as for *albipes* [BM; designation by Belkin 1968b:8-9]. Unjustified emendation for *albipes* Theobald 1901.

1938. *Anopheles albimanus bisignatus* Hoffmann 1938:176-177. TYPE: *Syntypes* adults, Gonzalez (Tamaulipas), Nov; Tampico (Tamaulipas), June, Oct, Nov, Dec, Jan; Altamira (Tamaulipas), June; El Mante (Tamaulipas), July; San Jeronimo, Laguna de Tamiahua (Veracruz), June, July, Mexico [UM], (Belkin, Schick and Heinemann 1965:34).

1938. *Anopheles albimanus trisignatus* Hoffmann 1938:177-178. TYPE: *Syntypes* adults, region of Tampico (Tamaulipas), Mexico, Dec, Jan [UM], (Belkin, Schick and Heinemann 1965: 34).

Anopheles (Nyssorhynchus) albimanus of Dyar (1922:103; 1925:187, 188, 194; 1928:103, 434-435); Root (1922a:322; 1922b:384-389, 390-391; 1923:267, 269, 276; 1924b:460-462; 1926a: 51; 1926b:709; 1932:779-782); Christophers (1924:38-39, 89); Barraud and Covell (1928:674); Lima (1928:94-95); Boyd and Aris (1929:309-399); Kumm (1929:6-8; 1941a:359; 1941b:93-97, 99-100); Hill (1930:712); Carley (1931:293-296); Edwards (1932:45); Senevet (1932:252; 1938:181-182; 1948c:437, 439); Townsend (1933a:101-102); Rozeboom (1936b:480-489; 1938a:95, 99-100; 1938b:289-301; 1942:237; 1963:110-114); Kumm and Ruiz (1939:437-438, 441); Lane (1939:19-21; 1944:263-265; 1949:401-402; 1953:256-259); Simmons (1939:124-125); Gabaldon (1940:3-7); Gabaldon, Lopez and Ochoa Palacios (1940:33); Gabaldon, Aquilera and Arevalo (1941:59); Komp (1941a:88, 92-97; 1942:5, 40, 43, 67-69, 80, 115-117, 132, 154-156); Rozeboom and Gabaldon (1941:95-97); Simmons and Aitken (1942:38, 45, 53, 60, 80-84); Cova Garcia (1943:467-472); Ross and Roberts (1943:35-36); Matheson (1944:115-116); Floch and Abonnenc (1945:1-3; 1946b:3-5); Levi-Castillo (1945:2, 7, 92-104; 1949:9, 10, 15, 27, 32, 57, 58, 67, 72, 76, 81, 85); Carpenter, Middlekauff and Chamberlain (1946:80-83); Gabaldon and Cova Garcia (1946a:19-32; 1952:181); Arnett (1947:194-196; 1950:106, 110, 112, 114); Vargas (1948:153-163; 1959:376, 382); Penn (1949:52, 68-69); Thompson (1950: 692-695); Vargas and Martinez Palacios (1950:119-123; 1953:326-327; 1956:119-122); Belkin (1952:121, 123, 130; 1965:14; 1968b:8-9); van der Kuyp (1954:49-50); Carpenter and La Casse (1955:55-57); Frizzi and Ricciardi (1955:403, 404, 406); Horsfall (1955:172-177); Perez Vigueras (1956:180-186); Vargas V. (1956:27, 29; 1957; 1958a; 1958b; 1961a:97-105; 1961b:153-170); Bejarano (1957:326-332); Rozeboom and Kitzmiller (1958:244); Schreiber and Guedes (1959b:128-129; 1960:356-357); Stone, Knight and Starcke (1959:30); Forattini (1962:371-376); Montchadsky and Garcia Avila (1966:32); Porter (1967:36); Elliott (1968:244); Keppler and Kitzmiller (1969:31); Belkin, Heinemann and Page (1970:24-27); Keppler, Kitzmiller and Rabbani (1973:42-49); Cova Garcia and Sutil O. (1976:30; 1977:14, 45, 63, 87); Cova Garcia, Pulido F. and Amarista M. (1977:157); Knight and Stone (1977:60).

Anopheles albimanus of Robineau-Desvoidy (1827:411); Wiedemann (1828:13); Dyar and Knab (1906a:175-176); Busck (1908:57); Darling (1909:2051-2053); Knab (1913:34-37, 40-42); Christophers (1915:390-391); Zetek (1915:221-271); LePrince and Orenstein (1916:43-114); Howard, Dyar and Knab (1917:979-984); Johnson (1919:424); Evans (1921:446-451; 1922:

213); Root (1924a:207); Gowdey (1926:74); Hoffman (1926:377; 1930:358); Senevet (1931: 76-79); Earle (1932:381-384); Hoffmann (1932:523-529; 1938:167-180); Clark (1934:643); Curry (1934:644-651); Hill (1934:425-428); Martini (1935:14, 15); Rozeboom (1935:521-528; 1936a:471-478; 1941:98-104; 1953:1116; 1962:668); Clark, Komp and Jobbins (1940:62-67); Kumm, Komp and Ruiz (1940:388-391, 419); Vargas (1940a:199-200; 1940b:67; 1941:112, 114, 116, 118; 1976:88, 89); Carr, Melendez and Melendez (1941:749-750); Kumm and Ram (1941:559); Carr and Hill (1942:600-601, 604, 606); Carr and Melendez (1942:59-60); Carr, Melendez, Ros and Melendez (1942:70-71); Kumm and Zuniga (1942:401, 404; 1944:8-15); Kumm, Bustamante and Herrera (1943:374); Russell, Rozeboom and Stone (1943:20, 26, 29, 30, 41); Eyles (1944:2, 10-11); King, Bradley and McNeal (1944:39); Weathersbee (1944:25-28); Carpenter, Chamberlain and Wanamaker (1945:402); Hill and Hill (1945:3; 1948:36-37); Paul and Bellerive (1947:63-66); Thompson (1947:78); Castellanos, Murrieta, Lassmann and Ortiz (1949:34-35); Burgess (1950:108); Senior-White (1950:4-5); Muirhead-Thomson (1951: 1114-1117); Charles and Senevet (1953:1109-1115); Rozeboom (1953:1116; 1962:668); van der Kuyp (1953:144, 145); Floch (1954:4); Vargas and Martinez Palacios (1955:82-121, 123); Jensen and Jones (1957:464-469); Vargas V. (1958c:1, 3); Foote and Cook (1959:112-113); Cova Garcia (1961:33-34, 68, 85-86, 113, 122-123, 154, 178); Fauran (1962:73-80; 1964:52-53); Hobbs (1962:245-251; 1973:420-423); Vincke and Pant (1962:2-11); Davidson (1963:25-33); Rachou, Lyons, Mourra Lima and Kerr (1965:32-61); Fauran and Courmes (1966:105); Stojanovich, Gorham and Scott (1966a:11, 19, 28; 1966b:19, 31, 38); Taylor (1966:393-397); Gorham, Stojanovich and Scott (1967:14, 45, 49; 1973:110, 136, 140); Scherer, Campillo-Sainz, Dickerman, Diaz Najera and Madalengoitia (1967:79-91); Central America Malaria Research Station (1968:8-37; 1969:5-53; 1970:5-41; 1971:9, 12-18, 24-41, 48-50, 55-56, 70-71; 1972:5-13, 17, 21-27, 31-32, 37-41, 57); Wilton and Fay (1970:628-632); Morales-Ayala (1971: 139); Ali and Rozeboom (1972:574-579); Breeland (1972a:751-754; 1972b:62-72; 1972c:99-106); Elliott (1972:757); Rabbani and Kitzmiller (1972:421-432); Wilton and Fetzer (1972: 459-460); Wilton, Fetzer and Fay (1972:23-27); Lofgren, Boston and Borkovec (1973:187-189); Shelton (1973:3-4, 8, 10); Hobbs, Lowe and Schreck (1974:389-393); Cova Garcia and Sutil O. (1975a:21; 1975b:212); Lowe, Schreck, Hobbs, Dame and Lofgren (1975:160-168); Warren, Richardson and Collins (1975:549-551); Garcia-Aldrete and Pletsch (1976:76, 79); Pletsch and Garcia-Aldrete (1976:87-92); Bautista-Garfias, Mercado-Sanchez and Morilla-Gonzalez (1977: 15-18); Warren, Collins, Richardson and Skinner (1977:607-611).

Anopheles (Anopheles) albimanus of Bonne and Bonne Wepster (1925:516).

Anopheles (Cellia) albimanus of Dyar (1918:151).

Cellia albimana of Coquillett (1906:13); Theobald (1907:106-109 in part; 1910:69-70 in part); Surcouf and Gonzalez-Rincones (1912:274); Lutz, Souza Araujo and Fonseca Filho (1919:85); Neiva and Pinto (1922a:321; 1922b:356-357); Boyd (1926:31, 48).

Nyssorhynchus albimanus of Blanchard (1905:202-204); Autran (1907:10-11); Surcouf and Gonzalez-Rincones (1912:271-272); Townsend (1934:493, ?).

Cellia albipes of Theobald (1903:110-113; 1905a:15-17; 1905b:11); Prout (1909:487).

Nyssorhynchus cubensis of Blanchard (1905:204-205); Surcouf and Gonzalez-Rincones (1912:272-273).

Cellia argyrotarsis (!) of Theobald (1905a:4; 1905b:11; 1907:105; 1910:68); Prout (1909:487).

Anopheles argyrotarsis (!) of Theobald (1901:123-125); Johnson (1919:425).

Laverania argyrotarsis (!) of Theobald (1902:183).

Anopheles (Nyssorhynchus) rondoni of Martini (1935:14, 24).

FEMALE (fig. 5). Wing: 3.16 mm. Proboscis: 2.05 mm. Palpus: 1.95 mm. Forefemur: 1.45 mm. Abdomen: about 2.5 mm. **Head:** Integument brown to dark brown. Interocular width 3, 4 ommatidial diameters. Proboscis about 1.4 length of forefemur. Posterior vertex and occiput with large, erect, white, truncate, weakly forked scales becoming darker posteriorly; anteriorly, vertex with a few, small, obovate, decumbent scales along upper orbitals and longer, narrow, white, decumbent scales along interorbital line. Frontal tuft with 14-20 long, white, setiform scales. Proboscis brown to dark brown, with decumbent scales and short setae; appearing

metallic dark copper when viewed at angle; labella lighter than labium. Palpal segments 1-3 predominantly same color as labium; segments 2, 3 with a small cream to white band at apex; segment 4 either all dark or yellow to golden brown on mediolateral surface, never white or cream; segment 5 white. **Thorax:** Pruinose areas of scutum silver gray to reddish; nonpruinose regions light brown to dark brown. Median anterior promontory area with 10-15 long, erect, white scales and a few, long, light setae. Upper humeral tuft scales similar to those on median anterior promontory, lower tuft scales shorter, darker and obovate or cuneate. Prescutellar region moderately large, dark, horseshoe shaped to triangular; bare space extending onto median portion of scutellum. *Ppl* with 1, 2 long, dark setae. *Sp* with about 2-8 light setae and a few, lanceolate, light scales. *Pra* with 5-10 long, dark setae and a patch of long white scales. Upper *stp* with 2-4 long, dark setae and approximately 10 cream to yellow, truncate, spatulate scales in a horizontal arc. Lower *stp* with 1, 2 long, dark setae and a small patch of scales similar in shape and color to those on upper *stp*. Upper *mep* with 5-10 long, dark setae oriented horizontally or diagonally; scales absent. **Legs:** Light scales on coxae generally white. Femora and tibiae as in section description; midfemur with anteroapical spot and knee spot moderate to large. Foretarsal segment 1 with less than apical 0.15 cream to white; segment 2 cream to white in apical 0.15-0.35; segment 3 cream to white in apical 0.1-0.6; segments 4, 5 normally all brown, occasionally apex of 5 with cream to light brown scales; specimens from Caribbean islands with smaller apical light bands on foretarsus. Midtarsus usually with fewer extensive light areas than in Oswaldoi Subgroup, appearing very dark; segment 1 and occasionally 2 with a very small, golden, apical band; segments 3, 4 without an apical light band; segment 5 with or without a golden apical band. Hindtarsal segment 1 with a yellow to white apical band, often indistinct; segment 2 dark in basal 0.4-0.6 (0.4-0.8); apical portion of segment 2 and all of segments 3, 4 white; very rarely base of segments 3,4 with a brown ring; segment 5 brown in about basal 0.5, remainder cream to white. **Wing:** Apex moderately rounded, not strongly tapered. Light spots normally cream, particularly on veins C and R; dark spots varying from light brown to almost black; considerable variation in lengths of light and dark spots. Vein C usually with large dark spots; presectoral and/or sectoral light spots often absent; C humeral light spot about 1.0-2.0 (0.95-2.50) of basal dark spot (basal dark spot usually greater than or equal to 0.5 of humeral light spot); subcostal light spot about 0.25-0.40 of subcostal dark spot; preapical light spot 0.25-0.45 of preapical dark spot. R with 2 dark spots, presectoral and sectoral, moderately long and subequal in length. R_{2+3} about 0.5 of R_2. Rs-R_{2+3} predominantly dark, with 2 or 3 usually small, light spots. Base of M usually light followed by a moderately long to long sectoral dark spot; preapical dark spot of variable length. Cu sectoral dark spot not reaching furcation. Vein A subcostal dark spot moderately large, about 0.2 length of vein. Apical light fringe spot small to moderate; small, inconspicuous, light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen:** Integument of tergites brown to dark brown; occasionally light mottling present on segments II-VII. Tergite I with light to dark, long setae laterally and along apical margin; without scales. Long setae in posterior 0.5-0.7 of tergites I-VII, and on mediolateral, lateral and apical margins; shorter setae more medially. Tergites II-VII with cream to golden, small, obovate scales in subtriangular pattern in proximal segments, and more extensive subrectangular pattern in apical segments; occasionally with darker median scales on tergites II-VII; caudolateral margin with large, conspicuous, outstanding, dark scale tufts on segments III-VII. Sternites II-VII with submedian and apical setae and submedian

white scales; caudomedian and caudolateral dark scale tufts on sternites III-VII similar to those on tergites, with a few light scales occasionally interspersed. Sternite VIII densely covered with small, cream to golden scales, medially with longitudinal stripe of dark scales.

MALE (fig. 5). Wing: 3.05 mm. Proboscis: 2.35 mm. Forefemur: 1.5 mm. Abdomen: about 2.75 mm. Essentially as in female except for sexual characters. **Head**: Palpal segment 4 with a basal and an apical dark band; mediolaterally with mixed light and dark scales; extreme base and apex with a few light scales; ventral surface usually dark scaled. **Antenna**: About 0.7 length of proboscis. **Legs**: Forefemur 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 5-8 moderately long, spiniform setae; setae longest toward apex. Claw on foreleg long, slightly curved; submedian tooth about 0.25 length of claw, acuminate and recurved at apex; external basal tooth subequal to submedian tooth and decurved.

MALE GENITALIA (fig. 8). **Segment VIII**: Tergite and sternite medially with numerous broad scales; scales more densely distributed on tergite. Posterior border of sternite with row of long setae. **Segment IX**: Sternite short, curved and subrectangular, anterior border almost parallel with posterior border, tapering at lateral margins. Slight, inconspicuous, ribbonlike, nonspiculose thickening (anterior apodeme) along anterior border of sternite. **Sidepiece**: Moderately narrow. Tergal surface usually with 4, 5 long, submedian tergomedial bristles and one long apicolateral bristle at base of clasper. Bristles laterad and mesad of tergomedial bristles 0.5 length of tergomedial bristles. Parabasal spine usually at least 2.0 length of its tubercle. Accessory spines long; longer more dorsal spine about 0.5 length of sidepiece; more ventral spine 0.58-0.70 of dorsal spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Ventromesal margin with row of short spicules. Spiniform narrow and moderately short, subequal to seta *b*. **Dorsal Claspette**: About 0.5 length of sidepiece. Pedicel moderately long and narrow; base moderately curved mesad. Leaflets broad and lanceolate; longest equal to or slightly less than 0.5 length of claspette; basomesal projection of dorsal leaflet small. **Ventral Claspette**: About 0.32-0.40 of sidepiece; without setae; apex of ventral lobe produced into a pair of rounded, striated lobes, separated by a moderately shallow median sulcus. Immediately basad of sulcus a very small, circular to oval, weakly sclerotized preapical plate. Ventral surface of basal lobule produced into a large, inflated, ovoid, bulbous lobe, often deflated and not apparent on slide. **Phallosome**: Aedeagus about 1.4 length of ventral claspette; moderately wide; apex rounded, slightly broader than long, with distinct membranous border; without leaflets; subapical, ventromesal, triangular projections nearly meeting or meeting on midline of ventral surface.

PUPA (fig. 8). Abdomen: 2.7 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Strongly pigmented, light brown to dark brown. Wing cases often with longitudinal dark stripes. Hairs 1-3-C 1-3 branched; 2-C shorter and weaker than 1,3-C. Hairs 4,5-C of subequal length; 4-C 2,3 branched (1-3); hair 5-C 2,3 branched (1-4). Hair 6-C single or forked. Hair 7-C 2-4 branched (2-5) near base, often one branch longer than other(s). Hairs 8,9-C subequal in length; 8-C single (1-3 branched), heavy; 9-C 1-3 forked about 0.3-0.5 from base. **Trumpet**: Weakly pigmented, light yellow to brown. Pinna moderately sclerotized and open; long, about 3.3-4.0 (2.9-4.5) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft broad, and pointed or rounded at base. **Metanotum**: Hair 10-C single, subequal to 11-C. Hair 11-C 2-4 branched (2-6). Hair 12-C 1,2 forked 0.25-0.50 from base, 1.5-2.0 length of 10-C. **Abdomen**: Hairs with fewer branches in general than remaining species in section. Strongly pigmented, light

brown to dark brown, often with darker, median, longitudinal stripe. Float hair 1-I with 8-13 major branches, extensively dendritic apically. Hair 2-I 3-5 forked (2-6) about 0.5 from base, moderately developed; 3-I single, subequal to 2-I. Hair 4-I 3-6 forked (3-7) about 0.3-0.5 from base. Hair 5-I single to triple, long. Hair 6-I single, very long, usually 2.0 length of 7-I. Hair 7-I 2-4 branched. Hair 9-I single, very long, slightly shorter than or equal to 6-I. Hair 0-II-IV 2-5 branched (2-6); 0-VII 1-3 branched (1-5). Hair 1-II 5-9 branched (5-11); 1-III 3-6 branched (2-7); 1-IV-VII single or rarely double, very long, about 1.5-2.0 length of segment; 1-IV slightly shorter than 1-V-VII. Hair 2-III 3-5 branched (2-6). Hair 3-IV 3-6 branched (3-7), inserted very close to hair 4-IV; 3-V 1-3 branched. Hair 5-III 4-8 branched (4-10), large. Hair 6-II single, very long, 2.0 or more length of 7-II; 7-II 2-5 branched (2-6). Hair 6-III-VI single, long. Hair 7-III-V 2-5 branched (2-6), small to moderately small. Hair 8-III-VII 2-5 branched (2-6), small. Hair 9-II very small, unpigmented; 9-III pigmented, small, about 2.0 length of 9-II; 9-IV thick, about 2.0 of 9-III and 0.3 of 9-V,VI; 9-V-VII slightly curved, acuminate; 9-VIII almost straight; 9-VII,VIII long, about 0.5 of segment and about 1.2 of 9-V,VI. Hair 10-III 2,3 branched (1-4), moderately long. Hair 4-VIII 1-3 forked. **Terminal Segments**: Apex of male genital lobe with small, short, moderately distinct, mammilliform protuberance; lobe broad and heavy. **Paddle**: Large, obovate, broad and emarginate at insertion of hair 1-P. Midrib with lateral margin more sclerotized than mesal margin, distally becoming indistinct. External buttress 0.65 length of paddle, distally very finely serrated; moderately distinct, short (0.02 mm), fine, filamentous spicules distad of buttress, extending around apex a short distance and becoming shorter along inner margin. Hair 1-P single, long (0.1 mm); 2-P 1,2 forked, subequal to 1-P.

LARVA (fig. 9). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.45 mm. **Head**: Integument usually extensively mottled, varying from greenish brown to dark reddish brown. Collar moderately wide (about 0.06 mm) and dark. Mental plate strongly sclerotized, almost black; median tooth moderately broad, about 1.5 as wide as adjacent tooth, tapered to a point. Inner clypeal hair (2-C) with about 8-10 barbs; outer clypeal (3-C) plumose with 8-10 short to moderately long branches; hairs 2-C widely spaced, clypeal index about 1.25. Hair 4-C single or forked apically, moderately long to long, usually extending to anterior margin of head capsule. Hairs 8,9-C 2,3 branched (2-4), large. Hairs 10,12-C 2-4 and 3-5 (3-6) branched respectively, moderately large. Hairs 13,15-C dendritic, strong and fairly long. **Antenna**: Mesal margin with numerous, moderately stout, acuminate spicules; ventral surface with fewer, shorter, stouter spicules; few or no spicules on dorsal surface. Hair 1-A 2-4 branched (2-5), small, slightly longer than width of antenna, inserted on basal third of antenna. Hair 4-A 2,3 forked (2-6), long. **Thorax**: Integument moderately to extensively pigmented, tawny to dark brown. Hair 1-P plumose, with a short to elongate flattened shaft and 21-24 (12-27) filiform branches; 2-P like 1-P but longer, 19-21 branched (19-29); hairs 1,2-P sharing common tubercle. Hair 9-P pectinate with 4-6 (4-7) long branches, long, subequal to 10-P. Hairs 10,12-P single and long. Hair 11-P 2,3 forked (2-4). Hair 14-P 5-10 branched (5-12), with a short flattened stalk. Hair 1-M 31-36 branched (21-46), with a broad, elongate, flattened shaft. Hair 2-M usually forked, 1-3 branched. Palmate hair 3-T with 10-14 (9-16) unsclerotized, moderately long, lanceolate leaflets. Hair 9-T pectinate with 3-5 branches (1-7) in apical half, very long. **Abdomen**: In general, the hairs with fewer and longer branches than in remaining species. Hair 0-II-VI 2-4 branched (2-6); 0-VI smallest; 0-VII 2 branched (1-4), small. Palmate hair 1-I with 12-14 (11-17) semitransparent, lanceolate leaflets; 1-II-VII with long, broad, heavily pigmented, lanceolate leaflets; 1-II,VII

smaller than 1-III-VI. Hair 2-II,III 3,4 branched (2-4), large; 2-IV,V single or rarely double, long; 2-V about 2.0 length of 2-IV. Hair 5-I 3 branched (3,4), moderate in size, located close to lateral margin; 5-III 5-9 branched (4-10), large. Hair 11-I 3,4 branched (2-5), large. Hair 13-I 3,4 branched (2-4), moderately large; 13-II 5,6 branched (3-8), moderately large; 13-III,IV 3,4 branched (2-4), large; 13-V 3-5 branched, very large; 13-VI 6-9 branched (3-10), moderately small. Tergal plate VII usually less than 2.0 size of plate VI. **Spiracular Lobe**: Pecten with 14-18 (13-21) acuminate teeth and with a conspicuous row of thin spinules on basal half of dorsal surface; teeth usually as follows beginning ventrally: (1) 1 long, (2) 5-12 mixed short to moderate, occasionally with a long interspersed, (3) 1 long, (4) 3-5 mixed short to moderate and (5) 2,3 long or combination of short and long. Lateral arm of spiracular apparatus very short to short, extending a short distance below the spiracular openings. Hairs 8,9-S 3,4 forked (2-5), with moderately long branches. **Anal Segment**: Hair 1-X single, very long, about 2.0 length of saddle, strongly developed; almost always inserted on saddle. Fine spicules over surface of anal segment except at base; spicules along apical border stronger and longer. Ventral brush (4-X) with 8 pairs of strongly developed, plumose hairs. Anal gills usually shorter than or equal to length of saddle, occasionally very short.

DISCUSSION. The monotypic Albimanus Group can be distinguished from the Oswaldoi Group in the **female** by the combination of (1) palpal segment 4 all dark or yellow to golden brown on mediolateral surface, never white or cream, (2) dark caudolateral scale tuft absent from abdominal segment II and (3) foretarsal segment 5 usually all dark; in the **male genitalia** by (1) sternite IX short, subrectangular, (2) ventral claspette completely without setae and with ventral surface produced into a pair of large, inflated, ovoid, bulbous lobes, (3) preapical plate very small, circular to oval, weakly sclerotized and (4) apex of ventral claspette rounded with a shallow median sulcus; in the **pupa** by the combination of (1) pinna of trumpet long, broad medially and appearing tapered toward apex, (2) hair 2-I 3-5 forked (2-6) about half distance from base, moderately developed, (3) hair 9-I very long, slightly shorter than or equal to 6-I, (4) hair 6-II single, very long, 2.0 or more length of 7-II, (5) hair 9-IV about 2.0 length of 9-III and (6) hair 9-VII,VIII long, about 0.5 length of segment; and in the **larva** by the combination of (1) inner clypeal hair (2-C) barbed and clypeal index about 1.25, (2) hair 4-C moderately long to long, (3) hair 1-P plumose with filiform branches, (4) hair 9-P,T pectinate, (5) hair 13-I,III,IV few branched, moderately large to large and (6) hair 1-X almost always inserted on saddle.

The external morphology of *albimanus* is very constant throughout its range. Usually the amount of intrapopulational variation is as great as or greater than the variation which occurs among populations, with the following exceptions. Many adults from southern Texas exhibit a greater proportion of dark basal banding on hindtarsal segment 2, often as much as 0.8 the length of the segment. Adults from the Antilles usually have proportionally smaller light areas on the foretarsus than those from the mainland. The extreme condition was observed in 4 specimens from Barbados that completely lack light apical rings on foretarsal segments 2 and 3. Similarly, hindtarsal segment 5 is predominately dark in several adults from Puerto Rico. The pupae from the Antilles often exhibit a greater number of branches than mainland specimens on many of the abdominal hairs. Noticeable characters in the larvae which vary among populations from different islands in the Antilles and also among different populations on the mainland are, (1) length of the median shaft of hair 1-P, which is usually moderately long but occasionally very short, (2) number and arrangement of pecten teeth and (3) size of the anal gills. Another variation, although not showing any

geographical pattern, occurs in several adults from Guayaquil (Ecuador), Acapulco (Mexico) and Barcelona (Venezuela); palpal segment 4 may be predominately light creamish brown, similar to that of *triannulatus*. Several of the specimens from Barcelona have a light apical band on foretarsal segment 4, also similar to that of *triannulatus*.

The small amount of morphological variation in *albimanus* is correlated with its genetic compatability and the stable banding pattern of the salivary chromosomes found among populations from several different localities. Hobbs (1962) examined 5 laboratory strains of *albimanus* from El Salvador, Guatemala, Mexico, Jamaica and the Gorgas Memorial Laboratory colony in Panama. He found that there were no heterozygous inversions and that the Mexico, El Salvador and Panama strains were interfertile. He concluded that there was no evidence for the existence of isolated strains and that *albimanus* is not polymorphic to any great degree. Similarly, Keppler and Kitzmiller (1969) showed complete reciprocal fertility between 4 field populations of *albimanus* from Mexico, Guatemala, Nicaragua, Costa Rica and one laboratory colony from El Salvador. Keppler, Kitzmiller and Rabbani (1973) examined the salivary chromosomes from the above 5 strains and found them to be "remarkably uniform," and after examining over 1000 slides discovered no individuals heterozygous for an inversion.

I believe that *albimanus* diverged from the main phyletic line very early in the evolution of the Albimanus Section (fig. 4). *An. albimanus* is the least derived species in the section and retains several ancestral characters which it shares with several species in the Argyritarsis Section of *Nyssorhynchus*. Almost none of these ancestral characters are found in the Oswaldoi Group except for a few in *triannulatus*. These characters are essentially those that distinguish the adult, male genitalia and larva of *albimanus* from the Oswaldoi Group, with the exception of the development of hair 9-P,T in the larva and the short ninth sternite in the male genitalia; the latter 2 characters seem to be derived since they occur nowhere else in the section.

Cytogenetically, *albimanus* is also quite distinct. In comparing the salivary gland chromosomes of *nuneztovari* with *albimanus, aquasalis* and *An. (Nys.) darlingi*, Kitzmiller, Kreutzer and Tallaferro (1973:443) stated that the similarities between *nuneztovari* and *albimanus* are not as "striking" as between *darlingi* and *aquasalis*. With respect to the banding of salivary chromosomes, *aquasalis* seems to be more like *darlingi* (of the Argyritarsis Section) than like *albimanus*. In comparing 3 species (*aquasalis, oswaldoi, albimanus*), Kitzmiller and Chow (1971:80-81) saw more homology between the salivary chromosomes of *aquasalis* and *oswaldoi* than they did between *aquasalis* and *albimanus*. Further they state, "If the *albimanus* salivary gland map is used as the standard map, it seems that many bands may probably have been added to *aquasalis* and *oswaldoi* by some process, perhaps duplication or translocation during evolution." The combination of these findings clearly indicate that *albimanus* is relatively remote from the remaining species in the Albimanus Section.

An. albimanus most likely evolved somewhere in Central America, radiating from its center of origin north and south along the Pacific and Atlantic seaboards. The species probably invaded the Greater Antilles via or south of the Yucatan Peninsula, becoming distributed throughout the Greater Antilles and the larger, more northern islands of the Lesser Antilles. Why *albimanus* has not invaded the southern islands of the Lesser Antilles is not known. The most likely explanation is that *albimanus* is still radiating from its center of origin and therefore has not yet been able to colonize the more southern islands in the Lesser Antilles. The rate at which colonization occurs is dependent on many factors and is different for each individual species. There

is considerable evidence that the Lesser Antilles are geologically more recent than the Greater Antilles (Martin-Kaye 1969; LePichon and Fox 1971), which *might* partially explain why *albimanus* has not yet extended its distribution into the Lesser Antilles.

Hoffmann (1938:176-178) described 2 interesting variations or mutants of *albimanus* (*bisignatus* and *trisignatus*) from the states of Tamaulipas and Veracruz, Mexico. These 2 "varieties" are distinguished by *bisignatus* having an additional black ring at the base of hindtarsal segment 3, and *trisignatus* having extra black rings at the bases of hindtarsal segments 3 and 4. Rozeboom (1963) established a colony of *bisignatus* and found that *trisignatus* individuals were fairly common in the F_4 generation. He stated that *trisignatus* apparently represents a more marked expression of the *bisignatus* gene or genes and that the trait was recessive. The occasional occurrence of these mutants probably led Martini (1935:24) to report *rondoni* from Mexico, most likely based on a female of *bisignatus*. I have examined specimens exhibiting either of these characters from Costa Rica, Guatemala and Texas.

BIONOMICS. Because of its medical importance, the literature on the bionomics of *albimanus* is voluminous. Several good reviews and/or studies concerning the natural history of *albimanus* include Breeland 1972a, c; Central America Malaria Research Station 1969-1972; Horsfall 1955:172-177; and Foote and Cook 1959:112-113.

The immatures have been found in the following aquatic habitats by the project "Mosquitoes of Middle America": potholes, drainage areas, spring seepages, borrow pits and ground pools (33%); ponds, lakes, dam spills and reservoirs (16%); streams and canals (21%); ditches (6%); swamps (6%); marshes (5%); crab holes (4%); animal and vehicle tracks (4%); rock holes (1%); and miscellaneous (4%). The immatures are tolerant of brackish water and were found in brackish habitats in about 3% of the collections. Previous studies indicate that *albimanus* can tolerate water up to and possibly greater than 0.67 seawater (Taylor 1966:394; van der Kuyp 1953; Horsfall 1955:172-177; Central America Malaria Reaearch Station 1970). The immatures are almost always collected in full sunlight or partial shade, although occasionally they are collected in deep shade. The breeding sites are usually characterized by abundant vegetation with scum and algae, and often are turbid with a muddy bottom. The immatures are often collected in polluted waters. The breeding sites are usually found in areas of secondary growth such as plantations, open woodlands and meadows. Aquatic plants often associated with the immatures are *Pistia* sp, *Elodea* sp, *Naias* sp, *Chara* sp and *Utricularia* sp.

At least 51 species in the family Culicidae have been found associated with *albimanus* including 2 species of the Albimanus Section, *triannulatus* and *aquasalis*. *An. albimanus* was most often collected with the following species in the majority of the habitats in which this species occurs: *Culex (Mel.) atratus, Cx. (Mel.) erraticus, Cx. (Cux.) nigripalpus, Cx. (Cux.) coronator* group, *Anopheles (Ano.) grabhamii, Uranotaenia (Ura.) socialis*; and to a lesser extent, *Psorophora (Gra.) confinnis* group and *Cx. (Mel.) pilosus*. Species commonly found in ground pool type habitats with *albimanus* are *An. (Ano.) neomaculipalpus, An. (Ano.) pseudopunctipennis, Aedes (Och.) taeniorhynchus, Ae. (Och.) tortilis, Ae. (Och.) scapularis, Cx. (Mel.) bastagarius, Cx. (Mel.) chrysonotum, Cx. (Mel.) dunni, Cx. (Mel.) educator, Cx. (Mel.) iolambdis, Cx. (Mel.)* spp, *Ur. (Ura.) geometrica* and *Ur. (Ura.) lowii*; and occasionally *An. (Ano.) apicimacula, An. (Ano.) punctimacula, Ae. (Och.) angustivittatus, Ae. (Och.) sollicitans, Cx. (Mel.) conspirator, Cx. (Cux.) declarator* group, *Ur. (Ura.) pulcherrima, Ps. (Gra.) cingulata* group, *Ps. (Gra.) jamaicensis* and *Chagasia* sp. Species associated with *albimanus* in ponds, lakes and marshes are *An. (Ano.) crucians, Aede-*

omyia (Ady.) squamipennis, Cx. (Mel.) madininensis, Cx. (Mel.) ocossa, Cx. (Cux.) maracayensis (?), *Mansonia (Man.) dyari, Ma. (Man.) titillans, Ps. (Gra.) pygmaea, Ur. (Ura.) apicalis, Dixella* sp, *Corethrella* sp 23 and *Co.* sp 36. In streams and ditches the following have been collected with *albimanus*: *An. (Nys.) argyritarsis, Cx. (Mel.) inhibitator* and *Ps. (Pso.) howardii*. Found rarely with *albimanus* in crab holes have been *Cx. (Cux.) habilitator, Cx. (Cux.) janitor, Deinocerites pseudes* and *De. cancer.*

An. albimanus is primarily restricted to the humid lowlands of Middle America, being most numerous up to an altitude of about 400 m, but occasionally it is collected at higher elevations. Molley (in Hoffmann 1932:528) collected *albimanus* near Guatemala City, Guatemala at 1372 m, and Clark in the same paper claims to have collected *albimanus* at 915 m in Costa Rica and 457 m in Haiti. The highest recorded altitude I have found was in Morelia, Mexico at 1941 m (Vargas and Martinez Palacios 1950:5).

The seasonal distribution of *albimanus* seems to vary from one locality to the next. Rachou, Lyons *et al.* (1965:37) stated that in El Salvador, in 6 of the 8 localities studied, *albimanus* was most abundant during the wet season and, in 2 of the 8, was most numerous during the dry season. The Central America Malaria Research Station (1969, 1970) and Breeland (1972b) reported that in some areas along the Pacific Coast in El Salvador, *albimanus* is predominant during the dry season because of the abundance of estuaries, rivers and permanent bodies of water along streams that get flushed out during the rainy season. However, in other areas *albimanus* is most abundant during the rainy season, in habitats such as ditches, flooded pastures and marshes (Breeland 1972a; Kumm and Zuniga 1944; Vargas and Martinez Palacios 1953; Paul and Bellerive 1947:63-66; Elliott 1968:242).

Most reports indicate that the adults of *albimanus* are most active from dusk to midnight (Breeland 1972a), sometimes beginning a little later, as in Colombia at 2200-2400 hours (Elliott 1972:757) and occasionally earlier, 1730-2100 hours in Haiti (Taylor 1966). Daytime adult resting sites include almost any protected area such as large rocks in wooded areas (Breeland 1972c; Central America Malaria Research Station 1970). Wilton and Fetzer (1972) showed human breath stimulated mating, which was at a maximum one hour after sunset in the laboratory, agreeing with the time Rozeboom (1941) observed in nature.

Taylor (1966) reports that in Haiti 75-92% of the biting activity was outdoors. Elliott (1968) also found that biting is greater outdoors than indoors. However, several workers report that in some areas, *albimanus* is the predominant mosquito biting indoors. Kumm, Komp and Ruiz (1940:388-389) stated that 96.4% of the anophelines captured in houses in Costa Rica were *albimanus* and 93.3% of those collected in stables. Kumm and Zuniga (1942:400) reported that in El Salvador, 87.6% of the house captures were *albimanus*. The conclusion of the 1970 report of the Central America Malaria Research Station was that *albimanus* may be more zoophilic than anthropophilic and more exophilic than endophilic but because of the "overwhelming" numbers becomes a serious problem. Host preference tests generally indicate that *albimanus* feeds principally on man and domestic animals, such as horses, cows, pigs, dogs, goats and chickens, and on nondomestic animals such as raccoons. It also prefers larger hosts to smaller (Breeland 1972a; Central America Malaria Reaearch Station 1970; Taylor 1966; Hill 1934; Thompson 1950; Weathersbee 1944).

An. albimanus is capable of flying considerable distances. LePrince and Orenstein (1916:114) released adults marked with an aqueous solution of an aniline dye, and recaptured individuals 366 to 1905 m from the release site. Hobbs, Lowe and Schreck (1974) reported release-recapture studies using fluorescent powders during

the dry season in El Salvador; 85,750 adults were released of which 924 were recaptured up to 11 days after release. The maximum distance the mosquitoes traveled was 3 km from the release site. The females were recaptured an average of 548 m from the release site and the males an average of 460 m. Lowe, Schreck *et al.* (1975) performed the same experiment at the same locality during the wet season, finding that the adults survived up to 14 days and were captured an average of 1000 m from their release sites.

MEDICAL IMPORTANCE. Kumm (1941a) stated that in 17 of 20 countries in the Caribbean region *albimanus* is the principal vector of malaria. Throughout its range *albimanus* is a very important vector of malaria except on the islands of Guadeloupe and Marie Galante in the Lesser Antilles. In some areas such as El Salvador it may be the only vector (Breeland 1972a). As early as 1909 Darling experimentally infected *albimanus.* He fed 100 mosquitoes on patients infected with *Plasmodium vivax* or *P. falciparum* and found 70.8% of the females became infected. Rozeboom (1938b:291-292) in one experiment infected 87.5% of the females of *albimanus* feeding on a patient with *P. falciparum.* For all Rozeboom's experiments in which a total of 113 *albimanus* fed on infected patients, 32.7% became experimentally infected.

Hill (1928:355) was the first to report finding *albimanus* naturally infected. Since then *albimanus* has been reported to be naturally infected in virtually every country in which it occurs. In general, natural infection rates have been reported to be exceptionally low. At the Central America Malaria Research Station (1970) a total of 434 salivary glands and 241 midguts of different females were dissected and none was infected. Likewise, Rozeboom (1938b:297) reported a natural infection rate of 1.1% in Santa Rosa, Panama. Because of the low infection rate, *albimanus* is considered by many to have the attributes of a relatively poor malaria vector. Nevertheless, Hobbs, Lowe and Schreck (1974) stated that even during the dry season *albimanus* is capable of surviving 11 days, a time long enough to become infective. The reason that *albimanus* is such an effective and successful vector is probably partly dependent upon its longevity and most importantly "because of its close contact with human populations and its relatively high population level . . ." (Belkin, Heinemann and Page (1970:26).

Warren, Richardson and Collins (1975) described 4 inbred morphological pupal phenotypes (pupal pleiomorphism) of *albimanus* that had been selected from a strain "established in September-October 1971 from female mosquitoes collected in stables near Lake Apastepeque, El Salvador." Interestingly, Warren, Collins *et al.* (1977) reported that the females of 3 of these phenotypes show considerable variation in their susceptibility to infection by *Plasmodium* sp. Their results indicate that all the phenotypes are much less susceptible to infection with *P. falciparum* than with *P. vivax.* The relative susceptibility of the different variants to infection with *P. vivax* was as follows: the green nonstriped phenotype was the most refractory; the brown, nonstriped phenotype intermediate; and the brown striped the most receptive.

A possible arbovirus in the Bunyamwera Group has been isolated from *albimanus* in Tlacotalpan, Veracruz, Mexico (Scherer, Campillo-Sainz *et al.* 1967). The Tlacotalpan virus was recovered in 1961 from 160 specimens collected at a pig baited, modified Magoon trap. The native population, cattle and pigs at several localities along the southeastern coast in the states of Veracruz and Tabasco, and one cow from the western central coast in the state of Nayarit showed antibodies to the virus.

Recently, Bautista-Garfias, Mercado-Sanchez and Morilla-Gonzalez (1977) experimentally infected females of *albimanus* with Venezuelan Encephalitis virus TC-83

by permitting them to feed on infected suckling mice. In a second experiment, 10, 11, 12 and 13 days after exposure to the virus, the females were again allowed to feed on mice. On their second feeding, the mosquitoes that had had an infected blood meal 10 days earlier transmitted the virus to one of the 6 mice to which they were exposed. The infected mouse died on the fifth day after exposure, and the virus was then "isolated and neutralized with a specific VEE antiserum."

DISTRIBUTION (fig. 1). *An. albimanus* is predominantly a tropical lowland species most abundant at elevations less than 400 m and occuring in greatest abundance in coastal plains or along waterways running to the coast. *An. albimanus* occurs as far north as the Brownsville area in Texas on the Gulf of Mexico. It extends south through Mexico and Central America and east along the Caribbean coast of Colombia to the Paria Peninsula in Venezuela. On the Pacific side it extends from Baja California Sur, Mexico to northern Peru (Piura). *An. albimanus* occurs commonly throughout the Greater Antilles, the Bahamas, the Florida Keys, the Cayman Islands and the Leeward Islands in the Lesser Antilles as far south as Montserrat and Antigua; it is found only occasionally on Guadeloupe (Basse Terre) and Marie Galante. *An. albimanus* does not occur in the Windward Islands of the Lesser Antilles, Trinidad, Tobago or farther southeast than the Paria Peninsula in Venezuela. It was reported to have occured in the past on Barbados (Charles and Senevet 1953; Rozeboom 1953), but it has not been found there recently.

Material Examined: 5467 specimens: 1026 males, 142 male genitalia, 2566 females, 624 pupae, 1109 larvae; 516 individual rearings: 228 larval, 214 pupal, 74 incomplete.

ANTIGUA (258 specimens: 32M, 10Mgen, 33F, 57P&p, 126L&l; 44 ind rear:22 l, 19p, 3inc). **St. George**: Emersons Pond, ANT 34. Fitches Creek, ANT 66, 67. **St. John**: Golden Grove Mill, ANT 32, 57. Potters, ANT 52, 53, 79. **St. Mary**: Bolands, ANT 61. **St. Paul**: Liberta, 8 Sep 1938, H. Box, 1M [BM1939-219] ; same locality, ANT 89, 91. **St. Peter**: All Saints, ANT 36. **St. Philip**: Freetown, ANT 69, 70, 72, 73, 75, 76. **Parish and locality not specified**: 11 Apr 1900, W. Forrest, 1F on slide [BM] ; 27 Nov 1900, same collector, 1M; 2 Dec 1900, same collector, 2F.

BAHAMA ISLANDS. Eleuthera (Island) (14F): Governor's Harbour, 31 Mar 1953, L. Giovannoli, E. Hayden, 3F. James Cistern, 1 Apr 1953, L. Giovannoli, E. Hayden, 11F. **New Providence** (Island) (55 specimens: 2M, 3F, 12P&p, 38L&l; 8 ind rear: 5p, 3inc): Harold Pond, BAH 46. Lake Cunningham, BAH 3. Yamacraw Beach, BAH 18. **San Salvador** (Island) (3F): Cockburn Town, 18 Mar 1953, L. Giovannoli, 2F. Locality not specified, 4 Sep 1923, P. Bartson, 1F.

BARBADOS (1M, 3F). Locality not specified, received 24 Apr 1928, 1M, 3F [JH].

BARBUDA (2L). Low Pond, 5 Jul 1955, Hummelinck, 2L.

BELIZE (170 specimens: 17M, 2Mgen, 150F, 1 l). **Belize**: Belize, BH A164; same locality, KO 115A-13, 14, 1M, 20F. Freetown, BH A186. Ladyville, BH 362. **Cayo**: Cayo, BH L37. Central Farm, BH L20. **Corozal**: Locality not specified, KO 115A-19, 5M, 30F. **Stann Creek**: Stann Creek, 30 Jul 1941, W. Kumm, 11F; same locality, KO 115A-17, 6M, 45F; same locality, KO 115A-23, 1M, 12F; same locality, KO 115A-24, 1M, 16F; same locality, 1F; same locality, 1M. **Toledo**: Punta Gorda, 9F; same locality, KO 115A-12, 1F. **District and locality not specified**: 1F.

CAYMAN ISLANDS. Grand Cayman (Island) (47 specimens: 3M, 2Mgen, 37F, 1P, 4L): North Sound Estate, CAY 119. West Bay, CAY 2, 10B. Locality not specified, CAY 11A.

COLOMBIA (30 specimens: 24M, 5Mgen, 1F). **Atlantico**: Calamar, 1966, J. Bequaert, 1F [MCZ]. **Cordoba**: Monteria, COL 421, 422.

COSTA RICA (179 specimens: 33M, 14Mgen, 100F, 19p, 13L&l; 16 ind rear: 7 l, 9p). **Cartago**: Atirro, CR 590. Concepcion, 26 Oct 1920[?], A. Alfaro, 5F. Turrialba, CR 394; same locality, 6, 7, 19 Sep 1920, A. Alfaro, 7F. **Guanacaste**: Liberia, 27 Jul 1962, F. Truxal, 1F; same locality, H. Kumm, 1Mgen [CU]. Palo Verde, CR 438. **Heredia**: Bolson, Jan 1921, A. Alfaro, 7F. **Limon**: Bananito, CRR 53, 1F. Cahuita, H. Kumm, no. 183, KO H-18-9, 1M. Finca La Lola, CR 160. Limon, F. Knab, no. 3151a, 1F; same locality, 1F (A-20) [CU] ; same locality, 1F. Matina, 16 Jul 1925, CRR 20, 3M, 8F; same data, CRR 21, 4F; same data, CRR 22, 6F; same data, CRR 25, 3F;

same data, CRR 26, 4F; same data, CRR, 27, 3F; same data, CRR 28, 2F; same locality, 3 Sep 1925, CRR 37, 1F. Pueblo Nuevo, CR 546. Puerto Viejo, 12, 15, 16 Jan 1921, A. Alfaro, 4F. Westfalia, CR 473. Zent, CR 543; same locality, 15 Jul 1925, CRR 16, 1F; same data, CRR 17, 2F; same locality, 2 Sep 1925, CRR 36, 1F. **Puntarenas**: Boca del Rio Barranca, CR 1, 29. Dominical, 28 May 1943, T. Aitken, CRM 19, 1F; same locality and collector, 1943, CRM 25, 4F; same data, CRM 26, 2M, 5F. Nicoya, H. Kumm, KO H-18-5, 5M. Puntarenas, CR 117. Tarcoles, CR 569. **Province not specified:** Bamos, 1F. Barranca, H. Kumm, no. 82, 1M [BM1938-696]; same locality, 1F (82A) [CU]; same locality, 1F (A-17) [CU]. Las Canas, 2F (A-5). Margarita, 21 Jan 1930, W. Komp, 1M (var. *trisignatus*). San Antonio, 20 Jul 1925, CRR 31, 1F; same locality, 27 Aug 1925, CRR 35, 2F. Santa Cruz, 10 Dec 1937, 1F. Locality not specified, 1938, H. Kumm, CRR 132, 2M, 2Mgen.

CUBA (81 specimens: 37M, 3Mgen, 41F). **La Habana:** Habana, Oct 1900, Carroll, 1F; same locality, 14 May 1902, Taylor, 1M; same locality, Cornell U. Expedition, 1M (1027-693) [CU]. San Antonio de los Banos, J. Pazos, 1F (201). **Oriente**: Banes, 1F (22) [MCZ]; same locality, 1M, 3F (24) [MCZ]; same locality, 1M (25) [MCZ]; same locality, 1M, 1F (26) [MCZ]; same locality, 2F (28) [MCZ]; same locality, 2M, 4F (32) [MCZ]; same locality, 1F (34) [MCZ]; same locality, 2F (36) [MCZ]. Guantanamo, U. S. Naval Station, 27 Oct 1953, K. Knight, coll. 449, 6M, 5F; same data except 28 Oct, coll. 454, 1M. Guaro, 3M, 1F (6) [MCZ]. Levisa, near Nicaro, 9 Jul 1953, K. Knight, coll. 381, 1M. Preston, 2M (13) [MCZ]. **Province not specified:** Soledad, 12 Apr 1926, 2M, 4F (45) [MCZ]; same locality, 12 Dec 1926, 1F (45) [MCZ]; same locality, 1926, 1M (43), 2F (45) [MCZ]. Locality not specified, Sep 1934, 8M; J. Pazos, 12F; K. Knight, coll. 447, 1M; CUB 32.

DOMINICAN REPUBLIC (262 specimens: 29M, 7Mgen, 131F, 41P&p, 54L&l; 37 ind rear: 17 l, 18p, 2inc). **Barahona:** La Haya, Jan 1928, 2F. **Distrito Nacional:** Arroyo Hondo, RDO 4, 6. Finca Engombe, RDO 28, 39, 69, 148, 159, 200, 256, 257, 267. Rio Haina, RDO 150, 204. Naiboa, RDO 162. **El Seibo:** Rio Magua, RDO 189. **La Vega:** Jima Abajo, RDO 5. Rincon, RDO 11. **Samana:** Santa Barbara de Samana, RDO 44. **Sanchez Ramirez:** La Mata, RDO 16. **San Cristobal:** Boruga, Canada, RDO 174. La Toma, RDO 23. San Cristobal, RDO 144. San Francisco mines, RDO 181; same locality, A. Busck, Sep 1905, 1F. Villa Altagracia, 10 Jun 1941, 6M, 6F. **San Pedro de Macoris:** San Pedro [de] Macoris, 31 Mar 1928, P. Ricart, 1M. **Valverde:** Arroyo de Aqua, RDO 232.

ECUADOR (105 specimens: 12M, 1Mgen, 62F, 2p, 28L&l; 2 ind rear: 1 l, 1p). **El Oro:** Locality not specified, 1943, E. Hopkins, ECUK 43, 1F. **Guayas:** Chongon, ECU 132. Guayaquil, Jan 1939?, H. Hanson, KO 155-28, 1F; same locality, Apr 1940, J. Murdock, 5M, 10F; same locality and collector, KO 115-23, 2M, 2F; same locality, Aug 1943, KO 111-4, 1F; same locality, 4 Mar 1964, R. Schuster, GAL 16, 14F; same locality, F. Campos R., 2M, 13F; same locality, ECU 102, 177. El Triunfo, ECU 2. **Los Rios:** Pichilingue, 16 Mar 1946, E. Hambleton, 8F. **Province not specified:** Rio Milagro, Oct 1943, R. Levi-Castillo, KO 115A-4, 1M, 1F. Locality not specified, F. Campos R., 1F; R. Levi-Castillo, 6F.

EL SALVADOR (39 specimens: 11M, 7F, 9p, 12L&l; 9 l ind rear). **Cuscatlan:** Locality not specified, Aug-Nov 1940, F. Figueroa, 1M, 4F. **La Libertad:** Congrejera, SAL 56. Hacienda Melara, SAL 55. **San Salvador:** Ilopango, 1M, 1F. **San Vicente:** Laguna de Apastepegue, SAL 54. **Usulutan:** Espiritu Santo [Island], 602, 2M.

GUADELOUPE. Basse Terre (1F, 3L): Jarry, FWI 1030. Viard, FWI 943. **Marie Galante** (Island) (1M, 1Mgen, 7L): Marie Galante Airport, FWI 921. St. Louis, FWI 264. Locality not specified, LAR 16.

GUATEMALA (107 specimens: 12M, 6Mgen, 25F, 25P&p, 39L&l; 23 ind rear: 9 l, 11p, 3inc). **Escuintla:** Amatitlan, GUA 45, 46, 49. Puerto de San Jose, GUA 35. **Izabal:** El Cedro, GUA 95. Entre Rios, GUA 104. Finca Yuma, GUA 92. Morales, GUA 75. Pt. Barrios, 18 Aug 1903, W. Stone, 1F. **Peten:** Pueblo Nuevo, Nov 1941, 8F. [Laguna] San Juan Acul, Apr 1942, 2F. **Retalhuleu:** Champerico, GUA 21, 126. **Zacapa:** Teculutan, GUA 14. **Department not specified:** Esquipulas, 1939, 1M, 3F (var. *bisignatus*).

HAITI (252 specimens: 57M, 2Mgen, 117F, 37P&p, 39L&l; 19 ind rear: 8 l, 9p, 2inc). **Artibonite:** Gonaives, HAR 12. **Nord:** Limbe highway, HAR 42. **Nordouest:** La Pointe, HAT 118. **Ouest:** Arcahaie, HAT 9, 11. Carrefour, HAT 3, 7, 8. Petit Goave, HAR 33, 35. Port au Prince,

HAT 2, 109, 110, 132, 134; same locality, 30 Mar, E. Petersen, 3M, 1F; same locality and collector, Feb 1924, 1M, 1F. Thor, HAT 105. **Sud:** Godet, HAT 12. **Department not specified:** Mar Franc, 9 Jul 1941, Jobbins, 3F. P. Margot Rd., 25 Jun 1941, Jobbins, 7F. Locality not specified, Nov 1928, S. Cook, 1M, 3F; 29 Oct 1929, ?S. Cook, HAR 8; Oct 1929, S. Cook, HAC 2; 1 Jan 1930, ?S. Cook, HAR 11; 27 Jun 1941, Jobbins, 4M; no data, HAR 43.

HONDURAS (111 specimens: 11M, 1Mgen, 74F, 13p, 12L&l; 13 ind rear: 8 l, 4p, 1inc). **Atlantida:** Humazones, HON 59. Ceiba, 28 Jul 1945, 2M, 1F. Lancetilla, HON 29, 36. Las Brisas, HON 60. **Colon:** Puerto Castilla, HON 97, 99, 100; same locality, K. Maxwell, 3M, 3F. Truxillo [Trujillo] , 28 Nov 1942, J. Duncan, KO 115A-11, 48F; same data, 5F. **Cortes:** Finca Chasnigua, HON 6. Puerto Cortes, HON 67. **Tegucigalpa:** Locality not specified, Jul 1945, KO 115-3, 1M. **Yoro:** Progreso, 26 Oct 1940, W. Komp, 1F.

JAMAICA (565 specimens: 71M, 10Mgen, 117F, 167P&p, 200L&l; 143 ind rear: 60 l, 65p, 18 inc). **Clarendon:** Milk River Bath, JA 868. **Kingston and St. Andrew:** Ferry, JA 350, 781, 896. Kingston, various dates 1902-1906, M. Grabham, 9M, 5F. Newstead, JA 962. Temple Hall, JA 46, 47, 48. **St. Ann:** Claremont, JA 742. Delight, JA 757. Runaway Bay, JA 766. **St. Catherine:** Caymanas, JA 1, 4, 29, 30, 32, 210, 743, 744, 746, 747. Central Village, JA 759. Congrieve Park, JA 22. Grange Farm, JA 20. Great Salt Pond Farm, JA 26. Gregory Park, JA 16, 17, 18. Naggo Head, JA 8, 10, 11, 23. Passage Fort, JA 12. Port Henderson, JA 9. Rio Cobre Dam, JA 819. Spanish Town, JA 24, 27, 35, 36. **St. Elizabeth:** Luana, JA 357. Black River, 2F. **St. Mary:** Castleton Botanical Gardens, JA 807. Fort Stewart, JA 808. **St. Thomas:** Albion Estate, JA 803, 873. Amity Hall, JA 58; same locality, 5 Dec 1962, T. Aitken, no. 53, 1F, 1L; same locality, 11 Dec 1962, T. Aitken, no. 136, 1P, 2L, 1 l. Chiswick, JA 65. Dalvey, JA 91, 148. Duckenfield Hall, JA 54, 55. Golden Grove, JA 56, 63. Grants Pen, JA 75, 77, 413, 800, 813, 814, 871, 872. Hampton Court, JA 149. Holland Bay, JA 57. White Bay, JA 121, 169. Winchester, 4 Dec 1962, T. Aitken, no. 5, 1F; same locality and collector, 5 Dec 1962, no. 25, 3F; same locality and collector, 6 Dec 1962, no. 44, 1F; same locality and collector, 7 Dec 1962, no. 38, 1F. Winchester House, JA 67, 205. Locality not specified, Mar 1928, M. Boyd, 2M, 9F. **Westmoreland:** Crab Pond Bay, JA 782, 785. Negril, JA 231, 935. **Parish not specified:** Cave Stream, R. Hill, no. 28, 1M, 1F. Locality not specified, 7 Dec 1899, F. Cundall, M. Grabham, 1F [BM] ; 8 Feb 1900, M. Grabham, 1M, 1F [BM] ; 19 May 1905, N. Y. S., 1M, 1F; 1910, F. Theobald, 1L (396) [BM] ; 1932, Washburn, 1F [BM1933-6] .

MEXICO (212 specimens: 10M, 7Mgen, 160F, 11p, 24L&l; 10 ind rear: 5 l, 5p). **Baja California Sur:** San Jose del Cabo, 23 Jan 1979, A. Bourge, D. Pletsch, 4F. **Guerrero:** Acapulco Airport, 4 Feb 1975, D. Pletsch, 1F. **Jalisco:** Puerto Vallarta, MEX 457. **Nayarit:** San Blas, 25-29 Jun 1956, W. McDonald, 14F, 2L. **Oaxaca:** Tehuantepec, MEX 106. **Quintana Roo:** Cancun, 22 Aug 1975, D. Pletsch, 1F. **Tabasco:** Tenosique, MEX 575. Villahermosa, 20 Jan 1942, 3F. **Tamaulipas:** Gonzalez, MEX 203, 204. Padilla, MX 13. Tampico, MEX 205, 206, 207, 208. **Veracruz:** El Naranjo, MEX 101. St. Lucrecia, Oct 1911, F. Urich, 1F. Tampico, 3 Sep 1902, Goldberger, 1M, 6F; same locality, 22 Jan 1921, J. Prince, 36F; same locality and collector, 10 Mar 1921, 1F; same locality and collector, 17 Dec 1921, 1F. Veracruz, 3F. **Yucatan:** [Isla de] Cozumel, 9 Dec 1942, D. Hall, 40F. Progreso, 25 Oct 1927, C. Hoffmann, 1F [AMNH] . **State not specified:** "Boleta 408," KO 115A-1, 1M. Intapa, 31 Oct 1973, D. Pletsch, 1F. Locality not specified, MEX 742.

MONTSERRAT (136 specimens: 11M, 6Mgen, 20F, 36P&p, 63L&l; 26 ind rear: 22 l, 1p, 3inc). **St. Anthony:** Delvins Village, MNT 81. Elberton Estate, MNT 2, 3. Foxs Bay, MNT 9, 10, 11, 39, 41, 43, 84, 88, 93. **St. Peter:** Happy Hill Village, MNT 15. Old Road Estate, MNT 50. Olveston Estate, MNT 24, 55. **Parish and locality not specified:** LAR 14.

NEVIS (145 specimens: 14M, 18F, 31P&p, 82L&l; 23 ind rear: 14 l, 4p, 5inc). **St. Paul Charlestown:** Charlestown, LAR 11. **St. Thomas Lowland:** Cades Bay, NVS 13. Cotton Ground, NVS 14. Paris Pond, NVS 1, 2, 46. Pinneys Estate, NVS 17, 47, 18, Vaughans, NVS 16.

NICARAGUA (215 specimens: 35M, 7Mgen, 115F, 15P&p, 43L&l; 14 ind rear: 8 l, 6p). **Chinandega:** Corinto, 13 Sep 1943, H. Crowell, KO 115-9, 16F; same locality and collector, 15 May 1945, KO 115-4, 1F; same locality and collector, 13 Sep 1945, KO 115-11, 11F. **Granada:** Granada, NIR 2, 2F; same locality, 26 Nov 1924, NIR 3, 1F; same locality, NIR 6, 3M, 1Mgen, 6F. **Leon:** Las Penconas, NI 22. Pantano El Esparto, NI 19, 29. Puerto Somoza, NI 16, 20, 25, 28. Simonillo, NI 30. **Managua:** Lago de Managua, NIR 5, 2M, 1Mgen, 4F. Managua, NIR 17, 3M,

10F. Tipitapa, 3 Jan 1925, NIR 16, 1M, 1Mgen, 4F. **Rivas**: Rivas, 21 Nov 1924, NIR 22, 1M, 1F. **Zelaya**: Bluefields, 13 Aug 1943, P. Woke, KO H-18-14, 1M, 2F; same locality, NI 39; same locality, 9F. Rama, 17 Aug 1943, P. Woke, 2M, 5F. **Department not specified**: El Recreo, 20 Aug 1943, P. Woke, KO H-18-13, 1M. "Pila Office," NIR 14, 5M, 1Mgen, 6F; same locality, NIR 15, 7F. Locality not specified, NIR 4, 2M, 1Mgen, 1F; NIR 9, 10M, 1Mgen, 4F; NIR 10, 1M, 2F; NIR 13, 3F; NIR 19, 1F; NIR 20, 1M; 22 Nov 1942, 4M, 1F.

PANAMA AND CANAL ZONE (1770 specimens: 394M, 47Mgen, 1012F, 108P&p, 209L&l; 100 ind rear: 26 l, 46p, 28inc). **Bocas del Toro**: Almirante, PA 669; same locality, Jan 1930, PAX 6, 16M, 19F. Big Creek, PA 652. Milla 2, PA 337. Punta de Pena, PA 238. **Canal Zone**: Ancon, Jul 1941, PAX 181, 2M, 6F; same locality, 7M, 44F [CU]. Chulupi, Rio Chagres, 31 Mar 1944, Pierce, KO 115A-32, 7M, 27F. Corozal, 3 Jul 1922, J. Shropshire, 1F [MCZ]. Cristobal, 13 Jul 1944, Sterns, *et al.*, ASM 68-1, 3M, 2F, 10L [CU]; same data, 49-68-1 [ASM 68-1], 2M, 1Mgen. Culebra, 3 May 1925, D. Baker, 3F [MCZ]; same locality and collector, 1925, 1M. Empire, 27 Oct 1924, J. Zetek, 1F [MCZ]. Escobal, PA 1158, 1159. Fort Clayton, 21 Mar 1925, D. Baker, 1F [MCZ]; same locality, Nov 1939, W. Komp, 1M, 3F; same locality, 1944, ASM 66-1, colony, 4M, 1Fgen, 3L [CU], 1F; same locality, Nov 1939, W. Komp, KO H-18-8, 1M. Fort Kobbe, 27 Oct 1939, PAX 149, 5M; same locality, 6 Feb 1963, F. Padilla, CZ 23, 1L; same locality, 10 Feb 1964, J. Rodriquez, CZ 118, 1 lpF, 1L. Fort Thomas, 3F [MCZ]. France Field, 19 Nov 1924, J. Zetek, 1F [MCZ]; same locality, 1925, Baker, 1M, 2F. Gamboa, Rio Chagres, 4 Oct 1944, Wood, Middlekauff, ASM 195-1, 2L [CU]. Gatun, Jan-Feb 1913, J. Zetek, 4F [AMNH], 92F. Juan Mina, Rio Chagres, 23 May 1939, PAX 112, 3M, 16F; same locality, PA 1122, 1123, 1125, 1160. Madden Dam, PA 1137. Mindi, May 1941, KO 115-10, 1M, 2F; same locality, KO 115-17, 5F. Mojo Pollo, Rio Chagres, 31 Mar 1944, KO 115A-15, 9M, 3F. Pacific side, Feb 1943, KO 115A-25, 1F. Paraiso, A. Jennings, 1M [CU]. Locality not specified, Feb 1933, D. Curry, 1M, 3F [BM1933-504]; Jun 1941, KO 115A-9, 2M, 1F; Jun 1941, KO 115A-30, 3M, 4F; 1941, KO 115-12, 2F; Jan 1943, KO 115-44, 8M, 9F; Jan 1944, KO 112-10, 1F; 6 Jul 1950, 4F; H. Crowell, KO 115-8, 7M, 3F; KO 115A-29, 1F; KO 115-45, 7M, 19F. **Colon**: Portobelo, PA 604. Santa Rosa, 28 Jul 1943, G. Fairchild, KO 115A-26, 3F; same locality, PA 43. **Darien**: Pucro, PA 631. **Los Santos**: Cape [Punta] Mala, 3 Feb 1944, Marucci, Wood, KO 115A-2, 3M, 3F. **Panama**: Chepo, PA 1064. Isla de San Jose, 15 Mar 1944, KO 115-27, 2F; same locality, 25 Jul 1944, KO 115A-7, 2F. Juan Diaz, PA 749, 801, 836. Juan Franco, 6 Jul 1941, PAX 177, 1M, 4F. Juan Mina, 6 Aug 1943, G. Fairchild, KO 115A-28, 23F; same locality and collector, 31 Aug 1943, KO 115A-27, 14F; same locality, date and collector, 5F; same locality and collector, 3 Sep 1943, KO 115A-18, 25F; same locality and collector, 5 Oct 1943, KO 115A-10, 18F; same locality, 17 Jul 1949, 1 l [JH]; same locality, 25 Jul 1949, 12 l [JH]; same locality, G. Fairchild, KO 115A-16, 6F. La Chorrera, 4 Jul 1944, 49-36-2 [ASM 36-2], 1M, 1Mgen, 2F; same locality, 6 Nov 1944, ASM 270-1, 6L [CU]; same locality, 2 Dec 1944, Wood, Griffing, ASM 328-1, 3L [CU]; same locality and date, ASM 329-1, 5L [CU]; same locality, 7 Dec 1944, ASM 334-1, 1Fgen, 11L [CU]; same locality, 7 Dec 1944, 1F; same locality, 13 Jan 1945, ASM 378-1, 1M [CU]; same locality, 23 Jan 1945, ASM 382-2, 2M [CU]; same locality, 16 Jul 1945, ASM 655, 1F; same locality and date, 5F; same locality, 27 Nov 1944, Wood, Griffing, ASM 299-2, 1L [CU]. Las Guacas, PA 13. Pacora, PA 1063. Paitilla, PA 755, 780. Panama City, 15 Sep 1935, PAR 25, 4M, 3Mgen. Panama Viejo, 27 Jul 1935, PAR 18, 1M, 1Mgen, 44F; same locality, 17 Nov 1944, R. Arnett, K. Frick, ASM 283-1, 1L [CU]. Tocumen, PA 547, 1147. **Province not specified**: Aguadiente, 31 Jan 1935, PAR 75, 74M, 3Mgen. Lagarto, 26 Jul 1945, Van Doran, ASM 680-2, 2F. Rio Chagres, 12 Feb 1943, KO 115A-8, 17M, 18F; same locality, 25 Jul 1945, Van Doran, ASM 679-1, 1F. Rio Pescado, 7 May 1937, 1M, 2F. Sabanas Rd., 30 Oct 1934, 1M, 1F. Laboratory colonies, PA 1178, PAR 118A, 120, 123, PAX 60, 61, 62, 63, 64, 65; colony, 17 Aug 1937, 3M, 2Mgen, 9F; colony, 31 Jul 1937, 1M, 1Mgen, 20F. Locality not specified, 28 Mar 1935, PAR 78, 1Mgen; 2 Oct 1935, PAR 92, 12M, 3F; 31 Jul 1937, 1M, 14F; no data, 3F.

PERU (10 specimens: 1M, 1Mgen, 2F, 3p, 3L&l; 3 ind rear: 2 l, 1p). **Piura**: Mallares, PER 18.

PUERTO RICO. Culebra Island (2M): Locality not specified, 20 Jan 1954, H. Hurt, 1M (567); same collector, 21 Jan 1954, 1M (569). **Puerto Rico** (Island) (416 specimens: 185M, 4Mgen, 151F, 27P&p, 49L&l; 16 ind rear: 5 l, 9p, 2 inc): Aguirre, 10 May 1920, H. Green, 2M, 2F. Arecibo, Mar 1942, H. Pratt, 2L. Carolina, Mar 1942, W. Hoffman, H. Pratt, 7p. Catano, PRA 31; same locality,

10 Nov 1943, H. Pratt, 1L. Cayey, 2 Dec 1943, J. Maldonado-Capriles, H. Pratt, 5L. Dorado, PR 151. Fort Buchanan, 14 Dec 1942, T. Aitken, 2M, 2F; same locality, 13 Jan 1943, H. Pratt, 1F; same data except 19 Jan, 2M; same data except 26 Jul, 1Mgen; same locality, PRA 69. Gurabo, PR 123; same locality, H. Pratt, 2L. Juan Diaz, Jul 1944, KO 106-17, 2M. Lares, 28 Apr 1944, H. Pratt, 1L. Levittown, PR 160, 166. Loiza, KO 115-1, 53F; same locality, KO 115-7, 6F. Loiza Aldea, 12 Sep 1935, R. Watson, 2F. Losey Field, 18 Nov 1942, A. Pritchard, 7L; same locality, 1944, H. Pratt, KO 115-5, 30M; same locality, KO 115-13, 42M; same locality, KO 115-16, 32M. Mayaguez, 25 Feb 1936, G. Tulloch, 9M, 14F; same locality, PR 116. Puerto Arturo, 30 Oct 1940, KO H-18-10, 3M, 2Mgen, 4F. Punta Salinas, 28 Mar 1942, W. Hoffman, H. Pratt, 3P. San Juan, Jan 1914, 1M, 2F; same locality, 3L. Tortuguero, Camp, 6 Feb 1943, G. Bradley, 3F. Tortuguero, Laguna, 25 Aug 1942, E. Charneco, 2L; same locality, 15 Dec 1944, H. Pratt, 2L. Yauco, 26 Dec 1942, J. Maldonado-Capriles, 5L. Locality not specified, Feb 1914, W. Wippitt, 2M, 6F; KO 115-2, 40M; H. Pratt, PRX 13, 2M, 1F; no data, 1M, 3F. **Vieques Island** (21 specimens: 5M, 1Mgen, 7F, 2p, 6L&l; 2 inc ind rear): Locality not specified, 27 Feb 1942, H. Hurlbut, 1 lp (AA 2-27-42-1); 3 Mar 1942, H. Hurlbut, 1 lp (AA 3-3-42-3); 1942, H. Hurlbut, 5M, 1Mgen, 6F, 4L; 10 Jan 1943, H. Pratt, 1F.

SAINT MARTIN (1L). Old Battery Cistern, 3 Jun 1955, Hummelinck, 1L (529b).

UNITED STATES. FLORIDA (24 specimens: 11F, 1p, 12L&l; 1 inc ind rear). **Monroe Co.**: Big Pine Key, 26 Mar 1948, J. Haeger, 1 lP (274-101) [CU]. Key West, 5 Sep 1946, Fernandez, 1F; same data except 25 Sep, 1F; same data except 26 Sep, 1F; same data except 17 Oct, 1F; same locality, C. Gardner, 2F. Marathon Key, 7 Aug 1946, USPHS, 1F. Stock Island, 31 Oct 1946, Fernandez, 1F; same locality, 15 Oct 1959, W. Warner, 1F; same data except 20 Oct, 1F. Vaca Key, 27 Aug 1947, W. Buren, 1F. Locality not specified, "Sta 338," 7 Dec 1949, J. Haeger, 11L. **TEXAS** (97 specimens: 8M, 4Mgen, 65F, 20L). **Cameron Co.**: Brownsville, 13 Oct 1923, R. Turner, 13F; same data except 24 Oct, 2F; same locality, 29 Nov 1939, 2F; same locality, reared 14 Dec 1939, 2M; same locality, 6 Aug 1942, W. Gordon, 1M, 1Mgen, 13F [CU]; same data except 10 Aug, 1M, 1Mgen, 5F [CU]; same locality, 13 Sep 1942, E. Garbera, 1F; same locality, 26 Sep 1942, E. Ross, 1L [ANS]; same locality, 28 Sep 1942, E. Ross, H. Roberts, 3F; same locality, 12 Oct 1942, T. Burns, 5F; same locality, 19 Nov 1942, E. Gerberg, 1Mgen, 3F [CU]; same locality, 1942, 1M, 1Mgen [CU]; same locality, 5 Jun 1943, W. Gordon, 5F [CU]; same locality, Jan 1944, C. Joyce, 1M; same locality, Oct 1944, R. Usinger, 5L; probably same locality, KO 115-25, 12F. Combes, Oct 1944, R. Usinger, 7L. Harlingen, Jan 1944, Col. Pfrejer, 1L. Locality not specified, 11 Jun 1937, T. McGregor, 1M. **Hidalgo Co.**: Edinburg, Oct 1944, R. Usinger, 3L. McAllen, 4 Nov 1923, R. Turner, 1F. **County not specified**: Rancho Viejes, Resaca, Oct 1944, R. Usinger, 2L. Yturria, Oct 1944, R. Usinger, 1L.

VENEZUELA (111 specimens: 6M, 1Mgen, 85F, 6P&p, 13L&l; 6 ind rear: 4 l, 1p, 1inc). **Anzoategui**: Barcelona, 8-15 Aug 1940, VZK 45, 1M; same locality, 25 Sep 1944, VZK 17, 1M, 2F; same locality, 26 Sep 1944, W. Komp, KO 115A-33, 13F; same data, KO 115-37, 11F; same data, KO 115-40, 10F; same data, KO 115-43, 18F. Puerto La Cruz, 27 Sep 1944, VZK 24A, 3M, 5F; same locality, 26 Sep 1944, KO 111-21, 18F; same locality, 25 Sep 1944, VZK 19, 1F. **Aragua**: Turiamo, 13 Aug 1944, E. Winton, KO 111-12, 2F. **Carabobo**: Boca de Yaracuy, VZ 259. La Cabrera Peninsula, VZ 93, 94, 95. Puerto Cabello, 12 Jul 1927, F. Root, 1M [BM1929-194]. **Zulia**: Independencia, Nov 1949, A. Gabaldon, 3L (1375, 210, Zone I, Lot 98). **State and locality not specified**: 14 May 1940, VZK 44, 1F.

VIRGIN ISLANDS. St. Croix (Island) (5L): Bethlehem, Nov 1939, H. Beatty, 2L. Caledonia, VI 12. **St. John** (Island) (1 lpM): Leinster Bay, VI 6. **St. Thomas** (Island) (1M, 1F): Locality not specified, LAR 1A.

OSWALDOI GROUP

FEMALES. Head: Light to dark. Palpal segments 2 and 3 predominantly dark with a small to medium white band at apices; erect outstanding scales on segments 1, 2 and basal 0.3-0.5 of 3, becoming less outstanding toward apex of 3; segment 3 with or without dorsolateral, golden to white speckled, longitudinal stripe; segment 4 with at least some white or cream on mediolateral surface, base and apex usually with brown band; segment 5 completely white or with small dark basal band. **Thorax:** Pruinose and scale patterns and color same as in section description. Occasionally upper *mep* with few light scales. Anterior *mep* with light scale patch in *triannulatus* only. **Legs:** Foretarsal segments 2 and 3 basally dark at least on dorsal surface and light in about apical 0.2-0.9 of segment; segment 4 usually all dark at least on dorsal surface, occasionally with a few golden to cream, apical scales or with a broader apical light area (*triannulatus*), rarely predominantly light (some *ininii*); segment 5 usually dark in about basal 0.5 and light in apical 0.5, but varying from predominantly dark (*triannulatus*) to predominantly light (some *strodei* and *ininii*). Midtarsal segments 1, 2 and 3 with a small to moderate, apical, light area, basally predominantly dark at least on dorsal surface; segment 4 all dark at least on dorsal surface, except in *ininii*; segment 5 with apical 0.3-0.5 golden to white, rarely completely cream (some *ininii*), usually dark at least on dorsal surface in basal 0.5-0.7. Hindtarsal segment 2 with basal 0.10-0.85 dark, apical remainder white; segment 3 usually all white, rarely dark at least on dorsal surface in basal 0.3 (0.20-0.35) of segment (*rondoni* and mutants); segment 4 light, very rarely basally dark (mutants). Dark basal areas and light apical areas of foretarsal segments 2-5, light apical areas of midtarsal segments 1-5 and dark basal area of midtarsal segment 5 appearing as complete or incomplete, light and dark bands or rings; light bands almost always complete (entirely encircling segment); dark basal bands usually appearing complete or almost complete with light scales usually on ventral surface. Hindtarsal segment 2 with dark basal area appearing as a dark basal band; segment 5 with basal dark and apical light areas appearing as complete bands. **Wing:** Wing spots as in section description, highly variable and important in species diagnoses. **Abdomen:** Caudolateral scale tufts present on tergites and sternites II-VII. Sternite I usually with a few, moderately long to long setae and occasionally some inconspicuous obovate to lanceolate, light scales in basal half.

MALES. Essentially as in females except for sexual characters. **Head:** Palpal segment 4 with a subbasal and a subapical dark band, ventral surface usually with some dark scales, rest of median surface predominantly light. **Antenna:** 0.75-0.85 length of proboscis. **Legs:** Forefemur 0.55-0.70 length of proboscis. Basal plantar surface of foretarsal segment 5 with short to long, spiniform setae.

MALE GENITALIA. Segment IX. Sternite moderately long to long, with a short to long, variously shaped, nonspiculose apodeme along anterior border. **Sidepiece, Clasper:** As in section description. **Claspettes:** Ventral claspette with setae at least on basal lobules in Oswaldoi Subgroup, or without setae and apicolaterally produced into auriculate lobes in the Triannulatus Subgroup. Preapical plate and apex of ventral claspette variously developed. **Phallosome:** Triannulatus Subgroup without leaflets; Oswaldoi Subgroup with or without leaflets.

LARVAE. Moderate to large, rarely small (*triannulatus*). **Head:** Moderately to heavily sclerotized. Median tooth of mental plate narrow to broad. Hairs 2-C widely spaced except in *anomalophyllus* and *strodei*. Hair 3-C equal to or shorter than 2-C. Hair 4-C usually short and branched, except in *nuneztovari* and *trinkae*. Hairs 8,9-C dendritic or weakly plumose, moderately small to large. Hairs 10,12,13-C large in

triannulatus and *ininii*, small to moderate in remaining species. Hair 15-C moderately large to large, single to numerously branched. Collar narrow to wide, heavily sclerotized. **Antenna**: Weakly to heavily pigmented. Spicules on mesal margin short and thin to long and stout. Hair 1-A small to moderately large or occasionally large (*ininii, benarrochi*). **Thorax**: Moderately to heavily pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common tubercle; 1-P palmate. Hairs 9,10,12-P single and long; 12-P longer than 9,10-P; 9-P subequal to 10-P; 11-P double or rarely triple, branched about 0.25 from base, about 0.5 or less length of 12-P. Hair 14-P with a moderately short to long, flattened shaft. Mesothoracic hair 1-M usually ovoid to elliptical in outline, with elongate flattened shaft. Metathoracic hair 2-T moderately long to long. Hair 3-T palmate, transparent to weakly pigmented, brushlike or with spreading lanceolate leaflets. Hairs 9,10-T single and long, 9-T shorter than 10-T. **Abdomen**: Hair 0-II-VII with few to numerous branches, usually more than 3 except in some *trinkae*. Palmate hair 1-I unpigmented to weakly pigmented, leaflets narrow to moderately wide; 1-II-VII usually strongly sclerotized, with long, narrow to broad, lanceolate leaflets. Hair 2-II highly variable, 3-10 branched. Hair 5-I small to large, 2-12 branched. Hair 11-I moderately large to large. Hair 13-I more than 3 branched (4-9), except in *triannulatus* and *benarrochi*. Hair 13-II,III small to moderately large, numerously branched (except 13-II in *triannulatus*); 13-IV small to moderate, never as large as in *albimanus*; 13-V moderately large to very large. **Spiracular Lobe**: Pecten highly variable. Lateral arms of spiracular apparatus varying from very short and directed caudolaterally to long and directed laterally. **Anal Segment**: Covered with spicules. Saddle reddish brown. Hair 1-X short to long, inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. The species comprising the Oswaldoi Group are distinguished from that in the Albimanus Group in the **females** by (1) palpal segment 4 with at least some white or cream on mediolateral surface, (2) presence of dark caudolateral scale tufts on abdominal segment II and (3) foretarsal segment 5 usually with at least an apical light band to occasionally completely light, except in some *strodei* and *triannulatus* where it is all dark; in the **male genitalia** by (1) sternite IX moderately long to long, subtrapezoidal or subtriangular, (2) ventral claspette with setae, *or if* without setae *then* apex of claspette expanded laterally into large auriculate lobes and (3) ventral surface of ventral claspette without bare, inflated, ovoid, bulbous lobes; in the **larvae** by (1) hair 4-C usually short except in *trinkae* and *nuneztovari* where it is longer, (2) hair 1-P palmate, (3) hair 9-P,T single and (4) hair 13-I,III,IV small to moderately large, *or if* large *then* hair 11-I large and 5-7 branched.

I am separating the Oswaldoi Group into 2 distinct subgroups, the monotypic Triannulatus Subgroup and the Oswaldoi Subgroup composed of 12 species (fig. 4). Almost all the characters separating the Oswaldoi Group from the Albimanus Group are derived, with the exception of those mentioned on page 14. *An. triannulatus* is the least derived species in the group, retaining many characters that are intermediate between the Albimanus Group and the Oswaldoi Subgroup. For example, in the female of *triannulatus*, (1) palpal segment 4 is usually darker than in the Oswaldoi Subgroup, but not as dark as in *albimanus* and (2) foretarsal segment 5 is predominantly dark; and in the larva, (1) hair 1-P is not plumose as in *albimanus*, but has numerous and very slender, almost filiform branches and (2) hair 13-I,III,IV is relatively large and few branched, as in *albimanus*.

The Oswaldoi Subgroup is a collection of very closely allied species. Their external morphology is interspecifically very similar and usually highly variable intraspecifically. For these reasons the keys are not always reliable, particularly in some cases for

the adult females and pupae. In *most* instances, the adult females of *aquasalis, rangeli, rondoni, oswaldoi, ininii* and *nuneztovari* are easily identified. *An. aquasalis* can be confused with *benarrochi*; however, since the distributions of the 2 species are so different, this usually is not a problem. *An. trinkae* is difficult to identify because the humeral light spot on the costal vein is not always less than twice the length of the basal dark spot. *An. oswaldoi* may be confused with *strodei, ininii* and occasionally *noroestensis*, so it is necessary to refer to the secondary characters listed in the key. *An. anomalophyllus* is very similar to *strodei*, but it is rare and encountered only in Panama and Costa Rica. Again it is reemphasized that reference should be made to the individual species description, discussion, bionomics and distribution sections when attempting to identify any specimens in this group.

The Oswaldoi Group is more or less restricted to tropical Central and South America, and is predominantly of South American origin. Only the relict species, *anomalophyllus*, appears to have evolved in Central America. The other species occurring in Central America, *aquasalis, oswaldoi, triannulatus* and *strodei*, probably have invaded this area in recent times. *An. strodei* extends the farthest north, having been collected in the state of Veracruz, Mexico (Vargas and Martinez Palacios 1956:142). On the Pacific side of the Andes, northern Peru is the southernmost limit of the group. Only one species, *aquasalis*, has invaded the Lesser Antilles, extending as far north as the island of Antigua. *An. aquasalis* is capable of breeding in brackish water which may explain its success in colonizing these Caribbean islands. East of the Andes the group extends as far south as the northern provinces of Argentina.

OSWALDOI SUBGROUP

FEMALES. Moderately large to large. **Head:** Palpal segment 4 predominantly white, usually with a basal and an apical dark band, and often with dark scales of varying amounts on ventral surface. **Thorax:** Integument light brown to almost black. Median anterior promontory area with long white scales often extending dorsad onto anterior of acrostichal line. Anterior *mep* without scales. **Legs:** Foretarsal segments 1-4 with varying amounts of white; segment 5 usually with apical 0.5 or more golden to white, except in some *strodei*. Midtarsal segment 3 with a small, apical, cream band. **Wing:** Variable. Vein C humeral light spot usually large except in most specimens of *nuneztovari* and *trinkae*.

MALES. Essentially the same as in female except for sexual characters. **Head:** Palpal segment 4 with a basal and an apical light band and with or without a subbasal and a subapical dark band, mediolaterally extensively cream to white, ventral surface dark. **Thorax:** Anterior *mep* without a scale patch.

MALE GENITALIA. Segment IX: Sternite moderately long to long, subtriangular or subtrapezoidal, with short to long, variously shaped, nonspiculose apodeme along anterior border. **Sidepiece, Clasper:** As in group description. **Claspettes:** Dorsal claspette as in species descriptions. Ventral claspette never bare, with short to long setae on basal lobules, or on basal lobules and on lateral and ventral surface of fused portion of lobe, setae extending to or near to apex. Preapical plate variable in shape and pigmentation. **Phallosome:** Aedeagus with or without leaflets; apex less than 1.5 as long as wide.

LARVAE. Moderate to large. **Head:** Hairs 2,3-C single and simple, barbed or plumose with short to long branches in about apical half; hairs 2-C narrowly or widely spaced. **Antenna:** Hair 1-A short to moderately long, except in *benarrochi* and *ininii*. **Thorax:** Submedian prothoracic group (1-3-P) with hair 1-P with fewer than 16 (except in some *strodei* and *ininii*) narrow to broad, lanceolate leaflets; 1,2-P with or

without common tubercle. Hair 14-P with a short to moderately long, flattened shaft. Metathoracic hair 3-T with semitransparent or weakly pigmented leaflets. **Abdomen**: Palmate hairs narrow to broad. Hair 11-I moderately large, 2-4 branched. Hair 13-I small to moderately large, usually more than 3 branched; 13-III usually small and numerously (5-14) branched; 13-IV small to moderate. Sclerotized tergal plate VII equal to or less than about 1.7 size of tergal plate VI. **Spiracular Lobe**: Pecten variable. Lateral arms of spiracular apparatus very short to moderately long, except long in *ininii*. **Anal Segment**: Covered with spicules. Hair 1-X moderately long to long, inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. Members of the Oswaldoi Subgroup can be distinguished from the Triannulatus Subgroup in the **female** by (1) palpal segment 4 more predominantly white, (2) absence of anterior mesepimeral scales, (3) absence of a large apical light band on foretarsal segment 4, except occasionally in *nuneztovari* and *ininii* and (4) foretarsal segment 5 half to completely light, except in some *strodei*; in the **male genitalia** by the presence of setae at least on the basal lobules of the ventral claspette; and in the **larvae** by (1) palmate hair 1-P usually with fewer than 16 narrow to broad leaflets, (2) hair 14-P with a short to moderate shaft, (3) hair 11-I moderately large, 2-4 branched, (4) hair 13-I small to moderately large, usually more than 3 branched, (5) hair 13-III usually small and numerously branched and (6) lateral arms of spiracular apparatus short to moderately long, except in *ininii*.

The relationships of the species within the Oswaldoi Subgroup is very difficult to determine because of the tremendous number of overlapping characteristics of the species in each of the different stages. The derived features of the male genitalia serve to link together the taxonomically important characters in the other life stages. Upon examination of the ventral claspette of the male genitalia, 2 distinct phyletic lines become apparent, which I am calling the Oswaldoi Complex and the Strodei Complex (fig. 4). Of these 2 complexes, the Strodei Complex is more closely akin to the Triannulatus Subgroup than is the Oswaldoi Complex. This was also evident to Gabaldon (1940:4), when he placed *strodei* and later (Gabaldon and Cova Garcia 1952: 178) *rondoni* and *benarrochi* in the same group as *triannulatus* in the Subseries Triannulatus, based on the morphology of the male genitalia. Other characters linking *triannulatus* to the Strodei Complex are the slender collar and numerous slender branches of hair 1-P in the larva, and the shape of the trumpet and the caudolateral spines in the pupa. The relationship of *benarrochi* to *triannulatus,* and to *rondoni* and *strodei* is not clear. However, the male genitalia of *benarrochi* are more like *strodei* than any other species in the Oswaldoi Subgroup. The Oswaldoi Complex is the more derived complex in the Oswaldoi Subgroup.

OSWALDOI COMPLEX

FEMALES. No diagnostic characters separating this complex from the Strodei Complex in the adult females are apparent.

MALES. Essentially as in females except for sexual characters.

MALE GENITALIA. Segment IX: Sternite long, about 0.5 length of phallosome, approximating shape of an isosceles trapezoid or a truncated triangle. Apodeme across anterior border short to long. **Sidepiece**: Parabasal spine moderately short to moderately long. **Ventral Claspette**: Nonrugose along apical margin, with setae on basal lobules and on lateral and ventral surface extending to or near to apex, apex not laterally expanded. Preapical plate moderately small to large, usually distinct. **Phallosome**: Aedeagus with or without leaflets, apically rounded or truncate (*noroestensis*).

LARVAE. Moderately large to large. There are no good diagnostic characters in the larvae to separate this complex from Strodei Complex. **Head:** Variable branching of inner and outer clypeal hairs (2,3-C); inner clypeals (2-C) widely spaced, except in *anomalophyllus.* Hair 4-C usually short, except in *nuneztovari* and *trinkae*. Hairs 10,12,13-C large in *ininii*, small to moderately large in remaining species. Collar always moderately wide to wide, heavily sclerotized. **Antenna:** Hair 1-A small to moderately large, except in *ininii*. Hairs 2,3-A relatively large, particularly in *ininii*. **Thorax:** In many but not all species, a large proportion of specimens with hairs 1,2-P of submedian prothoracic group (1-3-P) sharing a common tubercle, or base of 1-P not sclerotized and 1-P apparently arising separately from 2-P. Hair 14-P with short to moderately long, flattened shaft. **Abdomen:** Hair 0-II small to moderately large. Hair 5-I moderately large (except in *rangeli*) and close to lateral margin of abdomen. Hair 13-I-III small, numerously branched; 13-IV larger than 13-I-III, with fewer branches than 13-VI. **Spiracular Lobe:** Lateral arms of spiracular apparatus short, except moderately long in *noroestensis* and *oswaldoi*, and long in *ininii*. **Anal Segment:** Hair 1-X inserted on or not inserted on saddle. Anal gills short to long.

DISCUSSION. In general, the male genitalia and the larvae offer the best characters for separation of the species in the Oswaldoi Complex. The Oswaldoi Complex is distinguished from the Strodei Complex in the **male genitalia** by (1) presence of setae extending to the apex of ventral claspette or to at least as far as level of apical margin of preapical plate, (2) apex of ventral claspette not laterally expanded and (3) parabasal spine slightly shorter, usually extending neither to far margin of aedeagus nor to tubercle of other parabasal spine.

The species in this complex are very closely related. On the basis of the male genitalia, there seem to be 2 primary phyletic lines. *An. oswaldoi, galvaoi, noroestensis, aquasalis, ininii* and possibly *anomalophyllus* form one line, and *trinkae, nuneztovari* and *rangeli* compose the other (fig. 4). I have not designated these phyletic lines as separate taxa due to their close phylogenetic relationship and because it would tend to excessively complicate the presently proposed hierarchy.

The species of the first phyletic line, *aquasalis, noroestensis, galvaoi, oswaldoi, ininii* and *anomalophyllus*, are characterized by the tapering, rounded apex of the ventral claspette, with a distinct crescent shaped or oval preapical plate. *An. aquasalis* and *oswaldoi* are fairly widely distributed in Central and South America, *aquasalis* primarily along the Atlantic Coast and *oswaldoi* in the interior. *An. noroestensis* is widely distributed from the northeast of Brazil south to the northern states of Argentina, but is not found in northwestern South America or Central America. The latter 3 species are often broadly sympatric, but they usually occupy distinct niches. *An. aquasalis* is primarily associated with brackish water, *oswaldoi* with the forest and *noroestensis* with open drier areas. *An. galvaoi* seems to be primarily restricted to the high Amazon basin extending south into Mato Grosso and Sao Paulo and possibly east into Goias and Bahia. It would seem to be sympatric with *oswaldoi* throughout most of its range, although it is not clear if the range of *galvaoi* overlaps with that of *noroestensis*, its closest ally. *An. anomalophyllus* and, to a lesser extent, *ininii* retain many primitive characters which clearly distinguish them from the remaining species. Both species have restricted known distributions. *An. anomalophyllus* is a rare species, to date found only in Costa Rica and northern Panama. *An. ininii* has been collected only in French Guiana and Para, Brazil. The ventral claspettes of *ininii* and *anomalophyllus* look very much alike in outline and are, in general, similar to those of *oswaldoi, aquasalis, galvaoi* and *noroestensis.* The aedeagus of both species has leaf-

lets, very strongly developed in *anomalophyllus* and weakly developed in *ininii*. On the basis of the male genitalia, adult and larva, *ininii* seems to be clearly affiliated with the first phyletic line. In the case of *anomalophyllus*, the male genitalia correspond to the type in the Oswaldoi Complex, but the larva and adult look very much like the *strodei* type. For this reason I am unsure of the phylogenetic relationship between *anomalophyllus* and the rest of the species in the Oswaldoi Subgroup. One possibility is that *anomalophyllus* is an annectent relict form, intermediate between the Oswaldoi Complex and the Strodei Complex.

The other phyletic line in this complex, composed of *rangeli, trinkae* and *nuneztovari*, is again based primarily on the structure of the ventral claspette of the male genitalia, correlated with characters in the other stages. The ventral claspette of these species is broad at the apex and has setae on the ventral and lateral surfaces of the fused portion of the lobe. The adults of *rangeli, trinkae* and *nuneztovari* are exceedingly alike, making species diagnosis difficult. It is possible that the 2 latter species have not differentiated enough to become reproductively isolated, in which case they would be considered subspecies rather than species. As will be discussed later, this is really not so important, since they appear to be allopatric, and differ significantly in the immature stages and male genitalia. For these reasons, I feel justified in treating these 2 as separate species. The species in this second phyletic line are restricted to the Caribbean, Orinoco and Amazon drainage systems, with extensions into Bolivia and Mato Grosso.

2. Anopheles (Nys.) oswaldoi (Peryassu)

Figs. 2, 4, 6, 10, 11

1922. *Cellia oswaldoi* Peryassu 1922:179. TYPE: *Syntypes* males and females, Vale do Rio Doce (Espirito Santo) and Baixada Fluminense (Rio de Janeiro), Brazil, Mar and Apr [Museu Nac Rio de Janeiro] (Belkin, Schick and Heinemann 1971:6).

1932. *Anopheles (Nyssorhynchus) tarsimaculatus* var. *aquacaelestis* Curry 1932:566-571. TYPE: *Syntypes* male with genitalia slide, female and larva, Atlantic side of Canal Zone, Panama, no type locality cited, although Colon Hospital, 20 Jun 1929, C. H. Bath and lower Chagres River mentioned [LU]. Synonymy with *oswaldoi* by Senevet and Abonnenc (1938:487-493).

1942. *Anopheles (Nyssorhynchus) konderi* Galvao and Damasceno 1942:115-118. TYPE: *Syntypes* male(s), larva(e), pupa(e), right margin of Solimoes [Amazon], 300 km from Manaus, Coari (Amazonas), Brazil [LU, no material in FMSP, 651; apparently lost] (Belkin, Schick and Heinemann 1971:6). Synonymy with *oswaldoi* by Lane (1953:262).

