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MOSQUITO STUDIES (Diptera, Culicidae)

XXXI. A revision of the subgenus Carrollia of Culex
By Jose D. Valencia

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MOSQUITO STUDIES (Diptera, Culicidae)

XXXI. A REVISION OF THE SUBGENUS CARROLLIA OF CULEX¹

by

Jose D. Valencia²

INTRODUCTION

Carrollia, precinctive to the New World tropics, is probably the most distinctive subgenus of *Culex* and includes the only species with conspicuous metallic ornamentation in the adults in the entire genus. When I undertook this revision in 1969, the 14 described nominal species assigned to the subgenus were differentiated almost entirely on the basis of male genitalic characters and no larvae or pupae were adequately known for any species (Lane, 1953:496-498; Levi-Castillo, 1953: 92-94). My work stimulated other investigators to reexamine the group and recently 2 additional nominal species have been described from Venezuela and 2 other species have been redescribed from Brazil. In this revision, I am recognizing 16 species in the subgenus, with the reduction of 2 formerly regarded as taxonomically valid to synonymy and the description of 2 new species. For 14 of these species all the stages are associated through individual rearings and for *kompi* and *cerqueirai* the association of the pupa and larva, respectively, are presumptive only. In addition, I am recognizing 3 unnamed forms and it is very probable that there are 2 or 3 other species in the subgenus which I have tentatively identified as the previously described *antunesi* and *wilsoni*. These unresolved taxonomic problems are primarily due to the lack of material from Brazil.

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MATERIAL AND METHODS

MATERIAL. All together 6,238 specimens were examined for this study, 1,340 males, 939 females, 2,675 larvae and 1,285 pupae; included among these were 958 individual rearings (540 larval, 282 pupal, 136 incomplete) of 14 of the 16 recognized species. The bulk of this material was collected for the project "Mosquitoes of Middle America" (Belkin, Schick et al., 1965, 1967) and is deposited at the University of California, Los Angeles [UCLA]. The only other major source of material was the U.S. National Museum of Natural History [USNM]. Shared by these institutions is a small number of important specimens from the collection of W.H.W. Komp, which is unfortunately partially lacking in detailed data and has a complicated numbering system (see Schick, 1970:4-5). A few valuable specimens were borrowed from the Centro de Pesquisas Rene Rachou, Brazil [BH], the Division de Endemias Rurales, Venezuela [MDM], and the Institut Pasteur, French Guiana [PIG]. In July and August 1969, I collected additional material and made field observations in northcentral Venezuela. I examined the types of *babahoyensis*, *bonnei*, *metempsytus*, *urichii* [USNM]; *manaensis* [PIG]; and *rausseoi* [MDM]. J.N. Belkin examined the types of *anduzei*, *iridescens*, *soperi* [FH]; and *infoliatus* [ITH]. I am designating here a lectotype for *bihaiocolus* [USNM]. The types of the following species were not seen: *antunesi* [BH]; *mathesoni* [IHC]; *guerreroi* [MDM]; *wilsoni* and *secundus* [LU].

TAXONOMIC PROCEDURES. I have followed the classical comparative morphological taxonomic procedures as adapted to mosquito systematics by Belkin, Schick et al. (1965:10; 1967:10-11). Species were first segregated on the basis of a series of constant correlated morphological features in all stages, obtained in most instances from the type localities in case of previously described forms. They were then compared minutely for shared derived constant correlated features to determine the primary phyletic lines and these were assembled into groups, subgroups and complexes, on the basis of degree of similarity and divergence (see chapter on Taxonomic Characters). In the final interpretation of evolution of the subgenus, data from habitats and distribution were taken into account.

DESCRIPTIONS. The terminology and abbreviations used in the descriptions of the taxa in general follow Belkin (1962) except for a few modifications proposed by Belkin (1968a:49), Belkin, Heinemann and Page (1970:78) and Knight and Laffoon (1970a, 1970b), and a number of special terms which are explained in the chapter on taxonomic characters and are labelled on the figures. Except as stated for the adults of some species, all measurements were made on slide-mounted specimens; further details and special problems in measurements are given in the chapter on taxonomic characters. Descriptions are composite whenever more than 1 specimen was available. The method of presentation of data in general follows that of Belkin (1962). For the chaetotaxy of the immature stages the first figure(s) given following the hair number is the mode (frequency of at least 75%), followed by the range in the sample (usually 5-10 specimens,

exact number specified in the description). The diagnostic features were checked on all the available material; any departure from these is noted in the sections on Systematics under each species or group.

SYSTEMATICS. The diagnostic taxonomic features, probable affinities, individual and geographic variation, and nomenclatural problems are discussed for every species insofar as the available material permits. For groups and subgroups this section is combined with those on bionomics and distribution in a Discussion in which an attempt is made to synthesize the information from the individual species and to determine the evolutionary trends in that group or subgroup and its affinities with others. Much of this, of course, is speculation because of the paucity of data which may be subject to different interpretations.

BIONOMICS. The meager data on bionomics are derived primarily from the record forms used in the project "Mosquitoes of Middle America" and a few literature reports. They are largely restricted to data on the breeding sites of the immature stages and biting records of females.

DISTRIBUTION. Only synoptic distributional data are given: country, major political subdivision, locality, collection number (when available; if not available, then collector's name) and depository; reliable literature records are included. Full data for every specimen examined are entered in a permanent ledger and will be available upon request to interested parties on microfilm or other desired reproduction method from the Department of Biology, University of California, Los Angeles. On the maps, the probable distribution of each species is plotted by circumscribing the entire area of individual spot localities. Overlapping distributions of different species do not necessarily indicate complete sympatry as the species in question may occur at different elevations and in different plant formations.

ILLUSTRATIONS. The full chaetotaxy of the immature stages of every species is figured, with the modal hair branching determined as noted in the paragraph on descriptions. For the adults pertinent details of the external morphology of the female and head and claws of the male of a representative species of the *Bihaiolus* Group, *Urichii* Subgroup and the *Iridescens* Subgroup are figured from a "typical" specimen, whenever possible from the type locality. The male genitalia drawings of every species are usually based on several specimens, from the type locality whenever available. The figures of the cibarial armature of females are based usually on a limited number of specimens and may not be entirely reliable.

TAXONOMIC CHARACTERS

The following morphological features of the adults, larvae and pupae proved to be particularly useful for the diagnosis of species and as supraspecific characters for the determination of their affinities. For the recognition of the phyletic lines and their interrelationships it is essential to establish which of the states of each significant character is primitive and which is derived and whether or not the derived state has occurred only once in the evolution of the group. As noted by Adames (1971:3), because of the lack of paleontological evidence in mosquitoes, reliance has to be placed for the identification of the primitive state primarily on the trend within the taxon by comparison with related taxa of the same rank. In this case the taxa involved are the other subgenera of *Cu-*

lex, primarily of the Melanoconion Section (see the chapter on Systematics). In the following discussion I have indicated whenever possible the primitive state of the various characters on this basis. An even greater problem is the determination of the monophyletic origin (true homology) of a derived state, which is necessary for the recognition of true phyletic lines. The only criterion that I could use with the available material was that of extreme similarity of the derived states in the taxa being compared, as for example the position and development of hair 9-C on the head capsule of the larvae of all species of the Iridescens Group. When derived states of several characters in different stages or different body parts of the same stage are correlated in this manner then the monophyletic origin of the taxa involved is almost certain. Although close correspondence of derived states of a single character appears to be reliable criterion of true homology in most instances involving elaboration of new structures or shifts in position it is often useless in those dealing with reduction or loss of structures.

ADULTS

HEAD. The most significant taxonomic features on the head are in the development of the scales of the vertex.

Decumbent scales.—The trend is from a primitive narrow anterior band of dark broad scales and numerous light narrow scales to practically entirely light broad scales. The color of the broad decumbent scales is quite variable and often difficult to determine because of iridescence; in many instances scales that appear light from a dorsal aspect show a very dark blue iridescence from an anterior view.

Erect scales.—The trend is from very long slender ones extending forward to near the orbital bristles to derived shorter, broader ones confined to the posterior part of the vertex and occiput; the primitive color was probably also dark, but is pale in most species.

Appendages.—The proboscis/forefemur ratio shows no consistent trend in the subgenus; it was probably primitively near 1.0 in both sexes and shows an increase in at least 2 separate phyletic lines. The labium primitively has no elongate hairs except at the extreme base (basal bristles). The palpus/proboscis ratio is fairly uniform throughout the subgenus in the females except for a marked increase in *kompi* and independent decrease in *infoliatus* and possibly *iridescens*; there is a great deal more variation in the ratio in the males as can be expected and this occurs in several independent lines. The antenna/proboscis ratio shows a definite tendency towards an increase from the primitive condition of less than 1.0 in both sexes.

THORAX. There is a marked derived trend in the reduction in the mesonotal chaetotaxy from the presence of a few anterior acrostichals, a complete row of anterior and posterior dorsocentrals, numerous prescutellars and some lateral prescutals to the nearly complete absence of all of these. The primitive scalation of the mesonotum is sparse and largely composed of nearly straight linear dark scales; in the derived condition the scales are denser, broader and more strongly curved and often paler in the posterior part. The scutellar scales on the midlobe and lateral lobes are primitively linear, and narrow curved to broad in the derived condition. The pleuron exhibits several obviously derived features:

(1) darkening and development of a broad pruinose stripe; (2) reduction in the upper *stp* bristles; and (3) development of broad scales on *apn* and lower *stp*.

LEGS. The legs show relatively few significant taxonomic characters other than specific differences in the extent of the light basal scaling of the femora. The metallic spots of the femora show a great deal of individual variation and relatively few specific differences in location, size and intensity of iridescence; only in the *Urichii* Subgroup is there a marked derived condition in the development of a metallic spot on the forefemur. The large field of plantar setae on segment 5 and a smaller on segment 4 of the foretarsus and midtarsus of the *Bihaicolus* Group is probably a primitive condition. The loss of the tooth on the larger claw of the midtarsus of males of the *Iridescentis* Subgroup appears to be a derived state.

WING. The only significant taxonomic character noted on the wing is the type of plume scales on R_s , R_{2+3} , R_2 , R_3 and M . In the primitive condition these scales are long and linear and occur on all these veins; in the derived condition they are shorter and broader and are more restricted in distribution, being replaced by scales hardly differentiated from squame scales on R_2 and R_3 .

ABDOMEN. There appear to be few significant taxonomic characters on the pregenital segments of the abdomen. The following character states I have interpreted as being primitive: (1) abdomen subcylindrical, not distinctly compressed; (2) dorsal part of tergite I with few scales; (3) basal tergal light bands not developed; and (4) distal sternites without dark apical bands. The shape and position of the lateral metallic markings may show group differences but I did not study these in detail. There are also distinct specific differences in the size of these markings on the proximal segments; these are obscured to some extent by considerable individual variation.

CIBARIAL ARMATURE. The female cibarial armature was not studied in sufficient detail and in a sufficient number of specimens to determine whether or not reliable taxonomic characters are present. However, it appears that there are at least good specific differences. I am proposing the term **cibarial dome** for the hemispherical internal projection from the anterior (dorsal) wall of the cibarium just proximad of its junction with the pharynx. It protrudes into the proximal part of the pharynx (fig. 9). This structure is found throughout the *Melanocion* Section of *Culex* as well as in the genus *Deinocerites*.

FEMALE GENITALIA. The only group difference noted in the female genitalia was the presence of an atrial plate in the *Bihaicolus* Group; presumably this is the primitive condition in the subgenus. There appear to be specific differences in the number of setae on tergite IX, cercus, postgenital plate and insula but the sample studied was insufficient to evaluate the significance of these differences.

MALE GENITALIA. Previously described species have been characterized principally on male genitalic characters without adequate analysis of the considerable individual and population variation or much regard to the homology of the structures described. I have attempted to determine these homologies and for descriptive purposes have proposed several new terms as indicated below.

Sidepiece.—In the primitive state the sidepiece is elongate, more or less conical and without scales; the development of the short ovoid shape and of the scales may have been derived independently in several lines.

Subapical lobe.—Characteristic of the subapical lobe in the subgenus are 2 derived trends: (1) reduction and loss of the **distal division** probably independently

in several lines; and (2) development of an **accessory division** at or near the base of the **proximal division**, possibly more than once. In the *Bihaicolus* Group the distal division is represented by a reduced lobe adjacent to the proximal division (fig. 10) or is absent; in the *Urichii* Subgroup it is small and widely separated from the proximal division (figs. 20,22); and in the *Iridescens* Subgroup it is represented distad of the proximal division by a small bare protuberance (figs. 24,28), except in *secundus* in which it is apparently completely absent (fig. 26). The proximal division normally bears 2 apical specialized setae, *a* and *b* (fig. 10); occasionally a short subapical seta is more or less differentiated, it is arbitrarily designated seta *c* although it may not be homologous with seta *c* on the proximal division in the subgenus *Culex*. The accessory division is developed only in the *Iridescens* Subgroup (see) and may have arisen independently in each of the complexes of the group from different parts on or near the base of the proximal division.

Clasper.—Characteristic of *Carrollia* is the elaboration of the clasper. In the primitive state (*Bihaicolus* Group) it is simple, parallel-sided or slightly tapered apically. As in some groups of the *Melanoconion* Section of the genus it has: (1) a **snout**, an external apical recurved process associated with the spiniform; (2) a **ridged crest**, externally before the beak; and (3) in the distal part 3 **setae** which are here designated from the apex basad as seta *a* (the usual thickened spiniform) and the simple hairlike setae *b* and *c* (fig. 10). The derived states are: (1) the development of a distal **head** with an **outer curvature** and **inner pre-apical lobe** (fig. 26); (2) the modification of the crest to a flat sclerite; (3) the thickening or flattening of seta *b* which now may appear as the spiniform; and (4) the reduction of seta *a* to a hairlike state.

Phallosome.—The lateral plate of the aedeagus is of the usual *Melanoconion* type with a so-called basal hook. The primitive type of lateral plate appears to be broad, with a distinct **sternal spine**, a conspicuous lateral **external spine** and a simple apex (fig. 10). The derived conditions are: (1) narrowing of the plate; (2) loss of the external spine; (3) loss of the sternal spine; and (4) development of a long **caudal process** from the apex (fig. 26).

Proctiger.—The proctiger is also of the usual *Melanoconion* type. The primitive states are probably as follows: (1) the basal part broad and distal elongate; (2) paraproct sclerotization without basal mesal sternal lobe; (3) crown of paraproct with several flattened teeth; and (4) several cercal setae. The only phylogenetically significant derivation is the development of a **mesal sternal lobe** (fig. 26) at the base of the paraproct sclerotization. All the other derived states involve reduction of crown teeth, reduction or loss of cercal setae and shortening or broadening of the distal part of the paraproct and have occurred independently in several lines.