Anopheles (Nyssorhynchus) oswaldoi of Senevet (1934:49-52; 1948a:277-279; 1948c:437); Galvao and Lane (1938:175-177; 1941:10); Rozeboom (1938a:101; 1938b:289-290; 1942:239-240); Senevet and Abonnenc (1938:493); Lane (1939:25-26; 1944:262-268; 1949:403; 1953:261-263); Gabaldon (1940:5); Gabaldon and Aguilera (1940:65-66); Gabaldon, Cova Garcia and Lopez (1940:10, 11); Galvao (1940:426-432; 1943:141, 143, 149, 151); Komp (1941a:93, 95, 97; 1942:26, 39, 40, 43, 74-75, 80, 124-125, 132, 160-161); Rozeboom and Gabaldon (1941:92-98); Floch and Abonnenc (1942a:2; 1942b:2; 1946b:3-5; 1947:6; 1951:49-50); Fonseca and Fonseca (1942:93, 94); Galvao and Damasceno (1942:121); Oliveira and Verano (1942:353-358); Simmons and Aitken (1942:39, 46, 54, 62, 95-96); Cerqueira (1943:19); Galvis (1943:93); Ramos (1943:51-52, 56-60); Causey, Deane and Deane (1944:2, 4, 5; 1946:27); Correa and Ramos (1944b:130; 1944c:11-12); Deane, L. M., Causey and Deane (1946:7-9; 1948:874-876); Deane, M. P., Causey and Deane (1946:38, 45); Gabaldon and Cova Garcia (1946b:99-103); Amaral and Penido (1947:164, 168, 173-178); Arnett (1947:197); Vargas (1948:158; 1959:377, 383); van der Kuyp (1949a:67-68); Levi-Castillo (1949:9-11, 13, 15, 28, 67, 72, 76, 82, 86); Bejarano and Duret (1950:150, 153); Downs (1950:29-30); Duret (1950a:371; 1950b:302); Rey and Renjifo (1950:534, 537); Carvalho and Rachou (1951:475, 480); Rachou and Ferraz

(1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Senior-White (1951a: 330); Horsfall (1955:184); Senevet and Andarelli (1955:339); Vargas V. (1956:29; 1957; 1958a; 1958b); Bejarano (1957:326-333, 335-336; 1959:305, 315, 325); Castro (1959a:174); Stone, Knight and Starcke (1959:33-34); Cerqueira (1961:126); Fauran (1961:11); Forattini (1962: 421); Garcia and Ronderos (1962:137-139, 158-159); Belkin, Schick and Heinemann (1965:44; 1971:61); Morales-Ayala (1971:139); Consolim and Galvao (1973:177); Cova Garcia and Sutil O. (1976:31; 1977:23, 47, 62, 88); Knight and Stone (1977:63-64).

Anopheles oswaldoi of Kumm (1932:1); Gabaldon, Cova Garcia and Arevalo (1940:26, 28-32); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Rozeboom (1941:102-103); Vargas (1941:118); Downs, Gillette and Shannon (1943:29, 30, 33); Russell, Rozeboom and Stone (1943:26, 30, 37, 42, 48); Floch and Abonnenc (1946a:2); Vargas V. (1958a; 1958c:1, 3); Foote and Cook (1959:129-130); Cova Garcia (1961:34-35, 69, 86-87, 113, 123-124, 154); Maciel (1962:477); Vincke and Pant (1962:2-7, 10, 12, 14); Mattos and Xavier (1965:273); Stojanovich, Gorham and Scott (1966a:12, 18, 34; 1966b:21, 29, 43); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:112, 139, 149); Cova Garcia and Sutil O. (1975a:23; 1975b:211); Panday (1977:732, 734); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles (Nyssorhynchus) oswaldoi var. *oswaldoi* of Galvao and Lane (1937e:213-216; 1938: 175); Galvao (1938a:51, 52, 53-54, 58; 1938b:101-103); Galvao and Amaral (1938:13); Fonseca and Fonseca (1942:118).

Anopheles oswaldoi oswaldoi of Vargas (1943:59).

Anopheles (Nyssorhynchus) tarsimaculatus var. *oswaldoi* of Christophers (1924:40, 90); Galvao and Lane (1937a:77, 78; 1938:173-174).

Anopheles tarsimaculata var. *oswaldoi* of Root (1926a:51, 89, 107-108).

Nyssorhynchus (Nyssorhynchus) tarsimaculatus var. *oswaldoi* of Lima (1928:96-98).

Nyssorhynchus aff. *oswaldoi* (?) of Townsend (1934:495-497).

Cellia oswaldoi of Boyd (1926:31, 37).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Root (1922a:322; 1926b:684-700, 709-711; 1932:781); Christophers (1924:41, 90); Dyar (1925:187, 188, 195; 1928:439); Davis (1928: 549-553; 1933:278, 280); Shannon and Davis (1930:488); Senevet (1932:251; 1937:358-360); Shannon (1933:124-133, in part?); Komp (1936a:161-162); Galvao, Lane and Correa (1937:40, 41); Lane (1939:29); Pinto (1939:390-398); Leeson and Buxton (1949:251, ?).

Anopheles tarsimaculatus in part (?) of Pinto (1930:154, 156).

Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1924b:461-463).

Anopheles tarsimaculata in part of Dyar (1923:185); Godoy and Pinto (1923:29-33); Senevet (1934:29).

Anopheles (Anopheles) tarsimaculata in part of Bonne (1923:127-128); Bonne-Wepster and Bonne (1923:127); Root (1923:276; 1924b:460-463); Bonne and Bonne-Wepster (1925:511-515).

Cellia tarsimaculata in part of Neiva and Penna (1916:94); Peryassu (1921b:183); Bonne (1924: 133-137).

Anopheles (Nyssorhynchus) aquacoelestis (!) of Senevet and Abonnenc (1938:487-493).

Anopheles (Nyssorhynchus) konderi of Galvao (1943:143, 148, 149, 151); Causey, Deane and Deane (1944:2, 4, 5; 1946:27); Correa and Ramos (1944b:130); Deane, L. M., Causey and Deane (1946:8; 1948:876-877); Deane, M. P., Causey and Deane (1946:38, 42, 45); Vargas (1948:158); Lane (1949:403; 1953:262); Levi-Castillo (1949:11, 15, 28, 67, 72, 76, 81, 86); Castro, Garcia and Bressanello (1959:549).

Anopheles konderi of Cova Garcia (1964:200).

Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 6). Wing: 3.4 mm. Proboscis: 2.3 mm. Palpus: 2.25 mm. Forefemur: 1.5 mm. Abdomen: about 2.8 mm. **Head:** Integument brown to dark brown. Proboscis about 1.5 length of forefemur. Vertex with many long, narrow, erect, cuneate scales, each with a narrow threadlike base. Palpal segment 2 occasionally with dorsal light scales; segment 3 with a fairly extensive, conspicuous, dorsal or dorsolateral, longitudinal light stripe; apex of segment 2 with a small to moderate band of whitish scales; apex of segment 3 with a moderately large band of white scales, 0.18

(0.15-0.25) of segment; segment 4 predominantly white with a moderately large, basal, dark band and a small, apical, dark band, with or without a usually inconspicuous, dark, ventral stripe; segment 5 completely white. **Antenna**: Dorsomesal and mesal surfaces of flagellar segment 1 distally with a large, very prominent patch of long white scales. Flagellar segments 2-13 with 7-9 long, silver setae in basal whorl. **Thorax**: Integument brown to very dark brown. Median anterior promontory with numerous long, white, setiform scales extending dorsad onto anterior of acrostichal line. Silver to cream scales on scutum slightly longer than those of *aquasalis*. Prescutellar space usually horseshoe shaped. *Sp* with 4-9 moderately long, silver setae. *Pra* with about 7-10 long, silver setae and a patch of gray to silver scales. Upper *stp* with 4 (2-6) long, light to dark setae in horizontal to vertical arc and a patch of gray to silver scales in horizontal row. Lower *stp* with 1, 2 long setae and a small patch of gray to silver scales. **Legs**: Coxal light scales usually very light gray to white, usually not cream. Midfemur with anteroapical spot and knee spot conspicuous and moderate in size. Foretarsal segment 2 with apical 0.35 (0.20-0.45) cream to white; segment 3 with a large, 0.65-0.85 (0.50-0.85), apical, cream to white band, usually more extensive than in *aquasalis*; segment 4 all dark to at least 0.3 basally dark; segment 5 golden to light cream in about apical 0.5. Midtarsal segment 2 with a golden to cream band in apical 0.10 (0.05-0.30); segment 3 with a small, golden to cream, apical band; segment 4 all dark; segment 5 golden to white in apical 0.3-0.5. Hindtarsal segment 2 with a small dark band in basal 0.18 (0.12-0.25), remainder white. **Wing**: Light spots on vein C and R cream to very light cream, not white; more posterior veins may be white. Vein C humeral light spot 1.6-3.0 (1.1-3.8) of basal dark spot; subcostal light spot about 0.11-0.35 (0.1-0.5) of subcostal dark spot, almost never greater than 0.5; preapical light spot about 0.3 (0.25-0.40) of preapical dark spot; apical dark spot usually very small and inconspicuous. R sectoral dark spot usually conspicuously smaller than presectoral dark spot. Rs-R_{2+3} variable, more or less predominantly dark, with 3, 4 dark spots and 3, 4 light spots. R_3 with or without small apical dark spot. R_{4+5} subcostal and preapical dark spots usually moderately small. M highly variable, from almost all light, with few dark scales, to predominantly dark; preapical dark spot not extending onto M_{1+2}. Apical light fringe spot usually moderately long, conspicuous, occasionally divided; light fringe spot at apex of R_{4+5} moderately large; additional, inconspicuous, light fringe spots at apices of M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few setae and a few inconspicuous, lanceolate scales. Scales of caudolateral tufts on tergites and sternites long, very broad, outstanding, dark and obovate.

MALE. Wing: 3.4 mm. Proboscis: 2.7 mm. Forefemur: 1.5 mm. Abdomen: about 2.7 mm. Essentially as in female except for sexual characteristics. **Head**: Palpal segments 2 and 3 with cream scales along dorsomesal border; segment 4 predominantly cream to white, usually with a basal or a subbasal, and occasionally an apical, small, dark band; dark scales on ventral surface usually visible only when viewed ventrally. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with long, conspicuous, oblanceolate scales on dorsomesal margin. **Legs**: Forefemur about 0.65 length of proboscis. Basal plantar surface of foretarsal segment 5 with 6-8 moderately long, thick, spiniform setae. Claw on foreleg long and curved; submedian tooth 0.20-0.25 length of claw, moderately acuminate and recurved at apex; basal tooth moderately short and decurved, slightly less than length of submedian tooth.

MALE GENITALIA (fig. 10). **Segment VIII**: Tergite and sternite with moderately narrow, obovate scales; scales broader on sternite than on tergite. **Segment IX**:

Sternite similar to *aquasalis*, curved, subtrapezoidal and moderately long, about 0.2 length of sidepiece. Anterior apodeme subtrapezoidal or subtriangular, and long (longer than in *aquasalis*), about 0.25-0.33 length of sternite. **Sidepiece**: Moderately narrow, conical. Tergal surface usually with 3-5 long, submedian tergomedial bristles and 1, 2 subapicolateral bristles; with moderately long bristles mesad of tergomedial bristles. Tubercle of parabasal spine large, appearing equal to or greater than 0.5 length of parabasal spine. Basal apodeme about 0.2 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine 0.70-0.85 of longer spine. Internal spine strongly retrorse apically. **Clasper**: Spiniform attenuate, thin and long, subequal to seta *b*. **Dorsal Claspette**: Pedicel moderately narrow (narrower than in *aquasalis*); base rounded and weakly curved mesad. Leaflets moderately broad; basomesal projection of dorsal leaflet usually reduced. **Ventral Claspette**: About 0.5 length of sidepiece. Lateral margins tapered toward narrow apex, width at apex about 0.33 or less length of claspette and about as wide as or slightly wider than apex of aedeagus. Basal lobule very large, expanded laterally, with long strong setae distributed along basal margin often reflexed and caudally directed; setae along basal margin about 2.0 width of aedeagus; setae not concentrated on basomesal margin. Lateral and ventral surfaces (exclusive of basal lobule) with setae about equal to or slightly less than width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins and a moderately shallow median sulcus; sulcus with moderately sloping sides. Preapical plate large, usually crescent shaped, moderately to heavily sclerotized, located about 0.3-0.4 length of claspette basad of apex. Transparent membranous area immediately basad of preapical plate bordering vertex of mesal cleft. Refringent structure moderately thick, in shape of inverted horseshoe or V, usually without lateral arms and moderately pointed at vertex. **Phallosome**: Aedeagus about 1.0-1.2 length of ventral claspette; apex rounded, about as wide as long or slightly longer than wide; usually without, occasionally with very small, membranous leaflets.

PUPA (fig. 10). Abdomen: 2.5 mm. Trumpet: 0.45 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Brownish yellow to brownish black. Wing cases occasionally with dark, heavily sclerotized, longitudinal stripes. Hair 2-C slightly shorter than 1, 3-C; 1-C 1,2 branched; 2-C 1-3 branched; 3-C 2,3 branched (2-4). Hairs 4,5-C 1-3 forked. Hair 6-C 1,2 forked (1-3). Hair 7-C with 2-4 subequal branches, moderately long. **Trumpet**: Pinna moderately heavily pigmented, dark amber; short, about 1.6-2.1 (1.5-2.2) length of meatus; in lateral aspect, appearing truncate and flared apically, usually not appearing to taper toward apex. **Metanotum**: Hair 10-C single and moderately short (0.1 mm), slightly shorter than 11-C. Hair 11-C 2-4 branched (1-4) near base. Hair 12-C single, more than 2.0 length of 10-C. **Abdomen**: Hairs in general shorter than those of *aquasalis*. Hair 2-I 3-7 branched, dendritic, moderately long; 3-I about 0.50-0.75 length of 2-I. Hair 4-I variable, 3-5 branched (2-5). Hair 5-I 1-3 forked (1-4), moderately long. Hair 6-I single or double, moderately long. Hair 7-I 2,3 branched (2-4), 0.60-0.75 length of 6-I. Hair 9-I 1,2 branched, longer than 7-I and shorter than 6-I. Hair 0-II-VI 3-6 branched (2-6); 0-II,III usually with 1,2 more branches than 0-IV-VII; 0-VII 3,4 branched (3-5). Hair 1-II 6-9 branched (4-9) and 1-III 7-13 branched (3-13), both strongly developed and with median branches longer than lateral; 1-IV-VII single and long, about 1.5-1.7 length of segment. Hair 3-IV 3-5 branched (2-6); 3-V 2,3 forked (1-4), moderately long. Hair 5-III 5-8 branched (4-8), moderate; 5-IV 3-5 branched (2-5), larger and stronger than 5-III. Hair 6-II single, equal to or slightly longer than 7-II; 6-III single or double, moderately long. Hair 7-II 2,3 branched (2-4); hairs 7-III-V and 8-III-VII short, with 4 or fewer

branches, usually 2,3 branched; 7-VI single or double, moderately long; 7-VII single and long. Hair 9-II small and unpigmented; 9-III about 2.0 length of 9-II, weakly pigmented; 9-IV at least 2.0 of 9-III; 9-IV-VIII heavily pigmented; 9-IV,V shorter than 9-VI,VII; 9-V-VIII weakly curved, stout, short, usually 0.33 or less length of segment. Hair 10-III 1-3 forked (1-4), moderate. Hair 4-VIII 2-4 forked (1-4), moderately long. **Terminal Segments**: Male genital lobe with distinct, apical, mammilliform protuberance. **Paddle**: Very similar to that of *aquasalis* in size and shape. Subapex of paddle weakly to moderately emarginate at insertion of hair 1-P. Midrib distinct basally, indistinct distally. External buttress 0.65 length of paddle. External margin distad of buttress with fine short filamentous spicules extending around apex and terminating 0.5 from base on inner margin. Hair 1-P single, moderately long. Hair 2-P single or forked, subequal to 1-P.

LARVA (fig. 11). Head: 0.55 mm. Antenna: 0.35 mm. Anal Saddle: about 0.30 mm. **Head**: Moderately pigmented, light brown, with brown to dark brown mottling. Median tooth of mental plate moderately broad and pointed. Inner and outer clypeal hairs (2,3-C) plumose, with moderately long to long, usually dendritic branches in apical half; 2,3-C subequal in length; hairs 2-C widely spaced, clypeal index about 1.65. Hair 4-C 2-4 branched, moderately short, inserted moderately close to anterior margin, distance between insertion of 4-C and 2-C subequal to distance between insertion of 2-C and 3-C. Hairs 8,9-C highly variable, 4-7 (3-8) and 4-7 (4-10) branched respectively, moderately large, length about 1.5 distance separating hairs 5-C. Hair 12-C 2-4 branched, subequal to hairs 8,9-C. Hair 15-C 3-5 branched (2-5), moderately long. Collar dark brown, heavily pigmented and broad dorsomedially (about 0.06 mm). **Antenna**: Pigmentation similar to head capsule. Mesal margin with numerous, moderately long spicules becoming shorter and stouter apically; a few short spicules on ventral surface. Hair 1-A 5-8 branched (3-8), short, about as long as width of antenna at point of insertion. **Thorax**: Integument gray to dark yellowish brown or grayish black. Inner submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing common tubercle; palmate hair 1-P with 10-12 moderately narrow leaflets; 2-P 13-18 branched (12-18), 3.0-4.0 length of 1-P. Hair 14-P 6-8 branched from a short to moderately short, flattened stalk, lateral branches shorter than median. Mesothoracic hair 1-M strongly plumose, 23-29 branched. Metathoracic hair 2-T long, extending beyond caudal margin of thorax. Palmate hair 3-T moderately large, with 9-13 semitransparent, narrow leaflets. **Abdomen**: Integument as in thorax; more pigmented medially. Hair 0-II-VII 5-8 branched (4-8), moderately large to large. Palmate hair 1-I with 10-12 (8-16) moderately narrow, semitransparent leaflets; 1-II-VII with 18-25 moderately broad, spreading leaflets; 1-III-VI larger than 1-II,VII. Hair 2-II 5-8 branched, large; 2-III 4-7 branched, large; 2-IV single, moderately long; 2-V 2,3 branched, large. Hair 5-I 2,3 branched, moderate; 5-II 7-12 branched, moderate. Hair 9-I 3,4 branched (3-6), long. Hair 13-I,II,III 7-10, 6-11 and 8-11 (7-11) branched respectively, small; 13-IV 5-7 branched, moderately large; 13-V 3-5 branched (3-6), very large, with long branches extending beyond caudal margin of segment V; 13-VI 8-10 branched, about equal to 13-IV. **Spiracular Lobe**: Pecten with 13-16 teeth; most of median teeth subequal and of moderate length; serrations on dorsobasal margins of teeth moderately short. Lateral arm of spiracular apparatus moderately long, projecting caudolaterad or laterad, rounded at lateral margins, usually reaching spiracular openings. Hairs 8,9-S 3-5 branched. **Anal Segment**: Almost entire surface except for base covered with fine spicules, more strongly developed at apex. Hair 1-X longer than saddle; not inserted on saddle; inserted immediately ventrad of ventral margin of saddle and usually slightly more than 0.5 distance from base

of segment. Anal gills long (0.5 mm), as long as or longer than anal segment.

DISCUSSION. *An. oswaldoi* can be distinguished from other species in the Oswaldoi Subgroup in the **female** by the combination of (1) foretarsal segments 2 and 3 cream to white in apical 0.20-0.45 and 0.50-0.85 respectively, (2) foretarsal segment 4 all dark to more than 0.3 dark basally, (3) midtarsal segment 4 all dark, (4) hindtarsal segment 2 less than 0.25 dark basally and (5) vein C with a small, basal, dark spot, and humeral light spot 1.6-3.0 (1.1-3.8) length of basal dark spot; in the **male genitalia** by the combination of (1) basal lobules of ventral claspette very large, expanded laterally, with long setae along basal margin which are about 2.0 width of aedeagus, (2) lateral and ventral surfaces of ventral claspette (exclusive of basal lobules) with setae equal to or slightly less than width of aedeagus, (3) preapical plate large, usually crescent shaped, moderately to heavily sclerotized and (4) aedeagus usually without leaflets; in the **pupa** by (1) pinna of trumpet short, about 1.6-2.1 length of meatus, appearing truncate and flared apically, (2) meatal cleft pointed at base, (3) hair 9-V-VIII short, usually 0.33 or less length of segment, (4) hair 6-II equal to or slightly longer than 7-II and (5) hair 2-I 3-7 branched, moderately long; and in the **larva** by the combination of (1) hairs 2,3-C plumose, with usually dendritic branches, hairs 2-C widely spaced, clypeal index about 1.65, (2) hair 4-C moderately short, distance between insertion of 4-C and 2-C subequal to distance between insertion of 2-C and 3-C, (3) hairs 8,9-C moderately large, length about 1.5 distance separting hairs 5-C, (4) lateral arm of spiracular apparatus moderately long, (5) median teeth of pecten mostly subequal, (6) hair 1-X not inserted on saddle and (7) anal gills long, as long as or longer than anal segment.

The populations of *oswaldoi* examined in this study do not exhibit much interpopulational variation. In the larvae, the clypeals (2,3-C) of the Panamanian populations do not show as extensive branching as the South American populations. Frequently the branching of the clypeals is simple in Panamanian specimens rather than dendritic. In the male genitalia, the Panamanian populations sometimes have very small, membranous, basolaterally directed leaflets similar to those in *ininii, rangeli* and *nuneztovari*. It is possible that these leaflets are occasionally present in other populations, but I have not been able to observe them. However, the diagnostic key characters are constant, permitting identification of all stages.

An. oswaldoi is most closely related to *noroestensis, galvaoi* and *aquasalis.* The male genitalia of these species are very similar in general appearance; this is particularly evident when comparing *oswaldoi* with *galvaoi* and *noroestensis*. The shape of the preapical plate and the length of the setae on the ventral claspette of *galvaoi* and *noroestensis*, and the truncate aedeagus of *noroestensis* are the only characters which differentiate the male genitalia of these species from *oswaldoi*. There is also considerable overlap in the adults of *oswaldoi* and *noroestensis,* which sometimes makes species identification difficult. The larvae of *aquasalis* and *noroestensis* are similar to those of *oswaldoi,* differing mainly in the characters given above. The pupa of *noroestensis* is distinguished from that of *oswaldoi* only by a longer pinna and a slightly longer hair 9 on segments V-VIII.

Although *oswaldoi* may occur sympatrically, in the broad sense, with *aquasalis* and *noroestensis,* it is ecologically isolated from these species, breeding in fresh, usually well shaded water in the interior of forests. The center of origin for *oswaldoi* was probably a forested region in tropical South America. *An. oswaldoi* has extended its range through the isthmus of Panama as far north as Costa Rica.

Peryassu described *oswaldoi* as a species of *Cellia* in 1922. The following year Dyar (1923:185) listed *oswaldoi* as a synonym of *An. tarsimaculata* Goeldi 1905.

Bonne (1923:128; 1924:134, 135), and Bonne and Bonne-Wepster (1925:514) recognized 2 "races" of *tarsimaculatus* existing in Surinam: one that was exophilic in the interior of the country, characterized by a very small dark ring on the hindtarsal segment 2 (=*oswaldoi*), and the other a coastal species (=*aquasalis*). Root (1924b:461, 462), after studying a series of mounts of the male genitalia of *"oswaldoi"* and *tarsimaculata,* found no genitalic differences, and therefore synonymized *oswaldoi* again with *tarsimaculata.* Lima (1928:96-98) described constant differences between *tarsimaculatus* and *oswaldoi* in the adult, pupa and larva, but maintained that *oswaldoi* was only a variety of *tarsimaculatus.* In 1932, Curry described *aquasalis* and *aquacaelestis* as varieties of *tarsimaculatus.* He stated that the variety *aquacaelestis* "is undoubtedly quite similar in appearance to *A. oswaldoi* from Brazil, which Root (1926b:709-711) places in the synonymy of *A. tarsimaculatus*." Senevet (1934:49-52) revalidated *oswaldoi,* describing the pupa in some detail, and, in 1938, Senevet and Abonnenc synonymized *aquacoelestis* [*sic*] with *oswaldoi.* Galvao and Lane (1937e:218-221) stated that the species, *oswaldoi*, really consists of 3 types: *oswaldoi oswaldoi* Peryassu 1922, *oswaldoi* var. *metcalfi* Galvao and Lane 1937 and *oswaldoi* var. *noroestensis* Galvao and Lane 1937. In 1942, Galvao and Damasceno recognized *noroestensis* as a species separate from *oswaldoi* and considered *metcalfi* to be a *nomen nudum* [*sic, ?nomen dubium*]. In this same paper they described *konderi* as a species very closely related to *oswaldoi,* differing only in the shape of the apex of the aedeagus. I have not had the opportunity to examine any material from the type locality of *konderi.* However, since the proportions of the aedeagus appear to change depending on how the genitalia are mounted, and some variation does occur between different populations, I concur at this time with Lane (1953: 262) in synonymizing *konderi* with *oswaldoi.*

BIONOMICS. The immature stages of *oswaldoi* are found in the interior, usually in or on the margins of tropical forests, frequently along roads, in cultivated fields or grasslands adjacent to forested areas. The breeding sites are in permanent or temporary ground pools, margins of ponds or lakes, swamps and streamside pools; the sites are found most often in deep to partial shade, less often in full sun. The immature stages are commonly collected in the grassy margins of pools with muddy bottoms, and algae and abundant flotage are often present. The water is always fresh and may be turbid or clear. Galvao (1938b) reared *oswaldoi* in the laboratory at a mean temperature of 25.7°C and found that the time necessary for development from egg to adult was 12 days. The immatures are commonly encountered in association with *triannulatus* and less often *rangeli.* Occasionally *oswaldoi* has been collected with *ininii* and *nuneztovari* in Para, Brazil. Other species found in association with *oswaldoi* are *Anopheles (Ano.) neomaculipalpus, An. (Ano.) punctimacula, Culex (Cux.) coronator* group, *Uranotaenia (Ura.) geometrica* and *Ur. (Ura.) lowii.*

The adults of *oswaldoi* are largely restricted to the forest. They are exophilic and zoophilic. Of the 6470 adults of *oswaldoi* Deane, Causey and Deane (1948:876) captured in Para, Brazil, 83 or 1.3% were from inside houses. Rey and Renjifo (1950: 537) in 3 months, September through November, captured 2414 anophelines inside houses in northern Colombia of which only 0.75% were *oswaldoi.* Correa and Ramos (1944c:11) reported that from the Ilha de Santo Amaro, in the state of Sao Paulo, Brazil, 5.2% of the anophelines collected in houses were *oswaldoi.* Although primarily zoophilic, *oswaldoi* feeds freely on man inside the forest, such as in the Mojinga Swamp in Panama or in the forest of French Guiana (Rozeboom 1941:102-103; Floch and Abonnenc 1947:6; Curry 1932). Rozeboom (1942a:240), in the interior of the cacao growing districts of Trinidad, collected twice as many females of *oswal-*

doi on animal bait as on human bait and found none inside houses. Deane, Causey and Deane (1948) reported that the peak of biting activity of *oswaldoi* was between 1800 and 1900 h.

MEDICAL IMPORTANCE. *An. oswaldoi* has been experimentally infected with *Plasmodium vivax* and *P. falciparum* by Fonseca and Fonseca (1942:106-111) in the state of Sao Paulo, Brazil and by Rozeboom (1942a:240) in Trinidad. However, it has never been found naturally infected or otherwise implicated in transmitting malaria. Deane, Causey and Deane (1948:876) dissected 540 females from the northeast of Brazil and found none infected with *Plasmodium.* Lucena (1940b) and Correa and Ramos (1942b) reported finding *oswaldoi* var. *metcalfi* naturally infected in Brazil; however, these investigators were probably dealing with *noroestensis* or *aquasalis* and not *oswaldoi*. *An. oswaldoi,* at present, does not seem to be a vector of malaria.

DISTRIBUTION (fig. 2). *An. oswaldoi* is distributed throughout South America east of the Andes as far south as the northern provinces (Formosa, Missiones, Salta, Tucuman) of Argentina. It occurs throughout most of Colombia, Venezuela, the Guianas, Brazil, Paraguay and Bolivia; it also occurs in Ecuador and Peru east of the Andes. Northward, it extends into Panama and Costa Rica. It is also found in Trinidad, but not in Tobago or any other islands of the Antilles. It is not certain how far south *oswaldoi* occurs west of the Andes.

Material Examined: 1376 specimens: 244 males, 117 male genitalia, 561 females, 273 pupae, 181 larvae; 259 individual rearings: 129 larval, 118 pupal, 12 incomplete; 9 progeny rearings.

BOLIVIA (7F). **Beni:** Guayaramerin, 18 Feb 1944, 1F [MCZ] ; same locality, 3 Jun 1947, 5F (47-12258). **Pando:** Ingavi, Abuna?, 29 Dec 1943, 3111, [KO] 119A-30, 1F.

BRAZIL. Amazonas (9F): Manaus, Jun 1931, R. Shannon, 4F; same locality, F. Urich, 1F. Rio Amazonas above Manaus, 1914-18, R. Moffat, 1F [BM] . Rio Brancos, Aug 1930, 2F. Tonantins, Mar 1931, 1F. **Bahia** (1M, 2Mgen, 2F): Bonfim, 26 Jan 1930, 2F. Salvador, 1936, R. Shannon, 1M, 1Mgen. Locality not specified, M. Boyd, 1Mgen. **Mato Grosso** (1M, 1Mgen, 43F): Maracaju, Jun 1937, 1M, 1Mgen. Westborder, May 1931, R. Shannon, 1F (151). Locality not specified, May 1931, R. Shannon, 42F. **Para** (60 specimens: 8M, 9Mgen, 34F, 6p, 3 l; 6 ind rear: 2 l, 4p): Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.,* coll. 77, 1 pF. Belem, 14 Apr 1941, W. Komp, BRAK 2A, 3F; same locality, 16 Apr 1941, 1 l; same locality, 17 Apr 1941, BRAK 3, 4M, 3Mgen; same locality, Mar 1944, MacCreary, Bricken, 1Mgen; same locality, det. Deane, 1M [CU] ; same locality, W. Komp, 3Mgen. Bacuri, 28 Oct 1974, J. Reinert, *et al.*, coll. 62, 1Mgen, 2 lpM, 1 pM, 2 pF. Fordlandia, 31 Jun, R. Shannon, 1M, 1Mgen. Maraba area, 4 May 1976, 1F (M-6); same locality, 2 Jun 1976, 1F (R-3); same locality, 5 Jul 1976, 11F (M-6); same locality, 7 Jul 1976, 1F (M-8); same locality, 19 Oct 1976, 4F (1); same locality, 20 Oct 1976, 1F (1); same locality, 21 Oct 1976, 1F (1); same locality, 11 Nov 1976, 1F (1); same locality, 1976, D. Roberts, 3F. Locality not specified, N. Davis, 4F. **Rio de Janeiro** (1M, 2Mgen, 11F): Bangu, 11 Jun 1924, F. Root, 1 Mgen. Porto das Caixas, 3 Mar 1925, 1F (37); same locality, 29 May 1925, F. Root, 1M and 1Mgen (710210-1, lectotype of *metcalfi*). Rio de Janeiro, L. Saunders, 3F [BM1924-240] ; same locality, M. Boyd, 1F [BM 1925-336] ; same locality and collector, 6F. **Rondonia** (9F): Porto Velho, May 1931, R. Shannon, 5F. Guajara Mirim, May 1931, R. Shannon, 3F. **Sao Paulo** (6M, 2Mgen, 5F, 1 lp): Caraguatatuba, 1M, 1F. Juquia, Nov 1938, [?] J. Lane, 1F (1.116); same locality and collector, 1F [CU] . Santos, Guanuja, 1F. Sao Vincente, 1938, A. Galvao, 4M, 1F; same locality, 1M; same locality, 1Mgen (97-16), 1 lp (15-12) [JH] . Locality not specified, 1938, A. Galvao, 1Mgen.

COLOMBIA (57 specimens: 13M, 9Mgen, 6F, 11p, 18L&l; 2 inc ind rear). **Boyaca:** Puerto Boyaca, COM 651. **Caqueta:** Tres Esquinas, COM 652. **Meta:** Restrepo, Rd. to Cumaral, Jul 1935, KO 120A-4, 1M. Villavicencio, Jun 1947, CV 671, 2 lp, 9p, 15L, 1 l; same locality, 1947, L. Rozeboom, CV-P 38, 1F, E (progeny); same locality, Jun 1947, [CV] 671.1, 1Mgen [JH] . Puerto Lopez, COM 653. Puerto Porfia, COM 649. Locality not specified, 25 Nov 1936, COR 155, 2F. **Department not specified:** Puerto Nino, 21 Feb 1922, F. Miller, 1F. Locality not specified, 1943, [KO] 119A-21, 2F.

COSTA RICA (1Mgen). **Limon**: Puerto Viejo, Apr 1938, H. Kumm, 1Mgen.

GUYANA (8 specimens: 3M, 3F, 2L). **East Demerara-West Coast Berbice**: Mackenzie, Sep 1945, 111A-310, 2F; same locality, 15 May 1945, G. Giglioli, [KO] 119A-41, 3M, 1F; same locality, Sep 1949, 2L.

PANAMA AND CANAL ZONE (878 specimens: 144M, 65Mgen, 281F, 251P&p, 137L&l; 249 ind rear: 127 l, 113p, 9inc; 9 progeny rearings). **Canal Zone**: Atlantic side, May 1939, PAX 114, 3M, 5F. Escondido River, 19 May 1939, PAX 108, 2F. Fort Davis, 13 Mar 1923, D. Baker, 1F; same locality and collector, 30 Mar 1925, 1M; same locality, 12 Feb 1940, PAX 168, 4M, 2F. Fort Sherman, 8 Feb 1945, ASM 410-1, 1F; same locality, May 1945, 1M. France Field, 30 Aug 1924, J. Zetek, 1M, 1F; same locality and collector, 1 Nov 1924, 4M, 5F; same data, 1M, 2F [MCZ]; same locality, 11 Nov 1924, 1M, 8F; same locality, 23 Nov 1924, C. Mopp, 2M, 2F; same locality, 7 Mar 1925, D. Baker, 1F; same locality and collector, 9 May 1925, 1M, 1F; same locality, 6 Feb 1940, 2M, 4F. Gatun, Jan 1913, J. Zetek, 1Mgen; same locality, 7 Jul 1931, D. Curry, PAX 25, 3F. Mojinga Swamp, Oct 1935, PAX 54, 9M, 11F; same locality, 28 Oct 1948, No. 113, 1L; same locality, 2 Jul 1949, 16Mgen [JH]; same locality, 20 Jul 1949, 14Mgen; same locality, PA 729, 1175, 1176 (6 progeny rearings), 1177 (3 progeny rearings); same locality, 12F. [Rio] Chagres, 17, 19 Aug 1953, S. Carpenter, 20F; same locality and collector, 10 Sep 1953, 26F. Locality not specified, D. Curry, 1F [BM1933-504]; 5 Aug 1909, A. Jennings, 1Mgen. **Darien**: Paya, GG 1-126, 1-129, 1-133, 1-137, 1-138, 1-141. Rio Tuira, GG 1-159. **Panama**: Juan Diaz, 21 Mar 1935, PAR 16, 3F. La Chorrera, 29 Jan 1945, ASM 397-1, 1F. **Province not specified**: Rio Trinidad, 9 Jun 1912, A. Busck, 2F; same locality and collector, 3 Jul 1912, 1F. Locality not specified, 5 May 1952, S. Carpenter, 1F (620926-6); 30 Jul 1936, PAR 104, 3F.

PERU (71 specimens: 2Mgen, 67F, 2L). **Huanuco**: Tingo Maria, May 1946, E. Hambleton, 2 Mgen; same locality, [?1946], Emilio-Viale, 2L. **Loreto**: Iquitos, Mar-Apr 1931, R. Shannon, 67F.

SURINAME (23 specimens: 11M, 4Mgen, 8F). **Marowijne**: Moengo, 1944, Guicherit, 3F; same locality and collector, Oct 1945, 1M (46-V-8d), 1M (46-V-8e), 1Mgen. **Paramaribo**: Paramaribo, J. Bonne-Wepster, 4M, 1Mgen. **District not specified**: Billeton, 5 Jul 1943, 1F. "Leidino XIa," 21 Jun 1946, E. van der Kuyp, 5M, 2Mgen. Locality not specified, J. Bonne-Wepster, BB 897, 4F.

TRINIDAD AND TOBAGO. TRINIDAD (158 specimens: 52M, 14Mgen, 71F, 4p, 17L&l; 1 p ind rear). **Caroni**: Tabaquite, 22 Aug 1945, 2M, 5F; same data, [KO] 119A-31, 2F; same data, P. Woke, 3M, 2F; same locality and date, [KO] 119A-40, 1F; same data, [KO] 119A-42, 3M, 3F; same locality, 23 Aug 1945, 1 l; same data, [KO] 119A-33, 1F; same locality, 22 Aug 1945, [KO] 119A-39, 1M, 4F; same locality, 23 Aug 1945, [KO] 119A-29, 1F. **Nariva**: Charuma Forest, 27 Aug 1964, A. Guerra, TR 643, 1L. Nariva Swamp, 16 Nov 1961, T. Aitken, 1p; same locality, 18 Feb 1964, TR 77, 1L. Navet, 20 Aug 1964, A. Guerra, TR 610, 2L. **St. Andrew**: Cumuto, 2 Jun 1941, TRR 1, 2M, 2Mgen, 1F; same locality, 27 Jun 1941, TRR 15B, 1M, 1Mgen, 2F; same locality, 7 Aug 1941, TRR 26, 2F; same locality, TRR 64, 2M, 1Mgen, 3F. Mount Harris, 10-16 Jul 1964, F. Powdhar, 1F. Sangre Grande, 1941, W. Downs, coll. E-43-44, 3Mgen. Valencia, 29 Aug 1945, 1 l. **St. George**: Arima, 21 Aug 1938, E. de Verteuil, 1M [BM]; same locality, 8 Jul 1965, A. Guerra, TR 1247, 1Mgen, 1 pM. Curepe, 21 Jul 1931, E. de Verteuil, 1M [BM1931-562]. Diego Martin River, 8-26 Feb 1941, W. Komp, TRK 35, 17M, 13F. Fort Read, Oct 1944, 1F. Four Roads, 18 Mar 1941, W. Komp, [KO] 119A-6, 3M, 5F; same locality, 5 Jun 1941, TRR 3, 13M, 2 Mgen, 9F. Maraval, 1946, 5F. **County not specified**: St. Helena, 24 Oct 1936, TRK 33, 1M, 1M gen, 8F. Locality not specified, W. Downs, 1Mgen (301-3), 1Mgen (409-1), 1Mgen (413-2) [JH]; Mar 1941, W. Komp, KO 111-7, 1M; 22 Aug 1945, 2p, 1L, 10 l; no data, 1F.

VENEZUELA (16 specimens: 4M, 6Mgen, 5F, 1L). **Aragua**: Maracay, 1F. **Monagas**: Caripito, 10 Jun [1935], 1F. **Portuguesa**: Acarigua, 1Mgen. **State not specified**: Rancho Cachipo, 5 Sep 1936, Quire, [KO] 119A-7, 3M, 2F. Juasipati, May 1929, 2Mgen (52). San Joaquin, 16 Dec 1944, E. Winton, KO 111-16, 1M. Locality not specified, VZ 421; Jul 1937, P. Anduze, 1L; 1938, A. Gabaldon, 2Mgen; 1949, 1Mgen.

3. Anopheles (Nys.) galvaoi Causey, Deane & Deane
Figs. 3, 4, 6, 12

1943. *Anopheles (Nyssorhynchus) galvaoi* Causey, Deane and Deane 1943:293-296. TYPE: *Lectotype* female (R426), marked *capanemai* in register, Rio Branco (Acre), Brazil, O. R. Causey [FMSP, 694; designation by Belkin, Schick and Heinemann 1971:5].

Anopheles (Nyssorhynchus) galvaoi of Galvao (1943:142, 143, 145, 146, 148, 149, 151); Causey, Deane and Deane (1944:1, 2, 5, 6; 1945:248; 1946:27, 31); Correa and Ramos (1944b:131); Galvao, Lane and Unti (1944:45, 46); Deane, L. M., Causey and Deane (1946:7, 8, 9, 10, 12; 1948:877); Deane, M. P., Causey and Deane (1946:43, 45); Coher (1948:88); Senevet (1948a: 279); Lane (1949:403, 410, 413, 414; 1953:269-270); Levi-Castillo (1949:11, 15, 28, 58, 67, 72, 76, 82, 86); Carvalho and Rachou (1951:475, 480); Rachou and Ricciardi (1951:424, 425-426); Bejarano (1957:326, 330, 331); Vargas (1959:370); Cerqueira (1961:124); Forattini (1962:325, 370, 415, 418-419, 476, 484, 491); Garcia and Ronderos (1962:137, 138, 139, 158); Consolim and Galvao (1973:177, ?).

Anopheles galvaoi of Foote and Cook (1959:29); Maciel (1962:477-478); Mattos and Xavier (1965: 272); Gorham, Stojanovich and Scott (1967:18, 47, 54).

FEMALE (fig. 6). Wing: about 3.5 mm. Proboscis: 2.3 mm. Palpus: 2.2 mm. Forefemur: 1.5 mm. Abdomen: about 3.1 mm. Description based on only 4 damaged females (2 paratypes and 2 topotypes). **Head:** Integument dark brown. Proboscis about 1.5 length of forefemur. Vertex with numerous, long, erect, cuneate or weakly forked, white scales. Palpal segments 2 and 3 with an indistinct, dorsolongitudinal, light stripe; apex of segment 2 with a small, light, apical ring; segment 3 with a moderately large, light apical band; segment 4 with a basal and an apical, moderately small, dark band, remainder light without distinct ventral stripe of dark scales; segment 5 light. **Antenna:** Flagellar segment 1 with a patch of long, white, oblanceolate scales distally on dorsomesal surface, shorter scales mesally; with small light scales basally on lateral surface. Flagellar segments 2-13 each with about 6-9 long, silver setae in a basal whorl. **Thorax:** Integument brown. Median anterior promontory area with long, creamish to white, setiform scales extending dorsad onto most anterior part of acrostichal line. Scutum with moderately short (0.7 mm), obovate, creamish scales. Prescutellar space horseshoe shaped. Many of setae and scales missing or not apparent on pleuron. Upper *stp* with 2, 3 long, dark setae and many, small, obovate, cream scales in horizontal arc. Lower *stp* with one long, dark seta and a patch of small, obovate, cream scales. Upper *mep* with about 4 long, cream setae. **Legs:** Light scales on coxae grayish white to white. Midfemur with antero-apical spot and knee spot moderately large, distinct and light cream to white. Foretarsal segment 2 cream to white in apical 0.13-0.24; segment 3 cream to white in apical 0.16-0.40; segment 4 with a few, light, apical scales; segment 5 cream to white in apical 0.30-0.45. Midtarsal segment 2 creamish white to white in apical 0.08-0.11; segment 3 with a few, light, apical scales; segment 4 all dark or apically slightly lighter; segment 5 creamish white to white in about apical 0.5. Hindtarsal segment 2 brown in basal 0.42-0.55; segment 5 cream in about apical 0.5. **Wing:** Light scales on wing white except for creamish white scales on vein C. Vein C humeral light spot large, 2.1-3.6 of basal dark spot; basal dark spot small; presectoral light spot absent or consisting of only a single scale, so that presectoral and sectoral dark spots fuse into a single, large, dark spot; subcostal light spot 0.24-0.45 of subcostal dark spot; preapical light spot 0.35-0.48 of preapical dark spot; apical dark spot small. R presectoral dark spot small; sectoral dark spot very small, in one specimen consisting of only 2 dark scales. R_3 with 3 light spots and 3 occasionally indistinct, dark spots; apical dark spot small. R_{4+5} subcostal dark spot moderately small; preapical dark spot

moderately small to moderately large. M sectoral dark spot moderately small and inconspicuous, to moderately large with a few interspersed light scales. Cu sectoral dark spot moderately small. Cu_1 subcostal dark spot small, in one specimen consisting of only a single scale. Vein A subcostal dark spot small to moderate, about 0.15 of vein. Apical light fringe spot moderately small and divided; additional light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderate size, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few, light, obovate, submedian scales. Dark caudolateral scale tufts large, each scale about 0.1 mm long. Tergites II-VII densely covered with cream to golden, narrow, lanceolate scales in a subtriangular pattern on segments II, III, becoming more extensive and subrectangular on distal segments.

MALE. Wing: about 3.3 mm. Forefemur: 1.5 mm. Description based only on a single paratype male. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a dorsal stripe of cream to white scales, stripe longer on 2 than on 3; segment 4 witha light basal band, and a subbasal and a subapical, dark band, mediolaterally predominantly light, ventral surface inconspicuously dark. **Antenna**: Flagellar segment 1 with long, oblanceolate, white scales on dorsomesal surface. **Legs**: Claw on foreleg weakly curved; submedian tooth recurved at apex, about 0.25 length of claw; basal tooth subequal to submedian, decurved.

MALE GENITALIA (fig. 12). Description based on only 2 specimens (one paratype and one from Sao Paulo). In general very similar to those of *oswaldoi* and *noroestensis.* **Segment VIII**: Tergite and sternite with narrow, long, obovate scales; scales slightly broader on sternite than on tergite, darker medially on tergite. **Segment IX**: Sternite as for those of *oswaldoi* and *noroestensis*; subtrapezoidal, about 0.25 length of sidepiece. Anterior apodeme moderately long, about 0.2 length of sternite. **Sidepiece**: Moderately broad and subconical. Tergal surface with 5 alveoli for submedian tergomedial bristles, 2 long, strong bristles remaining on specimens; 1, 2 long subapicolateral bristles; 5, 6 moderately short to moderately long bristles mesad of tergomedial bristles, subbasal bristles longest. Parabasal spine moderately long and narrow; tubercle of spine moderately long, 0.3-0.4 of spine; combined lengths of tubercle and spine about 0.3 of sidepiece. Basal apodeme moderately short, about 0.2 length of sidepiece. Longer, more dorsal accessory spine slightly longer than 0.5 of sidepiece, curving caudally at apex; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine, strongly retrorse apically. **Clasper**: Spiniform long, slender and apically attenuate; seta *b* 1.5-2.0 length of spiniform. **Dorsal Claspette**: About 0.5 of sidepiece. Pedicel moderately narrow; base curved mesad. Leaflets about 0.40-0.47 length of claspette; dorsal leaflet with prominent basomesal projection. **Ventral Claspette**: About 0.5 length of sidepiece. Lateral margins tapered toward narrow apex, width at apex about 0.35 length of claspette and 1.25-1.50 width of apex of aedeagus. Basal lobule very large, expanded laterally and covered with very long, occasionally caudally reflexed setae distributed uniformly over lobule; setae on basal margin about 3.0 width of aedeagus. Ventral and lateral surfaces (exclusive of basal lobule) covered with short setae about 0.5 width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins separated by a moderately shallow V shaped median sulcus; lateral margins tapering apically. Preapical plate distinct, large, circular to semicircular with small basolateral projections directed basally, heavily sclerotized, located about 0.25 length of claspette basad of apex. Transparent membranous area small, not very distinct, with lateral margins projecting basolaterally. Refringent structure very distinct, in shape of inverted V, lateral arms not visible. **Phallosome**: Aedeagus equal to or slightly longer

than ventral claspette; apex rounded, about as wide as long (possibly shorter than *oswaldoi*); leaflets absent.

PUPA, LARVA. No specimens available.

DISCUSSION. *An. galvaoi* can be distinguished from other species in the Oswaldoi Complex in the **male genitalia** by the combination of (1) ventral claspette with basal lobule very large, covered with very long, uniformly distributed setae about 3.0 width of aedeagus, and ventral and lateral surfaces (exclusive of basal lobules) with short setae about 0.5 width of aedeagus, (2) preapical plate heavily sclerotized, circular to semicircular with small basolateral projections and (3) apex of aedeagus rounded, about as wide as long (possibly shorter than *oswaldoi*), without leaflets. The **female** of *galvaoi* is apparently very similar to those of *aquasalis* and *benarrochi.* Since there were only 4 damaged specimens available to me, I was not able to differentiate the female of *galvaoi* from those of the latter 2 species. Consequently, I have not included *galvaoi* in the key to females. Forattini (1962:418-419) states that Correa and Ramalho (1958) can distinguish *galvaoi* from *aquasalis* on the basis of the relative lengths of the dark basal spot and humeral light spot of vein C. Forattini reports that in *aquasalis* the basal dark spot is about 0.5 the length of the humeral (B_2) spot; whereas, in *galvaoi*, the basal dark spot is clearly less than 0.5 the length of the humeral light spot. For *aquasalis* this is not always true. Because *aquasalis* and *galvaoi* are not sympatric, there should be no problem in recognizing *aquasalis.* A problem also arises in that the wing of *benarrochi* has the same characteristics as described above for *galvaoi,* and it is possible that these 2 species occur sympatrically. The male genitalia of *galvaoi* are very similar to those of *oswaldoi* and *noroestensis*, *galvaoi* differing only by (1) longer setae on basal lobule of ventral claspette and shorter setae on ventral and lateral surfaces of the fused portion of ventral claspette when compared to *oswaldoi*, (2) circular or semicircular shape of preapical plate when compared to *oswaldoi* and (3) rounded apex of the aedeagus in contrast to *noroestensis.*

Neither the **larva** nor the **pupa** of *galvaoi* was available for this revision. However, the larva has been described by M. P. Deane, Causey and Deane (1946:36). From their description and key (p 43) it seems that *galvaoi* most closely resembles *goeldii (=nuneztovari), noroestensis* and *rangeli*. With regard to the larva, these investigators stated, ". . . it [*galvaoi*] can usually be separated from *A. goeldii* in which the posterior clypeal hairs are longer and simple or divided far from the base. In *A. goeldii, A. noroestensis* and *A. rangeli* the anterior clypeal hairs have even less numerous and shorter branches, and the leaflets of the abdominal palmate tufts of segments 5 to 7 are pointed at the tips." In their key, *galvaoi* is distinguished from *noroestensis* and *rangeli* by palmate hairs 1-V-VII possessing apically truncate leaflets. The difficulties of correctly identifying *galvaoi* are best summarized by Rachou and Ricciardi (1951: 426): *"Para se julgar dessa dificuldade, basta atentar-se para o fato de que esse mosquito, segundo os autores da especie, se assemelha ao* A. tarsimaculatus (A. aquasalis) *nas marcacoes do alado, ao* A. oswaldoi *na terminalia do macho, ao* A. noroestensis *na fase larvaria e possue ovos do tipo* oswaldoi, *donde se conclue que para se fazer um diagnostico conscientodas dessa especie e indispensavel que se analise todo esse conjunto, isto e todos as suas fases evolutivas."*

Based on the ventral claspette of the male genitalia, *galvaoi* shows the greatest affinity to *oswaldoi* and *noroestensis.* The larva seems to be very similar to that of *noroestensis.* For these reasons I am tentatively placing *galvaoi* between *oswaldoi* and *noroestensis* in this revision. The center of origin for *galvaoi* was probably within its present distribution, possibly in some refugium in the upper Amazon basin or along the eastern slope of the Andes.

BIONOMICS. Very little has been written about the natural history of *galvaoi*. Deane, Causey and Deane (1948:877) found the larvae in puddles containing grass and algae exposed to the sun. Forattini (1962:415) reports that the larvae are found in similar habitats to those of *rondoni*, such as puddles and marshes. The females are said to be crepuscular and have been collected on animal bait but not inside houses (Deane, Causey and Deane 1948).

MEDICAL IMPORTANCE. *An. galvaoi* is of no known medical importance.

DISTRIBUTION (fig. 3). *An. galvaoi* was described from the territory of Acre, Brazil. This species has been reported also to occur in Brazil in the following territories or states: Amazonas, Rondonia, Mato Grosso, Para, Sao Paulo, Rio de Janeiro (?) (Carvalho and Rachou 1951:475, 480); Goias (?) (Mattos and Xavier 1965:272); and Bahia (?) and Parana (?) (Rachou and Ricciardi 1951:425-426). Deane, Causey and Deane (1948:877) state that in the northeast and Amazon basin regions of Brazil, *galvaoi* is restricted to the high Amazon basin. These investigators encountered *galvaoi* in Rio Branco, Rio Zinho and Brasileia (Acre), and in Guajara Mirim (Rondonia). Garcia and Ronderos (1962:158) record *galvaoi* from Paraguay.

Material Examined: 7 specimens: 1 male, 2 male genitalia, 4 females.

BRAZIL. Acre (1M, 1Mgen, 4F): Rio Branco, O. Causey, 1M and 1Mgen (paratype 58037), 1F (paratype 58039), 1F (paratype); same locality, S.E.S.P. 699, 2F (13428-12 and 13428-42) [JH]. **Sao Paulo** [?] (1Mgen): Locality not specified, det. A. Galvao, 1Mgen (1085-28).

4. Anopheles (Nys.) noroestensis Galvao & Lane

Figs. 2, 4, 6, 13, 14

1937. *Anopheles (Nyssorhynchus) oswaldoi* var. *noroestensis* Galvao and Lane 1937e:220-221. TYPE: *Lectotype* male genitalia slide (2177, 10293), adult apparently lost, (possible syntype FMSP, 373), Novo Oriente [Pereira Barreto], near Lussanvira (Sao Paulo), Brazil [FH; designation by Belkin, Schick and Heinemann 1971:6].

1937. *Anopheles (Nyssorhynchus) oswaldoi* var. *metcalfi* Galvao and Lane 1937e:218-220. TYPE: *Lectotype* male (96) with genitalia on slide (710210-1), Porto das Caixas (Rio de Janeiro), Brazil, 29 May 1925, F. M. Root; one of several specimens identified as *tarsimaculatus* by Root (1926b:711), on which Galvao and Lane based their *metcalfi* [USNM; designation by Belkin, Schick and Heinemann 1971:6]. TRANSFERRED SYNONYMY.

1940. *Anofeles (Nyssorynchus) osvaldoi* (!) var. *ayrozai* Unti 1940a:379-383. TYPE. *Syntypes* female(s), larva(e), eggs, Vale do Rio Paraiba, Guaratingueta (Sao Paulo), Brazil, Nov 1939-Aug 1940 [NE; not in FH or SPM, Belkin, Schick and Heinemann 1971:6]. Synonymy with *noroestensis* by Galvao, Lane and Unti (1944:39).

1942. *Anopheles (Nyssorhynchus) clarki* Komp 1943:197-201. TYPE: *Holotype* dissected male genitalia mounted on slide, Monteros (Tucuman), Argentina, Jun 1940, C. A. Alvarado [USNM, 56476; male apparently lost].

Anopheles (Nyssorhynchus) noroestensis of Galvao and Damasceno (1942:125-129, 131); Barretto and Coutinho (1943:321); Correa (1943:128); Fonseca and Unti (1943:47-49); Galvao (1943:143, 148, 149, 151); Ramos (1943:52); Unti and Ramos (1943:28); Causey, Deane and Deane (1944:2, 4, 5; 1946:26); Correa and Ramos (1944b:130); Galvao, Lane and Unti (1944:37-43); Lane (1944:264, 265; 1949:403; 1953:264-266); Deane, L. M., Causey and Deane (1946:7, 9, 10, 12; 1948:878-880); Deane, M. P., Causey and Deane (1946:38, 43, 45); Amaral and Penido (1947:168, 173-179); Senevet (1948a:278); Levi-Castillo (1949:10, 11, 15, 28, 67, 72, 76, 82, 86); Duret (1950a:371; 1950b:301-302; 1952:347); Carvalho and Rachou (1951:474-477, 480); Pinotti (1951:670); Rachou and Ferraz (1951:542-543, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Gabaldon and Cova Garcia (1952:178, 193, 201); Horsfall (1955:170); Bejarano (1956:9, 20; 1957:326-335; 1959:305, 314, 323, 325); Guedes, Amorim and Schreiber (1957:247); de Andrade (1958b:117-125); Rachou (1958:148); Rachou, Moura Lima, Ferreira Neto and Martins (1958:417, 421, 423); Castro (1959a:175); Castro and Garcia (1959:600); Castro, Garcia and Bressanello (1959:549); Schreiber and Guedes (1959b:128-129; 1960:356-

357; 1961:657-658); Stone, Knight and Starcke (1959:33); Vargas (1959:370, 383); Cerqueira (1961:124); Forattini (1962:311, 394-395); Garcia and Ronderos (1962:137-139, 158); Belkin, Schick and Heinemann (1971:6); Consolim and Galvao (1973:177-179); Knight and Stone (1977:63).

Anopheles noroestensis of Foote and Cook (1959:29, 32); Schreiber and Guedes (1959a:97-98); Maciel (1962:473-775); Cova Garcia (1964:200); Mattos and Xavier (1965:272-273); Gorham, Stojanovich and Scott (1967:17, 47, 58; 1973:113, 138, 147).

Anopheles (Nyssorhynchus) oswaldoi var. *noroestensis* of Galvao (1938a:52, 54-56, 58; 1940:432-437); Galvao and Amaral (1938:14); Galvao and Lane (1938:176-177); Fonseca and Fonseca (1942:99); Oliveira and Verano (1942:355); Rozeboom (1942a:240).

Anofeles (Nyssorynchus) osvaldoi (!) *noroestensis* of Unti (1940a:378).

Anopheles oswaldoi noroestensis of Galvao (1938b:101-103); Russell, Rozeboom and Stone (1943: 51); Vargas (1943:59).

Anopheles (Nyssorhynchus) oswaldoi in part of Oliveira and Verano (1942:353-358).

Anopheles (Nyssorhynchus) oswaldoi var. *metcalfi* of Galvao and Lane (1938:175-176); Galvao (1940:428-433; 1943:142-143); Correa and Ramos (1942a:37, 40-44, 46-47; 1942b:381-386); Galvao and Damasceno (1942:123-125); Rozeboom (1942a:239).

Anopheles (Nyssorhynchus) oswaldoi var. *ayrozai* of Rozeboom (1942a:240); Correa and Ramos (1944b:130).

Anopheles clarki of Russell, Rozeboom and Stone (1943:44); Cova Garcia (1964:200).

Anopheles evansi of Gabaldon (1949:765).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Root (1922a:322, ?; 1926b:684-700, 709-711; 1932:779); Davis (1928:549-553); Shannon and Del Ponte (1928:42, 44-56, 53-54); Shannon and Davis (1930:488); Shannon (1931:10, 22); Lane (1939:27-29); Pinto (1939:390-398); Martinez and Prosen (1951:39, ?); Bejarano (1957:333-335); Castro (1959a:173-174).

Anopheles tarsimaculatus in part of Pinto (1930:154, 156); Kumm (1932:1-6); Unti and Ramos (1942:94, 99-100).

Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1923:271; 1924b:461-463).

Anopheles tarsimaculata in part (?) of Muehlens, Dios, Petrocchi and Zuccarini (1925:262-265).

Cellia tarsimaculata in part (?) of Peryassu (1921b:183); Neiva and Pinto (1922a:321; 1922b:356-357); Godoy and Pinto (1923:29-33).

Cellia albimana in part (?) of Neiva (1909:69-77); Lutz, Souza Araujo and Fonseca Filho (1918: 162).

Cellia albipes in part (?) of Bourroul (1904:35).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.1 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: about 2.7 mm. **Head:** Integument reddish brown to dark brown. Proboscis about 1.5 length of forefemur. Long, erect, white, cuneate scales on vertex. Occiput with predominantly cream to golden scales. Palpal segment 2 with a few lighter scales on dorsal surface; segment 3 usually with a gray to white, dorsolateral stripe; apex of segment 2 usually with a few light scales; apex of segment 3 with a broad, distinct, white band; segment 4 with a dark basal band and a smaller, dark, apical band, often dark scales extending along ventral surface to form a stripe; segment 5 white with dark basal band extending from apex of segment 4. **Antenna:** Flagellar segment 1 with numerous, short, white, obovate scales on basomesal, dorsal and dorsolateral surfaces, and a distinct patch of long setiform scales distally on dorsal and dorsomesal surfaces. Flagellar segments 2-13 each with about 7-9 long, silver setae in a basal whorl. **Thorax:** Integument as on head. Median anterior promontory area with numerous, long, white, setiform scales extending dorsad onto anterior of acrostichal line; lateral promontory area with numerous light scales. Silver to cream scales on scutum large. Prescutellar space small to moderate, subtriangular or horseshoe shaped. Upper *stp* with 4, 5 long, dark setae in a horizontal to vertical arc and a patch of gray to cream scales. Lower *stp* usually with a long dark seta and a patch of gray to cream scales. Upper *mep* with about 4-7 long, brownish setae and

occasionally 1, 2 small scales. **Legs:** Light scales on coxae pale gray or cream, usually not white. Foretarsal segment 2 cream to white in apical 0.26-0.55; segment 3 with a broad, cream to white band in apical 0.55-0.80; segment 4 all dark to 0.5 apically light; segment 5 cream, gray or golden in about apical 0.3-0.5. Midtarsal segment 2 cream in about apical 0.1; segments 3 and 4 predominantly dark, with a few gray or golden apical scales; segment 5 often light in about apical 0.5. Hindtarsal segment 2 with a dark band in basal 0.25-0.35 (0.2-0.4); segment 5 cream to white in about apical 0.5. **Wing:** Light spots on wing yellow to cream, not white, at least on anterior veins. Vein C humeral light spot more than twice, 2.0-4.5 (1.75-4.50), length of basal dark spot; usually subbasal light spot greater than or equal to subbasal dark spot; rarely subbasal light spot absent, or subbasal and presectoral dark spots fused into one large spot; often presectoral light spot absent and the presectoral and sectoral dark spots fused; subcostal light spot moderately large, 0.30-0.45 (0.25-0.46) of subcostal dark spot; preapical light spot moderately large, 0.30-0.43 (0.17-0.43) of preapical dark spot; apical dark spot small, but variable. R presectoral dark spot much larger than sectoral dark spot; sectoral dark spot often absent. Dark preapical spot of R_2 large, conspicuous, 0.45-0.54 (0.40-0.54) of vein. Apical dark spot of R_3 large, occasionally broken by a few light scales. M sectoral and preapical dark spots moderately large to large, conspicuous; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal dark spot usually smaller than subsequent preapical dark spot. Apical light fringe spot moderately large to large, conspicuous and unbroken to apex of R_{4+5}; additional small light fringe spots at the apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; occasionally a light fringe spot at level of 0.5 distance from base of A. **Abdomen:** Caudolateral scale tufts of segments II-VII with moderately large, obovate scales.

MALE. Wing: about 3.4 mm. Proboscis: 2.55 mm. Forefemur: 1.55 mm. Abdomen: about 2.75 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a dorsal line of cream scales; apex of segment 2 with a small white band; apex of segment 3 with a large white band; segment 4 with a brown basal band, rest of segment golden to white; segment 5 usually with a brown basal band extending along ventral surface to very near apex; dorsally and dorsolaterally remainder of segment 5 cream to white. **Antenna:** About 0.75 length of proboscis. Flagellar segment 1 with numerous, elongate, white setiform scales on dorsomesal margin. **Legs:** Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 6-8 moderately long, distinct, spiniform setae. Claw on foreleg long, moderately curved; submedian tooth about 0.25-0.30 length of claw, sharp and apically recurved; basal tooth subequal to submedian tooth, heavy and decurved.

MALE GENITALIA (fig. 13). In general very similar to that of *oswaldoi* and *galvaoi*. **Segment VIII:** Tergite and sternite with narrow, long, obovate scales. **Segment IX:** Sternite similar to that of *oswaldoi*, subtrapezoidal, moderately long, about 0.2 length of sidepiece. Anterior apodeme long, about 0.3 length of sternite and subtrapezoidal. **Sidepiece:** Moderately narrow and subconical. Tergal surface usually with 4, 5 long, submedian tergomedial bristles and 1, 2 subapicolateral bristles; with moderately short bristles mesad of tergomedial bristles, often sparse with only 2, 3 short bristles present, more basal and apical bristles occasionally longer than rest. Tubercle of parabasal spine appearing short, less than 0.5 of parabasal spine. Basal apodeme moderately long, usually 0.25 or slightly less length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, moderately to

strongly retrorse apically. **Clasper**: Spiniform long and moderately heavy; seta *b* about 1.5 of spiniform. **Dorsal Claspette**: Pedicel moderately broad, sinuous; base rounded and weakly curved mesad. Leaflets about 0.35-0.45 length of claspette, broad; basomesal projection of dorsal leaflet very reduced. **Ventral Claspette**: About 0.35-0.45 length of sidepiece. Lateral margins tapered toward a narrow apex, width at apex 0.20-0.36 length of claspette and slightly wider than apex of aedeagus. Basal lobules large, expanded laterally, with long, often reflexed setae; setae on basal margin about 1.5-1.8 width of aedeagus; setae not concentrated on basomesal margin. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about 0.5-0.7 width of aedeagus; setae extending to or nearly to apex. Apex with rounded, sclerotized lateral margins, separated by a shallow median sulcus. Preapical plate large, semicircular to oval, occasionally concave basally, heavily sclerotized, located about 0.3 length of claspette basad of apex. Transparent membranous area immediately basad of preapical plate in shape of inverted U. Refringent structure distinct, in shape of an inverted V, with or without lateral arms. **Phallosome**: Aedeagus subequal to length of ventral claspette; apex appearing distinctly truncate; leaflets absent.

PUPA (fig. 13). Abdomen: about 2.6 mm. Trumpet: 0.40 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Darkly pigmented. Wing cases often with dark, sclerotized, longitudinal stripes. Hair 2-C 1-3 branched, longer than 1,3-C; 1,3-C 2,3 branched. Hairs 4,5-C moderately developed; 4-C 1-3 forked; 5-C 2,3 forked (1-4). Hair 6-C 1,2 forked, long. Hair 7-C 2,3 branched, long, one branch usually about 1.5 length of other branch(es). **Trumpet**: Pinna moderately to heavily pigmented; moderately long, about 3.3-4.1 (3.3-4.3) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex (not as it appears in fig. 13). Meatal cleft usually basally pointed. **Metanotum**: Hair 10-C single and strong. Hair 11-C 3-5 branched, 1.0-1.3 length of 10-C. Hair 12-C single to triple, long, about 1.4-2.0 length of 10-C. **Abdomen**: Chaetotaxy in general very similar to that of *oswaldoi*. Hair 2-I 5-8 branched, moderately long. Hair 3-I single, about 0.5-1.0 length of 2-I. Hair 4-I 4,5 branched. Hair 5-I single or double, long. Hair 6-I single and long. Hair 7-I 2,3 branched, about 0.5 length of 6-I. Hair 9-I single, longer than 7-I and shorter than 6-I. Hair 0-II-VII moderately developed; 0-II,III 4-7 branched (3-7); 0-IV-VII 3-5 branched (2-6). Hair 1-II,III 5-9 (4-9) and 6-10 (5-10) branched respectively, strongly developed; 1-IV-VII strong and very long, 1.75-2.00 length of segment. Hair 2-IV-VII single or double, rarely triple, long, longer than that of *oswaldoi*, 0.5-0.7 length of segment. Hair 3-IV 3,4 branched (3-5), moderately long; 3-V 2,3 forked (1-3), moderately long. Hair 5-III 6-11 branched (5-12), strongly developed; 5-IV 3-5 branched (2-5), median branches longer and stronger than lateral branches; 5-V-VII heavy and long, usually equal to or slightly longer than segment. Hair 6-II-VI single or double, long; 6-II about 1.5 length of 7-II. Hair 7-II 2,3 branched (2-5); 7-III-V and 8-III-VII moderately short; 7-III 2,3 branched (2-4); 7-IV 1-4 branched (1-5); 7-V 1-3 branched; 7-VI,VII single, very long, about 0.7 length of segment; 8-III 2-4 branched (2-5); 8-IV-VI 1-3 branched; 8-VII 3 branched (2-4). Hair 9-II thin, pointed, small, unpigmented; 9-III small, 2.5 or less length of 9-II; 9-IV thick, 2.0-3.0 length of 9-III, heavily sclerotized; 9-V heavy, 1.5-2.0 (1.1-2.0) length of 9-IV; 9-VI strong, thick, weakly curved, 1.0-1.5 length of 9-V; 9-VII thick, curved, acuminate, 1.5-2.0 (1.4-2.0) length of 9-VI; 9-VIII straight, about equal to length of 9-VII; 9-II-VI less than 0.33 length of segment; 9-VII,VIII 0.3-0.5 length of segment. Hair 10-III 2,3 forked, moderately long; 10-IV,V single, very long. Hair 4-VIII 2,3 forked (1-3). **Terminal Segments**: Male genital lobe heavy, thick at base, with sides sloping toward apex; apex with distinct mammilliform protuberance. **Paddle**: Obovate,

slightly emarginate at insertion of hair 1-P. Midrib basally distinct, apically becoming indistinct. External buttress about 0.6 length of paddle. External margin distad of buttress with very fine, filamentous spicules extending around apex and becoming very sparse along caudal 0.5 of inner margin. Hair 1-P moderately short; 2-P single or forked, subequal to 1-P.

LARVA (fig. 14). Head: 0.6 mm. Antenna: 0.28 mm. Anal Saddle: about 0.3 mm. **Head**: Darkly pigmented, reddish brown. Median tooth of mental plate usually wider than combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical half; 3-C about 0.8-0.9 length of 2-C; hairs 2-C widely spaced, clypeal index about 1.7 (1.0-2.0). Hair 4-C 3,4 branched (2-5), moderately short to moderately long, 0.30-0.45 length of 3-C. Hairs 8,9-C often dendritic, moderately large, length about 1.5-2.0 distance separating hairs 5-C; 8-C 4-6 branched (4-7); 9-C 6-8 branched. Hair 10-C 3,4 branched (2-4); 12-C 4, 5 branched, large, subequal to 9-C. Hair 15-C 4-7 branched, moderately large. Collar very dark reddish brown, moderately wide to wide dorsomedially. **Antenna**: Slightly darker than remainder of head. Spicules along mesal margin moderately long and thin; shorter and fewer on ventral surface. Hair 1-A 4-8 branched, short, about as long as width of antenna at point of insertion. **Thorax**: Reddish brown or greenish brown. Inner submedian prothoracic group (1-3-P) usually with hairs 1,2-P not sharing a common tubercle; palmate hair 1-P with 10-14 moderately narrow, pointed, lanceolate leaflets; 2-P 13-18 branched (12-18). Hair 14-P 8,9 branched (7-10), large; branches long (0.3 mm), arising from a moderately short shaft, median branches longer than lateral and extending beyond anterior margin of thorax. Mesothoracic hair 1-M strongly plumose, 26-30 branched (26-32). Metathoracic hair 2-T long, extending beyond caudal margin of thorax. Palmate hair 3-T with 11-15 moderately long, narrow, semitransparent leaflets. **Abdomen**: Integument pigmented as thorax. Hair 0-II-VII moderately large to large; 0-II,III 6-9 branched (5-10); 0-IV-VII 5-7 branched (5-8). Palmate hair 1-I with 15-18 (13-18) semitransparent, narrow, spreading leaflets; 1-II-VII with pigmented, moderately narrow, pointed leaflets; 1-II-V with 21-30 leaflets; 1-VI with 24-25 leaflets; 1-VII with 19-28 leaflets; 1-II,VII slightly smaller than 1-III-VI. Hair 2-II 6-9 branched (4-9), strongly developed, large; 2-III 4-6 branched, large, more than 2.0 length of leaflets of 1-III and stronger than 2-II; 2-IV single, moderately long, about 1.5 length of leaflets of 1-IV; 2-V very long, 3.0-4.0 length of leaflets of 1-V. Hair 5-I 3-5 branched, moderately short, inserted less than 0.75 its length from lateral margin of abdomen; 5-II 8-10 branched, moderately developed. Hair 9-I 4,5 branched, moderately large. Hair 11-I 3,4 branched, large. Hairs 13-I,II,III 5-9, 7-9 (6-9) and 8,9 (8-12) branched respectively, moderately developed; 13-IV 3,4 branched, moderately long, subequal to 2-IV and about 1.5 length of leaflets of 1-IV; 13-V almost always 3 branched (3-5) at least on one side of larva, very large, subequal to 2-V, about 3.0-4.0 length of leaflets of 1-V and extending beyond caudal margin of segment; 13-VI 8-12 branched (6-12), moderately developed. **Spiracular Lobe**: Pecten with 15-20 teeth; arrangement of teeth variable, but similar to that of *oswaldoi*; teeth usually as follows beginning ventrally: (1) 1 long, (2) about 4-6 moderate followed by 2-5 mixed moderate to short, (3) 1 long, (4) 1-5 mixed moderate to short and (5) usually 1 or 2 long occasionally followed by a short tooth; occasionally with another long tooth interspersed in dorsal half of pecten; serrations on teeth moderate in length. Lateral arm of spiracular apparatus short to moderately short, directed caudolaterally. Hairs 8,9-S 4-7 and 5,6 (4-7) branched respectively, moderately large. **Anal Segment**: Most of segment covered with fine spicules more strongly developed apically. Hair 1-X about 1.5-2.0 length of saddle; inserted on sad-

dle near ventral margin, or occasionally on ventral margin of saddle at base of indentation. Anal gills long, usually longer than saddle.

DISCUSSION. *An. noroestensis* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) palpal segment 4 often with a dark ventral stripe, (2) hindtarsal segment 2 with a dark band in basal 0.25-0.35 (0.2-0.4), (3) foretarsal segment 3 with a light band in apical 0.55-0.80, (4) light wing spots yellow to cream (at least on anterior veins), and humeral light spot of vein C usually greater than 2.0 of basal dark spot, (5) subcostal light spot of vein C moderately large, about 0.30-0.45 of subcostal dark spot, (6) sectoral and preapical dark spots of vein M moderately large to large and (7) apical light fringe spot moderately large to large and conspicuous; in the **male genitalia** by the (1) apically truncate aedeagus subequal to length of ventral claspette, (2) basal lobule of ventral claspette large, expanded laterally, with setae along basal margin long, about 1.5-1.8 width of aedeagus, (3) apex of ventral claspette narrow, 0.20-0.36 length of claspette and (4) preapical plate large, semicircular to oval and heavily sclerotized; in the **pupa** by the combination of (1) pinna moderately long, about 3.3-4.1 length of meatus, appearing broad medially and tapered toward apex, (2) hair 9-V relatively short, 1.5-2.0 (1.1-2.0) length of 9-IV, (3) hair 9-VII 1.5-2.0 (1.4-2.0) length of 9-VI, (4) hair 9-VII,VIII longer than in *oswaldoi*, 0.3-0.5 length of segment, (5) hairs 2-V and 7-VI long, usually more than 0.5 length of segment, (6) hair 7-C with one branch about 1.5 length of other branch(es), (7) hair 2-I 5-8 branched and moderately long, 3-I about 0.5-1.0 length of 2-I, (8) hair 6-II about 1.5 length of 7-II and (9) hair 1-P moderately short; and in the **larva** by the combination of (1) hairs 2,3-C barbed in about apical half, hairs 2-C widely spaced, clypeal index about 1.7 (1.0-2.0), (2) hair 4-C 3,4 branched (2-5), moderately short to moderately long, 0.30-0.45 length of 3-C, (3) hair 14-P 8, 9 branched (7-10), large, with long branches, (4) hair 13-IV 3,4 branched, moderately long, about 1.5 length of leaflets of 1-IV, (5) hair 2-T long, extending beyond caudal margin of thorax, (6) hair 2-IV moderately long and 2-V very long, 3.0-4.0 length of leaflets of 1-V, (7) hair 5-I moderately short, inserted less than 0.75 its length from lateral margin, (8) hair 13-V very large, about 3.0-4.0 length of leaflets of 1-V, almost always 3 branched (3-5) at least on one side of larva and (9) lateral arm of spiracular apparatus short to moderately short, directed caudolaterally. *An. noroestensis* is difficult to diagnose in all stages, except for the male genitalia. The larva is almost identical with that of *rangeli,* except for the position of hairs 4-C and 5-I,II, and the relative lengths of several of the abdominal hairs. The pupa is very similar to those of *strodei, benarrochi* and *oswaldoi*. The adult is like those of *strodei* and *anomalophyllus*, except for the coloration of the scales of the thorax, coxae and wing, and the banding pattern of the foretarsus.

An. noroestensis is most closely allied to *oswaldoi* and *galvaoi*, and, to a somewhat lesser extent, to *aquasalis*. The male genitalia differ from those of *galvaoi* and *oswaldoi* primarily in the shape of the apex of the aedeagus, and from that of *oswaldoi* in the shape of the preapical plate. The basal band on the second hindtarsal segment of the adult is the main character separating *noroestensis* from *aquasalis, galvaoi* and *oswaldoi*. But because intraspecific variation is so great, individuals at the extremes (with either very small or very large second hindtarsal dark bands) cannot be distinguished from the adults of the latter 3 species. Ecologically, *noroestensis* occupies a different niche than either *aquasalis* or *oswaldoi*; it is found in fresh water in secondary growth areas, usually not in forested areas or coastal brackish water habitats.

The salivary and autosomal chromosomes were examined by Guedes, Amorim and Schreiber (1957) and Schreiber and Guedes (1959b; 1960; 1961). These authors

state that the X chromosomes are metacentric in neuroblasts and acrocentric in the salivary cells, and that some heterozygous inversions and asynaptic zones have been found in the autosomes.

An. noroestensis and *metcalfi* were first described as varieties of *oswaldoi* by Galvao and Lane at a meeting of the Sociedade de Biologia de Sao Paulo, 15 September 1937. The transcripts of this presentation were not published until 1938 in a festschrift for Lauro Travassos. In the interim, Galvao and Lane (1937e) described, in an abbreviated form, these new varieties and included them in keys along with illustrations of the eggs. The description of *metcalfi* was based on a description of an egg by Root (1926b:700) from Brazil. In comparing the surface ornamentation of the eggs, Root stated, "The species of the *Nyssorhynchus* group seem not to show the elongate hexagonal marking, so conspicuous in the eggs of such species as *quadrimaculatus* or *pseudomaculipes*. Instead, one finds the whole ventral and lateral portion of the egg studded with little white stars, each consisting of eight or ten short lines radiating from an imaginary common center." Because of the statement regarding the "little white stars," Galvao and Lane assumed that Root was describing a new and different species, unlike either *noroestensis, oswaldoi* or *tarsimaculatus*. In 1940, Galvao stated that in the state of Sao Paulo *metcalfi* must be rare or must not exist in that region, since no eggs had ever been collected with the characteristics described by Root. Later, Galvao and Damasceno (1942:123-125) reported that the eggs illustrated by Root (1926b) could have been those of *oswaldoi, noroestensis* or *tarsimaculatus*, and that it was impossible to tell what species his description referred to. They wrote, ". . . *julgamos que o* A. oswaldoi metcalfi *nao pode ser caracterizado pelo descricao de Galvao e Lane (1938) e o consideramos como* nomen nudum." By *nomen nudum* the authors, I believe, meant *nomen dubium*, since *nomen nudum* refers to a name not satisfying Articles 12-16 of the International Code of Zoological Nomenclature. As Mayr (1969:347) states, "A *nomen nudum* has no standing in zoological nomenclature and is best never recorded, not even in synonymy." Whereas a *nomen dubium* refers to a name for which there is insufficient evidence for recognition of the species to which the name was applied. In the same publication, Galvao and Damasceno (1942:125-129) raised *noroestensis* to specific rank based on the egg, larva, male genitalia and female. In 1971, Belkin, Schick and Heinemann (p 6) designated a male (96) with its genitalia on a slide (710210-1), collected by Root, 29 May 1925 in Porto das Caixas (Rio de Janeiro), as the lectotype of *metcalfi*. They stated that the lectotype was, "1 of several specimens identified as *tarsimaculatus* by Root (1926:711), on which Galvao and Lane based their *metcalfi* (USNM)." After careful examination of this lectotype, I am synonymizing *metcalfi* with *noroestensis*. The apex of the aedeagus clearly appears truncate, and the shape of the preapical plate corresponds to that of *noroestensis*. The dark basal band of hindtarsal segment 2 is 0.35 the length of the segment, also as in *noroestensis*. All the other characters examined correlate with those found in *noroestensis*. Additional specimens were collected near the type locality of *metcalfi* by J. N. Belkin, H. C. Barnett, G. K. Bryce and myself, December 1975 to February 1976 in the state of Rio de Janeiro. After studying these individually reared specimens and correlating the characters in the immatures and the adults, I have identified these specimens as *noroestensis*.

BIONOMICS. The immatures of *noroestensis* have been collected in both permanent and temporary water in drainage ditches, small ground pools, potholes and along stream margins. The immatures are usually found in fresh water, either exposed to the sun or partially shaded. The water is frequently turbid and brownish. One collection from the state of Rio de Janeiro was from a flooded grassy yard highly contami-

nated with pig and chicken feces. The immatures were all collected in regions of secondary growth or in areas of cultivation, and not in the forest, although they may occur along the edge of forested areas. Species that have been collected in association with *noroestensis* are *Anopheles (Nys.) albitarsis, Culex (Cux.) coronator* group, *Cx. (Cux.)* sp, *Cx. (Mel.)* sp and *Uranotaenia (Ura.) lowii.* Additional larval habitats reported in the literature are muddy puddles, rock holes and wells (Deane, Causey and Deane 1948:878-880), and marshes and swamps (Galvao 1940:433). Deane, Causey and Deane (1948) showed that *noroestensis* was highly sensitive to sodium chloride and would not develop to the third instar even in a dilute solution of 0.5%. They also reported collecting *noroestensis* at altitudes greater than 700 m in the state of Ceara, Brazil. Galvao (1938b:102) reared *noroestensis* in the laboratory at a mean temperature of 25.7°C and showed that the development from egg to adult required about 13 days.

Most reports indicate that *noroestensis* is not very anthropophilic or endophilic. Of the 1342 females collected in northeastern Brazil by Deane, Causey and Deane (1948), only 53 or 3.9% were collected in houses. Forattini (1962:394-395) also reported that *noroestensis* was not domestic or anthropophilic. Contrary to these authors, Correa and Ramos (1942a:37-47) indicated that *noroestensis* (as *metcalfi*) was largely anthropophilic and endophilic. Deane, Causey and Deane (1948) stated that *noroestensis* was most abundant during the rainy season (June 1941) in Ceara. In 2 days in June, they collected 447 females on animal bait, representing 96.9% of the anophelines captured. During the dry season in December over a 2 day period, they collected only 12 adults representing 35.3% of the anophelines caught. In host preference studies made between 1730 and 1930 hours in June, Deane, Causey and Deane (1948) collected 38 females on a horse and only one on a man. Biting peaked around sundown, and there was another small peak of activity at dawn, although some individuals could be captured throughout the night.

MEDICAL IMPORTANCE. *An. noroestensis* does not seem to be important as a primary vector of malaria. Correa and Ramos (1942a:37; 1942b:385-386) dissected 24 females of "*metcalfi*" which were collected inside houses in Ribeira, Sao Paulo, Brazil and found 2 (8.3%) with an oocyst infection of *Plasmodium* sp; however, I am not certain that the species these authors reported as *metcalfi* was actually *noroestensis*. Nevertheless, a photograph of the head capsule of the supposed *metcalfi* in Correa and Ramos (1942b:383) corresponds to that of *noroestensis*, as does the habitat in which these mosquitoes were collected. Deane, Causey and Deane (1948), after studying *noroestensis* in many different localities in the northeast of Brazil, stated that all indications are that this species is not important in the transmission of malaria. Forattini (1962:311) reported that it is possibly a secondary vector. *An. noroestensis* from Guaratingueta and Guaruja, Sao Paulo, Brazil has been experimentally infected with *Plasmodium vivax* by Fonseca and Unti (1943:47-52).

DISTRIBUTION (fig. 2). *An. noroestensis* is distributed throughout central and southeastern South America. Its northernmost limits are the southern margins of the Amazon basin and the northeastern states of Brazil (Maranhao, Ceara). In the west, *noroestensis* extends to the eastern versant of the Andes. *An. noroestensis* is reported to occur as far south as the provinces of Chaco, Corrientes, Formosa, Misiones, Salta, Santa Fe and Tucuman in Argentina (Garcia and Ronderos 1962:161).

Material Examined: 178 specimens: 22 males, 18 male genitalia, 57 females, 19 pupae, 62 larvae; 19 individual rearings: 9 larval, 7 pupal, 3 incomplete.

ARGENTINA (7 specimens: 2M, 3Mgen, 2F). **Tucuman:** Concepcion, N. Davis, 3Mgen (*clarki*) [JH]. Monteros, Jun 1940, 2M, 2F.

BOLIVIA (17 specimens: 6M, 4Mgen, 7F). **Santa Cruz**: Charagua, 16 May 1944, 3153, 4F. La Guardia, nr Santa Cruz, 27 Sep 1943, Torres Munoz, 3083, BOL 21, 4M, 3Mgen. **Department and locality not specified:** Carr, No. 2919, 2M, 1Mgen, 2F; same collector, 1F.

BRAZIL. Bahia (47 specimens: 1M, 9F, 37L): C. de Maria, 1F [JH]. Escondido, 1F [JH]. Itapebi, 3L [JH]. Itapira, Mar 1931, 1F. Jequie, 4F [JH]. Jitauna, 1F [JH]. Pindobacu, 2L [JH]. Poiri, 1L [JH]. Salvador da Bahia, 1972, J. Fowler, BRS 82, 3L; same data except Mar 1972, BRS 101, 1L; same data, BRS 110, 1L; same locality and collector, 1972, BRS 116, 3L; same data, BRS 127, 4L; same data, BRS 147, 1L; same data, BRS 149, 1L; same data, BRS 164, 3L; same data, BRS 171, 2L. Rio Ipitanga, 16 Mar 1972, J. Fowler, BRS 92, 3L. Santo Amaro, 1L [JH]. Santo Antonio, 1F [JH]. Locality not specified, thru M. Boyd, 1M; 8L [JH]. **Ceara** (1F): Guaramiranga, det. Deane, 1F [CU]. **Maranhao** (1Mgen): Locality not specified, 1Mgen (10.190) [JH]. **Pernambuco** (3M): Locality not specified, D. Lucen, 3M. **Rio de Janeiro** (86 specimens: 9M, 9Mgen, 27F, 19p, 22L&l; 19 ind rear: 9 l, 7p, 3inc): Bangu, F. Root, 1Mgen (105) [JH]; same locality, 3Mgen (109) [JH]. Itaquai, 19F [JH]; same locality, BRA 282. Mage, 1F [JH]. Seropedica, BRA 230, 231. Varzea das Mocas, BRA 253, 291. **Rio Grande do Norte** (2L): Rio Cajupiranga, on road to San Jose, 6 Jan 1945, H. Dalmat, 1L [CU]. Rio Pirangi, Cajupiranguinha, 1 Nov 1944, H. Dalmat, 1L [CU]. **Sao Paulo** (1M, 11F): Novo Oriente, 1938, A. Galvao, J. Lane, 1M, 11F. **State not specified** (1Mgen, 1L): Manibu, Rio Araray, 18 Oct 1944, H. Dalmat, 1L (21) [CU]. Locality not specified, F. Root, 1Mgen (109-25) [JH].

5. Anopheles (Nys.) aquasalis Curry

Figs. 2, 4, 6, 15, 16

1932. *Anopheles (Nyssorhynchus) tarsimaculatus* var. *aquasalis* Curry 1932:566-572. TYPE: *Syntypes* male with genitalia slide, female and larva, Atlantic side of Canal Zone (no type locality cited although Colon and Cristobal mentioned), D. P. Curry *et al.* [LU] (Belkin, Schick and Heinemann 1965:44).

1941. *Anopheles (Nyssorhynchus) emilianus* Komp 1941:794-800. TYPE: *Holotype* male with genitalia slide, northern outskirts of Belem (Para), Brazil, reared from larva collected in grassy pool, 14 Apr 1941, W. H. W. Komp [USNM]. Synonymy with *aquasalis* by Causey, Deane and Deane (1945:247-248).

1942. *Anopheles (Nyssorhynchus) oswaldoi* var. *guarujaensis* Ramos 1942:61-63. TYPE: *Syntypes* adults, larvae, eggs, Ilha do Guaruja (Sao Paulo), Brazil, Mar 1939, collected in part by Seccao de Ecologia (A. Carvalho Franco) [LU]. Synonymy with *tarsimaculatus* by Galvao and Damasceno (1942:131). Synonymy with *aquasalis* by Lane (1949:402).

1948. *Anopheles aquasalis* var. *guarauno* Anduze 1948:18. TYPE: *Syntypes* adults, reared from eggs of the normal *aquasalis "typicus,"* Pedernales (Delta Amacuro), Venezuela [NE]. Considered as subspecies by Lane (1953:260).

1948. *Anopheles aquasalis* var. *delta* Anduze 1948:18. TYPE: *Syntypes* adults, reared from eggs of the normal *aquasalis "typicus,"* Pedernales (Delta Amacuro), Venezuela [NE]. Considered as subspecies by Lane (1953:260).

1978. *Anopheles (Nyssorhynchus) deltaorinoquensis* Cova Garcia, Pulido F. and Amarista M. 1978:150-161. TYPE: *Syntypes* adults, eggs, larvae and pupae, holotype not specified according to Article 73(b), La Brea, Punta Gorda and Las Parcelas (Sucre), Caribe, Zona de Maturin and Boca de Guanipa (Monagas), and Capure, Punta de Tolete, Pedennales, Isla de Guanoco and Boca de Capurito (Delta Amacuro), Venezuela [DERM]. NEW SYNONYMY.

Anopheles (Nyssorhynchus) aquasalis of Senevet and Abonnenc (1938:487-493); Gabaldon (1940: 4-5); Gabaldon and Aguilera (1940:66-68, 72-80); Gabaldon, Cova Garcia and Arevalo (1940: 25-28); Gabaldon, Cova Garcia and Lopez (1940:10, 11, 13-16); Gabaldon, Lopez and Ochoa Palacios (1940:37-38); Galvao (1941:94; 1943:142-143); Rozeboom (1941:102; 1942a:242); Rozeboom and Gabaldon (1941:92-98); Galvao and Damasceno (1942:130-131); Komp (1942: 39, 40, 73-74, 81, 122-124, 132, 159-160); Simmons and Aitken (1942:38, 46, 54, 62, 87-90); Floch and Abonnenc (1943a:1-9; 1943b:1-8; 1945:2, 4-8, 11, 13-16; 1946b:3-5; 1947:1-5; 1951:44-48); Causey, Deane and Deane (1944:2, 4, 5, 6; 1945:243-250; 1946:27); Lane (1944: 263-266; 1949:402; 1953:259-261); Levi-Castillo (1945:105-116; 1949:10, 11, 15, 27, 32, 58,

67, 72, 76, 81, 85); Deane, L. M., Causey and Deane (1946:2-3, 7-10; 1948:881-894); Deane, M. P., Causey and Deane (1946:38, 42, 45); Arnett (1947:198); Coher (1948:87-88); Vargas (1948: 158; 1959:377); van der Kuyp (1949a:67-68); Downs (1950:29-30); Pinotti (1951:667-668, 673, 681-682); Senior-White (1951a:293-403; 1951b:465-512); Gabaldon and Cova Garcia (1952:179, 182, 189); Frizzi and Ricciardi (1955:399-407); Horsfall (1955:178-181); Vargas V. (1956:29; 1957:1; 1958a; 1958b); Bejarano (1957:326, 327, 329, 333); Rozeboom and Kitzmiller (1958:244); Schreiber and Guedes (1959b:128-129; 1960:356-357); Stone, Knight and Starcke (1959:31); Cerqueira (1961:121-122); Fauran (1961:8-9); Forattini (1962:311, 382-388); Belkin, Schick and Heinemann (1965:44); Kitzmiller and Chow (1971:65-85); Kreutzer, Kitzmiller and Rabbani (1975:363-364); Cova Garcia and Sutil O. (1976:31; 1977:18, 47, 63, 88); Cova Garcia, Pulido F. and Amarista M. (1978:155, 157).

Anopheles aquasalis of Rozeboom (1941:102); Kumm and Zuniga (1942:399); Downs, Gillette and Shannon (1943:33-42); Ross and Roberts (1943:33-34); Russell, Rozeboom and Stone (1943:26, 29, 30, 31, 42); Eyles (1944:12-13); Deane and Damasceno (1948:501-508); Deane, Vernin and Damasceno (1948:793-795, 804-807); Senior-White (1950:5-6; 1954); Floch (1954: 3-5; 1956:45-46); Vargas V. (1958c:1, 3); Foote and Cook (1959:114); Gabaldon and Guerrero (1959:433-434); Giglioli (1959:280; 1963:131-145); Cova Garcia (1961:35-36, 69, 87-88, 113, 124-125, 154; 1964:199-214); Fauran (1962:73-76; 1963:44-45; 1964:51-52); Sellers, Bergold, Suarez and Morales (1965:466-469); Fauran and Courmes (1966:104-105; 1967:70); Stojanovich, Gorham and Scott (1966a:12, 19, 30; 1966b:21, 31, 39); Gorham, Stojanovich and Scott (1967:18, 48, 50; 1973:114, 139, 141); Serie, Kramer and Chatenay (1968:198-200, 202-203, 208, 209); Hamon, Brenques and Chauvet (1970:33); Elliott (1972:757); Panday (1975a:297-301; 1975b:305-308; 1977:732, 734); Cova Garcia and Sutil O. (1975a:23; 1975b:212).

Anopheles (Nyssorhynchus) emilianus of Bruce, Knigin, Yolles and Graham (1943:441); Galvao (1943:142); Causey, Deane and Deane (1945:243-250); Cova Garcia and Sutil O. (1976:31; 1977:18, 47, 63, 88); Cova Garcia, Pulido F. and Amarista M. (1978:155, 157).

Anopheles (Nyssorhinchus) (!) *emilianus* of Cova Garcia (1964:199-217).

Anopheles emilianus of Russell, Rozeboom and Stone (1943:37, 42, 45); Cova Garcia and Sutil O. (1975a:23; 1975b:212).

Anopheles (Nyssorhynchus) tarsimaculatus of Root (1922a:322, in part?; 1926b:684-700, 709-711, in part; 1932:781, in part); Christophers (1924:39-40, 89, in part); Dyar (1925:187-188, 195, in part?; 1928:439-440); Kumm (1929:101-103, in part); Hill (1930:712); Shannon and Davis (1930:488, in part?); Shannon (1931:10, 22); Edwards (1932:45, in part?); Senevet (1932:252, in part?; 1937:358-360; 1938:179-181; 1948c:434-439); Antunes and Lane (1933: 97, in part); Davis (1933:278, 280, in part?); Earle (1936:459-469); Komp (1936a:161-162, in part); Galvao and Lane (1937a:77-78; 1937e:213-216; 1938:169, 170, 172-173, in part); Galvao, Lane and Correa (1937:40-41); Galvao and Amaral (1938:13); Root and Andrews (1938: 566-578); Rozeboom (1938a:96, 100-101, 104; 1938b:289, 293); Lane (1939:27-29, in part); Pinto (1939:398, in part?); Galvao (1940:421-425; 1941:92, in part?; 1943:141-143, 149, 151); Komp (1941a:93, 95, 97); Senevet and Quievreux (1941:248); Floch and Abonnenc (1942b:2); Galvao and Damasceno (1942:129-130); Galvao, Damasceno and Marques (1942:51-111); Barretto and Coutinho (1943:321); Correa (1943:124, 126, 127); Coutinho (1943:65-77); Ramos (1943:51-62); Correa and Ramos (1944a:105-108; 1944b:131; 1944c:10-11); Galvao, Correa and Grieco (1944:85-102); Galvao, Lane and Unti (1944:45); Amaral and Penido (1947:164-165, 168, 173-180); Vargas (1948:157-158); Carvalho and Rachou (1951:474-477, 480); de Andrade (1953a:95-107; 1953b:145-156; 1958a:17-30); Senevet and Andarelli (1955:339, 342); Bejarano (1957:333-335, in part); Rachou (1958:161-168).

Anopheles tarsimaculatus of Edwards (1922:75); Root (1922b:392); Cleare (1926:404-406); Hoffman (1930:366); Benarrochi (1931:691-693); Davis (1931:45-47, 49-50, in part); Shannon (1931:10, 22, in part); Beattie (1932:477-496, in part); Kumm (1932:1-6, in part); Buxton (1934:491-494); Hill (1934:425-428); Earle (1936:460-465, 467-468); de Verteuil and Spence (1937:450, 454-455); Kumm and Novis (1938:503); Kumm and Ruiz (1939:438, 441); Kumm, Komp and Ruiz (1940:388, 389, 391, 412, 419); Kumm (1941a:359); Vargas (1941:118); Unti and Ramos (1942:93, in part?); Oliveira, de Andrade and Nascimento (1951:151-247).

Nyssorhynchus tarsimaculatus in part (?) of Lima (1928:95-98); Townsend (1933b:7-12).
Anopheles (Nyssorhynchus) tarsimaculata in part of Root (1923:276; 1924b:461, 462).
Anopheles tarsimaculata of Dyar and Knab (1906b:160-161, in part); Busck (1908:58); Knab (1913:36, 37, in part); Zetek (1915:221-271); LePrince and Orenstein (1916:43-114); Howard, Dyar and Knab (1917:975-979, in part?); Bonne (1923:127-128, in part); Dyar (1923:185, in part); Muehlens, Dios, Petrocchi and Zuccarini (1925:252-254, 257, 264-265); Senevet (1931: 79-82, in part?).
Anopheles (Anopheles) tarsimaculata in part of Bonne-Wepster and Bonne (1923:127); Bonne and Bonne-Wepster (1925:511-515).
Anopheles (Cellia) tarsimaculata in part (?) of Dyar (1918:151).
Cellia tarsimaculata in part (?) of Neiva and Penna (1916:94); Peryassu (1921a:70; 1921b:181-183); Neiva and Pinto (1922b:356-357); Godoy and Pinto (1923:29-33); Bonne (1924:133-137); Boyd (1926:31, 36, 48).
Anopheles albimanus var. *tarsimaculata* of Evans (1921:460; 1922:213).
Cellia albimana in part (?) of Peryassu (1908:120-121); Neiva (1909:69-77); Theobald (1910:69-70); Godoy and Pinto (1923:29-33).
Anopheles albimanus in part of Nicholls (1912:251-268).
Anopheles albipes of Gray and Low (1902:194).
Cellia albipes in part (?) of Theobald (1903:110-113; 1905b:11); Bourroul (1904:33, 63, 75); Peryassu (1908:61).
Anopheles (Nyssorhynchus) oswaldoi var. *metcalfi* (?) of Lucena (1940a:107-112; 1940b:176-177).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.1 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: 2.85 mm. **Head:** Integument brown to dark brown. Proboscis about 1.5 length of forefemur. Palpal segment 2 with a few, light, erect scales on dorsal or dorsolateral surface; segment 3 with a gray to white, dorsal or dorsolateral, longitudinal stripe beginning 0.3-0.5 from base and usually ending near apex, with a white apical band larger than light apical band of segment 2; base and apex of segment 4 with dark scales occasionally extending onto base of 5; remainder of segments 4 and 5 white; ventral surface of 4 usually without a distinct stripe of dark scales. **Antenna:** Flagellar segment 1 with elongate, oblanceolate, white scales distally on dorsomesal surface, and often with shorter scales on dorsolateral surface; basally with short, obovate, white scales on dorsal or dorsolateral surface. Flagellar segments 2-13 each with basal whorl of 8-10 long, curved, silver setae. **Thorax:** Integument dark brown to almost black. Prescutellar space generally horseshoe shaped, occasionally triangular. *Ppl* with 2 (1-3) long, dark setae. *Sp* with 3-9 moderately long, light setae. *Pra* with 5-10 long setae, and a patch of about 7 long, broad, whitish scales. Upper *stp* with about 4 dark setae, and about 8 (6-11) gray to white, broad, obovate scales distributed in horizontal arc. Lower *stp* with 1, 2 long setae and a patch of about 6 gray to white, obovate scales. Upper *mep* with 3-6 long, dark setae; scales absent. **Legs:** Light scales on coxae light cream to grayish, not white. Foretarsal segment 2 cream to white in about apical 0.25 (0.15-0.36); segment 3 highly variable, light in apical 0.40-0.65 (0.40-0.70) in Central and South America, and light in apical 0.15-0.40 in the Lesser Antilles; segment 4 all dark or with a few, golden, apical scales; segment 5 with apical 0.3-0.7 golden to cream or gray. Midtarsal segment 2 with a cream band in apical 0.1-0.3; segment 3 with a small, apical, golden band; segment 4 all dark; segment 5 golden in apical 0.3-0.5. Hindtarsal segment 2 with brown band in basal 0.40-0.55 (0.3-0.6). **Wing:** Highly variable, characters listed below represent the usual conditon and some of the common variations. Dark spots on posterior veins distinct. Light spots at least on veins C and R light cream to yellowish, occasionally white on posterior veins. Vein C with humeral light spot 1.8-3.5 (1.5-3.5) of basal dark spot; basal dark spot usually 0.5 its length from humeral cross vein; occasionally presectoral light spot absent; very rarely both subbasal and

presectoral light spots absent, so that subbasal, presectoral and sectoral dark spots fused into one large, dark spot; subcostal light spot about 0.35 (0.3-0.5) of subcostal dark spot, occasionally longer in specimens from the Lesser Antilles; preapical light spot about 0.45 (0.3-0.6) of preapical dark spot; apical dark spot moderately small. Rs-R_{2+3} usually with an extra subcostal light and dark spot. R_3 variable, with 2 or 3 light and dark spots, occasionally apical dark spot absent. R_{4+5} subcostal and preapical dark spots moderately small. M sectoral dark spot distinct, usually moderately long although variable; preapical dark spot not extending onto M_{1+2}. Vein A subcostal dark spot moderately long, about 0.1-0.2 length of A. Apical light fringe spot small to moderate; additional small light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a moderately small, inconspicuous, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few, moderately long setae. Dark caudolateral scale tufts on tergites and sternites II-VII with scales long, broad and very conspicuous. Tergite densely covered with narrow, moderately large, light gray to golden scales in subtriangular pattern on segments II, III and rectangular pattern on IV-VIII.

MALE. Wing: 3.11 mm. Proboscis: 2.55 mm. Forefemur: 1.5 mm. Abdomen: about 2.8 mm. Essentially as in female except for sexual characters. **Head**: Palpal segment 2 and almost always segment 3 with a light dorsal stripe; segment 4 with pale golden, cream or white scales mediodorsally and laterally, usually with a basal and an apical, dark band, and scattered, inconspicuous, dark scales ventrally. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, curving, white, lanceolate scales on dorsomesal surface. **Legs**: Forefemur about 0.7 length of proboscis. Claw on foreleg curved and pointed; submedian tooth recurved at apex, about 0.2 length of claw; basal tooth subequal to submedian tooth, strongly decurved and blunt.

MALE GENITALIA (fig. 15). **Segment VIII**: Scales on tergite and sternite narrow, lanceolate to oblanceolate and predominantly light; scales somewhat narrower on sternite than on tergite. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme subtrapezoidal and moderately long, about 0.15 length of sternite. **Sidepiece**: Moderately narrow, conical. Tergal surface usually with 3, 4 long, submedian tergomedial bristles and one subapicolateral bristle; with moderately short bristles mesad of basal tergomedial bristles and longer bristles laterad of more apical tergomedial bristles. Parabasal spine usually at least 2.0 length of its tubercle. Basal apodeme about 0.2 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.70-0.75 of longer spine. Internal spine subequal to shorter accessory spine, moderately to strongly retrorse apically. **Clasper**: Spiniform blunt, moderately long, slightly less than or equal to length of seta *b*. **Dorsal Claspette**: Pedicel moderately broad; base broad and rounded, weakly curved mesad. Leaflets broad; dorsal leaflet with large, prominent basomesal projection. **Ventral Claspette**: Lateral margins tapered toward a moderately narrow apex, width at apex about 0.3 length of claspette. Basal lobule broad and semispherical, covered basally and laterally with radiating, moderately short setae; setae along basal margin about equal to or slightly longer than width of aedeagus; setae shorter on mesal margin and more or less uniformly distributed on lobule. Lateral and ventral surfaces (exclusive of basal lobule) with short setae; setae 0.5 or less width of aedeagus; setae extending to or nearly to apex. Apex with rounded lateral margins and a shallow median sulcus; sulcus with gently sloping sides. Preapical plate moderately small, circular to oval, weakly to heavily sclerotized, located about 0.3 length of claspette basad of apex. Region immediately basad of preapical

plate with a moderately broad, transparent, horseshoe shaped membranous area. Refringent structure in shape of inverted V. **Phallosome**: Aedeagus about 1.20-1.35 length of ventral claspette; apex rounded, slightly wider than long; leaflets absent.

PUPA (fig. 15). Abdomen: about 2.8 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. **Cephalothorax**: Dark brown to brownish black. Wing cases often with longitudinal sclerotized stripes. Hairs 1-3-C 2,3 branched (1-3); 1-C longest. Hairs 4, 5-C 2-4 forked (1-4). Hair 6-C 1-3 forked (1-4). Hair 7-C 2,3 branched, often caudal branch about 1.5-2.0 length of other branch(es). Hairs 8,9-C subequal in length; 8-C single; 9-C 1-3 forked (1-4). **Trumpet**: Pinna pale yellow, with margin moderately pigmented; moderately long, about 3.5-4.3 (3.5-4.7) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long and basally rounded. **Metanotum**: Hair 10-C single or occasionally double, short, about 0.50-0.75 length of 12-C. Hair 11-C 1-5 forked (2-6), equal to or slightly longer than 10-C. Hair 12-C 1-3 forked about 0.3 from base, long. **Abdomen**: Pigmented as on cephalothorax. Hair 2-I 4-8 branched (2-10) near or at base, moderately short, most branches subequal. Hair 3-I single or double, about 0.5 length of 2-I. Hair 4-I 4-6 branched (3-8), moderately long. Hair 5-I 1-3 branched, moderately long, slightly shorter than 6-I. Hair 6-I single and long. Hair 7-I 3-7 branched, 0.50-0.65 length of 6-I. Hair 9-I single, 0.65-0.85 length of 6-I. Hair 0-II-VI 2-6 branched (2-8); 0-VII 1-3 branched (1-5). Hair 1-II,III 4-9 branched (3-11), moderately long, median branches longer than lateral; 1-IV-VII very long, 1.50-1.75 length of segment. Hair 3-IV 3-8 branched (2-8), moderately developed; 3-V 2-4 forked (1-5), moderately long. Hair 5-III 3-6 branched (3-9) and 5-IV 2,3 branched (1-4), median branches longer than lateral; 5-V-VII single, subequal to length of segment. Hair 6-II single or double, about 2.0 length of 7-II; 6-III 1-3 forked, moderately long; 7-II 3-7 branched (2-7). Hairs 7,8-III-V 2-5 branched; 8-III-VII and 7-III,IV small; 7-V-VII 1-4 forked, moderately long. Hair 9-II minute, unpigmented; 9-III small, less than 2.0 length of 9-II; 9-IV usually blunt, always 2.0 or more length of 9-III; 9-V-VII moderately slender, curved, acuminate, long; 9-V 2.4-4.0 (2.3-5.0) length of 9-IV, slightly less than or equal to 0.5 length of segment; 9-VI 1.0-1.3 length of 9-V; 9-VII 1.1-1.5 length of 9-VI, usually greater than 0.5 length of segment; 9-VIII subequal to and straighter than 9-VII. Hair 10-III 2-4 forked (1-4). Hair 4-VIII 1-3 branched (1-4). **Terminal Segments**: Apex of male genital lobe with large, distinct, mammilliform protuberance. **Paddle**: Light brownish yellow. Large, obovate, moderately broad, emarginate subapically at insertion of hair 1-P. Midrib not reaching apex. External buttress about 0.6 length of paddle, serrated apically with very small teeth. External margin distad of buttress with fine, short, filamentous spicules extending around apex and becoming shorter along caudal 0.7 of inner margin. Hair 1-P strong and moderately long; 2-P 1-3 forked (1-4), weak, subequal to 1-P.

LARVA (fig. 16). Head: 0.6 mm. Antenna: 0.27 mm. Anal Saddle: 0.3 mm. **Head**: Heavily pigmented, mottled over much of ventral and dorsal surfaces, reddish brown to dark brown, lighter in ocular region. Inner and outer clypeal hairs (2,3-C) plumose in apical 0.3-0.7, with 7-12 simple, rarely dendritic, moderately short to long branches; 3-C occasionally with slightly longer branches than 2-C; hairs 2-C widely spaced, clypeal index 1.67. Hair 4-C 1-3 branched, short to moderately short, length usually less than or equal to distance between insertion of hairs 2-C and 3-C; inserted moderately close to moderately far from anterior margin of head. Hair 8-C 3-5 branched (2-6) near base, slightly longer than distance separating insertion of hairs 5-C. Hair 9-C dendritic, 3-6 branched (3-8), about 1.3 length of 8-C. Hair 12-C 3-5 branched (3-6), subequal to 9-C. Collar wide dorsomedially, moderately sclero-

tized, yellowish brown to reddish brown. **Antenna**: More heavily sclerotized than remainder of head. Mesal margin with numerous, strongly developed spicules thicker than in *oswaldoi*. Hair 1-A 4-7 branched (3-10), moderately short, always less than 2.0 width of antenna at point of insertion. **Thorax**: Reddish brown to dark reddish brown or dark greenish brown, often darker medially. Submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing a common tubercle; often hair 1-P arising from very weakly pigmented tubercle; palmate hair 1-P with 10-15 (10-18) moderately narrow leaflets; 2-P 16-20 branched (13-23), about 4.0 length of leaflets of 1-P. Hair 14-P 6-10 branched from a short, flattened stalk; lateral branches equal to or slightly shorter than median. Mesothoracic hair 1-M 25-40 branched, lanceolate in outline, lateral branches longer than basal and apical. Metathoracic hair 2-T long, usually extending to about caudal margin of thorax. Palmate hair 3-T with 10-15 (9-19) semitransparent, moderately long, spreading leaflets. Pro-, meso- and metathoracic pleural group spines long, strongly developed. **Abdomen**: Pigmented as on thorax, sternum lighter than tergum. Hair 0-II-VI 3-7 branched (2-8), moderately developed. Palmate hair 1-I with 11-15 (10-17) semitransparent, moderately narrow leaflets; 1-II,VII with 18-26 broad, pointed leaflets, smaller than 1-III-VI; 1-III-VI with with 20-30 (20-32) leaflets. Hair 2-II 3-6 branched, strongly developed; 2-III 2-5 branched, large; 2-IV single, moderately long; 2-V 1-3 branched, very long. Hair 5-I 3,4 branched (3-5), branches subequal and moderately long; 5-II 5-9 branched (4-9). Hair 9-I 4-7 branched (3-8). Hairs 13-I,II,III 4-7 (3-7), 5-9 (5-11) and 5-9 (5-13) branched respectively, small; 13-IV 4-6 branched (3-8), moderately large; 13-V 4-7 branched (3-7), large; 13-VI 8-13 branched (7-13), moderately small. **Spiracular Lobe**: Pecten with 12-19 teeth; median teeth mixed moderate and short. Lateral arm of spiracular apparatus very short. Hairs 8,9-S 3-5 branched (2-6). **Anal Segment**: Covered, except for base, with very fine, short spicules becoming stronger toward apex. Saddle rusty brown, with irregular ventral margin. Hair 1-X longer than saddle; inserted on ventral margin of saddle at base of indentation, or on saddle near ventral margin; inserted about 0.3 cephalad of caudal margin. Anal gills usually short, about 0.5 length of anal segment, very rarely equal to length of saddle.

DISCUSSION. *An. aquasalis* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) palpal segment 4 usually without a distinct ventral stripe of dark scales, (2) light scales on coxae light cream to grayish, not white, (3) foretarsal segment 3 highly variable, light in apical 0.40-0.70 in Central and South America and light in apical 0.15-0.40 in the Lesser Antilles, (4) hindtarsal segment 2 brown in basal 0.40-0.55 (0.3-0.6), (5) vein C with humeral light spot large, 1.5-3.5 length of basal dark spot, and with basal dark spot usually about 0.5 its length from humeral cross vein, (6) subcostal light spot on vein C usually less than 0.5 subcostal dark spot, (7) apical light fringe spot small to moderate, (8) dark spots on posterior veins distinct and (9) light wing spots at least on veins C and R light cream to yellowish, not white; in the **male genitalia** by the combination of (1) apex of ventral claspette moderately narrow, width at apex about 0.3 length of claspette, (2) basal lobule broad with uniformly distributed setae, setae along basal margin equal to or slightly longer than width of aedeagus, (3) lateral and ventral surfaces of ventral claspette (exclusive of basal lobules) with short setae 0.5 or less width of aedeagus and (4) preapical plate moderately small, oval to circular; in the **pupa** by the combination of (1) hair 7-C with one branch about 1.5-2.0 length of other branch(es), (2) pinna of trumpet moderately long, about 3.5-4.3 (3.5-4.7) length of meatus, with margin moderately pigmented, and with a long, basally rounded meatal cleft, (3) hair 10-C single, about 0.50-0.75 length of 12-C, (4) hair 12-C 1-3 forked, long, (5) hair

2-I 4-8 branched (2-10) near or at base, moderately short, (6) hair 3-I about 0.5 length of 2-I, (7) hair 7-I 3-7 branched, 0.50-0.65 length of 6-I, (8) hair 9-III small, less than 2.0 length of 9-II, and 9-IV always 2.0 or more length of 9-III, (9) hair 9-V 2.4-4.0 (2.3-5.0) length of 9-IV and (10) hair 9-V-VIII usually about 0.5 length of segment; and in the **larva** by the combination of (1) hairs 2,3-C plumose, with 7-12 simple, rarely dendritic branches, and hairs 2-C widely spaced, clypeal index about 1.67, (2) hair 4-C 1-3 branched, short to moderately short, (3) hair 8-C slightly longer than distance separating insertion of hairs 5-C, (4) pecten with median teeth mixed medium and short, (5) lateral arm of spiracular apparatus very short, (6) saddle with ventral margin irregular, hair 1-X inserted on ventral margin at base of indentation, or on saddle near ventral margin and (7) anal gills usually short, about 0.5 length of anal segment, rarely longer. The adults of *aquasalis* are easily distinguished in most cases from all other species in the Oswaldoi Subgroup except for *benarrochi*. Even so, *aquasalis* can usually be distinguished from *benarrochi* by the characters given in the above discussion and by its geographical distribution. Because of the paucity of material available for study of *benarrochi*, an attempt has not been made to separate *aquasalis* from the former in the key to the adult females. I believe that separation of these 2 species in the key would lead to unnecessary misidentification.

There does not seem to be any consistent geographical differentiation in *aquasalis* except when the females from Central and South America are compared with those from the Lesser Antilles, and then only in the banding pattern of the third foretarsal segment. The apical light band of foretarsal segment 3 on the mainland specimens varies from 0.40-0.70 the length of the segment, whereas the apical light band of the island specimens is in general much less than half (0.15-0.40) the length of the third foretarsal segment.

The amount of interpopulational and intrapopulational variation is very great in *aquasalis* from the Lesser Antilles. On first examination of the material from this region, I believed, as did Senior-White (1951a:306-307), that possibly I was looking at a different subspecies or even species. On further examination, I found that in almost every population from which I had a fair number of specimens, there occurred individuals that were almost identical with those examined from mainland and other island localities, suggesting a single, although highly polymorphic species. The greatest diversity was found among the specimens from the island of St. Lucia. In the adults from the Lesser Antilles, there are considerable differences in size and occasionally in color. Many of the adult males from St. Lucia show a reduction in the amount of white on palpal segments 4 and 5. In the females, the light banding on the midtarsi and the length of the wing spots also varies. Vein C occasionally has large subcostal and preapical dark spots, and vein M may be almost entirely dark. Some specimens from St. Lucia exhibit a fusion of the subbasal, presectoral and sectoral dark spots on vein C to form one large spot. In contrast, several specimens from Dominica exhibit a large subcostal light spot on the costal vein, often longer than 0.5 the length of the subcostal dark spot. In the male genitalia from the Lesser Antilles, the preapical plate varies from dark to light, and from a small rounded plate to a larger, lighter, more oval, diffuse plate; the refringent structure may be in the shape of an inverted U or V; the setae on the ventral claspette vary from short to moderately long; and the parameres may be short and thick at their bases, or long and slender. In the larvae and pupae from the Lesser Antilles, most of the variation occurs in the branching of the hairs; this is included in the data on chaetotaxy in the descriptions. In general, the pupae demonstrate considerably more variation than do the other stages; some of the variation includes the length and thickness of hair 9-IV-

VIII, the extent of branching of hair 1-I and the general pigmentation. In the larvae, the frontal ecdysial suture may be rounded or pointed. Usually the branches of hairs 2,3-C are long and simple, although occasionally they are dendritic; this is particularly evident in the St. Lucia specimens, while on the other hand, one specimen from Costa Rica had short clypeal branches. Also in the larvae, hair 4-C is often single and long in specimens from northern Brazil, Trinidad, Tobago and the Lesser Antilles. The pecten can vary in the number and the length of the teeth, with the St. Lucia specimens again demonstrating the greatest variability. The length of the anal gills varies apparently depending on the type of aquatic habitat; occasionally larvae have moderately large anal gills, usually when collected in fresh water.

The great amount of diversity within and sometimes among populations of *aquasalis* on the islands in the Lesser Antilles may possibly be attributed to 3 factors. First, under island conditions there may be decreased interspecific competition (fewer species present) that may result in a shifting and/or expansion of a species' niche, which may in turn be reflected in some external morphological character. Second, the founder effect is possibly an important factor; when only a few individuals colonize an island, genetic drift can result. And third, species may be subjected to quite different selection pressures on islands than they are on the mainland; the different selection pressures may then result in a phenotype different from that on the mainland. Although the immatures of *aquasalis* are found only occasionally in fresh water in Central and South America, many of the specimens examined from the Lesser Antilles have been collected in fresh water, even in rain barrels. This indicates that at least some niche expansion has occurred on certain of the islands.

The closest allies of *aquasalis* are *oswaldoi, galvaoi* and *noroestensis*. As previously mentioned (p 72), the male genitalia of these 4 species are very similar, differing primarily in the shape and sclerotization of the preapical plate, the length of setae on the ventral claspette and, in the case of *noroestensis*, the shape of the aedeagus. *An. aquasalis* does not share as many characters with *galvaoi, oswaldoi* and *noroestensis* as these share with each other; however, the larvae and, to some degree, the pupae of all 4 are similar.

The first cytogenetic studies of the salivary gland chromosomes of *aquasalis* were performed by Frizzi and Ricciardi (1955:403-407) on specimens from Sao Bento and Duque de Caxias, Rio de Janeiro, Brazil. These workers reported no chromosome abnormalities. Later, Kitzmiller and Chow (1971) examined the salivary gland chromosomes of *aquasalis* from 2 populations in Brazil, one collected near Belem and another collected near Rio de Janeiro. They found no inversions and stated, "*aquasalis, albimanus* and *oswaldoi* show a close morphological relationship." Further, when comparing the extent of regions of homologous banding, the chromosomes of *aquasalis* were more similar to those of *oswaldoi* than to those of *albimanus*. In comparing the chromosomes of *nuneztovari* with *albimanus, aquasalis* and *darlingi,* Kitzmiller, Kreutzer and Tallaferro (1973:443) found the "strongest" autosomal homologies between *nuneztovari* and *aquasalis*.

An. aquasalis, for many years prior to its description by Curry in 1932, was referred to as *tarsimaculata* (or *tarsimaculatus*) as is evident in the references listed in the synonymy (p 76-77). As early as 1915, Zetek recognized this brackish water mosquito in Panama and considered it a racial variety. Much of the information regarding *tarsimaculatus* has been summarized earlier in the Taxonomic History chapter (p 5-7). In 1941, Komp (1941b) described *emilianus* from Belem, Brazil, and stated that it could be separated from *aquasalis* by the shape of the aedeagus, the slightly longer setae covering the ventral claspette (both of which he states are sub-

ject to variation and are rather indefinite) and, most easily, by the egg. Causey, Deane and Deane (1945:247-248) studied 7000 ovipostions from isolated females of *aquasalis* and found considerable variation among the eggs even within a single oviposition. In addition, they noted, "Variations in the male genitalia as great as the differences described by Komp between *emilianus* and *aquasalis* may also be found among mosquitoes from the same oviposition." After examining the holotype adult male and its genitalia, and several other specimens from the type locality of *emilianus*, I agree with Causey, Deane and Deane (1945:247-248) and Floch and Abonnenc (1945:7) in the synonymy of *emilianus* with *aquasalis*. In 1942, Ramos described a variety of *oswaldoi, guarujaensis,* from the island of Guaruja in the state of Sao Paulo, Brazil. Galvao and Damasceno (1942:131) synonymized *guarujaensis* with *tarsimaculatus* which was later synonymized with *aquasalis* by Lane (1949:402). As with many species in the Albimanus Section, mutants have been described as varieties. Anduze (1948) described 2 varieties of *aquasalis* from Venezuela based on adults, *guarauno* and *delta*. *An. guarauno* supposedly has a black apical ring on the fourth hindtarsal segment, and *delta* supposedly has 2 additional apical dark rings on hindtarsal segments 3 and 4 (the ring on segment 4 being more pronounced than on 3).

Recently, Cova Garcia, Pulido F. and Amarista M. (1978) described *deltaorinoquensis* from Sucre, Monagas and Delta Amacuro, Venezuela. I have examined one specimen each of the male, male genitalia, female, pupa and larva labelled "*A. deltaorinoquensis,* 2697," which I received from Dr. P. Cova Garcia through Dr. J. N. Belkin. With the exception of the hindtarsal segments and the wing of the adults, and a few other characters in the immatures summarized below, all stages closely resemble those of *aquasalis*. The observed differences which distinguish these specimens are in the female (1) hindtarsal segment 2 dark in basal 0.66, (2) hindtarsal segment 3 with a small dark band in basal 0.1, (3) hindtarsal segment 4 with a small dark band in basal 0.16 and (4) vein C subcostal light spot small, 0.15 length of C subcostal dark spot; in the pupa (1) hair 2-I long (0.16 mm) and (2) hair 5-III,IV 7,9 and 4-6 branched respectively; and in the larva (1) clypeal hair 3-C with distinctly longer branches than 2-C, some branches dendritic, (2) hair 14-P 4,5 branched and (3) hair 13-I 8,9 branched. Cova Garcia, Pulido F. and Amarista M. also state that in the larva, the lateral arms of the spiracular apparatus are long, reaching the spiracular openings, and that in the male genitalia, the preapical plate is oval, similar in shape to a "grano de cafe." I did not see any significant differences from *aquasalis* in these latter characters in the available specimens. These authors report that the immatures of *deltaorinoquensis* were collected along the coast or along waterways, in brackish and fresh water, at elevations of 0-20 m above sea level. The preferred habitat was brackish mangrove swamps of *Rhizophora mangle, Laguncularia racemose* and/or *Avicennia nitida*. Additional immatures were encountered in puddles of rainwater and ground pools bordering rivers, streams and lakes. Most of the collections were from amber colored water with a high organic content. The immatures were associated with the following additional aquatic plants: *Pistia stratiotes, Eichhornia* sp, *Lemna* sp, *Azolla* sp, *Sagittaria guianensis, Salvinia* sp, *Utricularia* sp. The pH of the water tested varied from 6.6 to 8.4 and the salinity (gm/lit NaCl) from 7.5 to 17.4. In the laboratory at 26-29°C, *deltaorinoquensis* required 18 days for development from egg to adult (egg 2 days, larva 14 days, pupa 2 days). They report that of the 1681 adults captured, 1376 were *deltaorinoquensis* and 305 were *emilianus (=aquasalis).* Further, they state that both the immatures and adults of *emilianus* are commonly encountered in association with *deltaorinoquensis*. Nevertheless, they state that the adults reared from eggs of *emilianus* never had spotted [hind] tarsi, and, in contrast,

the legs of the adults reared from eggs of *deltaorinoquensis* were never white.

For the present, even though the differences enumerated above exist in the single specimen of each stage I examined, I do not recognize *deltaorinoquensis* as a distinct species. Geographically *aquasalis* and *deltaorinoquensis* are sympatric. Also, both "species" occupy a similar ecological niche, occurring primarily in brackish water habitats in relatively close proximity to the coast. In addition, as shown by Rozeboom's experiments (1963) with the mutant forms of *albimanus* (*bisignatus* with an extra dark band on hindtarsal segment 3 and *trisignatus* with extra dark bands on hindtarsal segments 3 and 4), a character or characters that "breeds true" in the laboratory from eggs isolated from a particular phenotype does not prove that this phenotype represents a separate species (see Discussion section for *rondoni*, p 134). Because of the great overall morphological, distributional and ecological similarity between these nominal taxa, I believe that, until more conclusive evidence becomes available, *deltaorinoquensis* should be considered a synonym of *aquasalis*.

BIONOMICS. As with *albimanus*, the literature on the bionomics and medical importance of *aquasalis* is voluminous. I will present only a brief summary.

An. aquasalis is considered to be primarily a brackish water mosquito; however, it has been collected from a wide variety of habitats in both fresh and brackish water. It is more or less restricted to the coast and areas that are influenced by the tides, although on certain occasions it has been collected considerable distances inland. Deane, Causey and Deane (1948:882) collected *aquasalis* 60 km from the coast in the state of Pernambuco, Brazil in a brackish water lake, Lagoa Salgada [Salty Lake]. In the Amazon basin, the same authors collected *aquasalis* 140 km from the coast on the right and left banks of Rio Para. Recently, adults that resemble *aquasalis* have been collected at numerous localities in the Maraba area, Para, Brazil (D. R. Roberts, personal communication). Since these collections were made about 500 km from the coast in fresh water, and the immatures have not been studied, I am reluctant to state that these adults are definitely *aquasalis*. Interestingly, in this region these adults are endophilic with an outdoor to indoor ratio of 3.9. Lucena (1946) collected *aquasalis* 252 km from the coast at Jupi in northeastern Brazil, at an altitude of 750 m and in an area in which the soil had a high salt concentration. In all these instances, except possibly in the Maraba area, salt seemed to be essential for the presence of *aquasalis* inland from the coast.

The immatures have been collected in mangrove swamps, brackish marshes, flooded meadows, rice fields, sugar cane plantations, ditches, fresh water ponds, pools along stream margins, temporary and semipermanent ground pools, large artificial containers and crab holes. Although there seems to be a preference for brackish water, many of the specimens examined came from fresh water but usually no farther than 5-8 km from the coast at altitudes of 200-300 m; its occurrence in fresh water is particularly common in the Lesser Antilles. Most of the collections were from aquatic habitats in full sun or partial shade, but some were in deep shade, such as in mangrove swamps and in crab holes. Deane, Causey and Deane (1948:885-886) stated that most of their collections came from water with a sodium chloride concentration of 0.2-1.0%, although some came from water with a concentration as high as 1.5%. They also found that the number of pupae and adults from larvae reared in 0.5-1.5% sodium chloride solutions was greater than the number produced when larvae were reared in fresh water. De Verteuil and Spence (1937:454) collected *aquasalis* in Trinidad in 70% sea water. Senior-White (1951a:310) reported that in the wet season in Trinidad, breeding is in water not exceeding 0.35% sodium chloride, but that during the dry season breeding occurs in water with a salt concentration of

2.38%. Causey, Deane and Deane (1945:247) showed that under laboratory conditions, *aquasalis* can complete development in pure sea water, and, if the water is allowed to evaporate, larvae continue to grow and pupate in water with a concentration as high as 7.4% sodium chloride. Floch and Abonnenc (1943a:7) collected larvae in fresh water about 3 km from the beach in French Guiana; these survived when placed in a 19 gm/lit solution of sodium chloride. They also placed larvae collected in brackish water into fresh water without any apparent ill effects. De Andrade (1958a:29) stated that *aquasalis* is an acidophilic species, and that larval density decreased as pH increased from 3 to 7. Buxton (1934:491) reported that larvae are rarely found in water containing more than 0.3 ppm ammonia. Senior-White (1951a: 312), however, stated that saline or ammonia concentration "plays no part in regulating either the oviposition or the larval life of *A. aquasalis.*" The larvae seem to be able to tolerate moderate amounts of pollution.

In Brazil (Deane, Causey and Deane 1948:884) and in Suriname (Panday 1975b: 305), the maximum density of *aquasalis* occurs during the rainy season. *An. aquasalis* during this season is found in a greater number of habitats than in the dry season when this species is more restricted to the coastal flats. Notwithstanding, in some areas *aquasalis* may be more abundant locally during the dry season. Downs, Gillette and Shannon (1943:39) found a higher density of *aquasalis* in Tobago and Trinidad in the dry season, because at that time the mouths of streams are blocked by sand bars which dam the streams and provide protected breeding habitats. Giglioli (1963: 132-133) discovered *aquasalis* to be particularly abundant during a drought in Guyana and noted, "During dry periods, tidal salt water invasion of the estuaries and lower reaches of the rivers extends far beyond the average level; thus, not only the prevalence of *A. aquasalis*, but its range as well, is increased."

The most common species collected in association with *aquasalis* in both fresh and brackish habitats are *An. albimanus, Culex (Cux.) nigripalpus, Cx. (Mel.) atratus* and *Aedes (Och.) taeniorhynchus*. In mangrove swamps and flooded meadows, *Ae. (Och.) tortilis* and *Cx. (Mel.) madininensis* are occasionally associated. *Psorophora (Gra.) cingulata* group and *Cx. (Cux.) coronator* group are commonly associated with *aquasalis* in fresh semipermanent ground pools and ditches, and *Cx. (Mel.) idottus* group and *Uranotaenia (Ura.) lowii* breed with *aquasalis* in permanent fresh water ponds. Occasionally *aquasalis* has been collected along stream margins in association with *Cx. (Cux.) declarator* group, and occasionally in crab holes with *Deinocerites magnus*. Other species that have been reported in association with *aquasalis* are *triannulatus* (rarely), *An. (Ano.) punctimacula, An. (Ano.) pseudopunctipennis, An. (Ano.) apicimacula* and *Chagasia bathana*. Common plant associates are *Typha angustifolia, Cyperus articulatus, Rhizophora* sp and *Avicennia* sp (mangroves), *Eleocharis mutata, Ipomoea reptans, Chara* sp, *Naias* sp and *Utricularia* sp. Frequently *aquasalis* is associated with mats of algae.

The adults of *aquasalis* are crepuscular, usually being active from dusk to a few hours after sundown. The adult females feed readily on man and on domestic animals such as cattle, horses, donkeys, dogs, sheep and pigs. They rest inside houses on the walls normally lower than one meter (Deane and Damasceno 1948:508). Throughout vast stretches of northeastern Brazil and in some areas of the Guianas and Lesser Antilles, it is the only anopheline that occurs in large numbers in houses; however, it is reported that less than 10% stay in the house for 24 hours (Deane, Causey and Deane 1948:891). Feeding preference studies indicate that *aquasalis* is more zoophilic than anthropophilic, except in the Lesser Antilles where it may be more anthropophilic. Nevertheless, when domestic animals are removed

from an area, which has happened in many places because of mechanization, man usually becomes the primary host; under these conditions *aquasalis* becomes a major health threat (Downs, Gillette and Shannon 1943; Giglioli 1959, 1963; Hamon, Mouchet *et al.* 1970:33). The adults of *aquasalis* are considered to be strong fliers capable of migrating considerable distances. In marked release and recapture studies conducted in Panama by LePrince and Orenstein (1916:114), individuals of *tarsimaculata (=aquasalis)* marked with aniline dye traveled from 366 to 1905 meters from the release station. De Verteuil and Spence (1937:454-455) reported that *aquasalis* was able to fly at least 4.8 km in Trinidad; however, this was not experimentally verified.

MEDICAL IMPORTANCE. *An. aquasalis* has been a major vector of malaria along the coast of Brazil south to the state of Parana, and in the Lesser Antilles. It is believed not to be a vector in Panama, probably because of its zoophilic behavior there. In Venezuela and the Guianas, *aquasalis* has played a role in residual malaria transmission (Gabaldon and Guerrero 1959; Floch 1956:45-46; Giglioli 1959:280; Hamon, Mouchet *et al.* 1970:33). *An. aquasalis* has been extremely important as a malarial vector in Trinidad, Tobago and in northeastern Brazil. De Verteuil and Spence (1937:454) reported that 70% of the mortality due to malaria from 1931 to 1933 in Trinidad was a result of the presence of *An. tarsimaculatus (=aquasalis)* within 4 miles of brackish water. *An. aquasalis* has been incriminated as the major vector of malaria in Grenada (Earle 1936; Root and Andrews 1938:577), St. Lucia (Earle 1936) and Guadeloupe (Fauran 1962:76). It has been found to be naturally infected with *Plasmodium* sp in Brazil (Deane, L. M., Causey and Deane 1946; Correa and Ramos 1944c; Coutinho 1943:69; Fonseca and Fonseca 1942:102-106, 110, 117), Trinidad and Tobago (Downs, Gillett and Shannon 1943:35-37), Grenada and St. Lucia (Earle 1936:463-465). In all the other areas where it is important as a potential vector, it is considered to be dangerous only when it occurs in large numbers. Thus, its vector effectiveness is dependent on adult density (Deane, L. M., Causey and Deane 1946; Forattini 1962:385; Senior-White 1951b) and to some extent on the presence of alternate hosts which serve to decrease the number of females feeding on man.

An. aquasalis does not seem to be important in the transmission of filariasis, although Deane, Causey and Deane (1948:893-894) found a filarial worm, *Wuchereria bancrofti*, in the thorax of a female in Belem, Para, Brazil. Venezuelan Encephalitis virus was isolated from one of 40 lots of *aquasalis* representing a total of 1537 specimens tested in Venezuela during the VE outbreak in 1962-1964 (Sellers, Bergold *et al.* 1965). *Aedes taeniorhynchus* appeared to be the major carrier during the above outbreak. *An. aquasalis* may or may not be capable of transmitting the virus.

DISTRIBUTION (fig. 2). *An. aquasalis* is primarily restricted to the coast, coastal lowlands and coastal waterways influenced by tides, except in the islands of the Lesser Antilles and possibly in Para, Brazil. It occurs in the state of Parana, Brazil, north along the coast, west through the Guianas, Venezuela and Colombia, and into Central America predominantly along the Atlantic side of Panama and Costa Rica to Nicaragua. On the Pacific side of South America, *aquasalis* is reported to occur as far south as the province of El Oro, Ecuador on the shores of the Gulf of Guayaquil. *An. aquasalis* is present in Trinidad, Tobago and the Lesser Antilles as far north as the Leeward Islands of Antigua and St. Kitts, but it does not occur in the Greater Antilles, Virgin Islands or the Bahama Islands.

Material Examined: 2159 specimens: 432 males, 132 male genitalia, 839 females, 189 pupae, 567 larvae; 150 individual rearings: 77 larval, 52 pupal, 21 incomplete.

ANTIGUA (62 specimens: 55F, 3p, 4L&l; 3 ind rear: 1 l, 2p). **St. George:** Fitches Creek, ANT 66, 67. **St. John:** Five Islands, 8 Oct 1948, H. Box, 1F [BM1939-219]; same locality, ANT 101. **Parish and locality not specified:** 1 Dec 1899, 1F on slide [BM]; 27 Sep 1950, 50F.

BRAZIL. Bahia (35 specimens: 1M, 25F, 9L): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 1 M, 25F. Salvador da Bahia, Mar 1972, J. Fowler, BRS 89, 3L; same locality and collector, 1972, BRS 117, 1L; same data, BRS 144, 2L; same data, BRS 180, 1L; same locality and collector, 1972-73, BRS 499, 2L. **Ceara** (1M, 2F): Aracati, Beirada, 1M, 2F [CU]. **Maranhao** (3M): [Sao Luis], 3M [JH]. **Para** (97 specimens: 20M, 8Mgen, 69F): Belem, Goeldi, KO H-20-28, 4F; same locality, Apr 1930, N. Davis, 15F; same locality, 13 Apr 1941, W. Komp, BRAK 2, 9M, 6Mgen, 25F; same locality and collector, 14 Apr 1941, 1M and 1Mgen (holotype of *emilianus*), 2F (paratypes of *emilianus*); same locality and collector, Apr 1941, 3M, 3F (paratypes and allotypes of *emilianus*); same data, 1M, 2F (paratypes of *emilianus*) [JH]; same data, 3M, 15F; same locality, 1944, Causey, 1M; same locality, Malinha, 1Mgen [JH]; same locality, 1M (689-4), 1M (889-2) [JH]; same locality, S. E.S.P. No. 592, 1F (11.082-4) [JH]; same locality, S.E.S.P. No. 597, 1F (11.352-1) [JH]; same locality, S.E.S.P. No. 626, 1F (11.934-2) [JH]. **Pernambuco** (10 specimens: 1M, 3F, 6L): Boa Viagem, nr Recife, 24 Aug 1944, R. Wenzel, 3L; same data except 4 Sep, 1L; same data except 5 Sep, 1L; same data except 7 Sep, 1L. Recife, Pontazinha, May 1945, E. Coner, 1F [CU]. Recife, Ibura Field, det H. Dalmat 1944, 1F (27-3-H-3) [CU]. Locality not specified, 1M (1269), 1F (1615). **Rio de Janeiro** (26 specimens: 6M, 3Mgen, 2F, 7p, 8L&l; 7 ind rear: 4 l, 3p): Duque de Caxias, BRA 227, 228. Itaguai, BRA 289. Itaipu, BRA 248. Rio de Janeiro, 1M (3551) [JH]. **Sao Paulo** (3M, 3F): Sao Vincente, 3M [JH]. Locality not specified, A. Lutz (3F). **State and locality not specified** (2Mgen): O. Causey, 1Mgen (689-2), 1Mgen (1269) [JH].

COSTA RICA (8 specimens: 2F, 1p, 5L&l; 1 l ind rear). **Limon:** Puerto Viejo, H. Kumm, No. 179, 1F [BM1938-696]. Westfalia, CR 473.

DOMINICA (105 specimens: 8M, 2Mgen, 31F, 10P&p, 54L&l; 6 ind rear: 4 l, 2inc). **St. Andrew:** Portsmouth, 2 Mar 1964, D. Bray, 2F; same locality, 19-21 Oct 1966, A. Gurney, 1F; same locality, L. Charles, 15L. **St. David:** Bataka, DOM 173. **St. John:** Cabrit Swamp, 23 Feb 1965, W. Wirth, 4M, 20F. Cotton Hill Estate, DOM 97. Picard Estate, DOM 158. Prince Rupert Bay, DOM 213. **St. Joseph:** Mero, DOM 77, 78, 79. **Parish not specified:** Canefield Estate, 25 Apr 1944, L. Charles, 10L. Clarke Hall, 21-31 Mar 1965, W. Wirth, 3F. Locality not specified, 1927, A. Carment, 1M [BM1928-132].

FRENCH GUIANA (109 specimens: 14M, 10Mgen, 51F, 15p, 19L&l; 15 ind rear: 4 l, 10p, 1 inc). **Guyane:** Cabassou (foret de), FGC 3278. Cabassou (Mont), FG 46. Cayenne, 14 Jul 1942, FGA 72-596, 1F; same locality, Dec 1942, FGA 83, 5M, 4F; same locality, 13 Aug 1947, 1M (852), 1Mgen; same locality, 20 Aug 1947, 1 lp; same locality, 5 Apr 1948, 1 lpF; same locality, FGC 3417; same locality, 1Mgen. Cayenne, road to Baduel, 11 Jul 1942, FGA 71-10, 1M. Couachi, FGC 4024. Fort Diamant, FGC 3293. Gallion (foret du), FGC 3381. Iracoubo, 12 Mar 1952, FGA 184, 1F. La Chaumiere, 2 Jul 1942, FGA 67, 3F. Montjoly, FG 69, FGC 3438. Raban, FG 43. Rorota (Lac du), FG 67.

GRENADA (47 specimens: 16M, 8Mgen, 11F, 5p, 7L&l; 5 ind rear: 3 l, 2p). **St. Andrew:** Grenville, GRR 12. Pearls Airport, GR 37. Pearls Bay, LAR 43, 44. Pearls Estate, LAR 46. **St. George:** Caliviny, GR 18. Point Saline, GR 8. **St. Patrick:** Mount Rodney Estate, GR 46. **Parish not specified:** Pevis Port, LAR 51. Locality not specified, GRR 126; 28 Jun 1929, No. 1, 1L, 2 lp [JH].

GUADELOUPE. BASSE TERRE (1F, 65L). **Baie Mahault:** Belcourt, FWI 816. La Jaille, FWI 871, 955. Jarry, FWI 1027. **Capesterre:** Roseau, FWI 1014. **Lamentin:** Blachon, FWI 1005. **Petit Bourg:** Ste. Claire, FWI 1012. Viard, FWI 944, 988, 989. **GRANDE TERRE** (120 specimens: 4M, 3Mgen, 4F, 12P&p, 97L&l; 9 ind rear: 4 l, 1p, 4inc). **Abymes:** Besson, FWI 202. Raizet, FWI 704, 851, 855, 927, 951, 959, 1022. **Anse Bertrand:** Port Louis, FWI 200, 929. **Gosier:** Anse Vinaigri, FWI 967. Blanchas, FWI 818. Grande Ravine, FWI 876. Labrousse, FWI 958, 960. Poucet, FWI 203. St. Feliz, FWI 931. **Morne-a-l'Eau:** Berville, FWI 865. Blain, FWI 973. **Ste. Anne:** Anse du Belley, FWI 1004. **MARIE GALANTE** (119 specimens: 8M, 7Mgen, 12F, 32P&p, 60L&l; 20 ind rear: 10 l, 10p). **Grand Bourg:** Route de Folle Anse, FWI 236. **St. Louis:** St. Louis, FWI 264.

GUYANA (155 specimens: 11M, 7Mgen, 137F). **East Berbice-Corentyne**: New Amsterdam, 10 Mar 1900, E. Rowland, 1F [BM] ; same locality, GUY 1, 17, 20A; same locality, Aiken, 1F. Locality not specified, 12 Feb 1908, Aiken, 3F; 1936, W. Komp, 22F. **East Demerara-West Coast Berbice**: Georgetown, 1931, W. Beveridge, 1M, 1F [BM1931-210] ; same locality, E. Rowland, 6F. Hyde Park, 29 Jul 1941, BGR 2, 1M, 1Mgen, 3F; same data, 1F (1D) [JH] . **North West**: Locality not specified, Sep 1949, BGR 7, 15F. **District and locality not specified**: 6 Mar 1941, GUYK 10, 1F; 10 Jul 1941, Fox, 2M [JH] ; Giglioli, GUYK 34, 1M, 1F; no data, 1F [JH] .

MARTINIQUE (46 specimens: 8M, 6Mgen, 6F, 13P&p, 13L&l; 13 ind rear: 5 l, 6p, 2 inc). **Anse d'Arlets**: Anses d'Arlets, FWIM 1. **Ste. Marie**: Riviere Charpentier, MAR 116. **La Trinite**: Galion Sugar Refinery, MAR 7. **Locality not specified**: July, A. Busck, 1F.

MONTSERRAT (1 lpF). **St. Anthony**: Foxs Bay, MNT 39.

PANAMA AND CANAL ZONE (327 specimens: 137M, 7Mgen, 166F, 8P&p, 9L). **Bocas del Toro**: Punta de Pena, PA 219, 253. **Canal Zone**: Ancon, 1912, J. Zetek, 1F; same locality, Jul 1941, PAX 181, 1F. Cocolis [Cocoli] , 26 Feb 1943, 1M. Cristobal, 13 Jul 1944, Sterns *et al.*, ASM 68-1, 2M, 2Mgen, 1F; same data, 3M, 2F, 10L [CU] . France Field, Mar 1941, 1M, 5F. Galeta Is., 3 Sep 1930, PAX 17, 5F. Gatun, 28 Feb 1930, D. Curry, PAX 7, 3M, 2F; same locality and collector, 29 Feb 1930, PAX 8, 6M, 6F; same locality and collector, Jan 1931, PAX 21, 9M, 17F; same locality, 25 Mar 1933, PAX 31, 8M, 22F; same locality, 10 Mar 1937, 2F; same locality, PAR 46, 10M, 2Mgen, 32F; same locality, KO H-19-18, 48M. Gatun Lake, 20 Feb 1934, PAX 36, 1M, 3F. Largo Reme [Remo] , 1926, D. Curry, 1F. Mindi, 10 May 1941, C. Brown, PAX 176, 31M, 28F. Mojinga Swamp, PA 1165. Mt. Hope, 29 Jan 1944, 5M, 2F. Pedro Miguel Locks, 22 May 1939, PAX 110, 1F. Locality not specified, Feb 1944, 1F. **Colon**: Colon, 11 May 1930, D. Curry, PAX 9, 1M, 1F; same locality and collector, 27 May 1930, PAX 10, 1F; same locality and collector, 7 Jun 1930, PAX 12, 1M; same locality and collector, 10 Jun 1930, PAX 13, 4M, 4F. Pina, 27 Jun 1945, 1F. Portobelo, PA 603, 604, 606. **Panama**: Chepo Road, 19 Nov 1939, PAX 157, 1M. **Province and locality not specified**: PAR 136, 1F; from D. Curry, 5L [JH] ; no data, 2Mgen [JH] .

SAINT KITTS (5F). Conaree Swamp, 22 Nov 1949, 5F.

SAINT LUCIA (192 specimens: 19M, 9Mgen, 23F, 38P&p, 103L&l; 30 ind rear: 24 l, 3p, 3inc). **Anse La Raye**: Anse La Raye, LU 71, 72, 127. Roseau Sugar Estate, LU 23. Roseau Sugar Factory, LU 20, 86. **Castries**: La Toc, LU 6. **Gros Islet**: Bois D'Orange, LU 37. Choc Swamp, LU 153, 154. Gros Islet, 24 Feb 1941, 1F; same locality, 29 Jul 1941, 4F; same locality, 2 Aug 1945, Ingle, 2F. Marisule, LU 39, 40. Union Agricultural Station, LU 150, 151, 157. **Laborie**: Sapphire Estate, LU 121. **Micoud**: Troumassee Estate, LU 118, 119. **Praslin**: Volet Estate, LU 98, 102. **Soufriere**: Soufriere, LU 84, 85. **Quarter and locality not specified**: No data, 1L.

SAINT VINCENT (1M). Locality not specified, 1M [BM] .

SURINAME (59 specimens: 11M, 8Mgen, 33F, 2p, 5L&l; 2 inc ind rear). **Coronie**: Friendship, 15 Jun 1946, E. Kuyp, 1Mgen (46-x-17a). Sarahmeer, 17 Jun 1946, E. Kuyp, 1Mgen (46-x-16b). Zoetwater Kanaal, 14 Jun 1946, E. Kuyp, 1M. Locality not specified, 15 Jun 1946, E. Kuyp, 3M, 1F. **Marowijne**: Moengo, Sep 1944, Guicherit, 2F. **Nickerie**: Nieuw Nickerie, 14 Jun 1946, E. Kuyp, 1Mgen (46-x-21a). **Paramaribo**: Charlesburg, 9 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22a), 1F, 2L; same locality, 11 Aug 1949, D. Geijskes, 4F [BM1949-475] ; same locality, SUR 49. **Suriname**: Domburg, SUR 39. Ma Retraite, SUR 70, 72. Morgenstand, 22 Jun 1946, E. Kuyp, 4M, 1 Mgen (46-ix-16b-82), 1Mgen (46-ix-16c-83), 3F, 1 lp (87), 1 l (88). Meerzorg II, 10 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22b). Ornamibo, 23 Jun 1946, E. Kuyp, 1F, 1 lp. Tweekinderem, 22 Jun 1946, E. Kuyp, 1M, 1Mgen (46-x-22d). **District and locality not specified**: SUR 117; H. Polah, 1F.

TRINIDAD AND TOBAGO. **TOBAGO** (28 specimens: 3M, 2Mgen, 7F, 6P&p, 10L&l; 6 ind rear: 2 l, 3p, 1inc). **St. Patrick**: Bon Accord Estate, 16 Nov 1965, T. Aitken, R. Martinez, A. Guerra, TOB 22, 1 pF; same data, TOB 24, 1 lpM, 1 lpF, 1 lP, 6L. Golden Grove, 19 Nov 1965, T. Aitken, R. Martinez, A. Guerra, TOB 58, 1Mgen, 1 pM; same data, TOB 59, 5F. Orange Hill, 30 Nov 1965, R. Martinez, A. Guerra, TOB 142, 1Mgen, 1 pM, 1L. **TRINIDAD** (463 specimens: 143M, 47 Mgen, 171F, 24p, 78L&l; 20 ind rear: 14 l, 5p, 1inc). **Caroni**: Caroni Swamp, 15 Oct 1964, A. Guerra, TR 762, 1Mgen, 1 pM, 1 pF, 1 lpM, 1 lpF; same data, TR 763, 1 lpF, 2L. Locality not specified, Jan 1946, 2F. **Mayaro**: Guayaguayare Rd., 27 Oct 1964, A. Guerra, TR 797, 4L. **St. Andrew**: Cumuto, 11 Jul 1941, TRR 21B, 1M, 1Mgen. Turure Rd. nr Guaico, 9 Apr 1966, A. Guerra, TR 1492, 1Mgen, 1 lpM, 1 lpF, 1P, 3L. **St. David**: Redhead, 28 Feb 1964, A. Guerra, TR 122,

1 lpF, 3L; same data, TR 124, 1L; same data, TR 125, 1 lpM, 2 lpF. Sans Souci, 5 Mar 1964, A. Guerra, TR 147, 1Mgen, 2 pF, 3 lpM, 1 lpF, 2L; same data, TR 148, 1 pF, 2L. Toco, 6 Mar 1964, A. Guerra, TR 162, 1L; same data, TR 166, 2L; same data, TR 167, 4L; same data, TR 168, 2L; same locality, TRK 9, 26M, 1Mgen, 21F. **St. George**: Blanchisseuse, 27 Mar 1941, W. Komp, KO 111-9, 9M; same locality, 10 Apr 1964, A. Guerra, TR 306, 1 l. Chaguaramas, 29 Jun 1961, T. Aitken, 1 lp. Diego Martin River, 8-26 Feb 1941, W. Komp, TRK 35, 24M, 2Mgen, 40F. El Socorro, Nov 1945, 4M, 2F. Long Stretch, 5 Feb 1941, TRK 4, 1Mgen. Piarco, Golden Grove, 14 Sep 1954, 1F [BM] ; same locality, Sep 1954, 1F [BM] . Port of Spain, 10 Jun 1941, 6Mgen [JH] ; same locality, 14 Jun 1941, TRR 7, 14M, 5Mgen, 7F; same locality, 16 Jun 1941, L. Rozeboom, 4L; same data, 24L [JH] ; same locality, 23 Jun 1941, TRR 56, 1M, 1Mgen; same locality, 26 Jun 1941, TRR 57, 28M, 7Mgen, 1F; same locality, 9 Jul 1941, TRR 59, 16M, 4Mgen, 27F. **St. Patrick**: La Brea, 29 Jul 1966, A. Guerra, TR 1563, 2F, 1 lpF. Lillette Swamp, 9 Jul 1966, T. Aitken, R. Martinez, TR 1552, 2M, 1Mgen, 1F, 3p, 5L. **County not specified**: S. Joseph, 2 Aug 1899, F. Urich, 2F. Locality not specified, 1915-1928, J. Dickson, 1 l (191) [BM] ; 22 Jul 1931, E. de Verteuil, 1F [BM1931-562] ; 25 Jul 1931, E. de Verteuil, 1M, 1F [BM1931-562] ; Mar 1941, W. Komp, KO 111-7, 2M, 3F; Jul 1941, 1Mgen [JH] ; May 1963, T. Aitken, 2M, 9F; Jun, A. Busck, 36F; W. Downs, 9Mgen [JH] ; F. Urich, 1M, 3F; no data, 5M, 5Mgen (750915-23, 24, 25, 26, 27).

VENEZUELA (62 specimens: 14M, 3Mgen, 19F, 12p, 14L&l; 12 ind rear: 9p, 3inc). **Anzoategui**: Barcelona, 16 Sep 1944, VZK 20, 2M. **Aragua**: Turiamo, 11 Sep 1944, VZK 3, 2M, 5F; same locality, Sep 1944, VZK 30, 4M, 1F. **Carabobo**: Boca de Yaracuy, VZ 259. Puerto Cabello, 1M gen [JH] . **Guarico**: El Sombrero, 14 Jul 1945, 1F. San Juan de los Morros, 17 Jan 1945, 1M, 1F. **Monagas**: Punta Tigre, Rio Guanaco, 3 Jan 1929, F. Urich, 1F [BM1929-453] . Jusepin, 30 Apr 1945, 2M. **Province not specified**: Higuerote, Nov 1949, 1L (616-Zone I, Cot. 185).

6. *Anopheles (Nys.) ininii* Senevet & Abonnenc

Figs. 2, 4, 6, 17, 18

1938. *Anopheles (Nyssorhynchus) ininii* Senevet and Abonnenc 1938:494-500. TYPE: *Syntypes* 2 females with associated larval and pupal skins and genitalia slides, St. Elie mines, Sinnamary River (Inini), French Guiana, artificial reservoir, 7 Feb 1938 [NE; Belkin (1968b:53) reported that type was lost or destroyed during Algerian conflict] .

Anopheles (Nyssorhynchus) ininii of Rozeboom and Gabaldon (1941:97-98); Floch and Abonnenc (1942b:2; 1943a:1-3; 1946a:1-4; 1946b:3-5; 1947:6; 1951:17, 50-51); Senevet (1948a:277-279; 1948b:431-432; 1948c:436-437); Levi-Castillo (1949:10, 15, 28, 58, 67, 77, 82, 86); Gabaldon and Cova Garcia (1952:178, 191); Senevet and Andarelli (1955:339); Stone, Knight and Starcke (1959:33); Vargas (1959:370); Fauran (1961:10-11); Belkin, Schick and Heinemann (1965:23); Belkin (1968b:53).

Anopheles ininii of Russell, Rozeboom and Stone (1943:51); Foote and Cook (1959:28, 29).

FEMALE (fig. 6). Wing: 3.7 mm. Proboscis: 2.3 mm. Palpus: 2.35 mm. Forefemur: 1.6 mm. Abdomen: about 3.1 mm. Dark, very similar to that of *oswaldoi*. **Head**: Integument dark brown with silver pruinose areas. Interocular space moderately wide, about 3-6 ommatidial diameters. Proboscis about 1.4 length of forefemur. High contrast between the integument and white erect scales on vertex, and decumbent scales on interorbital line and upper orbitals. Erect scales of vertex as those of *oswaldoi*. Dark scales of palpus dark brown to black; apex of palpal segment 2 with a small white band; apex of segment 3 with a moderately large, white band; dorsal surface of 2 and 3 with tan scales, not always conspicuous on 2, but as a longitudinal stripe on 3; segment 4 with a moderately large, dark, basal band and usually a much smaller, dark, apical ring; dark scales on ventral surface of segment 4 extending distad from basal band to form a distinct, dark, ventral stripe, usually not reaching the dark apical ring; mediolateral surface of segment 4 and 5 white. **Antenna**: Flagellar segment 1 with long, numerous, very prominent, white scales on dorsomesal surface. Flagellar segments 2-13 each with 7-9 setae in basal whorl. **Thorax**: Integu-

ment dark brown to brownish black. Short light scales on scutum ivory to silver. Anterior promontory area with long, white, setiform scales extending dorsad onto acrostichal line; humeral scale tuft very prominent, with white scales above and numerous, cuneate, brownish black scales below. Prescutellar space large, horseshoe shaped and very dark. Upper *stp* with about 3 long setae and 10 gray to white, obovate scales. Lower *stp* with one long seta and about 8 scales; scales similar to those of upper *stp*, occasionally lighter, in a large, conspicuous, diagonal patch. Upper *mep* with 5,6 setae; scales absent. **Legs**: Coxal scales white. Foretarsal segments 3-5 predominantly cream to white; light apical bands on segments 2 and 3 0.45 (0.35-0.55) and 0.75 (0.70-0.86) respectively; segment 4 often all light cream to golden brown or with a small, dark, basal area rarely longer than 0.3 of segment; often dark basal scales on segments 1-3 and occasionally 4,5 primarily restricted to dorsal, or dorsal and part of anterior and posterior surfaces so that basal bands appear incomplete ventrally; segment 5 all cream to about 0.5 basally dark. Midtarsal segments 2 and 3 with a small cream band in apical 0.08-0.17 and 0.12-0.24 respectively; segment 4 with a cream band in apical 0.15-0.25; segment 5 from completely cream to dark in about basal 0.5. Hindtarsal segment 2 with a dark band in basal 0.17-0.26; segment 5 cream to white in apical 0.5-0.6. **Wing**: Light wing spots white to very light cream. Dark spots dark brown to brownish black. Vein C humeral light spot 2.0-3.3 (1.5-3.3) of basal dark spot; subcostal light spot 0.35-0.70 of subcostal dark spot; preapical light spot 0.25-0.50 of preapical dark spot; apical dark spot small. R presectoral dark spot moderately small; sectoral dark spot small. Rs-R_{2+3} usually with an extra, small to moderately large, subcostal dark spot. M highly variable, with a moderately long to very long, sectoral dark spot; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal and preapical dark spots small to moderate. Apical light fringe spot moderately small to large, undivided or divided by a few dark scales between R_2 and R_3, and/or R_3 and R_{4+5}; additional light fringe spots as in remaining species. **Abdomen**: Tergite I with a few light scales along caudomedian border. Sternite I with a few setae. Caudolateral scale tufts large and prominent on segments II-VII. Light scales of tergites II-VII often overlapping bases of dark caudolateral tufts. Scales on sternite II-VII as in section description except very distinct and numerous.

MALE. Wing: 3.6 mm. Proboscis: 2.9 mm. Forefemur: 1.6 mm. Abdomen: about 3.2 mm. Large, essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a dorsal cream stripe; segment 4 with a white band at base and apex, a small, brown, subbasal band usually present; segment 4 cream to white mediolaterally and brown ventrally. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, thin, conspicuous, white, lanceolate scales. **Legs**: Forefemur about 0.55 length of proboscis. Basal plantar surface of foretarsal segment 5 with 7,8 moderately long, spiniform setae; setae longest toward apex. Claw on foreleg large, curved, acuminate; submedian tooth long, about 0.25 length of claw, tapering to blunt recurved point; basal tooth long, subequal to submedian tooth, strongly decurved.

MALE GENITALIA (fig. 17). **Segment VIII**: Tergite and sternite with moderately large, obovate scales. Sternite with a few, median, dark scales, and laterally with cream to white scales. Tergite with dark scales along posterior margin. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme a sclerotized band across anterior border of sternite, about 0.15 length of sternite, occasionally appearing weakly bilobed. **Sidepiece**: Subconical. Tergal surface with 4, 5 long, submedian, tergomedial bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine moderately long, at least 2.0 length of its tubercle. Basal

apodeme thick, moderately long, about 0.2 length of sidepiece. Longer, more dorsal accessory spine slightly longer than 0.5 length of sidepiece; more ventral spine 0.65-0.70 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform long and narrow, subequal to seta *b*. **Dorsal Claspette**: Long, 0.55-0.70 length of sidepiece. Pedicel moderately thick; base rounded, occasionally curved mesad. Leaflets long, about 0.5 length of claspette, sharply curved mesad about 0.5 from base; dorsal leaflet with small basomesal projection. **Ventral Claspette**: Strongly conoid; long, about 0.5 length of sidepiece; narrow at apex, width at apex about 0.3 length of claspette. Basal lobule very large, extending laterad, and usually bent at base ventrally so that setae on basal margin projecting caudad; setae along basal margin very strong and long, about 2.0-3.0 width of aedeagus; setae distributed uniformly over surface of lobule. Lateral and ventral surfaces (exclusive of basal lobule) with short setae about 0.5 width of aedeagus; setae extending toward apex only as far as level of apical margin of preapical plate. Apex without setae, produced into rounded cone with a very small, median sulcus. Preapical plate distinct, very large, crescent shaped, heavily sclerotized. Refringent structure rooflike, in shape of an inverted V with a rounded vertex. **Phallosome**: Aedeagus about 0.5-0.6 length of sidepiece; apex about as long as wide, moderately rounded, with or without very small, membranous leaflets as in *nuneztovari*.

PUPA (fig. 17). Abdomen: about 2.9 mm. Trumpet: 0.5 mm. Paddle: 0.8 X 0.6 mm. In general, setae long and numerously branched. **Cephalothorax**: Heavily sclerotized. Wing cases with or without longitudinal stripes. Hair 2-C 2,3 forked (1-3), longer than 1,3-C; 1-C 2 branched (1-3), shorter than 3-C; 3-C 2,3 branched near base. Hairs 4,5-C subequal; 4-C 2-4 forked; 5-C 2-5 forked. Hair 6-C 1-3 branched. Hair 7-C 2,3 branched (1-4) near base, shorter branches subequal to 6-C, with one branch about 1.25-1.50 length of shorter branch(es). **Trumpet**: Similar to that of *strodei* and *aquasalis*. Pinna amber; about 3.7-4.4 (3.6-4.6) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long, moderately pointed at base. **Metanotum**: Hair 10-C single or double, strong, moderately long, slightly less than or equal to 11-C. Hair 11-C 3-5 branched near base. Hair 12-C 1-3 forked, about 2.0 length of 10-C. **Abdomen**: Heavily sclerotized. Hair 2-I 5-8 branched near base, moderately long; 3-I single or double, slightly more than 0.5 length of 2-I. Hair 4-I 5-8 branched. Hair 5-I 2,3 forked (1-3), long. Hair 6-I single and very long. Hair 7-I 3-6 branched, 0.5 length of 6-I. Hair 9-I single, longer than 7-I and shorter than 6-I. Hair 0-II,III,VI,VII moderately large; 0-IV,V large; 0-II 4-7 branched (4-10); 0-III 5-7 branched (4-7); 0-IV,V 4-6 branched (3-8); 0-VI 4-7 branched; 0-VII 4-6 branched. Hair 1-II,III 8-12 (8-13) and 7-13 (6-14) branched respectively, large; 1-IV-VII very long, 1.75 to more than 2.00 length of segment. Hair 3-IV 4-6 branched (4-7); 3-V 3-5 forked (2-5). Hair 5-II 4-7 branched (4-8) near base, moderately small; 5-III numerously, 9-13 (5-13) branched, moderately developed; 5-IV 2-6 branched (2-8), large, subequal to length of segment; 5-V-VII single, long. Hair 6-II single or double, long, at least 2.0 length of 7-II. Hair 7-II 4-6 branched; 7-III,IV about 3-7 branched, moderately developed; 7-V 3,4 branched, longer than 7-III,IV; 7-VI usually double (1-4 branched), moderately long, about 0.5 or less length of segment. Hair 8-III-VII moderately developed; 8-III-VI about 2-5 branched; 8-VII 4-6 branched. Hair 9-II very small, unpigmented; 9-III blunt, stout, short, subequal to or slightly longer than 9-II, pigmented; 9-IV stout, about 2.0 of 9-III; 9-V acuminate, stout, curved, 1.75-2.00 (1.4-2.4) length of 9-IV; 9-VI strong, relatively short, about 0.25-0.33 length of segment; 9-VII 1.4-1.8 (1.3-1.8) length of 9-VI; 9-VII,VIII tapering to a fine point, long, about 0.5 or more length of segment; 9-VII curved;

9-VIII almost straight. Hair 10-III 2-4 forked, moderately long. Hair 4-VIII 2-4 forked. Sum of branches of hairs 1-III, 5-III and 0-VI 22-27 (22-31). **Terminal Segments**: Male genital lobe heavy, thick, with mammilliform protuberance moderately prominent. **Paddle**: Large, obovate, weakly emarginate at insertion of hair 1-P. External buttress 0.55 length of paddle. External margin distad of buttress with moderately long, filamentous spicules extending around apex and becoming minute along caudal 0.5 of inner margin. Hair 1-P moderately long (0.1 mm); 2-P 1-3 forked, subequal to 1-P.

LARVA (fig. 18). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. **Head**: Moderately large. Very darkly pigmented, often almost black. Setae strongly developed and long. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical half, often appearing simple; hairs 2-C widely spaced, clypeal index about 1.25; 3-C about 0.8-0.9 length of 2-C. Hair 4-C 4,5 branched (3-6), short, not extending to base of 2-C. Hairs 8,9-C 6-8 branched (5-10), strongly developed; 9-C weakly plumose with moderately long shaft, longer than 8-C, subequal to 2.0 distance separating insertion of 5-C and 6-C. Hair 10-C 3,4 branched, subequal to 8-C. Hair 12-C 4-6 branched, subequal to 8-C. Hair 15-C about 5 branched, strongly developed, long. Collar heavily pigmented and wide dorsomedially. **Antenna**: Very heavily pigmented. Mesal margin with strongly developed, stout spicules; ventral surface with numerous, shorter, heavy spicules; dorsal surface with a few small spicules. Hair 1-A dendritic, 7-9 branched (6-10), long, about 2.0 width of antenna at point of insertion, inserted about 0.25-0.33 from base of antenna. Hairs 2,3-A long and narrow. **Thorax**: Dark, greenish brown, heavily pigmented. Submedian prothorax group (1-3-P) often with 1,2-P sharing common tubercle, occasionally tubercle appearing more sclerotized at insertion of 2-P than at insertion of 1-P; palmate hair 1-P with 11-16 (10-18) long, moderately narrow leaflets; 2-P 14-17 branched (10-17), long, almost 4.0 length of 1-P. Hair 14-P 7-10 branched (7-13) from moderately long shaft. Mesothoracic hair 1-M 28-33 branched, apical branches shorter than lateral. Metathoracic hair 2-T long, extending to or beyond caudal margin of thorax. Palmate hair 3-T with 12-18 (10-18) large, weakly pigmented leaflets. Prothoracic pleural group spine larger than mesothoracic spine; metathoracic pleural spine smallest. **Abdomen**: Hair 0-II-VI large; 0-II,III,V,VI about 6-10 branched (5-10); 0-IV 5-8 branched. Palmate hair 1-I with 14-17 (11-20) weakly pigmented, moderately long, narrow, spreading leaflets; 1-III-VI with 23-30 (20-31) long, narrow, lanceolate leaflets; 1-I,II,VII shorter than 1-III-VI. Hair 2-II 4-6 branched (3-6), moderately large; 2-III 3-4 branched, large; 2-IV single, slightly longer than length of leaflets of 1-IV; 2-V single, very long (0.3 mm). Hair 3-I single, moderately long. Hair 5-I 4,5 branched (3-6), moderately developed; 5-II 8-10 branched, medium. Hair 9-I about 4-7 branched. Hair 13-I,II, III 4-6 (4-9), 7-11 (6-11) and 8-10 (6-14) branched respectively, small; 13-IV 3,4 branched, larger than 13-I-III; 13-V large, extending beyond caudal margin of segment; 13-VI 7-12 branched. **Spiracular Lobe**: Pecten with 15-22 teeth; many (8-11) of median teeth subequal. Lateral arm of spiracular apparatus long, directed laterally, appearing truncate on lateral margin at point of contact with spiracular opening. **Anal Segment**: Covered with very fine spicules becoming very short and inconspicuous basally. Saddle reddish brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin, never on lateral margin at base of indentation; inserted about 0.3 cephalad of caudal margin. Anal gills very long, usually 2.0 or more length of saddle.

DISCUSSION. *An. ininii* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) palpal segment 4 with a dark basal band extending distad on the ventral surface to form a distinct, dark, ventral

stripe usually not reaching apical dark ring, (2) foretarsal segments 3-5 predominantly cream to white with dark scales often present only on dorsobasal surface of segment, segments 2 and 3 light in apical 0.45 (0.35-0.55) and 0.75 (0.70-0.86) respectively, segment 4 often all light cream to golden brown or with a small, dark, basal area rarely longer than 0.3 length of segment, segment 5 from about 0.5 basally dark to all cream, (3) midtarsal segment 4 with a cream band in apical 0.15-0.25, and segment 5 from completely cream to 0.5 basally dark, (4) hindtarsal segment 2 with a dark band in basal 0.17-0.26, (5) wing spots white to very light cream, (6) humeral light spot on vein C about 2.0-3.3 (1.5-3.3) of basal dark spot and (7) subcostal light spot on vein C 0.35-0.70 of subcostal dark spot; in the **male genitalia** by the combination of (1) ventral claspette strongly conoid, narrow and rounded at apex, width at apex about 0.3 length of claspette, (2) basal lobule very large, extending laterad and usually bent at base ventrally so that setae on basal margin projecting caudad, (3) setae along basal margin of basal lobule very strong and long, 2.0-3.0 width of aedeagus, setae distributed uniformly over surface of lobule, (4) setae on lateral and ventral surfaces of ventral claspette (exclusive of basal lobule) short, about 0.5 width of aedeagus, extending toward apex only as far as level of apical margin of preapical plate, (5) preapical plate heavily sclerotized, very large, crescent shaped and (6) apex of aedeagus with or without very small, membranous leaflets; in the **pupa** by the combination of (1) setae in general long and numerously branched, (2) hair 7-C 2,3 branched (1-4), shorter branches subequal to 6-C, with one branch about 1.25-1.50 length of shorter branch(es), (3) hair 5-II 4-7 branched (4-8) near base, moderately small, (4) hair 9-V 1.75-2.00 (1.4-2.4) length of 9-IV, (5) hair 9-VII 1.4-1.8 (1.3-1.8) length of 9-VI and about 0.5 or more length of segment, tapering to a fine point, (6) hair 2-I 5-8 branched near base, moderately long, hair 3-I slightly more than 0.5 length of 2-I, (7) hair 6-II single or double, at least 2.0 length of 7-II and (8) sum of branches of hairs 1-III, 5-III and 0-VI 22-27 (22-31); and in the **larva** by the combination of (1) hairs 2,3-C single and barbed in about apical half, hairs 2-C widely spaced, clypeal index about 1.25, hair 3-C about 0.8-0.9 length of 2-C, (2) hair 4-C short, not extending to base of 2-C, (3) hairs 8,9-C 6-8 branched (5-10), strongly developed, 9-C weakly plumose with moderately long shaft, subequal to 2.0 distance separating insertion of hairs 5-C and 6-C, (4) hair 1-A dendritic, 7-9 branched (6-10), long, about 2.0 width of antenna at point of insertion, (5) hair 14-P 7-10 branched (7-13) from moderately long shaft, (6) hair 13-IV 3,4 branched, larger than 13-I-III, (7) lateral arm of spiracular apparatus long, directed laterally, appearing truncate on lateral margin, (8) hair 1-X inserted on saddle near ventral margin, never on ventral margin at base of indentation and (9) anal gills very long, usually 2.0 or more length of saddle.

An. ininii is a highly derived species, but it still retains a few ancestral characters which it shares with other species in the Oswaldoi Group and with some species in the Argyritarsis Section. These ancestral characters are in the larva (1) hair 13-IV large, with few branches and (2) hair 1-X inserted on saddle near but not on ventral margin; and in the male genitalia (1) the frequent presence of very small leaflets on the apex of the aedeagus and (2) possibly the shape of the ventral claspette. Although *ininii* often has very small leaflets on the aedeagus as do *nuneztovari* and *rangeli*, it is probably more closely related to *oswaldoi, galvaoi, noroestensis* and *aquasalis*. *An. oswaldoi* occasionally has leaflets on the aedeagus, and in general its ventral claspette is similar to that of *ininii*. The preapical plates are almost identical in *oswaldoi* and *ininii*, and the setae are distributed similarly on the basal lobules of the ventral claspette. The females of *oswaldoi* and *ininii* also are very much alike in all characters except for the fourth palpal segment and the banding patterns of the foretarsus.

It is impossible to differentiate these 2 species on the basis of the wing or the second hindtarsal segment. Likewise, the larvae of *oswaldoi* and *ininii* share many similar characters, such as the length of the lateral arm of the spiracular apparatus, the development of hairs 8,9-C and the arrangement of teeth on the pecten; these characters are usually more strongly developed (*i.e.* longer, larger) in *ininii*, except for the branching of hairs 2,3-C which has been strongly reduced in *ininii* as compared to *oswaldoi*. Ecologically, *ininii* occurs sympatrically with *oswaldoi*, the immatures being found in many of the same habitats, although it usually occurs in more open areas than *oswaldoi*. Speciation of *ininii* may have occurred in a geographically isolated area (refugium) in northern central South America.

BIONOMICS. Very little is known about the bionomics of *ininii*, particularly regarding the adults. Almost all the information relating to the larval habitats discussed below came from data recorded on collection forms by John F. Reinert while in Para, Brazil in 1974. The immatures of *ininii* are found along grassy margins of ponds, lakes, reservoirs, temporary or permanent ground pools, and animal or wheel tracks, in full sun or occasionally in partial shade. The water is fresh, clear, and with algae and emergent vegetation, although vegetation is usually scanty in the larval habitat. The general habitat in Para was characterized as secondary scrub. The 3 species in the Albimanus Section collected in association with *ininii* were *oswaldoi, nuneztovari* and *triannulatus*; the last 2 species were by far more common. The following 11 species have also been found in association with *ininii*: *Anopheles (Ano.)* sp, *Culex (Cux.) coronator* group, *Cx. (Cux.) mollis, Cx. (Mel.) bastagarius, Cx. (Mel.) dunni* group, *Cx. (Mel.) ?rachoui, Cx. (Mel.) zeteki* group, *Cx. (Mel.)* sp, *Cx. (Ads.) amazonensis, Uranotaenia (Ura.) geometrica* and *Ur. (Ura.) pulcherrima*. The type material of *ininii* was collected in an artificial reservoir in St. Elie, French Guiana (Senevet and Abonnenc 1938:501-511). Floch and Abonnenc (1947:6; 1951:50-51) reported that *ininii* occurs in dense vegetation with *An. (Nys.) braziliensis, darlingi, nuneztovari, oswaldoi* and *triannulatus*. Floch and Abonnenc (1951:17) reported that in 9 years a total of 6 specimens were collected.

MEDICAL IMPORTANCE. Nothing is known about the adult behavior or the medical importance of *ininii*.

DISTRIBUTION (fig. 2). *An. ininii* has been collected only in French Guiana and in the state of Para, Brazil.

Material Examined: 192 specimens: 32 males, 14 male genitalia, 57 females, 66 pupae, 23 larvae; 66 individual rearings: 18 larval, 48 pupal.

BRAZIL. Para (192 specimens: 32M, 14Mgen, 57F, 66p, 23L&l; 66 ind rear: 18 l, 48p). Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.*, coll. 77, 1 pF; same data, coll. 79, 3Mgen, 7 pM, 7 pF; same data, coll. 80, 2 pM, 1 pF; same data except 163 km W of Altamira and 6 Nov, coll. 85, 5Mgen, 4 lpM, 5 lpF, 4 pM, 1 pF, 5L; same data except 158 km W of Altamira and 9 Nov, coll. 111, 1 pM. Bacuri, Gleba 29, Lote 03, 20 Oct 1974, J. Reinert *et al.*, coll. 5, 1M, 1Mgen; same data except Gleba 36, Lote 02 and 23 Oct, coll. 33, 3 lpF; same data except Gleba 29, Lote 03 and 25 Oct, coll. 44, 2Mgen, 2 lpM, 2 lpF, 1 pM; same data except Gleba 36, Lote 02 and 26 Oct, coll. 50, 1M gen, 2 pM, 1 pF; same data except Gleba 34, Lote 02 and 28 Oct, coll. 62, 2Mgen, 2 pM, 1 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 2 lpM, 2 pM, 2 pF. Belem, APEG Forest, 22 Nov 1974, J. Reinert *et al.*, coll. 140, 1 pF. Jatobal, 18 Feb 1976, Moramay, 1102, 3 pF; same data except 19 Feb, 1104, 2 pM, 7 pF. Maraba area, 3 Jun 1976, 1F (R-5); same locality, 15 Jun 1976, D. Roberts, 1F (A-1); same locality, 23 Jun 1976, 5F (A-2); same locality, 24 Jun 1976, D. Roberts, 11F (A-1); same locality, 21 Oct 1976, 2F (1); same locality, 8 Nov 1976, 1F (1); same locality, 9 Nov 1976, 1F (2).

7. Anopheles (Nys.) anomalophyllus Komp

Figs. 2, 4, 6, 19, 20

1936. *Anopheles (Nyssorhynchus) anomalophyllus* Komp 1936:163-164. TYPE: *Holotype* male with genitalia slide, Wenham's Farm, near Almirante (Bocas del Toro), Panama, bred from pupa, Feb 1929, W. H. W. Komp [USNM, 52018].

Anopheles (Nyssorhynchus) anomalophyllus of Lane (1939:21; 1944:262; 1949:402; 1953:263-264); Komp (1941a:90, 93, 96; 1942:39, 43, 75, 80, 125-127, 132, 161-162); Rozeboom and Gabaldon (1941:92-98); Galvao and Damasceno (1942:132); Simmons and Aitken (1942:39, 46, 52, 62, 87); Levi-Castillo (1949:9, 15, 27, 58, 67, 72, 76, 85); Gabaldon and Cova Garcia (1952:182); Vargas V. (1956:29; 1957; 1958a; 1958b); Bejarano (1957:326, 328, 330, 331); Stone, Knight and Starcke (1959:31); Vargas (1959:376); Belkin, Schick and Heinemann (1965: 43); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles anomalophyllus of Kumm and Ruiz (1939:438); Kumm, Komp and Ruiz (1940:389, 408); Kumm (1941b:95-97); Rozeboom (1941:103); Russell, Rozeboom and Stone (1943:26, 29, 31); Vargas V. (1958c:1, 3); Cova Garcia (1964:200); Stojanovich, Gorham and Scott (1966a:10, 19, 30).

FEMALE (fig. 6). Description based primarily on 4 specimens from Costa Rica. Wing: 3.1 mm. Proboscis: 1.9 mm. Palpus: about 1.9 mm. Forefemur: 1.2 mm. Abdomen: about 2.7 mm. Generally very similar to *strodei*. **Head:** Integument dark brown. Proboscis about 1.6 length of forefemur. Vertex with very elongate, cuneate or slightly forked, cream to white scales. Dorsal surface of palpal segment 2 with a very few, light, erect scales; dorsal surface of segment 3 with light scales forming a longitudinal stripe; segments 2 and 3 with light apical band, apical band of 2 much smaller than apical band of 3; segment 4 with a basal and an apical dark band, light scales on ventral surface darker than on lateral surface, apparently with light brown to brown scales forming an indistinct ventral stripe; segments 4 and 5 predominantly white; base of 5 with a few dark scales extending from apex of 4. **Antenna:** Flagellar segment 1 with moderately long to long, white, oblanceolate scales distally on dorsomesal surface; base of 1 with small, gray to white, obovate scales. **Thorax:** Integument light brown to reddish brown. Elongate, white anterior promontory scales extending onto acrostichal line. Prescutellar space horseshoe shaped. Upper *stp* with 3,4 long, light brown to dark brown setae and a horizontal row of light scales. Lower *stp* with one long brown seta and a patch of light scales. Upper *mep* with about 4, 5 long, cream to light brown setae; scales not visible in specimens examined. **Legs:** Integument predominantly reddish brown. Light scales on coxae white. Midfemur with long, narrow, cream anteroapical spot and a small knee spot. Foretarsal segments 2 and 3 with a white band in apical 0.35 (0.29-0.42) and 0.51 (0.23-0.78) respectively; segment 4 all brown; segment 5 cream in about apical 0.5. Midtarsal segments 1 and 2 with a small, inconspicuous, white apical band; segment 3 with a cream apical ring (inconspicuous in one specimen); segment 4 all dark; segment 5 with a cream band in about apical 0.5. Hindtarsal segment 2 with brown band in basal 0.4 (0.30-0.45); segment 5 cream in apical 0.5-0.7. **Wing:** Slightly narrower and more pointed at apex than that of *aquasalis*. Light spots of wing white except for vein C and possibly R. Vein C humeral light spot about 2.5 (2.3-4.0) of basal dark spot; subcostal light spot 0.23-0.60 of subcostal dark spot; preapical light spot about 0.5 of preapical dark spot; 2 specimens with presectoral and sectoral dark spots fused. R presectoral dark spot moderately short to long; sectoral dark spot very small in 2 specimens and absent in the other 2. R_{4+5} subcostal and apical dark spots small to moderately small. M sectoral dark spot small to moderate, in 2 specimens absent or indistinct. Apical light fringe spot moderately large, distinctly broken by dark scales

between R_3 and R_{4+5}; additional, small, inconspicuous, light fringe spots at apices of all veins posterior of, and including, R_{4+5}; a moderately large, inconspicuous, light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Dark scales of caudolateral tuft on tergites and sternites relatively small, about 0.07 mm. Remainder of abdomen as for that of *aquasalis.*

MALE. Wing: 2.8 mm. Proboscis: 2.1 mm. Forefemur: 1.45 mm. Abdomen: about 2.6 mm. **Head**: Palpal segments 2 and 3 with cream dorsal stripe; segment 4 predominantly cream, with a basal and an apical white band, and with or without a subbasal and a subapical dark ring. **Antenna**: About 0.7-0.8 length of proboscis. Flagellar segment 1 with moderately long, white, lanceolate scales. **Legs**: Forefemur 0.7 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 7 moderately long, spiniform setae. Claw on foreleg large, curved, acuminate; submedian tooth long, tapering to a blunt, slightly recurved apex; basal tooth strongly decurved.

MALE GENITALIA (fig. 19). Description based on 5 damaged specimens, including holotype and 2 paratypes. **Segment IX**: Sternite long, about 0.2 length of sidepiece, curved, subtrapezoidal. Anterior apodeme on anterior border moderately developed, subtrapezoidal. **Sidepiece**: Tergal surface with 4,5 long, submedian, tergomedial bristles, basal 3 approximated; bristles mesad of tergomedial bristles moderate in length. Parabasal spine tapering, slender, moderately long, about 2.0 length of its tubercle. Basal apodeme moderately thick, 0.18 length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 length of sidepiece; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform acuminate and moderately long, slightly less than length of seta *b* (one specimen). **Dorsal Claspette**: About 0.6 length of sidepiece. Pedicel moderately broad; internal apodeme distinct. Leaflets broad, as in section description. **Ventral Claspette**: On holotype slide, about 0.87 length of aedeagus; width at apex about 0.2 length of claspette. Basal lobule large, expanded at base; setae along basal margin long, 1.5-2.0 width of aedeagus. Lateral and ventral surfaces (exclusive of basal lobule) with short setae extending to or nearly to apex. Apex striated, rounded and appearing domelike. Preapical plate moderately large, oval to semicircular, moderately sclerotized, located about 0.3 length of claspette basad of apex. Refringent structure not apparent. **Phallosome**: Aedeagus with apex rounded, longer than wide; with a pair of long, pointed, sclerotized leaflets about 0.4 length of aedeagus, leaflets directed basolaterally and serrated with 4,5 small teeth apically; subtriangular median sclerotizations at base of apex directed caudomesad instead of mesad as in remaining species.

PUPA (fig. 19). Abdomen: about 2.8 mm. Trumpet: 0.48 mm. Paddle: 0.8 mm. Description based on 2 laterally oriented specimens; outline of drawing based on *strodei*, many of setal lengths approximate. **Cephalothorax**: Very dark brown. Hairs 4, 5-C 3 and 2 branched respectively near base. Hair 6-C 3 forked. Hair 7-C 2 branched. **Trumpet**: Pinna long, about 4.5 length of meatus. Meatal cleft long, basally rounded. **Metanotum**: Hair 10-C single, short (0.1 mm). Hair 11-C slightly shorter than 12-C, 4 branched near base, median branch longer than lateral. Hair 12-C single, about 2.0 length of 10-C. **Abdomen**: Very darkly pigmented brownish black. Hair 2-I 6 branched 0.25 from base, long (0.16 mm), about 2.0 length of 3-I. Hair 4-I 4 branched, short. Hair 5-I single and moderately long. Hair 6-I single and long. Hair 7-I 3 branched near base, slightly longer than 0.5 length of 6-I. Hair 9-I single, slightly shorter than 6-I. Hair 0-II,III 3 and 4 branched respectively, moderately long; 0-IV-VII 3-5 branched. Hair 1-II 9 branched, strongly developed; 1-III 7,9 branched,

strong; 1-II,III with median branches longer than lateral; 1-IV-VII single, very long, 1.5-1.8 length of segment, longer on anterior segments than on posterior. Hair 3-IV 5 branched, moderately long; 3-V 2 forked 0.5 from base, long. Hair 5-III 9 branched, subequal to 1-III; 5-IV 5 branched, lateral branches shorter than median; 5-V-VII single, long, subequal to length of segment. Hair 6-II single, probably slightly longer than 7-II; 6-III single, long. Hair 7-II 3 branched; 7-III 2 forked, moderately developed; 7-V double, longer than 7-IV; 7-VI,VII single, long. Hair 8-III 2 forked, moderately long; 8-IV 1,2 forked, moderately long; 8-V single, moderately long; 8-VI,VII 2 and 3 branched respectively. Hair 9-II very small; 9-III strongly developed, more than 2.0 length of 9-II, heavily pigmented; 9-IV stout, 2.0 of 9-III; 9-IV-VII thick, acuminate, slightly curved, progressively longer from IV to VII, relatively short, less than 0.33 length of segment; 9-VIII subequal to 9-VII. Hair 10-III 3 forked, moderately long. Hair 4-VIII 2,3 forked, moderately long. **Terminal Segments** and **Paddle** not clearly discerned because of lateral orientation of specimens. Buttress about 0.7 length of paddle, serrated distally with small teeth. Hair 1-P moderately short (0.05 mm).

LARVA (fig. 20). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.3 mm. **Head**: Moderately pigmented. Median tooth of mental plate moderately wide, less than combined width of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed, with 8-10 and 4-9 barbs respectively; barbs of 3-C longer than those of 2-C; 3-C about 0.6-0.7 length of 2-C; hairs 2-C closely approximated, clypeal index about 2.5. Hair 4-C 2,3 branched, short, not reaching base of 2-C; distance between insertion of 4-C and 2-C about 1.5 distance between insertion of 2-C and 3-C. Hairs 8,9-C 3-5 branched (2-6), large; 8-C slightly shorter than 9-C. Hair 12-C 4-7 branched, large, subequal to 9-C. Hair 15-C single or forked, long. Collar wide dorsomedially, dark, heavily pigmented. **Antenna**: Darkly pigmented. Mesal margin with numerous, strong, long spicules; ventral surface with few, moderately strong, short spicules. Hair 1-A 5,6 branched (3-6), short, slightly longer than width of antenna at point of insertion, inserted about 0.3 from base of antenna. **Thorax**: Darkly pigmented. Submedian prothoracic group (1-3-P) with 1,2-P sharing a common sclerotized tubercle; palmate hair 1-P with 9-12 long, moderately broad to broad, pointed, lanceolate leaflets; 2-P 12-14 branched (12-17), about 3.0 length of 1-P. Hair 14-P 7-10 branched from a short, flattened stalk, lateral branches shorter than median. Mesothoracic hair 1-M 20-30 branched (20-32). Metathoracic hair 2-T moderately short. Palmate hair 3-T with 10-14 (10-16) moderately short, semitransparent, lanceolate leaflets. **Abdomen**: Hair 0-II-VII moderately large to large; 0-II, III,V-VII 4-7 branched; 0-IV 6,7 branched. Palmate hair 1-I with 12-16 narrow, moderately long, semitransparent leaflets; 1-II-VII with long, moderately narrow, pigmented leaflets; 1-II,VII smaller than 1-III-VI; 1-III,VI slightly smaller than 1-IV,V. Hair 2-II 4-7 branched, large; 2-III 3-6 branched (3-7), moderately long; 2-IV single, medium, about 2.0 length of leaflets of 1-IV; 2-V single, long. Hair 5-I 3-5 branched (3-8); 5-II 8-11 branched, moderately developed. Hair 9-I 5-9 branched, moderately large. Hair 11-I 2-4 branched, moderately large. Hair 13-I,II,III 5-7, 7-10 (5-12) and 6-10 branched respectively, moderately small; 13-IV 4,5 branched, moderately large; 13-V 3,4 branched (3-7), moderately large to large. **Spiracular Lobe**: Pecten with 13-17 teeth; many of median teeth subequal, with a few mixed long and short. Lateral arm of spiracular apparatus short, similar to that of *aquasalis* but narrower. Hairs 8, 9-S 3-5 branched, medium. **Anal Segment**: Hair 1-X longer than saddle; inserted on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin. Anal gills slightly shorter than or about equal to length of saddle.

DISCUSSION. The female of *anomalophyllus* is very similar in appearance to those of *noroestensis* and *strodei*. It is not possible to separate *anomalophyllus* from the 2 latter species, particularly *strodei*, except by careful correlation of the characters given below and by comparing them with the descriptions of *noroestensis* and *strodei*. Locality data are also extremely useful in identifying *anomalophyllus* because of its limited distribution in Panama and Costa Rica. Due to insufficient material, *anomalophyllus* is not included in either the key to females or the key to pupae. *An. anomalophyllus* can be distinguished from the other species in the Oswaldoi Sub-Group, except for *strodei*, in the **female** by the combination of (1) palpal segment 4 apparently with an indistinct brown ventral stripe, (2) prescutellar space horseshoe shaped, (3) foretarsal segment 2 0.35 (0.29-0.42) apically white and segment 3 0.51 (0.23-0.78) apically white, (4) foretarsal segment 5 with a cream band in about apical 0.5, (5) midtarsal segment 5 cream in about apical 0.5, (6) hindtarsal segment 2 with brown band in basal 0.4 (0.30-0.45), (7) light spots of wing white except for vein C and possibly R, (8) humeral light spot of vein C about 2.5 (2.3-4.0) length of basal dark spot and subcostal light spot 0.23-0.60 length of subcostal dark spot and (9) caudolateral dark scale tufts of tergites and sternites of abdomen relatively small, about 0.07 mm; in the **male genitalia** by (1) aedeagus with long serrated leaflets about 0.4 length of aedeagus, (2) basal lobule large, expanded at base, with long setae along basal margin 1.5-2.0 width of aedeagus and (3) preapical plate moderately large, oval to semicircular, moderately sclerotized; and in the **larva** by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C closely approximated, clypeal index about 2.5, (2) collar wide dorsomedially, dark, heavily pigmented, (3) hairs 1,2-P sharing a common tubercle, (4) palmate hair 1-P with 9-12 long, moderately broad to broad, pointed, lanceolate leaflets, and 2-P 12-14 branched (12-17), (5) hair 1-M 20-30 branched (20-32), (6) hair 13-V moderately large to large and (7) hair 1-X inserted on ventral margin of saddle at base of indentation, or less often on saddle near ventral margin.

It is unclear exactly what species are the closest allies of *anomalophyllus*. I am placing *anomalophyllus* in the Oswaldoi Complex on the basis of the similarities in the male genitalia. In general appearance, the ventral claspette is similar to those of the other species in the Oswaldoi Complex, including the presence of setae on the ventral and lateral surfaces of the fused portion of the claspette. *An. anomalophyllus* retains long serrated leaflets on the aedeagus, an ancestral character it shares with no other species in the Albimanus Section. Since phylogeny cannot be demonstrated on the basis of ancestral characters, the presence of the leaflets does not aid in establishing phylogenetic relationships. However, the female and particularly the larva of *anomalophyllus* are very similar to those of *strodei*. The larva is so much like that of *strodei*, that identification is possible only when all diagnostic characters given in the key are correlated. It is probable that very early in the divergence of the species in the Oswaldoi Subgroup, a population of an ancestral species became isolated in the Panamanian Isthmus and speciated into what is now recognized as *anomalophyllus*. Therefore, *anomalophyllus,* sharing characters with both the Oswaldoi Complex and Strodei Complex, represents a separate intermediate phylogenetic line. However, at this time I do not feel that enough information and material are available to justify the establishment of a separate monotypic taxon of higher category for *anomalophyllus*.

BIONOMICS. *An. anomalophyllus* is a rare mosquito of limited distribution known from very few collections. All collections of *anomalophyllus* have been from running streams at elevations from less than 100 m to about 600 m. Komp (1936a:

160-161) stated that the stream at the type locality was shaded. Kumm, Komp and Ruiz (1940:391, 408) took one larva from a sunlit pooled stream at Finca Canada, near Turrialba, Costa Rica. In 1971, D. A. Schroeder collected one fourth instar larva along a slow moving, clear, fresh, semipermanent, grassy stream in a cacao plantation outside of Zent, Costa Rica.

MEDICAL IMPORTANCE. *An. anomalophyllus* is of no medical importance.

DISTRIBUTION (fig. 2). *An. anomalophyllus* is a rare species found only in southern and central Costa Rica and on the Atlantic coast of western Panama.

Material Examined: 36 specimens: 4 males, 5 male genitalia, 8 females, 2 pupae, 17 larvae; 2 individual rearings: 1 larval, 1 incomplete.

COSTA RICA (27 specimens: 3M, 2Mgen, 8F, 2P&p, 12L&l; 2 ind rear: 1 l, 1inc). **Cartago:** Turrialba, Finca Canada, [H. Kumm], No. 33, 1M. **Limon:** Amubre [Amubri], [H. Kumm], No. 1496, 1 lpF [JH], 4F, 4 l; same locality, 2F. Chase, Jan 1930, W. Komp, 1M, 1Mgen; same data except Feb 1932, 1L, 1 l. Suerre, [H. Kumm], No. 1426, 1Mgen; same data except No. 1427, 1L [JH], 1 lP, 1L. Zent, CR 456, 1L. **Province not specified:** Margarita, 1 l [JH]. Volcan, [H. Kumm], No. 1071, 1M, 1F.

PANAMA (9 specimens: 1M, 3Mgen, 5L&l). **Bocas del Toro:** Almirante, 19 Dec 1928, W. Komp, 1 l; same data except 1 Jan 1929, 3 l; same data except Feb 1929, 1M and 1Mgen (holotype), 2Mgen (paratypes); same data except date not specified, 1L.