PUPAE

The pupae of the subgenus are remarkably uniform, with only a few phylogenetic characters that are correlated with those of the adults and larvae. Although there are some differences in the chaetotaxy of most species the individual and sometimes geographical variations are so great that they are difficult to use for diagnosis. In the descriptions I have given data on the mode and range of branching for all the cephalothoracic and metanotal hairs and for selected

abdominal hairs which may prove to be useful for future work with larger samples than available for this study.

CHAETOTAXY. The most significant phylogenetic characters in the pupal chaetotaxy are the positions of hair 2 on abdominal segment II and hair 3 on segment VI, and the development of cephalothoracic hair 5. The primitive position of hair 2-II laterad of 3-II in nearly the entire tribe Culicini is preserved in the Bihaiolus Group; the derived position mesad of 3-II is found in all members of the Iridescens Group. The position of hair 3-VI is extremely varied in the Culicini but appears to be primitively laterad of hair 1 in the Melanoconion Section of *Culex*; this position is found in the Iridescens Group, while in the Bihaiolus Group 3-VI is mesad of hair 1. Cephalothoracic hair 5-C is elongated in the Bihaiolus Group and the Urichii Subgroup while it is short in the Iridescens Subgroup; the latter is probably the derived condition in the subgenus. The only other hairs that appear to show significant phylogenetic differences are abdominal hairs 3-II,III, 1-III and 5-VI. Specific differences have been noted primarily in the development of abdominal hairs 1-IV, 3-IV, 4-VI, 5-IV,V, 6-III-V and 9-VII,VIII.

TRUMPET. As in most other Culicini a short broad flared trumpet with a relatively large pinna is the primitive condition in *Carrollia*, retained in the Bihaiolus Group and to a lesser extent in the Urichii Subgroup. In the Iridescens Subgroup the derived states involve elongation and narrowing of the trumpet and reduction of the size of the pinna.

PADDLE. The paddle in *Carrollia* presents no significant taxonomic characters other than changes in shape. There is a tendency for the loss of hair 2-P independently in several lines and even the reduction of 1-P.

FOURTH INSTAR LARVAE

In the larvae of *Carrollia* there are many excellent constant phylogenetic characters that are concordant with similar characters of the adults and to a lesser extent of the pupae. There are also good specific differences but the hair branching often shows considerable individual as well as population variation. In the descriptions I have given data on the mode and range of branching for all cephalic and thoracic hairs and for selected abdominal hairs. Further study of these in larger samples may reveal additional reliable specific differences.

HEAD. A striking feature of *Carrollia* is the anterior position of cephalic hairs 5,6-C which is probably the primitive condition in the Melanoconion Section of the genus but may also be related to the shape of the head capsule and the confined habitat utilized for breeding sites. Another unusual primitive feature is the retention and strong development of hair 2-C in the entire subgenus, known elsewhere in the tribe only in the genus *Deinocerites*. These 2 groups also share the loss of hair 3-C, rarely represented by a spicule. The primitive normal position of hair 9-C is retained in the Bihaiolus Group but this hair is removed to near the collar in all members of the Iridescens Group, a unique feature in the tribe Culicini. There is also a definite derived trend for the caudal migration of hairs 12,14-C in the Iridescens Subgroup. Characteristic of the subgenus is the derived condition of hair 11-C which is relatively poorly developed and located farther ventrad from the base of the antenna than in any other group in the tribe. Specific differences are most evident in the development of hairs 5-7-C. The anten-

na is very uniform throughout the subgenus and is of the primitive type without differentiation of a wider basal part. Maxillary hair 5-MP of all members of the Iridesens Group is greatly thickened, obviously a derived condition from the simple seta of the Bihaiocolus Group.

THORAX. The taxonomic characters of the thorax are primarily useful at the specific level. The following derived states are evident however at the subgroup level: (1) in the Iridesens Subgroup, spicules on the prothorax, enlargement and substellate to stellate development of hairs 0-P, 14-M and 13-T; and (2) in the Urichii Subgroup, thickening and enlargement of hairs 8-P and 13-T.

ABDOMEN. There appear to be no significant major group characters except for the following hairs (derived states): (1) in the Iridesens Group, dendritic hair 11-I, short dendritic hair 3-VI; and (2) in the Iridesens Subgroup, enlargement of hair 1-II. The conspicuous enlargement of hair 1-VII is found also in some other container-breeding groups of the Melanoconion Section of *Culex* and in *Deinocerites*. The strong development of hair 6 on segments III-VI is probably a primitive character as it occurs in some groups of the Melanoconion Section, in the subgenus *Culex* and in *Deinocerites*. The most significant characters at the level of complexes and species were found to be in the development and branching of hairs 7-II, 6-III-V, 1-III-V, 3-II-V, and 13-III-V.

SEGMENT VIII. The type and arrangement of comb scales divides the subgenus into the 2 principal groups. The single row of long spinelike scales is undoubtedly a derived condition as the patch of short apically fringed scales is characteristic of *Deinocerites* and all primitive forms in the other subgenera of *Culex*.

SIPHON. A derived character of the Urichii Subgroup is the presence of elongate spicules on the siphon. The siphon index is useful for the diagnosis of several species but shows considerable individual and geographical variation in many species. In the ventral siphonal tufts there is a derived trend in the reduction in the number of hairs and in the number of branches in individual hairs; the primitive condition is retained in the Urichii Subgroup. The shape of the pecten teeth is varied but shows no consistent group characters; there is a great deal of individual variation in the number of pecten teeth in most species.

ANAL SEGMENT. A very important group character, as in other mosquito larvae, is the development of the ventral brush. The primitive condition of a large number of hairs, and these with numerous branches, is retained in the Urichii Subgroup. In the Bihaiocolus Group the number of hairs is large but their branching is reduced. In the Iridesens Subgroup there is a reduction in the number of hairs but relatively little in their branching. The primitive state of hair 1-X is probably an unbranched condition and that of 2-X a large multiple fan-shaped hair; both of these are a characteristic condition in the Urichii Subgroup; the derived branching of 1-X and reduction of 2-X are found in the Bihaiocolus Group and the Iridesens Subgroup. There are no significant taxonomic characters on the saddle except in *guerreroi*. The gills are quite varied in the different species but there is no detectable phylogenetic trend.

SYSTEMATICS

TAXONOMIC HISTORY. Although the taxonomic history of *Carrollia* is rather simple it is necessary to summarize it here as no previous revision of the group

has been made. Adolpho Lutz (1905:81-82) described *Carrollia* as a distinct genus with *iridescens* as the only included species. The combination *Carrollia iridescens* appeared earlier as a *nomen nudum* (Lutz, 1904:16) and this was repeated by Blanchard (1905:634). Coquillett (1906a:61) described *urichii* in the genus *Melanoconion* and retained it in this genus in his classification of the mosquitoes of North and Middle America (Coquillett, 1906b:23). Dyar and Knab (1906:223) and Dyar (1906:18) transferred *urichii* to *Mochlostyrax* on the basis of larval characters. Subsequently Dyar and Knab (1909:101) recognized the affinities of *urichii* and transferred it to *Carrollia* which they treated as a full genus following Peryassu (1908:167-169,343) who had redescribed the adults and provided a brief description and figure of the larva of *Carrollia iridescens*.