8. Anopheles (Nys.) rangeli Gabaldon, Cova Garcia & Lopez

Figs. 3, 4, 6, 21, 22

1940. *Anopheles (Nyssorhynchus) rangeli* Gabaldon, Cova Garcia and Lopez 1940:13-20. TYPE: *Holotype* male (309.5), Puerto Cabello (Carabobo), Venezuela [MDM].

Anopheles (Nyssorhynchus) rangeli of Gabaldon and Aquilera (1940:69-73, 76); Galvao (1941:93; 1943:149, 150, 151); Rozeboom and Gabaldon (1941:91-98); Galvao and Damasceno (1942: 121-122); Simmons and Aitken (1942:39, 46, 52, 61, 96); Cerqueira (1943:19; 1961:126); Galvis (1943:91-92); Causey, Deane and Deane (1944:2; 1946:27); Lane (1944:263; 1949:403; 1953:266-268); Deane, L. M., Causey and Deane (1946:7, 9, 12; 1948:897-899); Deane, M. P., Causey and Deane (1946:38, 43, 45); Gabaldon and Cova Garcia (1946b:114-118; 1952:178, 195-196); Senevet (1948a:278); Bates and de Zulueta (1949:134-139); Levi-Castillo (1949:10, 15, 28, 72, 76, 86); Rey and Renjifo (1950:534, 537); Bejarano (1957:326, 329, 331); Stone, Knight and Starcke (1959:34); Vargas (1959:377, 383); Forattini (1962:395-396); Belkin, Schick and Heinemann (1965:72); Morales-Ayala (1971:139); Cova Garcia and Sutil O. (1976: 28; 1977:23, 46, 64, 85); Cova Garcia, Pulido F. and Amarista M. (1978:157).

Anopheles rangeli of Gabaldon, Cova Garcia and Arevalo (1940:28-29); Cova Garcia and Marcano (1941:57-58); Rozeboom (1941:103); Russell, Rozeboom and Stone (1943:26, 30, 41, 49); Renjifo and de Zulueta (1952:600-601); Komp (1956:39-40); Foote and Cook (1959:12, 13, 23, 26, 29, 32); Cova Garcia (1961:37-38, 68, 90-91, 114, 125-126, 153); Vincke and Pant (1962:2-4, 6, 7, 10, 12, 13); Mattos and Xavier (1965:273); Stojanovich, Gorham and Scott (1966b:22, 30, 44); Gorham, Stojanovich and Scott (1967:60; 1973:112, 138, 150); Elliott (1972:757); Cova Garcia and Sutil O. (1975a:22; 1975b:213).

FEMALE (fig. 6). Wing: 3.3 mm. Proboscis: 2.0 mm. Palpus: 2.0 mm. Forefemur: 1.2 mm. Abdomen: about 2.6 mm. **Head:** Integument light brown to dark brown with light pruinose areas. Interocular distance 3,4 ommatidial diameters. Proboscis about 1.7 length of forefemur. Erect scales on vertex as those of *oswaldoi*, long, narrow, tapering at base into threadlike stalk. Palpal segment 2 occasionally with many, light, dorsal scales; segment 3 with an indistinct to conspicuous, creamish, dorsolongitudinal stripe, apex with a moderately large, white band; segments 4 and 5 predominantly white; base of 4 with a moderately small, dark band and apex with a small to indistinct, dark band; segment 5 occasionally with a few, dark, basal scales; segment 4 usually without brown scales forming a distinct ventral stripe.

Antenna: Dorsomesal and mesal surfaces of flagellar segment 1 with numerous, elongate, white scales. Flagellar segments 2-13 each with 8-10 silver setae in basal whorl. **Thorax:** Integument extremely variable, tan to very dark brown. Scutum largely reddish cream, tan or silver, particularly in pruinose areas. Pleuron often with integument very light so that pruinose light regions hard to distinguish from nonpruinose areas. Anterior promontory scales extending dorsad onto acrostichal line. Prescutellar space usually large and subtriangular. *Sp* with 4-8 setae and a few, elongate, light scales. *Pra* with 6-10 elongate, light, setiform scales, and a patch of elongate lanceolate scales, with some shorter obovate scales interspersed. Upper *stp* with 4 (3-5) long setae and a patch of about 10 cream to white, small, obovate to lanceolate scales in a horizontal arc. Lower *stp* with one long, usually light seta, and 4-8 cream to white scales in diagonal patch. Upper *mep* with about 6 long, dark setae; anteriorly often with a setiform scale shorter than setae; often with 1-4 light, moderately small, obovate scales, either dorsal or anterior to setae; often scales rubbed off or difficult to see. **Legs:** Light scales on coxae white, grayish white or very light cream. Foretarsal segments 2 and 3 with a cream to white band in apical 0.30-0.45 and 0.7 (0.60-0.85) respectively; segment 4 predominantly dark, with or without apical cream ring; segment 5 light in about apical 0.5. Midtarsal segment 2 with light band in apical 0.10-0.35; segment 3 with small light apical band; segment 4 with or without light apical scales; segment 5 light in about apical 0.5. Hindtarsal segment 2 with a brown band in basal 0.28 (0.24-0.35); segment 5 cream to white in about apical 0.5. **Wing:** Light spots of vein C very light cream, remaining veins with light spots white. Wing characterized by several large light spots. Vein C humeral light spot about 1.8-3.5 (1.0-3.7) of basal dark spot; subcostal light spot usually greater than 0.5 (0.45-1.00) of subcostal dark spot; preapical light spot large, 0.40-0.65 of preapical dark spot. R presectoral and sectoral dark spots usually small, occasionally sectoral dark spot absent. Rs-R_{2+3} highly variable. R_{2+3} and R_2 preapical light spots usually large. M predominantly light, sectoral dark spot often indistinct; preapical dark spot not extending onto M_{1+2}. Cu_1 subcostal and preapical light spots small to moderately long; occasionally subcostal spot absent. Apical light fringe spot large, conspicuous and undivided, or with a few dark scales anterior to apex of R_{4+5}; additional, moderate size, light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; occasionally a conspicuous, fairly large, light spot between base of wing and A. **Abdomen:** Sternite I with a few, moderately long to long, dark setae, and usually a few, small, inconspicuous, obovate to moderately lanceolate, light scales in basal 0.5. Caudolateral scale tufts of segments II-VII with scales large, dark brown, obovate and conspicuous.

MALE. Wing: 3.2 mm. Proboscis: 2.45 mm. Forefemur: 1.4 mm. Abdomen: about 3.0 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a light, dorsal stripe; lateral surface of segment 3 speckled with cream and dark scales; segment 4 extensively light, occasionally with a subbasal and a subapical, small, brown band; base and apex of 4 usually white, medially cream with a few, scattered, dark scales. **Antenna:** About 0.8 length of proboscis. Flagellar segment 1 with numerous, conspicuous, long, white, lanceolate scales on dorsomesal surface. **Legs:** Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 6 moderately short, heavy, spiniform setae; 2 apical spiniform setae longer than others. Claw on foreleg similar to that of *aquasalis*, except submedian tooth slightly more attenuate toward apex.

MALE GENITALIA (fig. 21). **Segment VIII:** Tergite and sternite with narrow lanceolate scales; scales broader on sternite than tergite. **Segment IX:** Sternite long, about 0.25 length of sidepiece, subtrapezoidal. Anterior apodeme long, subtriangular,

may not extend entire width of sternite. **Sidepiece**: Moderately narrow, conical. Tergal surface usually with 3,4 long, submedian, tergomedial bristles and one or 2 subapicolateral bristles; with moderately short bristles mesad of tergomedial bristles, except for occasionally a stronger, longer, basomesal bristle. Parabasal spine slender, about 2.0 length of its tubercle. Basal apodeme long and narrow, about 0.25 length of sidepiece. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.7-0.8 of longer spine. Internal spine subequal to shorter accessory spine, strongly retrorse apically. **Clasper**: Spiniform moderately developed, acuminate, subequal to seta *b*. **Dorsal Claspette**: Pedicel moderately broad; base rounded and usually curved mesad. Dorsal leaflet with a moderately developed basomesal projection. **Ventral Claspette**: Large, about 0.5 length of sidepiece; width at apex 0.4-0.5 length of claspette. The nonfused dorsal lobe may appear to project beyond apex of fused ventral lobe, depending on angle of observation. Basal lobule very large, expanded laterally at base and usually curved ventrally; setae along basal margin strong, reflexed caudally and long, about 1.5 length of aedeagus; basomesal margin with a concentration of long setae directed caudally into mesal cleft. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about as long as width of aedeagus; setae extending to or nearly to apex. Apex truncate; lateral margins abruptly angled, rounded, sclerotized; apex medially membranous and weakly emarginate. Preapical plate small, oval, heavily sclerotized; located about 0.15 length of claspette basad of apex; convex apically, flat or slightly concave basally, occasionally with small basomesal projection, often produced basolaterally into short, caudolaterally directed, sharp points. Membranous area transparent, horseshoe shaped, immediately basad of preapical plate, extending basad bordering mesal cleft. Refringent structure in shape of an inverted horseshoe, often indistinct, without lateral arms. **Phallosome**: Aedeagus about 1.0-1.2 length of ventral claspette; apex rounded with tapering sides, slightly longer than wide; with or without very small membranous or weakly sclerotized leaflets.

PUPA (fig. 21). Abdomen: 2.5 mm. Trumpet: 0.45 mm. Paddle: 0.7 X 0.5 mm. **Cephalothorax**: Hairs 1-3-C subequal; 1,2-C 2,3 branched; 3-C 1-3 branched. Hairs 4,5-C 2-4 forked (1-4); 4-C slightly shorter than 5-C. Hair 6-C single or 2,3 forked in apical 0.5, subequal to 7-C. Hair 7-C 2,3 branched, branches subequal or one branch slightly longer than other(s). **Trumpet**: Very similar to that of *aquasalis*. Pinna weakly pigmented; moderately long, 3.8-5.4 (3.6-5.4) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long, open, basally rounded. **Metanotum**: Hair 10-C single, heavy, moderately short. Hair 11-C 4-6 branched (2-6), subequal to or slightly longer than 10-C. Hair 12-C single or double, about 2.0 length of 10-C. **Abdomen**: Hair 2-I 5-8 forked (2-8) 0.20-0.33 from base, occasionally dendritic, long; 3-I single or double, subequal to 2-I. Hair 4-I 4-6 branched (3-6), moderately long. Hair 5-I 1-3 branched, moderately long. Hair 6-I single or occasionally double, long, about 2.0 length of 7-I. Hair 7-I 3,4 branched (2-5) near base. Hair 9-I single, slightly shorter than 6-I. Hair 0-II-IV 4-7 branched (3-7), moderate; sum of branches of 0-II and 0-III ranging from 8 to 14; 0-V,VI 3-5 branched, smaller than 0-II-IV; 0-VII 2-4 branched. Hair 1-II,III strongly developed; 1-II 5-9 branched (3-9); 1-III 4-7 branched (2-10); 1-IV-VII strong, very long, 1.7-2.0 length of segment. Hair 3-IV,V 3-6 (2-6) and 2-4 forked respectively, moderately long. Hair 5-III 4-8 branched (3-8), strong; 5-IV 1-4 branched, median branch much longer than lateral; 5-V-VII single, long, about length of segment. Hair 6-II single or occasionally double, about 2.0 length of 7-II; 6-III single, long. Hair 7-II 3,4 branched (2-5); 7-III,IV 2-4 branched (1-4), small; 7-V single to triple; 7-VI,VII single

or rarely double, long. Hair 8-III 3-5 branched (2-5); 8-IV,VII 2-4 branched (1-4); 8-V, VI 1-3 branched (1-4). Hair 9-II minute, unpigmented; 9-III about 2.0 length of 9-II, unpigmented or occasionally pigmented; 9-IV-VII strongly pigmented; 9-IV moderately pointed, at least 2.0 of 9-III; 9-V moderately thin, curved, acuminate, usually 2.3 (2.0-4.5) length of 9-IV; 9-VI-VIII thin, acuminate, subequal to 0.5 length of segment; 9-VI,VII more curved than 9-VIII; 9-VI slightly shorter than 9-VII,VIII; 9-VII 1.1-1.5 (1.1-1.7) length of 9-VI. Hair 10-III 2-4 forked (1-4) in basal 0.3-0.5, moderately developed. Hair 4-VIII 2,3 forked (2-4) about 0.5 from base, subequal to 9-VIII. **Terminal Segments**: Male genital lobe as that of *aquasalis* only broader at base, and sides tapering more medially toward apex. **Paddle**: Broad distally, obovate, very weakly emarginate at insertion of hair 1-P. External buttress 0.7 length of paddle, serrated apically. Spicules on external and internal margin as in *aquasalis*. Hair 1-P moderately long; 2-P single or double, subequal to 1-P.

LARVA (fig. 22). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.25 mm. **Head**: Moderately pigmented. Median tooth of mental plate as broad as combined widths of 2 adjacent teeth from one side, tapering abruptly to a point. Inner and outer clypeal hairs (2,3-C) single, and simple or barbed; hairs 2-C widely spaced, clypeal index about 1.67; 3-C slightly shorter than 2-C. Hair 4-C 2-3 branched (1-4), short, not extending to base of 2-C. Hairs 8,9-C 4-6 (2-6) and 5-7 branched respectively, dendritic, moderately large. Hair 12-C 3-5 branched, moderately large, subequal to 9-C. Hair 15-C 2-4 branched. Collar wide dorsomedially, dark, strongly pigmented. **Antenna**: Moderately pigmented. Mesal margin with long, moderately thin spicules extending almost to base. Hair 1-A 4-6 branched, short, slightly longer than width of antenna at point of insertion, inserted in basal 0.25 or less of antenna. **Thorax**: Moderately pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common tubercle; palmate hair 1-P with 9-13 (8-14) long, broad, lanceolate leaflets; 2-P 13-17 branched (10-19), about 4.0 length of leaflets of 1-P. Hair 14-P 6-9 branched (5-9) from a short to moderately short, flattened stalk; branches long, lateral branches slightly shorter than median. Mesothoracic hair 1-M 28-37 branched, lateral branches equal to or slightly longer than apical branches. Metathoracic hair 2-T moderately long, reaching or not reaching posterior margin of thorax. Palmate hair 3-T with 12-18 semitransparent, moderately long, moderately broad to broad, spreading leaflets. **Abdomen**: In general, tergal hairs shorter in length and inserted closer to midline than in other species in Oswaldoi Complex. Hair 0-II-VI moderately developed; 0-II,III 6-9 branched; 0-IV,V 4-8 branched (3-10); 0-VI 4-6 branched (4-7). Palmate hair 1-I-VII with moderately narrow to broad, acuminate, lanceolate leaflets; 1-I-VII longer than those of other species in Oswaldoi Complex; 1-I with 13-16 (13-17) weakly pigmented leaflets; leaflets of 1-I,II,VII slightly shorter than those of 1-III-VI. Hair 2-II 5-8 branched (5-10); 2-III 3-5 branched (3-6), relatively short, 1.5-2.0 length of leaflets of 1-III; 2-IV single, moderately short, slightly longer than leaflets of 1-IV; 2-V single, about 3.0-4.0 length of leaflets of 1-V. Hair 5-I 3-5 branched, short, inserted 0.75-1.00 its length from lateral margin of abdomen; 5-II 5-9 branched (5-12), short, inserted as 5-I. Hair 9-I 4-6 branched (3-6), moderately small. Hair 11-I 2 branched (2-4), moderately large. Hair 13-I,II,III 4-7 (3-7), 6-10 (5-10) and 7-9 (6-10) branched respectively, small; 13-IV 3 branched (3-5), moderately short, slightly longer than leaflets of 1-IV; 13-V 3-5 branched, moderately long, subequal to 2-V; 13-VI 6-11 branched, small. **Spiracular Lobe**: Pecten with 15-19 teeth; many of median teeth subequal in length. Lateral arm of spiracular apparatus short as in *aquasalis*, directed caudolaterally. Hairs 8,9-S 3-5 forked (3-8). **Anal Segment**: Covered with very fine spicules over about apical

0.7 of segment; fewer spicules in basal 0.5 of membranous portion of segment. Saddle tan to brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin of saddle or on ventral margin at base of indentation, rarely inserted just ventrad of ventral margin; inserted about 0.3 cephalad of caudal margin. Anal gills about 0.35-0.40 mm long, much longer than saddle.

DISCUSSION. *An. rangeli* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** by the combination of (1) upper *mep* often with 1-4 light obovate scales, (2) foretarsal segment 2 with a light band in apical 0.30-0.45 and segment 3 with light band in apical 0.7 (0.60-0.85), (3) hindtarsal segment 2 with a brown band in basal 0.28 (0.24-0.35), (4) wing with several large light spots, humeral light spot of vein C about 1.8-3.5 (1.0-3.7) length of basal dark spot, (5) subcostal light spot of vein C usually greater than 0.5 (0.45-1.00) length of subcostal dark spot, (6) preapical light spot of vein C 0.40-0.65 of preapical dark spot, (7) presectoral and sectoral dark spots of vein R usually small, (8) vein M predominantly light with sectoral dark spot often indistinct and (9) apical light fringe spot large, conspicuous and usually undivided; in the **male genitalia** by (1) ventral claspette large, apex truncate and wide, width at apex 0.4-0.5 length of claspette, apex with abruptly angled, rounded lateral margins, (2) basal lobule very large, usually curved ventrally, with long setae along basal margin about 1.5 width of aedeagus, (3) long setae along basomesal margin of basal lobule concentrated and directed caudally into mesal cleft, (4) preapical plate small, oval, heavily sclerotized, convex apically, flat or slightly concave basally, occasionally with small basomesal projection and (5) apex of aedeagus with or without very small, membranous or weakly sclerotized leaflets, apex slightly longer than wide; in the **pupa** by the combination of (1) hair 7-C with branches subequal or one branch slightly longer than other(s), (2) pinna moderately long, about 3.8-5.4 length of meatus, in lateral aspect appearing broad medially and tapered toward apex, (3) hair 11-C subequal to or slightly longer than 10-C, (4) hair 2-I 5-8 forked (2-8) 0.20-0.33 from base, occasionally dendritic, long, subequal to 3-I, (5) hair 0-II moderate, 5-7 (4-7) branched, (6) sum of branches of hairs 0-II and 0-III ranging from 8 to 14 and (7) hair 9-III about 2.0 length of 9-II, unpigmented or occasionally pigmented, 9-V usually 2.3 (2.0-4.5) length of 9-IV, 9-VII thin, acuminate, about 0.5 length of segment, 1.1-1.5 (1.1-1.7) length of 9-VI; and in the **larva** by the combination of (1) hairs 2,3-C single, and simple or barbed, hairs 2-C widely spaced, clypeal index about 1.67, (2) hair 4-C short, not extending to base of 2-C, (3) hairs 8,9-C 4-6 (2-6) and 5-7 branched respectively, dendritic, moderately large, (4) palmate hair 1-P with 9-13 (8-14) long, broad leaflets, (5) hair 2-IV single, moderately short, (6) hair 5-I,II short, inserted 0.75-1.00 its length from lateral margin of abdomen, (7) hair 13-IV 3 branched (3-5), moderately short, (8) lateral arm of spiracular apparatus short and (9) hair 1-X inserted on saddle near ventral margin of saddle or on ventral margin at base of indentation, rarely inserted just ventrad of ventral margin.

An. rangeli forms the sister group of *nuneztovari* and *trinkae*. It differs from these 2 species in the female usually by (1) the absence of ventral dark line on palpal segment 4, (2) presence of a few light upper *mep* scales and (3) presence of a small basal dark spot and a large subcostal light spot on vein C. The male genitalia of these 3 species are very similar, *rangeli* differing only in the (1) presence of a concentration of long setae along the basomesal margin of the basal lobule, (2) development of the preapical plate and (3) structure of the apex of the ventral claspette to some degree. The pupa of *trinkae* and the larva of *noroestensis* are very much like those of *rangeli* and can be distinguished only by the characters given in the keys. Locality data are

extremely useful in distinguishing the larva of *rangeli* from *noroestensis,* since the distributions of the 2 species do not overlap, except possibly in Bolivia and southwestern Brazil.

There seems to be no significant variation between the populations I have studied. Intrapopulational variation seems as great as or greater than interpopulational variation. Gabaldon and Aguilera (1940:69-72, 76) examined material from Maracay, Dividive, Pampanito and Pampan, Venezuela, and could find no significant differences, although the specimens from Trujillo had a tendency to be darker and smaller. They also studied progeny rearings and found considerable variation between siblings; in one family they studied (LV4), the dark band on hindtarsal segment 2 varied from 28.3 to 42.0%. Also, as in all the species in this section, there is considerable variation in the relative lengths of the wing spots and in the tarsal banding.

BIONOMICS. The immatures of *rangeli* occur in marshy depressions, temporary ground pools, animal and wheel tracks, semipermanent ditches, stream margins, and lakes. They are usually found in full sun or partial shade, and usually not in the forest proper but in open glades, meadows, and scrub or grassland areas. There is usually abundant vegetation in the breeding site, and occasionally the aquatic habitat has decaying vegetation or is contaminated with feces. The immatures are always found in fresh water. Gabaldon, Cova Garcia and Arevalo (1940:28-31) reported that the larvae of *rangeli* cannot tolerate sodium chloride in concentrations as low as 0.05%. The time of development from egg to adult averaged 24 days for specimens from La Victoria (Aragua), Villa de Cura (Aragua) and Puerto Cabello (Carabobo), Venezuela; however, the temperature at which the immatures developed was not reported. The average number of eggs deposited at one oviposition varied from 23 to 217 with a mean of 80.3. In Colombia, the seasonal peak in the populations of *rangeli* occurs in June at the beginning of the rainy season, and *rangeli* continues to be very abundant until December or January (Bates and de Zulueta 1949:136, 137). The larvae and pupae are commonly associated with 3 species in the Albimanus Section, *trinkae, triannulatus* and, in some areas, *strodei*. They have also been collected with *oswaldoi* (Gabaldon 1940). Other species found in association with *rangeli* are *An. (Nys.) argyritarsis, An. (Ano.) punctimacula, Culex (Cux.) corniger, Cx. (Cux.) coronator* group, *Cx. (Cux.) declarator* group, *Psorophora (Gra.) confinnis* group and *Uranotaenia (Ura.) lowii. An. rangeli* occurs in lowlands and at higher elevations; our highest collection was made at 950 m above sea level.

The adults are predominantly exophilic. Rey and Renjifo (1950:537) collected 2414 anophelines inside houses from September to November near Cucuta, Colombia, of which only 0.62% were *rangeli.* Of the 3722 adults collected by Deane, Causey and Deane (1948:899), only 25 or 0.7% were from inside houses. In 131 hours of collecting inside houses, they found only 5 specimens of *rangeli*; however, in less than 41 hours collecting outside, they captured 1391 individuals. The majority of the specimens were collected on horses or bulls, although many were biting man. In Boca de Acre, in a collection made at sundown simultaneously from a cow and a man, 5 females of *rangeli* were collected from the cow and 8 from the man. Elliott (1972:757) reported that in Peru the peak hours of biting by *rangeli* were 1800-2000 h and 0400-0600 h.

MEDICAL IMPORTANCE. Very little is known about the vector capacity of *rangeli*. It does not seem to be a vector of malaria, although Forattini (1962:396) stated that it has been suspected of transmitting malaria in Ecuador. Deane, Causey and Deane (1948:899) dissected 363 females from Rio Branco (Acre), Brazil, and found none infected with *Plasmodium* sp. Rey and Renjifo (1950:537) did not find

rangeli naturally infected in the Cucuta area of Colombia during a malaria epidemic in which *Plasmodium falciparum* (18%), *P. vivax* (55%) and *P. malariae* (27%) were present in the human population.

DISTRIBUTION (fig. 3). *An. rangeli* occurs in the upper Amazon and Orinoco basins, Colombia, Venezuela, Ecuador (Morona Santiago, Napo, Pastaza), and south through eastern Peru and into northern Bolivia (Beni, Santa Cruz).

Material Examined: 1181 specimens: 196 males, 113 male genitalia, 437 females, 267 pupae, 168 larvae; 126 individual rearings: 53 larval, 44 pupal, 29 incomplete; 11 progeny rearings.

BOLIVIA (7 specimens: 2M, 2Mgen, 3F). **Beni:** San Ignacio, 18 Sep 1943, Carr, 3F. Todos Santos, Jun 1946, E. Soracho, BOL 36, 2M, 2Mgen.

BRAZIL (1Mgen, 1F). **Acre:** Rio Branco, 1949, A. Galvao, 1Mgen [JH]. **Amazonas:** Boca do Acre, det. Deane, 1F [CU].

COLOMBIA (780 specimens: 130M, 26Mgen, 317F, 186p, 119L&l; 43 ind rear: 17 l, 26 inc; 11 progeny rearings). **Boyaca:** Puerto Boyaca, COM 650. **Caldas:** La Dorada, 22 Jun 1943, KO 120A-2, 1M; same locality, 23 Jun 1942 [1943], 1M, 1F; same locality, 25 Jun 1943, W. Komp, KO 120A-11, 3M; same locality, 26 Jun 1943, KO 120A-5, 1M, 1F. **Caqueta:** Tres Esquinas, COM 490, 491, 493. Florencia, H. Kumm, 1F [BM]. **Meta:** Restrepo, Jul 1935, KO 120A-4, 1M, 1F; same locality, Sep 1935, W. Komp, KO H-19-8, 1M, 1F; same locality, 13 Jun 1937, 1M, 4F; same locality, COB 50; same locality, 1Mgen. Vega Grande, 24 Nov 1936, COR 147, 11F. Villavicencio, 26 May 1941, M. Bates, CV 265, 2M, 1Mgen; same locality and collector, 30 May 1941, CV 267, 3M, 1Mgen, 1F; same locality and collector, 26 Jun 1941, 1Mgen; same locality, 1 Jun 1942, 1F; same locality, 3 Jun 1942, W. Komp, 1M; same locality and collector, Jun 1942, KO 120A-3, 1M; same data, KO 120A-21, 6M, 2F; same locality and collector, ?1942, KO 120A-23, 14M, 2F; same locality, 15 Jul 1943, KO 120A-8, 20F; same locality, 15 Aug 1943, KO 120A-6, 7F; same locality, 22 May 1944, KO 120A-13, 28F; same locality and date, KO 120A-16, 1M; same locality, 23 May 1944, W. Komp, KO 120A-14, 27F; same locality and collector, 8 Jun 1944, 40F; same data, KO 120A-17, 18F; same locality, 20 Jun 1944, COK 47, 37F; same locality, 1944, M. Bates, 2 l; same data, CV 90, 1F; same data, CV 91, 1F; same data, CV 93, 1M; same locality, 3 May 1947, 3Mgen [JH]; same locality, 3 May 1947, L. Rozeboom, CV-P 1 (progeny rearing), 18p, 7L, 4 l; same data, CV-P 2 (progeny rearing), 17p, 3L, E; same data, CV-P 3 (progeny rearing), 5M, 5Mgen, 3F, 14p, 3L; same data, CV-P 4 (progeny rearing), 15p, 5L; same data, CV-P 5 (progeny rearing), 8 lp, 14p, 1 l; same data, CV-P 6 (progeny rearing), 16p, 3L, 1 l; same data, CV-P 7 (progeny rearing), 15p, 8 L, 1 l; same data, CV-P 8 (progeny rearing), 12p, 5L, 3 l; same data, CV-P 9 (progeny rearing), 13p, 6 l; same data, CV-P 10 (progeny rearing), 5p, 3 l; same data, CV-P 11 (progeny rearing), 10 lp; same locality and collector, 6 May 1947, CV-P 17, 1F; same data, CV-P 18, 1F; same data, CV-P 27, 1F; same locality, 9 May 1947, 1Mgen [JH], 3L; same data, [CV] 370.10, 3L, 1 l [JH]; same locality, 14 May 1947, CV 379, 1F; same locality, 23 May 1947, M. Bates, Cabo, L. Rozeboom, CV 389, 1M; same data, CV 391, 3M, 1F; same locality and date, 4p, 4L [JH]; same locality, 27 May 1947, M. Bates, Cabo, L. Rozeboom, CV 394, 2F; same data, CV 395, 3M, 3F; same locality, May 1947, CV 396A, 1F; same locality, 10 Jun 1943 [1947], L. Rozeboom, Cabo, [CV] 423.2, 1 lp [JH]; same locality, 28 Jul 1948, [CV] C595.104, 1Mgen [JH]; same locality, CV 732, 7 lp, 5L; same locality, COB 39, 42, 53, 60, 61, 63, 70, COM 607; same locality, 27 Jul 1974, J. Kitzmiller, COZ 41, 62M, 77F; same locality, 4M, 2F. Locality not specified, 24 Nov 1936, COR 147 A, 8F. **Santander:** Barranca[bermeja], 8 Sep 1943, D. Fierro, COT 68, 2M, 1Mgen.

ECUADOR (182 specimens: 35M, 14Mgen, 33F, 65p, 35L&l; 67 ind rear: 33 l, 34p). **Morona Santiago:** Sucua, 6Mgen. Locality not specified, Zamosa, 2Mgen. **Napo:** Limoncocha, 3 Jun 1977, Y. Huang, coll. 45, 1 pM, 1 pF, 1 lpF; same data except 8 Jun, coll. 57, 4 pM, 4 pF, 7 lpM. Tena, 1.5 km S of, 13 May 1977, Y.Huang, coll. 26, 5 pF, 2 lpF; same data except 32 km S of Tena, coll. 27, 3 lpF; same data except 12.5 km SE of Tena and 24 May, coll. 38, 1Mgen, 1 pM, 3 pF, 2 lpM, 4 lpF; same data except 11.7 km SW of Tena and 25 May, coll. 40, 1Mgen, 3 pM, 6 lpM, 3 lpF; same data, coll. 41, 1 lpF; same data except 1.5 km S of Tena and 27 May, coll. 44, 1F, 1 pM, 1 lpF. **Pastaza:** Puyo, 39 km N of, 6 May 1977, Y. Huang, coll. 9, 1Mgen, 1 pM, 1 lpF; same data except 4 km NE of Puyo and 7 May, coll. 10, 2 pF; same data except 5.3 km NE of Puyo,

coll. 14, 1Mgen, 1 pM, 1 lpF, 1 l; same data except 16 km NE of Puyo, coll. 15, 1 lpF; same data except 1.5 km S of Puyo and 19 May, coll. 32, 1 pF, 1L; same data, coll. 34, 1Mgen, 2 pM, 1 pF; same data except 23 km SE of Puyo, coll. 35, 1Mgen, 3 pM.

PERU (35 specimens: 10M, 23F, 2L). **Huanuco:** Cochicote, 12, 13 Oct 1965, J. Hitchcock, 14 F. Tingo Maria, Apr 1946, A. Valde Rerma [?], 1M, 2F; same locality, E. Viale, 2L; same locality, E. Hambleton, 6M, 7F. **Province not specified:** Rio Perene, 1939, Kuczunski, Godard, 3M.

VENEZUELA (177 specimens: 19M, 70Mgen, 60F, 16p, 12L&l; 16 ind rear: 3 l, 10p, 3inc). **Aragua:** Cagua, VZ 99. Maracay, 3 Sep 1926, M. Nunez Tovar, 28F; same locality and collector, 11 Sep 1926, 1F; same locality and collector, 9 Oct 1926, 2F; same locality, 9 May 1927, 1Mgen (H36a), 1 lp [JH]; same locality, 11 May 1927, 1F (H38a); same locality, 27 May 1927, 1Mgen (40a) [JH]; same locality, 10 Jun 1927, 2Mgen (63b+c), 2 lp [JH]; same locality, 20 Aug 1928, R. Hill, 1Mgen [JH]; same locality and collector, Aug 1928, 1Mgen (20), 1Mgen (23) [JH]; same locality and collector, 25 Sep 1928, 3Mgen (38) [JH]; same locality and collector, 1928, 13Mgen [JH]; same locality, 2 May 1929, 3Mgen [JH]; same locality, Jun 1929, 1Mgen (57) [JH]; same locality, 22 Jul 1929, 2Mgen (49) [JH]; same locality, 1929, [R. Hill], 22Mgen [JH]; same locality, 20 Aug 1942, VZK 50, 1F; same locality, VZ 130, 131. Turmero, VZ 45, 336. **Carabobo:** Puerto Cabello, 26 Dec 1938, 1L; same locality, 28 Feb 1941, 1M; same locality, 2 Aug 1941, 1M, 1F; same locality, 1Mgen [JH]. **Cojedes:** San Carlos, 8-15 Jun 1941, 2M, 5F; same locality, 16-22 Jun 1941, 2M, 3F; same locality, VZ 115. Tinaquillo, VZ 119. **Distrito Federal:** Caracas, 2Mgen [JH]. **Monagas:** Caripito, 11 Jun 1935, 1M. **Portuguesa:** Acarigua, 13 Jan 1941, 1Mgen (23) [JH]; same data, VZK 49, 1M, 1F. **Trujillo:** Pampanito, 1-7 Aug 1938, 2M, 7F. **State not specified:** Trinidad, 1Mgen (130-8), 1Mgen (49-11) [JH]. Locality not specified, 15 Jul 1929, [R. Hill], 2Mgen (40) [JH]; 1929, 5Mgen (13) [JH]; 1949, 1Mgen, 2L; no data, 3M, 2F.

9. Anopheles (Nys.) trinkae Faran

Figs. 3, 4, 7, 23, 24

1979. *Anopheles (Nyssorhynchus) trinkae* Faran 1979:26-39. TYPE: *Holotype* male (MEP Acc. 638, coll. 29-9) with associated genitalia and larval and pupal exuviae on slides, 1.5 km S of Puyo (Pastaza), Ecuador, large temporary ground pool, 15 May 1977, Yiau-Min Huang [USNM, 76123].

Anopheles (Nyssorhynchus) nuneztovari in part of Simmons and Aitken (1942:39, 46, 53, 95); Galvao (1943:146); Galvis (1943:88-89); Gabaldon and Cova Garcia (1952:193); Lane (1949: 403; 1953:268-269); Stone, Knight and Starcke (1959:33); Vargas (1959:376, 382); Forattini (1962:396-400); Morales-Ayala (1971:139); Kitzmiller, Kreutzer and Tallaferro (1973:435-455, ?in part); Kreutzer, Kitzmiller and Rabbani (1975:363-364, ?in part); Knight and Stone (1977: 63).

Anopheles nuneztovari in part of Russell, Rozeboom and Stone (1943:37, 47); Foote and Cook (1959:24, 26, 29, 32); Stojanovich, Gorham and Scott (1966b:22, 30, 43); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:111, 138, 147-148); Elliott (1968:248-252; 1972:756-763, ?in part).

Anopheles (Nyssorhynchus) goeldii (?) of Cerqueira (1943:19).

FEMALE (fig. 7). Wing: 3.4 mm. Proboscis: 2.2 mm. Palpus: 2.1 mm. Forefemur: 1.5 mm. Abdomen: about 3.0 mm. **Head:** Integument reddish brown to dark brown. Proboscis about 1.4 length of forefemur. Vertex with long, white, spatulate or setiform scales becoming shorter, darker and more cuneate caudolaterally on occiput; occipital scales golden; postoccipital scales reddish brown to brownish black. Apex of palpal segment 2 with a small white band; apex of segment 3 with a large white band; segment 2 with a few, erect, cream to white scales; segment 3 with a cream to white, dorsal or dorsolateral stripe; segment 4 with a moderately large, dark, basal band and a smaller, dark, apical band, usually with a single row of dark scales on ventral surface, not always visible; segment 5 white, occasionally with a few, dark, basal scales extending from apex of 4. **Antenna:** Flagellar segment 1 with numerous, long, oblanceolate scales on dorsomesal and mesal surfaces in apical 0.5; with shorter scales on dorsolateral surface and small obovate scales at base. Flagellar segments 2-

13 each with a basal whorl of about 8,9 long, silver setae. **Thorax**: Integument of scutum reddish tan to dark brown, and extensively pruinose. Anterior promontory area with setiform scales extending a short distance dorsad onto acrostichal line. Prescutellar space moderately large, horseshoe shaped. Pleuron light brown to brown. *Sp* with 7 (3-9) light setae. Upper *stp* with 4 (2-4) long, dark setae in horizontal arc, and about 6-15 cream, obovate scales. Lower *stp* with 1-3 long setae, and a diagonal patch of 5-11 cream, obovate scales. Upper *mep* with 7-9 long, cream setae, and occasionally one or 2 cream, obovate scales. **Legs**: Dark scales reddish brown. Light scales on coxae white. Midfemur with both anteroapical spot and knee spot distinct. Foretarsal segments 2 and 3 with a white band in apical 0.31-0.46 and 0.6-0.9 respectively, usually longer than in *nuneztovari*; segment 4 golden to white in apical 0.3 (0.1-0.5); segment 5 cream to white in about apical 0.5. Dorsal surface of midtibia and midtarsal segments 1,2 and usually 3 with a cream stripe. Midtarsal segments 1-3 with a small, cream, apical band, band largest and most distinct on 2; segment 4 all dark; segment 5 cream in apical 0.3-0.7. Hindtarsal segment 2 with a dark band in basal 0.3-0.4 (0.30-0.43); segment 5 light cream to white in about apical 0.5. **Wing**: Light wing spots white or very light cream. Dark wing spots not usually as extensive as in *nuneztovari*. Vein C humeral light spot about 1.3-2.5 (1.3-4.0) of basal dark spot, usually 2.0 or less of basal dark spot; basal dark spot usually not reaching humeral crossvein; subbasal dark spot equal to or longer than subbasal light spot, often 2.0 of subbasal light spot; subcostal light spot 0.25-0.43 (0.25-0.65) of subcostal dark spot; preapical light spot about 0.31-0.46 of preapical dark spot; apical dark spot moderate and distinct. R presectoral dark spot moderately large; sectoral dark spot relatively small, rarely absent. R_2 preapical dark spot about 0.5 of vein. R_{4+5} subcostal and apical dark spots moderately small. M sectoral dark spot variable, small to large, lighter than dark spots on C, often with interspersed light scales; preapical dark spot not extending onto M_{1+2}. Cu sectoral dark spot moderately large and distinct. Cu_1 subcostal spot usually as large as or larger than preapical dark spot. Vein A subcostal dark spot moderately short to moderately long. Apical light fringe spot moderately small and divided by small dark spots between R_2 and R_3, and R_3 and R_{4+5}; additional light fringe spots as those of *nuneztovari*. **Abdomen**: As that of *nuneztovari*, except caudolateral and sternomedian scale tufts on segments II-VII small.

MALE. Wing: 3.2 mm. Proboscis: 2.5 mm. Forefemur: 1.45 mm. Abdomen: 2.45 mm. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a conspicuous, cream, dorsal stripe; apex of segment 2 and base of segment 3 with a small white band; apex of segment 3 with a moderately broad, white band; segment 4 with a basal and an apical brown band, occasionally with white scales interspersed in small basal band, and usually with a few, white, subapical scales; segment 4 with mediolateral surface predominantly light cream, ventral surface usually with inconspicuous dark scales. **Antenna**: About 0.70-0.75 length of proboscis. Flagellar segment 1 with numerous, long, white, oblanceolate scales on dorsomesal margin. **Legs**: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 8 moderately long to long, spiniform setae; longest setae about 0.3 length of segment. Claw on foreleg moderately large, weakly curved, acuminate; submedian tooth 0.25-0.33 length of claw, moderately thin and apically recurved; basal tooth moderately long, heavy and decurved.

MALE GENITALIA (fig. 23). **Segment VIII, Segment IX, Sidepiece, Clasper** and **Dorsal Claspette** essentially the same as those of *nuneztovari*. **Ventral Claspette**: Very similar to that of *nuneztovari* except for the following. Moderately long, 0.40-

0.50 length of sidepiece; apex moderately broad, width at apex 0.43-0.50 (0.38-0.54) length of claspette. Preapical plate moderately small, semicircular to oval, weakly to moderately sclerotized. **Phallosome**: Aedeagus about 0.5 length of sidepiece and 1.00-1.20 (1.00-1.33) length of ventral claspette; apex rounded, about as wide as or slightly wider than long; leaflets not visible on any specimen examined.

PUPA (fig. 23). Abdomen: about 2.5 mm. Trumpet: 0.5 mm. Paddle: 0.75 X 0.55 mm. Only exuviae examined. **Cephalothorax**: Wing cases with moderately pigmented longitudinal stripes. Hair 1-C 2-4 branched; 2,3-C 2,3 branched. Hairs 4,5-C 2-5 forked; 4-C slightly shorter than 5-C. Hair 6-C 2,3 forked (1-3), usually as long as or slightly longer than short branch(es) of 7-C; 7-C 2-4 branched, with one branch about 1.5 length of other branch(es). **Trumpet**: Pinna moderately pigmented; long, about 3.6-4.0 (3.5-4.1) length of meatus; in lateral aspect, not appearing to taper toward apex. Meatal cleft basally rounded. **Metanotum**: Hair 10-C single or double, subequal to 11-C. Hair 11-C 2,3 branched. Hair 12-C 1-3 branched (1-4), about 1.5-2.0 length of 10-C. **Abdomen**: Hair 2-I 4-6 forked (2-6), moderately long to long, branches arising at least 0.20 distad of base. Hair 3-I single, about 0.5-0.9 length of 2-I. Hair 4-I 4-6 branched (3-6), moderately long. Hair 5-I 1-3 branched. Hair 6-I single, long, about 2.0 length of 7-I. Hair 7-I 4-7 branched (3-7). Hair 9-I single, about 0.7 length of 6-I. Hair 0-II 1-3 branched (1-4), small; 0-III-VII moderately developed; 0-III 3-6 branched (2-6); sum of branches of 0-II and 0-III 4-7 (3-9); 0-IV 4, 5 branched (2-5); 0-V 2-5 branched; 0-VI 2,3 branched (2-4); 0-VII 1-3 branched. Hair 1-II,III strongly developed; 1-II 6-10 branched (4-13); 1-III 3-9 branched (1-10); 1-IV-VII single, long, 1.75-2.00 length of segment. Hair 3-IV dendritic, 3-6 branched (1-6), moderately developed; 3-V 3-5 forked (1-5). Hair 5-III 5-7 branched (5-9), strongly developed; 5-IV 2-5 branched (1-5), moderately long, median branch often longer than lateral; 5-V-VII single (1-3 branched), long, subequal to length of segment. Hair 6-II single or double, long, about 2.0 length of 7-II. Hair 7-II 3-7 branched (3-8); 7-III,IV 3-5 branched, short; 7-V 2-4 forked, longer than 7-III,IV; 7-VI,VII single or double, long. Hair 8-III,IV 2-6 branched (2-7); 8-V,VI 2-4 branched (1-4); 8-VII 2-4 branched, moderately short, slightly longer than 8-III-VI. Hair 9-II small, unpigmented, thinner and more pointed than 9-III; 9-III small, less than or occasionally equal to 2.0 length of 9-II; 9-IV heavy, 1.6-3.6 length of 9-III, strongly pigmented; 9-V moderately thin, acuminate, long, 2.5-4.5 (2.5-4.9) length of 9-IV; 9-VI equal to or slightly longer (1.0-1.3) than 9-V; 9-VII 1.05-1.25 (1.05-1.30) length of 9-VI; 9-VIII usually straighter than 9-V-VII, subequal to 9-VII; 9-V-VIII about 0.5 length of segment. Hair 10-III 3,4 forked (2-6), long. Hair 4-VIII 3-5 forked (2-5), about 0.65-0.70 length of 9-VIII. **Terminal Segments**: Male genital lobe large, heavy, with a very prominent mammilliform protuberance. **Paddle**: Large, obovate, emarginate at insertion of hair 1-P. External buttress 0.6 (0.53-0.68) length of paddle, serrated apically. External margin distad of buttress with fine, short, filamentous spicules extending around apex and becoming shorter and fewer along caudal 0.3-0.5 of inner margin. Hair 1-P moderately long; 2-P subequal to 1-P.

LARVA (fig. 24). Head: 0.6 mm. Antenna: 0.25 mm. Anal Saddle: 0.3 mm. **Head**: Heavily pigmented, dull reddish brown. Median tooth of mental plate moderately broad, less than combined width of 2 adjacent teeth from one side, tapering to blunt point. Inner and outer clypeal hairs (2,3-C) single, and simple or with very small barbs; hairs 2-C widely spaced, clypeal index about 1.25; 3-C 0.5-0.8 length of 2-C. Hair 4-C single or 2 forked, long, 0.7-1.0 length of 3-C and usually extending to beyond base of 2-C. Hair 8-C 2 branched (2,3) near base, occasionally forked, length about 2.0 distance separating insertion of 2-C and 3-C. Hair 9-C weakly dendritic, 4-

6 branched (4-7), equal to or slightly longer than 8-C. Hair 12-C 2-5 branched, moderately long. Hair 15-C 2-4 forked. Collar wide dorsomedially, heavily pigmented. **Antenna**: Pigmented as remainder of head. Mesal margin with stout, moderately long spicules; ventral surface with fewer and shorter spicules. Hair 1-A 4-6 branched, short, inserted in basal 0.25 of antenna. **Thorax**: Darkly pigmented, reddish brown. Submedian prothoracic group (1-3-P) with or without hairs 1,2-P sharing a common tubercle; 3-P occasionally arising from the same tubercle as 2-P; palmate hair 1-P with 11-15 (10-18) moderately narrow to narrow, pointed, pigmented, lanceolate leaflets; 2-P 15-19 branched (12-20), 3.0-4.0 length of 1-P. Hair 14-P 7-10 branched (6-11) from a moderately short shaft. Mesothoracic hair 1-M 28-37 branched (26-37). Metathoracic hair 2-T single, moderately long but not reaching posterior margin of thorax. Palmate hair 3-T with 9-13 (9-17) semitransparent, moderately narrow, pointed, lanceolate leaflets. Pleural group spines as those of *nuneztovari*. **Abdomen**: Hair 0-II 1-3 branched, very short, about 0.5 or less length of leaflets of 1-II, inconspicuous; 0-III-VII 1-3 branched (1-4), small to moderately small. Palmate hair 1-I moderately small, with 12-16 (10-17) narrow, semitransparent, spreading, lanceolate leaflets; 1-II-VII with strongly pigmented, moderately narrow, pointed, lanceolate leaflets; 1-II 23-27 branched (19-30); 1-III 24-32 branched; 1-IV 22-29 branched; 1-V 23-30 branched (22-30); 1-VI 21-27 branched (20-30); 1-VII 20-26 branched; 1-II,III,VII slightly shorter than 1-IV-VI. Hair 2-I 2 branched (1-3), very small; 2-II 6,7 branched (4-9), moderately large; 2-III 3-5 branched (2-6), large; 2-IV single or rarely double, about 1.5 length of leaflets of 1-IV; 2-V single, very long. Hair 3-I single (1,2 branched), moderately long. Hair 5-I 3,4 branched (3-5), small; 5-II 6-11 branched (5-11), small. Hair 9-I 5,6 branched (4-6). Hair 13-I,II,III 4-6 (3-7), 7-9 (7-10) and 6-8 (6-9) branched respectively, small; 13-IV 3,4 branched, moderately large, 1.5-2.0 length of leaflets of 1-IV; 13-V 3-5 branched (2-6), very large; 13-VI 8-10 branched (6-10), moderately small. **Spiracular Lobe**: Pecten with about 15-17 teeth; median teeth subequal, occasionally mixed short to moderate, with 2-4 long interspersed; serrations on teeth moderately long. Hair 8-S 3-4 branched (3-5), moderately long, subequal to 9-S; 9-S 3-5 branched. Lateral arm of spiracular apparatus short. **Anal Segment**: Apically with short thin spicules. Saddle reddish brown. Hair 1-X longer than saddle; inserted on saddle near ventral margin of saddle, or rarely on ventral margin at base of indentation. Anal gills longer than saddle.

DISCUSSION. *An. trinkae* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** (except occasionally *nuneztovari* and *rangeli*) by the combination of (1) palpal segment 4 usually with a single ventral row of dark scales, (2) prescutellar space moderately large and horseshoe shaped, (3) foretarsal segment 2 with a large white band in apical 0.31-0.46 and segment 3 with a very large white band in apical 0.6-0.9, (4) foretarsal segment 4 golden to white in apical 0.3 (0.1-0.5), (5) hindtarsal segment 2 with a dark band in basal 0.3-0.4 (0.30-0.43), (6) light wing spots white or very light cream, (7) humeral light spot of vein C 1.3-2.5 (1.3-4.0) length of basal dark spot and (8) subcostal light spot of vein C 0.25-0.43 (0.25-0.65) length of subcostal dark spot; in the **male genitalia** by the same characters as in *nuneztovari* except that (1) ventral claspette long, 0.40-0.50 length of sidepiece and length of aedeagus 1.00-1.20 (1.00-1.33) length of claspette, (2) width of apex of ventral claspette 0.43-0.50 (0.38-0.54) length of claspette and (3) apex of aedeagus rounded, about as wide as or slightly wider than long and without apparent leaflets; in the **pupa** by the combination of (1) hair 7-C with one branch about 1.5 length of shorter branch(es), (2) pinna long, about 3.6-4.0 (3.5-4.1) length of meatus, not appearing to taper toward apex in lateral aspect, (3) hair 11-C 2,3 branched, subequal

to 10-C, and hair 12-C 1-3 branched (1-4), about 1.5-2.0 length of 10-C, (4) hair 2-I 4-6 forked (2-6), moderately long to long, and 3-I about 0.5-0.9 length of 2-I, (5) hair 0-II 1-3 branched (1-4), small, (6) sum of branches of hairs 0-II and 0-III usually less than 8 (3-9) and (7) hair 9-III less than or equal to 2.0 length of 9-II, 9-V 2.5-4.5 (2.5-4.9) length of 9-IV, 9-VII 1.05-1.25 (1.05-1.30) length of 9-VI and 0.5 or more length of segment; and in the **larva** by the combination of (1) hairs 2,3-C single, and simple or with very small barbs, hairs 2-C widely spaced, clypeal index about 1.25, and 3-C 0.5-0.8 length of 2-C, (2) hair 4-C single or 2 forked, long, 0.7-1.0 length of 3-C, usually extending to beyond base of 2-C, (3) hairs 1,2-P sharing or not sharing a common tubercle, 3-P occasionally arising from same tubercle as 2-P, palmate hair 1-P with 11-15 (10-18) moderately narrow to narrow, pointed, lanceolate leaflets, (4) hair 0-II 1-3 branched, very short, about 0.5 or less length of leaflets of 1-II, inconspicuous, and 0-III-VII 1-4 branched, small to moderately small, (5) hair 13-IV moderately large, 1.5-2.0 length of leaflets of 1-IV and (6) hair 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation.

Superficially, the larva and male genitalia of *trinkae* appear similar to those of *nunez tovari*, and the pupa is much like that of *rangeli*; however, these stages can readily be distinguished by the characters above. Unfortunately, the key features of the adult female can easily be confused with those of either *nunez tovari* or *rangeli*, and occasionally (when the humeral light spot of the costal vein is greater than 2.0 the length of the basal dark spot) the adults can be mistaken for those of *strodei*. To alleviate this problem, *trinkae* keys out twice in the key to adult females. Because the adult female is the most unreliable stage for identification, careful attention should be given to the male genitalia, larva and pupa for positive species determination.

In the adult female, the wings of specimens from Ecuador differ from those of specimens from Colombia by possession of a proportionally smaller basal dark spot and a larger subcostal light spot on the costal vein. The immatures from Ecuador have 1-5 fewer branches on several of the abdominal hairs than those examined from Colombia, and palmate hair 1-P of the larva from Ecuador has more numerous (14-18) and narrower branches.

Since *rangeli* and *trinkae* occur sympatrically (the immatures have been collected from the same aquatic habitats), it is reasonable to assume that they are genetically isolated. With respect to *nunez tovari* with which *trinkae* shows the greater affinity, it is unknown if *trinkae* and *nunez tovari* are sympatric over any part of their ranges. Therefore, it is impossible to state with absolute certainty that these latter 2 species have evolved sufficiently to maintain separate gene pools if they were to associate in nature. However, after having examined numerous individual rearings and one large progeny rearing of *trinkae* from several different localities, I feel confident that *trinkae* represents a species distinct from both *rangeli* and *nunez tovari*.

BIONOMICS. The data on the bionomics of *trinkae* were extracted from the collection records compiled by Yiau-Min Huang while she was in Ecuador. Additional information came from field notes on one collection from Colombia (COB 42).

The immatures of *trinkae* have been collected in temporary and permanent, small to large ground pools (43%), wheel tracks (19%), ponds and lakes (19%), streamside pools (14%), and ditches (5%). All collections were from either clear or slightly colored fresh water exposed to the sun. Several collections came from the sides of roads and one was from a sugar cane plantation. Many of the ground pools were in grassy areas so that emergent and submerged vegetation was abundant. Green algae frequently occurred in the aquatic habitats. Most of the collections were made near human habitations, usually within 1 km of the nearest house. The collections came

from localities ranging in elevation from 82 to 950 m above sea level, and all were from the eastern slope of the Andes. Huang characterized the general habitat in Ecuador as "scrub with scattered trees." Hueck and Seibert (1972) recognize these regions of Colombia and Ecuador where *trinkae* occurs as the "*Andes septentrionales y Cordilleras*," the "*bosques tropicales y subtropicales, deciduos y mesofiticos de Colombia y Venezuela*" and the "*laderas orientales de los Andes medios*." The immatures of *trinkae* occurred with 2 other species in the Albimanus Section, *rangeli* and rarely *triannulatus*. Other species that have been found associated with *trinkae* are *Culex (Mel.) bastagarius, Cx. (Mel.) chrysonotum* and *Cx. (Mel.) pilosus*.

Because of the uncertainty of the geographical range of *trinkae* and its morphological similarities with *rangeli* and *nunez tovari*, there is some confusion as to which of these 3 species is referred to in much of the literature on bionomics and distribution. For example, Elliott (1968, 1972) studied the adult behavior of "*nunez tovari*" in 5 localities in Colombia and contrasted this with the behavior of *nunez tovari* in Brazil. There is a possibility, although an unlikely one, that at some of the localities Elliott worked not on the behavior of *nunez tovari* but on the behavior of *trinkae*. Nevertheless, without voucher specimens it is impossible to be certain. Similarly, the distribution records for *nunez tovari* and *rangeli* from Ecuador and parts of Colombia may really refer to *trinkae*. For these reasons many of the references listed in the synonymy of *trinkae* should be considered tentative.

MEDICAL IMPORTANCE. Nothing is known about the vector potential of *trinkae*. As with the literature on bionomics and distribution, many of the references to either *rangeli* or *nunez tovari* concerning transmission of malaria could refer to *trinkae*. Huang (personal communication) states that in the Ecuadorian provinces of Pastaza and Napo, *rangeli* was thought to be the vector of malaria. Likewise, Forattini (1962:393) reports that *rangeli* has been suspected as a carrier of malaria in Ecuador; but in no other country has *rangeli* ever been thought to be important as a vector. Since *trinkae* is often easily confused with *rangeli* in the adult female, it is *possible* that *trinkae* is transmitting malaria in Ecuador.

DISTRIBUTION (fig. 3). *An. trinkae* is known to occur along the eastern slope of the Andes from Villavicencio, Colombia south to Puyo, Ecuador. It is not known how much farther north or south the range of this species extends. Cerqueira (1943: 19) reports *goeldii* from several localities in Bolivia based on examination of adult females and 2 male genitalia. I do not know if this represents *nunez tovari* or *trinkae*.

The following corrections in the "Material Examined" section of the original description of *trinkae* (Faran 1979:33-34) should be noted: (1) collections CV 737, 738 and 739 are *not* progeny rearings, (2) on page 34, line 4, "Acarias, 3 Jun 1949" should be changed to "Acacias, 3 Jun 1947" and listed under the department of Meta in Colombia, (3) Ecuador coll. 26 (page 34, line 5-6) is *not trinkae*, but *rangeli* and (4) Ecuador colls. 32 and 33 (page 34, line 19-21) were made 1.5 km S of Puyo, *not* 4.3 km E Puyo as stated.

Material Examined: 385 specimens: 73 males, 18 male genitalia, 60 females, 127 pupae, 107 larvae; 127 individual rearings: 56 larval, 48 pupal, 23 incomplete; 1 progeny rearing.

COLOMBIA (102 specimens: 12M, 6Mgen, 17F, 24p, 43L&l; 24 ind rear: 3 l, 21 inc; 1 progeny rearing). **Meta:** Acacias, 3 Jun 1947, [CV] 408.1, 1 lp [JH]. Villavicencio, 26 May 1947, L. Rozeboom, CV-P 28 (progeny rearing), 12M, 6Mgen, 15F, 8 lp, 12L; same locality, 14 Feb 1948, [CV] 537.1, 1 lp [JH]; same locality, CV 737, 3 lp, 4L; same locality, CV 738, 4 lp, 3L; same locality, CV 739, 5 lp, 4L; same locality, COB 42.

ECUADOR (283 specimens: 61M, 12Mgen, 43F, 103P&p, 64L&l; 103 ind rear: 53 l, 48p, 2inc). **Napo:** Tena, 11.7 km SW of, 25 May 1977, Y. Huang, coll. 40, 4 pM, 1 pF, 2 lpM, 2 lpF; same

data except 13 km SW of Tena, coll. 43, 1 lpM. **Pastaza:** Puyo, 5 May 1977, Y. Huang, coll. 4, 1 Mgen, 2 pM, 2 pF, 1L; same data, coll. 5, 2L; same data, coll. 6, 1 lpM; same data except 20 km N of Puyo and 6 May, coll. 8, 1Mgen, 1 pM, 1 pF, 1 lpM, 1 lpF; same data except 39 km N of Puyo, coll. 9, 2 pM, 1 pF, 1 lpF, 1 lP; same data except 4 km NE of Puyo and 7 May, coll. 11, 1 pF, 1 lpM, 1 lpF, 1 lP, 2L; same data except 16 km NE of Puyo, coll. 15, 1Mgen, 1 lpM, 1 lpF; same data, coll. 16, 1Mgen, 1 pF, 2 lpM, 1 lpF; same data except at Puyo and 8 May, coll. 17, 1Mgen, 5 pM, 3 pF, 3 lpF; same data, coll. 18, 1Mgen, 3 pM, 1 pF, 1 lpF; same data except 31 km W of Puyo and 9 May, coll. 20, 3L; same data except 12 km W of Puyo, coll. 23, 1Mgen, 1M; same data except 1.5 km S of Puyo and 15 May, coll. 29, 1Mgen, 2 pM, 1 pF, 4 lpM, 5 lpF; same data, coll. 30, 1Mgen, 4 pM, 3 pF, 6 lpM, 2 lpF, 1F, 1 l; same data except 4.3 km E of Puyo and 17 May, coll. 31, 1Mgen, 2 pM, 2 lpM, 4 lpF; same data except 1.5 km S of Puyo and 19 May, coll. 32, 1Mgen, 5 pM, 7 lpM, 3 lpF; same data, coll. 33, 1Mgen, 2 pM, 1 pF, 1F.

10. Anopheles (Nys.) nuneztovari Gabaldon

Figs. 3, 4, 7, 25, 26

1940. *Anopheles (Nyssorhynchus) nuneztovari* Gabaldon 1940:5-6. TYPE: *Holotype* male, San Carlos (Cojedes), Venezuela [MDM].

1941. *Anopheles (Nyssorhynchus) goeldii* Rozeboom and Gabaldon 1941:89-91. TYPE: *Holotype* male with associated genitalia slide, labelled "N. gorgasi no. 6," Boa Vista, Rio Tapajos (Para), Brazil, C. H. T. Townsend [USNM].

1945. *Anopheles (Nyssorhynchus) dunhami* Causey 1945:231-234. TYPE: *Holotype* male with associated genitalia slide, Tefe (Amazonas), Brazil, captured on animal bait [USNM, 58036].

Anopheles (Nyssorhynchus) nuneztovari of Gabaldon and Aguilera (1940:68, 69); Gabaldon, Cova Garcia and Lopez (1940:9); Rozeboom and Gabaldon (1941:91-98); Komp (1942:5, 26, 34); Simmons and Aitken (1942:39, 46, 53, 95); Galvao (1943:146); Floch and Abonnenc (1946b: 1, 3-5; 1947:6; 1951:57-58); Gabaldon and Cova Garcia (1946b:98-99; 1952:178, 193, in part); Deane, Causey and Deane (1948:894-897); Senevet (1948a:278; 1948c; 434-438); Vargas (1948: 158; 1959:376, 382, in part); vander Kuyp (1949a:67, 68); Lane (1949:403; 1953:268-269, in part); Rey and Renjifo (1950:534-538); Bejarano (1957:326, 329, 330, 331); Giglioli (1959: 280); Stone, Knight and Starcke (1959:33, in part); Cerqueira (1961:125-126); Fauran (1961: 11); Forattini (1962:396-400, in part); Hamon, Mouchet *et al.* (1970:32-33); Belkin, Schick and Heinemann (1971:6); Morales-Ayala (1971:139); Gabaldon (1972:634-639); Kitzmiller, Kreutzer and Tallaferro (1973:435-455); Kreutzer, Kitzmiller and Rabbani (1975:363-364); Cova Garcia and Sutil O. (1976:27; 1977:23, 48, 64, 84); Cova Garcia, Pulido F. and Amarista M. (1978:157); Kitzmiller (1979:26-31); Faran (1979:26, 27, 30, 31, 32, 33).

Anopheles nuneztovari of Russell, Rozeboom and Stone (1943:37, 47); Floch and Abonnenc (1946a:2); Foote and Cook (1959:24, 26, 29, 32, in part); Gabaldon and Guerrero (1959:433-434); Cova Garcia (1961:37-69, 89-90, 114, 127-128, 152); Vincke and Pant (1962:2-18, 28, 31, 35-42); Stojanovich, Gorham and Scott (1966b:22, 30, 43, in part); Gorham, Stojanovich and Scott (1967:15, 47, 58; 1973:111, 138, 147-148, in part); Elliott (1968:248-252 ; 1972:756-763, ?in part); Cova Garcia and Sutil O. (1975a:24; 1975b:213); Perez de Valderrama and Scorza (1976:212-220); Scorza, Tallaferro and Rubiano (1976:129-130); Panday (1977:728-737; 1979b:57); Panday and Panday-Verheuvel (1979:36).

Anopheles nunes-tovari (!) of Mattos and Xavier (1965:273).

Anopheles (Nyssorhynchus) dunhami of Deane, Causey and Deane (1948:897); Senevet (1948a: 278); Lane (1953:268); Elliott (1972:758, 762).

Anopheles (Nyssorhynchus) goeldii of Gabaldon and Aguilera (1940:72); Gabaldon, Aguilera and Arevalo (1941:60); Galvao and Damasceno (1942:122-123); Simmons and Aitken (1942:39, 46, 53, 61, 94-95); Cerqueira (1943:19, ?); Galvao (1943:149, 151); Causey, Deane and Deane (1944:2, 5, 6; 1946:27); Floch and Abonnenc (1944b:2); Lane (1944:263; 1949:403); Deane, L. M., Causey and Deane (1946:6, 7, 9, 10, 12); Deane, M. P., Causey and Deane (1946:42, 45); Senevet (1948a:278); Levi-Castillo (1949:11, 15, 28, 67).

Anopheles goeldii of Russell, Rozeboom and Stone (1943:37, 42, 46).

Anopheles (Nyssorhynchus) tarsimaculatus in part of Shannon (1933:124-132).
Nyssorhynchus tarsimaculatus in part of Townsend (1933b:7-12).
Nyssorhynchus albimanus in part (?) of Townsend (1934:493-494).
Anopheles (Nyssorhynchus) gorgasi in part of Townsend (1933a:101-102).
Anopheles (Nyssorhynchus) sp, *goeldii* series of Bruce, Knigin, Yolles and Graham (1943:442).
Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.2 mm. Proboscis: 2.1 mm. Palpus: about 2.1 mm. Forefemur: 1.5 mm. Abdomen: about 2.9 mm. Moderate size. Integument dark brown to very dark brown, with considerable contrast between light and dark regions. **Head:** Proboscis about 1.4 length of forefemur. Palpal segments 1 and 2 and base of 3 with predominantly dark, outstanding scales; segments 2 and 3 with a small, white, apical band and a small to moderate, white, apical band respectively; segments 2 and 3 with or without a dorsal or lateral speckling of light scales; segment 4 with base and usually apex dark scaled, usually ventral surface with row of dark scales; segment 5 usually completely white, occasionally with a few, dark, basal scales. **Antenna:** Flagellar segment 1 with numerous, white, oblanceolate setae distally on dorsomesal and mesal surfaces; basally with shorter obovate scales. Flagellar segments 2-13 each with a basal whorl of about 8-10 tan to silver setae. **Thorax:** Anterior promontory area with long, white, setiform scales usually not extending far dorsad onto acrostichal line. Prescutellar space subtriangular or horseshoe shaped. *Sp* with 4-8 moderately long, light setae and a few obovate scales. Upper *stp* with 3-5 long, dark setae above a patch of light scales in horizontal arc. Lower *stp* with 1,2 long setae and a diagonal patch of light scales. Upper *mep* with 7 (5-9) long, cream to brown setae; scales absent. **Legs:** Light scales on coxae white to pale cream. Midfemur with both anteroapical spot and knee spot distinct. Foretarsal segments 2 and 3 cream to white in apical 0.2-0.4 (0.15-0.44) and 0.55 (0.40-0.75) respectively; segment 4 with a small, cream, apical band; segment 5 golden to cream in about apical 0.5. Midtarsal segments 1 and 2 with a small, golden, apical band; segments 3 and 4 all dark, occasionally with a few, lighter, apical scales; segment 5 with apical 0.25-0.50 lighter than base. Hindtarsal segment 2 brown to dark brown in basal 0.25-0.32 (0.20-0.32); segment 5 dark in about basal 0.5, apical 0.5 cream to white. **Wing:** Light wing spots usually cream, not white, at least on anterior veins. Large dark wing spots distinct. Vein C humeral light spot about 0.7-1.3 (0.7-1.7) of basal dark spot; basal dark spot often extending to humeral crossvein; subbasal dark spot usually longer than subbasal light spot; sectoral dark spot occasionally absent; subcostal light spot 0.20-0.55 of subcostal dark spot, usually less than 0.5; preapical light spot about 0.36 (0.2-0.5) of preapical dark spot; apical dark spot moderately long and distinct. R presectoral dark spot moderately large, usually much larger than sectoral dark spot. R_2 preapical dark spot large, about 0.3-0.5 of R_2. R_{4+5} subcostal and apical dark spots moderate, very dark and conspicuous. M sectoral dark spot variable, moderately long to long, 0.25-0.70 of M; preapical dark spot not extending onto M_{1+2}. Dark spots of M_{1+2} and M_{3+4} very dark and conspicuous. Cu_1 subcostal, preapical and apical, and Cu_2 preapical dark spots moderately long and distinct. Vein A subcostal dark spot moderately long, about 0.2 (0.15-0.30) of A. Apical light fringe spot moderately small (to large in Venezuelan specimens) and divided or undivided by a few dark scales between R_2 and R_3, and R_3 and R_{4+5}; additional, and in most cases conspicuous, small, light fringe spots at apices of R_{4+5}, M_{1+2}, Cu_1, Cu_2 and A; a moderately conspicuous to inconspicuous, light fringe spot between base of wing and A. **Abdomen:** Sternite I with a few, moderately long to long setae, longer setae sternomedially and shorter setae laterally; with occasionally a few, scattered, inconspicuous, light,

lanceolate to obovate scales, usually only visible on slide preparations. Caudolateral and sternomedian dark scale tufts on segments II-VII with scales conspicuous, large and broad.

MALE. Wing: 3.4 mm. Proboscis: 2.75 mm. Forefemur: 1.6 mm. Abdomen: about 3.2 mm. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with a stripe of light scales along dorsal surface; segment 4 with a basal and an apical, white band, and a subbasal and a subapical, smaller, dark band; mediolateral surface of segment 4 largely speckled with cream scales with a few intermingled dark scales; ventral surface of 4 inconspicuously dark scaled. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with conspicuous, long, white, lanceolate, dorsomesal scales. **Legs**: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with about 7 long, stout, spiniform setae. Claw on foreleg long, weakly curved; submedian tooth long, about 0.5 length of claw, and moderately thick at base, tapering to a blunt, very slightly recurved tip; basal tooth thick, strongly decurved and blunt, subequal to submedian tooth.

MALE GENITALIA (fig. 25). **Segment VIII**: Tergite and sternite with narrow to moderately broad, obovate scales. Tergite usually with darker scales on caudal and caudolateral margins. Sternite with median dark scales and lateral, cream to white scales. **Segment IX**: Sternite long, about 0.25 length of sidepiece, subtrapezoidal. Anterior apodeme moderately short, subrectangular to subtriangular, extending across anterior border of sternite. **Sidepiece**: Tergal surface with 4,5 long, submedian tergomedial bristles and one subapicolateral bristle; bristles mesad of tergomedial bristles moderately long. Parabasal spine long, at least 2.0 length of its tubercle. Basal apodeme moderately thick, pointed, long, about 0.20-0.25 length of sidepiece. Longer, more dorsal accessory spine slightly less than 0.5 length of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform moderately developed, acuminate, subequal to seta *b*. **Dorsal Claspette**: Pedicel long, moderately narrow to moderately broad; base rounded, curved mesad; internal apodeme conspicuous. Leaflets broad and less than 0.5 (0.37-0.47) length of claspette; dorsal leaflet with prominent, fairly large basomesal projection. **Ventral Claspette**: Moderately short, 0.25-0.40 length of sidepiece; lateral margins not tapering appreciably medially toward apex; apex broad, width at apex about 0.50-0.60 (0.50-0.64) length of claspette. Basal lobule moderately expanded laterally, not appreciably wider than apex of claspette; setae along basal margin moderately long, slightly longer than to 1.5 width of aedeagus but never 2.0 width; setae distributed evenly over basal surface and radiating in different directions; no concentration of long setae on basomesal margin directed caudad toward vertex of mesal cleft. Ventral and lateral surfaces (exclusive of basal lobule) with short setae about 0.5 width of aedeagus, setae extending to or nearly to apex. Depending on angle of observation, apex of ventral claspette appearing either truncate or with a variously developed median sulcus with gradual to steeply sloping sides; apex with abruptly angled, rounded, sclerotized, lateral margins. Preapical plate moderately small, semicircular to oval, weakly to moderately heavily sclerotized, located about 0.2 length of claspette basad of apex. Transparent membranous area basad of preapical plate as in *rangeli* except slightly more pointed at vertex. Refringent structure inconspicuous to moderately conspicuous, in shape of inverted V, with rounded vertex; lateral arms occasionally apparent. **Phallosome**: Aedeagus about 0.5 length of sidepiece and 1.33-1.60 (1.31-1.89) length of ventral claspette; apex moderately rounded, usually wider than long; with or without very small, membranous, nonserrated, pointed, basolaterally directed leaflets.

PUPA (fig. 25). Abdomen: about 2.8 mm. Trumpet: 0.45 mm. Paddle: 0.75 x 0.55 mm. Only exuviae examined. **Cephalothorax**: Moderately to heavily pigmented. Wing cases with heavily sclerotized stripes. Hairs 1-3-C 2,3 branched (2-4); 2-C shorter than 1,3-C. Hair 4-C 2-4 branched, about 0.7 length of 5-C. Hair 5-C 2,3 branched (2-4). Hair 6-C 2 forked (2,3) 0.25-0.70 from base, moderately short, slightly longer than 5-C. Hair 7-C 2,3 branched (1-3) near base, long, subequal to 6-C, one branch about 1.25 length of shorter branch(es). **Trumpet**: Pinna moderately pigmented; moderately long, about 3.5-4.5 (3.0-4.8) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft long and basally rounded. **Metanotum**: Hair 10-C 1-3 branched, less than 0.5 length of 12-C and about 0.8 length of 11-C. Hair 11-C 3-5 branched (2-7) usually near base. Hair 12-C 1-3 branched, very long. **Abdomen**: Hair 2-I dendritic, 5-8 branched (3-9) near base, large, with long branches; 3-I single or double, long, 0.7-1.0 length of 2-I. Hair 4-I 4-6 branched (4-7), moderately short. Hair 5-I 1-3 branched, long. Hair 6-I single or occasionally double, very long, usually more than 2.0 length of 7-I. Hair 7-I 3-5 branched (2-5) near base. Hair 9-I single or rarely double, about 0.7 length of 6-I. Hair 0-II-V 4-7 branched (3-8), moderately large; 0-VI,VII 2-5 branched, moderately short. Hair 1-II,III 6-8 (6-13) and 5-9 (4-11) branched respectively, strongly developed, median branches longer than lateral; 1-IV-VII very long, 1.6-2.0 length of segment. Hair 3-IV 4-6 branched (3-9) near base, moderately large; 3-V 2-4 forked (1-4). Hair 5-III,IV 4-11 and 3-5 (2-5) branched respectively, strongly developed; 5-V-VII single, as long as or slightly longer than segment. Hair 6-II 1-3 branched, 1.4-1.8 length of 7-II or occasionally longer; 6-III 1-3 branched, long. Hair 7-II 3-5 branched (2-6); 7-III 3-5 branched (1-6); 7-IV 4-6 branched (2-6); 7-V 2-4 branched, longer than 7-III,IV; 7-VI,VII single or rarely double, long. Hair 8-III,VII 3-5 branched (2-5); 8-IV 3 branched (2-6); 8-V,VI 2-3 branched (2-4). Hair 9-II small, unpigmented; 9-III pointed, almost always less than 2.0 length of 9-II, pigmented; 9-IV thick, pointed, usually 2.0 or more of 9-III; 9-V-VIII thick, curved, acuminate, short, about 0.33 length of segment; 9-V,VI slightly shorter than 9-VII,VIII; 9-VIII straighter than 9-V-VII. Hair 10-III 3-5 branched (2-5), moderately long. Hair 4-VIII 3,4 branched (3-5), subequal to 9-VIII. **Terminal Segments**: Male genital lobe as in *aquasalis*, with a very prominent mammilliform protuberance. **Paddle**: Obovate with moderately broad, rounded apex, weakly emarginate at insertion of hair 1-P. External buttress 0.65-0.75 length of paddle, with distinct spiculiform serrations near apex. Spicules on external margin conspicuous, continuing around apex and along inner margin to about 0.3 from base. Hair 1-P single, moderately long; 2-P 2,3 branched (1-3), about 0.5 length of 1-P.

LARVA (fig. 26). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. **Head**: Moderately to very heavily pigmented. Median tooth of mental plate blunt, as broad as combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single and barbed in apical 0.5-0.7, barbs usually longer on 3-C; hairs 2-C widely spaced, clypeal index 1.0-1.3; 3-C slightly shorter (0.75-0.90) than 2-C. Hair 4-C single or 2-4 forked, moderately long, 0.30-0.60 length of 3-C and usually extending to near or beyond base of 2-C. Hair 8-C 3-5 branched (2-7) near base, moderately large, length greater than 2.0 distance separating insertion of hairs 2-C and 3-C. Hair 9-C dendritic, 5-8 branched (4-8), slightly longer than 8-C. Hair 12-C 3,4 branched (2-5), moderately long. Hair 15-C 2-6 branched, moderately long. Collar wide dorsomedially, heavily pigmented. **Antenna**: Usually lighter than remainder of head. Mesal margin with moderately short, thin spicules; fewer and shorter spicules on ventral surface. Hair 1-A 5-7 branched (5-8), short, about as long as width of

antenna at point of insertion, inserted about 0.25 from base of antenna. **Thorax**: Darkly pigmented. Submedian prothoracic group (1-3-P) with or without 1,2-P sharing a common sclerotized tubercle, often base of 1-P not sclerotized; palmate hair 1-P with 9-12 (9-15) pigmented, moderately broad leaflets; 2-P 12-18 branched (11-20); 3-P not sharing tubercle with 2-P. Hair 14-P 6-9 branched (5-11) from a moderately short, flattened shaft. Mesothoracic hair 1-M 27-31 branched (25-35). Metathoracic hair 2-T 1-3 forked, moderately long. Palmate hair 3-T with 11-15 (9-18) semitransparent, moderately long, narrow leaflets. Mesothoracic pleural group spine large, subequal to prothoracic spine; metathoracic spine smallest. **Abdomen**: Hair 0-II-VII 5-8 branched (4-10), large, very conspicuous; 0-II subequal to or longer than length of leaflets of 1-II. Palmate hair 1-I with 13-16 semitransparent, spreading, narrow, pointed leaflets; 1-III-VI with 23-31 long, pointed, moderately narrow to moderately broad leaflets; 1-II,VII with 20-27 leaflets, slightly shorter than 1-III-VI. Hair 2-I 3-5 branched (2-6), small; 2-II 6-9 branched (4-10), large; 2-III 4,5 branched (3-6), large; 2-IV single or occasionally double, moderately long; 2-V single, very long. Hair 3-I single or occasionally double, moderately long. Hair 5-I 4,5 branched (3-5), moderately small; 5-II 8-11 branched (6-13), small. Hair 9-I 5-7 branched (4-7). Hair 13-I 5-7 branched (4-8), small; 13-II,III 8-10 branched (7-11), small; 13-IV 4-6 branched (3-6), moderate, equal to or slightly longer than leaflets of 1-IV; 13-V 4-6 branched (4-7), large; 13-VI 7-10 branched (6-10), moderately small. **Spiracular Lobe**: Pecten with 15-19 (14-19) teeth; length of teeth highly variable, usually median teeth mixed moderate and short, except for one long tooth in middle; dorsally pecten usually terminating with 2,3 long teeth; serrations on teeth moderately long, conspicuous. Hairs 8,9-S 3-6 branched; 8-S subequal to 9-S. Lateral arm of spiracular apparatus short, directed caudolaterally. **Anal Segment**: Covered with short thin spicules. Saddle dark reddish brown, with irregular ventral margin. Hair 1-X longer than saddle; inserted on saddle near ventral margin, on ventral margin at base of indentation, or just ventrad of ventral margin. Anal gills subequal to length of saddle.

DISCUSSION. *An. nuneztovari* can be distinguished from the other species in the Oswaldoi Group in the **female** (except occasionally *rangeli* and often *trinkae*) by the combination of (1) integument dark brown to very dark brown with considerable contrast between light and dark regions, and light wing spots usually cream at least on anterior veins, (2) usually ventral surface of palpal segment 4 with row of dark scales, (3) foretarsal segment 2 with a light band in apical 0.2-0.4 (0.15-0.44) and segment 3 with a light band in apical 0.55 (0.40-0.75), (4) foretarsal segment 4 with a small, apical, cream band, (5) hindtarsal segment 2 with a dark band in basal 0.25-0.32 (0.20-0.32), (6) large dark wing spots distinct, humeral light spot of vein C usually smaller than in *trinkae,* 0.7-1.3 (0.7-1.7) of basal dark spot, (7) subbasal dark spot of vein C usually longer than subbasal light spot, (8) subcostal light spot of vein C 0.20-0.55 of subcostal dark spot, usually less than 0.5 and (9) subcostal and apical dark spots of vein R_{4+5} and dark spots of M_{1+2} and M_{3+4} all very dark and conspicuous; in the **male genitalia** by the combination of (1) ventral claspette moderately short, 0.25-0.40 length of sidepiece, width at apex about 0.50-0.60 (0.50-0.64) length of claspette, and apex appearing either truncate or with median sulcus, (2) basal lobule moderately expanded laterally, setae along basal margin moderately long, slightly longer than to 1.5 width of aedeagus but never 2.0 width, setae distributed evenly over basal surface and radiating in different directions, not concentrated along basomesal margin as in *rangeli*, (3) ventral and lateral surfaces of ventral claspette (exclusive of basal lobule) with short setae about 0.5 width of aedeagus, (4) preapical plate semicircular to oval, and weakly to moderately heavily sclerotized and (5) length of aedeagus

1.33-1.60 (1.31-1.89) length of ventral claspette, apex of aedeagus usually wider than long, moderately rounded and with or without very small, membranous leaflets; in the **pupa** by the combination of (1) hair 7-C subequal to 6-C, one branch about 1.25 length of other branch(es), (2) pinna moderately long, about 3.5-4.5 (3.0-4.8) length of meatus, appearing broad medially and tapered toward apex in lateral aspect, (3) hair 10-C less than 0.5 length of 12-C and about 0.8 length of 11-C, (4) hair 2-I dendritic, 5-8 branched (3-9), large, 3-I 0.7-1.0 length of 2-I, (5) hair 6-I usually more than 2.0 length of 7-I and (6) hair 9-II small, unpigmented, 9-III pointed, almost always less than 2.0 length of 9-II, pigmented, 9-IV usually 2.0 or more length of 9-III, and 9-V-VIII thick, curved, acuminate, short, about 0.33 length of segment; and in the **larva** by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C widely spaced, clypeal index 1.0-1.3, (2) hair 3-C 0.75-0.90 length of 2-C, (3) hair 4-C single or 2-4 forked, moderately long, 0.30-0.60 length of 3-C, usually extending to near or beyond base of 2-C, (4) palmate hair 1-P with 9-12 (9-15) pigmented, moderately broad leaflets, (5) hair 0-II-VII 5-8 branched (4-10), large, very conspicuous, 0-II subequal to or longer than leaflets of 1-II, (6) hair 13-IV 4-6 branched (3-6), moderate, equal to or slightly longer than leaflets of 1-IV, 13-V 4-6 branched (4-7) and (7) hair 1-X inserted on saddle near ventral margin, on ventral margin at base of indentation, or just ventrad of ventral margin.

In the specimens from Venezuela as compared to elsewhere, the immatures usually have hairs with somewhat fewer branches, while the adults have the light apical band on foretarsal segment 2 usually wider, the apical light fringe spot and subcostal light spot on vein C usually larger, and the sectoral dark spot on vein C often absent.

An. nuneztovari and *trinkae* are sister species based on shared derived (synapomorphic) characters in the larvae and male genitalia, and together these species form the sister group of *rangeli*. The male genitalia of the 2 former species are so similar that it is possible to distinguish them only when comparing the lengths of the aedeagi relative to the lengths of their corresponding ventral claspettes. The larvae of *nuneztovari* and *trinkae* share the derived feature of the long hair 4-C and are easily separated by the characters enumerated in the key. Unfortunately, the adult females of all 3 of the above species can sometimes be confused due to intraspecific variability and the paucity of reliable differentiating characters. It is very important when there is some doubt, to examine as many specimens as possible, and to correlate all the characters given in the key.

Based on the male genitalia, Gabaldon described *nuneztovari* from San Carlos, Cojedes, Venezuela in 1940. Rozeboom and Gabaldon (1941) described a similar form of *Nyssorhynchus* from the Amazon basin which they called *goeldii* and stated that *goeldii* and *nuneztovari* were distinguished by differences in the "mesosome" (phallosome) and the "fused dorsal lobes" (ventral claspettes) of the male genitalia. Again based on the apex of the mesosome of the male genitalia, which was said to be without leaflets and broader than in *goeldii,* Causey (1945) described *dunhami* from Tefe in the upper Amazon basin. Floch and Abonnenc (1946b:1) synonymized *goeldii* with *nuneztovari* after comparison of the male genitalia of *goeldii* with several specimens of *nuneztovari.* Lane in his "Neotropical Culicidae" (1953:268) listed *dunhami* as a synonym of *nuneztovari*, so *nuneztovari* became the valid name for the above 3 nominal species.

Elliott (1968:248-252) studied the relationship of the indoor biting activity of *nuneztovari* with regard to human activity in 5 Colombian localities. In 1972 (p 758), Elliott stated that 2 species were confused under the name *nuneztovari*: "In Brazil and Surinam, in Ecuador, and almost certainly in Bolivia and Peru, there is a species

that bites at sunset, and therefore mainly outside houses, and preferentially on animals. In northern Colombia and western Venezuela, a closely similar but slightly smaller species bites later in the night, and therefore mainly inside houses." According to Elliott, the possible sympatry of the 2 types in Venezuela and Colombia could have lead to confusion, such that the behavior of the nonvector has been attributed to the vector of malaria in this region. Whether or not Elliott was dealing only with *nuneztovari*, or with *nuneztovari* and *trinkae,* is not known to me.

Although I have not examined the holotype of *nuneztovari*, I have studied the holotype and several paratypes of *goeldii*, the holotype of *dunhami*, and numerous other specimens from Brazil (Amazonas, Para, Rondonia), the Guianas and Venezuela (Aragua, Zulia, Barinas and Cojedes, including 3 male genitalia from the type locality of *nuneztovari*). I have been unable to find any apparently significant differences among any of these specimens and therefore am considering them to be all *nuneztovari*. However, when more information and material becomes available which can be correlated with the morphological differences I have observed and with those behavioral and chromosomal differences reported by others, it is possible that *goeldii* will be resurrected to specific status.

Kitzmiller, Kreutzer and Tallaferro (1973) studied the salivary chromosomes of *nuneztovari* from 3 populations in Brazil, 2 in western Venezuela and one in northern Colombia. They reported that the Colombian and Venezuelan populations consistently differ from the Brazilian populations by a homozygous inversion in the X-chromosome. They stated that the 2 "types" could be easily distinguished by this fixed homozygous inversion. Also, they compared the chromosomal banding patterns of *nuneztovari* with those of *An. (Nys.) darlingi, aquasalis, albimanus* and later (Kreutzer, Kitzmiller and Rabbani 1975:363-364) *An. (Nys.) argyritarsis.* The similarities between *nuneztovari* and *albimanus* were not as great as between *darlingi* and *aquasalis*. The autosomal homologies were strongest between *aquasalis* and *nuneztovari*, and *aquasalis* shared more homologous regions with *argyritarsis* than did *nuneztovari.*

BIONOMICS. The immatures of *nuneztovari* are found in open marshy areas, ponds and lakes often in the grassy margins, small or large permanent or temporary ground pools, animal or wheel tracks, and along stream margins; they are found in fresh water that is in full sun or partial shade. Aquatic vegetation may be abundant and algae are often present. *An. nuneztovari* is collected in the interior or in clearings within the forest, and in areas of secondary growth (scrub) such as around villages. In the laboratory, the larvae cannot tolerate a sodium chloride concentration of even 0.5%. *An. triannulatus* and especially *ininii* are frequently associated with this species in ponds and lakes; occasionally *oswaldoi* is also collected with *nuneztovari.* Other species associated with *nuneztovari* are *Culex (Mel.) bastagarius, Cx. (Mel.) dunni* group, *Cx. (Mel.) ensiformis, Cx. (Mel.) rachoui* (?), *Cx. (Mel.) zeteki* group, *Cx. (Cux.) coronator* group and *Uranotaenia (Ura.) geometrica.*

Considerable work has been done on the adult behavior of *nuneztovari* from Colombia by Elliott (1968:248-252; 1972) which I will briefly summarize. Elliott studied the relationship between the biting activity indoors and outdoors with regard to human activity in 5 localities in Colombia: El Pescado, Rio Fuego, Puerto Reyes, Turbo and Las Aranas. At Rio Fuego he found the months *nuneztovari* was most abundant were April and May; biting occurred the first 2 hours of the evening outdoors, the next 2 hours indoors and over the entire night with an outdoor to indoor ratio of 1:1. At all the other stations he reported the same pattern. In the months of highest density, biting reached a peak shortly before midnight, indoor biting being

equal to or slightly greater than outdoor. In the months of low density, biting peaked an hour or so earlier than during the high density season, biting being slightly greater outdoors than indoors. He states, "there are indications of a negative correlation between the seasonal density and the proportion of outdoor biting . . ." *An. nuneztovari* in Colombia also showed earlier peaks of activity during the light phases of the moon (Elliott 1972:756). Biting activity was unimodal, not showing early evening or morning peaks. *An. nuneztovari* collected outside in resting places equidistant between animals and houses had a human blood index (HBI) of less than 10%. This species usually rests one meter high or less on the walls inside houses, although occasionally (15%) above this height. Because it feeds inside while most people sleep, it is effectively endophilic.

In 3 months (September to November), Rey and Renjifo (1950) collected 3301 anophelines inside houses and in stables in northern Colombia of which 14.4% were identified with certainty as *nuneztovari* and 67.2% as a mixture of *nuneztovari* and *rangeli.* Of the total of 2722 *nuneztovari* and *rangeli* collected, a study of the eggs from 501 of these females revealed that 476, or 95%, were *nuneztovari.* These authors therefore concluded that the majority of females collected inside were actually *nuneztovari.* The principal time *nuneztovari* entered houses was 2200-2400 h.

Gabaldon (1972:635) stated that before spraying the inside walls of houses with DDT in Venezuela, *nuneztovari* was very endophilic, remaining in the houses and resting on the walls and ceiling after taking a blood meal. Spraying of insecticides, however, selected for "intense exophilism." *An. nuneztovari* is still anthropophilic, but, immediately after taking a blood meal, the females leave the house, thereby avoiding a lethal dose of insecticide by not resting on the walls. Gabaldon stated that, even though strongly exophilic, "*A. nuneztovari* in Venezuela, for example, maintains a human blood preference of around 80%, and a man-biting rate of more than 100 during a night indoors." Gabaldon believes that this intense exophilism has been largely responsible for refractory malaria in Venezuela.

Panday (1977:728-737) reported a unimodal distribution of biting activity of *nuneztovari* in Suriname occurring 1800-1900 h, the peak beginning at the termination of twilight (1830 h, sunset was fixed at 1800 h). His recent surveys showed a tremendous increase in the numbers of *nuneztovari* in the "hilly and mountainous forest region" in the interior of Suriname. He believes that to a large extent this increase is due to the construction of Afobaka dam, which has been responsible for the formation of Brokopondo storage lake. From daily collections 15 m inside the forest near the lake, 1800-1900 h, on human bait, July-December 1976, 13,824 females were captured. He stated that "*An. nuneztovari* seems to be the dominant anthropophilic *Anopheles* species" in this region and implicated it as the primary vector of *Plasmodium falciparum.* In laboratory studies on the life cycle of this species, Panday found the egg stage lasts one day, larval stages 7 days and pupal stage one day. The first gonadotrophic cycle requires 5 days, whereas all subsequent cycles require 4 days. The maximum parous rate during the above period was 0.69 with a minimum of 0.14 and a mean of 0.34. He also reported that grassy vegetation seems essential for oviposition. Contrary to what is observed in Venezuela, the adults are susceptible to DDT, dieldrin and malathion.

In Para, Brazil, the females seem to be primarily exophagous, unlike *nuneztovari* in Colombia and Venezuela. Deane, Causey and Deane (1948:895-896) reported that of the 21,967 females of *nuneztovari* collected, only 411 or 1.9% were captured inside houses. In 29 hours collecting inside houses in Maraba, Para, one specimen of *nuneztovari* was found; however, in 31 hours outside on animal bait, 978 females

were captured. Feeding preference studies, comparing a horse and a man as bait, indicate that *nuneztovari* feeds freely on man outdoors. Recent studies, conducted from March 1975 to April 1976 by the U. S. Army Medical Research Unit-Belem (USAMRU) in Palestina (100 km SW of Maraba, Para), also indicate that *nuneztovari* is exophilic and most active at sunset. In this region, *nuneztovari* was the dominant anopheline captured in landing and resting collections.

Scorza, Tallaferro and Rubiano (1976:130-131) conducted precipitin tests to determine what hosts females of *nuneztovari* were feeding on in Santa Barbara, Barinas, Venezuela. Of those blood fed, 75% tested positive for the immune sera used in this study and 25% did not react; 74.2% (289) had fed on cattle, 13% (50) on dogs, 7.4% (29) on humans, 4.5% (19) on chickens, 0.7% (3) on horses, 0.2% (1) on cats and none on pigs.

MEDICAL IMPORTANCE. *An. nuneztovari* is a major vector of malaria in western Venezuela and northern Colombia. It was first discovered naturally infected with *Plasmodium* sp by Rey and Renjifo (1950). Gabaldon and Guerrero (1959:434) stated that in some areas where *nuneztovari* was transmitting malaria the spleen indices were close to 100%. They also found that in areas not close to the jungle, malaria disappeared when the local inhabitants took chloroquine; however, in districts near forests chloroquine failed to stop transmission. Hamon, Mouchet *et al.* (1970:32-33) also indicated that the importance of *nuneztovari* depends on the amount and density of vegetation around houses. Vector density is reduced in areas where vegetation has been cleared around houses.

In Suriname, Panday (1977:728-737) reported that *nuneztovari* may have been the principal vector of *Plasmodium falciparum* in recent epidemics. He stated that *An. (Nys.) darlingi,* thought to be the primary vector of malignant malaria, has not been captured in the epidemic regions. In these same areas *nuneztovari* has been collected in great numbers. Since *nuneztovari* is the dominant anthropophilic mosquito and has a fairly high parous rate (mean 0.34), Panday states that this species in the Brownsweg area, "may well act as a good vector of pathogens."

An. nuneztovari has not been reported to be an important vector of malaria in the Amazon basin. Deane, Causey and Deane (1948) dissected 405 adults and found all to be negative for *Plasmodium* sp. Recently, in the Maraba area of Para, Brazil, Dixon and Roberts (personal communication) found both *P. falciparum* and *P. vivax* in the local human population in the absence of recognized primary or secondary vectors. Dixon and Roberts stated, "In August 1975, 4 teenage members of a colonist family in Gleba 36 [a small village] became ill with malaria (3 with falciparum and 1 vivax; all denied recent travel from their lote)." Furthermore, a high percentage of the transient workers who are initially negative for *Plasmodium* sp, contract malaria after working a short time in this region. As in Suriname, *darlingi*, thought to be the vector of malaria along waterways, is not collected in the Maraba area. Although *nuneztovari* occurs in high densities in this region, the entomological and/or epidemiological data are insufficient to implicate this species as a vector. Several other anophelines have been collected in this general locality, such as *ininii, oswaldoi, strodei, triannulatus, ?aquasalis, An. (Nys.) allopha, An. (Nys.) braziliensis, An. (Ano.) ?mattogrossensis* and *An. (Ano.)* sp. None of these species has been considered a primary vector with the exception of *?aquasalis* which occurs in relatively low numbers. For these reasons, *nuneztovari*, a known or suspected vector in other countries of northern South America, should be carefully investigated as a potential vector in Para, Brazil.

Scorza, Tallaferro and Rubiano (1976:129-136) attempted to infect *nuneztovari*

experimentally with *P. falciparum* and *P. vivax* and found that this species is highly susceptible to the former. The results for *P. vivax* were unexpected. Mosquitoes that had shown a high rate of early infection with *P. vivax* (55.9% with young oocysts) when dissected after 20 days had neither mature oocysts nor sporozoites. They explained this by the fact that the patient used to infect the mosquitoes had ingested the sporocide pyrimethamine which resulted in suppression of the development of *P. vivax*. The strain of *P. falciparum* used in the experiment was resistant to chloroquine and pyrimethamine.

DISTRIBUTION (fig. 3). *An. nuneztovari* occurs throughout much of the Amazon basin; it is also found in the Guianas, northern Colombia and Venezuela, and eastern Panama. It is not known how far south it occurs in Colombia and Venezuela, nor how far west in the Amazon basin. Cerqueira's report (1943:19) of *goeldii* from Bolivia may refer to *trinkae* or *nuneztovari*.

Material Examined: 529 specimens: 106 males, 61 male genitalia, 153 females, 115 pupae, 94 larvae; 114 individual rearings: 70 larval, 42 pupal, 2 incomplete.

BRAZIL. Amazonas (30 specimens: 9M, 4Mgen, 15F, 1 lp): Manaus, May 1901, Durham, 2F; same locality, Jun 1931, R. Shannon, 7M, 2Mgen; same data, 1F [BM]; same locality and date, 1M, 11F; same locality, 1942, A. Galvao, M.286-2A, 1 lp, 1Mgen. Tefe, 1945, O. Causey, 1M and 1M gen (holotype of *dunhami*), 1F. **Mato Grosso** (6F): Westborder, May 1931, R. Shannon, 6F. **Para** (324 specimens: 63M, 21Mgen, 101F, 89p, 501; 89 ind rear: 501, 39p): Altamira, 163 km W of, 6 Nov 1974, J. Reinert *et al.*, coll. 85, 1 lpM, 1Mgen. Bacuri, Gleba 36, Lote 05, 23 Oct 1974, J. Reinert *et al.*, coll. 31, 1 pM, 1Mgen; same data except Lote 02, coll. 33, 3Mgen, 11 lpM, 6 lpF, 5 pM, 2 pF; same data except 26 Oct, coll. 50, 1Mgen, 4 lpM, 7 lpF, 2 pF; same data except Gleba 34, Lote 05, coll. 51, 1Mgen, 1 lpM; same data except Gleba 29, Lote 09 and 28 Oct, coll. 60, 1 pM; same data except Gleba 34, Lote 02, coll. 62, 5Mgen, 1 lpM, 6 lpF, 13 pM, 6 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 2Mgen, 6 lpM, 7 lpF, 3 pM, 6 pF. Belem, 1944, O. Causey, 3M, ?2F; same locality, 6 Nov 1968, T. Aitken, 4M, 4Mgen; same locality, 29-30 Sep 1970, T. Aitken, A. Toda, 2M, 2Mgen, 2F; same locality, BRB 43. Boa Vista, C. Townsend, 6M, 6Mgen, 11F (including holotype and paratypes of *goeldii*). Curralinho, 1935, H. Kumm, 2F (K.91) [BM 1936-319]; same data, Rio Aracaca, 1F (K.256) [BM1936-319]. Fordlandia, Jun 1931, R. Shannon, 2M, 1Mgen, 8F; same data, 2F [BM]; same locality, 2M, 1F. Itupiranga, 17 Feb 1976, Moramay, 3F (1050). Maraba area, 4 May 1976, 5F (M-6); same locality, 6 May 1976, 1F (M-8); same locality, 2 Jun 1976, 6F (R-3); same locality, 3 Jun 1976, 1F (R-5); same locality, 4 Jun 1976, 2F (M-6); same locality, 6 Jun 1976, 1F (M-8); same locality, 9 Jun 1976, 1F (M-3); same locality, 17 Jun 1976, 3F (A-3); same locality, 23 Jun 1976, 1F (M-11); same locality, 7 Oct 1976, 1M (1261); same locality, 8 Oct 1976, 1M (1262); same locality, 1976, D. Roberts, 10F. Palestina, 100 km SW of Maraba, 21 Sep 1976, Moramay, 1F (N-1252). **Rondonia** (1Mgen, 4F): Guajara Mirim, May 1931, [R. Shannon], 1F. Porto Velho, May 1931, R. Shannon, 1Mgen (43.11.17a), 3F.

COLOMBIA (1F). **Atlantico**: Barranquilla, L. Dunn, 1F.

FRENCH GUIANA (2Mgen). **Inini**: Oyapock, 1Mgen [JH]. Saut Tigre, 30 Oct 1945, 1Mgen (No 778 23A).

GUYANA (2M, 6F). **East Berbice-Corentyne**: Kwakwani, 18 Jan 1942, G. Giglioli, KO 111-18, 1F; same locality and collector, 13 Jan 1943, KO 111-20, 4F. **West Demerara-Essequibo Coast**: MacKenzie, Sep 1945, KO 111-29, 1M. **District not specified**: 1942, G. Bevier, KO 111-8, 1M, 1F.

PANAMA (22 specimens: 5M, 4Mgen, 4F, 5p, 4L&l; 5 ind rear: 1 l, 3p, 1inc). **Darien**: Pucro, PA 630. Rio Tuira, GG 1-159, 43.

SURINAME (35 specimens: 19M, 11Mgen, 5F). **Brokopondo**: Brownsweg, Prof. Dr. Ir. W. J. van Blommestein Meer, 21 Oct 1975, R. Panday, 4F; same locality and collector, 31 Jul 1976, 3M, 1Mgen; same locality and collector, 9 Aug 1976, 6M, 3Mgen; same locality and collector, 7M, 5M gen. **Marowijne**: Moengo, 6 Jun 1945, Guicherit, 1M. **Paramaribo**: Paramaribo, 5-9 Jul 1945, Tillema, 2M, 1Mgen (46-v-8a), 1Mgen (46-v-8b), 1F.

VENEZUELA (96 specimens: 8M, 18Mgen, 11F, 20p, 39L&l; 19 larval ind rear). **Aragua**: Maracay, 1 Aug 1929, R. Hill, 1Mgen (56) [JH]; same locality, 3 Sep 1926, M. Nunez Tovar, 6F.

Barinas: Andres Eloy Blanco, Aug 1977, [P. Cova Garcia], 8 lpM, 11 lpF, 15 L. Locality not specified, Jan 1943, Iriarle [?], 1F. **Cojedes**: San Carlos, 2Mgen; same locality, 1Mgen [JH]. **Zulia**: Mene Grande, 2Mgen (no 3) [JH]; same locality, 6Mgen [JH]. **State and locality not specified**: 27 Dec 1939, A. Gabaldon, 1Mgen [JH]; same collector, [1977], 1 p, 3L, 3Mgen; same collector, 1Mgen [JH]; no data, 1L (1949), 1L (1950), 1Mgen.

STRODEI COMPLEX

FEMALES. No diagnostic characters distinguishing the adult females of this complex from the species in the Oswaldoi Complex are apparent.

MALES. Essentially as in females except for sexual characters.

MALE GENITALIA. Segment IX: Sternite moderately long to long. Anterior apodeme short to moderately long. **Sidepiece**: Parabasal spine moderately long to long, often reaching lateral margin of aedeagus on other side. **Ventral Claspette**: Setae on lateral and ventral margins extending only a short distance toward apex, not as far as level of apical margin of preapical plate, absent from apex. Apex truncate, rugose or deeply striated, expanded laterally into rounded or pointed lobes. Preapical plate oval to circular, distinct. **Phallosome**: Aedeagus rounded apically, without leaflets.

LARVAE. Moderately large to large. **Head**: Inner and outer clypeal hairs (2,3-C) plumose with moderately long branches, or single and barbed; inner clypeals (2-C) widely spaced in *benarrochi* and closely approximated in *strodei*. Hair 4-C short and branched. Collar moderately narrow to narrow dorsomedially, heavily pigmented. **Antenna**: Hair 1-A large in *benarrochi*, small in *strodei*. Hairs 2,3-A moderately developed. **Thorax**: Submedian prothoracic group (1-3-P) usually without 1,2-P sharing a common tubercle. Hair 14-P with a short to moderately short, flattened shaft. **Abdomen**: Hair 0-II moderately small. Hair 5-I moderately large and close to lateral margin of abdomen. Hair 13-I small, numerously branched; 13-IV moderately large in *strodei*, small in *benarrochi*. **Spiracular Lobe**: Lateral arm of spiracular apparatus short in *strodei*, moderately long and heavy in *benarrochi*. **Anal Segment**: Hair 1-X short in *benarrochi*, long in *strodei*; inserted on saddle. Anal gills moderately long to long.

DISCUSSION. The Strodei Complex is characterized in the **male genitalia** by the apex of the ventral claspette being laterally expanded, rugose and without setae. This complex is composed of 3 species. Two of these, *strodei* and *rondoni*, are extremely similar and represent a clearly defined phyletic line. These 2 species share several derived characters. The male genitalia are almost identical, and the larvae reportedly differ only in the number of branches of a few setae. *An. strodei* is widely distributed throughout Central and South America, often being found at relatively high altitudes. *An. rondoni* is limited to the interior of southern South America on the eastern side of the Andes extending south to the northern provinces of Argentina. *An. rondoni* is highly derived in the adult female, possessing a dark basal band on hindtarsal segment 3, and unique and extensive dark spots on the wing.

An. benarrochi is the most derived species in the complex. Partly because it has so many unique characters, its phylogenetic relationship to the rest of the species in the Oswaldoi Subgroup is not clearly understood. On the basis of the male genitalia, I am placing *benarrochi* in this complex, but it may be shown later to be more closely allied with the Oswaldoi Complex. The distribution of *benarrochi* is similar to that of *rangeli*, these species occurring principally in the Orinoco basin and extending south into Brazil and Peru. The adult of *benarrochi* is very similar to that of *aquasalis*, making species identification based on external morphology very difficult. The

larva of *benarrochi* is very different from that of *strodei,* having unique characters such as a large hair 1-A of the antenna and a small, numerously branched hair 13-IV.

11. Anopheles (Nys.) strodei Root

Figs. 1, 4, 7, 27, 28

1926. *Anopheles (Nyssorhynchus) strodei* Root 1926b:711-714. TYPE: *Lectotype* male (64) with associated genitalia on slide (750923-29), a few miles from Agua Limpa, near Juiz de Fora (Minas Gerais), Brazil, 27 Mar 1925 [USNM; designation by Stone and Knight 1956: 280]. RESURRECTED FROM SYNONYMY with *evansi* (Brethes 1926).

1940. *Anopheles (Nyssorhynchus) strodei* var. *ramosi* Unti 1940b:489-491. TYPE: *Syntypes* larvae, Lorena (Sao Paulo), Brazil, Mar 1940 [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *arthuri* Unti 1941:9. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *artigasi* Unti 1941:9. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. TRANSFERRED SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *albertoi* Unti 1941:9-10. TYPE: *Syntypes* eggs, Vale do Rio Paraiba [do Sul] (Sao Paulo), Brazil, elev. ca 500 m [NE]. NEW SYNONYMY.

1941. *Anopheles (Nyssorhynchus) strodei* var. *lloydi* Unti 1941:10. TYPE: *Holotype* egg, Panama, locality not specified [NE]. NEW SYNONYMY.

Anopheles (Nyssorhynchus) strodei of Davis (1928:549-550); Shannon and Del Ponte (1928:45, 46, 54-55); Hill (1930:711-713); Shannon (1931:10; 1933:120); Curry (1932:566-568; 1934: 647); Edwards (1932:45); Root (1932:779); Senevet (1934:52-54; 1948a:278; 1948c:437); Komp (1936a:161; 1941a:88, 93, 96, 97; 1942:39, 40, 43, 71-73, 80, 120-122, 132, 158-159); Galvao, Lane and Correa (1937:41-42); Galvao and Lane (1937a:77, 78; 1937b:275-282; 1937c: 26; 1937d:65-69; 1937e:214, 221-223); Correa (1938:104-109; 1943:126); Galvao (1938a:52, 56-57; 1940:443-447; 1943:143-144, 149, 150; 1950:38-48); Galvao and Amaral (1938:13); Rozeboom (1938a:102-103; 1938b:290; 1941:102; 1942a:240-241); Senevet and Abonnenc (1938:489-494); Galvao and Barretto (1939a:113-114); Barretto (1940:159-164); Lane (1939: 27; 1944:263-266; 1953:271-273); Gabaldon, Lopez and Ochoa Palacios (1940:34-35); Unti (1941:3-18); Correa and Ramos (1942a:37-46; 1943:35, 36; 1944b:131; 1944c:11); Fonseca and Fonseca (1942:94); Komp (1942:43, 71-72, 81, 120-122, 132, 158-159); Simmons and Aitken (1942:39, 46, 53, 62, 96-97); Fonseca and Unti (1943:43, 45, 47-49); Kumm, Bustamante and Herrera (1943:373-375); Unti and Ramos (1943:27-28); Causey, Deane and Deane (1944:2, 5, 6; 1946:26); Deane, L. P., Causey and Deane (1946:6, 8, 9, 12; 1948:904-906); Deane, M. P., Causey and Deane (1946:42, 45); Floch and Abonnenc (1946b:3-5; 1947:7; 1951:55-57); Gabaldon and Cova Garcia (1946b:118-120; 1952:184, 196, 201); Amaral and Penido (1947:168); Arnett (1947:198; 1950:103, 106, 110, 113); Bates and de Zulueta (1949:132); Levi-Castillo (1949:9-11, 16, 28, 58, 67, 72-73, 77, 82, 86); Duret (1950a:372; 1950b:302; 1952:347-348); Vargas and Martinez Palacios (1950:130-133; 1956:129-132); Carvalho and Rachou (1951:474-477, 480); Martinez and Prosen (1951:38); Pinotti (1951:670); Rachou and Ferraz (1951:542-543, 547-553); Rachou and Ricciardi (1951:425-426, 432-437); Horsfall (1955:185); Bejarano (1956:9, 20; 1957:326, 327, 331-333, 337-339; 1959:317, 325); Schreiber and Pompeu Memoria (1956:1-3); Vargas V. (1956:29; 1957; 1958a; 1958b); Guedes, Amorim and Schreiber (1957: 247-248); Rachou, Moura Lima, Ferreira Neto and Martins (1958:417, 421, 423); Rachou (1958:148); Castro (1959a:175); Castro, Garcia and Bressanello (1959:549, 550); Stone, Knight and Starcke (1959:32); Schreiber and Guedes (1959b:128-129; 1960:356-357; 1961:658); Vargas (1959:377, 382); Cerqueira (1961:127); Forattini (1962:388-394); Aragao, Ferreira Neto and Martins (1973:291); Consolim and Galvao (1973:177-179, 181); Cova Garcia and Sutil O. (1975a:19; 1975b:213; 1977:19, 43, 64, 84); Cova Garcia, Pulido F. and Amarista M. (1978: 157).

Anofeles (!) *(Nyssorhynchus) strodei strodei* of Unti (1940b:493-505).

Anopheles strodei of Benarrochi (1931:691); Kumm (1932:4; 1941b:93-97); Galvao (1938c:133-134); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Kumm, Komp and Ruiz (1940: 388, 389, 391, 412, 419); Vargas (1941:110, 118, 120; 1950:106, 121); Unti and Ramos (1942:94-105); Russell, Rozeboom and Stone (1943:49-50); Castellanos, Murrieta, Lassman and Ortiz (1949:34); Senior-White (1951a:294); Renjifo and de Zulueta (1952:600-601, 610); Vargas and Martinez Palacios (1955:82-83, 106, 114, 121); Vargas V. (1958c:1, 3); Foote and Cook (1959:22, 23); Schreiber and Guedes (1959a:97-98); Cova Garcia (1961:40-41, 67, 92-93, 114, 129-130, 155); Maciel (1962:471-473); Vincke and Pant (1962:2, 4, 6, 7, 10); Mattos and Xavier (1965:273-274); Cova Garcia and Sutil O. (1975a:19; 1975b:213).

Nyssorhynchus (Nyssorhynchus) strodei of Lima (1928:100-102).

Anopheles (N.) strodei ramosi of Unti (1941:10).

Anopheles (Nyssorhynchus) evansi of Root (1927:477); Dyar (1928:438); Pinto (1930:153-154, 156-157; 1932:287, 293; 1939:425-427); Senevet (1931:108; 1932:252); Komp (1941b:801-802); Martinez, Prosen and Carcavallo (1959:111-112).

Anopheles (Nyssorhynchus) evansae of Stone, Knight and Starcke (1959:32); Fauran (1961:10); Stojanovich, Gorham and Scott (1966a:10, 19, 32; 1966b:18, 29, 41); Gorham, Stojanovich and Scott (1967:17, 43, 54; 1973:114, 135, 144); Belkin, Schick and Heinemann (1968:10; 1971: 5); Vargas (1976:87, 88, 89).

Anopheles tarsimaculata in part (?) of Howard, Dyar and Knab (1917:978); Petrocchi (1923:139).

Cellia tarsimaculatus in part (?) of Neiva and Penna (1916:94); Peryassu (1921a:70); Neiva and Pinto (1922a:321; 1922b:355-357).

Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.3 mm. Proboscis: 2.0 mm. Palpus: 2.0 mm. Forefemur: 1.4 mm. Abdomen: 2.8 mm. Highly variable in size and diagnostic characters. **Head**: Integument light brown to very dark brown. Proboscis about 1.4 length of forefemur. Scales on vertex and occiput predominantly white; occiput with white to cream, cuneate scales extending caudolaterally onto median occiput; erect scales on vertex very conspicuous, long, white, lanceolate to cuneate, and tapering into thread-like stalk at base. Dorsal surface of palpal segments 2 and 3 with a few light scales more extensive on segment 3; apices of 2 and 3 with a white band; segment 4 with a basal and an apical brown band, and often with a narrow brown stripe on ventral surface; segment 5 completely white. **Antenna**: Flagellar segment 1 with elongate white scales on dorsomesal surface, and with an incomplete ring of small scales at base. Flagellar segments 2-13 each with a basal whorl of 8-10 setae. **Thorax**: Integument reddish brown to dark brown. Light scales of scutum and scutellum silver to white. Anterior promontory area with elongate scales extending dorsad onto acrostichal line. Humeral tuft scales numerous and prominent. Prescutellar space moderately small and usually horseshoe shaped. *Sp* with numerous (6-9), moderately long, light setae. Upper *stp* with 3-6 long setae and a horizontal patch of about 10 obovate to lanceolate, gray to white scales. Lower *stp* with 1,2 long setae and a small patch of scales similar to those on upper *stp*. Upper *mep* with 6-8 long, cream setae; scales absent. **Legs**: Light scales on coxae usually white or very light cream. Midfemur with both anteroapical spot and knee spot fairly large and conspicuous. Foretarsal segments 2 and 3 with a cream to white band in apical 0.25 (0.18-0.35) and 0.5 (0.25-0.80) respectively; segment 4 all brown, occasionally with a few, lighter, apical scales; segment 5 usually one color, golden to brown or with a few lighter apical scales, rarely with apical 0.5 lighter than basal 0.5. Midtarsal segments 1 and 2 with a small, golden to white, apical band in about 0.1 and 0.1-0.4 respectively; segment 3 either all dark or with a small, golden to cream, apical band; segment 4 all dark; segment 5 usually with a small cream band in less than apical 0.3. Hindtarsal segment 2 with a brown band in basal 0.35-0.45 (0.30-0.50). **Wing**: Lengths of wing spots variable. Light wing spots usually white, occasionally very light cream on vein C; in general, light spots relatively large. Vein C

humeral light spot 2.0-4.0 (1.2-4.1) of basal dark spot; often sectoral light spot absent; subcostal light spot moderately large, 0.35 (0.25-0.50) of subcostal dark spot; preapical light spot variable, 0.2-0.5 of preapical dark spot; apical dark spot small. R presectoral and sectoral dark spots small, occasionally sectoral spot absent. Vein M with preapical dark spot not extending onto M_{1+2}. Remainder of light spots on wing usually small but variable. Apical light fringe spot small to moderately large, usually divided; additional light fringe spots at apices of R_{4+5}, M_{1+2}, M_{3+4}, Cu_1, Cu_2 and A; a light fringe spot at level of 0.5 distance from base of A. **Abdomen**: Sternite I with a few, moderately short, lateral setae, and long median setae in basal 0.5, occasionally with a few, inconspicuous, lanceolate, light scales. Dark caudolateral scale tufts on segments II-VII with large cuneate scales.

MALE. Wing: 3.4 mm. Proboscis: 2.6 mm. Forefemur: 1.55 mm. Abdomen: about 3.15 mm. Essentially as in female except for sexual characters. Size extremely variable. **Head**: Palpal segments 2 and 3 with a conspicuous, cream to white, dorsal stripe; segment 4 extensively light, white basally and apically with a dark subbasal band; medially 4 predominantly cream to white, occasionally with a speckling of dark scales. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with numerous, long, white, oblanceolate scales on dorsomesal surface; long mesal setae of flagellar whorl 1 distinctly white; occasionally setae white on mesal margins of flagellar whorls 2-5. **Legs**: Forefemur about 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with 6,7 long, spiniform setae; longest setae about 0.3 length of segment. Claw on foreleg moderately large, curved and acuminate; submedian tooth moderately thick, tapering to slightly recurved tip; basal tooth large, decurved and blunt.

MALE GENITALIA (fig. 27). **Segment VIII**: Tergite and sternite with moderately narrow, light, obovate scales. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme subtriangular to subtrapezoidal, moderately long, about 0.15-0.25 length of sternite. **Sidepiece**: Tergal surface with 4-6 long, submedian tergomedial bristles and 1,2 long, subapicolateral bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine moderately slender and tapering, long, usually at least 2.0 length of its tubercle; apex of parabasal spine almost reaching lateral margin of aedeagus on other side. Basal apodeme moderately long and thick. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine about 0.8 of longer spine. Internal spine subequal to shorter accessory spine. **Clasper**: Spiniform heavy, fusiform, moderately short, shorter than seta *b*. **Dorsal Claspette**: Long, equal to or slightly greater than 0.5 length of sidepiece. Pedicel moderately broad; base usually not curved mesad. Leaflets slightly less than 0.5 length of claspette, strongly concave mesally; dorsal leaflet with a small basomesal projection. **Ventral Claspette**: Large, 0.45-0.52 length of sidepiece; apex very wide, width at apex 0.5-0.6 length of claspette. Basal lobule large, expanded laterally and occasionally bending ventrad at base so that setae distributed over basal margin project caudad; setae along basal margin long, 2.0-3.5 width of aedeagus. Apex without setae, more or less truncate and rugose or deeply striated, with a small, V shaped median sulcus. Apex strongly expanded laterally into large rounded lobe; apicolateral lobe with convex basal and lateral margins, and usually weakly concave apical margin; depending on angle of observation, apex occasionally medially produced into small, hemispherical cap with median sulcus at its vertex. Setae on lateral margins extending toward apex to base of apicolateral lobes. Preapical plate moderate, oval to circular, weakly to moderately sclerotized and moderately well-defined, located about 0.25 length of claspette basad of apex. Refringent structure in shape of

inverted horseshoe. **Phallosome**: Aedeagus about 0.5 length of sidepiece; apex rounded, slightly longer than wide; without leaflets.

PUPA (fig. 27). Abdomen: 2.75 mm. Trumpet: 0.5 mm. Paddle: 0.8 X 0.5 mm. Pupa very similar to that of *triannulatus*. **Cephalothorax**: Dark brown. Hairs 1-3-C moderately long; 2-C 3 branched, subequal to 1,3-C; 1,3-C 2,3 branched. Hairs 4,5-C 3,4 branched or forked, subequal in length. Hair 6-C 2,3 forked distally, long. Hair 7-C 1-3 branched near base, long, one branch conspicuously longer, 1.5-2.0 length of other branch(es). **Trumpet**: In general, similar to that of *aquasalis*. Pinna amber; long, about 3.8-4.6 (3.7-4.8) length of meatus; in lateral aspect, appearing broad medially and tapered toward apex. Meatal cleft moderately open, basally pointed. **Metanotum**: Hair 10-C single, moderately long, equal to or slightly shorter than 11-C. Hair 11-C 3-6 branched usually near base. Hair 12-C 1-4 forked, about 1.75 length of 10-C. **Abdomen**: Pigmented as cephalothorax. Hair 2-I 5-7 branched near base, moderately long; hair 3-I about 0.75 length of 2-I. Hair 4-I about 5-7 branched. Hair 5-I single or double, long. Hair 6-I single or double, very long (0.35 mm). Hair 7-I 3 branched, 0.5 or less length of 6-I. Hair 9-I single, subequal to 6-I. Hair 0-II-VII moderately large; 0-II 4-6 branched; 0-III-V 3-6 branched; 0-VI 2-4 branched; 0-VII 1-4 branched. Hair 1-II,III 5-8 (3-8) and 4-7 (3-7) branched respectively, strongly developed; 1-IV-VII strong, very long, about 1.6-2.0 length of segment. Hair 3-IV 4-6 branched, large; 3-V 2-4 forked (2-5), long. Hair 5-II 3-5 branched, moderately long; 5-III,IV 5-8 and 3-5 (2-5) branched respectively, large; 5-V-VII single or often 5-V double, long, all equal to or longer than length of segment. Hair 6-II 1-3 forked, very long, at least 2.0 length of 7-II. Hair 7-II 3-5 branched near base. Hairs 7-III-V, 8-III-VII branched near base, moderately developed; 7,8-III 3-5 branched; 7,8-IV 2-4 branched; 7-V 3,4 branched; 7-VI long, equal to or slightly longer than 0.5 length of segment; 8-V-VII 2-4 branched. Hair 9-II thin, small, unpigmented; 9-III stout, short, less than 2.0 length of 9-II, unpigmented to strongly pigmented; 9-IV about 2.0 of 9-III; 9-V stout, slightly curved, 1.8-2.3 (1.7-2.3) of 9-IV; 9-VI curved, moderately long, 1.1-1.5 (1.1-1.8) of 9-V, much shorter than 9-VII,VIII; 9-VII 1.5-2.0 of 9-VI; 9-VII,VIII thin, tapering to fine point, very long, usually equal to or longer than 0.5 length of segment. Hair 10-III 3-5 branched near base, moderately long. Hair 4-VIII 2-4 forked, subequal to 9-VIII. Sum of branches of hairs 1-III, 5-III and 0-VI less than 18. **Terminal Segments**: Male genital lobe broad, heavy, lateral margin tapering at slight angle from base toward apex, appearing thicker than those of other species, with distinct mammilliform protuberance. **Paddle**: Large, obovate, very weakly emarginate at insertion of hair 1-P. External buttress 0.6 length of paddle. External margin distad of buttress with moderately short, filamentous spicules extending around apex and along inner margin to 0.5 from base. Hair 2-P 1, 2 forked, subequal to 1-P.

LARVA (fig. 28). Head: 0.6 mm. Antenna: about 0.3 mm. Anal Saddle: about 0.3 mm. Highly variable, several differences between Panamanian populations and southeastern Brazilian populations. **Head**: Dark reddish brown, heavily pigmented. Inner and outer clypeal hairs (2,3-C) single and barbed in about apical 0.5; hairs 2-C closely approximated, clypeal index about 3.0-4.0; 3-C about 0.6 length of 2-C. Hair 4-C 1-4 branched, small to moderately small, usually not reaching base of 2-C. Hairs 8,9-C 2-7 branched near base, 2.0 length of distance separating insertion of 2-C and 3-C. Hairs 10,12-C 2-4 and 3-5 branched respectively, subequal to 8,9-C. Hair 15-C 1-3 branched, long. Collar moderately thin dorsomedially, heavily pigmented. **Antenna**: Moderately to heavily pigmented. Mesal margin with moderately thin, very sharp spicules. Hair 1-A 4-6 branched, short. **Thorax**: Submedian pro-

thoracic group (1-3-P) not sharing a common tubercle; rarely 1,2-P sharing common tubercle; palmate hair 1-P with 13-17 narrow, lanceolate leaflets; 2-P with a small sclerotized tubercle, 16-23 (16-24) branched, apical branches subequal to lateral. Hair 14-P 7-13 branched from a short to moderately long stalk. Mesothoracic hair 1-M 31-35 branched, ovate in outline, apical branches much shorter than lateral. Metathoracic palmate hair 3-T with 10-16 narrow, semitransparent leaflets, moderately small. Hair 4-T 3-5 branched (2-5), small. Pro-, meso- and metathoracic pleural group spines moderately developed, prothoracic spine slightly longer than meso- and metathoracic spines. **Abdomen**: Hair 0-II-VI 5-8 branched (4-9), moderately long to long. Palmate hair 1-I with 12-16 (11-16) semitransparent, spreading, narrow, pointed leaflets; 1-II-VII with pigmented, long, moderately narrow to moderately broad, pointed leaflets. Hair 2-II 4-6 branched; 2-V single, long. Hair 5-I 3-5 branched, moderately small; 5-III 8-11 branched. Hair 9-I 5-7 branched; 9-IV,V 10-13 (6-13) and 7-13 branched respectively. Hair 11-I 3,4 branched, medium. Hairs 13-I,II,III 5-8, 7-10 and 7-11 branched respectively, small; 13-IV 4-6 branched (4-7), moderately large; 13-V 4-6 branched, very large, extending beyond caudal margin of segment. **Spiracular Lobe**: Pecten with 14-17 teeth; median teeth mostly subequal; number and placement of long teeth variable; serrations on basal half of teeth from short to moderately long. Lateral arm of spiracular apparatus short to moderately short. Hairs 8,9-S 4-7 and 5-7 (4-9) branched respectively, moderately developed. **Anal Segment**: Covered with very thin, moderately long spicules becoming longer at apex. Saddle reddish brown with irregular lateral and apical margins. Hair 1-X long; inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation; inserted about 0.3 cephalad of caudal margin. Hair 2-X relatively short, about 0.7 length of 3-X. Anal gills longer than saddle.

DISCUSSION. *An. strodei* can be distinguished from the other species in the Oswaldoi Group in the **female** (except for *anomalophyllus*, and occasionally *noroestensis* and *trinkae*) by the combination of (1) palpal segment 4 often with a narrow brown stripe on ventral surface, (2) light scales on coxae usually white or very light cream, (3) foretarsal segments 2 and 3 cream to white in apical 0.25 (0.18-0.35) and 0.5 (0.25-0.80) respectively, (4) foretarsal segment 5 usually entirely golden to brown or with a few light apical scales, rarely with apical 0.5 lighter than basal 0.5, (5) midtarsal segment 5 usually with a small cream band in less than apical 0.3, (6) hindtarsal segment 2 brown in basal 0.35-0.45 (0.30-0.50), (7) light wing spots usually white, occasionally very light cream on vein C, (8) basal dark spot of vein C small, humeral light spot 2.0-4.0 (1.2-4.1) of basal dark spot, (9) subcostal light spot of vein C 0.25-0.50 of subcostal dark spot and (10) abdomen with dark caudolateral tuft scales large and cuneate; in the **male genitalia** by (1) apex of ventral claspette very wide, width at apex 0.5-0.6 length of claspette, without setae, more or less truncate, rugose or deeply striated, strongly expanded laterally into large rounded lobe which is convex on basal and lateral margins and weakly concave on apical margin, (2) setae along basal margin of basal lobule long, 2.0-3.5 width of aedeagus, (3) setae on lateral margins of ventral claspette extending toward apex only to base of apicolateral lobes, (4) preapical plate moderate, oval to circular, weakly to moderately sclerotized, moderately well-defined and (5) apex of aedeagus without leaflets, slightly longer than wide; in the **pupa** by the combination of (1) hair 7-C with one branch conspicuously longer, 1.5-2.0 length of other branch(es), (2) pinna long, 3.8-4.6 (3.7-4.8) length of meatus, with basally pointed meatal cleft, (3) hair 10-C single, moderately long, equal to or slightly shorter than 11-C, (4) hair 12-C 1-4 forked, about 1.75 length of 10-C, (5) hair 5-II 3-5 branched, moderately long, (6) sum of branches of hairs 1-III,

5-III and 0-VI less than 18, (7) hair 6-II 1-3 forked, very long, at least 2.0 length of 7-II and (8) hair 9-III stout, short, less than 2.0 length of 9-II, 9-V 1.8-2.3 (1.7-2.3) of 9-IV, 9-VII thin, tapering to fine point, very long, 1.5-2.0 of 9-VI and about 0.5 length of segment; and in the **larva** by the combination of (1) hairs 2,3-C single and barbed, hairs 2-C closely approximated, clypeal index about 3.0-4.0, (2) collar moderately thin dorsomedially, heavily pigmented, (3) hairs 1,2-P rarely sharing common tubercle, palmate hair 1-P with 13-17 narrow leaflets, 2-P 16-23 branched (16-24), (4) hair 1-M 31-35 branched, ovate in outline, apical branches much shorter than lateral, (5) hair 13-V very large, extending beyond caudal margin of segment and (6) hair 1-X inserted on saddle near ventral margin, or rarely on ventral margin at base of indentation.

An. strodei varies throughout its geographic range. Unfortunately with regard to the immatures, only material from Colombia, Venezuela, Panama and Brazil was available for this study. The only individually reared specimens examined came from Brazil, Colombia and Panama. In general, the immatures from Brazil are much larger and darker than those from Colombia, Venezuela and Panama. In larvae from Sao Paulo, Brazil, hair 8-C is 4 or 5 branched, whereas in the Panamanian specimens it is 1-3 branched. Also, hair 9-III-V in the Brazilian specimens has fewer branches (1-6) than it does in the Panamanian specimens. As in the immatures, the adult females from the states of Mato Grosso and Sao Paulo, Brazil are much larger and darker than those from Central America. Although not showing any geographical variation, foretarsal segment 5 in the adults is usually of uniform color, which is unique in the Oswaldoi Subgroup; only rarely is it 0.5 apically light, 0.5 basally dark. As evident in the description of the adult female, the relative sizes of the wing spots are highly variable; in one specimen from Panama the subcostal light spot of vein C is longer than the subcostal dark spot, similar to that of *rangeli.*

Although it was not possible to examine the eggs of *strodei* for this study, it should be mentioned that the eggs are extremely diverse. Five different varieties (*typicus, artigasi, arthuri, albertoi, lloydi*) were described by Unti (1940b; 1941) based on variations in the morphology of the egg. Rozeboom (1938a:102-103, 106) recognized 3 different types of eggs designated Types A, B and C from Panama, about which he stated, "it seems unlikely that the different types of *strodei* eggs were deposited by separate races, as they were all collected from the same breeding place at the same times, and there were all kinds of gradations between the extremes." Galvao (1943:143-144) recognized 3 major types of eggs representing different forms, including Rozeboom's types. The great variation in the eggs and in the other stages has lead to *strodei* being considered a complex of species similar to the *Anopheles (Ano.) maculipennis* Meigen 1818 complex of Europe or the *An. (Cel.) gambiae* Giles 1902 complex of Africa. Other important papers written on the eggs of *strodei* are those of Galvao and Lane 1937b:272-275; Galvao 1938a:56-57, 1940:445; Galvao and Barretto 1938:113-114; Kumm 1941b:94-97; and Rozeboom 1942a:240-241.

Besides the diversity in the external morphology, there is considerable variation in the banding patterns of the salivary chromosomes of *strodei.* Several workers (Schreiber and Pompeu Memoria 1956:1-3; Guedes, Amorim and Schreiber 1957: 247-248; Schreiber and Guedes 1959b, 1960, 1961) have studied the salivary glands of *strodei* and have found many heterozygous inversions, asynaptic zones and (rarely) translocations in the chromosomes. These authors stated they were able to locate 3-11 "anomalous zones" per nucleus. This is in contrast with the cytogenetics of some of the other species in the section which have been studied. *An. aquasalis* and *albi-*

manus show no chromosomal variation in the populations that have been examined, and *nuneztovari* has only one homozygous inversion. Schreiber and Guedes (1961) hypothesized that the high degree of polymorphism in the chromosomes of *strodei* is correlated with the great variation in the morphology of the eggs.

Whether or not *strodei* represents a complex of species cannot be ascertained with any confidence with the information presently available to me. Until more material and more data concerning the bionomics and genetics are available, I am treating *strodei* as a single species.

The closest ally to *strodei* is *rondoni.* The male genitalia of *strodei* and *rondoni* are almost identical except that in *rondoni* the setae on the ventral claspette do not extend toward the apex to base of apicolateral lobes. Differences reported to distinguish *rondoni* from *strodei* are listed in the discussion of *rondoni.*

I no longer consider *evansi* as the valid name of the presently discussed species. Brethes (1926a) described, in French, *evansi* from material that was sent to him from Tucuman, Argentina by N. C. Davis. In another description (1926b) in Spanish, Brethes included a mislabelled diagram of the male genitalia of *evansi* which is impossible to identify as any particular species in the Albimanus Section. Later the same year, Root (1926b) described *strodei* from the state of Minas Gerais, Brazil, and clearly illustrated the diagnostic characters of this species in all the life stages except the egg. The following year, for some reason that is unclear to me, Root (1927:477) included *strodei* as a synonym of *evansi* in a paper on *Chagasia fajardi* (Lutz 1904). Davis (1928:549-550), who furnished Brethes with the type material of *evansi,* referring to Brethes' description stated, "It is true that some Anophelines showing the genitalic characteristics of *strodei* have been taken in northern Argentina . . . but by far the greater number are of the type which Root accepts as *tarsimaculatus.*" Davis then pointed out the errors Brethes made in labelling his diagram, and said that it is "barely possible" that Brethes was working with both *tarsimaculatus* and *strodei,* and that drawings of the male genitalia represent a composite. In either case I agree with Davis that Fig. 2C of Brethes (1926b), which appears to be the spiculose apex of a ventral claspette, does not look like anything seen in *strodei.* Also, the ninth sternite in fig. 2A appears to be too broad to be *strodei.* Lima (1928:100-102) wrote that Davis had told him that what Brethes described was not *strodei,* but that since he (Davis) had not seen the type he was not sure of the validity of *evansi*; also Davis again stated that possibly *evansi* was the same as *tarsimaculatus.* Shannon and Del Ponte (1928:54) synonymized *evansi* with *tarsimaculatus,* giving as evidence the figure of the ventral claspette. According to Bejarano (1957:336), Del Ponte, in his unpublished 1941 thesis on the revision of the Argentine species of *Anopheles,* stated that possibly specimens classified by Brethes as *evansi* could be *oswaldoi.* Casal (in Belkin, Schick and Heinemann 1968:10) designated the lectotype male genitalia slide of *evansi* which had the following Brethes label, "*Cellia evansi* Brethes=tarsimaculata auct. (nec Goeld), Tucuman, N. C. Davis ded., III.1926, Pr. micr. An. M.," in Del Ponte's hand "384," "DP14," "DP14=?noroestensis G. y L., 1938 [signature in ink], Tipo de evansi." From this label it is apparent that Del Ponte looked at the male genitalia of *evansi* some time after 1937 and tentatively synonymized *noroestensis* with *evansi,* in which case *evansi* would become the valid name for *noroestensis.* Gabaldon (1949:765), writing about the vector status of West Indian and South American anophelines, also considered *noroestensis* and *clarki* as synonyms of *evansi.* However, not having examined the type specimen of *evansi,* I am not proposing at this time any nomenclatorial changes regarding the biological species *noroestensis.* I am only considering *strodei* as the valid name of the species described here, since it has

been extensively used in the past in referring to this taxon, and because there is substantial evidence that the lectotype of *evansi* does not represent this species. For the present, I am considering *evansi* as a *nomen dubium.*

As in the adult females of some of the other species in the Albimanus Section, mutants or anomalous specimens of *strodei* have been described with extra black rings on hindtarsal segments 3, 4 and 5, segments 3 and 4, and segments 4 and 5 (Rachou and Ferraz 1951:542-543).

BIONOMICS. The immatures of *strodei* occur predominantly in ground pools. In addition, it has been collected from animal tracks, ponds, lakes, swamps, stream margins, potholes, marshy depressions, ditches, seepage areas and rock holes. It is found only in fresh water, usually in the full sun or partial shade but occasionally in deep shade. It occurs over a wide range of elevations, from near but usually not on the coast to altitudes of 1600 m (Unti 1941). It is commonly found in mountainous areas, plains and plateaus in the interior. The immatures usually are associated with abundant vegetation such as grasses, algae and *Utricularia* sp. Galvao (1940:443-447) stated that the immatures can tolerate large fluctuations in temperature (17.5-33.0° C), pH (5.9-7.2) and amounts of organic material. Unti (1941) has reported collecting the larvae in water as cold as 2°C. He also found *strodei* in water poor or rich in organic material, varying in nitrate concentration from 0.008% to 0.064%, and in water with sometimes high concentrations of bicarbonates or sulfates. On one occasion, he discovered immatures in water with a pH of 4.0 and a high sulfate residue from a nearby paper plant. The larvae have been collected with 3 other species of *Nyssorhynchus, allopha, argyritarsis* and *rangeli.* They have been collected with 32 other species of mosquitoes: *Aedes (Och.) crinifer, Ae. (Och.) dupreei* group sp B of Heinemann and Belkin 1979:79, *Ae. (Och.)* sp, *Anopheles (Ano.) ?apicimacula, An. (Ano.) eiseni, An. (Ano.) neomaculipalpis, An. (Ano.)* sp, *Culex (Cux.) coronator* group, *Cx. (Cux.) declarator* group, *Cx. (Cux.) mollis, Cx. (Cux.) nigripalpus, Cx. (Cux.) thriambus, Cx. (Cux.)* spp 72 and 85 of Heinemann and Belkin 1978a:184, *Cx. (Mel.) bahiense, Cx. (Mel.) bastagarius, Cx. (Mel.) chrysonotum, Cx. (Mel.) conspirator, Cx. (Mel.) dunni, Cx. (Mel.) dureti, Cx. (Mel.) educator, Cx. (Mel.) ?egcymon, Cx. (Mel.) erraticus, Cx. (Mel.) ?inadmirabilis, Cx. (Mel.) ?iolambdis, Cx. (Mel.) pilosus, Cx. (Mel.)* sp, *Psorophora (Gra.) cingulata* group, *Uranotaenia (Ura.) coatzacoalcos, Ur. (Ura.) lowii, Ur. (Ura.) pulcherrima, Ur. (Ura.)* sp.

The adult females of *strodei* are exophilic, feeding predominantly on mammals other than humans. They only rarely enter houses to feed; in Brazil, Deane, Causey and Deane (1948:905) collected 1895 adults of *strodei* of which only one was from inside a house. In host preference studies using a human and a horse as bait in Alagadico in 1942, Deane, Causey and Deane (1948:906) collected 17 females on the human and 23 on the horse during the crepuscular hours. Kumm, Komp and Ruiz (1940:388) in Costa Rica and Rozeboom (1938b:290, 293) in Panama occasionally found *strodei* inside houses, but usually *strodei* showed a preference for animals and fed outside. The only exception was reported by Correa (1938), who found a very high density of *strodei* at the Fazenda Santa Alice in the state of Sao Paulo, Brazil, and collected 165 females from inside a house which represented 95.3% of all anophelines captured. In Panama (Curry 1932:566; Rozeboom 1938b:290) and Colombia (Renjifo and de Zulueta 1952:601; Bates and de Zulueta 1949:135-137), the peak abundance of *strodei* is during the early part of the dry season. In Santa Catarina, Brazil, *strodei* occurs in the lowest numbers during the cold months. The adults are usually most active around dusk, although they are reported to feed throughout the night (Deane, Causey and Deane 1948:904-906; Barretto 1940:160).

MEDICAL IMPORTANCE. *An. strodei* does not seem to be an important vector of malaria. As mentioned earlier (p 18), it has been incriminated only once as a vector of malaria, and that was by Correa (1938) at the Fazenda Santa Alice, Sao Paulo, Brazil. In that study Correa dissected 163 females collected inside houses and found 2 of them (1.2%) naturally infected with oocysts. Galvao and Lane (1937d), Galvao (1938c), and Fonseca and Unti (1943) have easily and successfully experimentally infected *strodei* with *Plasmodium vivax.* Because of its predominantly exophilic and zoophilic habits, *strodei* can be considered a possible health problem only when it occurs at very high densities.

DISTRIBUTION (fig. 1). *An. strodei* is widely distributed throughout Central America and much of South America east of the Andes. Its northernmost limit is reported to be the state of Veracruz, Mexico on the Gulf of Mexico; on the Pacific side it is reported from as far north as the Costa Rica-Nicaragua border. In South America, it is found in northern and eastern Colombia, Venezuela, the Guianas, Brazil, Bolivia, Paraguay and northern Argentina. *An. strodei* is found on the eastern slope of the Andes in Colombia, Bolivia and northern Argentina; it is presumably also found in eastern Ecuador and Peru, although there are no records. It is not known if it occurs on the Pacific slope of the Andes, although it is reported to occur in the Magdalena River drainage in northern Colombia. The southernmost limit east of the Andes is in the province of Buenos Aires, Argentina. *An. strodei* does not occur on any of the Caribbean islands, including Trinidad and Tobago.

Material Examined: 566 specimens: 63 males, 25 male genitalia, 146 females, 41 pupae, 291 larvae; 41 individual rearings: 21 larval, 12 pupal, 8 incomplete.

ARGENTINA (1M, 1F). **Tucuman:** Locality not specified, 23 Aug [?1941], Alvarado, 1F; 28 Aug 1941, 1M.

BOLIVIA (6F). **Santa Cruz:** Loma Alta, 19 May 1944, 3092, KO 111-22, 4F. San Antonio del Parapeti, 9 May 1944, 3151, KO 111-26, 2F.

BRAZIL. Amazonas (6F): Manaus, Jun 1931, R. Shannon, 6F. **Bahia** (3F, 7L): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 3F. Prado, 1F [JH]. Salvador da Bahia, 1972, J. Fowler, BRS 277, 3L; same data, BRS 278, 4L. **Minas Gerais** (6 specimens: 2M, 1Mgen, 2F, 1L): Agua Limpa, near Juiz de Fora, 27 Mar 1925, [F. Root], 1M (64) and 1Mgen (750923-29, lectotype of *strodei*), 1F (64, paratype of *strodei*); same data, 1M (64), 1L (paratypes) [JH]. Lassance, 12 May 1925, [F. Root], 1F (81) [JH]. **Para** (14 specimens: 1M, 7F, 3p, 3 l; 3 larval ind rear): Maraba area, 7 Jun 1976, 2F (M-1); same locality, 18 Jun 1976, 1F (M-4); same locality, 21 Jun 1976, 1F (M-9); same locality, 25 Jun 1976, 1F (M-13). Palestina, 100 km SW of Maraba, 12 Feb 1976, Moramay, 1 lpM (1001); same data except 14 Feb, 2 lpF (1002). **Rondonia** (1F): Guajara Mirim, May 1931, R. Shannon, 1F. **Sao Paulo** (80 specimens: 14M, 10Mgen, 14F, 15P&p, 27L&l; 15 ind rear: 12 l, 2p, 1inc): Boraceia Field Station, BRA 114, 150, 151, 157. Itapetininga, 28 km W of, BRA 166, 167. Itapira, 1Mgen (No. 3, SPM-88, 89). Juquia, J. Lane, 1F (1.113). Porto Ferreira, 1M, 1Mgen. Santos, 1F. Sao Paulo, Butantan, 1939, [Worontzow], 1M (191-3), 1M (191-9) [JH]; same locality, 707, 3M, 3F [JH]. Sao Paulo de Piracicaba, A. Ayroza, 1Mgen (No. 4, SPM 88). Sao Paulo, Pinheiros, 1937, A. Galvao, 5M; same locality and collector, 1940, 2M. Sao Pedro, 1F (No. 4). Locality not specified, 1Mgen (No. 5, SPM 88, 89); 1943, 1Mgen (819-27); Galvao, 1 l (14-18) [JH]. **State and locality not specified** (2M, 1Mgen): J. Lane, 1M (851), 1M (854), 1Mgen (740515-33).

COLOMBIA (10 specimens: 2F, 1p, 7L&l; 1 inc ind rear). **Meta:** Villavicencio, Mar 1946, 2L (425) [JH]; same locality, 6 May 1947, L. Rozeboom, CV-P 26, 1F; same locality, 9 May 1947, 1 lp, 4L [JH]; same locality, 1947, L. Rozeboom, CV-P 32, 1F.

COSTA RICA (3F). **Province not specified:** Barranca, H. Kumm, 1F (84) [BM1938-696]. No data, 2F.

PANAMA AND CANAL ZONE (402 specimens: 43M, 8Mgen, 93F, 19P&p, 239L&l; 19 ind rear: 5 l, 10p, 4inc). **Bocas del Toro:** Punta de Pena, PA 238. **Canal Zone:** Chiva Chiva, 15 Aug 1944, Wood, ASM 102, 1L; same locality, 18, 20 Mar 1947, 2M, 1F; same locality, 20 Mar 1947, 2 F. [Ft.] Clayton and Corozal Army Reservations, Feb 1943, 1M, 2F. Ft. Clayton, 24 Apr 1944,

P. Adams, 2L. Stilsons Lake [Pond], 21 Oct 1924, D. Curry, 1Mgen. Locality not specified, Feb 1933, D. Curry, 3M [BM1933-504]. **Chiriqui:** El Hato del Volcan, PA 636, 637. Palo Santo, PA 646. **Panama:** Arraijan, 6 Feb 1940, PAX 166, 7M, 11F. Bejuco, PA 542. Juan Diaz, 4 Jan 1935, 3F; same locality and date, L. Rozeboom, 1L [JH]; same locality, 2 Dec 1936, 1F; same locality and date, L. Rozeboom, 2L [JH]; same locality, 7 Dec 1936, 6M, 12F; same locality and date, L. Rozeboom, 12L [JH]; same locality, 16 Dec 1936, 6M, 17F, 8L; same locality, 16 Dec 1936, L. Rozeboom, 3M, 11F; same data, 1L [JH]; same locality and collector, 29 Dec 1936, 2L [JH]; same locality, 1936, L. Rozeboom, 2M, 5F; same locality, PA 750, 838. La Chorrera, 31 May 1944, ASM 29, 7L; same locality, 4 Jul 1944, ASM 36, 1F; same locality, 26 Sep 1944, ASM 180, 2L; same locality, 6 Nov 1944, ASM 263, 1F, 1L; same locality, 6 Nov 1944, ASM 266, 4L; same locality, 27 Nov 1944, Wood, Griffing, ASM 297, 1L; same locality and collectors, 14 Dec 1944, ASM 337, 1F; same locality, 7 Dec 1944, K. Frick, R. Arnett, ASM 333, 1L; same locality, 13 Feb 1945, Van Doran, Turney, ASM 409, 1F; same locality, 12 Mar 1945, ASM 437, 1M, 1Mgen; same locality, 12 Mar 1945, ASM 445, 1F. Pacora, PA 761. Tocumen and Tapia, 5M, 15F. Tocumen, PA 548. **Province not specified** (1Mgen, 18 l): 6 Nov 1935, L. Rozeboom, 1Mgen; 1936, L. Rozeboom, 18 l [JH].

PARAGUAY (3F). **Alto Parana:** Locality not specified, "Calle 12," 22 Aug 1975, 3F.

VENEZUELA (20 specimens: 5Mgen, 5F, 3p, 7L&l; 3 ind rear: 1 l, 2inc). **Aragua:** Maracay, 10 May 1927, F. Root, 1F [BM1929-194]; same locality, 13 May 1927, 1 lp (10a) [JH]; same locality, 26 May 1927, 1L [JH]; same locality, 10 Jun 1927, 1 lp, 1Mgen (63e) [JH]; same locality, 1M gen (H36) [JH]; same locality, Jun 1929, 2Mgen. Turmero, VZ 337. **State not specified:** Guanoco River, L. Wehekind, 1F [BM1930-69]. Locality not specified, 1929, 1Mgen (6) [JH]; no data, 2F.

12. Anopheles (Nys.) rondoni (Neiva & Pinto)

Figs. 1, 4, 7, 12

1922. *Cellia rondoni* Neiva and Pinto 1922a:322. TYPE: *Lectotype* 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 to Ladario, on Rio Paraguai (Mato Grosso), Brazil [IOC; designation of lectotype and restriction of type locality by Belkin, Schick and Heinemann 1971:6].

Anopheles (Nyssorhynchus) rondoni of Davis (1928:539, 541, 543, 545, 546, 554-561; 1933:278-279); Dyar (1928:436); Shannon and Del Ponte (1928:42, 46, 57, 60); Edwards (1932:45); Root (1932:779); Galvao and Lane (1937e:214); Galvao and Amaral (1938:13); Lane (1939: 26-27; 1944:264, 265; 1949:403-404; 1953:273); Pinto (1939:345); Galvao (1940:447-448; 1943:143, 149, 150); Vargas (1940a:199); Fonseca and Fonseca (1942:95); Cerqueira (1943: 19); Correa and Ramos (1943:135-137; 1944b:132); Deane, L. M., Causey and Deane (1946:7, 9, 12; 1948:906); Deane, M. P., Causey and Deane (1946:42, 45); Senevet (1948a:278); Leeson and Buxton (1949:251-253); Levi-Castillo (1949:9, 10, 11, 16, 28, 58, 67, 76, 82, 86); Duret (1950a:372; 1950b:302; 1952:347); Galvao (1950:44); Rachou and Ferraz (1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Gabaldon and Cova Garcia (1952:178, 196, 201); Horsfall (1955:124, 170, 171, 182); Bejarano (1956:9, 10; 1957:326, 328, 331, 336-337; 1959:316, 325); Rozeboom and Kitzmiller (1958:244); Castro, Garcia and Bressanello (1959:549); Stone, Knight and Starcke (1959:34); Vargas (1959:370); Cerqueira (1961:127); Forattini (1962:421, 427); Rozeboom (1963:112); Belkin, Schick and Heinemann (1971:6); Consolim and Galvao (1973:177, 178, 181); Cova Garcia, Pulido F., Amarista M. (1978:157).

Anopheles rondoni of Muehlens, Petrocchi and Zuccarini (1925:251,253,254,257,264,265); Davis and Shannon (1928:448-456); Pinto (1930:154); Russell, Rozeboom and Stone (1943:37, 41, 49); Foote and Cook (1959:16, 26, 29, 32); Maciel (1962:477); Mattos and Xavier (1965:273); Gorham, Stojanovich and Scott (1967:19, 43, 60; 1973:115, 136, 138, 150).

Cellia rondoni of Neiva and Pinto (1922b:356-357); Bonne (1924:133, 134); Brethes (1926b:313).

Nyssorhynchus (Nyssorhynchus) rondoni of Lima (1928:102).

Anopheles (Anopheles) rondoni of Bonne and Bonne-Wepster (1925:522).

Anopheles (Nyssorhynchus) tarsimaculatus var. *rondoni* of Christophers (1924:40, 90).

Cellia tarsimaculata in part of Bonne (1924:133-137).
Cellia albimana in part (?) of Neiva (1909:69-77).

FEMALE (fig. 7). Wing: 3.6 mm. Proboscis: 2.05 mm. Palpus: 2.1 mm. Forefemur: 1.6 mm. Abdomen: about 3.0 mm. **Head**: Integument dark brown. Interocular space 3,4 ommatidial diameters. Proboscis about 1.3 length of forefemur. Scales light on vertex extending caudally onto median occiput, slightly darker on occiput, dark brown laterad on postgenae. Erect scales on vertex similar to those of *oswaldoi.* Palpal segments 1, 2, 3 and 5 as in group description; segment 4 with a basal and an apical brown band, ventral surface with a row of brown scales, mediolateral scales white usually with dark scales interspersed. **Antenna**: Flagellar segment 1 with numerous, unusually long (longer than segment 2), narrow, white, oblanceolate to setiform scales along dorsomesal surface and a few, moderately long, white, lanceolate scales on apicolateral surface. Flagellar segments 2-13 each with basal whorl of 8-10 long, silver setae. **Thorax**: Integument dark brown to black, extensively pruinose. Anterior promontory scales extending a short distance dorsad onto acrostichal line. Prescutellar space large, subtriangular, very dark brown to black. Bare space at caudal end of posterior fossa small, distinct and rectangular. Upper *stp* with 2-4 long setae, and a large patch of about 15 cream, obovate scales. Lower *stp* with 1-3 setae, and 8-10 scales similar to those on upper *stp,* scales more numerous and extensive than those of other species in group. Upper *mep* with about 5 long setae; scales apparently absent. **Legs**: Light scales on coxae white to pale cream. Foretarsal segments 2 and 3 with a white band in apical 0.2-0.3 and 0.3-0.5 respectively; segment 4 all dark. Fore- and midtarsal segment 5 golden in apical 0.33-0.50. Midtarsal segments 2 and 3 with a small, cream to white, apical band. Hindtarsal segment 1 with a distinct, white, apical ring; segment 2 with a brown band in basal 0.65-0.85; segment 3 with brown band in basal 0.20-0.35; segment 5 white in about apical 0.5. **Wing**: Light wing spots cream. Vein C predominantly dark; basal dark spot small, less than 0.3-0.5 of humeral light spot; subbasal, presectoral and sectoral dark spots fused into a very long, dark spot, occasionally with a few, interspersed, light scales; preapical light spot moderately small, 0.2-0.3 of preapical dark spot; apical dark spot relatively large. R presectoral dark spot moderately long, longer than sectoral dark spot. Rs-R_{2+3} subcostal dark spot moderately large, divided or not divided by a small light spot. R_2 preapical dark spot large, about 0.5 length of vein. M sectoral dark spot distinct, small to moderately long; preapical dark spot of vein M extending unbroken onto M_{1+2}, rarely with a few light scales; base of M_{1+2} dark at furcation. Remainder of dark spots small to moderate. Apical light fringe spot small, with or without dividing dark scales; remainder of light fringe spots as in section description but small and usually inconspicuous. **Abdomen**: Tergite I with a few, long, lanceolate to setiform, cream scales along caudal border. Sternite I with a few setae. Light scales on tergites II-VII extensive, long and narrow. Caudolateral and ventral scale tufts with moderately long, broad scales.

MALE. Wing: 3.3 mm. Proboscis: 2.9 mm. Forefemur: 1.85 mm. Abdomen: about 2.8 mm. Essentially as in female except for sexual characters. Description based primarily on 2 specimens from Jujuy, Argentina. **Head**: Palpal segments 2 and 3 with a light dorsal stripe; segment 4 predominantly white, occasionally with a small, dark, apical band, ventrally dark scaled. **Antenna**: About 0.75 length of proboscis. Flagellar segment 1 with long oblanceolate scales on dorsomesal margin. **Legs**: Forefemur about 0.55 length of proboscis. Spiniform setae of basal plantar surface of foretarsal segment 5 moderately long. Claw on foreleg long, acuminate; submedian tooth tapered to a slightly recurved point; basal tooth not visible on any

specimens examined.

MALE GENITALIA (fig. 12). **Segment VIII:** As that of *strodei.* **Segment IX:** Sternite moderately long, subtrapezoidal. Anterior apodeme a moderately short band. **Sidepiece:** Tergal surface with 4,5 long, submedian tergomedial bristles; bristles mesad of tergomedial bristles moderately long. Parabasal spine and its tubercle long, apex of spine extending to or beyond lateral margin of aedeagus on other side; tubercle about 0.5 length of spine. Basal apodeme moderately long, about 0.15-0.20 length of sidepiece. Longer, more dorsal accessory spine at least 0.5 length of sidepiece; more ventral spine about 0.75 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper:** As that of *strodei.* **Dorsal Claspette:** About 0.5 length of sidepiece. Pedicel moderately narrow; base curved mesad. Leaflets broad, subequal in length to pedicel; dorsal leaflet with moderately developed basomesal projection. **Ventral Claspette:** Similar to that of *strodei.* Large, slightly less than 0.5 length of sidepiece; apex broad, width at apex about 0.7 length of claspette. Basal lobule as that of *strodei*, with setae along basal margin long, about 2.0 width of aedeagus. Apex more or less truncate and rugose, with a small, U shaped median sulcus. Apex strongly expanded laterally, as that of *strodei,* into large, rounded lobe; apicolateral lobe appears slightly heavier than that of *strodei.* Setae usually on basal lobule only, not extending toward apex to base of apicolateral lobe. Preapical plate moderate, circular to oval, very weakly sclerotized and ill-defined, located about 0.25 length of claspette basad of apex. Refringent structure inconspicuous, in shape of inverted horseshoe. **Phallosome:** As that of *strodei.*

PUPA, LARVA. No specimens available.

DISCUSSION. This species can be distinguished from other species in the Oswaldoi Subgroup in the **female** by (1) palpal segment 4 with a ventral row of brown scales, (2) prescutellar space large, subtriangular, very dark brown to black, (3) foretarsal sement 3 light in apical 0.3-0.5, (4) hindtarsal segment 2 with a large dark band in basal 0.65-0.85, (5) hindtarsal segment 3 with a dark band in basal 0.20-0.35, (6) vein C predominantly dark, subbasal, presectoral and sectoral dark spots fused into a very long, dark spot, occasionally with a few, interspersed, light scales, and apical dark spot relatively large, (7) vein R_2 with large preapical dark spot and (8) the preapical dark spot of vein M extending uninterrupted onto M_{1+2}; and in the **male genitalia** by the combination of (1) ventral claspette similar to *strodei*, except that setae usually on basal lobule only, not extending toward apex to base of apicolateral lobe, (2) apex of ventral claspette strongly expanded laterally into large rounded apicolateral lobe which appears slightly heavier than in *strodei* and (3) preapical plate moderate, circular to oval, very weakly sclerotized and ill-defined.

An. rondoni is the sister species of *strodei.* The male genitalia are almost identical with the exception of the characters mentioned above. Although I did not have the opportunity to study the **larva** of *rondoni,* several authors (Davis 1933:278-279; Correa and Ramos 1943; Galvao 1940:444-445) report that it is similar to that of *strodei,* differing only in that *rondoni* has (1) fewer branches on hair 1-P (11-14), (2) fewer branches on the palmate hairs (20-24) and (3) fewer teeth on the pecten.

Rozeboom (1963:112) believed that *rondoni* was a mutant melanic form of *strodei,* just as *bisignatus* and *trisignatus* are melanic mutants of *albimanus, cuyabensis* is of *triannulatus,* and *guarauno, delta* and *deltaorinoquensis* are of *aquasalis.* Davis (1933) stated that *rondoni* could not be a variety of *tarsimaculatus* or *strodei* because it "breeds true" when isolated. However, Rozeboom (1963:112) demonstrated that *bisignatus* (a mutant of *albimanus*) also breeds true when isolated from other "normal" individuals of *albimanus.* I do not discount the possibility of Rozeboom's

hypothesis being correct; however, at present I do not believe that *rondoni* is a mutant form of *strodei. An. rondoni* has been collected in considerable numbers (Davis and Shannon 1928) in numerous different localities. It has a fairly large distribution, occurring at times sympatrically with *strodei.* Besides the extra hindtarsal dark band and large prescutellar space, the wing spots of *rondoni* are very different from *strodei* and are unique within the Oswaldoi Subgroup. Furthermore, mutants of *strodei* that exhibit extra hindtarsal bands do not possess the other characters which distinguish *rondoni.* Whether or not hybridization occurs between *strodei* and *rondoni* has not been investigated. Until more is known about the biology of *rondoni* I am considering it a separate species, albeit with a high degree of affinity toward *strodei. An. rondoni* may be a relatively new species recently diverging from *strodei.* From its present distribution it would seem that *rondoni* evolved in the region of northern Argentina, Bolivia and southern Brazil.

BIONOMICS. Most of the discussion presented is from the work of Davis and Shannon (1928) on the bionomics of *rondoni* in and around the city of Ledesma, in the villages of Canitas and Calilegua, Jujuy, Argentina from March 1926 until May 1927.

Davis and Shannon first discovered the immatures of *rondoni* along the margin of a reservoir in Ledesma. They soon found that a shallow ditch adjacent to a reedy swamp behind the reservoir was a highly favored aquatic habitat of *rondoni.* From that ditch 100 larvae were collected from which 75 adults emerged: 72 were *rondoni,* 2 were *An. (Ano.) pseudopunctipennis* and one was *"tarsimaculatus."* Later Davis and Shannon encountered the immatures of *rondoni* in clear water such as in ditches, drying pools at the edge of swamps, a puddle in a road and in heavy growths of grass in a flooded meadow; the aquatic habitats were sometimes with considerable detritus, but not with algae. The type specimens were collected on the right margin of the Paraguay River, and later material was collected on the left margin of the S. Lourenco River. *An. rondoni* is most abundant in the province of Jujuy, Argentina and in Rincao, Sao Paulo, Brazil in March, during the late summer. In Jujuy, it is present all year, although occasionally in low numbers.

The adults are usually active early in the evening. On one occasion 120 females were collected on a horse between 1730 and 1800 h, flight commencing while it was still daylight (Davis and Shannon 1928). The females are commonly found inside houses (Davis and Shannon 1928; Pinto 1939:402, 404; Shannon and Del Ponte 1927:60). Of 1266 anophelines collected in houses in the area of Ledesma, 118 or 9.3% were *rondoni.* Davis and Shannon concluded that *rondoni* is not as domestic as *pseudopunctipennis,* "but still is found in houses in appreciable numbers."

MEDICAL IMPORTANCE. *An. rondoni* has never been incriminated as a vector of malaria. It has never been found naturally infected with *Plasmodium* sp. During the malaria season in Jujuy, Davis and Shannon (1928) dissected 88 individuals and all were negative. In 3 different experiments, Davis and Shannon unsuccessfully attempted to infect *rondoni* with *Plasmodium falciparum, P. vivax* and *P. malariae.* Shannon and Del Ponte (1927:60) reported that Davis was able to infect *rondoni* experimentally; however, I have not found any other reference to that work.

DISTRIBUTION (fig. 1). *An. rondoni* occurs in southern and southeastern South America. In Brazil it has been reported from the states of Acre, Goias, Mato Grosso, Parana, Sao Paulo, Santa Catarina and Rio Grande do Sul. In Bolivia it is known in the departments of Santa Cruz, Beni and Tarija (Gabaldon and Cova Garcia 1952: 196; Cerqueira 1943:19). The southern distributional limit is in northern Argentina where it has been reported in the provinces of Chaco, Corrientes, Formosa, Misiones,

Salta, Santa Fe and Tucuman (Garcia and Ronderos 1962:161).

Material Examined: 69 specimens: 12 males, 10 male genitalia, 47 females.

ARGENTINA (62 specimens: 12M, 7Mgen, 43F). **Jujuy**: Calilegua, 5 May 1926, R. Shannon, 24F. Ledesma, 23 Mar 1926, R. Shannon, lot 18, 4Mgen (5, 6, 7, 8); same locality, 1926, N. Davis, R. Shannon, 3F (Bac Ent nota 18); same locality, 30 Mar 1927, R. Shannon, 1Mgen; same locality, 31 Mar 1927, E. Del Ponte, R. Shannon, 1F; same locality, Mar 1927, R. Shannon, 1M (187), 1M gen (37); same locality, Mar 1927, N. Davis, 9M, 7F [JH] ; same locality and collector, 1927, 1M; same locality and collector, 21 Mar, 1M; same locality and collector, 1Mgen. Locality not specified, Nov [?1938] , W. Paterson, 2F [BM] . **Salta**: Oran, 15 Mar 1961, R. Salta, 2F [AMNH] . **Province and locality not specified:** No data, 4F.

BOLIVIA (3F). **Beni:** Guayaramerin, 15 Apr 1947, S. Blatmas, 1F; same locality, 5 Jul 1947, 1F (47-12258). San Ignacio, 17 Sep 1943, Torres Munoz, 3053B, [KO] 116-9, 1F.

PARAGUAY (1F). **Olimpo**: P[uerto] Esperanza, Rio Paraguay, 30 Dec 1919, U. Cornell Expedition, 1F [CU] .

COUNTRY NOT SPECIFIED (3Mgen). Locality not specified, 3Mgen [JH] .

13. Anopheles (Nys.) benarrochi Gabaldon, Cova Garcia & Lopez

Figs. 1, 4, 7, 29, 30

1941. *Anopheles (Nyssorhynchus) benarrochi* Gabaldon, Cova Garcia and Lopez 1941:3-22. TYPE: *Syntypes* male, female, pupa, larva and egg, La Ceiba (Trujillo), Venezuela [MDM] .

Anopheles (Nyssorhynchus) benarrochi of Galvao (1943:146); Vargas (1943:59; 1959:377, 383); Causey, Deane and Deane (1944:2, 5; 1946:26); Lane (1944:263; 1949:402; 1953:277-278); Deane, L. M., Causey and Deane (1946:6, 8, 9, 12; 1948:900-901); Deane, M. P., Causey and Deane (1946:42, 45); Gabaldon and Cova Garcia (1946b:91; 1952:178, 189); Coher (1948:88-89); Senevet (1948a:278; 1948c:436); Bates and de Zulueta (1949:135); Levi-Castillo (1949:10, 15, 28, 58, 67, 72, 76, 82, 86); Stone, Knight and Starcke (1959:32); Cerqueira (1961:123); Forattini (1962:418); Belkin, Schick and Heinemann (1965:72); Morales-Ayala (1971:139); Cova Garcia and Sutil O. (1976:32; 1977:23, 44, 64, 89).

Anopheles benarrochi of Russell, Rozeboom and Stone (1943:37, 41, 44); Renjifo and de Zulueta (1952:600-601); Foote and Cook (1959:24, 26, 29); Cova Garcia (1961:41-42, 68, 93-94, 114, 130-131, 155); Mattos and Xavier (1965:271); Stojanovich, Gorham and Scott (1966b:20, 31, 40); Gorham, Stojanovich and Scott (1967:16, 47, 51; 1973:113, 139, 142); Elliott (1972: 757); Cova Garcia and Sutil O. (1975a:20; 1975b:213).

FEMALE (fig. 7). Wing: 3.3 mm. Proboscis: 2.05 mm. Palpus: 2.1 mm. Forefemur: 1.4 mm. Abdomen: 2.7 mm. Very similar to that of *aquasalis.* **Head:** Integument light brown to reddish brown. Interocular space about 3,4 ommatidial diameters. Proboscis about 1.45 length of forefemur. Palpal segments 1-3 as in group description; white apical band of segment 3 moderately large; segment 4 with a basal and an apical brown band of subequal size, mediolaterally white, usually with single row of brown scales on ventral surface; segment 5 with a small, brown, basal ring extending from apex of 4. **Antenna:** Flagellar segment 1 with numerous white scales; distally with elongate oblanceolate scales on dorsal and dorsomesal surfaces, scales shorter on dorsolateral surface; basally with moderately short, obovate or cuneate scales forming an incomplete band on dorsomesal, dorsal and lateral surfaces. Flagellar segments 2-13 each with basal whorl of 8-10 tan to silver setae. **Thorax:** Integument light brown to reddish brown. Anterior promontory scales extending short distance onto acrostichal line. Humeral scale tuft dark brown below, usually not extensive. Prescutellar space small, horseshoe shaped. Upper *stp* with 3,4 long setae, and a row of moderately small, cream, obovate scales. Lower *stp* with one long seta, and a small diagonal patch of scales. Upper *mep* with about 3,4 long setae; scales absent. **Legs:** Light scales on coxae usually white. Midfemur with both anteroapical spot

and knee spot moderate size, cream or white and conspicuous. Foretarsal segments 2 and 3 with a white band in apical 0.28 (0.2-0.4) and 0.65 (0.5-0.8) respectively; segment 4 occasionally with a light apical band; segment 5 with a cream to golden band in apical 0.25-0.50. Midtarsal segment 2 with a moderately long, cream to white band in apical 0.15-0.20; segment 3 with a small, cream, apical band; segment 4 all dark or with a few, golden, apical scales; segment 5 cream in about apical 0.5. Hindtarsal segment 2 with a brown band in about basal 0.40-0.55 (0.36-0.55). **Wing:** Light wing spots cream on anterior veins, white on posterior veins. Often dark wing spots on more posterior veins indistinct. Vein C humeral light spot about 2.5 or more of basal dark spot; subcostal light spot 0.4 (0.3-0.5) of subcostal dark spot; preapical light spot 0.35 (0.30-0.45) of preapical dark spot; apical dark spot small. R presectoral and sectoral dark spots moderately small. R_3 dark spots often light brown and inconspicuous. M mostly white, sectoral dark spot present or absent; with a small preapical dark spot not extending onto M_{1+2}. M_{1+2} apical dark spot, Cu subcostal dark spot and A subbasal dark spot often indistinct. Apical light fringe spot large, unbroken or broken by a few, small, dark scales; remainder of light fringe spots as in section description, except for 2 large, fairly conspicuous spots between base of wing and vein A. **Abdomen:** Tergite I with a few, cream, obovate scales medially on caudal border. Sternite I with a few scattered setae, no scales visible. Remainder of abdomen as in section description.

MALE. Wing: 3.4 mm. Proboscis: 2.7 mm. Forefemur: 1.6 mm. Abdomen: about 2.9 mm. Essentially as in female except for sexual characters. **Head:** Palpal segments 2 and 3 with a light dorsal stripe; segment 4 almost all cream to white, with or without a small, dark, basal band, and occasionally with a dark apical band, ventral surface cream to white with a few, scattered, dark scales. **Antenna:** About 0.75 length of proboscis. Flagellar segment 1 with long, thin, white, oblanceolate scales. **Legs:** Forefemur about 0.6 length of proboscis. Foretarsal segment 5 with about 7 short to moderately long, spiniform setae on basal plantar surface. Claw on foreleg large, curved and acuminate; submedian tooth thin, slightly recurved at apex; basal tooth short, strongly decurved.

MALE GENITALIA (fig. 29). **Segment VIII:** Sternite and tergite with moderately long, light, obovate scales. **Segment IX:** Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apodeme a short band across anterior margin. **Sidepiece:** Tergal surface usually with 4,5 long, submedian tergomedial bristles and 1,2 long subapicolateral bristles; bristles mesad of tergomedial bristles moderately short. Combined length of parabasal spine and its tubercle long, apex of spine extending beyond lateral margin of aedeagus on other side and occasionally to tubercle of opposite parabasal spine; tubercle about 0.5 length of spine. Basal apodeme moderately long, about 0.15 length of sidepiece and thick. Longer, more dorsal accessory spine about 0.5 length of sidepiece; more ventral spine 0.8-0.9 of longer spine. Internal spine subequal to shorter accessory spine. **Clasper:** Spiniform fusiform, occasionally hooked apically, moderate, subequal in length to seta *b*. **Dorsal Claspette:** Slightly longer than 0.5 length of sidepiece. Leaflets broad and long, about 0.5 length of claspette; dorsal leaflet with a large basomesal projection. **Ventral Claspette:** Small, about 0.33 length of sidepiece; apex wide, width at apex about 0.5 length of claspette. Basal lobule small, narrow, curving mesad; setae along basal margin short, about equal to or slightly longer than width of aedeagus. Apex moderately expanded laterally, apicolateral margin sharply angled and moderately pointed. Depending on angle of observation, apical margin either appearing truncate or with a variously developed median sulcus; apical margin unsclerotized and distinctly rugose. Setae on

lateral margins extending toward apex to or nearly to base of apicolateral lobes. Preapical plate small, circular, heavily sclerotized. Refringent structure rooflike, with arms projecting basolaterally. **Phallosome**: Aedeagus 1.20-1.45 length of ventral claspette; apex rounded, about as broad as long; without leaflets.

PUPA (fig. 29). Abdomen: about 2.65 mm. Trumpet: 0.5 mm. Paddle: 0.8 X 0.6 mm. **Cephalothorax**: Hairs 1-3-C moderately developed; 1-C 2,3 branched (1-3); 2,3-C 1-3 branched. Hair 4-C 3,4 branched, subequal to 5-C. Hair 5-C 3-5 branched (2-5). Hair 6-C 2,3 forked (1-3). Hair 7-C 3,4 branched (2-4) near base; 6,7-C subequal, moderately short. **Trumpet**: Pinna moderately pigmented; long, about 4.5-5.1 (4.4-5.5) length of meatus; in lateral aspect, not appearing to taper toward apex. Meatal cleft moderately pointed. **Metanotum**: Hair 10-C single or occasionally double, moderately long, subequal to 11-C and more than 0.5 length of 12-C. Hair 11-C 3-5 branched. Hair 12-C 1-3 branched in basal 0.3, moderately long. **Abdomen**: Hair 2-I 4-6 branched (4-7) about 0.3-0.5 from base, often dendritic, slightly longer than 3-I; 3-I thin, long. Hair 4-I 4-9 branched, moderately large. Hair 5-I 1-3 branched, long. Hair 6-I single or double, about 1.5-2.0 length of 7-I. Hair 7-I 3-5 branched (3-6). Hair 9-I single, slightly longer than 7-I. Hair 0-II-VII moderately developed; 0-II 3-6 branched; 0-III 4-8 branched (4-9); 0-IV,V 4-7 branched; 0-VI 4,5 branched; 0-VII 3-5 branched. Hair 1-II,III 6-10 and 5-9 branched respectively, strongly developed. Hair 3-II inserted very near to or on caudal margin of segment adjacent to 1-II; 3-III 1-3 branched (1-4); 3-IV 4-6 branched (4-7); 3-V 3-5 forked, moderately developed. Hair 5-III,IV 7,8 and 3-5 branched respectively, median branches longer than lateral; 5-V-VII long, subequal to or slightly shorter than length of segment; 5-V occasionally double. Hair 6-II 2,3 branched (1-3) near base, 1.2-1.7 length of 7-II; 6-III 3-5 forked (2-5). Hair 7-II 4-6 branched; 7-III-V moderate; 7-III, IV 3-6 branched (3-8); 7-V 2-4 branched (1-4); 7-VI,VII single or occasionally double, long. Hair 8-III-VII moderately developed; 8-III,VII 3-6 branched (2-8); 8-IV,VI 2-5 forked; 8-V 2,3 forked. Hair 9-II-VIII in general short and stout; 9-II minute, unpigmented; 9-III very small, about 2.0 or less length of 9-II; 9-IV heavy, small, about 2.0 of 9-III, pigmented; 9-V heavy, usually less than 2.0 of 9-IV; 9-VI slightly longer than 9-V; 9-VII,VIII heavy, acuminate, about 0.33 length of segment. Hair 10-III 2-5 branched, moderately developed. Hair 4-VIII 4-6 forked (3-8), subequal to 9-VIII. **Terminal Segments**: Male genital lobe long and broad; apex with distinct mammilliform protuberance. **Paddle**: Large and caudally broad. Emarginate at insertion of hair 1-P. External buttress about 0.66 length of paddle. External margin with short, fine, filamentous spicules extending around apex and becoming indistinct along inner margin. Hair 1-P moderately short; 2-P subequal to 1-P.

LARVA (fig. 30). Head: 0.6 mm. Antenna: 0.3 mm. Anal Saddle: 0.3 mm. In general large. **Head**: Heavily pigmented. Median tooth of mental plate moderately large, less than combined width of 2 adjacent teeth from one side. Hairs 2-C single and barbed in about apical 0.5, widely spaced, clypeal index about 1.4; hair 3-C plumose, subequal to 2-C, with moderately long, conspicuous branches in about apical 0.5. Hair 4-C 2-4 branched (1-4), small, occasionally reaching base of 2-C. Hairs 8,9-C weakly plumose, short; 8-C 4-7 forked, slightly longer than distance between insertion of hairs 5-C and 6-C; 9-C 6-10 forked (5-10), longer than 8-C. Hairs 10,12-C 3,4 and 4-6 branched respectively, moderately developed. Collar moderately narrow dorsomedially and heavily pigmented. **Antenna**: Moderately pigmented. Mesal margin with stout, medium length spicules increasingly shorter from middle toward base and apex; spicules usually absent in basal and apical 0.2. Hair 1-A 5-9 branched, long, at least 2.0 width of antenna at point of insertion, inserted about 0.35-0.40

from base of antenna, branches long. Hairs 2,3-A wide and long, about 0.3 length of antenna; mesal margins with conspicuous, featherlike, serrated fringe. **Thorax**: Moderately to strongly pigmented. Submedian prothoracic group (1-3-P) not sharing a common tubercle; palmate hair 1-P with 12-16 long, moderately broad, pointed leaflets; 2-P relatively few branched (11-16), arising from a very small tubercle, lateral branches equal to apical. Hair 14-P 6-9 branched from a moderately short stalk, lateral branches shorter than median. Mesothoracic hair 1-M 27-30 branched (23-30); 2-M 1-3 forked apically, moderately long. Metathoracic hair 2-T moderately long. Palmate hair 3-T with 9-12 (8-12) semitransparent, broad, moderately long, pointed leaflets. Hair 4-T 3-5 branched, moderately small. Prothoracic pleural group spine large, longer than spines of meso- and metathoracic group. **Abdomen**: Many hairs more extensively branched than those of *strodei.* Hair 0-II,III,VI,VII 3-5 branched (2-5); 0-IV,V 4-6 branched (4-7). Palmate hair 1-I with 8-13 (8-14) semitransparent, moderately long, broad, pointed leaflets; 1-II-VII with heavily pigmented, moderately broad, spreading leaflets, often apically truncate. Hair 2-II 4-6 branched (3-6); 2-V 3,4 branched, moderately large. Hair 5-I 3-5 branched, moderately developed; 5-III 9-13 branched (8-13), moderately large. Hair 9-I 5,6 branched (5-7); 9-IV 7-10 branched; 9-V 8-12 branched (8-13). Hair 11-I 3,4 branched, moderately large. Hair 13-I,II,III 5-7 (4-8), 7-12 (6-12) and 7-14 branched respectively, small; 13-IV 10-13 branched (6-13), small; 13-V 4-6 branched (4-7), large. **Spiracular Lobe**: Pecten with 11-15 teeth; most of median teeth subequal and of moderate length; basal serrations on ventral surface of teeth fairly conspicuous. Lateral arm of spiracular apparatus moderately long and thick. Hairs 8,9-S 2-5 branched. **Anal Segment**: Covered with moderately strong spicules. Hair 1-X moderately short, as long as or slightly longer than saddle; inserted on saddle, on or very near ventral margin. Anal gills about 0.35 mm, 1.00-1.25 length of saddle.

DISCUSSION. The adult female of *benarrochi* is very similar to that of *aquasalis* and, to a lesser extent, to that of *strodei.* In order to correctly identify these 3 species, the characters given below must be correlated and compared with those given in the Discussion sections of the latter 2 species. It must be emphasized that the number of specimens of *benarrochi* that were available for study was not large, and the majority were from the same general locality. For these reasons great care must be taken in examining material from localities other than those studied here. *An. benarrochi* can be distinguished from the other species in the Oswaldoi Subgroup in the **female** (except for occasionally *aquasalis*) by the combination of (1) palpal segment 4 usually with a row of brown scales on ventral surface, (2) light scales on coxae usually white, (3) foretarsal segment 3 with a white band in apical 0.5-0.8, (4) hindtarsal segment 2 brown in basal 0.40-0.55 (0.36-0.55), (5) light wing spots cream on anterior veins and white on posterior veins, (6) vein C with humeral light spot about 2.5 or more of basal dark spot, (7) vein R with presectoral and sectoral dark spots moderately small, (8) vein M mostly white, sectoral dark spot present or absent, (9) apical light fringe spot large, unbroken or broken by a few dark scales and (10) dark spots on veins R_3, M_{1+2} and M_{3+4}, Cu subcostal dark spot, and A subbasal dark spot often indistinct; in the **male genitalia** by the combination of (1) ventral claspette small, apex wide, width at apex about 0.5 length of claspette, (2) apex of ventral claspette rugose, moderately expanded laterally with apicolateral margin sharply angled and moderately pointed, appearing truncate or with a median sulcus, (3) setae on ventral claspette extending toward apex to or nearly to base of apicolateral lobe, (4) preapical plate small, circular, heavily sclerotized and (5) basal lobule narrow, curving mesad, with setae along basal margin about equal to or slightly longer than

width of aedeagus; in the **pupa** by the combination of (1) hairs 6,7-C subequal and moderately short, (2) pinna long, about 4.5-5.1 length of meatus, not appearing to taper toward apex in lateral aspect, (3) hair 10-C moderately long, subequal to 11-C and more than 0.5 length of 12-C, (4) hair 2-I 4-6 branched (4-7), long, slightly longer than 3-I, (5) hair 9-I slightly longer than 7-I, (6) hair 6-II 1.2-1.7 length of 7-II and (7) hair 9-III very small, about 2.0 or less length of 9-II, 9-V heavy, usually less than 2.0 of 9-IV, 9-VII,VIII heavy, short, about 0.33 length of segment; and in the **larva** by the combination of (1) hair 2-C single and barbed, 3-C plumose with moderately long branches in about apical 0.5, hairs 2-C widely spaced, clypeal index about 1.4, (2) hair 4-C small, (3) collar moderately narrow dorsomedially and heavily pigmented, (4) hair 1-A of antenna 5-9 branched, long, at least 2.0 width of antenna at point of insertion, (5) hairs 1,2-P not sharing a common sclerotized tubercle, (6) hair 13-IV 10-13 branched (6-13), small, (7) lateral arm of spiracular apparatus moderately long and thick and (8) hair 1-X moderately short, as long as or slightly longer than saddle, inserted on saddle, on or very near ventral margin.

An. benarrochi is the most highly derived species in the Oswaldoi Subgroup. The derived characters include in the male genitalia the small distinct ventral claspette with its narrow, mesally curved basal lobules; in the pupa the position of hair 3-II adjacent to 1-II; and in the larva the large antennal hair 1-A, the small numerously branched hair 13-IV and the short hair 1-X.

The closest allies of *benarrochi* are *rondoni* and *strodei,* with which it shares in the male genitalia the nonsetaceous, laterally expanded apicolateral lobes and the rugose apical margin of the ventral claspette, and in the larva the narrow collar and hair 1-X inserted on the saddle. It should be stressed that the latter 2 characters in the larva may be ancestral and may not be indicative of close phylogenetic relationship.

BIONOMICS. Very little is known of the natural history of *benarrochi.* The immatures have been reported from stagnant ground pools, abandoned wells and small streams, exposed to the full sun or partial shade, and in water containing a large amount of organic material (Deane, Causey and Deane 1948:900-901; Cerqueira 1961:123). *An. benarrochi* is not found in the lower Amazon basin, and nowhere is it encountered in great abundance (Deane, Causey and Deane 1948). Deane, Causey and Deane (1948) collected the larvae in association with *triannulatus, An. (Nys.) albitarsis* and *An. (Ano.) peryassui.*

The females rarely enter houses and feed primarily on animals. Of a total of 545 adults of *benarrochi* collected by Deane, Causey and Deane (1948) only 46 or 8.4% were from inside houses. Elliott (1972:757) reports that the peak hours of biting for the females in Peru is between 1800-2000 h and 0400-0600 h, which correlates with the observation of Deane, Causey and Deane (1948) that *benarrochi* is crepuscular.

MEDICAL IMPORTANCE. *An. benarrochi* has never been implicated as a vector of malaria. Deane, Causey and Deane (1948) dissected 31 blood-fed females and found none infected with *Plasmodium* sp.

DISTRIBUTION (fig. 1). *An. benarrochi* is limited primarily to the Orinoco basin and the eastern versant of the Andes including the llanos plateau region of Colombia, parts of the upper Amazon in Brazil (Rondonia, Acre, Amazonas) and Loreto, Peru.

Material Examined: 293 specimens: 60 males, 33 male genitalia, 85 females, 64 pupae, 51 larvae; 6 progeny rearings.

COLOMBIA (286 specimens: 57M, 30Mgen, 85F, 64p, 50L; 6 progeny rearings). **Meta:** Villavicencio, 1947, L. Rozeboom, CV-P 34 (progeny rearing), 8M, 7Mgen, 9F, 15p, 9L; same data, CV-P 35 (progeny rearing), 6M, 3Mgen, 8F, 15p, 9L; same data, CV-P 36, 1F; same data, CV-P 37 (progeny rearing), 10M, 4Mgen, 12F, 18p, 13L; same data, CV-P 40 (progeny rearing), 1F, 1p, 5L; same data, CV-P 42 (progeny rearing), 19M, 4Mgen, 24F, 14L; same data, [CV-]P 42 (progeny rearing),

1Mgen, 10F [JH]; same data, CV-P 43 (progeny rearing), 9M, 3Mgen, 10F, 15p; same data, [CV-]P 43 (progeny rearing), 5M, 5Mgen, 10F [JH]; same data, 3Mgen [JH].

PERU (7 specimens: 3M, 3Mgen, 1L). **Loreto**: Iquitos, Apr 1931, R. Shannon, 3M, 3Mgen; same locality, A. Cornejod, 1L.

TRIANNULATUS SUBGROUP

14. Anopheles (Nys.) triannulatus (Neiva & Pinto)

Figs. 1, 4, 7, 31, 32

1922. *Cellia triannulata* Neiva and Pinto 1922b:356-357. TYPE: *Holotype* female, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso), Brazil [LU; not in IOC] (Belkin, Schick and Heinemann 1971:6).

1923. *Cellia cuyabensis* Neiva and Pinto 1923:235-236. TYPE: *Lectotype* small wing mounted on slide (403) together with wing of type of *rondoni,* marked Matto Grosso, C. Pinto, remainder of adult apparently lost, Fazenda Sao Joao, right bank of Rio Cuiaba (Mato Grosso), Brazil [IOC; designation of Belkin, Schick and Heinemann 1971:7]. Synonymy with *triannulatus* by Galvao and Barretto (1939b:150-154).

1925. *Anopheles bachmanni* Petrocchi 1925:71-75. TYPE: *Syntypes* males and females, Corrientes, Entre Rios, Formosa, Argentina [NE; according to O. H. Casal in Belkin, Schick and Heinemann 1968:10]. NEW SYNONYMY.

1927. *Anopheles (Nyssorhynchus) davisi* Paterson and Shannon 1927:1277-1280. TYPE: *Holotype* male (200) with associated genitalia on slide, Tres Pozos, Embarcacion (Salta), Argentina, 20 Apr 1927, Paterson, Shannon and Shannon [USNM]. TRANSFERRED SYNONYMY.

1928. *Anopheles (Nyssorhynchus) perezi* Shannon and Del Ponte 1928:56-57. TYPE: *Syntypes* females, [La Finca] Santa Barbara, Departamento de la Capital (Tucuman), Argentina, 7 Apr 1927, Shannon and Del Ponte [NE; according to O. H. Casal in Belkin, Schick and Heinemann 1968:10]. TRANSFERRED SYNONYMY.

1941. *Anopheles (Nyssorhynchus) triannulatus* var. *chagasi* Galvao 1941:92-95. TYPE: *Syntypes* females and eggs, type locality restricted to Manaus (Belkin, Schick and Heinemann 1971:7), originally described from Chaves (Para), and Itacoatiara and Manaus (Amazonas), Brazil [LU]. Synonymy with *triannulatus* by Lane (1949:404).

Anopheles (Nyssorhynchus) triannulatus of Dyar (1928:437); Edwards (1932:45); Galvao and Lane (1937e:214; 1941:10-18); Pinto (1939:406-425); Lane (1939:29-30); Galvao and Barretto (1939b:150-156); Galvao (1940:437-443; 1943:144, 149, 150, 151); Komp (1941a:93, 97; 1941b:792; 1942:37, 43, 69-71, 80, 118-120, 132, 156-158; 1956:39); Correa and Ramos (1942a:42-43; 1944b:132); Fonseca and Fonseca (1942:94, 95, 97, 99); Rozeboom (1942a: 241-242; 1963:112); Simmons and Aitken (1942:39, 45, 53, 61, 97-99); Bruce, Knigin, Yolles and Graham (1943:441-442); Cerqueira (1943:19-20); Fonseca and Unti (1943:49-50); Galvis (1943:89-91); Unti and Ramos (1943:28); Causey, Deane and Deane (1944:2, 4, 5; 1946:26); Lane (1944:262-268; 1949:404); Deane, L. M., Causey and Deane (1946:7, 9, 10; 1948:901-904); Deane, M. P., Causey and Deane (1946:38, 39, 42, 45); Floch and Abonnenc (1946b:3, 5; 1947:7; 1951:52-55); Gabaldon and Cova Garcia (1946a:19-20; 1946b:121-124); Amaral and Penido (1947:168); Arnett (1947:198-199; 1950:106, 110, 112); Senevet (1948a:278; 1948c: 434-439); Vargas (1948:157-158); Bates and de Zulueta (1949:134, 137, 139); Levi-Castillo (1949:9, 10, 11, 13, 16, 28, 67, 73, 77, 82, 86); Duret (1950a:474-475; 1950b:302; 1952:348); Carvalho and Rachou (1951:475-476, 480); Rachou and Ferraz (1951:542, 547-553); Rachou and Ricciardi (1951:424-426, 432-437); Horsfall (1955:185); Bejarano (1956:9, 10, 20, 21; 1957:327-328, 339-342; 1959:319, 325); Rozeboom and Kitzmiller (1958:244); Vargas V. (1958b); Castro, Garcia and Bressanello (1959:550); Stone, Knight and Starcke (1959:34); Faran (1961:11-12); Forattini (1962:311, 400-405); Belkin, Schick and Heinemann (1968:10; 1971:6, 7); Consolim and Galvao (1973:177); Cova Garcia, Pulido F. and Amarista M. (1978: 157).

Anopheles triannulatus of Rozeboom (1941:101-102); Vargas (1940a:199-200; 1941:114); Russell, Rozeboom and Stone (1943:26, 30, 37, 41, 50); Floch and Abonnenc (1944a:1-7; 1946a:2); Renjifo and de Zulueta (1952:600-601); Vargas V. (1958c); Foote and Cook (1959:20, 23); Maciel (1962:475-476); Vincke and Pant (1962:2-4, 6, 7, 10); Mattos and Xavier (1965:274-275); Stojanovich, Gorham and Scott (1966a:13, 18, 35; 1966b:22, 28, 44); Gorham, Stojanovich and Scott (1967:15, 45, 46, 60; 1973:111, 151).

Anopheles (Nyssorhynchus) triannulatus triannulatus of Galvao and Lane (1941:11-17); Vargas (1941:114, 118; 1959:376, 382); Galvao (1943:149, 150); Lane (1953:274-276); Vargas V. (1956:28, 33; 1957; 1958b); Bejarano (1957:339-342; 1959:305, 321); Cerqueira (1961:127-128); Garcia and Ronderos (1962:137-139, 161-162); Morales-Ayala (1971:139).

Anopheles triannulatus triannulatus of Vargas (1943:58).

Anopheles (Anopheles) triannulata of Bonne and Bonne-Wepster (1925:520-521).

Cellia triannulata of Bonne (1924:133, 134).

Anopheles (Nyssorhynchus) tarsimaculatus var. *triannulatus* of Christophers (1924:40-41, 91).

Anopheles (Nyssorhynchus) bachmanni of Root (1926b:684-696, 714-715); Davis (1928:562); Dyar (1928:427, 430, 435); Shannon and Del Ponte (1928:55); Hill (1930:712; 1934:425-429); Shannon and Davis (1930:488); Shannon (1931:10, 22; 1933:118, 126-132); Curry (1932:566-572; 1934:646); Edwards (1932:45); Antunes and Lane (1933:91-97); Townsend (1933a:101); Senevet (1934:47-49; 1937:361-362); Komp (1936a:161); Galvao and Lane (1937a:77, 78; 1937e:214, 223); Galvao, Lane and Correa (1937:41); Galvao and Amaral (1938:13); Rozeboom (1938a:101-102; 1938b:290-300); Kumm and Ruiz (1939:438); Pinto (1939:406-425); Kumm, Komp and Ruiz (1940:389, 391, 410, 419); Komp (1941a:95); Floch and Abonnenc (1942a:2; 1942b:2); Cova Garcia and Sutil O. (1976:31; 1977:22, 46, 62, 88).

Anopheles bachmanni of Petrocchi (1923:139); Muehlens, Petrocchi and Zuccarini (1925:265); Hill (1928:355); Benarrochi (1931:691-693); Davis (1931:46-47, 49-50); Kumm (1932:4); Pinto (1932:287); Rozeboom (1935:521-528); Kumm and Novis (1938:503); Clark, Komp and Jobbins (1940:62); Gabaldon, Lopez and Ochoa Palacios (1940:38); Gabaldon, Ochoa Palacios and Perez Vivas (1940:42-55); Cova Garcia and Sutil O. (1975a:22; 1975b:211).

Anopheles (Nyssorhynchus) triannulatus bachmanni of Garcia and Ronderos (1962:137, 138, 139, 162); Morales-Ayala (1971:139).

Anopheles triannulatus bachmani (!) of Cova Garcia (1961:39-40, 68, 91-92, 113, 128-129, 154).

Anopheles buchmanni (!) of Clark (1934:642).

Nyssorhynchus (Nyssorhynchus) bachmanni of Lima (1928:98-100).

Nyssorhynchus bachmanni of Townsend (1934:494).

Anopheles (Nyssorhynchus) davisi of Shannon and Del Ponte (1928:43-45); Pinto (1939:406-425); Castro (1959a:174); Castro, Garcia and Bressanello (1959:549).

Anopheles davisi of Renjifo and de Zulueta (1952:600-601).

Anopheles (Nyssorhynchus) triannulatus davisi of Galvao and Lane (1941:11-17); Galvao (1943:144, 149, 151); van der Kuyp (1949a:67-68); Rey and Renjifo (1950:534, 537); Lane (1953:276-277); Vargas V. (1956:28); Bejarano (1956:9, 20, 21; 1957:339-342; 1959:305, 320); Vargas (1959:382).

Anopheles triannulatus davisi of Vargas (1943:58).

Anopheles (Nyssorhynchus) cuyabensis of Dyar (1928:437); Edwards (1932:45); Galvao and Lane (1937e:214); Pinto (1939:410, 412-414).

Nyssorhynchus (Nyssorhynchus) cuyabensis of Lima (1928:103).

Anopheles (Nyssorhynchus) tarsimaculatus var. *cuyabensis* of Christophers (1924:40, 90).

Anopheles (Anopheles) cuyabensis of Bonne and Bonne-Wepster (1925:521).

Anopheles (Nyssorhynchus) perezi of Edwards (1932:45).

Anopheles tarsimaculatus in part (?) of Edwards (1922:75).

Nyssorhynchus tarsimaculatus in part of Townsend (1933b:1, 7-12).