Considerable confusion occurred during this early period of very intensive and competitive taxonomic studies on mosquitoes. Unaware of Lutz's paper, Theobald (1907:206-209) redescribed the genus *Carrollia* and *C. iridescens*, but these re-descriptions should not be considered as proposals of new taxa (see Belkin, 1971:42). Theobald's description of the scutellar scaling, repeated in a later key (1910:113), was misleading and he probably had at least 2 species included under *iridescens*. Theobald (1910:455,458) did not recognize the affinity of *urichii* but questioned its inclusion in *Melanoconion*, suggesting that it might be more properly placed in *Janthinosoma*. At about the same time further confusion arose with the report of *Culex (Carrollia) iridescens* from the Canal Zone by Busck (1908:70). The identification, made by Dyar and Knab (Busck, 1908:50), was erroneous and actually 2 other species, described later, were involved. This misidentification persisted in Howard, Dyar and Knab (1915:461-466) who treated *Carrollia* as a genus, redefined it and provided the first keys to the adults, male genitalia and larvae of *urichii* and "*iridescens*" together with detailed descriptions of the species including figures of the male genitalia and larvae. Dyar (1918:108) reduced *Carrollia* to a subgenus of *Culex* and suggested that *urichii* might be placed in a separate subgenus but he did not recognize the misidentification of *iridescens* from Panama.

The Bonnes were the first investigators to make significant additions to the knowledge of the subgenus. They proposed the name *secundus* for the misidentified "*iridescens*" from Panama and described *infoliatius* but retained incorrectly "*iridescens*" for the Surinam species (Bonne-Wepster and Bonne, 1920:170-171). Dyar quickly followed with the description of *metempsytus* from Costa Rica and proposed *bonnei* for the "*iridescens*" from Surinam (Dyar, 1921:154-155). The latter was not accepted by Bonne and Bonne-Wepster (1925:196-207), who reviewed all the previously described species. The unjustified replacement name *Carrollella* of Lutz (1921:161) was not noted either by the Bonnes or by Dyar (1925:176) who incorrectly placed *amazonensis* Lutz, 1905 in the subgenus.

Dyar and Nunez Tovar described *bihaicolus* as a new species in 2 separate publications (1927:4-5, Spanish; 1928:91, English) just prior to the appearance of Dyar's monograph on the mosquitoes of the Americas (Dyar, 1928). In the latter work Dyar accepted *Carrollella* as a replacement for the subgeneric name *Carrollia*, removed *amazonensis* from the subgenus and considered all the previously described 7 nominal species to be valid taxonomically except *bonnei* which he retained as a synonym of *iridescens* following Bonne and Bonne-Wepster (1925). Dyar's (1928:270) unfortunate error in indicating the presence of only narrow curved scales on the vertex of the head of *Carrollella* was followed by Edwards (1932:220), who also accepted Dyar's taxonomic treatment but reverted to the use of *Carrollia*, and

also later by Lane (1953:496), probably directly from Edwards. The keys in Dyar's monograph provided little help in the identification of species.

The most recent comprehensive treatment of *Carrollia*, by Lane (1953:496-514), was very superficial as it did not include a description of the adult morphology of even 1 species and provided a more or less workable key to male genitalia only. All the 12 nominal species described to that date were treated as taxonomically valid, including in addition to those previously mentioned in this review: *anduzei* Cerqueira & Lane, 1944; *antunesi* Lane & Whitman, 1943; *mathsoni* Anduze, 1942; *soperi* Antunes & Lane, 1937; and *wilsoni* Lane & Whitman, 1943. The diagnoses of these additional species by the original authors were based almost entirely on male genitalia except for *antunesi* and *soperi*. Other than the original descriptions, the only significant taxonomic contributions during this period were those of Antunes and Ramos (1939) on the *iridescens* complex, with a designation of the neotype of *iridescens* and the resurrection of *bonnei*; Senevet and Abonnenc (1939; 1958) on the species from French Guiana; a few distributional records listed under the individual species in the taxonomic treatment; and an unwarranted synonymy of *infoliatus* with *bihaicolus* by Komp (1936:64; 1956:39).

Subsequent to Lane's review, 2 additional species have been described, *babahoyensis* Levi-Castillo, 1953 and *manaensis* Floch & Fauran, 1955. Stone and Knight (1957) designated lectotypes for *bonnei* and *metempsychus*. In the world catalog (Stone, Knight and Starcke, 1959:282-283) all 14 nominal species were considered to be taxonomically valid. Recent papers dealing with *Carrollia* are those of Casal and Garcia (1968) reporting *soperi* from Argentina and indicating several characters useful in the separation of females; Belkin (1968; 1971) on the type specimens and designation of lectotypes; the description of 2 new species from Venezuela, *guerreroi* and *rausseoi*, by Cova Garcia, Sutil and Pulido (1971; 1972); and an adequate redescription of *anduzei* and a confused one of *secundus* from Brazil by Barata and Cotrim (1972).

PROPOSED CLASSIFICATION. The species recognized in this revision fall into 2 clearly marked major groups on at least 2 correlated characters each in external adult features, male genitalia, pupal chaetotaxy and larval features. Only generalities on the groups and their components are briefly reviewed here; details are presented in the discussions of the groups, subgroups and individual species.

The Bihaiocolus Group of 5 named species (*bihaicolus*, *guerreroi*, *rausseoi*, *metempsychus*, *infoliatus*) and the unnamed sp. 3a from Panama has undoubtedly retained more primitive features in all stages and is closer to the ancestral stock of the subgenus. It is characterized primarily by these primitive features: (1) in the adults, strongly developed dorsocentral bristles; pleuron pale; (2) in the male genitalia, lateral plate of phallosome with subapical external spine and not produced caudad; clasper simple; (3) in the pupae, abdominal hair 2-II laterad of 3-II; hair 3-VI mesad of 1-VI; and (4) in the larvae, head hair 9-C in normal position; comb scales apically fringed and in a patch. The group is so compact that it is not divided into subgroups. However, 2 phyletic lines are discernible largely on differences in the development of the subapical lobe of the male genitalia. The Infoliatus Complex (*infoliatus*, *metempsychus*) has lost the distal division of the subapical lobe which is retained in the Bihaiocolus Complex (*bihaicolus*, *guerreroi*, *rausseoi*). Species 3a is known in the larva only and cannot be placed in either complex at this time. The species are poorly differentiated except in male genitalia. On general adult features, only *infoliatus* is readily separated from the others. The

pupae are extremely similar and the diagnostic characters of the larvae are rather tenuous. Two species (*bihaicolus*, *infoliatu*s) are widespread dominant modern forms; *metempsytus* is moderately common in a more restricted area; and *guerreroi*, *rausseoi* and probably sp. 3a are relict forms.

The Iridescent Group of 11 named species, 2 unnamed forms and possibly 3 additional forms is characterized primarily by derived features: (1) in the **adults**, dorsocentral bristles not developed on mesonotal disc; pleuron with pruinose stripe; (2) in the **male genitalia**, lateral plate of phallosome without subapical external spine and with a long caudal process; clasper complex; (3) in the **pupae**, abdominal hair 2-II mesad of 3-II; hair 3-VI laterad of 1-VI; and (4) in the **larvae**, head hair 9-C removed caudad; comb scales elongate, spinelike and in a single row.

The Iridescent Group is divided into 2 very distinct major phyletic lines. The small *Urichii* Subgroup of 2 poorly differentiated species, the dominant widespread *urichii* and the restricted *anduzei*, is characterized by a combination of derived and primitive features: (1) in the **adults**, upper sternopleurals present; hindtarsal segment 4 with a broad basal white ring; (2) in the **male genitalia**, distal division of the subapical lobe present; caudal process of lateral plate of phallosome curved ventrad; seta b of clasper simple; (3) in the **pupae**, cephalothoracic hair 5-C strongly developed; and (4) in the **larvae**, ventral brush with at least 5 pairs of hairs; prothoracic hair 8-P spikelike.

The Iridescent Subgroup is the largest and most diverse major phyletic line in the subgenus. It is characterized primarily by derived features in all stages: (1) in the **adults**, upper sternopleurals absent; hindtarsal segments entirely dark scaled; (2) in the **male genitalia**, distal division of the subapical lobe represented by only a knoblike protuberance or completely absent; caudal process of lateral plate of phallosome straight or curved laterad; (3) in the **pupae**, cephalothoracic hair 5-C weak; and (4) in the **larvae**, ventral brush usually with only 4 pairs of hairs; prothoracic hair 8-P weak or stellate. Several phyletic lines are evident within this subgroup but their relationships are obscure. The derived male genitalic features characterizing these different lines are not concordant with the mosaic of primitive and derived features of the pupae and larvae. For the present, I am dividing the subgroup into 2 complexes. The Iridescent Complex (*bonnei*, *secundus*, *iridescent*s, sp. 8a, sp. 9a) consists of a single phyletic line that is clearly marked by the strongly differentiated preapical lobe on the clasper of the male genitalia and the presence of erect scales on anterior part of the vertex of the head of the adults. The Antunesi Complex lacks these features and consists of 4 apparently separate phyletic lines: *Soperi*, *Babahoyensis* and *Kompi*, each with a single species, and *Antunesi* with at least 3 species (*antunesi*, *cerqueirai*, *wilsoni*) and possibly 3 additional forms.

DISTRIBUTION (figs. 2-5). The subgenus *Carrollia* is precinctive to the New World tropics. Its northernmost record is from the State of Vera Cruz in southern Mexico and its southern limit appears to be in the States of Sao Paulo and Parana in Brazil and the Province of Misiones in northeastern Argentina. The subgenus is not known from the Caribbean islands and on the Pacific coast of South America it has not been reported south of the Guayas River Basin in Ecuador. The distribution is not continuous through the range but is limited to areas of tropical, subtropical and cloud forests from near sea level to as high as 2,000 meters.

The species of *Carrollia* are concentrated on the northern margins of South America where all the groups, subgroups and complexes are represented by 14

named species and by sp. 3a. As noted under the discussion of the systematics of *antunesi* and *wilsoni*, their populations in this area may not be conspecific with topotypic southern populations and may be represented by 2 or 3 unnamed forms. In the vast Amazon Basin only 4 species are known, *infoliatius* of the Bihaicolus Group, *urichii* and *anduzei* of the Urichii Subgroup and *bonnei* of the Iridesccens Complex, but it is probable that 1 or more members of the Antunesi Complex remain undiscovered here. South of the Amazon Basin the Bihaicolus Group and the Urichii Subgroup are absent and only 6 species or forms have been reported, all apparently derived precinctives, 3 in the Iridesccens Complex (*iridesccens*, sp. 8a, sp. 9a) and 3 in the Antunesi Complex (*soperi*, *antunesi*, *wilsoni*).

AFFINITIES. *Carrollia* has all the characteristics diagnostic of the genus *Culex* as currently interpreted: (1) in the **adults**, pulvilli developed; female genitalia with a short cercus; sidepiece of the male genitalia with a subapical lobe and para-proct with a crown of teeth; (2) in the **pupae**, hair 9-VIII sternal and removed from caudolateral angle; and (3) in the **larvae**, siphon with numerous accessory subventral tufts; ventral brush of anal segment strongly developed.

The relationship to the Melanoconion Section of *Culex* (subgenera *Aedinus*, *Anoedioporpa*, *Melanoconion*, *Micraedes*, *Microculex*, *Tinolestes*) is evident in the following features: (1) in the **adults**, vertex of head with at least an anterior border of broad scales; phallosome of the male genitalia with a simple "hooked" lateral plate; female with a cibarial dome; (2) in the **larvae**, siphon with distal accessory hairs reduced in size. The pupae of this section are not known sufficiently to distinguish them from other sections of the genus.

Carrollia shows some affinities also with other genera of the tribe Culicini. With *Deinocerites* it shares the retention of head hair 2-C and the similar differentiation of the distal accessory hairs of the siphon of the larva; and the presence of the cibarial dome in the female. The cibarial dome is also differentiated in *Galindomyia*, currently considered to be a distinct genus but probably merely an aberrant subgenus of *Culex* of the Melanoconion Section. Because of these annectent features, *Carrollia* appears to be an offshoot from a very primitive stock of the genus *Culex*.

Carrollia is differentiated from the other subgenera of *Culex*: (1) in the **adults** by the development of metallic spots on the femora of the legs and on the abdominal tergites, (2) in the **larvae** by the retention of hair 2-C on the head. As noted above, the pupae of other subgenera of the Melanoconion Section are too poorly known to establish distinguishing characters.

EVOLUTION. Although our present knowledge of the systematics, distribution, bionomics and affinities of *Carrollia* is fragmentary some general aspects of the evolution of the subgenus may be discerned.

The subgenus probably originated from a stock of the Melanoconion Section of *Culex* which possessed many primitive features, some apparently annectent with the genus *Deinocerites*. The place of origin was undoubtedly somewhere in the northern margin of the present South American continent, possibly at the northern end of the Andean Cordilleras, where all the groups, subgroups and complexes are presently found and where several relicts are known. Subsequent radiation appears to have occurred largely in the same general area.

The first division was undoubtedly into the Bihaicolus Group stock which retained primitive character states and the Iridesccens Group stock with derived features. The Bihaicolus Group stock probably occupied the west end of the distribu-

tion of the subgenus at that time and the Iridesccens Group stock the eastern part. The Iridesccens Group was then divided into the *Urichii* Subgroup stock, probably also in the west, and the Iridesccens Subgroup stock. The splitting of the *Bihaicolus* Group into the 2 complexes may have taken place at the same time. All these events were probably coincidental with major geologic changes in this unstable marginal continental area.

Subsequent radiation and speciation in the *Bihaicolus* Group (fig. 2) took place largely in the northwest corner of South America with a major invasion of Central America and only 1 penetration southward into the Guiana Shield and the Amazon Basin. The *Urichii* Subgroup (fig. 3), which retained a number of primitive features, expanded its range into the Guiana Shield and the Amazon Basin with only 1 derivative. The evolution of the highly derived Iridesccens Subgroup is not at all clear but it appears that the subgroup was fragmented into several phyletic lines, again in northern South America. Three of these lines, the Iridesccens Complex and the *Soperi* and *Antunesi* lines of the *Antunesi* Complex spread into South America south of the Amazon Basin.

Speciation in *Carrollia* appears to have occurred primarily by allopatric differentiation of populations. However, there are suggestions of introgression involved in the formation of some species, sp. 3a, sp. 9a, *soperi*, *cerqueirai* and possibly *kompfi*. The obligate association of *Carrollia* with humid forests has played a major part in the speciation and present distribution of the subgenus. These forests are now widely disjunct except in the Amazon Basin and their geographical and altitudinal distributions have undoubtedly varied in the past.

BIONOMICS

Species of *Carrollia* are silvan mosquitoes, restricted to humid areas of tropical, subtropical and cloud forests. The highly ornamented adults are diurnal in activity but have been seldom collected in nature as they are apparently not attracted to humans or to the baits used in traps. The immature stages are found in various types of container habitats, natural and artificial, but have been found occasionally in water on the ground, probably containing decaying leaves or other organic matter.