FEMALE (fig. 7). Wing: 2.6 mm. Proboscis: 1.8 mm. Palpus: 1.65 mm. Forefemur: 1.15 mm. Abdomen: 2.2 mm. A small, often predominantly dark species. **Head**: Integument brown to dark brown. Interocular distance about 3,4 ommatidial diameters. Proboscis about 1.55 length of forefemur. Dorsal surface of palpal seg-

ment 2 with or without a few light scales; dorsal surface of segment 3 with few to several, light scales forming a longitudinal stripe from about 0.5 distad of base to near apex; palpal segments 2 and 3 with a small to moderately wide, white, apical band; segment 4 variable but always with a basal and an apical, dark band, ventral surface dark scaled, and mediolateral surface from almost completely dark with few light scales to predominantly white; segment 5 white with or without a few dark scales at base extending from apex of 4. **Antenna**: Base of flagellar segment 1 dorsolaterally with small, white, obovate scales; apical 0.5 on dorsomesal surface with several long, narrow, lanceolate scales. **Thorax**: Integument reddish brown to very dark brown or maroon. Light scales of scutum moderately long and narrow. Upper *stp* with 3-5 long setae, and a patch of silver, cuneate to obovate scales in a horizontal arc. Lower *stp* with 1,2 long setae, and a patch of scales similar to those of upper *stp* in a diagonal row. Upper *mep* with 2-6 setae closely approximated dorsocaudally; scales absent. Anterior *mep* with a conspicuous, moderately large patch of silver to white, cuneate scales oriented horizontally at same level as scales on upper *stp*. **Legs**: Light coxal scales usually white. Foretarsal segments 2 and 3 with a pale cream to white band in apical 0.20 (0.15-0.35) and 0.6 (0.35-0.75) respectively; segment 4 with a pale cream to white band in apical 0.55 (0.45-0.65); segment 5 dark, occasionally with a few, golden, apical scales. Midtarsal segments 1 and 2 with a cream apical band; segments 3-5 completely dark or with a few, light, apical scales. Hindtarsal segment 2 with a dark band in basal 0.5 (0.4-0.7). **Wing**: Dark wing spots predominantly large. Light wing spots usually cream to yellowish at least on veins C and R. Vein C often almost completely dark, light spots occasionally obsolete; basal dark spot usually reaching humeral crossvein; humeral light spot small, almost always shorter (0.5-1.3) than basal dark spot; subbasal dark spot longer than subbasal light spot; subcostal light spot about 0.15 (0.1-0.2) of subcostal dark spot; preapical light spot about 0.25 (0.1-0.4) of preapical dark spot; apical dark spot moderately large and conspicuous. R presectoral dark spot usually large. R_2 preapical dark spot large, usually at least 0.5 length of vein. R_{2+3} about 0.5 of R_2. M sectoral dark spot variable, usually very large, often 0.7 of vein. M_{3+4} preapical dark spot and vein A subcostal dark spot large. Light fringe spots as in section description. **Abdomen**: Sternite I with a few, moderately long to long setae along lateral margin, no scales visible. Remainder of abdomen as in section description except tergites II-VII usually not as densely and extensively covered with silver to cream scales as in other species in section, and light scales concentrated toward midline of tergites.

MALE. Wing: 2.75 mm. Proboscis: 2.3 mm. Forefemur: 1.30 mm. Abdomen: about 2.6 mm. Essentially as in female except for sexual characters. **Head**: Palpal segments 2 and 3 with or without light dorsal stripe; segment 2 usually with only a few light scales; segment 4 with a basal and an apical, white band, and a subbasal and a subapical, moderately large to large, dark band, mediolaterally with or without cream to white scales which are less extensive than those of the Oswaldoi Subgroup. **Antenna**: About 0.8 length of proboscis. Flagellar segment 1 with long, white, oblanceolate scales. **Legs**: Forefemur 0.6 length of proboscis. Basal plantar surface of foretarsal segment 5 with moderately long, spiniform setae; setae conspicuously longer apically, about 0.3 length of segment 5. Claw on foreleg large, curved, acuminate; submedian tooth about 0.2 length of claw, with conspicuously recurved apex; basal tooth moderately short and decurved.

MALE GENITALIA (fig. 31). **Segment VIII**: Tergite and sternite with moderately broad, light scales. Tergite with light scales and interspersed darker scales. **Segment IX**: Sternite long, about 0.2 length of sidepiece, subtrapezoidal. Anterior apo-

deme large, about 0.33 length of sternite, subtriangular. **Sidepiece**: Moderately narrow, conical. Tergal surface with 3-5 long, submedian tergomedial bristles, basal bristles shorter than apical; with very few, short to moderate bristles (occasionally absent) mesad of tergomedial bristles and one or 2 long subapicolateral bristles. Parabasal spine long, its tubercle about 0.5 or less length of spine, and apex of spine often extending beyond lateral margin of aedeagus on other side. Basal apodeme thick, moderately long, about 0.20-0.25 length of sidepiece. Accessory spines usually not appearing blunt but sharply hooked apically; longer, more dorsal spine about 0.5 length of sidepiece; more ventral spine 0.70-0.85 of longer spine. Internal spine subequal to shorter accessory spine, apically retrorse. **Clasper**: Spiniform thin, short, equal to or slightly shorter than seta *b*. **Dorsal Claspette**: Pedicel moderately heavy, indented subbasally; base rounded, mesally hooked. Leaflets very broad, strongly curved, less than 0.5 length of claspette; dorsal leaflet with base produced into prominent, mesally rounded or triangular basomesal projection. **Ventral Claspette**: Without setae. Long, about 0.5 length of sidepiece; apex wide, width at apex 0.6-0.7 length of claspette. Basal lobule moderately large. Lateral margins of claspette tapering slightly medially toward apex. Apex truncate and rugose. Apicolateral margins produced into large, striated, auriculate, laterally projecting lobes. Preapical plate near apex, small, oval, heavily sclerotized, often appearing as 2 small, heavily sclerotized, adjacent, circular dots embedded in a small, moderately sclerotized, oval plate. Transparent, inverted U shaped, membranous band mesally bordering vertex and lateral margins of basal lobules. Basal lobules interconnected by a weakly sclerotized, speckled membrane; membrane conspicuously more sclerotized at vertex of mesal cleft than basally. **Phallosome**: Aedeagus narrow, long, subequal to length of ventral claspette; apex rounded, about 1.5 as long as wide; without leaflets.

PUPA (fig. 31). Abdomen: 2.13 mm. Trumpet: 0.4 mm. Paddle: 0.65 X 0.44 mm. Small and dark. Branches of hairs relatively long. **Cephalothorax**: Brown to brownish black. Hairs 1-3-C 2,3 branched (1-4); 2-C slightly shorter than 1,3-C. Hairs 4,5-C 2-4 branched (2-5); 5-C about 1.5 length of 4-C. Hairs 6,7-C 1-3 branched; 6-C forked about 0.5 from base, shorter than 7-C; 7-C with one branch very long (0.3 mm), about 1.5-2.0 length of other branch(es). **Trumpet**: Pale yellow to yellow. Pinna very long, about 4.0-6.5 (3.4-8.0) length of meatus, narrow; in lateral aspect, not appearing to taper toward apex. Meatal cleft long, open and basally rounded. **Metanotum**: Hair 10-C single, short, much shorter than 11-C and 0.5 or less length of 12-C. Hair 11-C 3 branched near base. Hair 12-C 2,3 branched (2-4). **Abdomen**: Brown to brownish black, darker dorsomedially. Float hair (1-I) with 7-15 major branches, secondarily very dendritic. Hair 2-I 3-6 branched near base, moderately long; 3-I single, subequal to 2-I. Hair 4-I 4-6 branched (4-7), moderately large, subequal to 2-I. Hair 5-I single and long. Hair 6-I single, very long (0.35 mm), about 2.0 length of 7-I. Hair 7-I 3-6 branched (1-6). Hair 9-I single, subequal to 6-I. Hair 0-II-VII few branched (2-5), moderately small. Hair 1-II,III strongly developed; 1-II 8-11 branched (8-12); 1-III 4-8 branched, median branches longer than lateral; 1-IV-VII very long, 1.75-2.00 length of segment; 1-V,VI longer than 1-IV,VII. Hair 3-IV 3-6 branched (2-6), moderately long; 3-V 2-4 forked. Hair 5-III 5-8 branched (5-9), lateral branches shorter than median; 5-IV double or triple, long; 5-V-VII single, subequal to length of segment. Hair 6-II single, very long, about 2.0 length of 7-II; 6-III 1-3 forked, long. Hair 7-II 3-6 branched; 7-III,IV 4 or fewer branched, moderately small; 7-V 1-3 branched, about 1.5 length of 8-V; 7-VI,VII single, long. Hair 8-III-VII 1-3 branched, small. Hair 9-II,III thin, sharp, small, unpigmented; 9-III slightly longer than 9-II; 9-IV moderately small, 2.0 or more length of 9-II,III, pigmented;

9-V 2.7-6.0 (2.3-6.0) length of 9-IV; 9-V-VIII slender, curved, acuminate, very long; 9-V,VI slightly shorter than 9-VII,VIII; 9-VII 1.1-1.4 (0.90-1.42) length of 9-VI; 9-V-VIII about 0.5 or more length of segment. Hair 10-III 2,3 forked, moderately long. Hair 4-VIII 2-4 forked, subequal to 9-VIII. **Terminal Segments**: Male genital lobe broad, with a moderately large mammilliform protuberance. **Paddle**: Large, weakly oblique, truncate; midrib fairly distinct, extending almost to apex. External buttress about 0.68 length of paddle. External margin with moderately short, filamentous spicules extending around apex and along inner margin to 0.66 from base; spicules very short on inner margin. Hair 1-P moderately large. Hair 2-P less than or equal to 1-P.

LARVA (fig. 32). Head: 0.5 mm. Antenna: 0.25 mm. Anal Saddle: 0.27 mm. In general small and dark. **Head**: Usually very dark and strongly pigmented. Median tooth of mental plate moderately narrow, less than combined widths of 2 adjacent teeth from one side. Inner and outer clypeal hairs (2,3-C) single, and simple or barbed in about apical 0.5; 3-C shorter than 2-C; hairs 2-C widely spaced, clypeal index about 1.3. Hair 4-C 2-4 branched, small, not reaching base of 2-C, inserted slightly laterad of an imaginary median line separating 2-C and 3-C. Hairs 8,9-C 3-5 branched (2-6), long, about 2.0 distance separating insertion of 5-C and 6-C. Hair 10-C 2-4 branched, large. Hairs 12,13-C 4-7 branched (3-7), large. Hair 15-C 3-5 forked. Collar narrow dorsomedially, heavily pigmented. **Antenna**: Darkly pigmented. Mesal margin with strong, stout spicules; ventral surface with stouter, shorter spicules. Hair 1-A 4-6 branched (3-6), short. Hairs 2,3-A large, about 0.4 length of antenna. **Thorax**: Moderately to heavily pigmented at least medially; grayish brown to almost black. Submedian prothoracic group (1-3-P) with 1,2-P not sharing a common tubercle; palmate hair 1-P with 15-20 (13-20) very narrow to narrow, lanceolate leaflets (rarely filiform); 2-P 16-23 branched, arising from small pigmented tubercle, about 3.0 length of 1-P. Hair 11-P double, branched 0.25 from base. Hair 14-P 11-14 branched (9-15) from an elongated, flattened shaft, lateral branches shorter than median. Mesothoracic hair 1-M 26-40 branched. Metathoracic palmate hair 3-T with 9-14 large, narrow, semitransparent leaflets. Hair 4-T 3-5 branched, moderately long. Pro-, meso- and metathoracic pleural group spines large; mesothoracic spine larger than pro- and metathoracic spines. **Abdomen**: Hairs usually proportionally longer than those of other species in group. Hair 0-II-VI 6-11 branched (5-12). Palmate hair 1-I with 14-17 (12-18) semitransparent, narrow, pointed leaflets; 1-II-VII with about 20-30 pigmented, narrow, pointed leaflets. Hair 2-II 6-9 branched (5-10), large; 2-V single or occasionally double, very long. Hair 5-I 4-6 branched (3-6), moderately developed; 5-III 7-11 branched. Hair 9-I 6-9 branched (5-10), branches long; 9-IV,V 7-12 branched (6-12). Hair 11-I 5-7 branched (3-7), large. Hair 13-I 3 branched (2-4), very large; 13-II 7-11 branched, moderately large; 13-III,IV 4-6 branched (3-7), large; 13-V triple, very large. Sclerotized tergal plate VII about 2.0 size of tergal plate VI. **Spiracular Lobe**: Pecten with 14-18 teeth; many of median teeth subequal; serrations conspicuous in basal half of teeth. Hairs 8,9-S 4-7 branched, large; 8-S smaller than 9-S. Lateral arm of spiracular apparatus long, directed laterally, truncate at lateral apex and reaching spiracular openings. **Anal Segment**: Covered with moderately long spicules. Saddle reddish brown. Hair 1-X long; inserted on saddle near ventral margin, about 0.3 cephalad of caudal margin. Anal gills slightly longer than saddle.

DISCUSSION. The monotypic Triannulatus Subgroup can be distinguished from the Oswaldoi Subgroup in the **female** by (1) anterior mesepimeron with a conspicuous patch of silver to white, cuneate scales, (2) palpal segment 4 with mediolateral surface having a reduced number of light scales, (3) foretarsal segment 4 with a light

band in apical 0.55 (0.45-0.65), (4) foretarsal segment 5 dark, occasionally with a few, apical, golden scales, (5) hindtarsal segment 2 brown in basal 0.5 (0.4-0.7), (6) vein C with large dark spots, light spots occasionally obsolete, humeral light spot small, 0.5-1.3 length of basal dark spot, apical dark spot moderately large and conspicuous and (7) vein M with sectoral dark spot usually very large, often 0.7 length of vein; in the **male genitalia** by (1) ventral claspette without setae, apicolateral margins produced into 2 large, striated, auriculate, laterally projecting lobes, (2) preapical plate small, oval, heavily sclerotized and (3) aedeagus long, subequal to length of ventral claspette, with apex about 1.5 as long as wide; in the **pupa** by the combination of (1) pinna narrow, very long, about 4.0-6.5 (3.4-8.0) length of meatus, not appearing to taper toward apex in lateral aspect, (2) hair 7-C with one branch about 1.5-2.0 length of other branch(es), (3) hair 10-C single, short, 0.5 or less length of 12-C, (4) hair 3-I subequal to 2-I, (5) hair 6-I,II very long, about 2.0 length of hair 7 on same segment, (6) hair 9-III slightly longer than 9-II, unpigmented, 9-IV 2.0 or more length of 9-III, 9-V 2.3 or more length of 9-IV, 9-V,VI slightly shorter than 9-VII,VIII and about 0.5 or more length of segment and (7) paddle large, weakly oblique, truncate; and in the **larva** by the combination of (1) hairs 2-C single, and simple or barbed, widely spaced, clypeal index about 1.3, (2) collar narrow dorsomedially, heavily pigmented, (3) palmate hair 1-P with 15-20 (13-20) very narrow to narrow, lanceolate leaflets, 2-P 16-23 branched, arising from a small pigmented tubercle, about 3.0 length of 1-P, (4) hair 14-P 11-14 branched (9-15) from an elongated, flattened shaft, (5) hair 11-I 5-7 branched, large, and 13-I 2-4 branched, very large, (6) hair 13-III,IV 4-6 branched (3-7), large, (7) tergal plate of segment VII large, about 2.0 size of tergal plate VI and (8) lateral arm of spiracular apparatus long, directed laterally.

Although the chaetotaxy of the larva and pupa varies, morphologically *triannulatus* is fairly uniform throughout its range. In the larva, there is considerable variation in the number and width of the leaflets of hair 1-P and in the length of the lateral arms of the spiracular apparatus which varies from long to very long. In the pupa, hair 1-III usually has 3 branches in specimens from Brazil and 4,5 branches in those from Panama. On an average, pupae examined from Brazil had one fewer branch per hair than pupae from Panama. In the female, the sectoral dark spot of vein M usually is smaller in Panamanian specimens than in the Brazilian specimens, although this is a highly variable character.

An. triannulatus possesses several derived characters including in the female (1) presence of a patch of light scales on the anterior mesepimeron, (2) apical light band of foretarsal segment 4 and (3) the unique wing spotting; in the male genitalia (1) shape of the apex of the ventral claspette and (2) shape of the aedeagus; and in the larva (1) elongated, flattened shaft of hair 14-P and (2) long lateral arms of the spiracular apparatus. These derived characters which distinguish *triannulatus* from the Oswaldoi Subgroup necessitates, I believe, placement of *triannulatus* in a monotypic subgroup.

In addition, *triannulatus* retains several ancestral characters which it shares with the Albimanus Group and with some species of the Argyritarsis Section, such as, in the adult, the small amount of white on palpal segment 4 and the predominantly dark foretarsal segment 5; in the male genitalia, the absence of setae on the ventral claspette; and in the larva, the number and width of the branches of hair 1-P and the large, sparingly branched hair 13-I,III,IV.

Within the Oswaldoi Subgroup, *triannulatus* shows a greater affinity to the Strodei Complex than to the Oswaldoi Complex. This species shares many synapomorphic

characters with *strodei* and *rondoni* such as, in the male genitalia, the apicolateral expansion of the ventral claspette; in the pupa, the very long pinna of the trumpet and the very long, slender hair 9-VII,VIII; and in the larva the relatively narrow collar and hairs 1-3-P not sharing a common tubercle.

The taxonomy of *triannulatus* has been very confusing in part due to the numerous mutant forms which have been described as separate nominal species. In fact, the description of *triannulatus* by Neiva and Pinto (1922b) was based on an anomalous specimen that had extra black basal bands on the second and third hindtarsal segments. In 1923, Neiva and Pinto described another mutant form, *cuyabensis,* distinguished from *triannulatus* by having only one extra basal black ring on the fourth hindtarsal segment. Petrocchi (1925) described the more typical form she called *bachmanni,* clearly illustrating its male genitalia. Later, 2 other nominal species were described, *davisi* Paterson and Shannon 1927 and *perezi* Shannon and Del Ponte 1928, both said to be very closely related to *bachmanni.* Lima (1928:103), after examining a cotype of *cuyabensis,* stated that this species was extremely similar to *bachmanni.* Dyar (1928:435) the same year listed *davisi* and *perezi* as synonyms of *bachmanni.* In 1930, Pinto synonymized *bachmanni* with *cuyabensis,* stating, *"Os estudos de Davis reforcam o nosso ponto de vista de que a pequena mancha negra existente na base do IV articulo do tarso posterior de* A. cuyabensis *e uma variacao. Caso este fato venha a se confirmar o* A. bachmanni *caira forcosamente na sinonimia de* A. cuyabensis *que foi descrito dois anos antes."* Galvao and Barretto (1939:150-154) synonymized *cuyabensis, bachmanni, davisi* and *perezi* with *triannulatus* based on Pinto's (1939:406-425) observations and on their own findings. These investigators studied material from Itapira, Brazil and discovered specimens of *cuyabensis* together with *bachmanni.* Pinto (1939) concurred with Galvao and Barretto after comparing the holotype of *triannulatus* with a female identified by Shannon as *bachmanni* (no. 2899, Resistencia) and with topotypic material of *cuyabensis.* Pinto stated that all 3 were the same species, *triannulatus* being the senior synonym. He also considered the holotypes of *triannulatus* and *cuyabensis* as atypical forms similar to those described in other species in the section. Pinto studied the larvae, males and females of *bachmanni* from other localities in Brazil and found the male genitalia to be the same as those of the topotypic material of *triannulatus* and *cuyabensis.* In the same publication (Pinto 1939), he also listed *perezi* as a synonym of *triannulatus.*

Later, Galvao and Lane (1941:11-14) examined abundant material of *triannulatus* and stated that they had observed all forms corresponding to the descriptions of *bachmanni, cuyabensis* and *triannulatus.* However, Galvao and Lane recognized *triannulatus* as being composed of 2 subspecies, *t. triannulatus* and *t. davisi.* The principal characters reportedly used to distinguish *t. triannulatus* from *t. davisi* were (1) pattern of the exochorion in the egg, (2) larval hair 1-P filamentous and with more branches (20-30) than in *davisi,* (3) female smaller than that of *davisi* and (4) adult wing with sectoral dark spot of Cu larger and reaching the furcation (Paterson and Shannon 1927; Galvao and Lane 1941; Rozeboom 1942a:241-242; Deane, Causey and Deane 1948:901-904). Some investigators believe that the differences between *triannulatus* and *davisi* are so striking that *davisi* merits species status (Deane, Causey and Deane 1948). I have examined adults from very near the type locality of *bachmanni,* from the type locality of *davisi* and from Salobra and other localities in Mato Grosso, Brazil where Galvao reportedly collected *t. triannulatus.* Though there is some variation in the size of wing spots, I could not see anything in the adults which would lead me to consider *triannulatus* as being composed of 2 subspecies. Likewise in the larva, although the number and width of the branches of hair 1-P and the

length of the lateral arms of the spiracular apparatus varied, the variation was usually intrapopulational and present as a continuum. It is possible, however, that I did not ever see a true example of *t. triannulatus*, since it is considered to be much less common than *t. davisi.* In that case, my consideration of *triannulatus* as being composed of a single variable taxon may be incorrect.

Galvao (1941) described another variety of *triannulatus, chagasi,* from Chaves (Para), and Itacoatiara and Manaus (Amazonas), Brazil. *An. chagasi* was later synonymized with *triannulatus* by Lane (1949:404).

An. triannulatus, like several of the other species in the section, has been reported to be highly polymorphic in the egg stage. Galvao (1940:441-442) recognized 4 types of *triannulatus* eggs: 2 types were of *t. triannulatus* and 2 of *t. davisi*; this is discussed in detail in Rozeboom (1942a:241-242).

BIONOMICS. The immatures of *triannulatus* are most commonly collected in permanent ponds, lakes, canals, slow streams or river margins, ditches, and swamps, either exposed to the full sun or partially shaded. Occasionally *triannulatus* is collected in semipermanent and temporary rock holes, small ground pools, and animal tracks. The immatures are found in clear, fresh water, never brackish, and are usually associated with *Pistia* sp. Other commonly associated aquatic plants are *Eichhornia* sp, *Azolla* sp, *Utricularia* sp, *Jussiaea* sp, *Elodea* sp and *Salvinia* sp. The immatures have been collected in association with 7 other species in the Albimanus Section: *albimanus, oswaldoi, ininii, nuneztovari, rangeli, strodei* and on one occasion *aquasalis.* Other mosquitoes collected with *triannulatus* are *Anopheles (Ano.) apicimacula, An. (Ano.) neomaculipalpus, Uranotaenia (Ura.) apicalis, Ur. (Ura.) leucoptera, Ur. (Ura.) lowii, Ur. (Ura.) pulcherrima, Culex (Cux.) coronator* group, *Cx. (Mel.) bastagarius, Cx. (Mel.) dunni, Cx. (Mel.) educator, Cx. (Mel.) egcymon, Cx. (Mel.) elevator, Cx. (Mel.) ensiformis, Cx. (Mel.) erraticus, Cx. (Mel.) ocossa, Cx. (Mel.) panocossa, Cx. (Mel.) zeteki* group, *Aedeomyia (Ady.) squamipennis, Mansonia (Man.) dyari* and *Ma. (Man.) leberi. An. triannulatus* is most abundant in Colombia during the dry season (Bates and de Zulueta 1949:137) and is common in Panama from April to September, "from the end of the dry season well into the rainy season" (Arnett 1947:198-199).

The adult females are primarily exophilic and zoophilic. They are rarely found inside houses. In French Guiana, Floch and Abonnenc (1944a:1-7) collected 2102 anophelines in houses, of which 6 were *triannulatus.* Deane, Causey and Deane (1948:901-904) reported that of 15,583 specimens of *triannulatus* collected, only 714 or 4.6% were taken in houses. They stated that *triannulatus* feeds outside, although it will feed readily on man. Rozeboom (1938b: 294-297) in Panama found that only 0.5% of the anophelines in houses were *triannulatus,* and they preferred to feed on pigs rather than humans. He collected *triannulatus* in numbers around stables and pig sties. The only contrary finding was by Gabaldon (1949:765), who reported a large number of *triannulatus* inside a house in the Rio Apure region of Venezuela. Hill (1934) collected *triannulatus* in the area around Maracay, Venezuela in stables, houses, dairy farms, and a farm and an orphanage where malaria epidemics were a yearly occurrence. He performed precipitin tests on 262 blood engorged females and found 14 had fed on man, 173 on horses and 38 on cattle; 37 did not react to the test. He concluded that *triannulatus* "definitely perfers animal blood." However, several investigators (Rozeboom 1935:527; Deane, Causey and Deane 1948:901-904; Floch and Abonnenc 1947:7) have stated that *triannulatus* is a vicious biter, feeding readily on man outside even during the day although most actively at dusk.

MEDICAL IMPORTANCE. Throughout most of its range, *triannulatus* does not seem to be important as a vector of malaria. Only once *triannulatus* was found to have a natural oocyst infection and that was in Cojedes, Venezuela (Gabaldon and Cova Garcia 1946a:19-20). Benarrochi (1931) incriminated *triannulatus* as a possible vector of malaria at a boy's school near Maracay, Venezuela, as it was the most common species present during a marlaria epidemic. Hill (1934:428) stated that with a high density "it is probable that this species can act as a malaria transmitter."

Several investigators (Godoy and Pinto 1923; Bonne and Bonne-Wepster 1925; Rozeboom 1935; Floch and Abonnenc 1944a; Fonseca and Unti 1943:50) have experimentally infected *triannulatus* with *Plasmodium vivax* and *P. falciparum.* In comparing the susceptibility of *triannulatus* to infection with *P. vivax* and *P. falciparum* with that of *albimanus,* Rozeboom (1935:524-525) found a larger percentage of the specimens of *triannulatus* refractory to infection.

Because of the feeding behavior and low susceptibility to plasmodial infection, *triannulatus* is probably not a serious health threat, except when present in very large numbers.

DISTRIBUTION (fig. 1). *An. triannulatus* is widely distributed throughout South America east of the Andes as far south as the Argentine provinces of Chaco, Corrientes, Formosa, Jujuy, Salta, Santa Fe, Tucuman and Misiones. East of the Andes, it occurs throughout Brazil, Paraguay, most of Bolivia, the Guianas, Colombia, Venezuela, Ecuador and Peru. On the Pacific side of the Andes, *triannulatus* extends as far south as Tumbes, Peru. It is found in Central America as far north as central Nicaragua.

Material Examined: 2354 specimens: 545 males, 84 male genitalia, 1058 females, 301 pupae, 366 larvae; 262 individual rearings: 93 larval, 156 pupal, 13 incomplete; 3 progeny rearings.

ARGENTINA (52 specimens: 12M, 6Mgen, 32F, 1 lp). **Chaco:** Resistencia, 22 Feb 1927, R. Shannon, 7M, 1Mgen, 5F; same data except 23 Feb, 1M, 4Mgen; same data except 25 Feb, 1Mgen; same locality, Feb 1927, N. Davis, 2M, 1F [JH] ; same locality, L. Rozeboom, 10M, 5F. **Jujuy:** Ledesma, Mar 1923, N. Davis, 1F. **Salta:** Embarcacion, 20 May 1927, R. Shannon, 2M, 5F. **Province not specified:** Salta Alto, Sierra, Apr 1960, 8F. Santa Barbara, Finca, 8 Apr 1927, E. Del Ponte, 4F; same locality and date, R. Shannon, 2F. Santa Maria, 19 Nov 1962, R. Salta, 1F [AMNH] . Locality not specified, N. Davis, 1 lp [JH] .

BOLIVIA (63F). **Beni:** Guayaramerin, 19 Apr 1947, S. Blatman, 31F; same locality, 13 May 1947, 8F; same locality, 8 Jun 1947, 7F (47-12258); same locality, 23 Jun 1947, 12F (47-12258). San Ignacio, 17 Sep 1943, 3052, KO 117-27, 1F; same locality, 18 Sep 1943, Torres Munoz, 3055-A, KO 117-25, 1F. Trinidad, Aug 1946, E. Soracho, 3F.

BRAZIL. Amazonas (1F): Manaus, Jun 1931, R. Shannon, 1F. **Bahia** (7F): Bonfim, 26 Jan 1930, N. Davis, R. Shannon, 1F; same locality and collectors, 1F. Itapira, Mar 1931, 1F [JH] . R. Barboza, 21 Apr 1930, J. Serafim, 1F. Locality not specified, H. Kumm, 3F [BM1931-302] . **Mato Grosso** (3M, 2Mgen, 10F): Maracaju, Dec 1937, 2M, 1Mgen; same locality, 1937, 1M, 1Mgen, 1F. Salobra, 1936, J. Lane, 6F. Westborder, May 1931, R. Shannon, 3F. **Para** (597 specimens: 71M, 1Mgen, 346F, 127p, 52L&l; 127 ind rear: 40 l, 87p). Altamira, 150 km W of, 5 Nov 1974, J. Reinert *et al.,* coll. 77, 1 pM, 2 pF; same data except 163 km W of Altamira and 6 Nov, coll. 85, 3 lpM, 6 lpF, 6 pM, 1 pF; same data except 164 km W of Altamira, coll. 98, 2F; same data except 158 km W of Altamira and 9 Nov, coll. 111, 1M, 3 lpM, 2 lpF, 5 pM, 5 pF. Bacuri, Gleba 36, Lote 05, 23 Oct 1974, J. Reinert *et al.,* coll. 31, 2 pF; same data except Lote 02, coll. 33, 1F, 5 lpM, 12 lpF, 16 pM, 13 pF; same data except 26 Oct, coll. 50, 1M, 2F, 3 lpM, 4 lpF, 3 pM, 1 pF; same data except Gleba 29, Lote 03 and 25 Oct, coll. 44, 1 lpM, 1 lpF; same data except Lote 09 and 28 Oct, coll. 60, 2 pM; same data except Gleba 34, Lote 02, coll. 62, 1M, 1F, 4 pM, 5 pF; same data except Gleba 38, Lote 02 and 29 Oct, coll. 64, 1 pF. Belem, BRA 42, BRB 9. Boa Vista, 12 Aug, C. Town-

send, 3F. Fordlandia, Jun 1931, R. Shannon, 1M, 1Mgen, 49F. Itupiranga, 17 Feb 197[6], Moramay, 1 pM (1050); same locality and collector, 1 Jun 1976, 2 pM, 1 pF (1200). Maraba area, 4 May 1976, 10F (M-6); same locality, 6 May 1976, 1F (M-8); same locality, 18 May 1976, D. Roberts, 14F (R-1); same data except 19 May, 15F (R-2); same locality, 20 May 1976, 20F (R-3); same locality, 22 May 1976, D. Roberts, 26F (R-5); same data except 23 May, 3F (R-3); same data except 8 Jun, 6F (M-2); same data except 9 Jun, 4F (M-3); same data except 10 Jun, 5F (M-4); same locality, 14 Jun 1976, 1F (M-6); same locality, 15 Jun 1976, D. Roberts, 6F (M-7); same data except 16 Jun, 1F (M-8); same data except 24 Jun, 3F (A-1); same locality, 29 Jun 1976, 11F (M-1); same locality, 30 Jun 1976, 7F (M-2); same locality, 1 Jul 1976, 6F (M-3); same locality, 2 Jul 1976, 8F (M-4); same locality, 3 Jul 1976, 10F (M-5); same locality, 6 Jul 1976, 2F (M-7); same locality, 7 Jul 1976, 3F (M-8); same locality, 8 Jul 1976, 4F (M-9); same locality, 9 Jul 1976, 1F (M-8); same locality, 12 Jul 1976, 7F (M-12); same locality, 17 Aug 1976, 1F (C-7); same locality, 9 Sep 1976, 1F (A-7), 1F (N-1); same locality, 8 Oct 1976, 3M (1262); same locality, 11 Oct 1976, 1F (1263); same locality, 19 Oct 1976, 6F (1); same locality, 21 Oct 1976, 5F (1); same locality, 28 Oct 1976, 2F (1); same locality, 8 Nov 1976, 5F (1); same locality, 9 Nov 1976, 5F (2); same locality, 10 Nov 1976, 1F (1), 1F (2); same locality, 12 Nov 1976, 2F (2); same locality, 19 Nov 1976, 1F (2); same locality, 1976, D. Roberts, 2M, 17F. Maraba area, Fonte Lenta, 1176, Kiu 13-M-A, 1 pM, 2 pF. Palestina, 100 km SW of Maraba, 18 Aug 1976, Moramay, 1 pM (1045). Trinidad, Botanical Gardens, Oct 1924, J. Petroca, 1M. **Pernambuco** (1M, 8F): Recife, Sep 1929, 8F; same locality, Oct 1929, R. Shannon, 1M. **Rio Grande do Norte** (11 specimens: 1M, 1Mgen, 8F, 1 L): Natal, Cajupiranga, 16 Nov 1943, MacCreary, Bricker, 3F; same locality, 19 Jan 1944, 1F; same locality, 20 Jan 1944, 1M, 1Mgen; same locality, 24 Mar 1945, det. H. Dalmat, 1F [CU]. Natal, Rio Cajupiranguinha, 21 Apr 1945, det. H. Dalmat, 1F [CU]. Natal, Lagoa Segui, 23 Apr 1945, det. H. Dalmat, 1F [CU]. Rio Cajupiranga, on road to San Jose, 6 Jan 1945, H. Dalmat, 1L [CU]. San Jose, 13 Oct 1944, H. Dalmat, 1F [CU]. **Pernambuco** (1M): Afogados [de Ingazeira], 1944, H. Dalmat, 1M. **Rondonia** (14F): Porto Velho, Rio Madeira, May 1931, R. Shannon, 14F. **Sao Paulo** (1M, 1Mgen): Juquia, J. Lane, 1M, 1Mgen. **Sergipe** (1F): Estancia, Dec 1929, R. Shannon, 1F. **State not specified** (2Mgen, 2F): Parahyba, 20 Mar 1930, 2Mgen; same locality, Mar 1930, R. Shannon, 1F. Piraja, BRR 4, 1F.

COLOMBIA (270 specimens: 91M, 20Mgen, 63F, 45p, 51L&l; 8 larval ind rear; 3 progeny rearings). **Amazonas**: Leticia, 25 Jul 1975, J. Kitzmiller, COZ 74, 2M, 2F. **Antioquia**: Arquia, L. Dunn, 2F. La Pintada, COK 45A, 2M. Murindo, L. Dunn, 2F. **Atlantico**: Barranquilla, Nov-Dec 1924, L. Dunn, 1M, 9F; same locality, 24 Nov [1943], E. Palacio, COT 33, 1F. Calamar, 1966, J. Bequaert, 1M [MCZ]. **Boyaca**: Lago de Palagua, COM 601, 602, 603. Puerto Boyaca, COM 604, 650, 651. **Cordoba**: Monteria, COB 12, COL 421, 427. **Magdalena**: Aracataca, Mar 1913, J. Egbert, 1F. **Meta**: Villavicencio, 2 Jun 1942, W. Komp, KO 117-18, 19M, 4F; same locality and collector, ?1942, KO 120A-23, 1M; same locality, 1 Jun 1944, COK 38, 4F; same locality, 15 Jun 1944, COK 44A, 4F; same locality, 1944, M. Bates, CV 90, 1F; same locality, 6 May 1947, L. Rozeboom, CV-P 25 (progeny rearing), 16M, 3Mgen, 14F, 12p, 14L; same locality and collector, 1947, CV-P 31 (progeny rearing), 6M, 1Mgen, 6F, 13p, 13L; same data, CV-P 39 (progeny rearing), 12M, 5F, 12p, 13L; same locality, 9 May 1947, 1L. **Department not specified**: Cauca Valley, Jul 1943, W. Earle, KO 117-17, 1M. Locality not specified, COR 538, 1M, 1F; COR 508, 1F.

COSTA RICA (14 specimens: 6M, 1Mgen, 5F, 2L). **Province not specified**: Barranca, H. Kumm, No. 450, KO H-18-35, 3M, 1F; same locality and collector, No. 450, 2F [BM], 2M, 2L; same locality, 1M, 1Mgen, 2F.

ECUADOR (61 specimens: 12M, 1Mgen, 11F, 24p, 13 l; 23 ind rear: 13 l, 10p). **Napo**: Limoncocha, 4 Jun 1977, Y. Huang, coll. 48, 2 pF, 1 lpM; same locality and collector, 5 Jun 1977, coll. 49, 2 pM, 1 pF, 6 lpM, 1 lpF, 1p. Tena, 1.5 km S of, 13 May 1977, Y. Huang, coll. 26, 1Mgen, 1 pM, 3 pF, 1 lpM, 3 lpF; same locality and collector except 12.5 km SE of Tena, 24 May 1977, coll. 38, 1 lpF. **Pastaza**: Puyo, 5-9 May 1977, Y. Huang, coll. 28, 1 pM.

FRENCH GUIANA (15 specimens: 5M, 2Mgen, 3F, 2p, 3 l; 2 larval ind rear). **Guyane**: Cayenne, 1943, H. Floch, ?3M, 2F; same locality, FG 122. Lac du Rorota, 15 Oct 1939, FGA 7-224, 1F.

GUYANA (55 specimens: 18M, 5Mgen, 28F, 1p, 3L; 1 p ind rear). **East Berbice-Corentyne**: New Amsterdam, Jul 1936, 1Mgen. **East Demerara-West Coast Berbice**: Georgetown, 28 Sep 1945,

KO 117-21, 1F; same locality, 1 Oct 1945, KO 117-23, 1F; same data, KO 117-24, 1F; same locality, GUY 40; same locality, W. Beveridge, 1M, 1F [BM1931-210]. Hyde Park, 30 Jul 1941, BGR 3, 3M, 3Mgen. MacKenzie, Sep 1945, KO 117-26, 4F. **District not specified:** Coast, Sep 1949, BGR 9, 2M, ?15F. Locality not specified, 1940, G. Bevier, KO 117-11, 8M, 1F; same date and collector, 2M, 2F; 1942, G. Bevier, KO 117-4, 2F; no data, 3L (1B).

PANAMA AND CANAL ZONE (907 specimens: 291M, 37Mgen, 283F, 89P&p, 207L&l; 88 ind rear: 28 l, 55p, 5inc). **Bocas del Toro:** Almirante, 1932, W. Komp, 1M, 1Mgen. **Canal Zone:** Barro Colorado Island, 20 Feb 1942, KO 111-14, 2F; same locality and date, KO 117-8, 1F. Cano Saddle, 7 May 1923, R. Shannon, 6F. Empire, 16 Jun 1944, ASM 43-2, 7M, 4Mgen, 4L [CU], 2L. Empire, Rio Mandinga, 24 Aug 1944, Wood, Van Doran, ASM 131-5, 3L [CU], 2L. Fort Clayton, 23 Apr 1944, 3F. Gamboa, 5 Apr 1939, W. Komp, 1M, 2F; same locality, 10 Jun 1943, Col. Elton, 9F; same locality, 10 Jun 1943, W. Komp, 2F; same locality, 22 Jun 1944, Stearns, Middlekauff, ASM 12-1, 1L [CU]; same locality, 28 Sep 1944, Van Doran, Turney, ASM 194, 2L; same data, 1 L [CU]; same locality, 6 Jan 1947, PAX 239, 4M, 4F; same locality, 28 Jan 1947, 5M, 5F; same locality, 18 Apr 1947, H. Brooks, 3F, 3 l; same locality and collector, 22 May 1947, 1M, 4F; same locality and date, 1M; same locality, PA 912A. Gatun Lake, Apr 1935, PAX 47, 38M; same locality, 23 May 1939, 2M; same locality, 8 Aug 1940, W. Komp, 1Mgen. Juan Mina, Rio Chagres, 23 May 1939, 3M; same locality, PA 1122, 1124, 1125, 1160, 1161. La Pita, 11 Feb 1922, J. Shropshire, 1M, 2F. Mandinga Bridge, 22 Jan 1942, 3M, 4F. Mendoza, Gatun Lake, 18 May 1939, 1M. Pedro Miguel, 27 Jan 1947, 1M, 5F. Rio Chagres at Las Guacas, 23 Feb 1940, PAX 174, 14M, 14 F; Rio Chagres, below Las Guacas, 31 Mar 1944, E. Pierce, KO 117-14, 4M, 2F. Rio Chagres, 12 Feb 1942, 1M, 1F; same locality, 12 Feb 1943, KO 117-2, 20M, 19F; same locality, 31 Mar 1944, 3 l; same locality, 5 Jan 1947, 2M, 3F; probably same locality, KO 117-16, 2M, 2F. Rio Chilibre, PA 27. Rio Gatun, 10 Apr 1945, KO 117-22, 6F. Rio Gatuncillo, PA 1136. Rio Mandinga, Aug 1937, W. Komp, KO H-18-31, 11M. Rio Paja, 5 Jan 1934, 1M, 2 l; same locality, 1 l. Locality not specified, Feb 1933, D. Curry, 2M, 1F [BM1933-504]; 26 Feb-22 Mar 1944, H. Hoogstraal, 1M. **Cocle:** La Vieja, 7 Nov 1936, L. Rozeboom, 3L [JH]. **Colon:** Colon, 24 Jun 1921, W. Chidester thru J. Zetek, 1F. Santa Rosa, 30 Aug 1935, L. Rozeboom, 2L. **Panama:** Juan Mina, 6 Aug 1943, G. Fairchild, KO 117-3, 13F; same locality and collector, 5 Oct 1943, KO 117-6, 6F; same locality and collector, KO 117-5, 4F; same locality, PA 12, 31. La Chorrera, 31 May 1944, ASM 29, 1L [CU], 1L; same locality, 19 Sep 1944, Van Doran, ASM 168, 1L; same locality, 27 Nov 1944, Wood, Griffing, ASM 298-1, 5L [CU]; same data, ASM 299-2, 1L [CU]; same locality, 7 Dec 1944, K. Frick, R. Arnett, ASM 333, 3L; same locality, 8, 9 Jan 1945, Wood, Van Doran, ASM 370-2, 1F; same locality, 13 Jan 1945, K. Frick, ASM 377, 1L. Las Guacas, Dec 1934, 11M, 7M gen, 3F; same locality, 5 Feb 1935, PAX 42, 81M, 67F; same locality, 4 Apr 1935, 15M, 4Mgen; same locality, 14 Aug 1936, L. Rozeboom, 2L; same locality and collector, 6 Feb 1937, 1F; same locality and collector, 19 Mar 1937, 1F; same locality and date, 2M, 1F [AMNH]; same locality, L. Rozeboom, 24 May 1937, 1M, 1Mgen; same locality, 6 Aug 1937, 1L [JH]; same locality, Aug 1937, 1M, 1Mgen. Pacora, La Joya, Feb 1945, KO 117-20, 2F. Pedregal, PA 1163. Pequeni, PA 942. Rio Abajo, 7 Jul 1944, K. Frick, R. Arnett, ASM 59, 1L. Tocumen, PA 557, 559, 1066, 1144, 1145, 1148, 1162. **Province not specified:** Rio Pescado, 16 Jul 1936, L. Rozeboom, 1L. Locality not specified, 17 Dec 1934, 1L; 14 Aug 1936, L. Rozeboom, 4L; 1937, 3M, 8F; 1937, 621001-7, 8, 1M, 1F.

PARAGUAY (2M, 2Mgen, 7F). **Capital:** Asuncion, 1925, F. Soper, 1Mgen; same data, 1M [JH]. **Central:** Asuncion, 12 km on rd. to Villa Rica, 10 Oct 1942, KO 111-1, 3F. **La Cordillera:** San Bernardino, Fiebrig, 1M, 1Mgen, 2F. **Department and locality not specified:** 1922, Fiebrig, 2 F [BM].

PERU (86F). **Loreto:** Iquitos, Mar-Apr 1931, R. Shannon, 68F; same locality, 22 Jul 1975, J. Kitzmiller, PERZ 33, 2F. San Antonio, 17 Aug 1965, J. Hitchcock, Jr., 2F; same locality and collector, 18 Aug 1965, 3F; same locality and collector, 21 Aug 1965, 1F; same locality and collector, 23 Aug 1965, 4F; same locality and collector, 25 Aug 1965, 6F.

SURINAME (27 specimens: 3M, 1Mgen, 1F, 4p, 18L&l; 4 ind rear: 2p, 2inc). **Paramaribo:** Paramaribo, J. Bonne-Wepster, 1F. **Suriname:** Ma Retraite, SUR 206. **District not specified:** Kropie Kreek, 25 Sep 1974, 16L. Nord, Kabelstation, 26 Jun 1946, E. Kuyp, 1M, 1Mgen, 2 lp.

VENEZUELA (132 specimens: 27M, 3Mgen, 79F, 8p, 15L&l; 8 ind rear: 2 l, 1p, 5inc). **Aragua:** Maracay, 20 Aug 1926, M. Nunez Tovar, 9F; same locality and collector, 3 Sep 1926, 16F; same locality and collector, 9 Oct 1926, 11F; same locality and collector, 10 Oct 1926, 9F; same locality, 11 Sep 1926, 1F; same locality, 12 Mar 1927, 1F (No. 9); same locality, 10 May 1927, 1F [JH]; same locality, 12 May 1927, F. Root, 1F [BM1929-194]; same locality and collector, 24 May 1927, 2M, 2F [BM1929-194]; same locality, 17 May 1927, 3L (17) [JH]; same locality, 31 May 1927, 1M (No. 45); same locality, 7 Jun 1927, 3 lp (Nos. 54a, b, d) [JH]; same locality, 8 Jun 1927, F. Root, 1M [BM1929-194]; same locality, 18 Jun 1927, 1 lp (77a) [JH]; same locality, 21 Jun 1927, 1 lp (83a) [JH]; same locality, 1L. **Carabobo:** Mariara, VZ 68. Valencia, 10 Aug 1927, M. Nunez Tovar, 1M, 1F. **Cojedes:** Rd. to San Carlos, 10 Dec 1941, H. Hanson, KO 111-6, 5F. **Distrito Federal:** Caracas, 19 Apr 1938, A. Gabaldon, KO H-18-32, 7F; same data, KO H-18-34, 18M, 4F. **Guarico:** Calabozo, 22-31 May 1941, VZK 48, 1M, 3F. Chaguaramas, 4 Jul 1945, E. Winton, 1M. **Monagas:** Caripito, KO 117-12, 1M, 1F; same locality, 5 Sep 1936, KO 117-15, 1M, 2F. **State not specified:** Cap El Callai, CDC, 2L. Locality not specified, 4 Mar 1937, Anduze, 2M gen [CU]; 1949, 1Mgen, 2L; no data, 8L, 2F.

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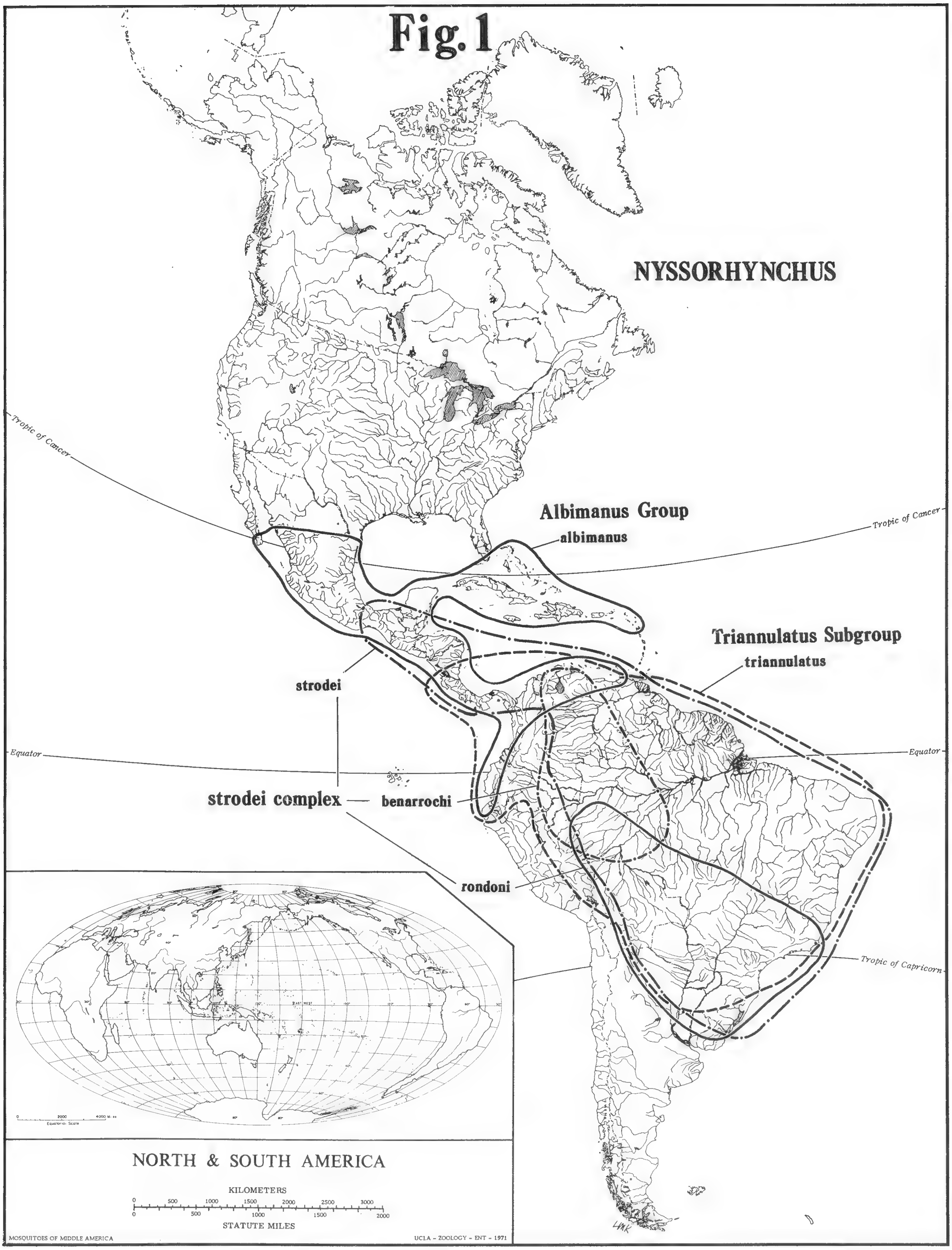
FIGURES

1. Distribution of *albimanus, triannulatus, strodei, rondoni* and *benarrochi*
2. Distribution of *oswaldoi, noroestensis, aquasalis, ininii* and *anomalophyllus*
3. Distribution of *galvaoi, rangeli, trinkae* and *nuneztovari*
4. Hypothesized phylogenetic tree of Albimanus Section
5. *Anopheles (Nyssorhynchus) albimanus*: male and female heads and claws; male foretarsus 5; female thorax, legs, wing and abdomen
6. Wings of *oswaldoi, galvaoi, noroestensis, aquasalis, ininii, anomalophyllus* and *rangeli*
7. Wings of *trinkae, nuneztovari, strodei, rondoni, benarrochi* and *triannulatus*
8. *Anopheles (Nyssorhynchus) albimanus*: male genitalia and pupa
9. *Anopheles (Nyssorhynchus) albimanus*: larva
10. *Anopheles (Nyssorhynchus) oswaldoi*: male genitalia and pupa
11. *Anopheles (Nyssorhynchus) oswaldoi*: larva
12. Male genitalia of *rondoni* and *galvaoi*
13. *Anopheles (Nyssorhynchus) noroestensis*: male genitalia and pupa
14. *Anopheles (Nyssorhynchus) noroestensis*: larva
15. *Anopheles (Nyssorhynchus) aquasalis*: male genitalia and pupa
16. *Anopheles (Nyssorhynchus) aquasalis*: larva
17. *Anopheles (Nyssorhynchus) ininii*: male genitalia and pupa
18. *Anopheles (Nyssorhynchus) ininii*: larva
19. *Anopheles (Nyssorhynchus) anomalophyllus*: male genitalia and pupa
20. *Anopheles (Nyssorhynchus) anomalophyllus*: larva
21. *Anopheles (Nyssorhynchus) rangeli*: male genitalia and pupa
22. *Anopheles (Nyssorhynchus) rangeli*: larva
23. *Anopheles (Nyssorhynchus) trinkae*: male genitalia and pupa
24. *Anopheles (Nyssorhynchus) trinkae*: larva
25. *Anopheles (Nyssorhynchus) nuneztovari*: male genitalia and pupa
26. *Anopheles (Nyssorhynchus) nuneztovari*: larva
27. *Anopheles (Nyssorhynchus) strodei*: male genitalia and pupa
28. *Anopheles (Nyssorhynchus) strodei*: larva
29. *Anopheles (Nyssorhynchus) benarrochi*: male genitalia and pupa
30. *Anopheles (Nyssorhynchus) benarrochi*: larva
31. *Anopheles (Nyssorhynchus) triannulatus*: male genitalia and pupa
32. *Anopheles (Nyssorhynchus) triannulatus*: larva

Fig. 1


NYSSORHYNCHUS
Tropic of Cancer
Tropic of Cancer
Albimanus Group
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strodei complex
benarrochi
rondoni
Tropic of Capricorn
0 2000 4000 M. ea
Equatorial Scale
NORTH & SOUTH AMERICA
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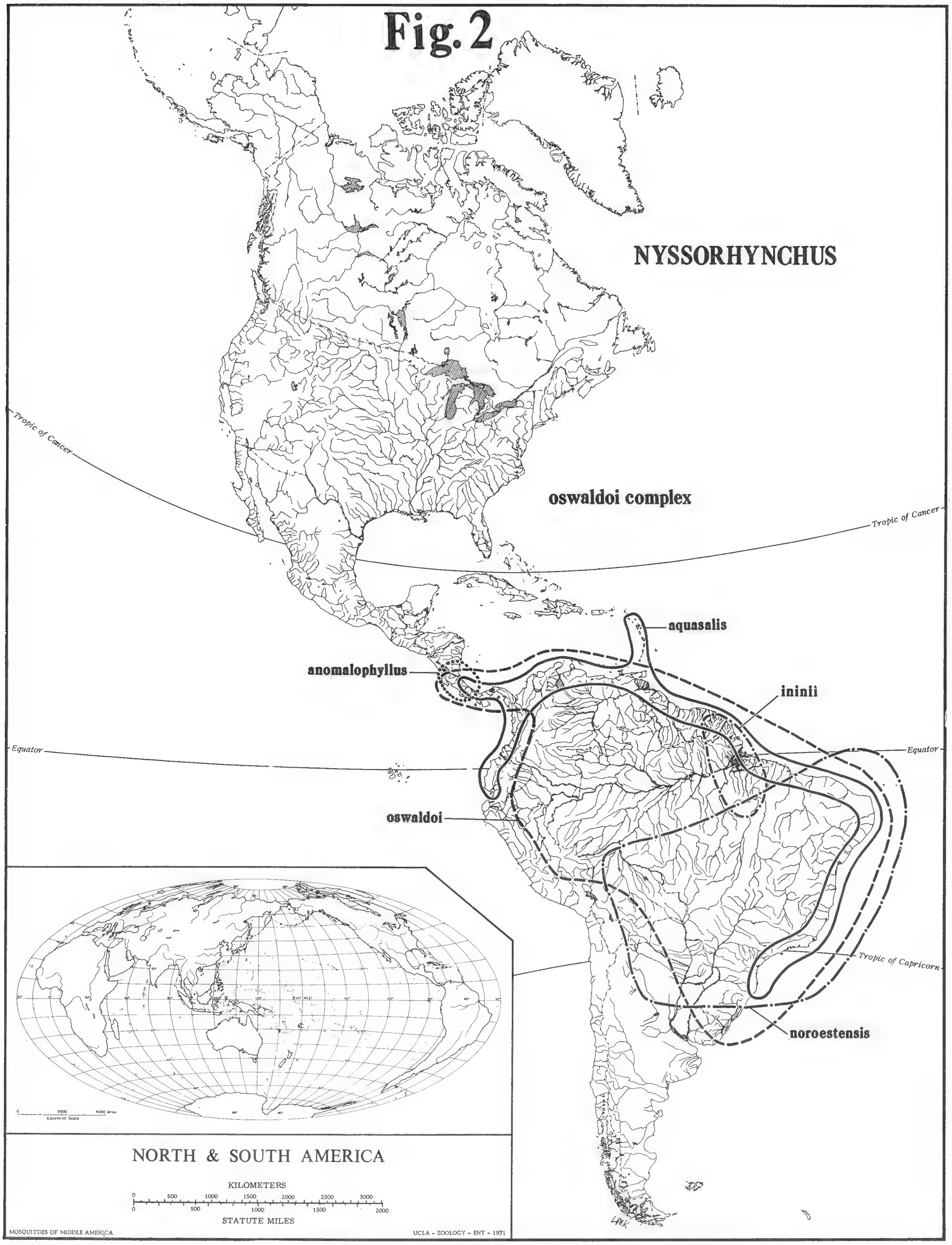
Fig. 2


NYSSORHYNCHUS
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Equatorial Scale
NORTH & SOUTH AMERICA
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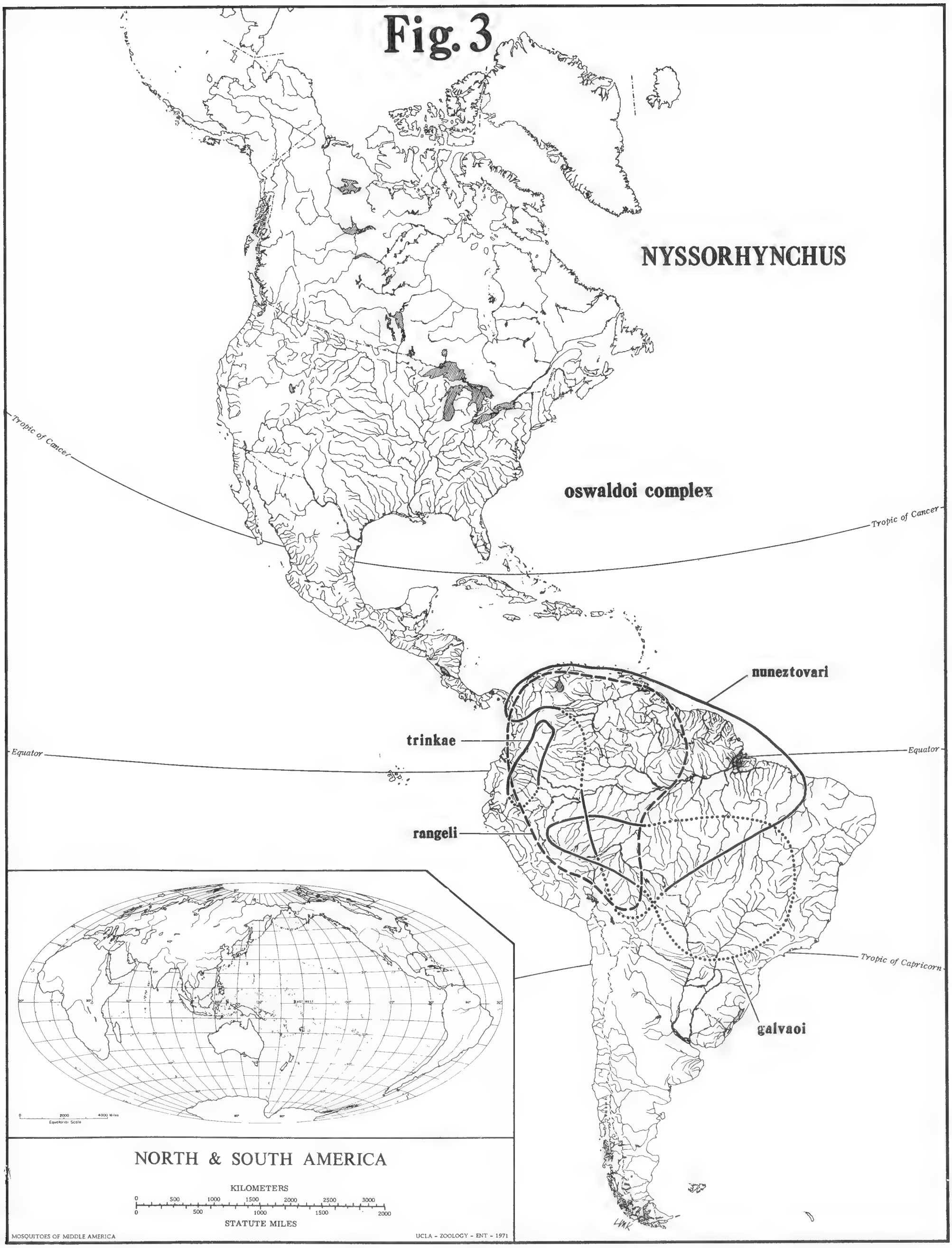
Fig. 3


NYSSORHYNCHUS
oswaldoi complex
Tropic of Cancer
Tropic of Cancer
nuneztovari
trinkae
Equator
Equator
rangeli
Tropic of Capricorn
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0 2000 4000 Miles
Equatorial Scale
NORTH & SOUTH AMERICA
KILOMETERS
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MOSQUITOES OF MIDDLE AMERICA
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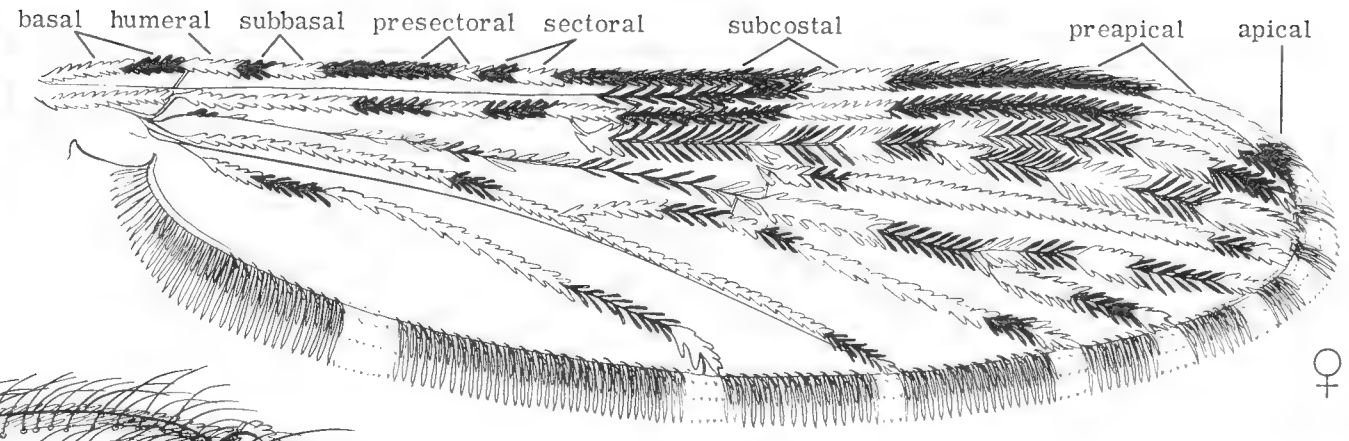
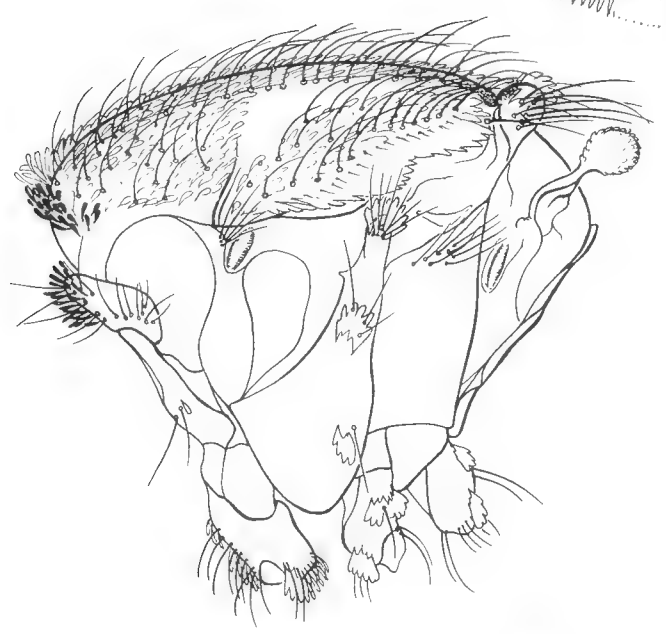
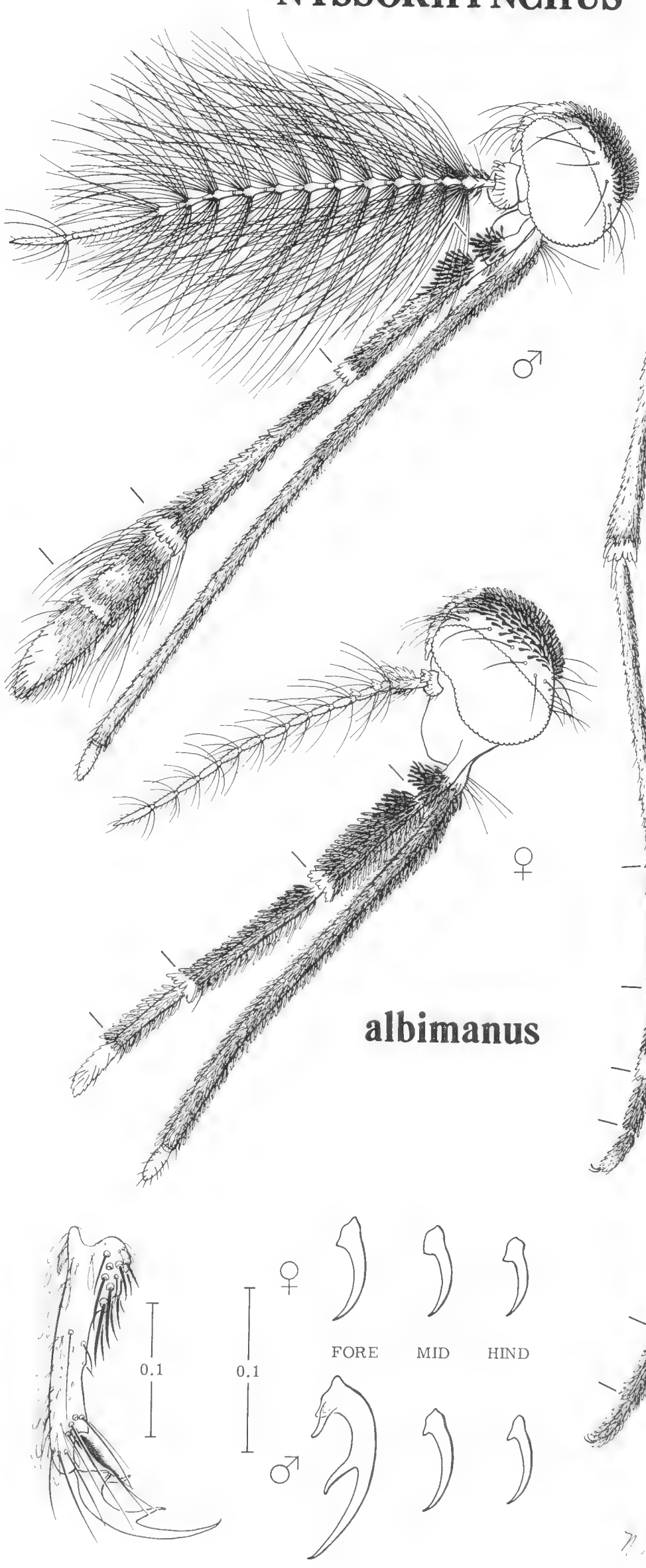
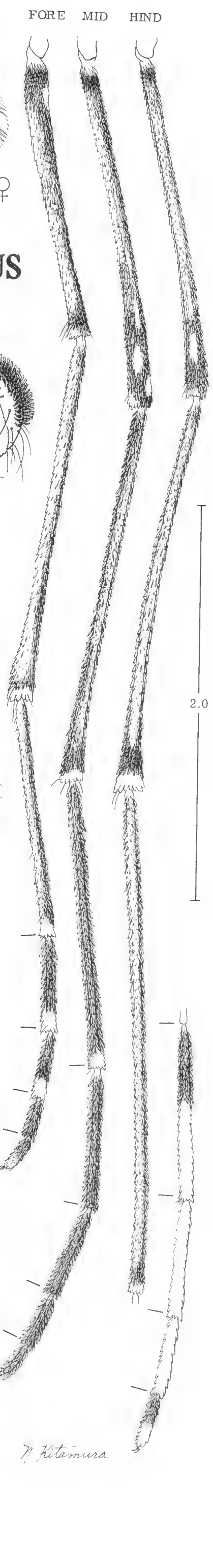
Fig. 4 Hypothesized phylogenetic tree of the Albimanus Section.

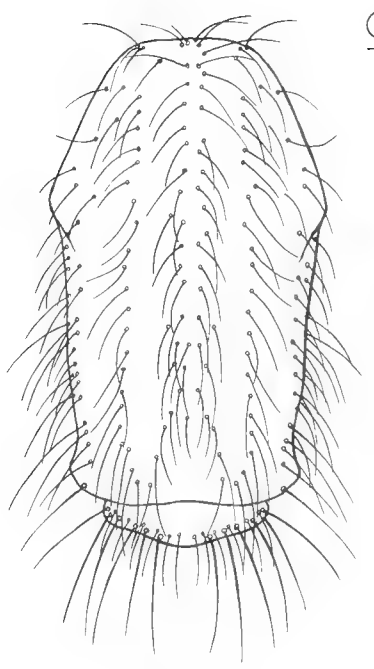
Fig. 5

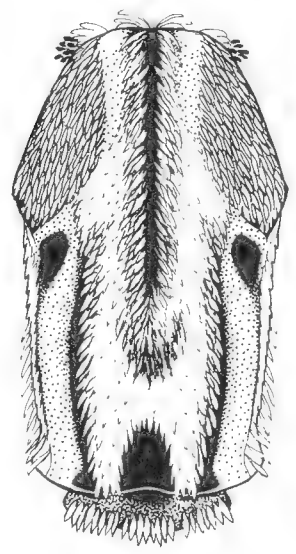


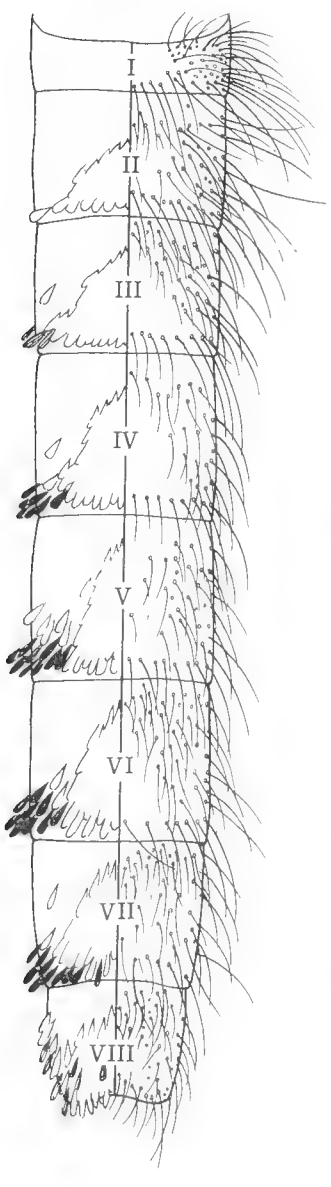


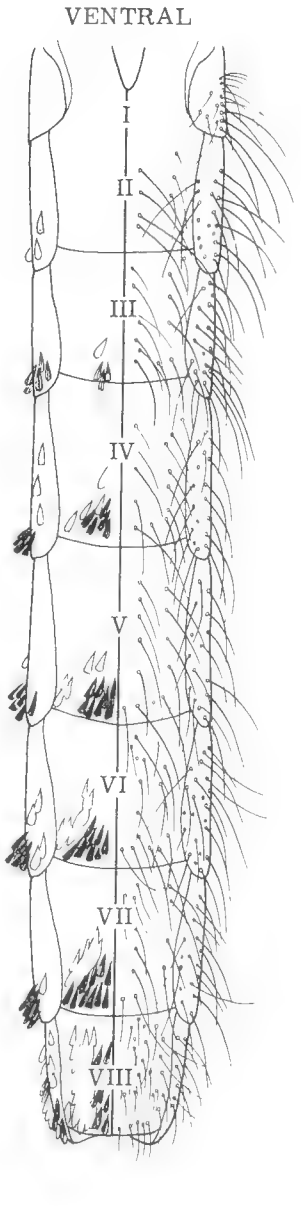












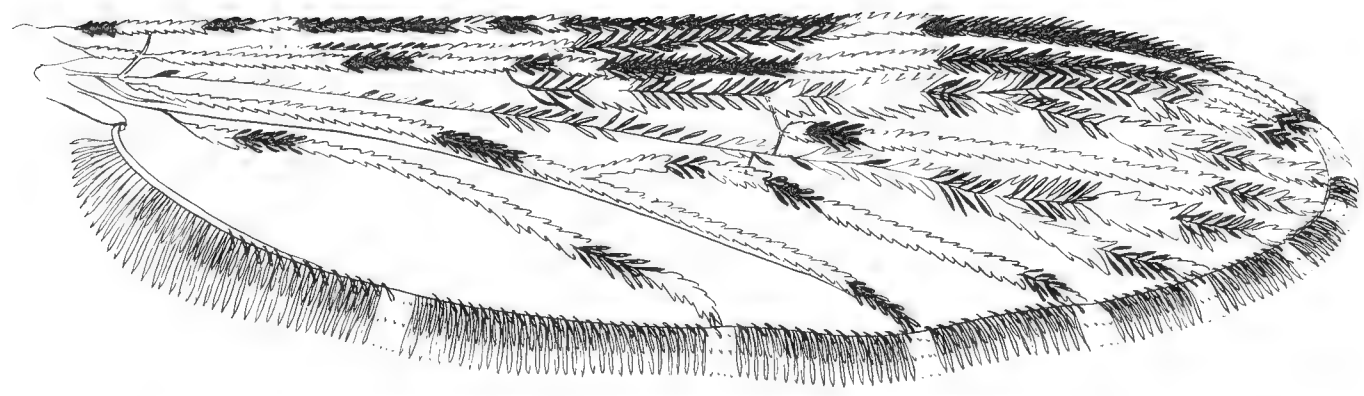
NYSSORHYNCHUS

albimanus

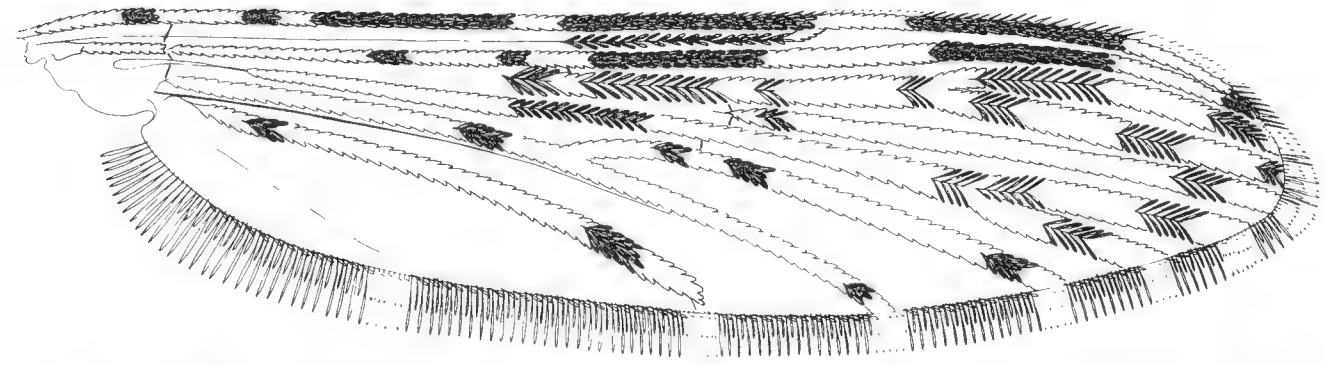
N. Kitamura

Fig. 6

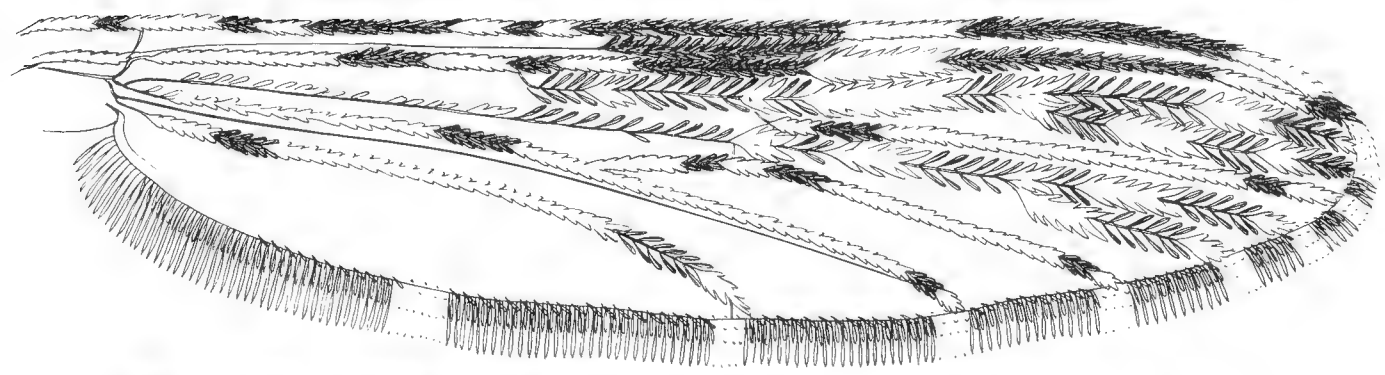
NYSSORHYNCHUS



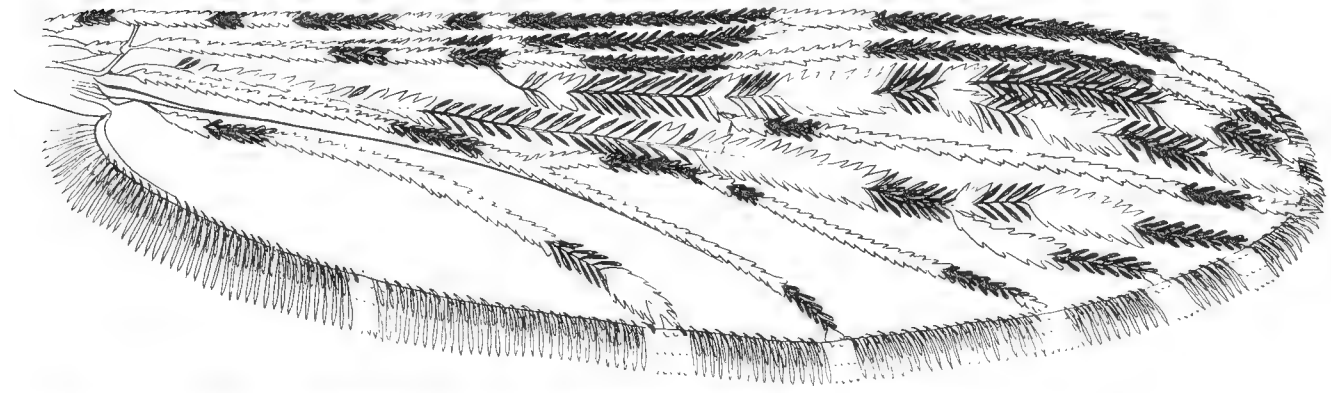
oswaldoi



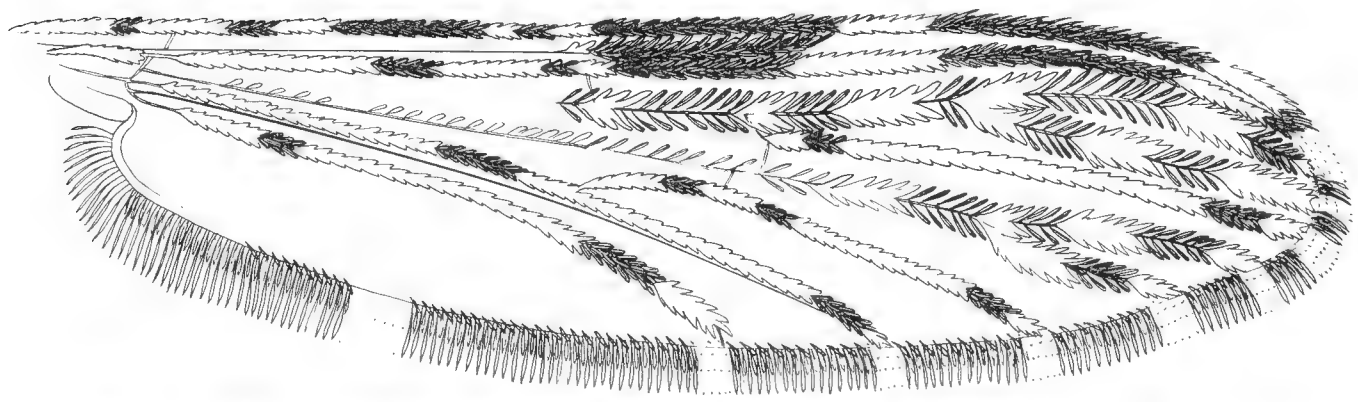
galvaoi



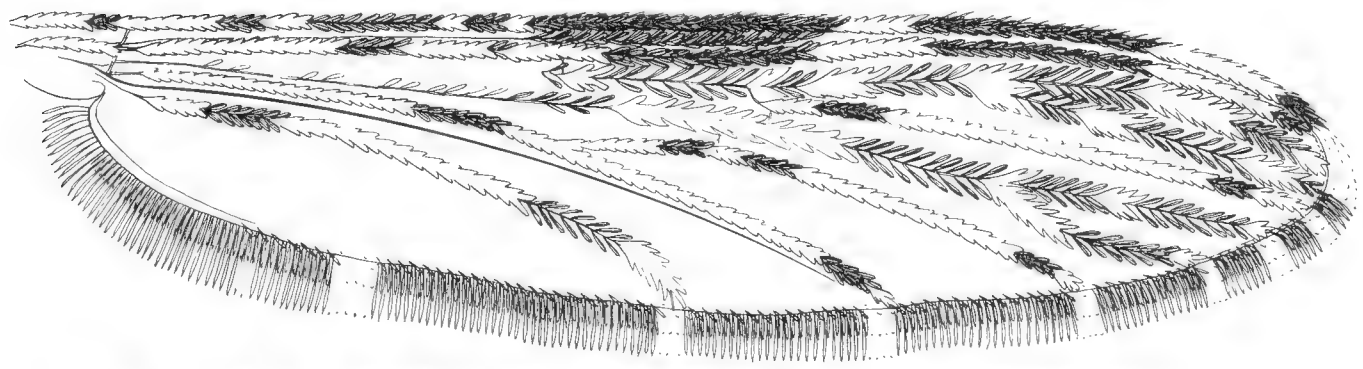
noroestensis



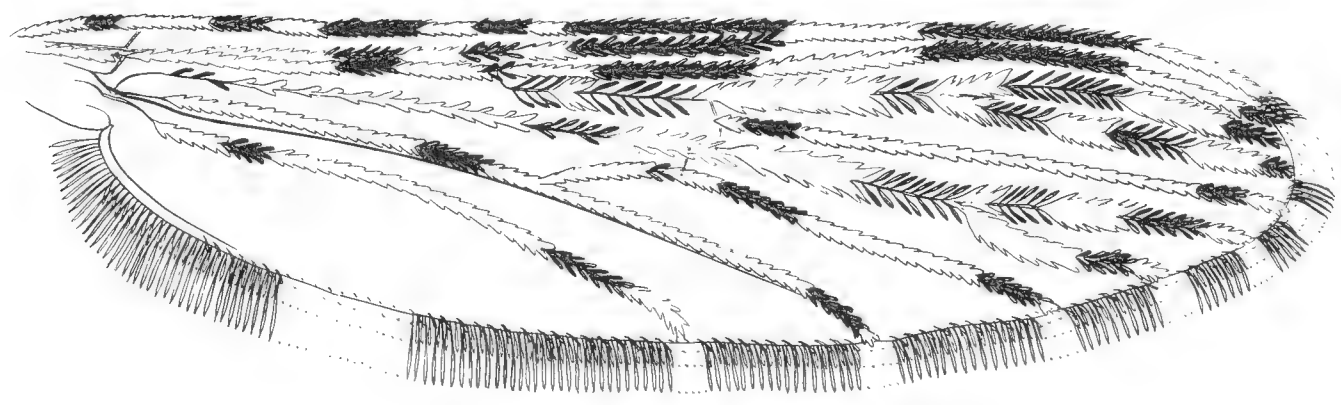
aquasalis



ininii



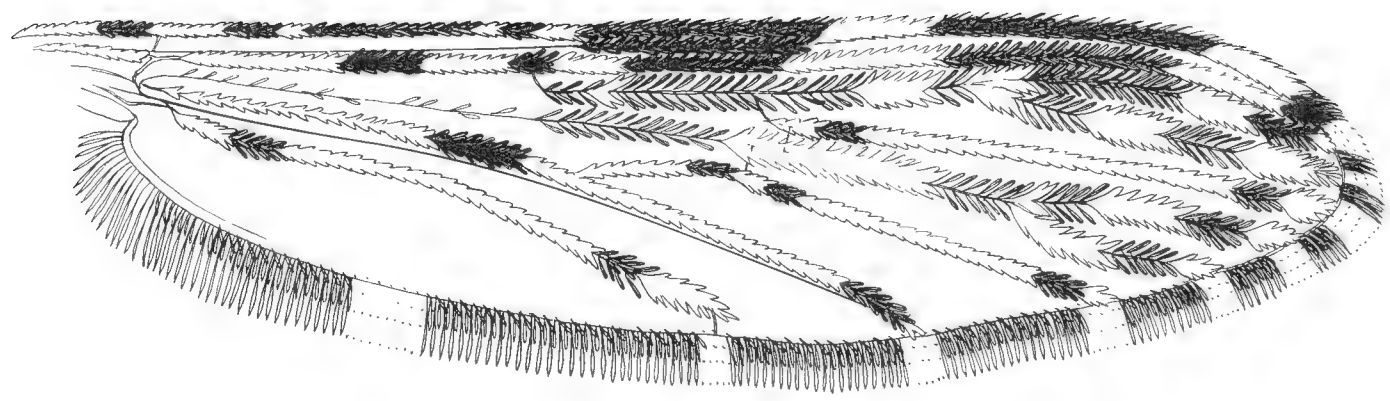
anomalophyllus



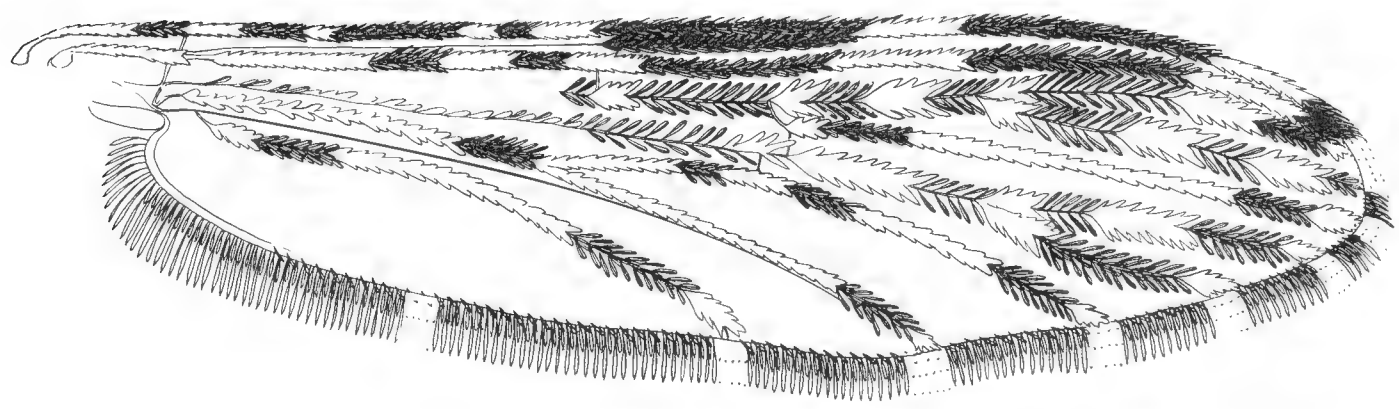
rangeli

Fig. 7

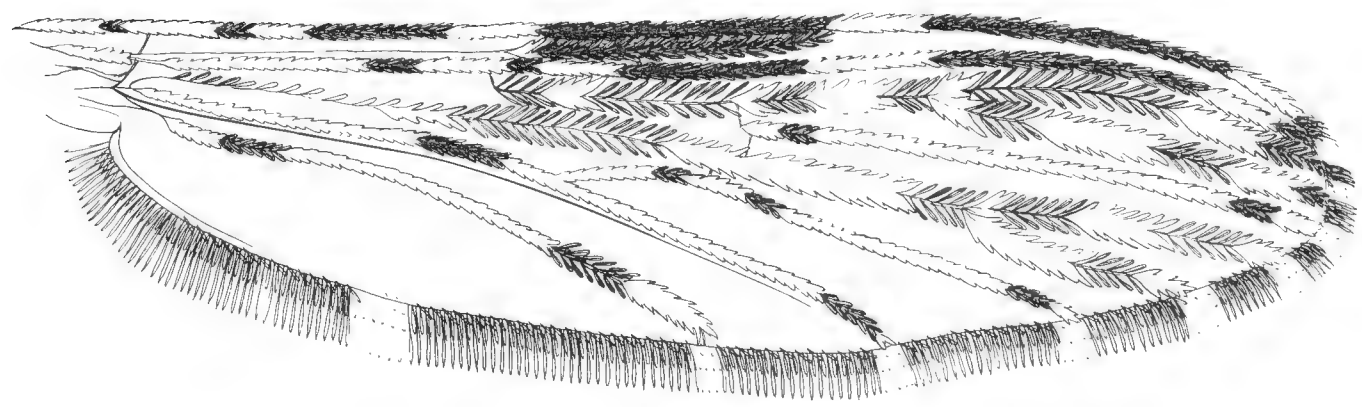
trinkae



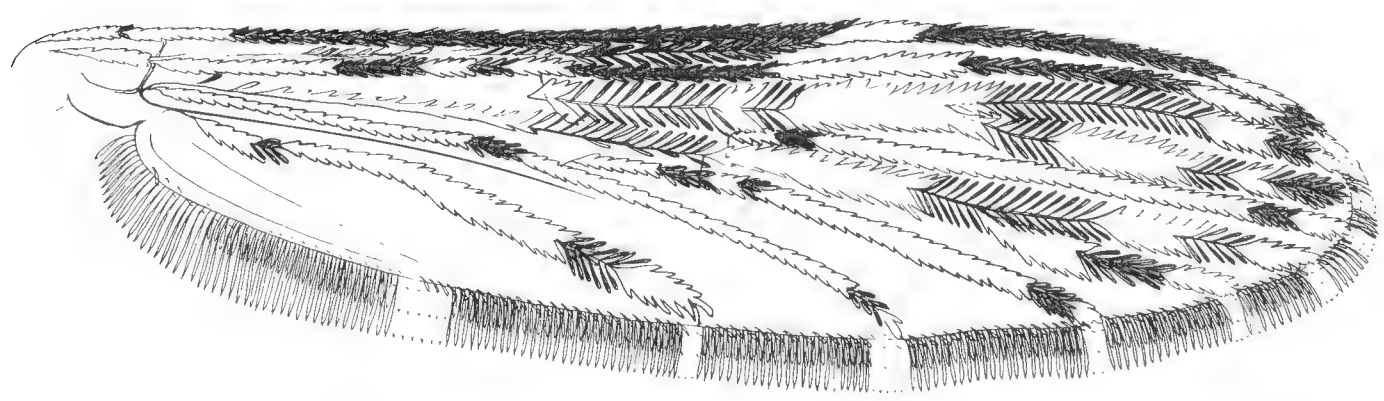
nuneztovari



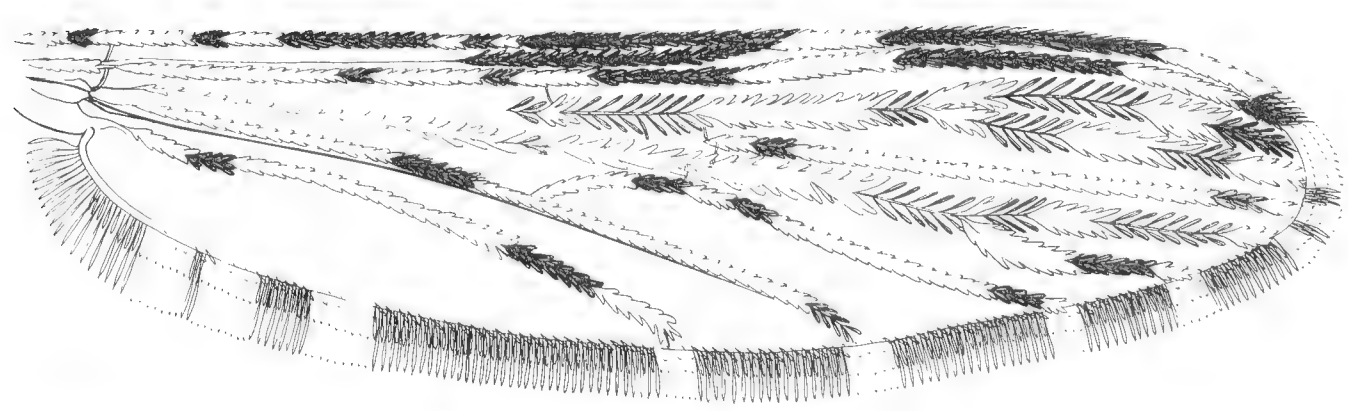
strodei



rondoni



benarrochi



triannulatus

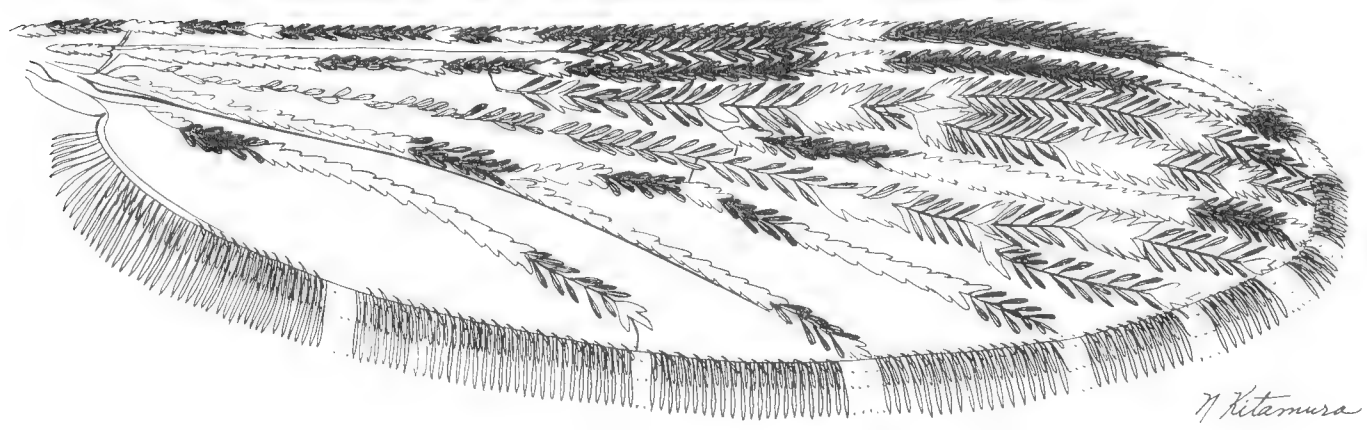
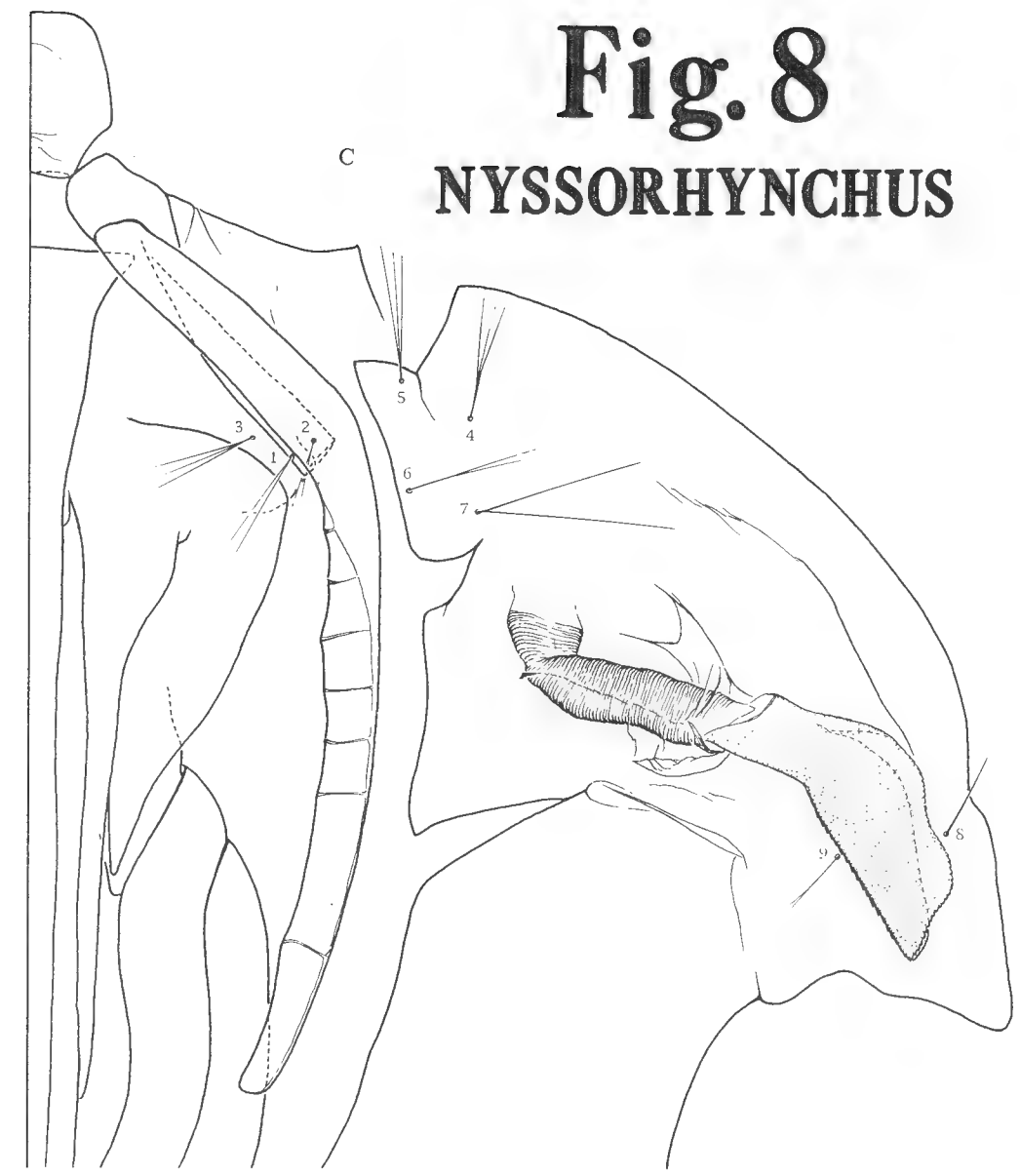
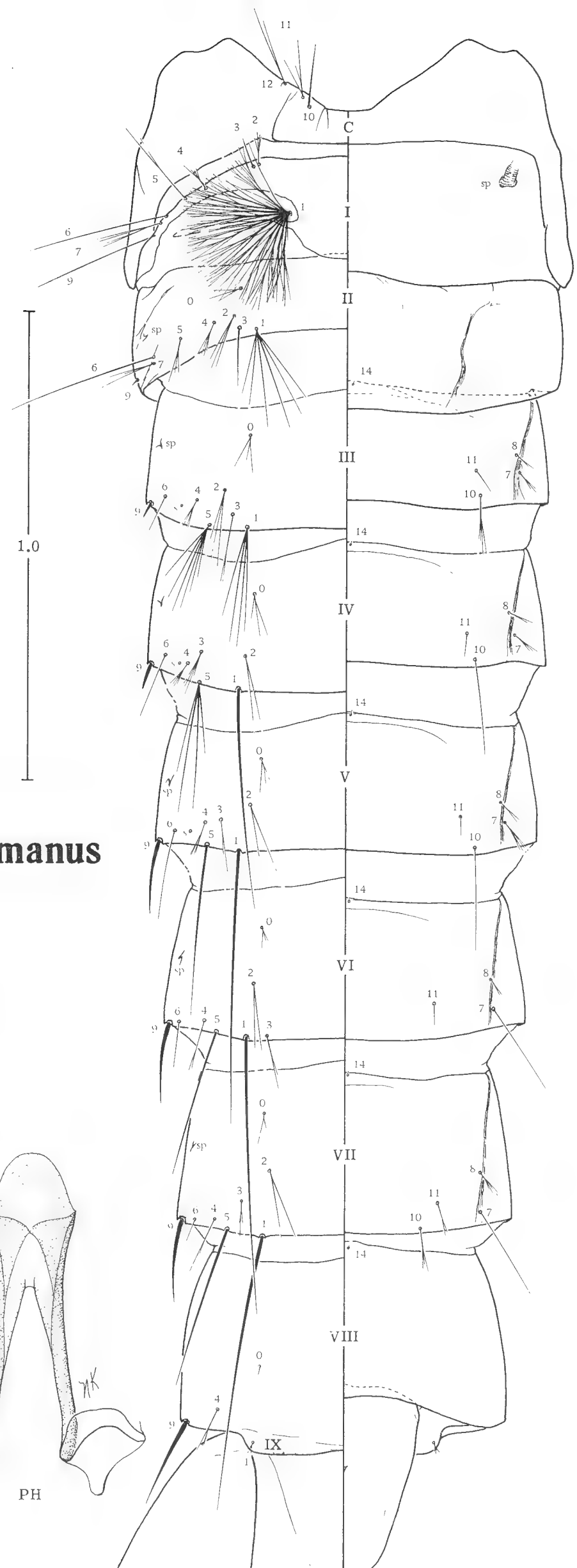
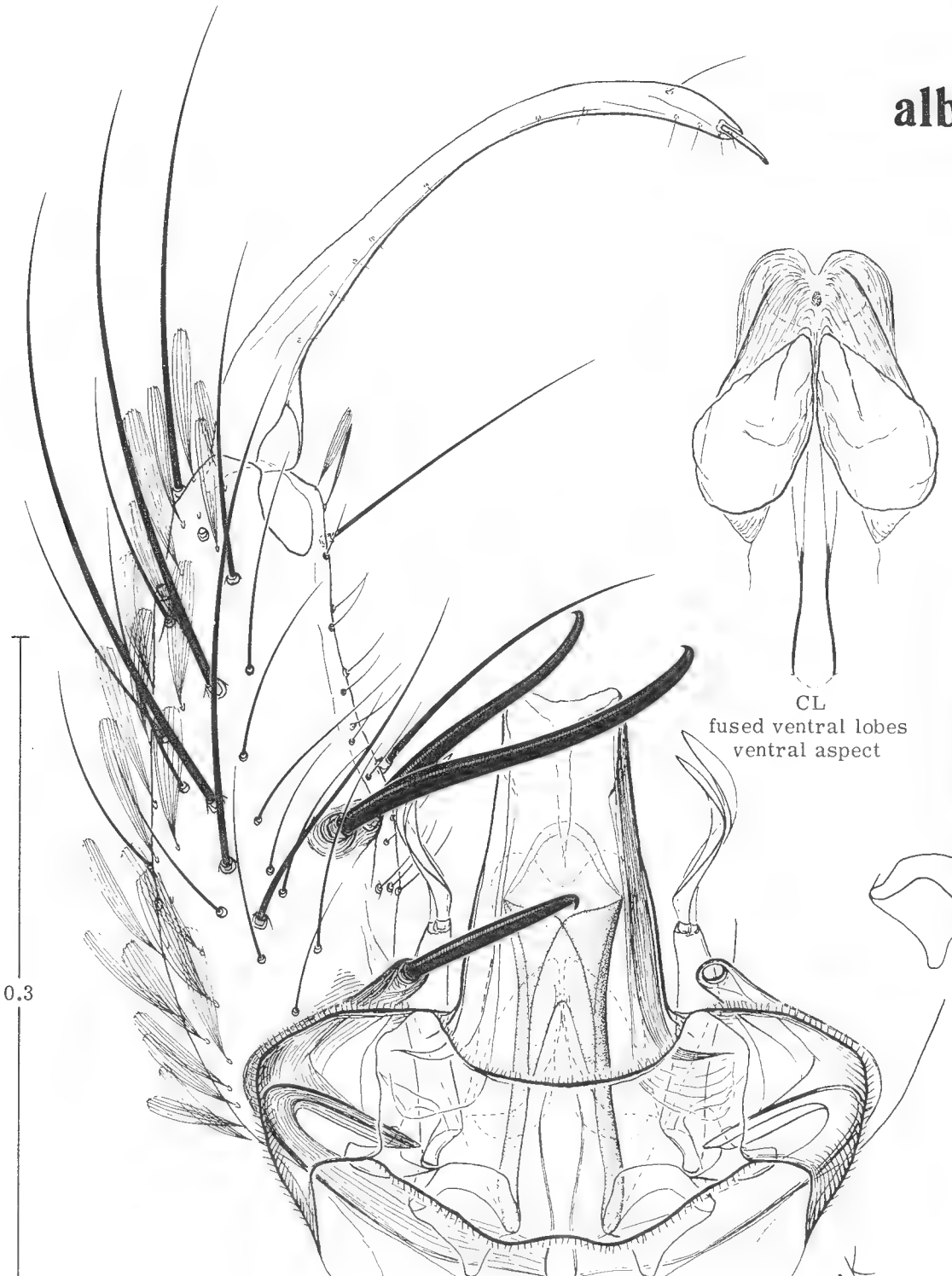


Fig. 8

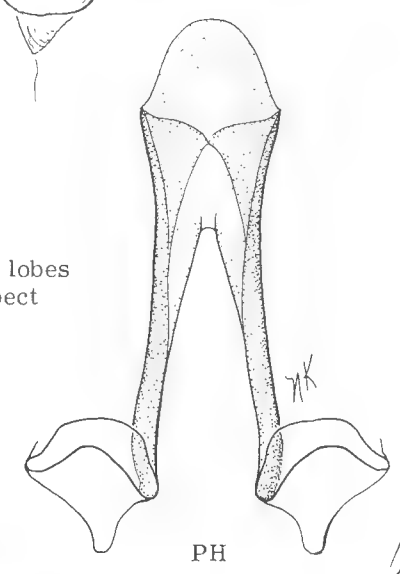
NYSSORHYNCHUS albimanus







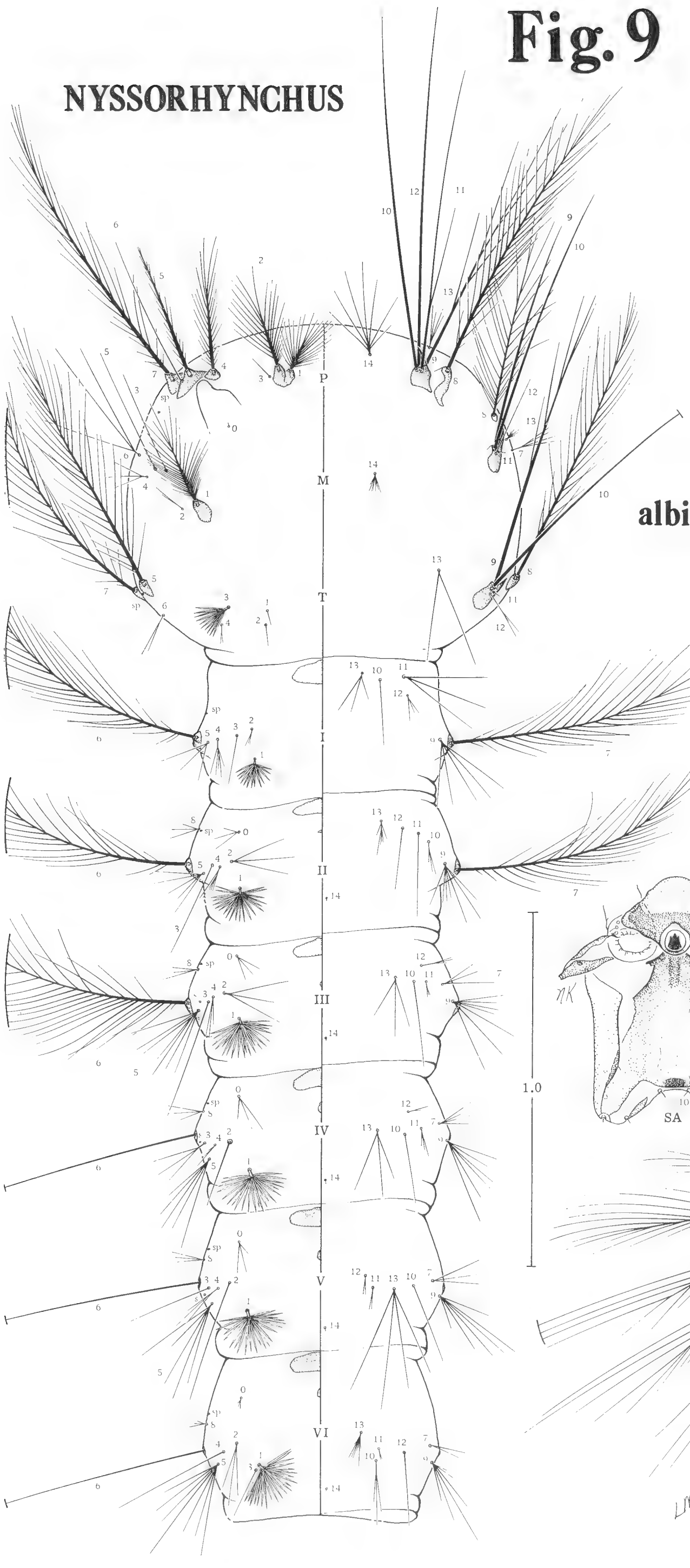
CL
fused ventral lobes
ventral aspect

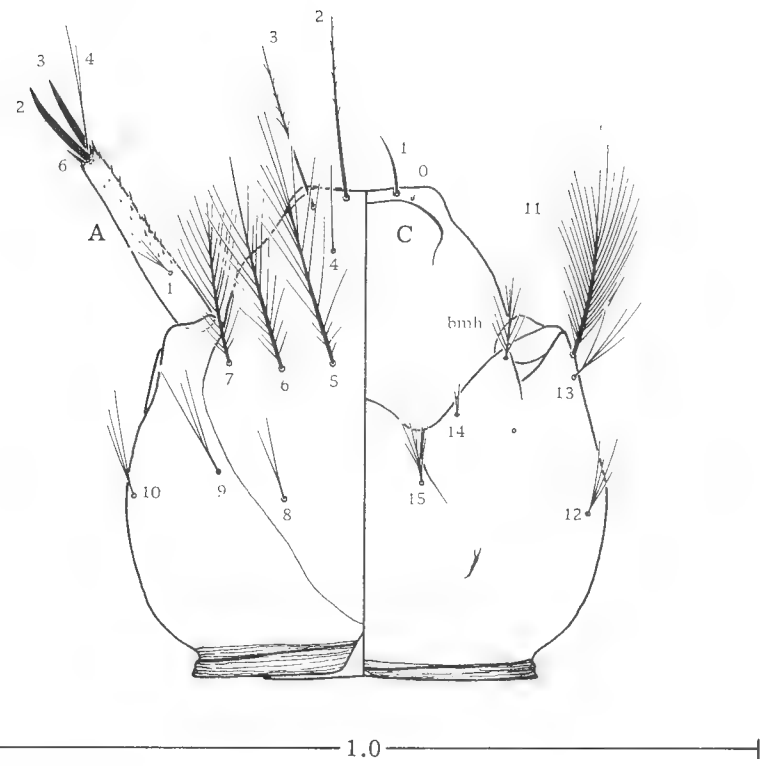


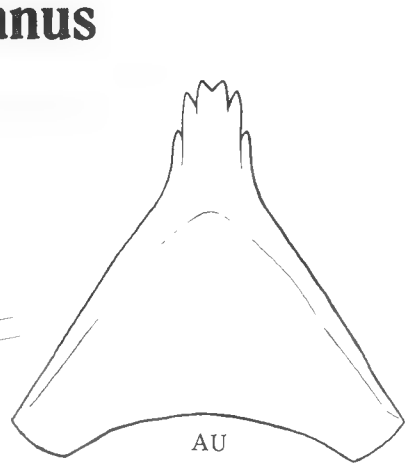
PH

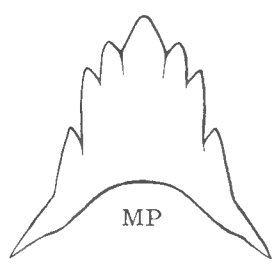
Fig. 9

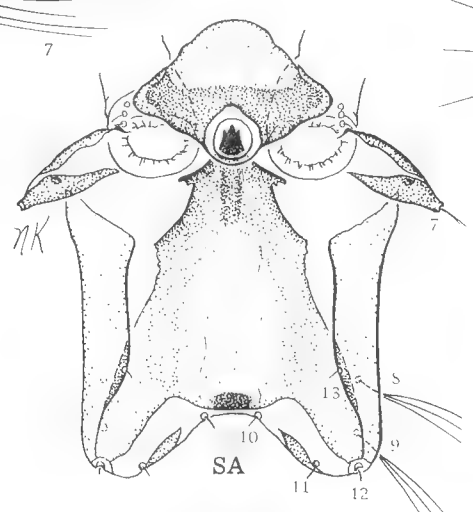
NYSSORHYNCHUS albimanus











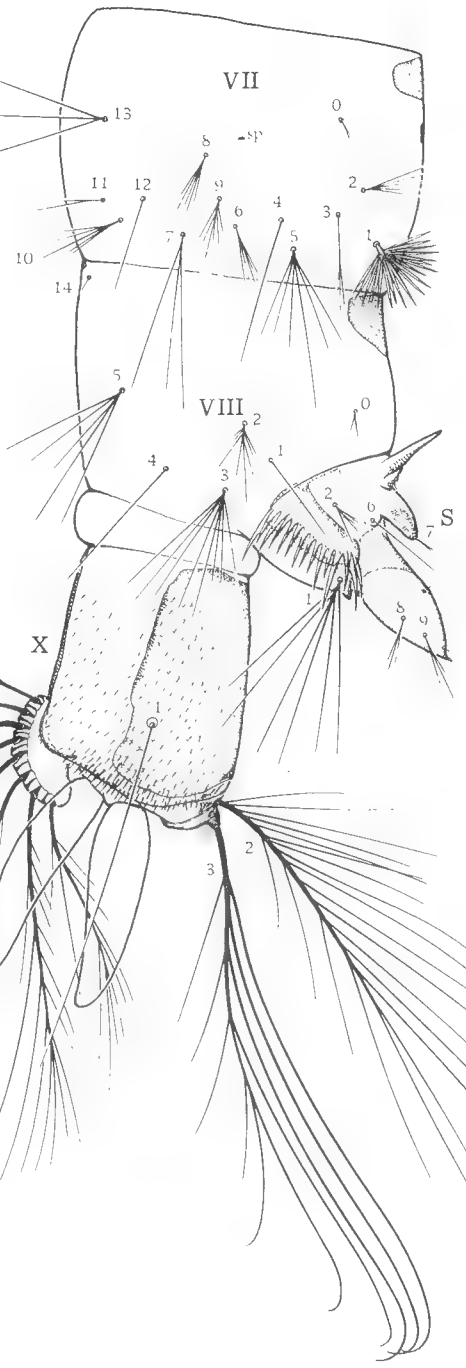
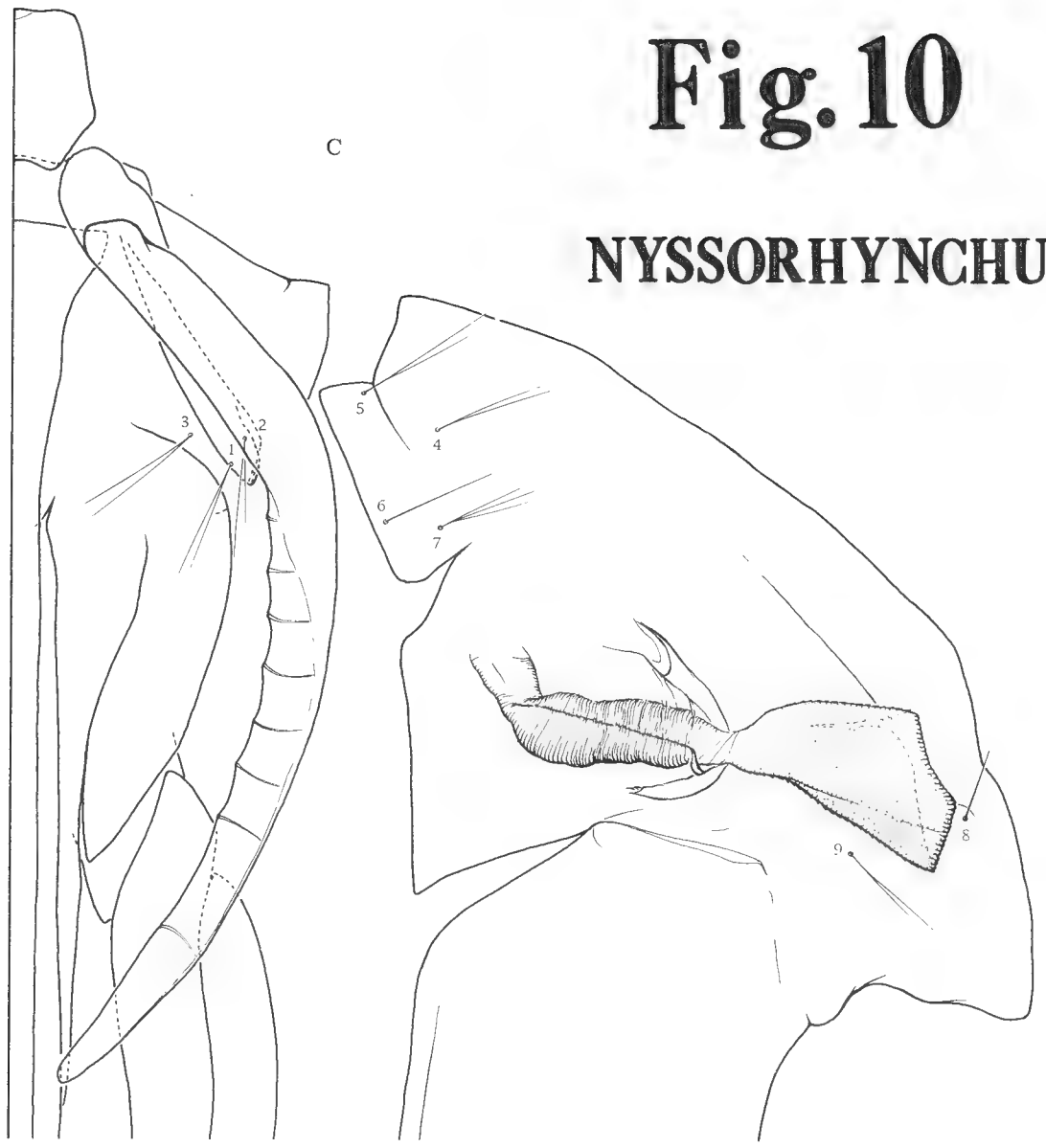
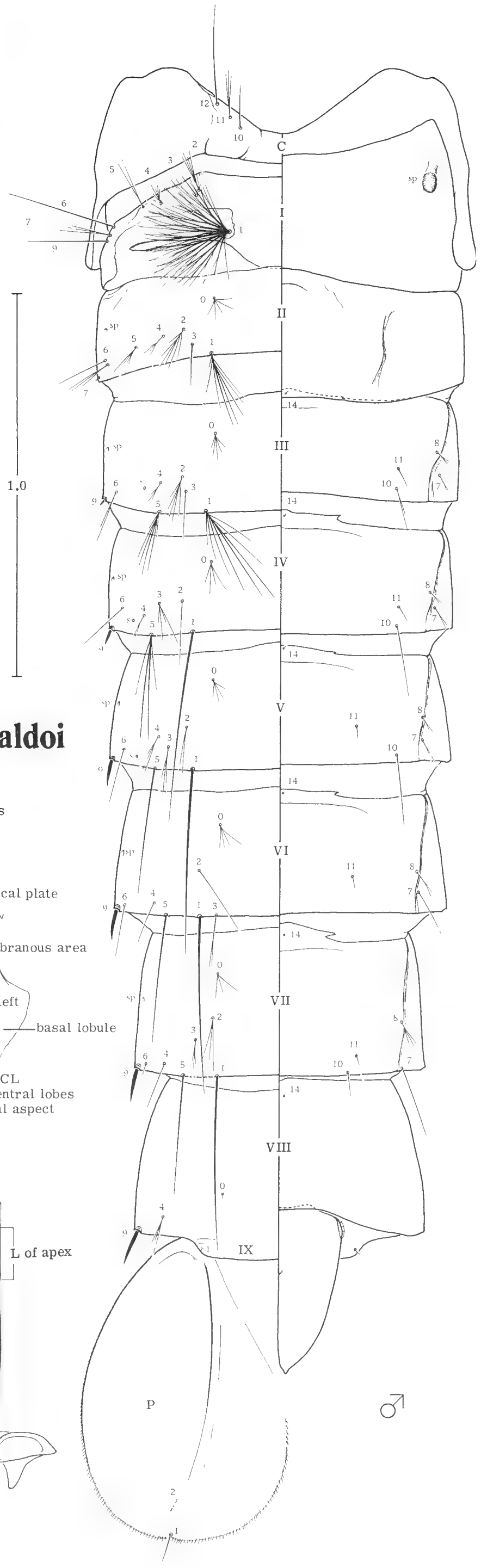


Fig. 10

NYSSORHYNCHUS oswaldoi





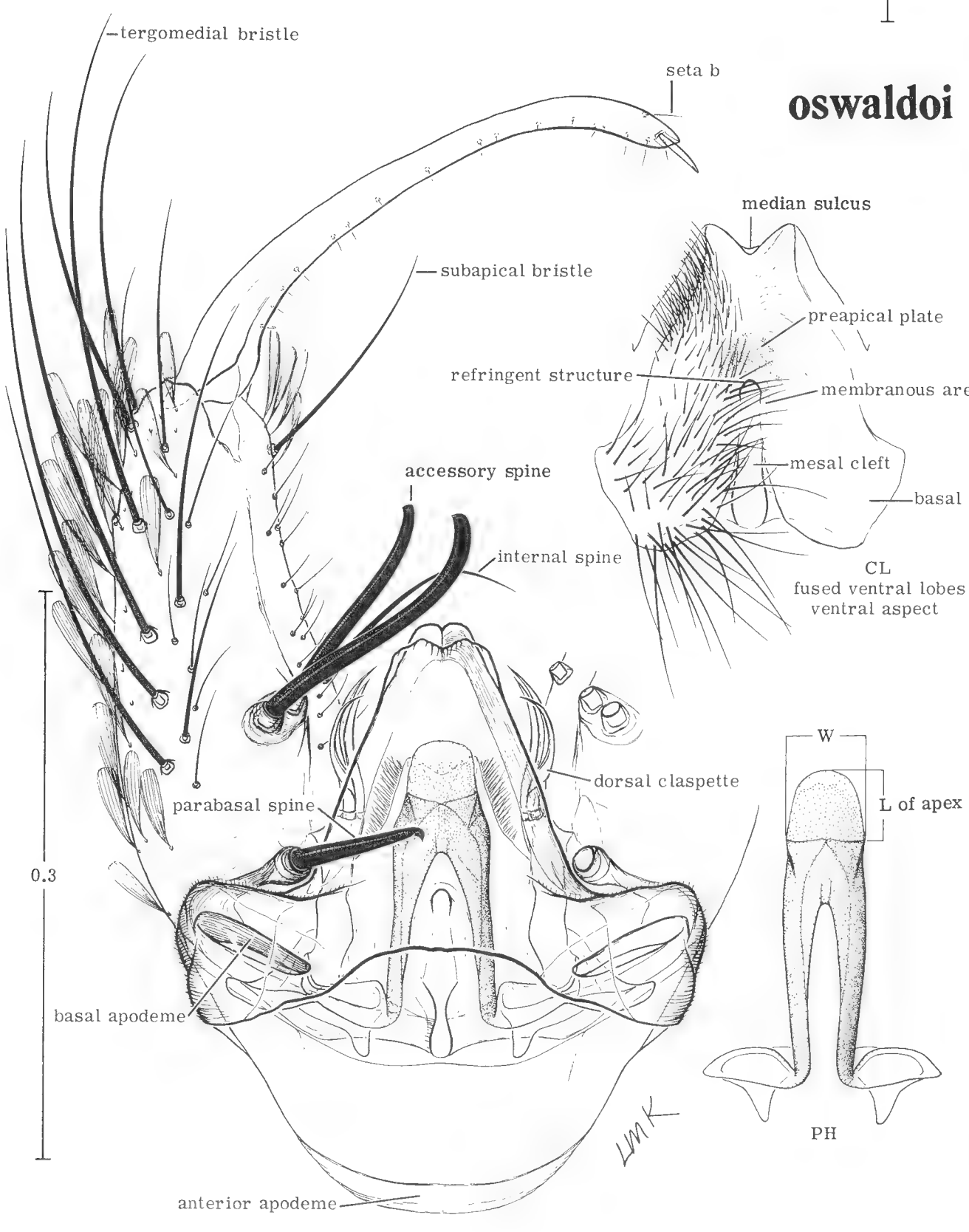
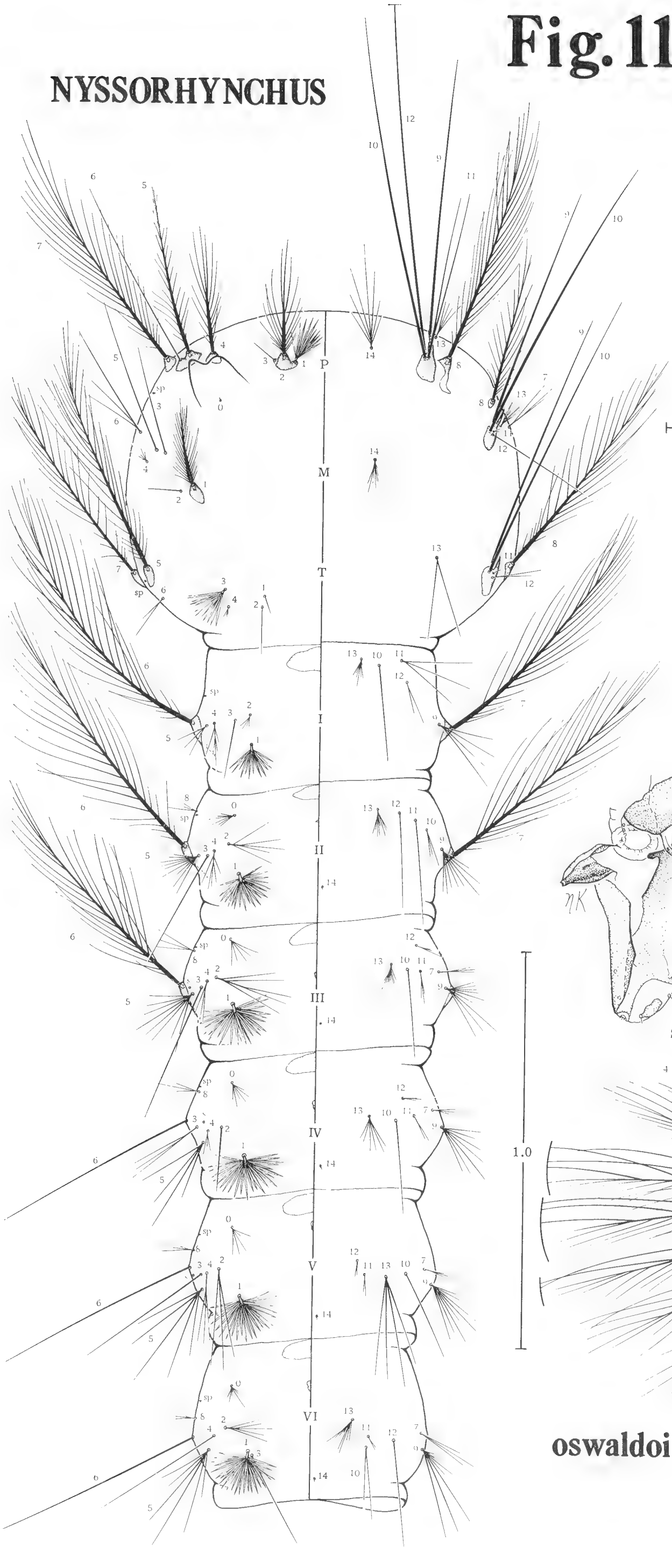
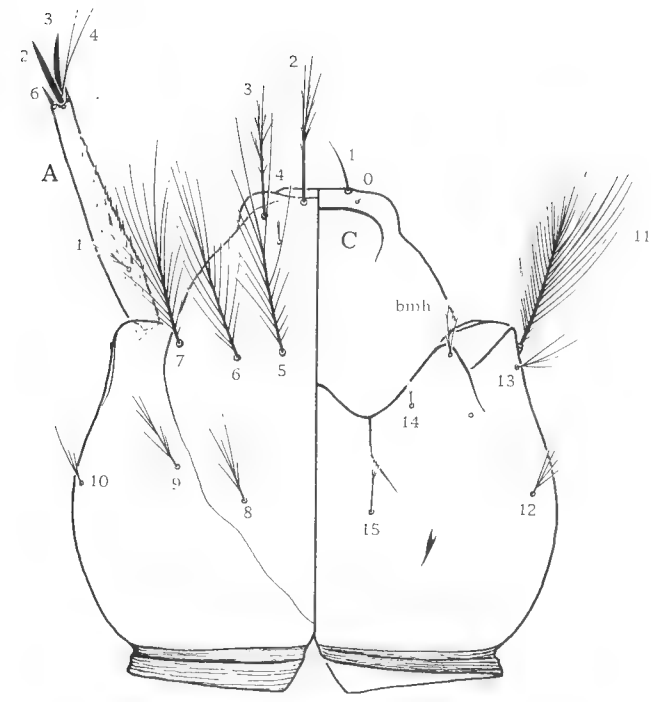


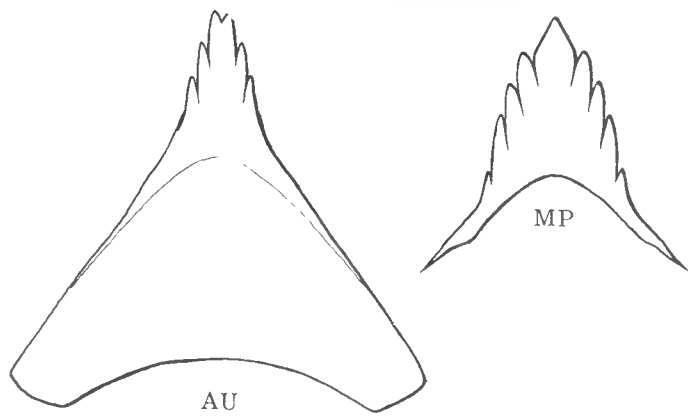
Fig. 11

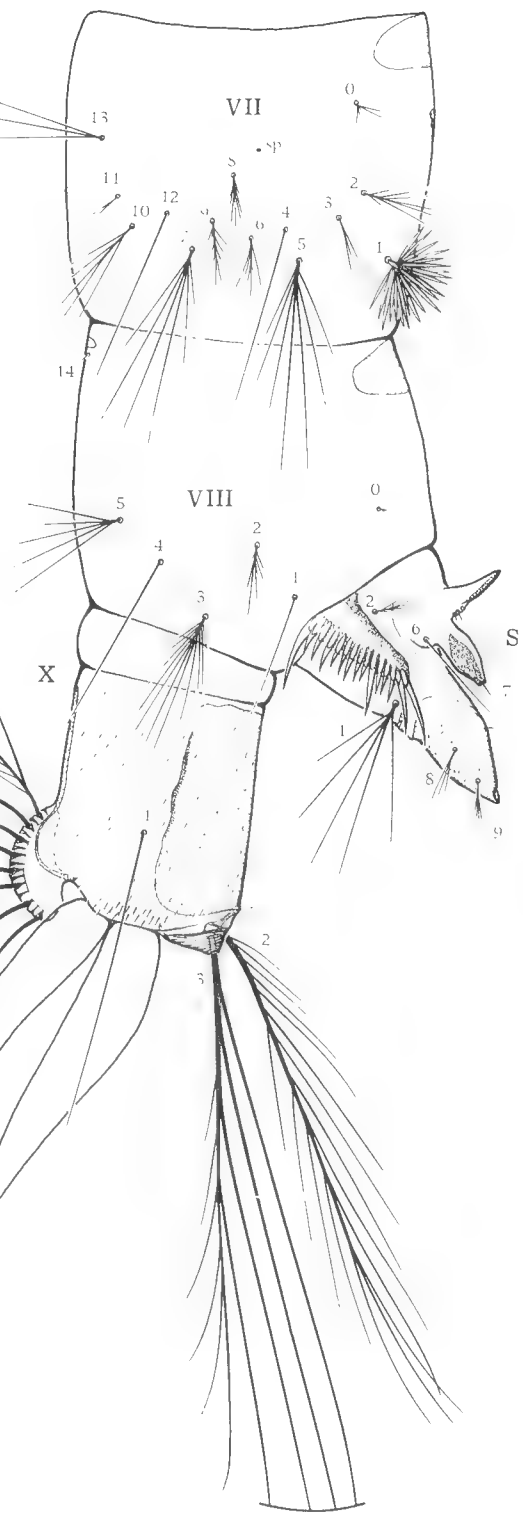
NYSSORHYNCHUS





1.0





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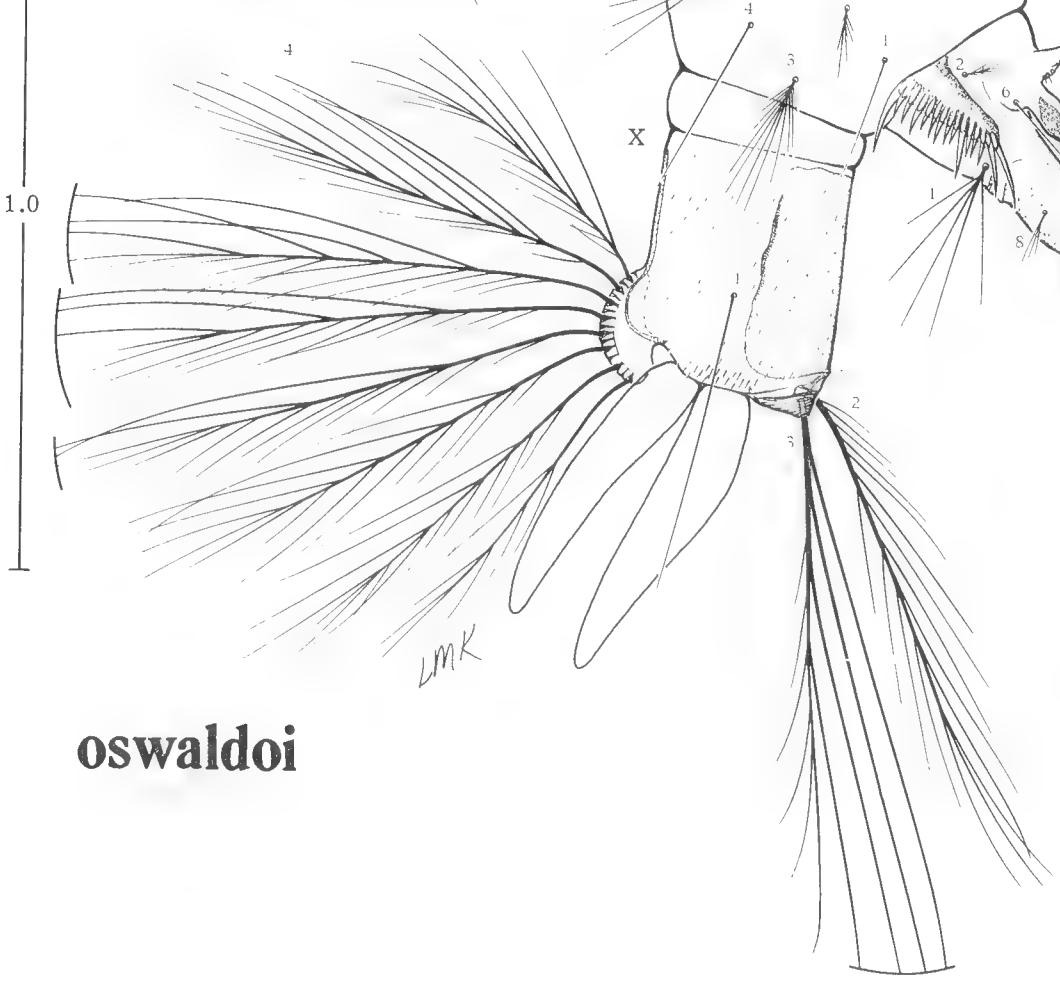


oswaldoi

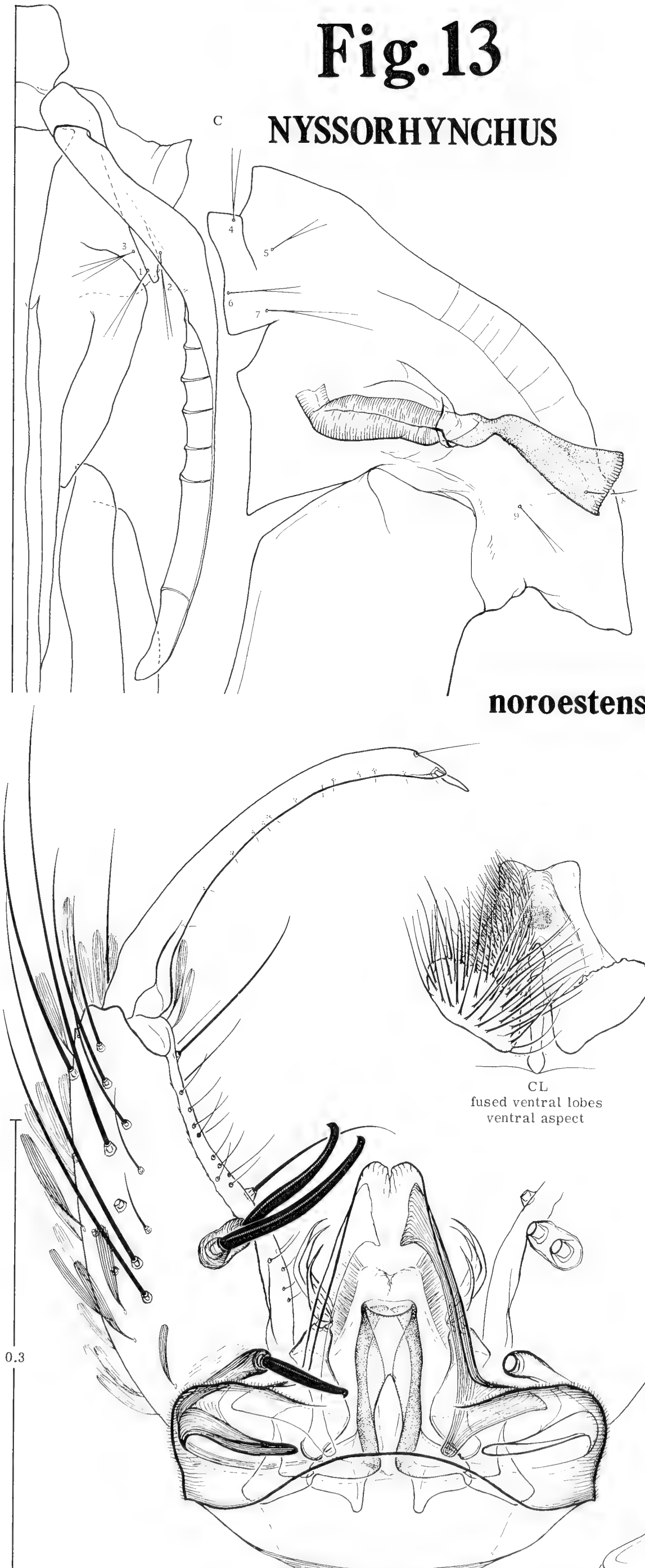
Fig.12

NYSSORHYNCHUS

Fig. 13

NYSSORHYNCHUS

noroestensis



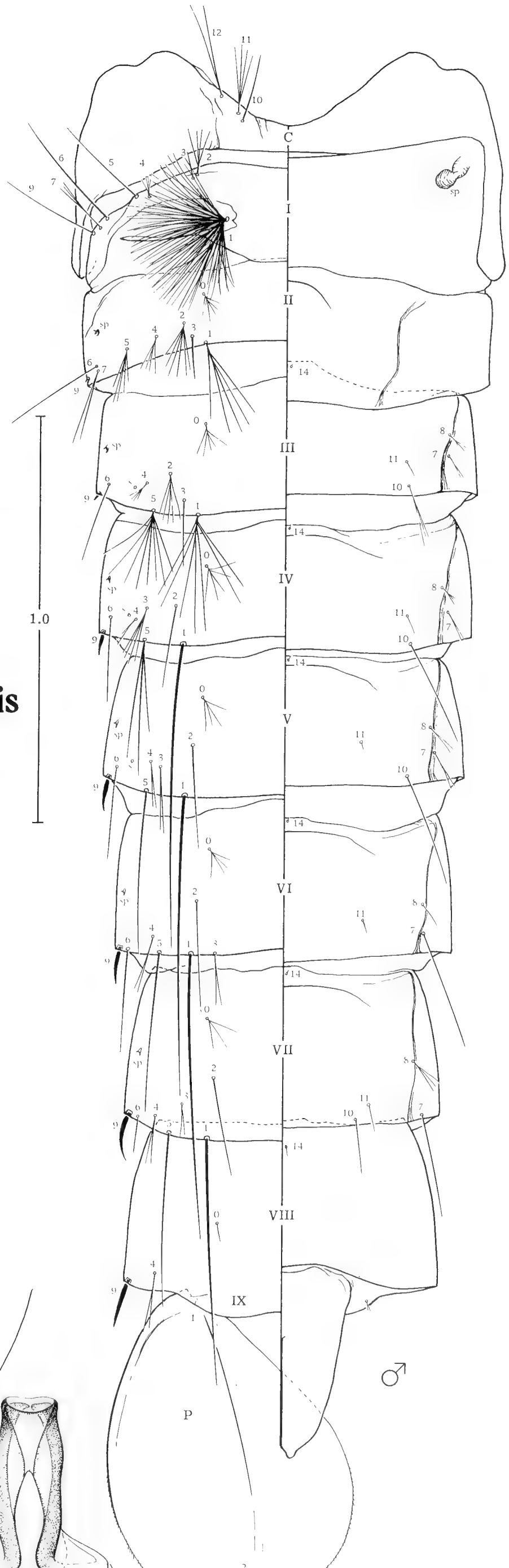
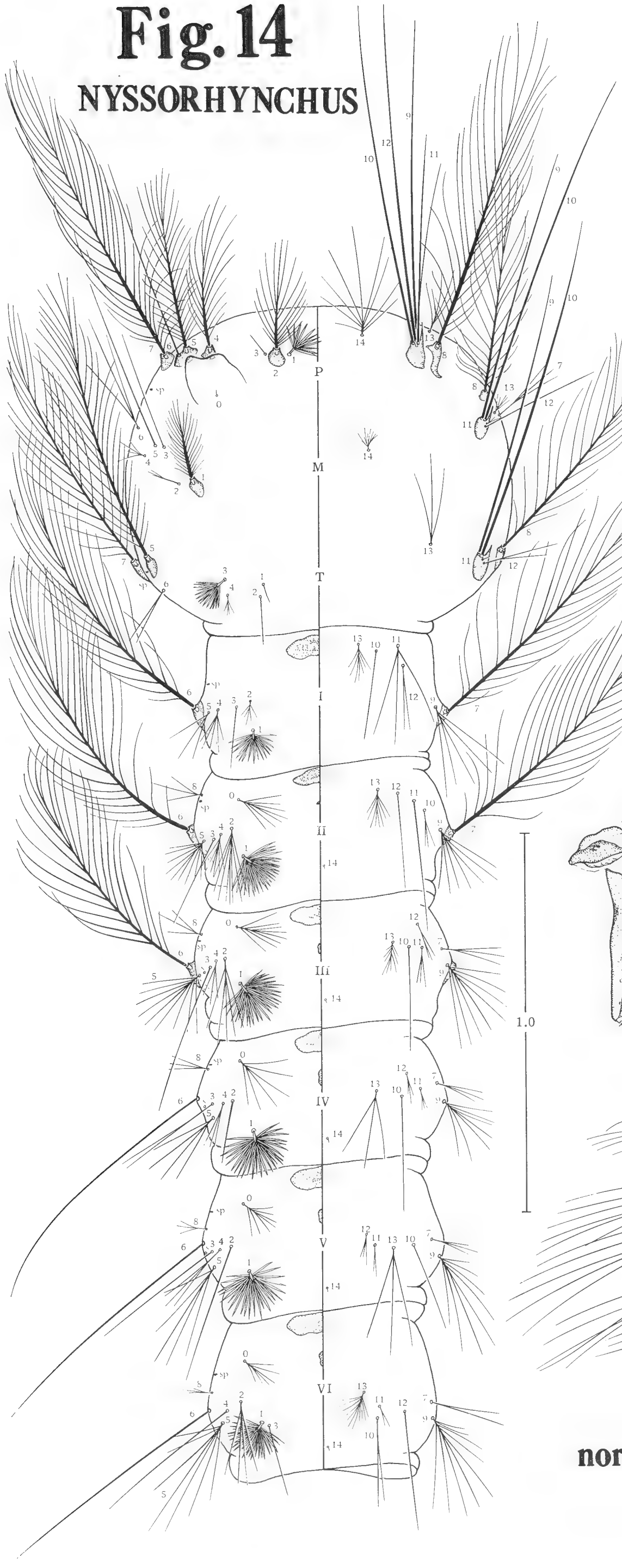
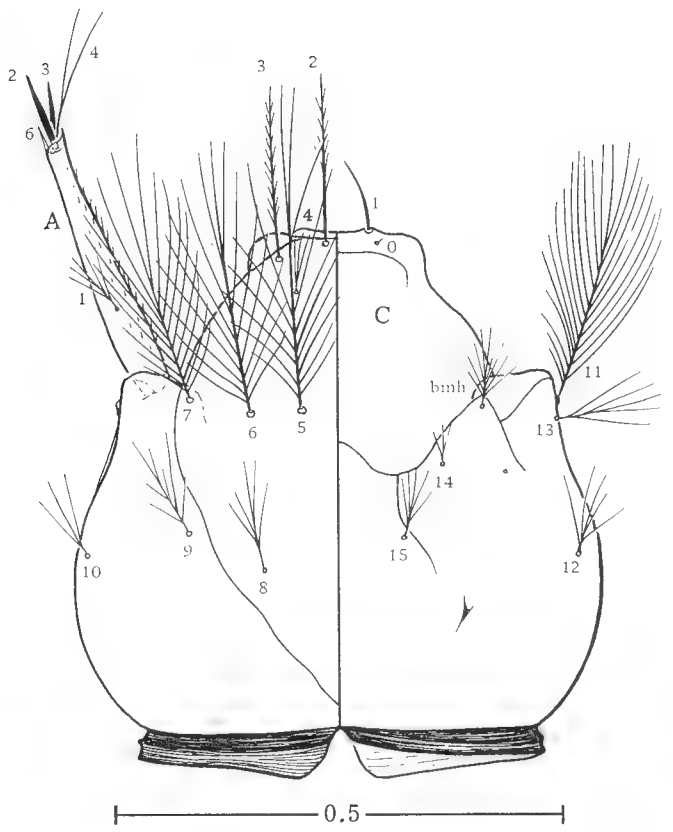
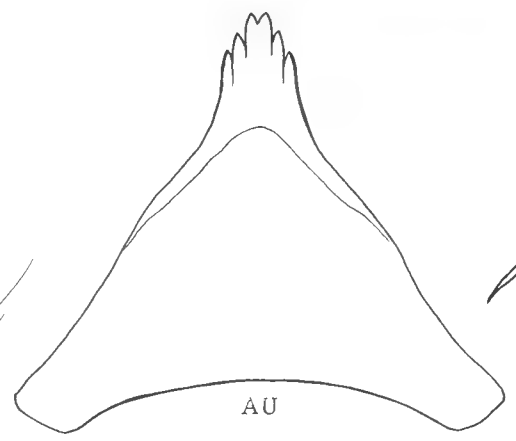


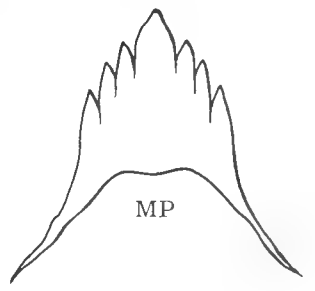
Fig. 14

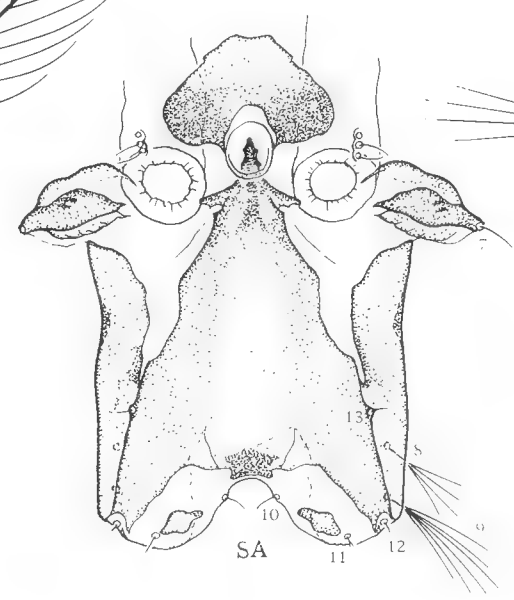
NYSSORHYNCHUS

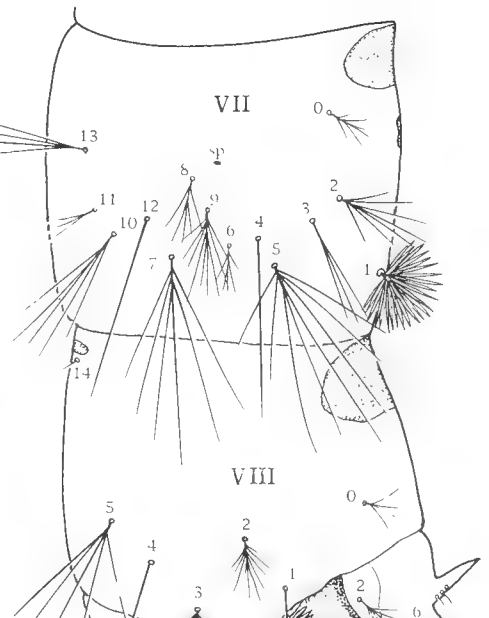


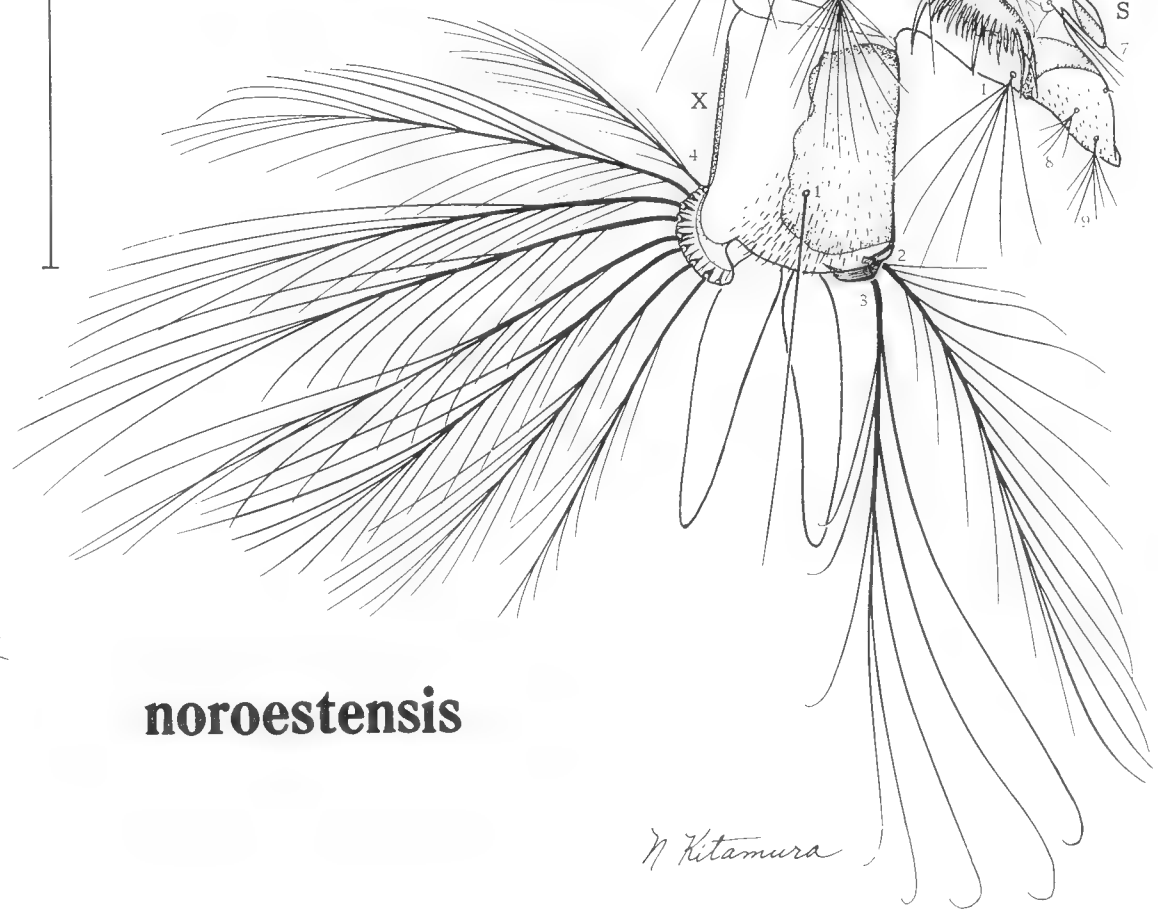












noroestensis

N. Kitamura

Fig. 15

NYSSORHYNCHUS

aquasalis

C

1.0

0.3

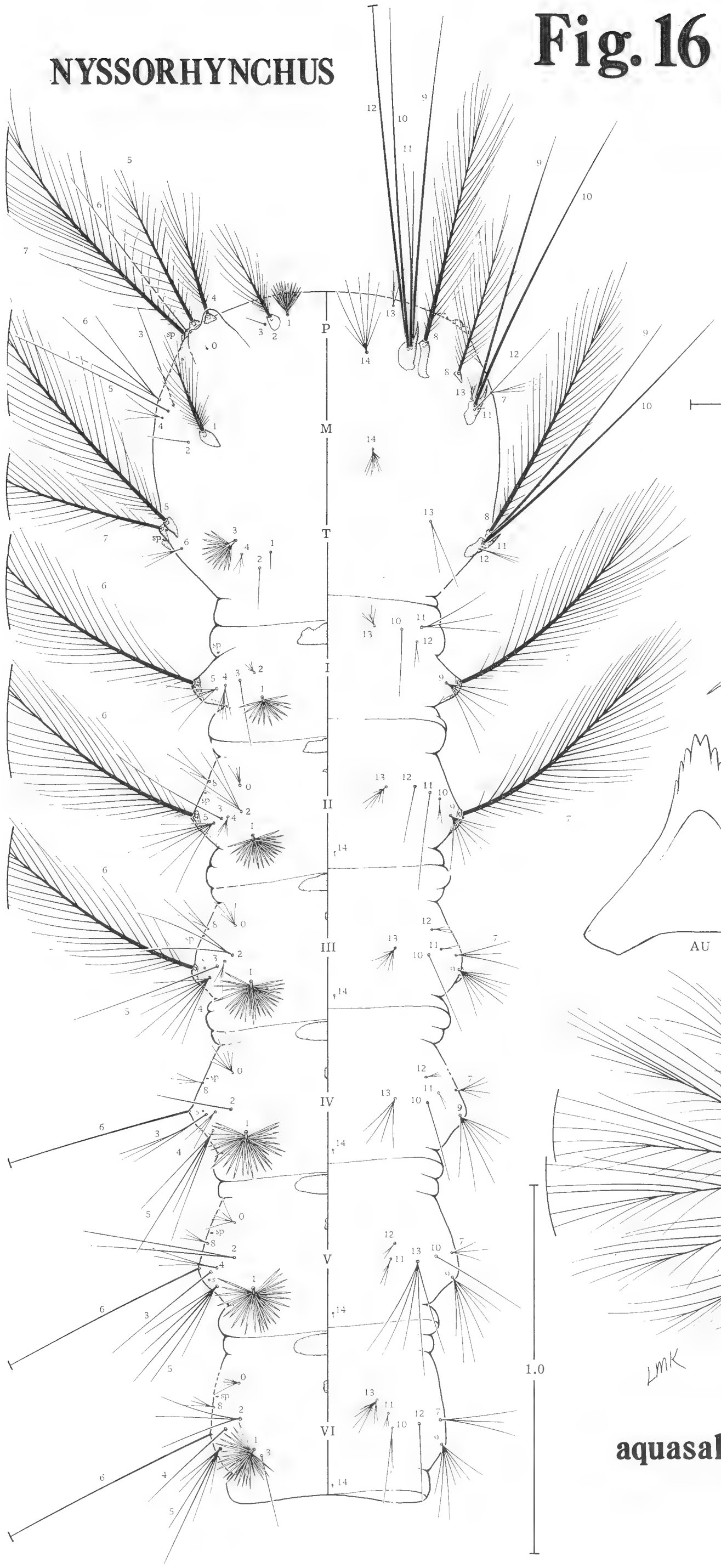
CL
fused ventral lobes
ventral aspect

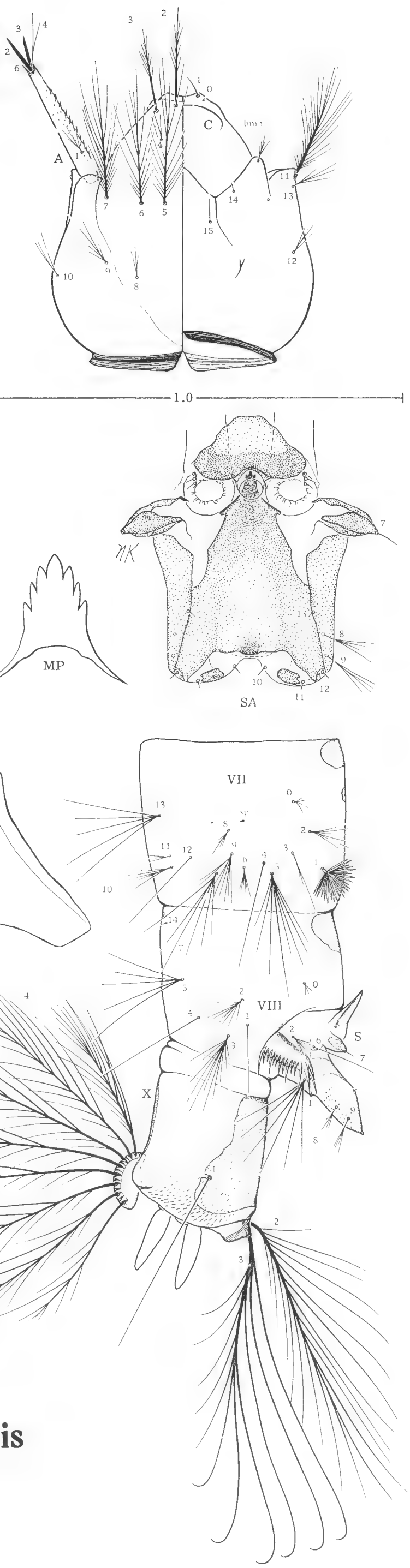
PH

I
II
III
IV
V
VI
VII
VIII
IX
P
♂

NYSSORHYNCHUS

Fig. 16

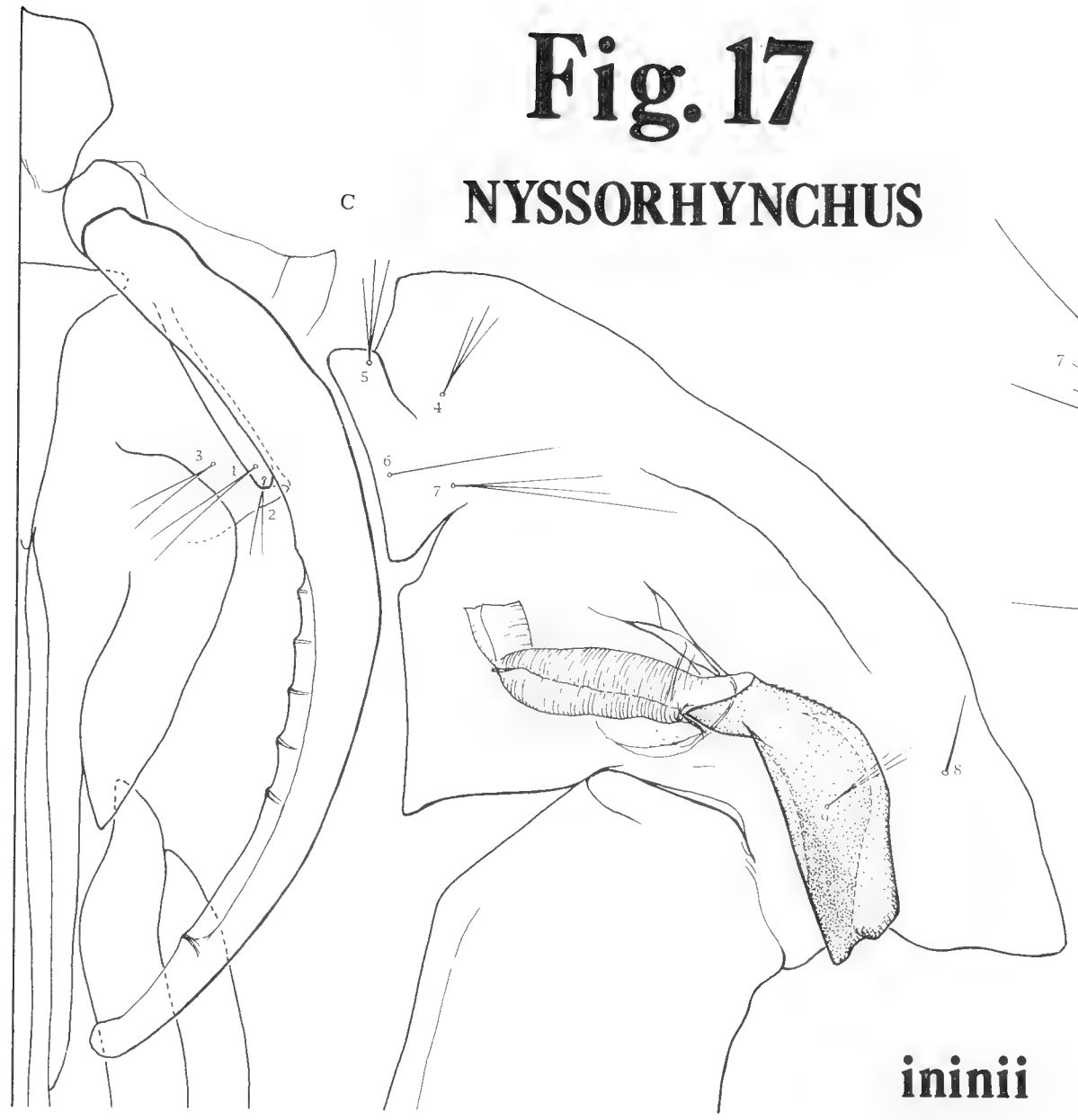


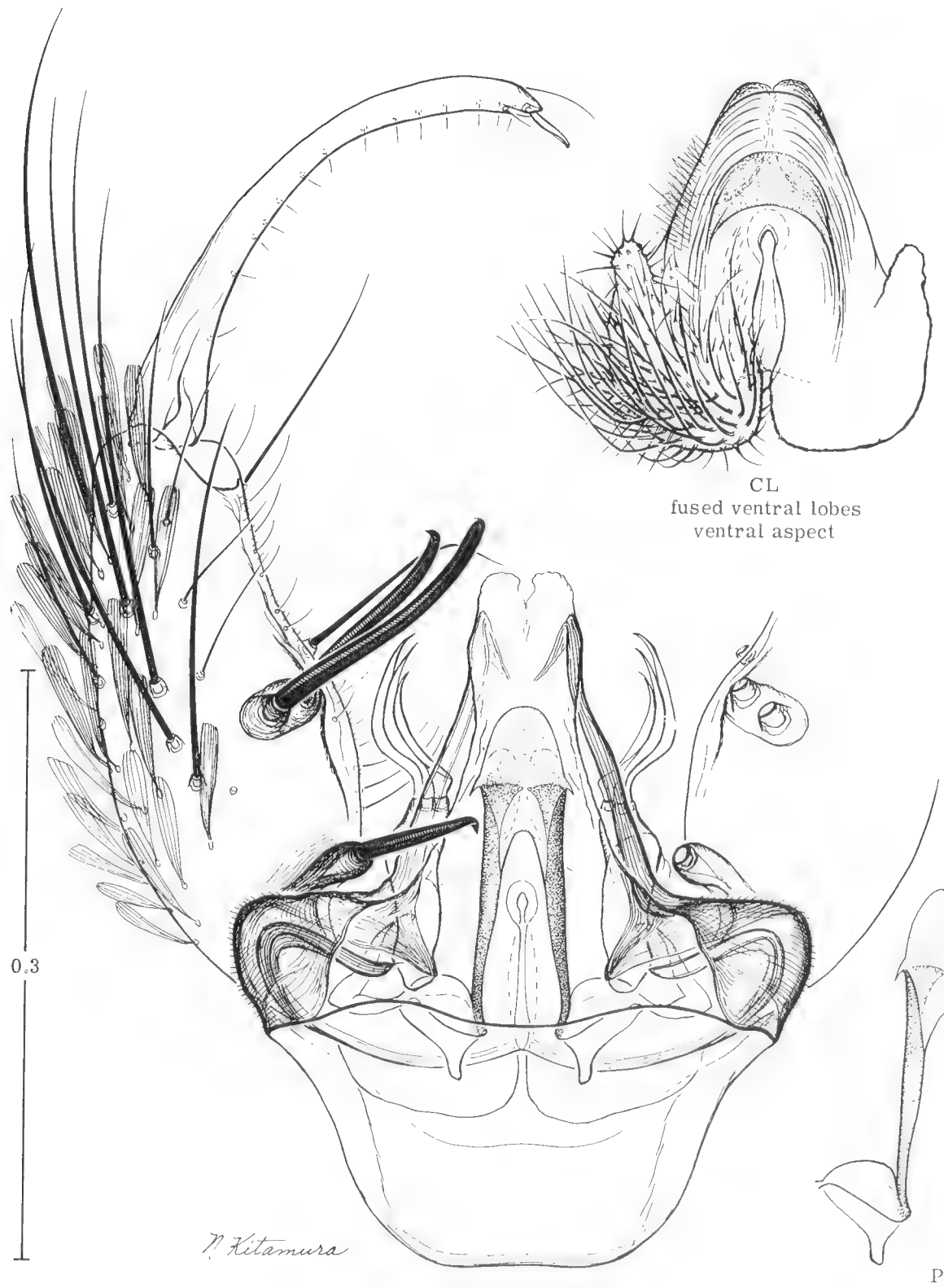


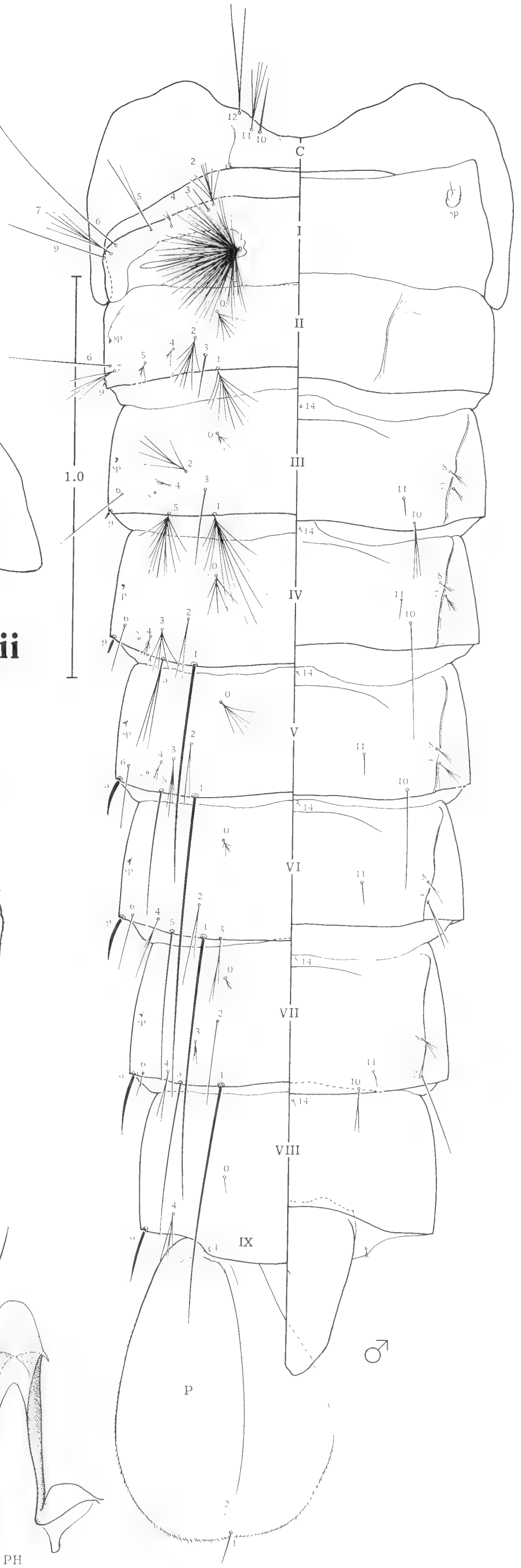
aquasalis

Fig. 17

NYSSORHYNCHUS

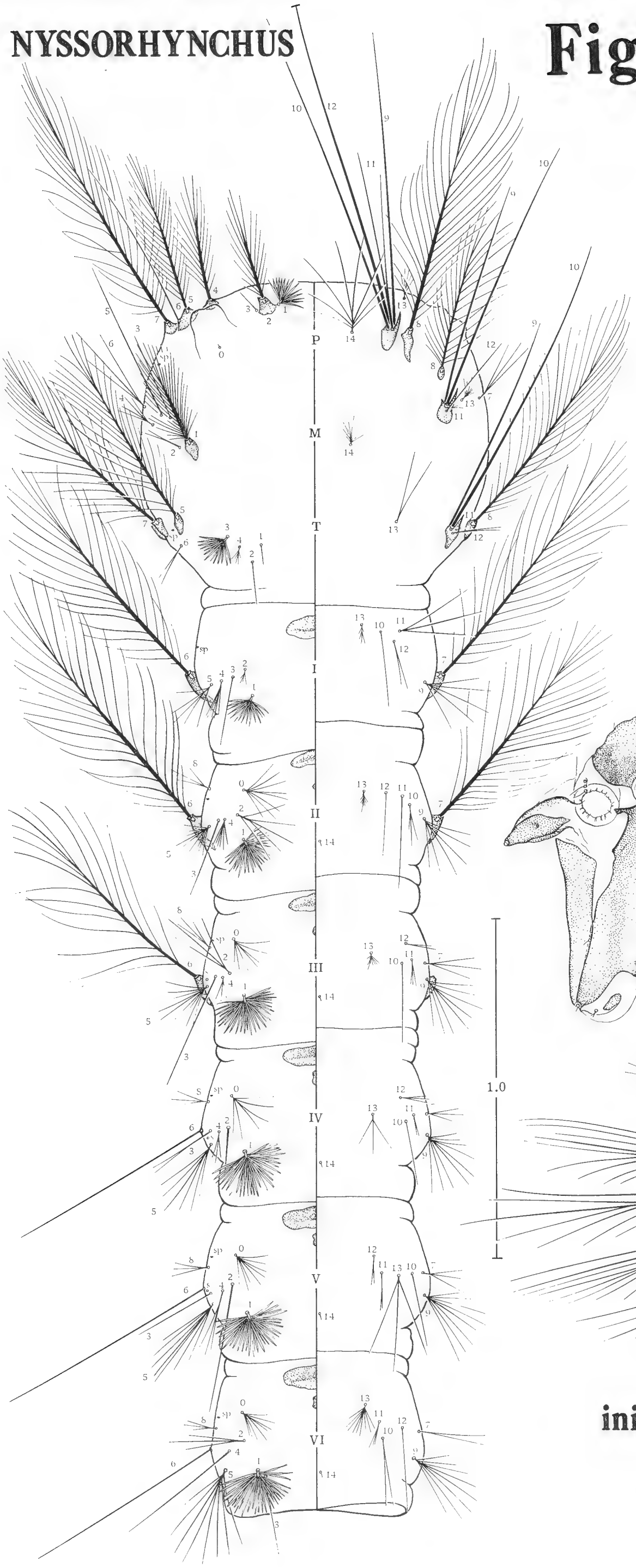


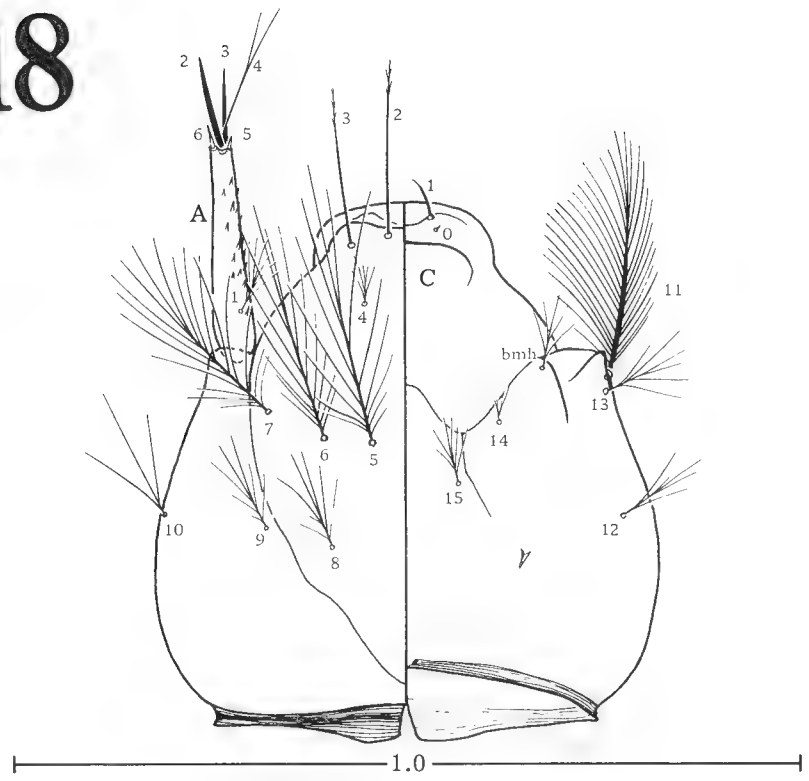


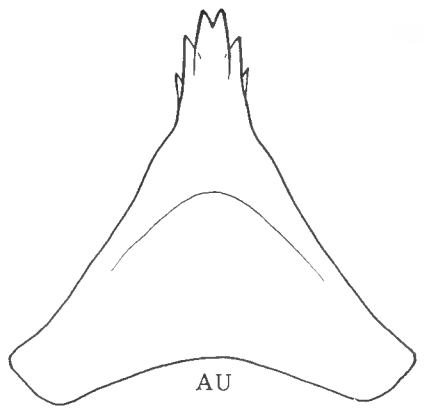


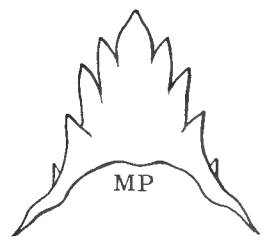
NYSSORHYNCHUS

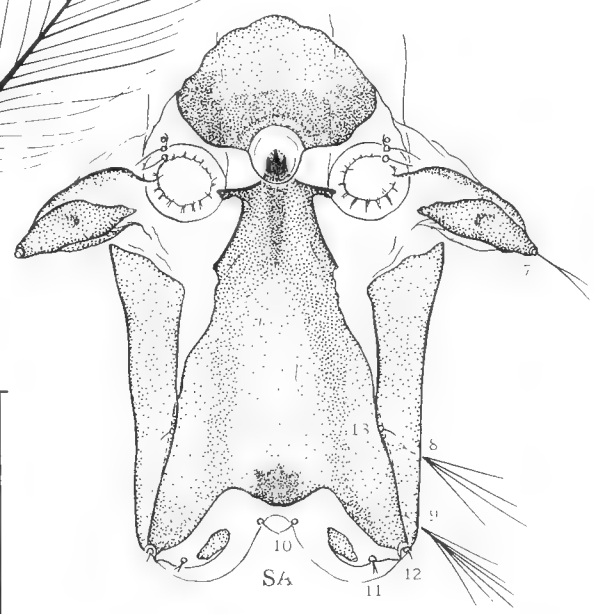
Fig. 18

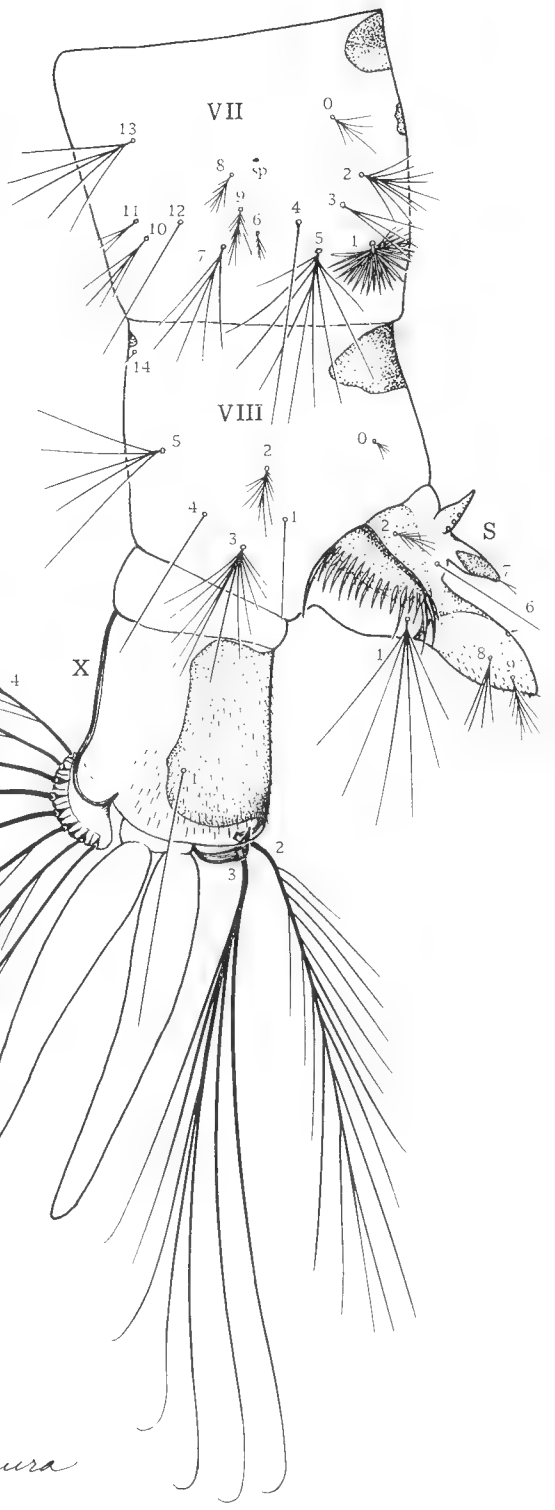












ininii

Y. Kitamura

Fig. 19

NYSSORHYNCHUS

anomalophyllus

C

1.0

0.3

CL
fused ventral lobes
ventral aspect

PH

P

I

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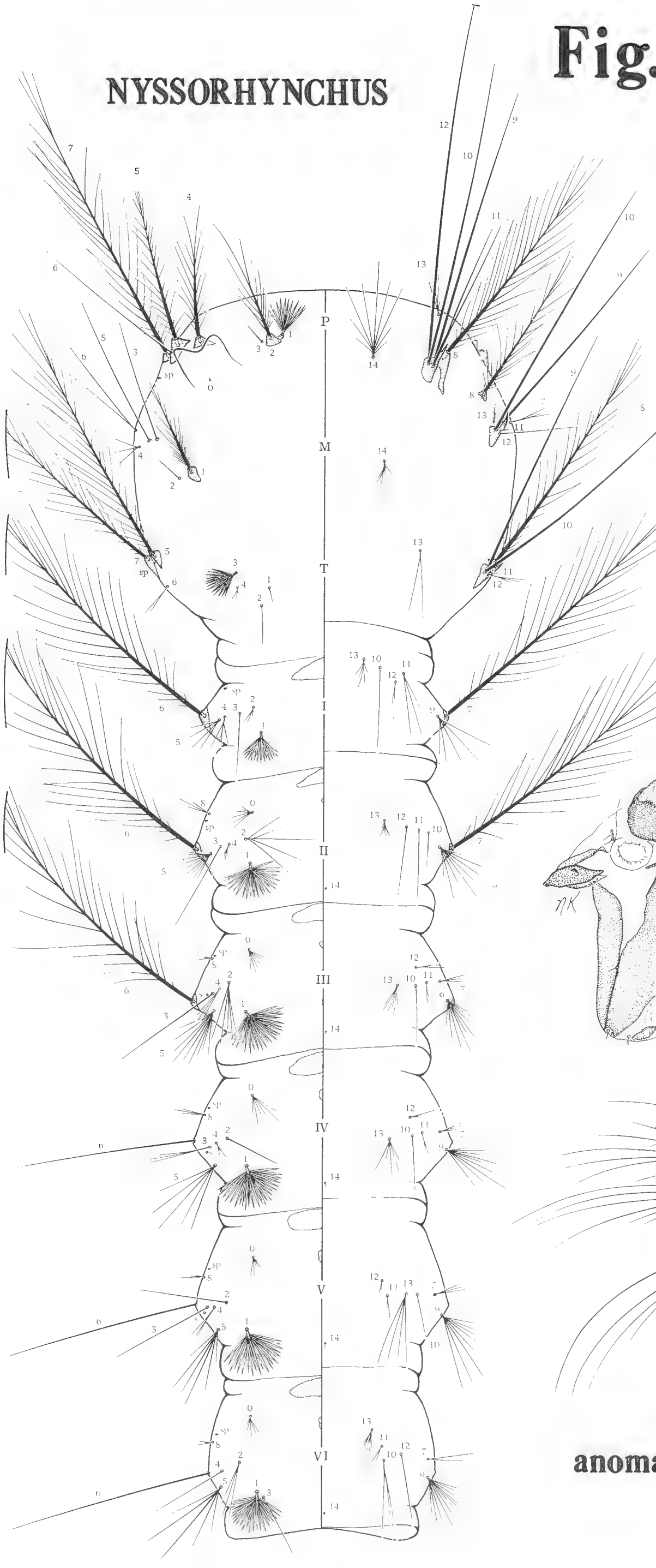
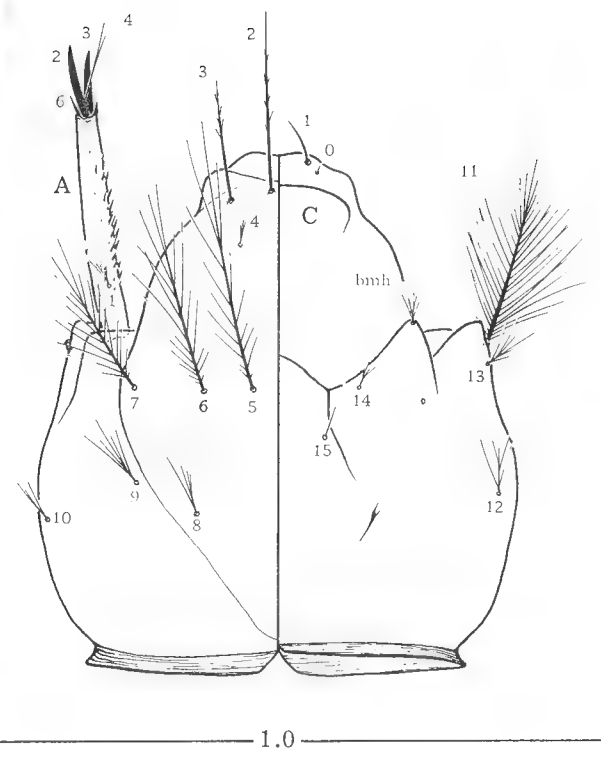
N. Kitamura

Fig. 20

NYSSORHYNCHUS





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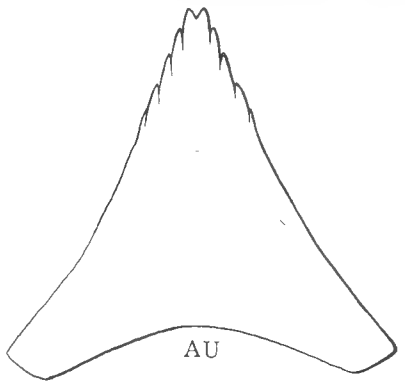
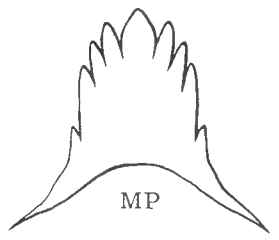
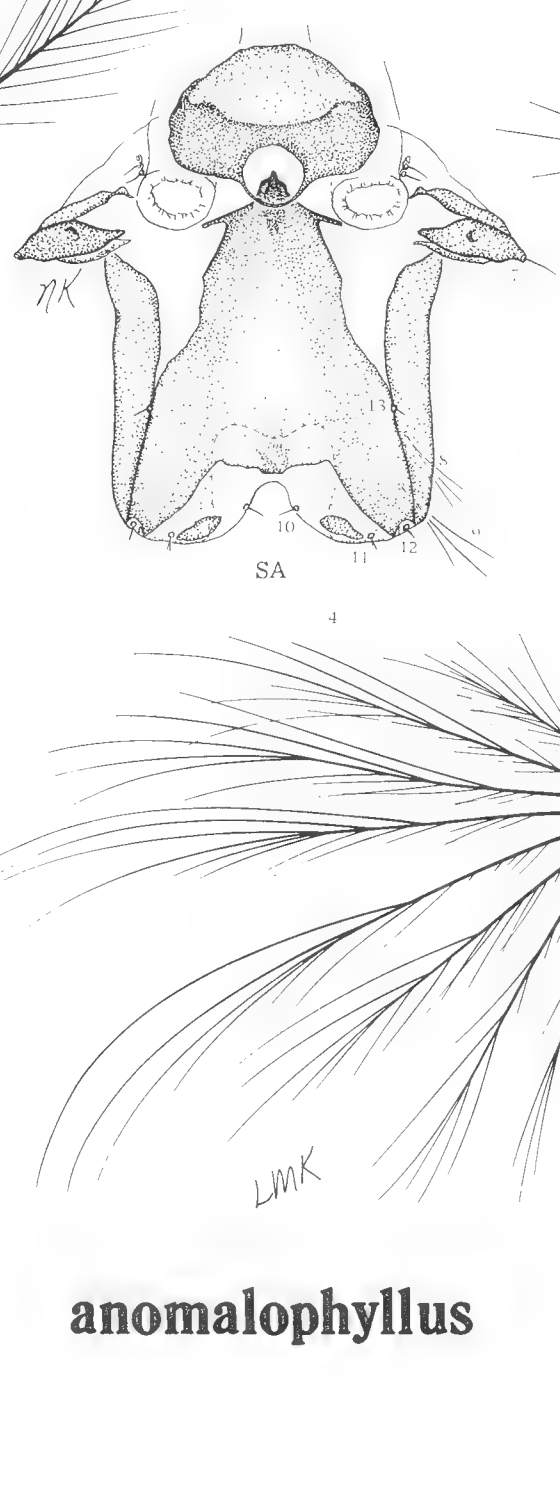