ADULTS. Practically nothing is known of the blood-feeding habits of females of *Carrollia*. The only record of feeding on humans is that of Levi-Castillo (1953c: 163) for *babahoyensis*. There are a few reports of collections of adults, presumably females, on humans or in animal-baited traps: *infoliatus* (Cerqueira, 1961: 136); *urichii* (Komp, 1936:64; Kumm and Novis, 1938:503, agouti baited; Cerqueira, 1961:136) and *soperi* (Antunes and Lane, 1937:22). A few species have also been found in unbaited traps, by sweeping, or collected in an unspecified manner as adults: *bihaicolus*; *infoliatus* (Antunes, 1937:79); *urichii*; *anduzei* (Barata and Cotrim, 1972:30); *bonnei*; *soperi* (Casal and Garcia, 1968:97).

IMMATURE STAGES. The recorded natural breeding sites of *Carrollia* include flower bracts of *Heliconia* and leaf axils of *Dieffenbachia* (both only for *bihaicolus*), leaf axils of bromeliads (for *iridesccens* only, Forattini, 1965:34); fallen leaves and spathes and fronds of palms (very frequently), fallen nuts and fruits (occasionally), treeholes and cut or broken bamboo (very frequently). Several species, especially dominant widespread ones, are often found in artificial containers of all types, wooden, metal, glass, rubber and even concrete and leather, and have also

been recovered from bamboo or wooden traps. There are a few records of breeding in ground waters: *urichii* (rockholes), *secundus* (ground seepage), *iridescens* (ground pools). The dominant species utilize a wide variety of habitats while the relict ones appear to be confined to only 1 or 2 natural types but are also sometimes found in artificial containers (*guerreroi*).

It is not uncommon to find several sympatric species of *Carrollia* breeding in the same habitat. These are usually members of different groups or subgroups but occasionally one finds members of the same complex together. Associated with species of *Carrollia* are many species of other groups of container breeders. At least 41 such associates have been recorded, representing nearly every sympatric group of container breeders: *Aedes (Howardina) ioliota* Dyar & Knab, 1913, *A. (Ochlerotatus) fluviatilis* (Lutz, 1904), *A. (Protomacleaya) daryi* Schick, 1970, *A. (P.) homoeopus* Dyar, 1922, *A. (P.) impostor* Schick, 1970, *A. (P.) insolitus* (Coquillett, 1906), *A. (P.) podographicus* Dyar & Knab, 1906, *A. (P.) terrens* (Walker, 1856); *Anopheles (A.) eiseni* Coquillett, 1902, *An. (Kerteszia) neivai* Howard, Dyar & Knab, 1913; *Culex (Anoedioporpa) conservator* Dyar & Knab, 1906, *C. (An.)* sp.; *Culex (C.) chidesteri* Dyar, 1921, *C. (C.) corniger* Theobald, 1903, *C. (C.) mollis* Dyar & Knab, 1906, *C. (C.) quinquefasciatus* Say, 1823, *C. (Lutzia)* sp., *C. (Melanoconion)* sp., *C. (Microculex) kukenan* Anduze, 1942, *C. (Microc.) stonei* Lane & Whitman, 1943; *Haemagogus (H.) iridicolor* Dyar, 1921, *H. (Stegoconops) equinus* Theobald, 1903, *H. (S.) soperi* Levi-Castillo 1955, *H. (S.) spegazzinii falco* Kumm, Osorno-Mesa & Boshell Manrique, 1946; *Limatus asulleptus* (Theobald, 1903), *L. durhamii* Theobald, 1901; *Orthopodomyia albicosta* (Lutz, 1904), *O. fascipes* (Coquillett, 1905); *Sabethes (Sabethinus) undosus* (Coquillett, 1906), *Sabethes* spp.; *Toxorhynchites (Lynchiella)* spp.; *Trichoprosopon (Ctenogoeldia) magnum* (Theobald, 1905), *T. (Runchomyia) ulopus* (Dyar & Knab, 1906), *T. (T.) digitatum* (Rondani, 1848), *T. (T.) pallidiventer* (Lutz, 1905); *Wyeomyia aporonoma* Dyar & Knab, 1906, *W. arthrostigma* (Lutz, 1905), *W. complosa* Dyar, 1928, *W. felicia* (Dyar & Nunez Tovar, 1927), *Wyeomyia* spp.; *Corethrella* spp.

TAXONOMIC TREATMENT

Subgenus *CARROLLIA* Lutz

1904. *Carrollia* Lutz, 1904:16. *Nomen nudum*.
 1905. *Carrollia* Lutz, 1905:81-82. TYPE SPECIES: *Carrollia iridescens* Lutz, 1905, Brazil; monobasic.
 1921. *Carrollella* Lutz, 1921:163. TYPE SPECIES: *Carrollia iridescens* Lutz, 1905, Brazil. Unjustified emendation of *Carrollia* Lutz, 1905 believed to be preoccupied by *Carollia* Gray, 1838, *Carolia* Cantraine, 1838 and *Carolia* Gray, 1867.

Culex (Carrollia) of Dyar (1918:108; 1925:176); Bonne-Wepster and Bonne (1920:170-171); Bonne and Bonne-Wepster (1925:196-207); Edwards (1932:220-221); Antunes and Ramos (1939:376-385); Lane (1939:81-83; 1953:496-514); Senevet and Abonnenc (1939:123-129; 1958:287-293); Lane and Whitman (1943:389-397); Cerqueira and Lane (1944:216-220); Stone and Knight (1957:44,53,58-59); Stone, Knight and Starcke (1959:282-283); Cerqueira (1961:136); Fauran (1961:44); Cova Garcia, Sutil and Rausseo (1966a:28,111-117; 1966b:42-44,84,141,231-235,343-344); Casal and Garcia (1968:97-98); Barata and Cotrim (1972:17-30).

Culex (*Carrollella*) of Dyar (1928:280-285); Komp (1936:64; 1956:39); Antunes (1937:78).
Carrollia of Theobald (1907:206-209; 1910:113); Peryassu (1908:34,44,167,169,343); Dyar and Knab (1909:101); Surcouf and Gonzales-Rincones (1911:144); Howard, Dyar and Knab (1915:461-466); Townsend (1934:489-490).
Carrollella of Martini (1931:217); Shannon (1931a:8; 1931b:137).
Carrollia of Blanchard (1905:634).
Mochlostyrax in part of Dyar and Knab (1906:223).
Melanoconion in part of Coquillett (1906:23).