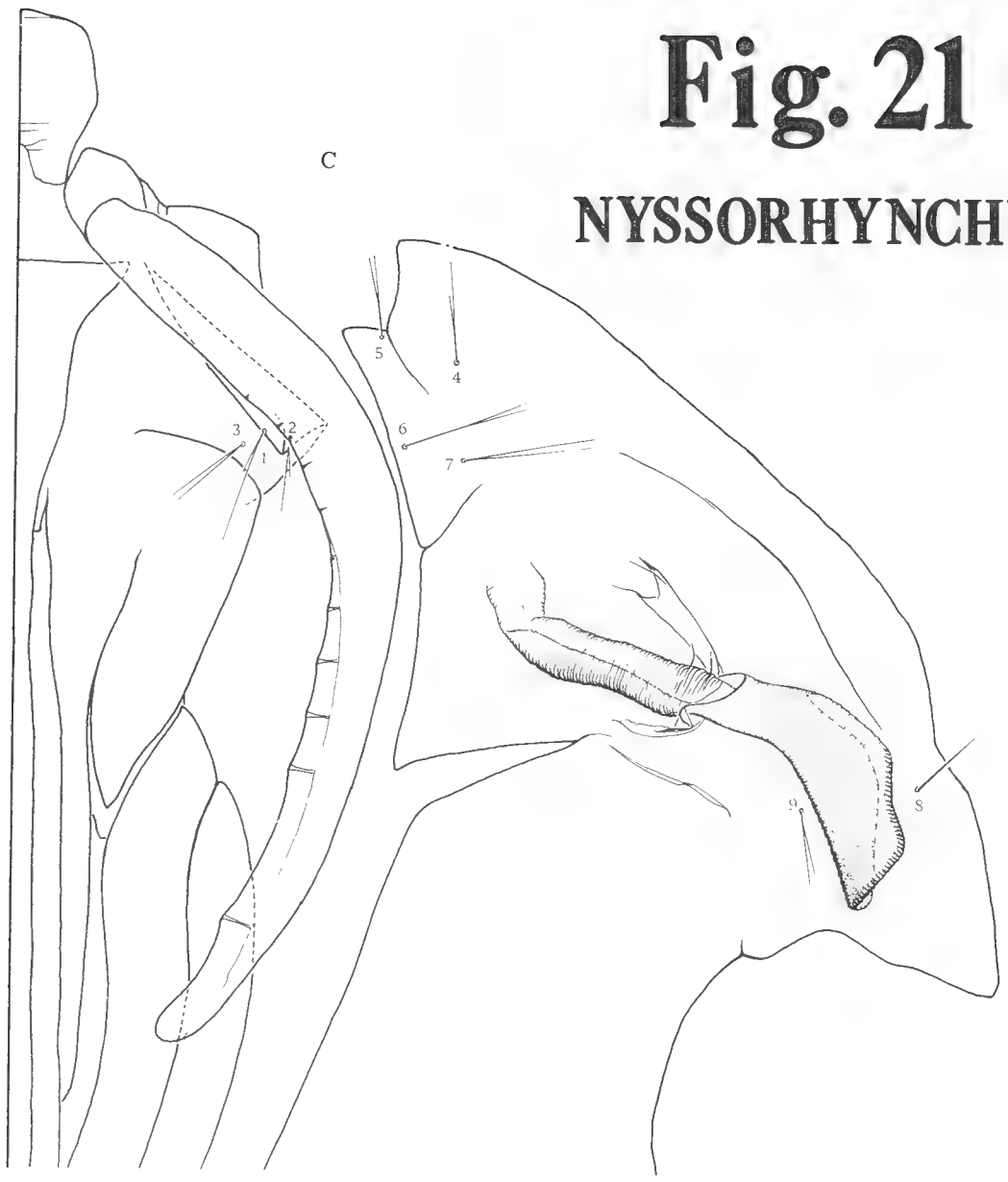


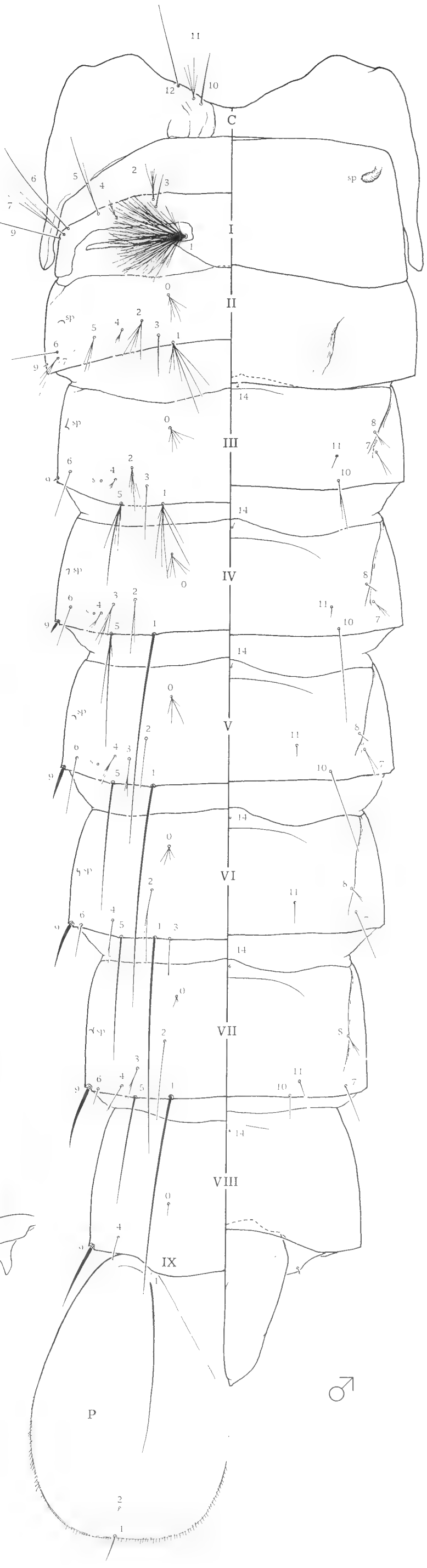
anomalophyllus

Fig. 21

NYSSORHYNCHUS

rangeli





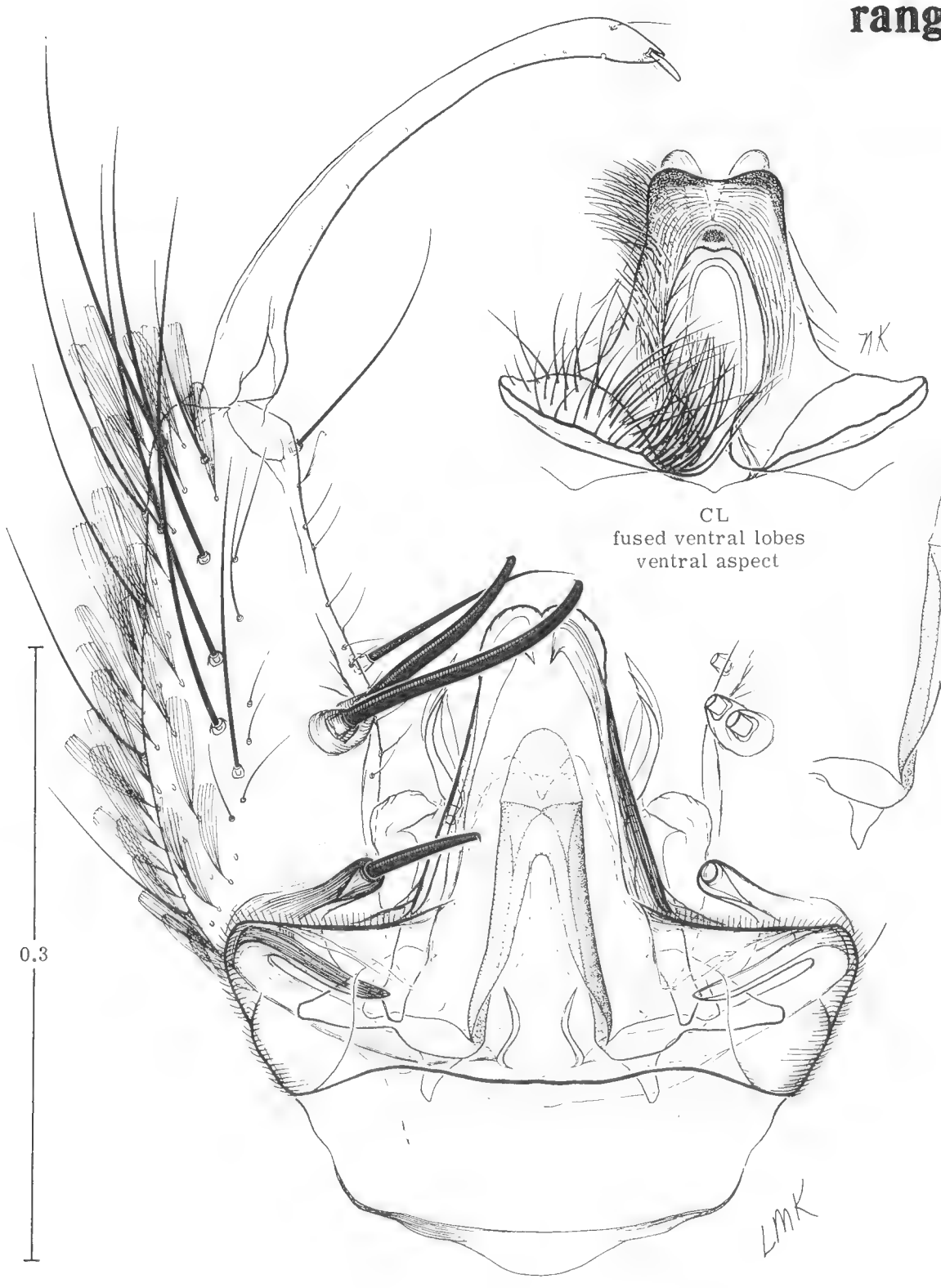
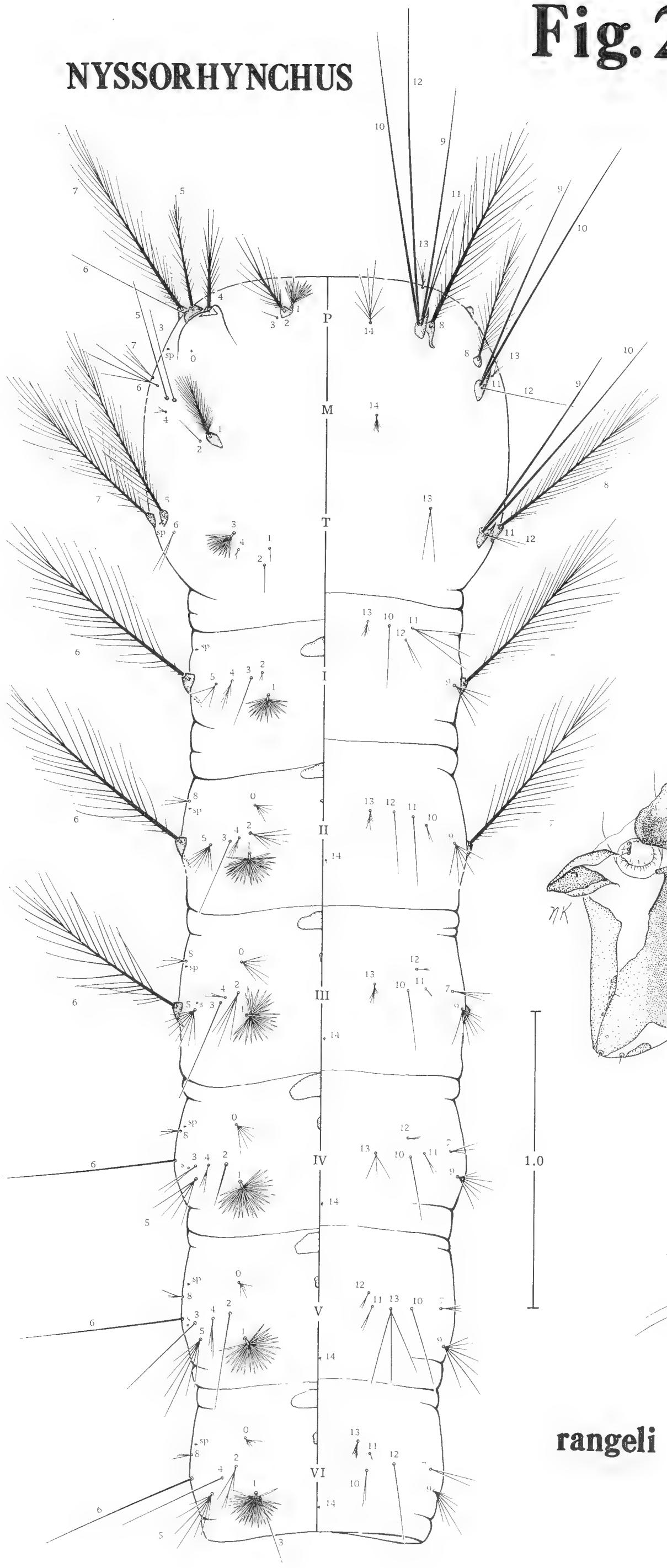
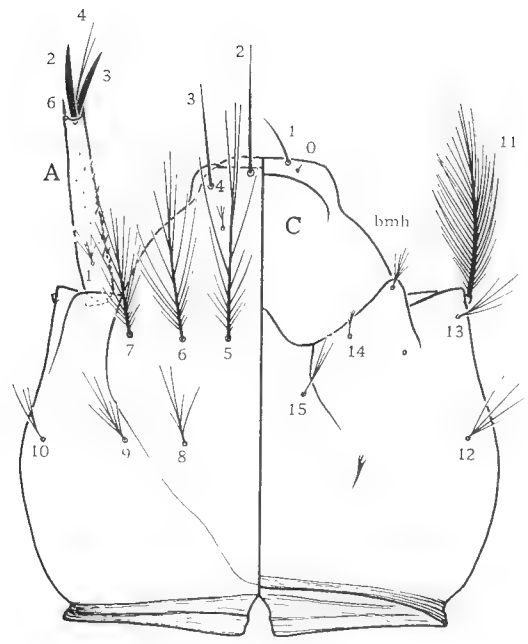
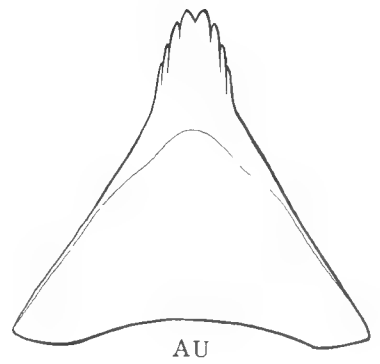


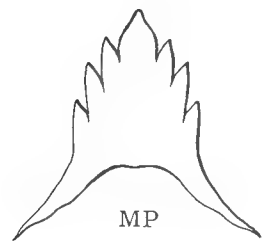
Fig. 22

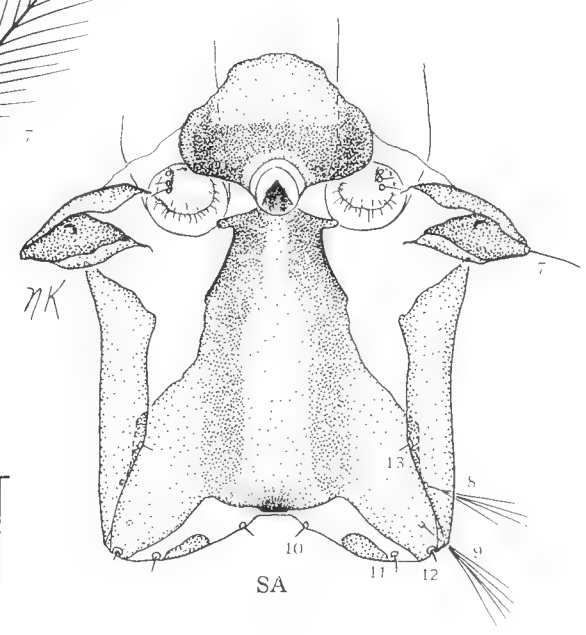
NYSSORHYNCHUS

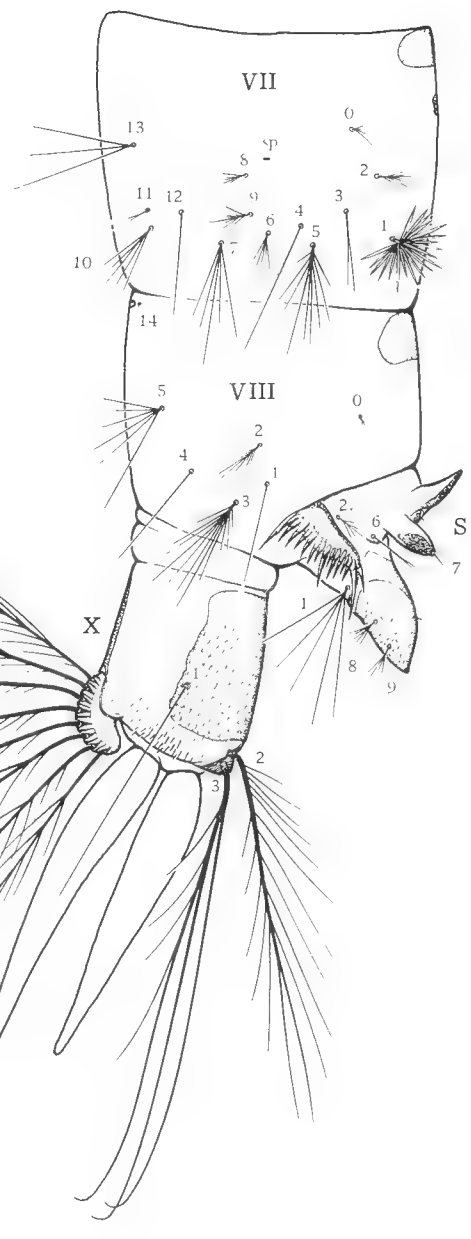








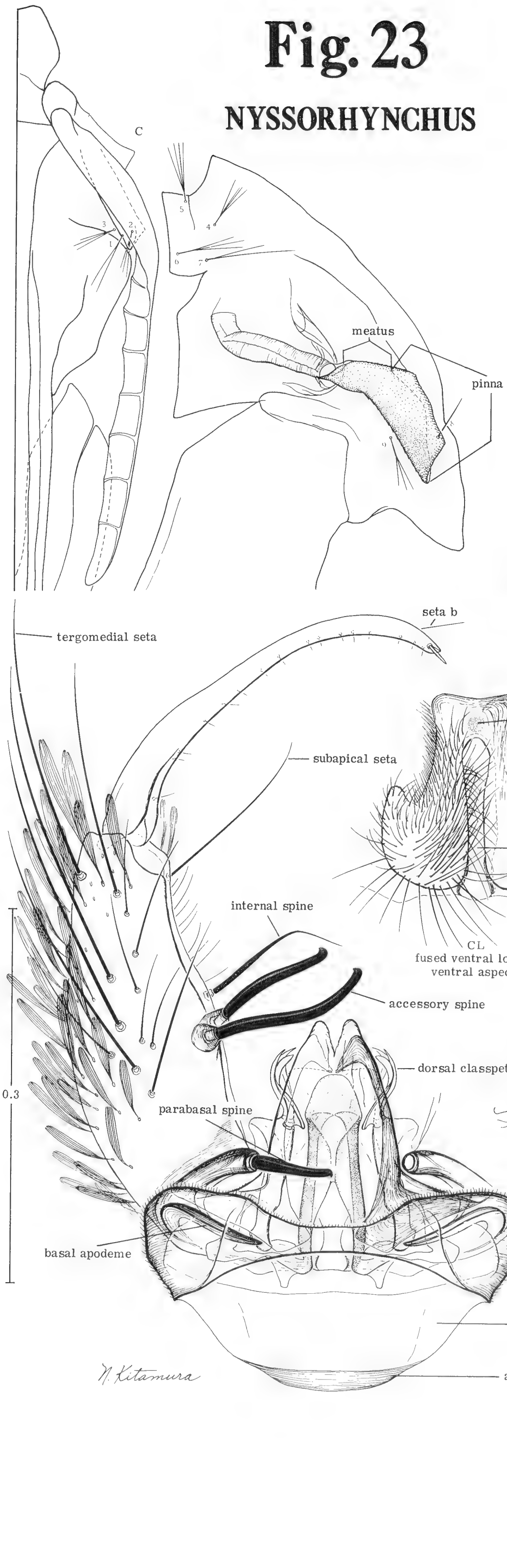




rangeli

Fig. 23

NYSSORHYNCHUS trinkae



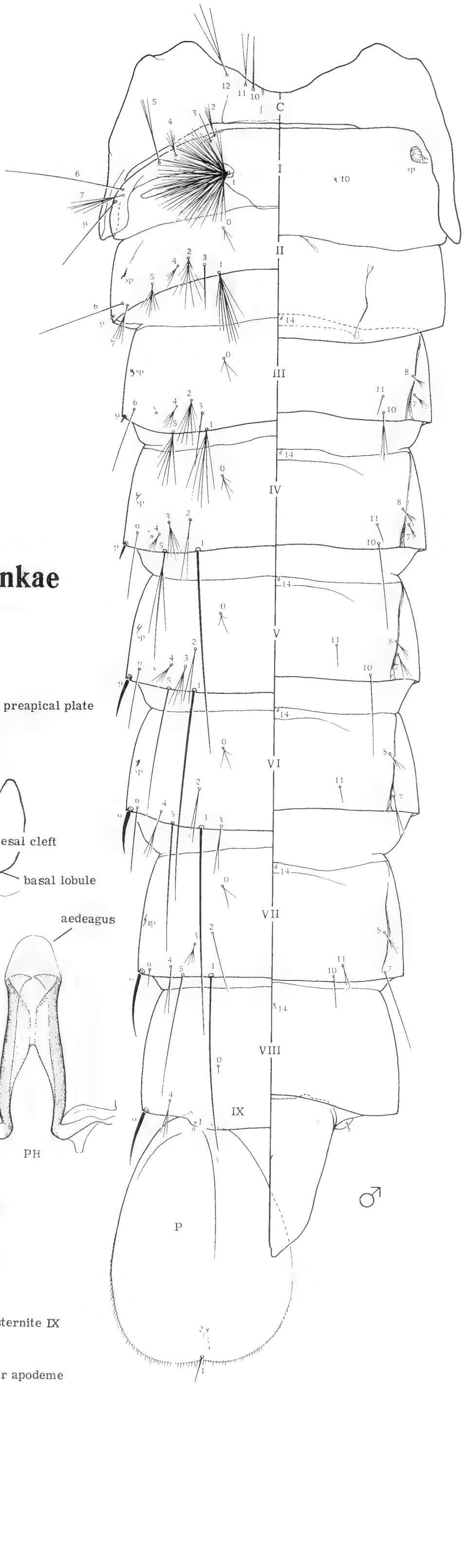
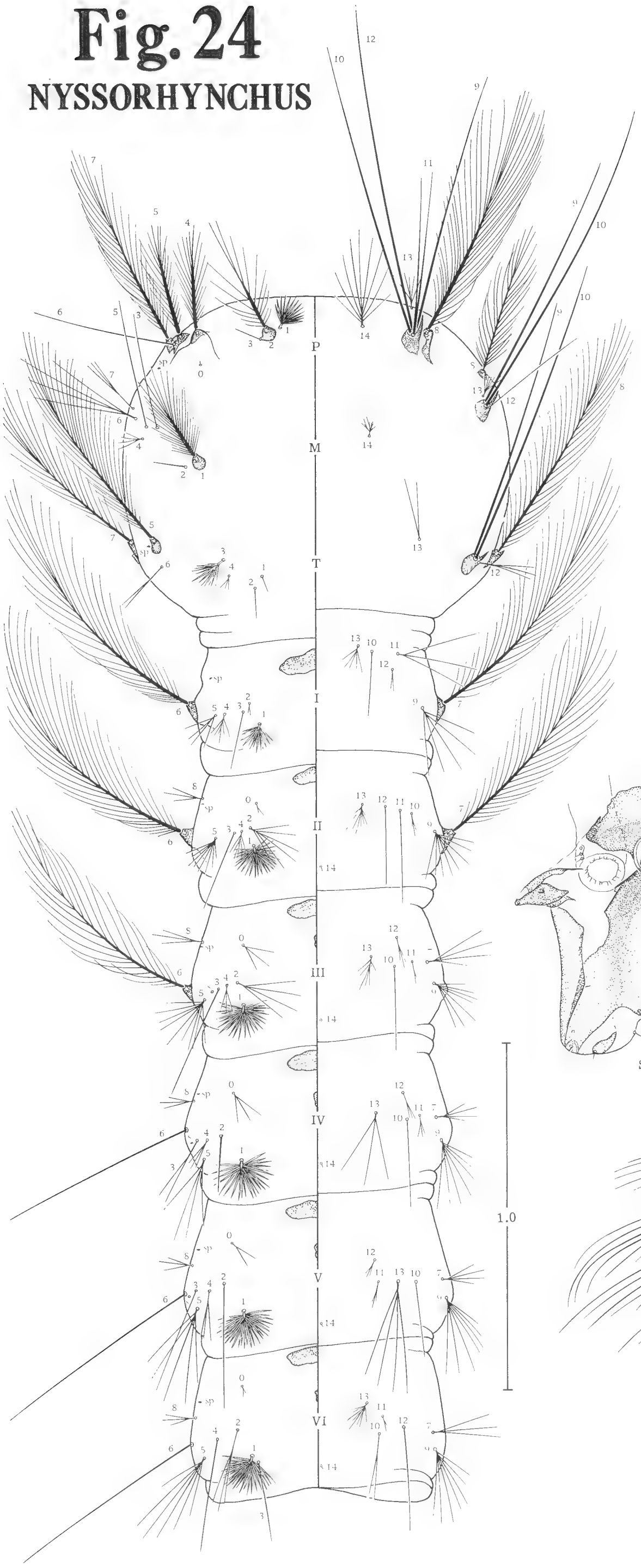
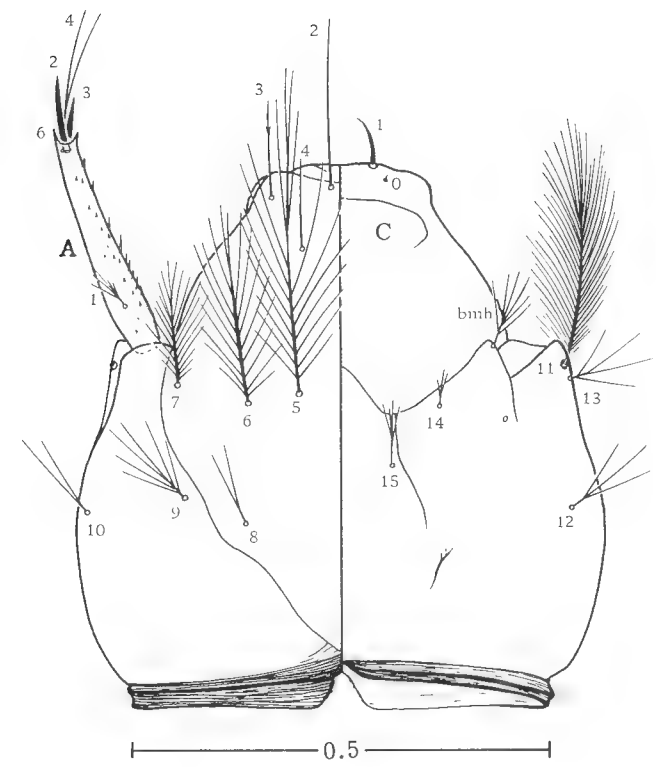
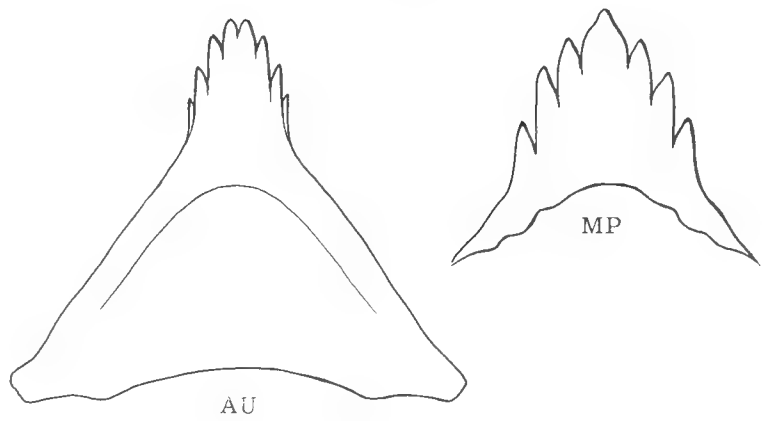


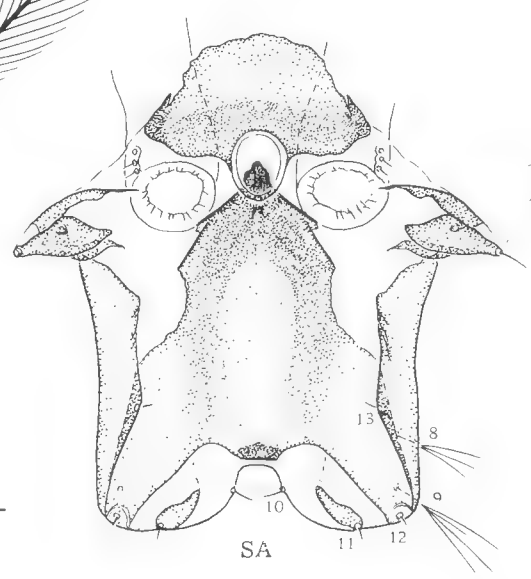
Fig. 24

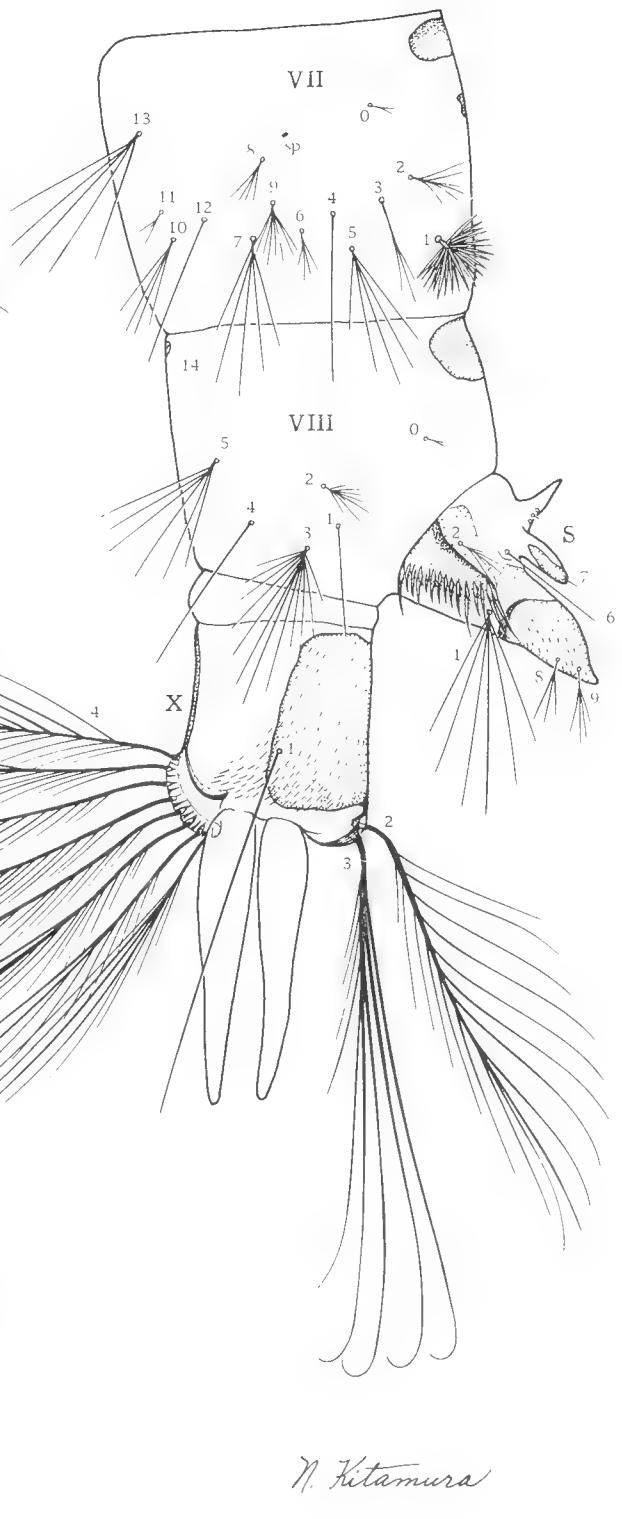
NYSSORHYNCHUS











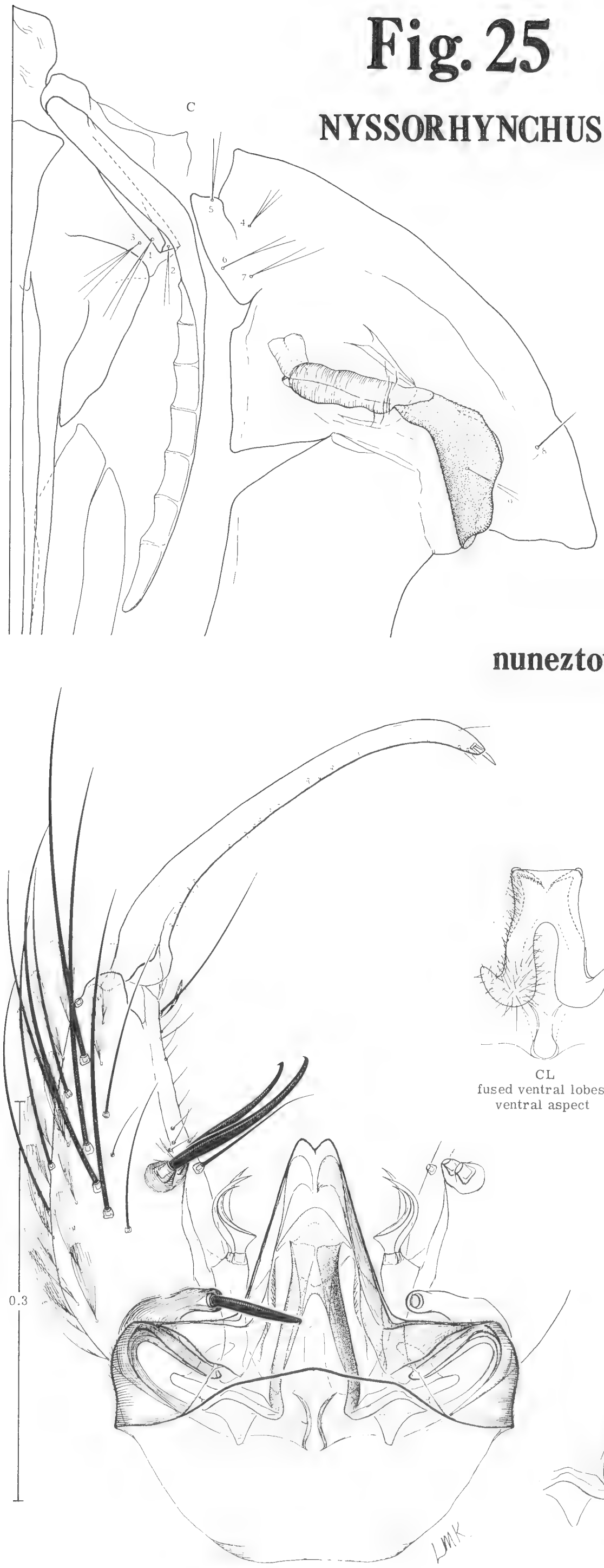
trinkae

N. Kitamura

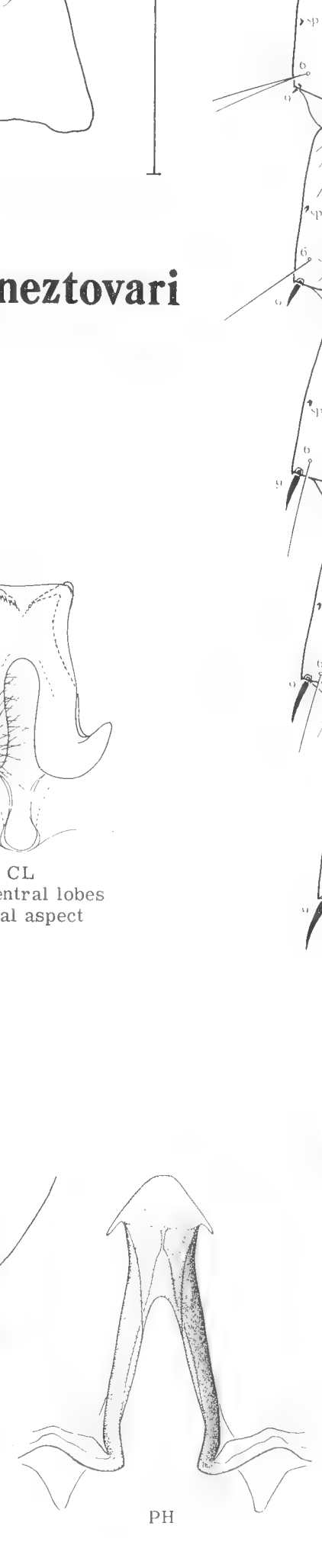
Fig. 25

NYSSORHYNCHUS

nuneztovari



CL
fused ventral lobes
ventral aspect



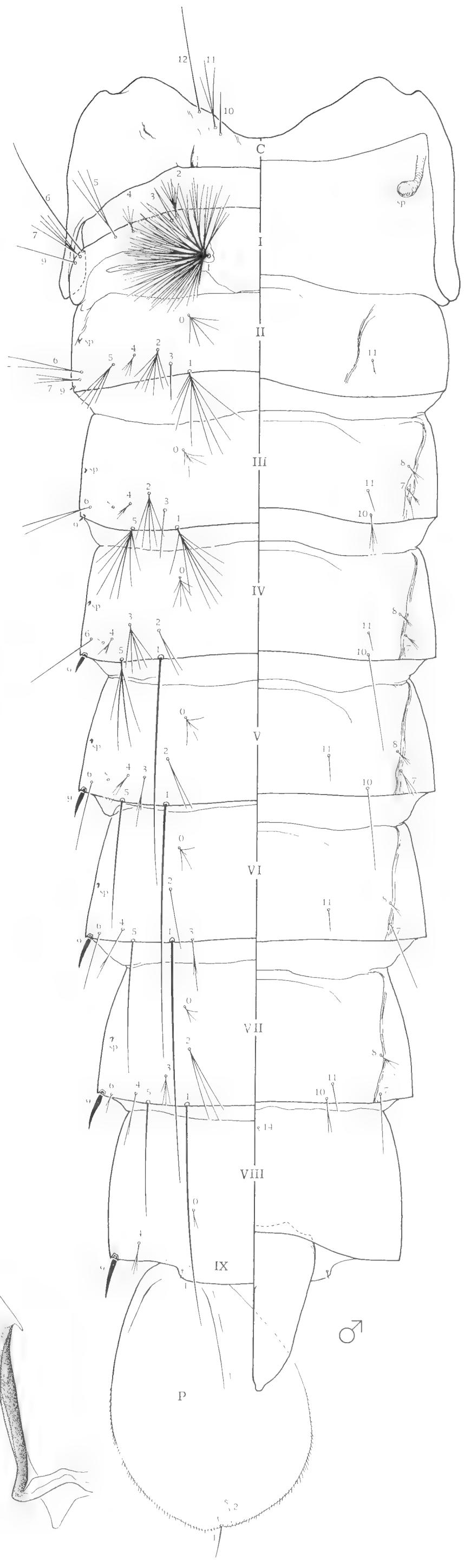
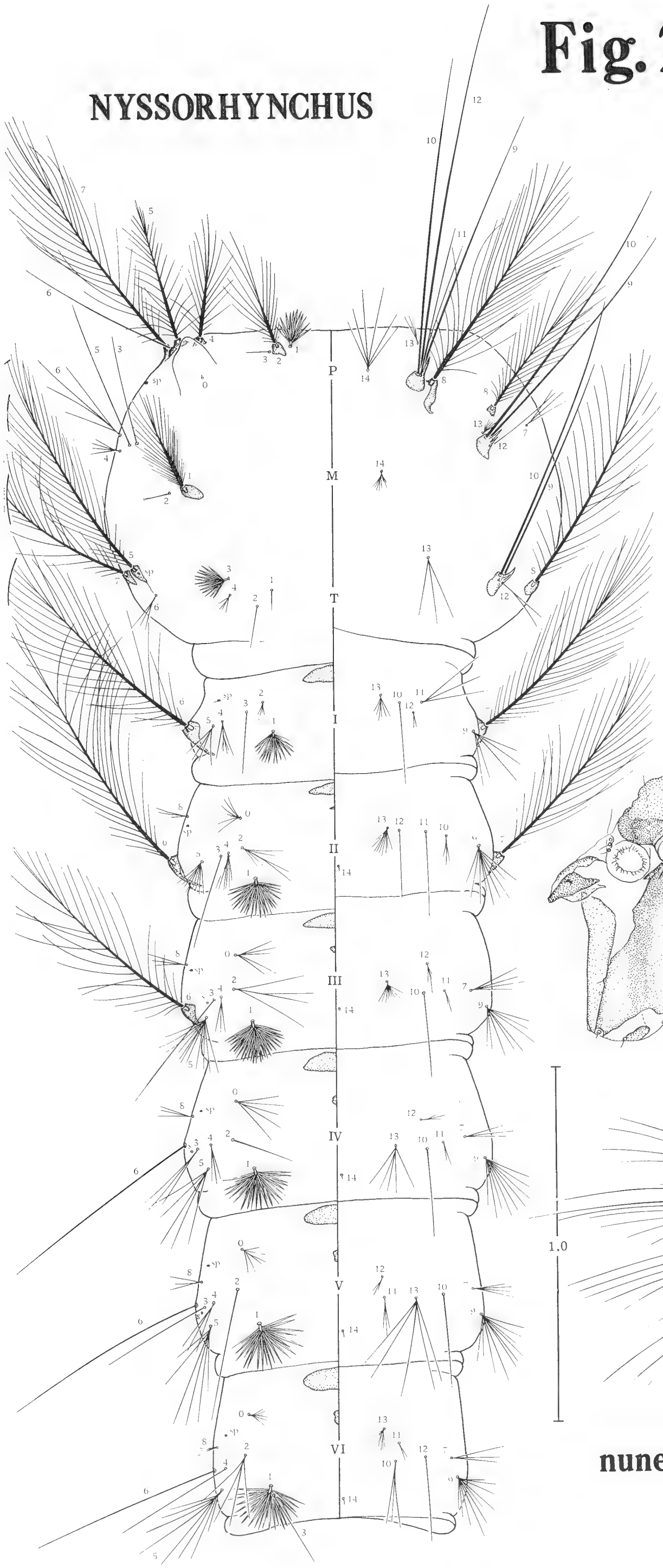
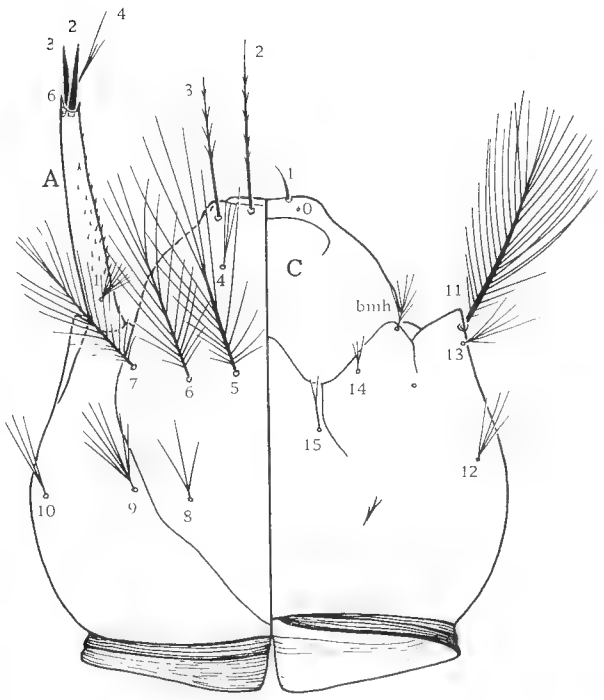


Fig. 26

NYSSORHYNCHUS





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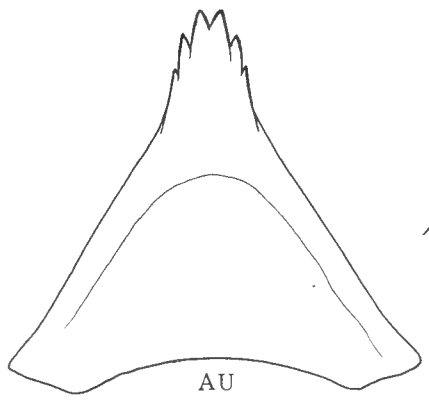
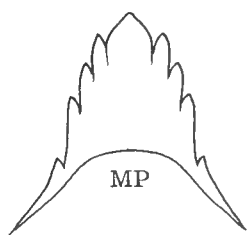
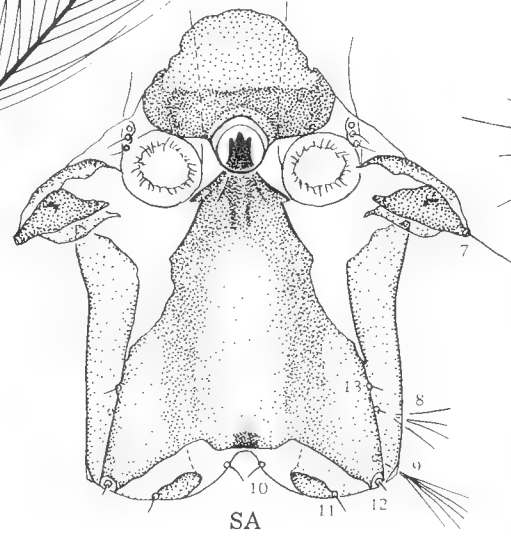






1.0

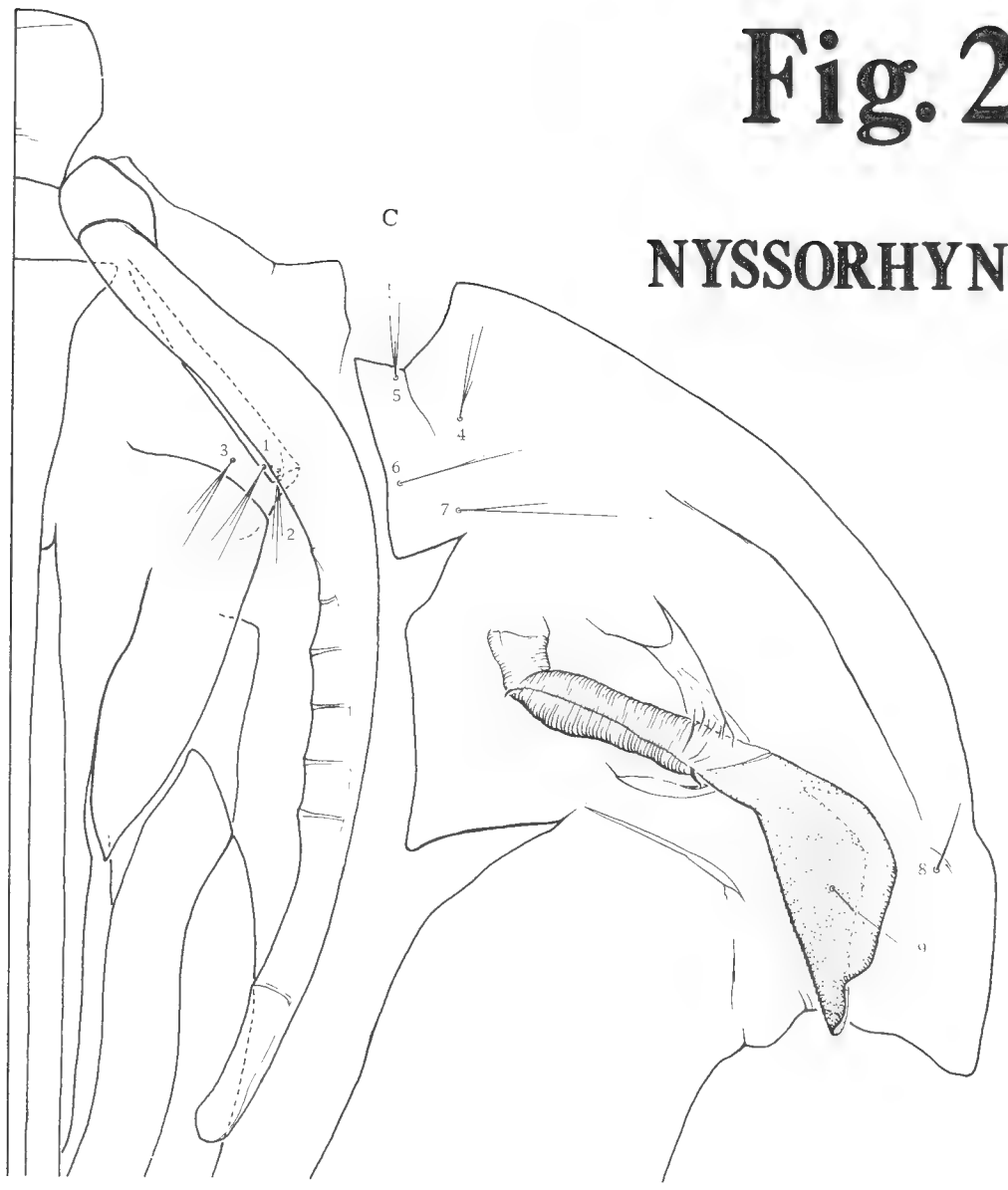
nuneztovari

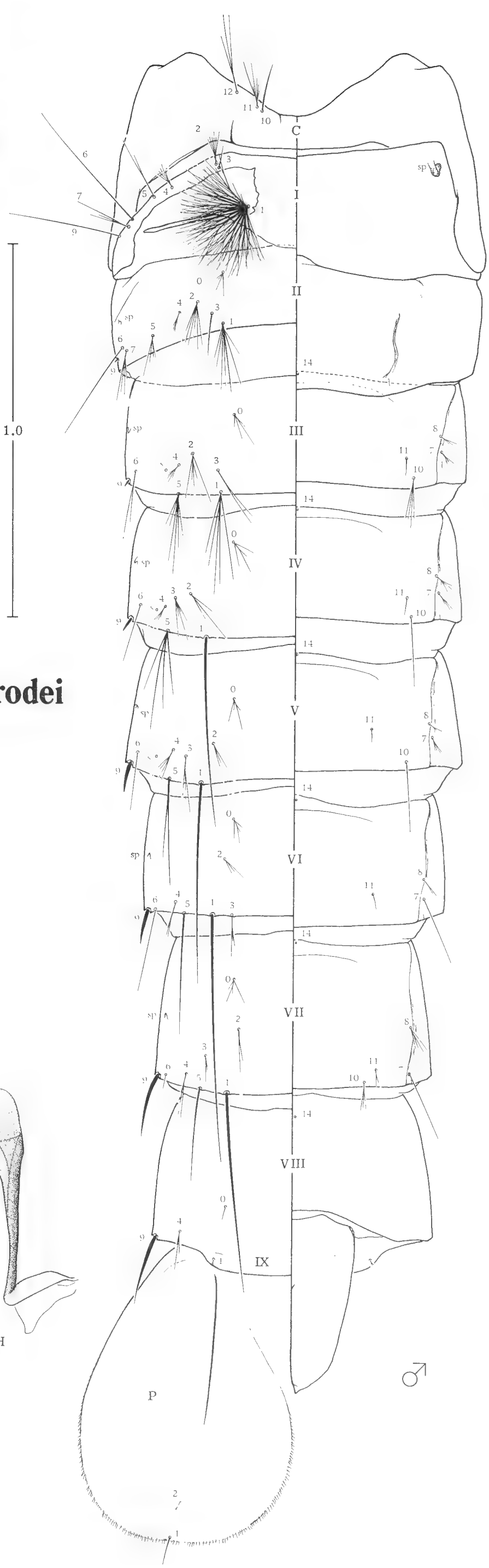
N. Kitamura

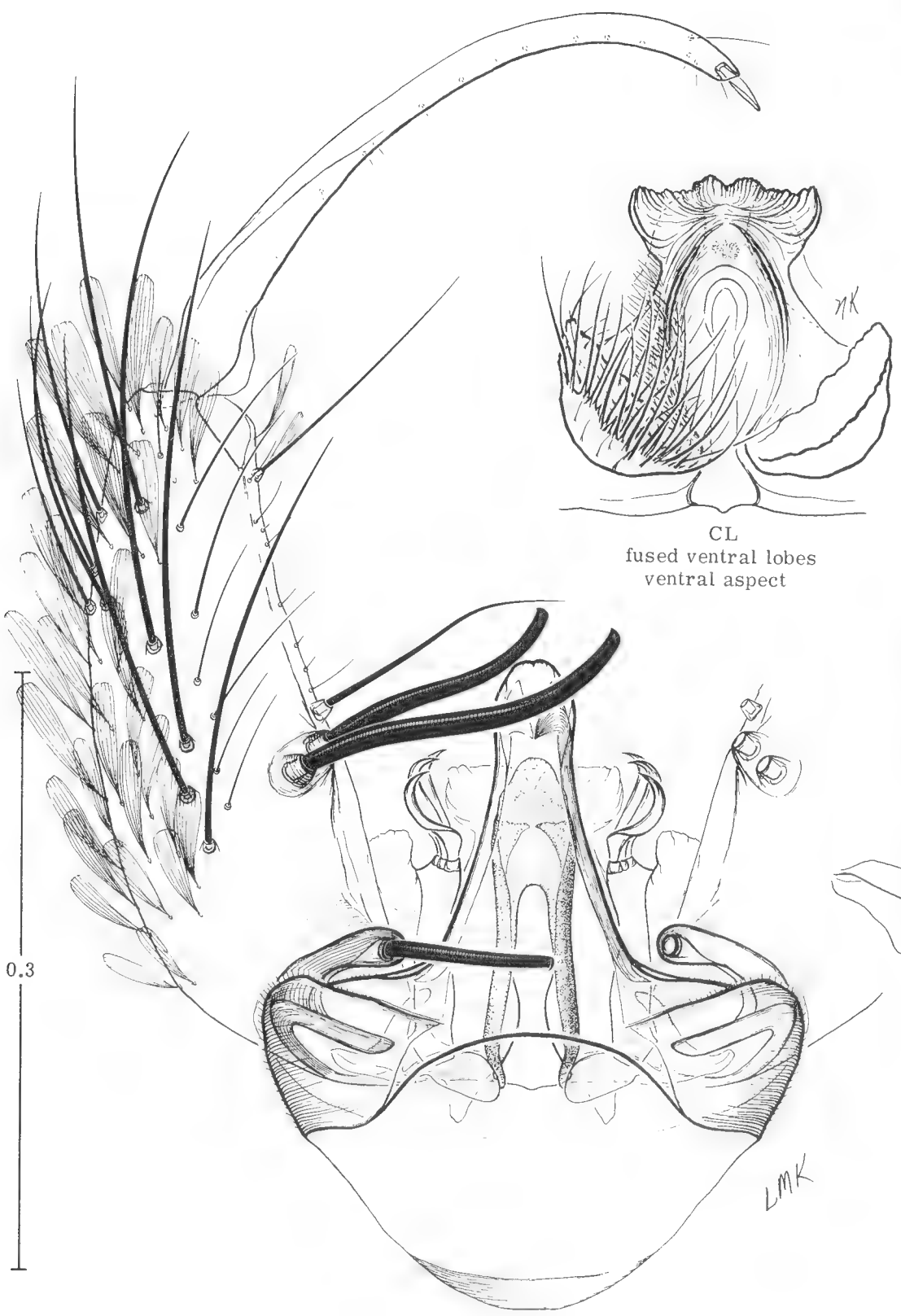
Fig. 27

NYSSORHYNCHUS

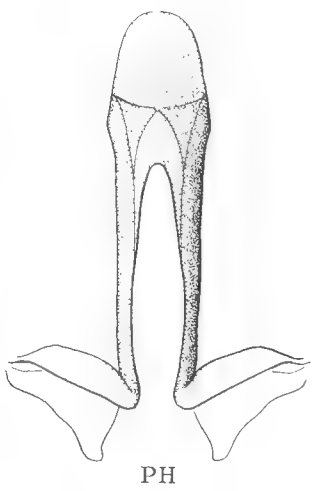
strodei







CL
fused ventral lobes
ventral aspect



PH

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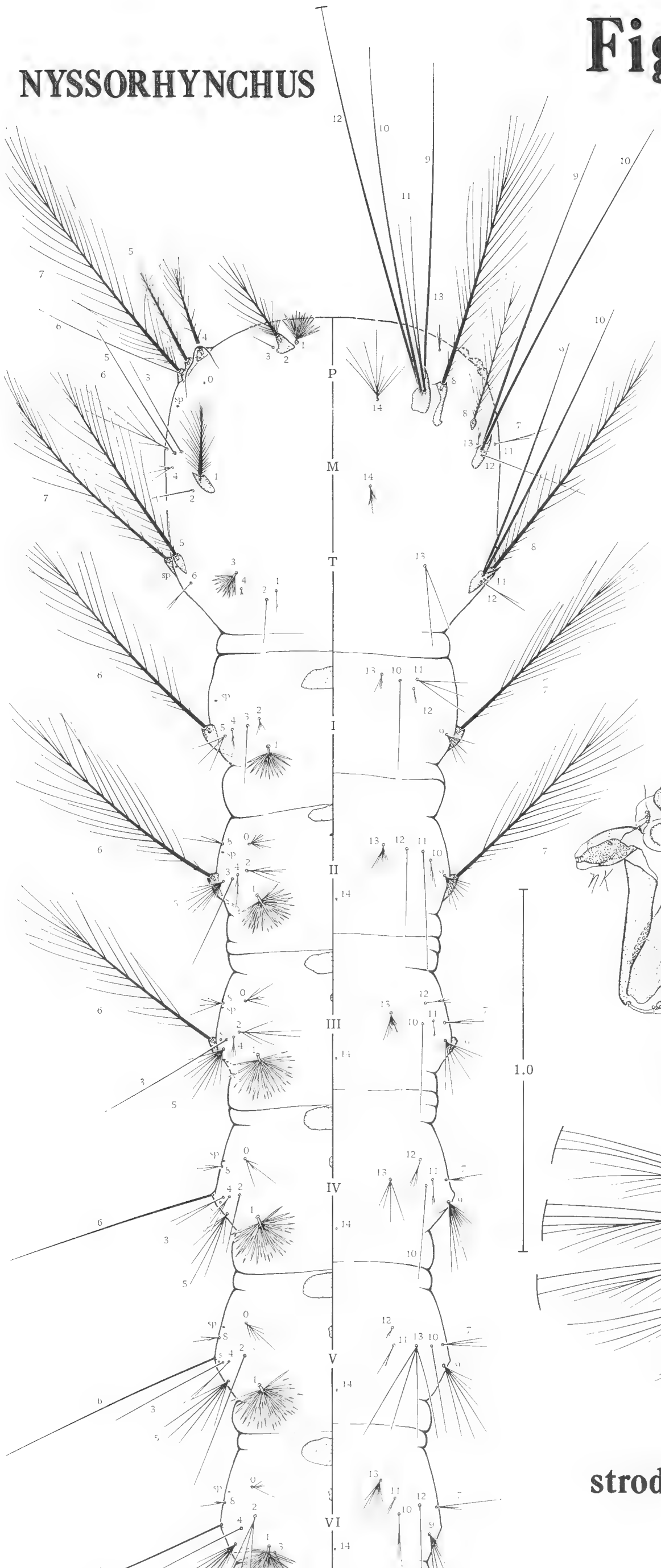
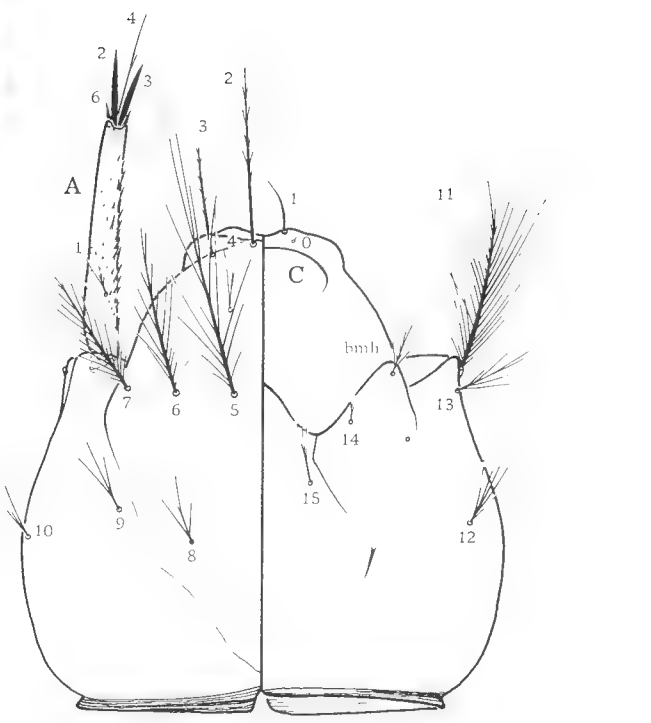
Fig. 28

NYSSORHYNCHUS





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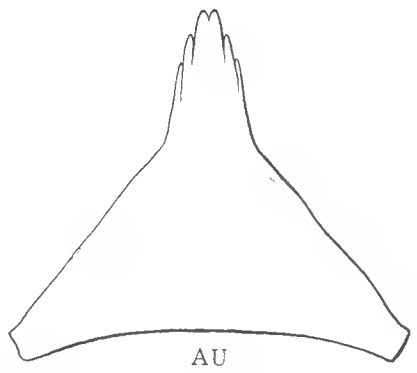

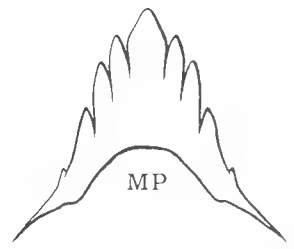

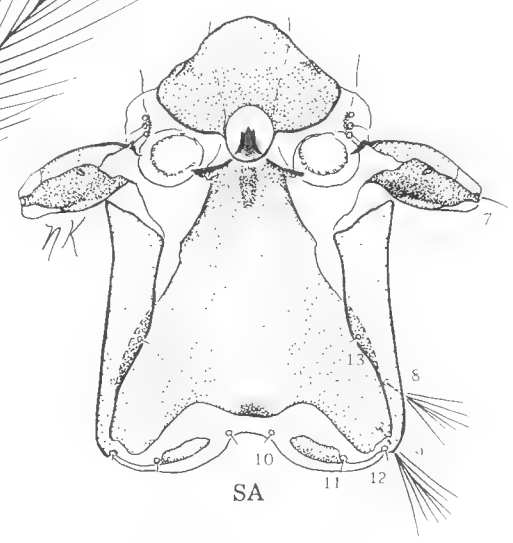

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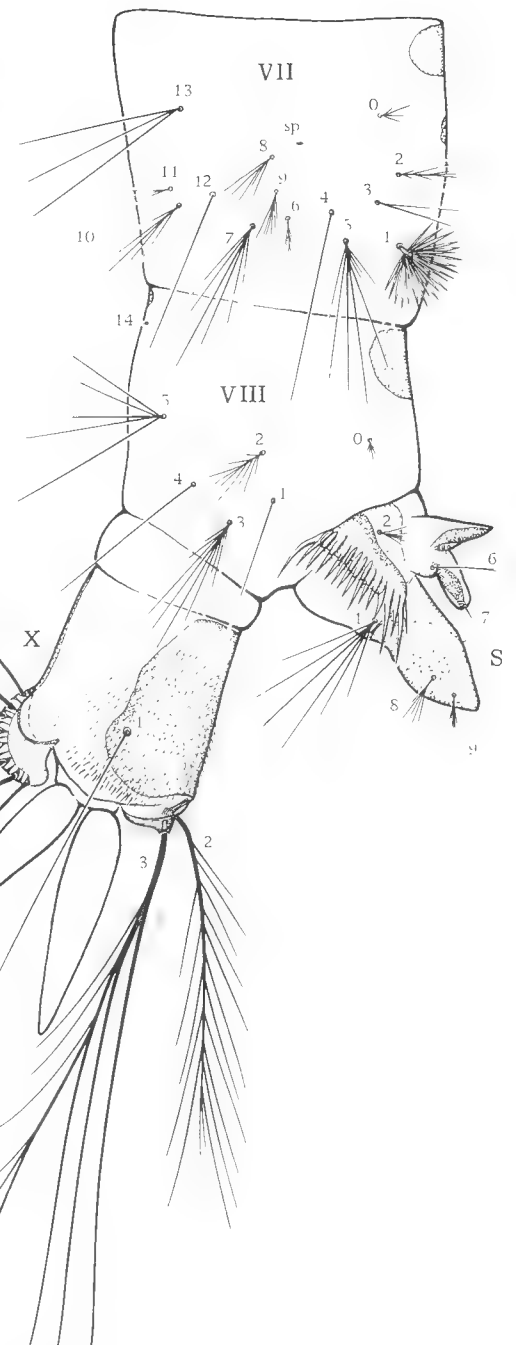
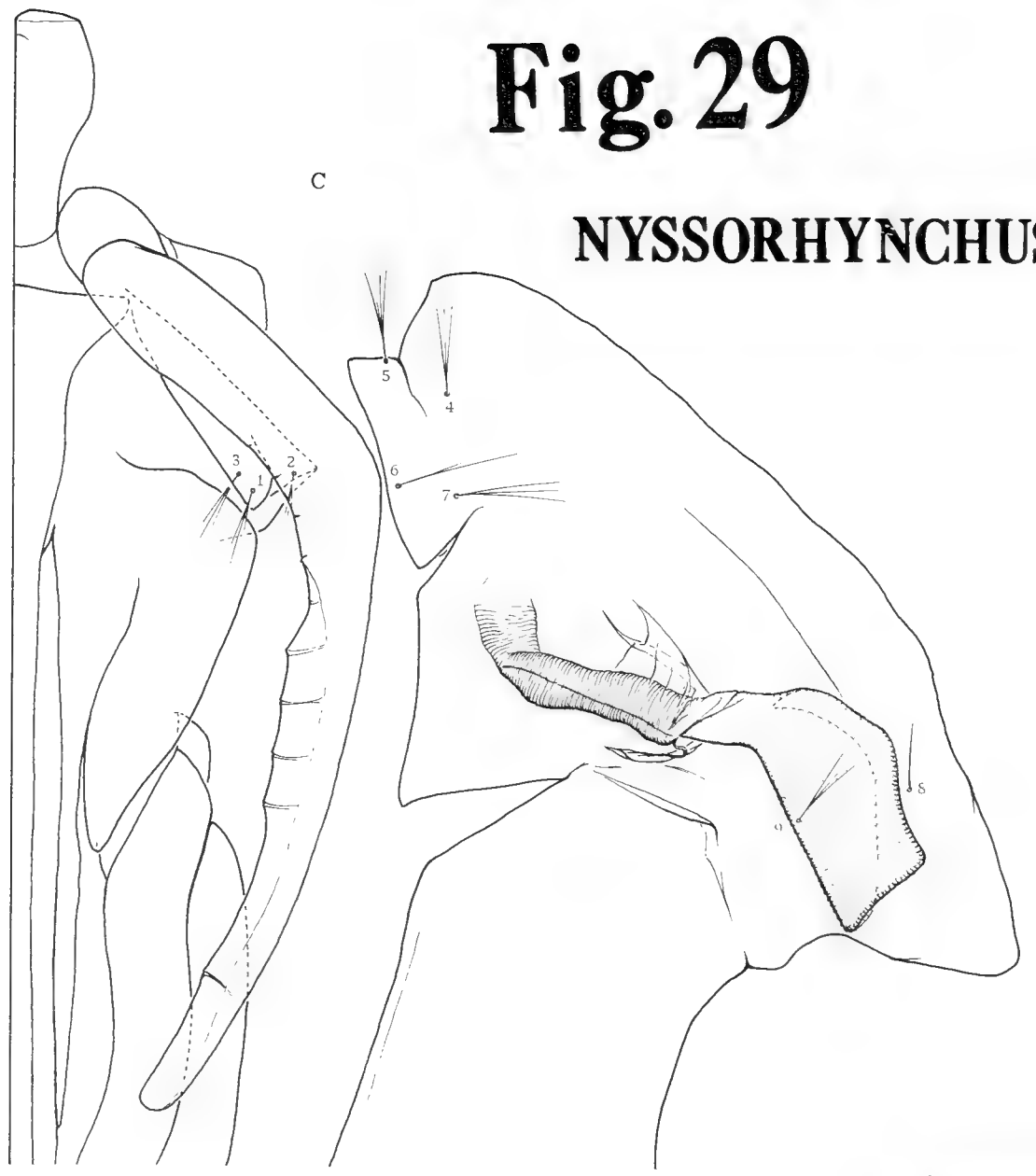


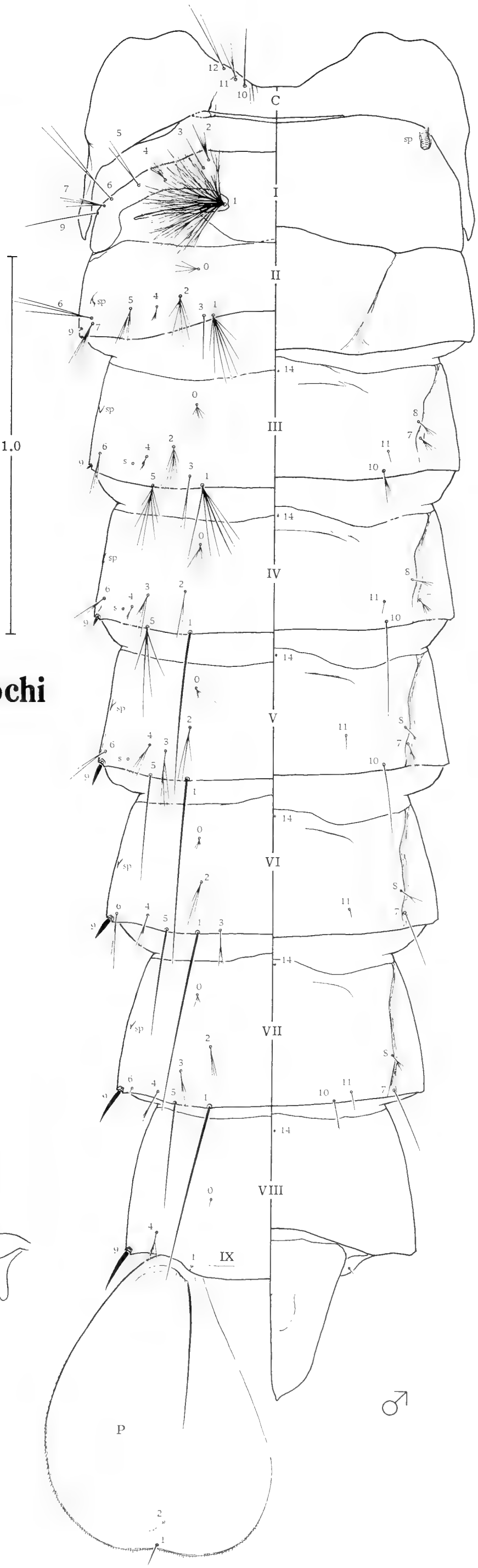
strodei

Fig. 29

NYSSORHYNCHUS

benarrochi





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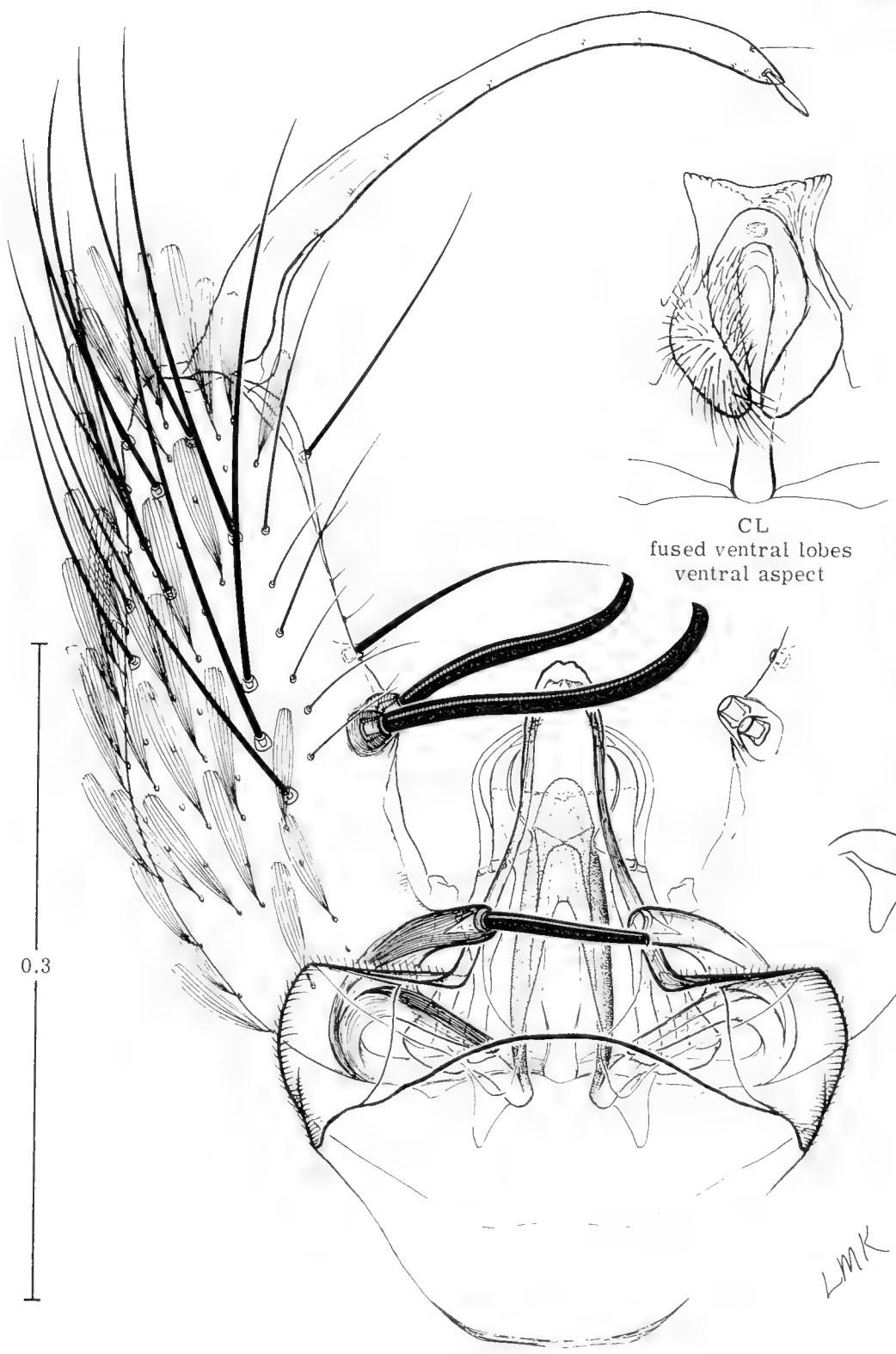
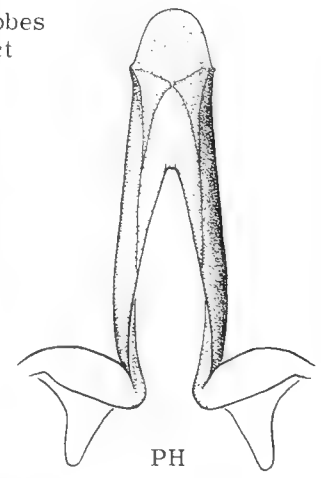


CL
fused ventral lobes
ventral aspect



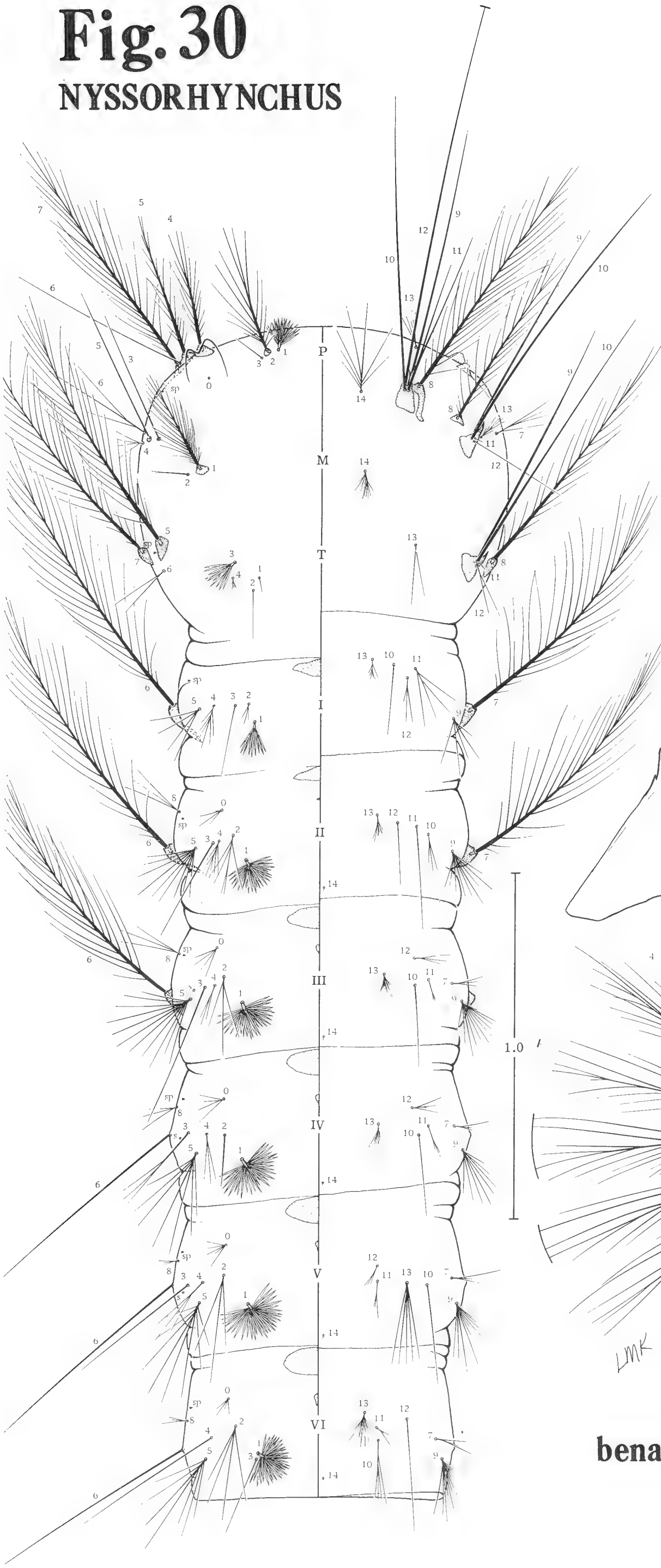
PH

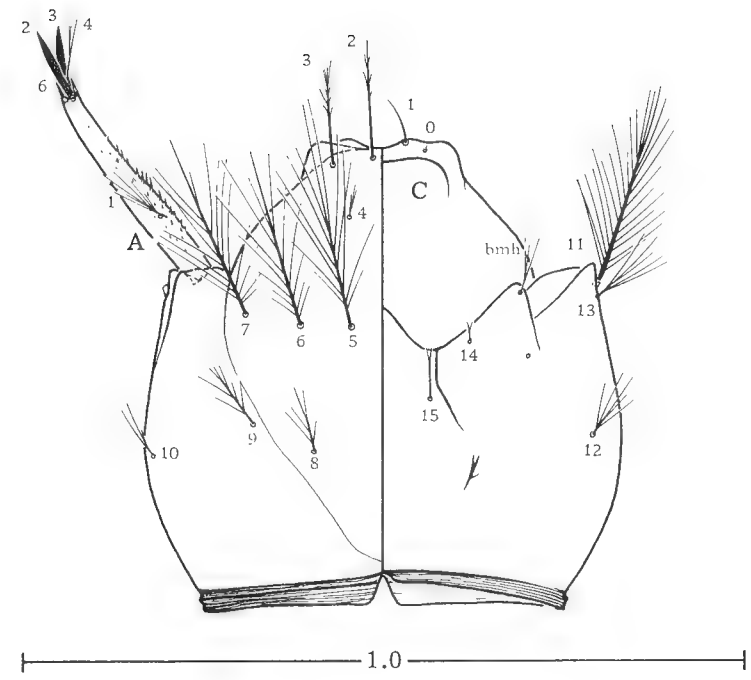
0.3

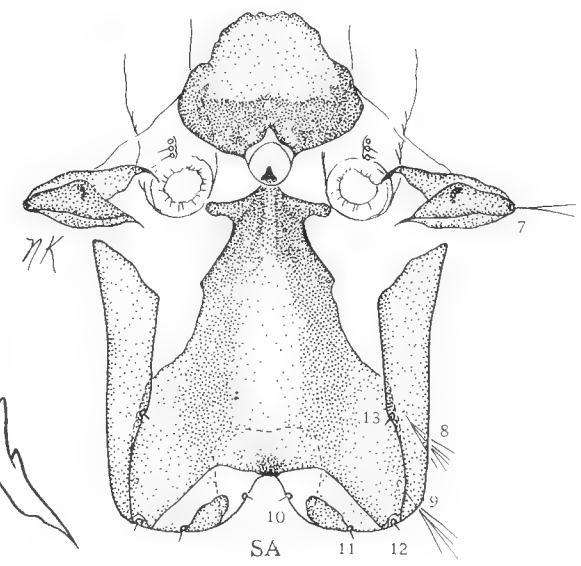
LMK

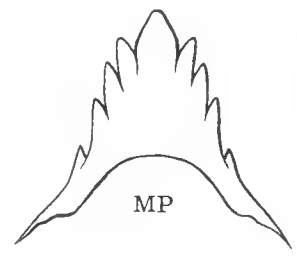
Fig. 30

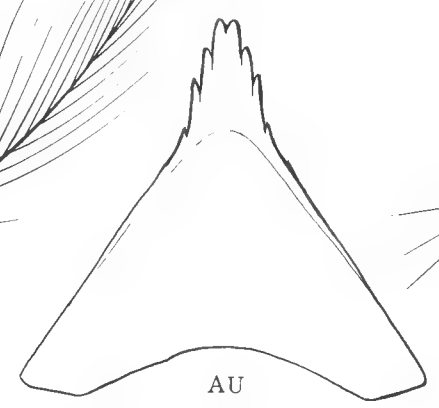
NYSSORHYNCHUS

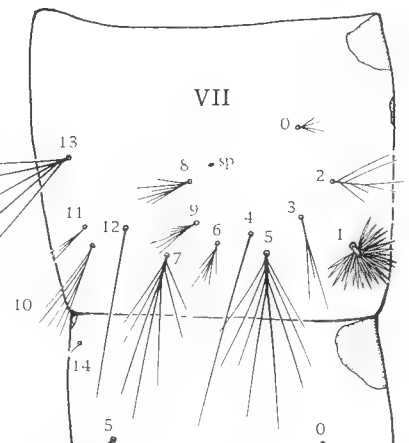


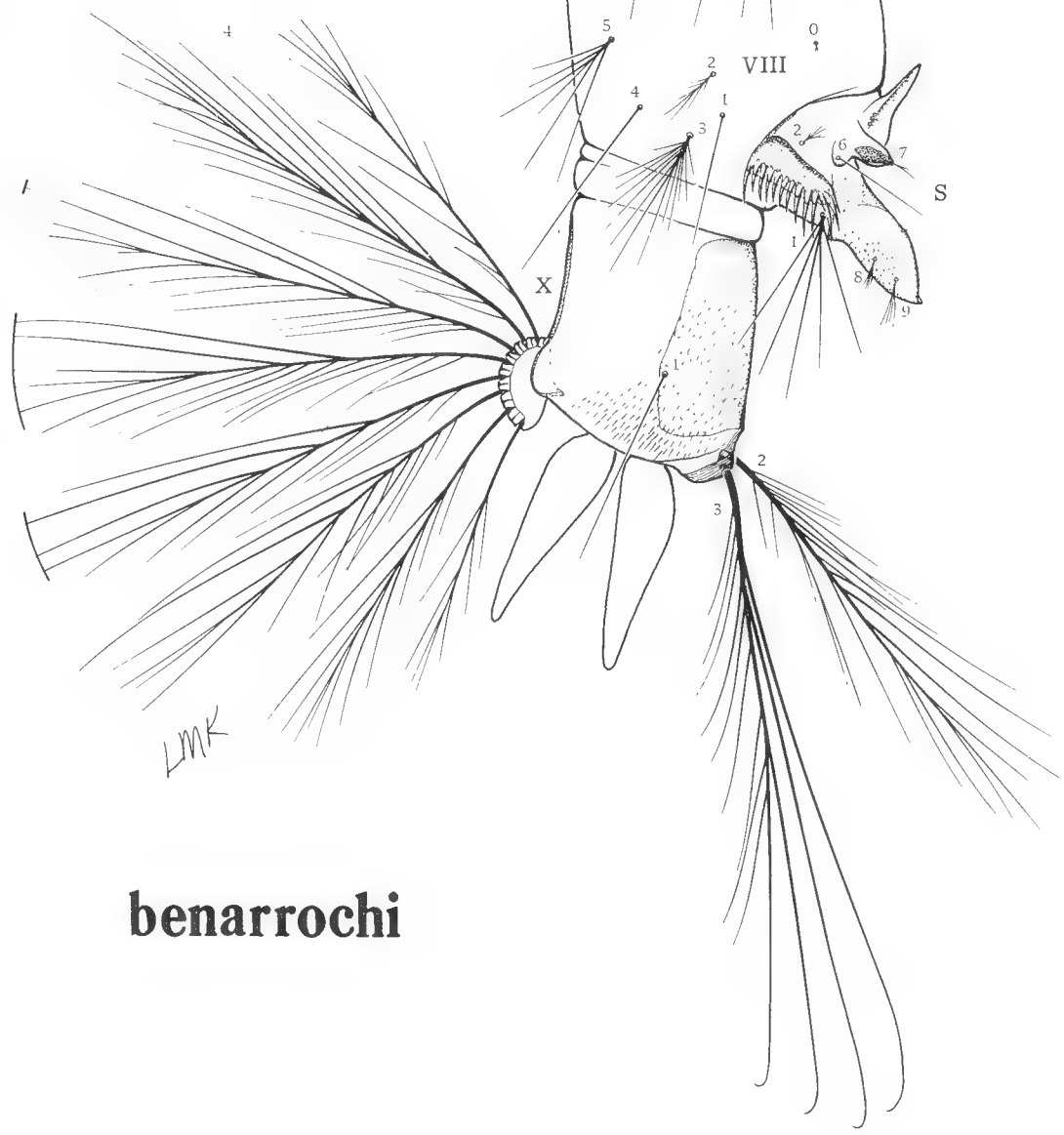












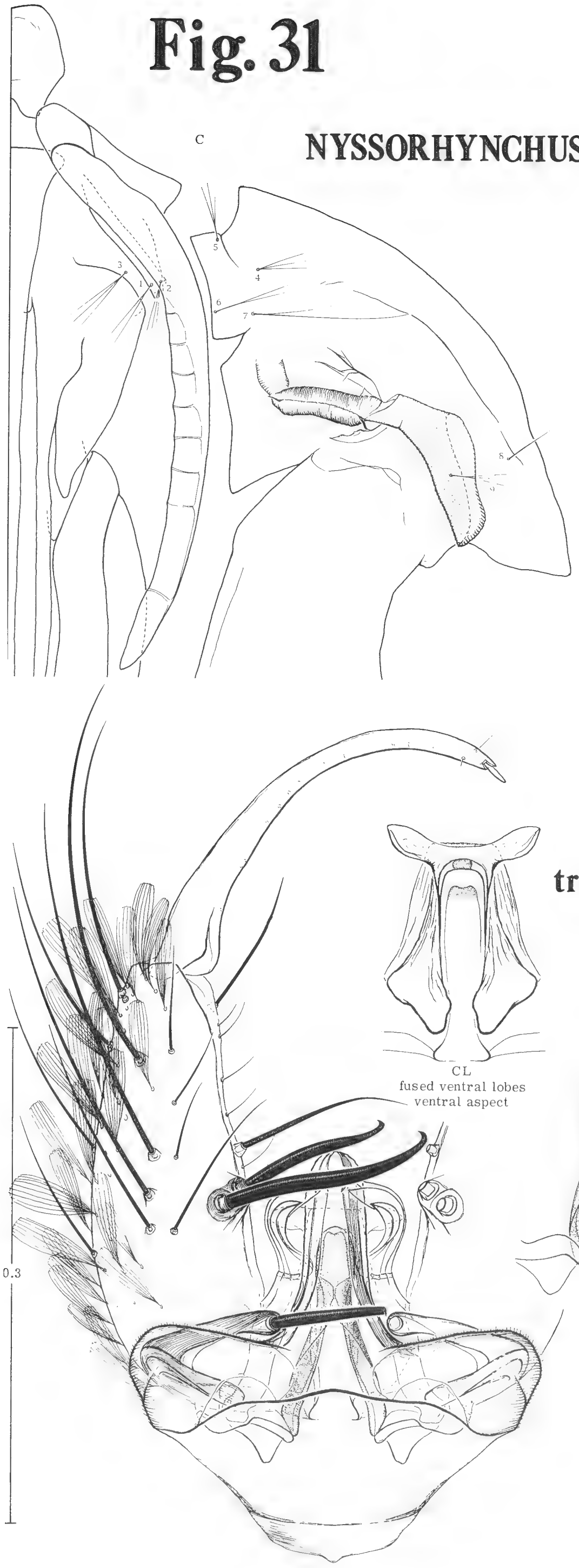
benarrochi

Fig. 31

C

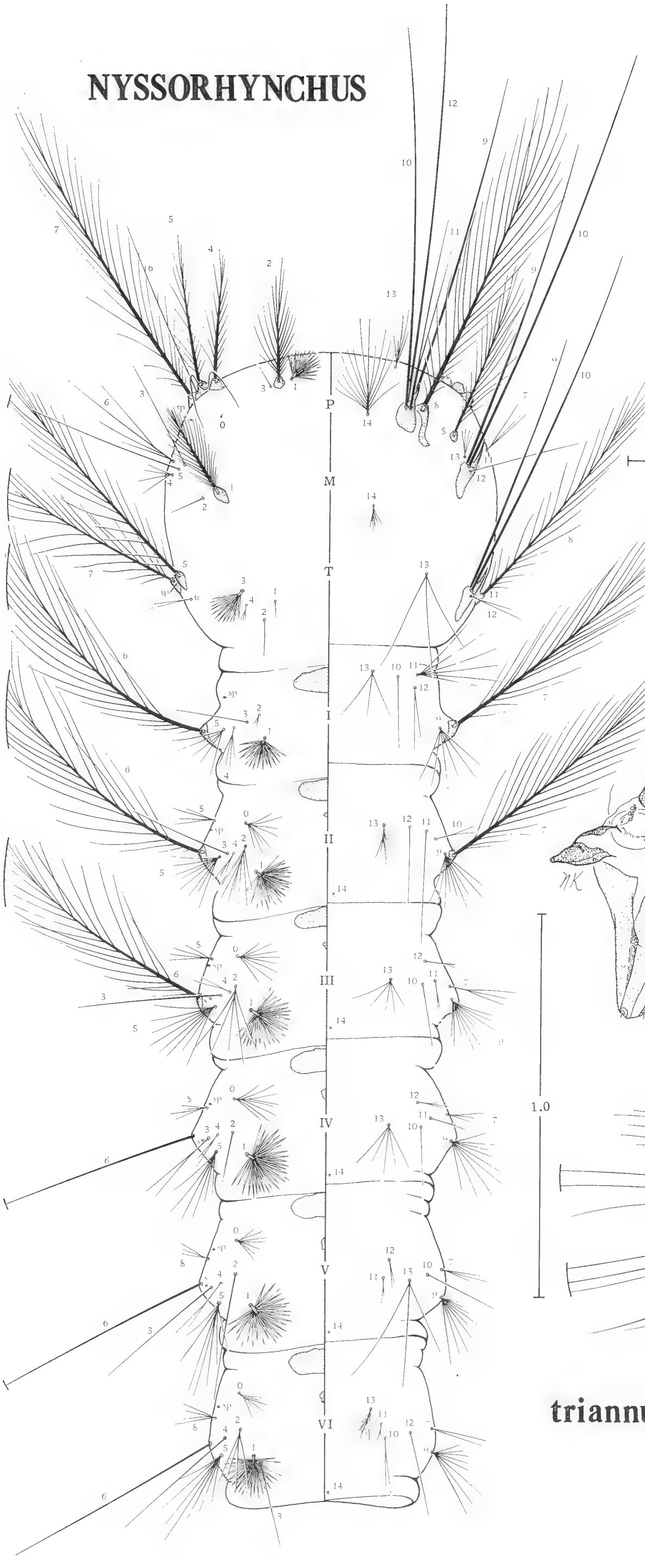
NYSSORHYNCHUS

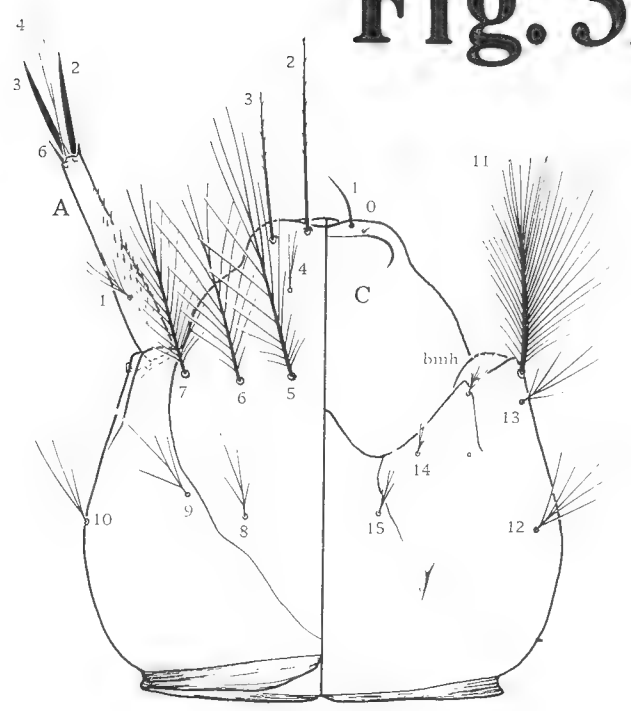
triannulatus



NYSSORHYNCHUS

Fig. 32





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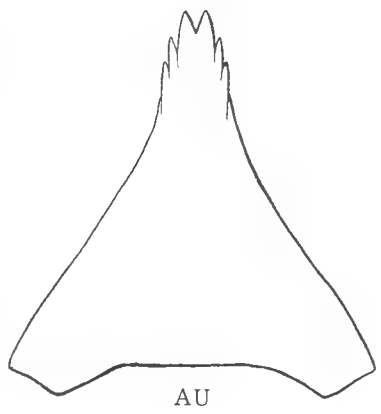

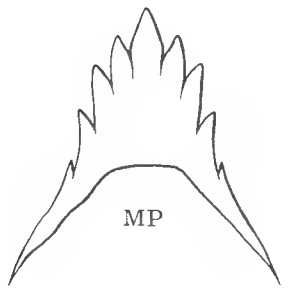

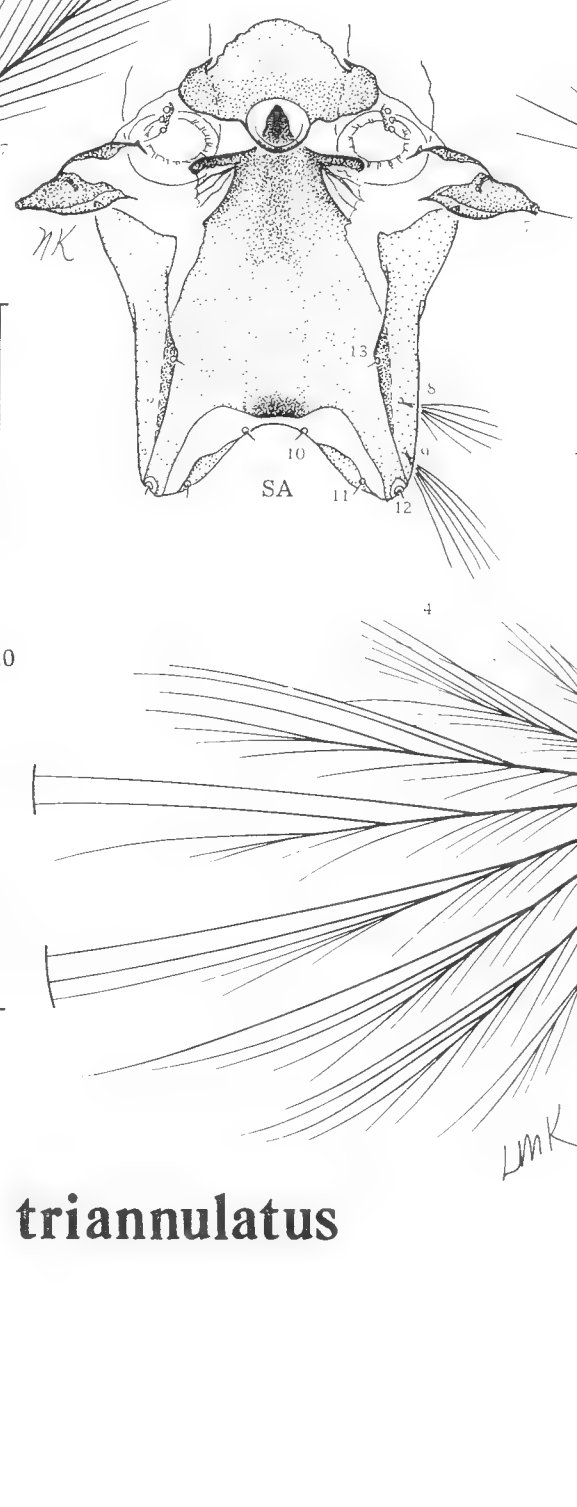

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triannulatus

TABLE OF DISTRIBUTIONS

DISTRIBUTION / SPECIES		1. *albimanus*	2. *oswaldoi*	3. *galvaoi*	4. *noroestensis*	5. *aquasalis*	6. *ininii*	7. *anomalophyllus*	8. *rangeli*	9. *trinkae*	10. *nuneztovari*	11. *strodei*	12. *rondoni*	13. *benarrochi*	14. *triannulatus*
UNITED STATES	Florida	●													
	Texas	●													
MEXICO	North	●													
	South	●										★			
GUATEMALA		●										★			
BELIZE		●													
EL SALVADOR		●													
HONDURAS		●										★			
NICARAGUA		●				★									★
COSTA RICA		●	●			●		●				●			●
PANAMA	West	●	★			●		●				●			●
	Central	●	●			●						●			●
	East	●	●			★					●	★			★
ECUADOR	Pacific	●				★									★
	Amazon		★						●	●					●
PERU			●						●					●	●
COLOMBIA	Pacific	★				★			★						★
	Caribbean	●	★						●		●	★			●
	Orino-Amazon		●						●	●		●		●	●
VENEZUELA	Caribbean	●	●			●			●		●	●		★	●
	Orinoco		●						●		●	★			●
BAHAMAS		●													
GREATER ANTILLES		●													
LESSER ANTILLES	Leeward	●				●									
	Windward					●									
TRINIDAD			●			●									
GUIANAS			●			●	★		★		●	★			●
BRAZIL	Amazon		●	●		●	●		●		●	●		★	●
	Northeast		●	?	●	●						●			●
	South		●	●	●	●			★			●	★		●
PARAGUAY			★	★	★							●	●		●
ARGENTINA			★		●							●	●		●
BOLIVIA			●		●				●	?	?	●	●		●

CONSPECTUS OF TAXONOMIC CHANGES

Resurrected From Synonymy

strodei Root 1926, from synonymy with *evansi* (Brethes 1926), to specific rank, p 129-130.

New Synonymies

albertoi Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

arthuri Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

bachmanni Petrocchi 1925, from subspecies of *triannulatus* (Neiva and Pinto 1922), to synonymy with *triannulatus,* p 141, 147.

deltaorinoquensis Cova Garcia, Pulido F. and Amarista M. 1978, to synonymy with *aquasalis* Curry 1932, p 75, 83-84.

lloydi Unti 1941, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123, 128.

ramosi Unti 1940, from variety of *evansi* (Brethes 1926), to synonymy with *strodei* Root 1926, p 123.

Transferred Synonymies

artigasi Unti 1941, from synonymy with *arthuri* Unti 1941, to synonymy with *strodei* Root 1926, p 123, 128.

davisi Paterson and Shannon 1927, from synonymy with *bachmanni* Petrocchi 1925, to synonymy with *triannulatus* (Neiva and Pinto 1922), p 141, 147-148.

metcalfi Galvao and Lane 1937, from synonymy with *oswaldoi* (Peryassu 1922), to synonymy with *noroestensis* Galvao and Lane 1937, p 67, 73.

perezi Shannon and Del Ponte 1928, from synonymy with *bachmanni* Petrocchi 1925, to synonymy with *triannulatus* (Neiva and Pinto 1922), p 141, 147.

Nomina Dubia

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gorgasi Dyar and Knab 1907, from synonymy with *albimanus* Wiedemann 1820, to *nomen dubium,* p 14.

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