FEMALES. Small to medium-sized; mesonotum light brown to dark brown or black; pleuron pale to dark; midfemur with 2 pale metallic spots, hindfemur and sometimes forefemur with 1 similar spot; tarsi all dark or hindtarsal segment 4 with broad basal pale ring (Urichii Subgroup); pregenital abdominal segments subcylindrical (Bihaicolus Group) or distinctly compressed, tergites II-VII with pale metallic lateral spots. Abdominal pale metallic spots basically silvery white with varying intensity of violet reflections; femoral markings silvery white to golden with similar iridescence. Dark scales of head, labium, palpus, legs and abdomen almost always with strong deep blue, greenish blue or purple metallic iridescence. *Head*: Eyes contiguous above antennal bases, interocular space not developed. Decumbent scales of vertex broad on an anterior transverse band of varying width, interrupted on midline in Urichii Subgroup; narrow decumbent scales in the middle posteriorly on vertex and on occiput or absent; no indication of a frontal tuft, rarely a pair of setae below interorbital bristles; orbital line without scales; a patch of broad decumbent light scales laterally continuous with band of broad decumbent scales of vertex. Erect scales forked, elongate; numerous to relatively few; extending to orbital bristles or confined to posterior part of vertex and occiput. One pair of strongly developed interorbital (frontal) bristles and a continuous row of shorter orbitals; a few very short hairs or hairlike scales sometimes present caudad of orbitals. Clypeus prominent, bare. Proboscis slender, distinctly shorter than abdomen; subequal to forefemur to distinctly longer; labium slightly dilated and flattened apically, dark scaled, sometimes with pale scales ventrally and rarely also dorsally; labellum small, with scales on basal part. Palpus usually short, 0.16-0.25 of proboscis, rarely nearly 0.5 (*kompi*); usually 3-segmented, sometimes with a minute apical 4th segment, palpifer not differentiated from basal segment; segment 3 elongate; all 3 segments with dark scales. Antenna subequal to proboscis or distinctly longer; scape poorly differentiated; torus (pedicel) normal, usually with 3-14 short setae on anterior mesal surface; flagellar segment 1 less than 1.5 of segment 2, with or without distinct submedian whorl of moderately long bristles; segments 2-13 subequal, with distinct basal whorl of 8-10 long bristles, progressively shorter on distal segments. *Thorax*: Mesonotal integument shiny, pigmentation varied from black to light brown; vestiture of linear to narrow curved scales varied from sparse to dense, usually dark but sometimes predominantly pale. Prescutellar space bare in distal half or less. Scutellar scales linear to broad, varied in color. Paratergite bare. Acrostichals usually absent on disc, a few short ones caudad of anterior promontory usually present, rarely (*infoliatius*) extending to level of scutal angle or even beyond but never reaching prescutellar space; dorsocentrals present (Bihaicolus Group) or absent on disc; humerals present; prescutals (fossals) present (Bihaicolus Group) or absent; prescutellars nearly always present; anteaalars and supraalars always present; scutellars strongly developed; 1 parascutellar bristle. Pleural integument pale, greenish or whitish, and dull (Bihaicolus Group), or

darkened in upper part and with a broad diagonal pruinose stripe extending from *ppn* to metapleuron, margined with dark below; scaling restricted. *Apn* with long and short bristles and sometimes broad dark scales; *ppn* with a few short upper bristles forming a more or less continuous line with stronger posterior bristles, upper part with or without narrow scales, lower always bare; *ppl* with a few strong bristles; *psp* usually bare, sometimes with a few broad or very narrow short pale scales; *pst* bare; *stp* with or without upper bristles, lower posterior bristles always present, scales present or absent; *pra* with a few bristles; 1 strong lower *mep* bristle (rarely absent) and several weaker upper *mep* bristles always present, scales usually absent; meron, metameron and metapleuron bare. *Legs*: Coxae with pale integument and largely pale scaling; forecoxa with large anterior patch of scales and a few bristles near lower margin, basolateral area with or without scales and bristles; midcoxa with anterolateral patch of scales and bristles; hindcoxa with anterolateral patch of scales and a few short bristles near lower margin, sometimes a separate smaller scale patch near base, posterior surface usually without scales but with a dorsoventral row of moderately strong bristles. Femora varied in length; forefemur usually distinctly shorter or subequal to proboscis; midfemur slightly swollen and longest; hindfemur more slender than others. Forefemur pale scaled at base for a varied distance; anterior surface dark scaled except for a few pale scales apically and sometimes a poorly differentiated pale metallic preapical spot (*Urichii* Subgroup); posterior surface varied from largely pale to largely dark. Midfemur pale scaled at base for varied distance; anterior surface dark scaled except sometimes for a few pale scales apically and always with 2 pale metallic spots near dorsal margin, 1 submedian and the other preapical, rarely the 2 spots connected by metallic streak; posterior surface usually largely dark. Hindfemur extensively pale at base; anterior surface with silvery white to pale golden ventral streak, remainder dark except for a light metallic subdorsal postmedian or preapical streak or elongate spot, sometimes connected to ventral light streak, usually a few apical pale scales; posterior surface pale scaled for variable distance from base. Knee spots poorly developed. Tibiae usually entirely dark scaled; midtibia slightly longer than others, hindtibia shortest. Tarsi entirely dark scaled or hindtarsal segment 4 with broad basal white or whitish ring (*Urichii* Subgroup); scaling rather shaggy; basal segment of foretarsus and midtarsus shorter than respective tibiae, that of hindtarsus slightly longer than hindtibia; segment 5 of foretarsus subequal to segment 4 or slightly shorter, that of midtarsus slightly shorter; segment 5 and to a lesser extent segment 4 of foretarsus and midtarsus with a large distal field of specialized plantar bristles; segment 5 of hindtarsus about 0.5 of segment 4; pretarsi small, not deeply inserted into tarsal segments 5; claws all simple, without basal spicules, those of foreleg and midleg moderate and subequal, those of hindleg much shorter; empodium spiculose; pulvilli short and spiculose. *Wing*: Membrane with conspicuous microtrichia. Veins entirely dark scaled; dorsally all veins with short broad squame scales except for long linear or relatively short narrow plume scales on R_s , R_{2+3} , M and sometimes on R_2 and R_3 (*Urichii* Subgroup). Base of vein R usually with a few (remigial) bristles; cell R_2 longer than its stem; vein $1A$ ending well distad of furcation of Cu ; plical vein without scales on base of ventral surface; fringe normal, dark; alula with even row of long hairlike scales only; upper calypter with even row of long bristles. *Haltere*: Stem pale; at least distal part of stem and all of knob with dark scales. *Abdomen*: Pregenital segments subcylindrical (*Bihaicolus* Group) or more or less distinctly compressed.

Tergite I with a more or less extensive scale patch dorsally; laterotergite with numerous hairs and often with a few broad scales. Tergites II-VII predominantly dark scaled and with conspicuous lateral light metallic spots of varied size and position; white or whitish basal transverse bands present only in Iridescens Subgroup; distal and lateral margins with bristles more prominent laterally. Sternites II-VII with pale scales only or IV-VII with apical dark bands; apical margins with long bristles. *Cibarial Armature*: Cibarial bar with a single row of 3-10 teeth rounded or truncate apically, and sometimes with filamentous spicules alternating with teeth; lateral flange slender, with or without projecting lobe. Cibarial dome strongly developed, with numerous closely packed minute imbricate denticles of varied shapes.

FEMALE GENITALIA. Small, inconspicuous. Segment VIII partially retracted into segment VII, densely covered with scales and bristles; sternite longer than tergite, caudal margin deeply emarginate, bristles moderately developed. Tergite IX narrow, poorly sclerotized except sometimes for basal margin; dorsolateral bristles always present. Cercus short and very broad, more or less rounded apically; with more or less numerous setae in distal part. Postgenital plate prominent, projecting beyond cercus; more or less rounded apically; with numerous setae, primarily distally; base of plate distant from cowl. Cowl strongly sclerotized, articulating laterally with tergite IX; atrial plate present (*Bihaiolus* Group) or absent. Sigma membranous, not differentiated. Insula largely membranous, with a patch of 15-30 setae. Spermathecae 3, very large and subequal.

MALES. Essentially similar to females except for usual sexual characters. Labium with false joint distad of middle; with or without long bristles near base and/or distally; often with pale scales ventrally. Palpus porrect, very slender, from 0.31 to nearly as long as proboscis; predominantly dark scaled but sometimes with pale scales on mesoventral surface of segment 3; segments 1 and 2 without scales ventrally; segments 4 and 5 with very few bristles. Antenna from slightly longer than proboscis to distinctly shorter; flagellar whorl bristles very long and numerous; flagellar segments 12 and 13 elongate, segment 13 slightly longer and with short, sparse basal whorl. Claws of foreleg and midleg enlarged and uneven; larger anterior claw of foreleg always and that of midleg sometimes (*Bihaiolus* Group, *Urichii* Subgroup) with a submedian tooth and with a very small pulvillus; posterior claw of foreleg and midleg always simple and without pulvillus; hindclaws small, simple and equal as in females but with very short pulvilli.

MALE GENITALIA. Small, inconspicuous; basic structure as in the Melanconion Section of the genus. *Segment VIII*: Deeply retracted into segment VII; proximal part poorly sclerotized and without setae or scales; distal part densely covered with scales. Tergite broader than long; caudal border rounded laterally, with or without median emargination; distal part with 3-6 or more rows of strong setae. Sternite usually subquadrate; caudal border truncate, with 1 complete and sometimes 1 or 2 additional incomplete rows of setae. *Segment IX*: Tergite short except laterally; connected to sternite by very narrow sclerotized bar; lobes approximated or widely separated, small, simple, conical or flattened and rounded, with 2-12 setae directly largely laterad. Sternite without setae; variously developed. *Sidepiece*: Elongate and conical to short and ovoid; scales present or absent; with or without conspicuous spicules. Dorsal surface with long bristles sparse, usually restricted to lateral half; usually a differentiated apicotergal seta near base of clasper. Ventral surface with numerous long bristles, many longer than clasper; frequently a small, rounded apicosternal process near base of clasp-

er, with long spicules and short setae. *Subapical Lobe*: Varied in position and development. Proximal division always present; always with an elongate columnar process bearing 2 flattened apical specialized setae (*a* and *b*) which are often contorted, and sometimes 1 differentiated subapical or apical relatively simple seta (*c*), additional setae sometimes present on stem and base of process. Distal division either: (1) completely absent, (2) represented by a small protuberance with 1 or 2 depressions but usually bare, or (3) a small lobe with 1 or more specialized apical setae adjacent to proximal division or widely separated from it. An accessory division frequently developed near base of proximal division as a simple long digitiform process, as a complex lobe with broad dorsal expansion or as 2 separate columnar processes. *Clasper*: Slender; strongly curved dorsad distally; shorter to longer than sidepiece. Various developed from simple and more or less uniform in width or gradually tapered to conspicuously modified with a narrow basal part and a distal head with an outer preapical curvature and/or a projecting inner preapical lobe. Snout always developed. Crest ridged or a flat sclerite. Three distal setae always developed; seta *a* (= spiniform) associated with beak, simple or thickened; seta *b* in normal position or on the inner lobe, simple, thickened or flattened, seta *c* in normal position and always simple. *Phallosome*: Aedeagus simple, composed of a pair of lateral plates with a submedian tergal bridge of varied degrees of sclerotization. Lateral plate with basal "hook"; distal part with or without sternal spine, external spine or caudal process. Paramere simple; basal piece complex. *Proctiger*: Strongly developed; basal part very broad, distal part narrowed, usually sharply. Paraproct sclerotization broad at base, with or without a mesal sternal lobe; distal part narrow; crown with a single row of a few flattened, usually blunt, teeth. Basolateral sclerotization crescentic, projecting conspicuously dorsad under lobe of tergite IX. Basal sternal process not developed. Cercal sclerite poorly developed, usually membranous; cercal setae 1-3 or absent.

PUPAE. *Cephalothorax*: Integumentary sculpturing tubercular. All hairs present, variously developed; 1-C moderate, single or double; 2,3-C approximated, subequal or 3-C longer; 4-C always shorter than 5-C, single to multiple; 5-C short to very long; 6,7-C approximated, 6-C always shorter and anterior; 8,9-C well caudad of trumpet base and moderately approximated. *Trumpet*: Not placed on distinct tubercle; inserted closer to wing base than middorsal line; short to very long; tracheoid in at least basal 0.25; pinna large to small, minute in *komp*. *Metanotum*: Integumentary sculpturing tubercular; hairs 10-12-C moderately developed, double to multiple. *Abdomen*: Integumentary sculpturing finely imbricate; spiracular sensilla (rudimentary spiracles) well developed. Most hairs with few branches or single. Hair 1-I (float hair) with 5-15 primary branches and 40-120 secondary branches, strongly pigmented, barbed or secondarily dendritic; 1-II always close to midline, frequently multiple; 1-III-VII removed laterad, usually weak, single or with a few branches, 1-III sometimes thickened and enlarged. Hair 2 always small and single; 2-II mesad or laterad of hair 3; hair 2-III-VII always mesad of hair 1. Hair 3-VI mesad or laterad of hair 1; hair 3-II,III often thickened and enlarged. Hair 5-IV,V nearly always long and single. Hair 6 poorly developed, single or branched. Hair 9-II-VI normal in position and single; 9-VII,VIII usually strongly developed. *Terminal Segments*: Hair 1-IX not developed. Median caudal lobe about half as long as broad. Female genital lobe subequal to or slightly longer than median caudal lobe; cercal lobe poorly differentiated. Male genital lobes (sidepieces) about twice as long as median caudal lobe.

Paddle: Usually ovate, always longer than broad; midrib well developed; external buttress moderately developed; external margin with weak short spicules on external buttress, remainder and all of inner margin usually without distinct spicules. Hair 1-P weak, single or double, rarely absent; 2-P usually absent.

FOURTH INSTAR LARVAE. *Head*: Head capsule subquadrate; usually slightly wider than long and usually widest just caudad of antenna; ocular bulge not developed; ventral surface flat, anterior dorsal surface moderately convex (*Bihai- colus* Group) or flat (*Iridescens* Group); integument smooth or finely sculptured. Labrum poorly differentiated dorsally, its anterior margin slightly concave; mental plate normal, with 8-11 teeth on each side of median tooth; labial plate very long and narrowed anteriorly; maxillary suture complete, projecting caudad of posterior tentorial pit but not reaching collar; collar poorly developed. Mouth-brushes with numerous filaments, some pectinate; mandible and maxilla normal. Hair 0-C in normal position, simple; 1-C arising from a lateral process of labrum, strongly developed and pigmented, usually curved ventromesad; 2-C always developed and single; 3-C nearly always absent but rarely represented by a spicule; 4-6-C always in anterior 0.3 of head capsule; 4-C short and usually multiple; 5,6-C both moderately long and barbed, 5-C always multiple and usually shorter than 6-C, latter usually with 2 or 3 branches, rarely single or multiple; 7-C multiple, usually barbed, shorter than 5,6-C; hairs 8,10-C in normal position; 9-C normal in development and position near level of 8,10-C (*Bihai- colus* Group) or removed far caudad to near collar and more or less stellate; 11-C short, with few to numerous branches, removed far caudad ventrally from antennal base; 12-C long, single or double; 13-C long, always single; 14,15-C short, with a few branches or single, position varied; 16,17-C not developed. Maxillary hair 5-MP a simple bristle near apex (*Bihai- colus* Group) or greatly thickened, brush-tipped and arising near the middle of maxilla; 6-MP short, single or branched. *Antenna*: About 0.30-0.60 of head capsule length; shaft very slender and nearly uniform in diameter, straight or slightly curved mesad; integument smooth or with very minute inconspicuous spicules (exaggerated in figs.). Hair 1-A inserted usually in middle third of shaft, short, not reaching apex of shaft, branches few or rarely absent; 2-6-A short, not markedly modified. *Thorax*: Integument smooth or with spicules in anterior part of prothorax. All hairs present except 13-P. Prothorax: hair 0-P very short to moderate, always multiple, sometimes dendritic or sub-stellate; 1-3-P on strongly developed common tubercle; 1-P long, usually single; 2-P usually distinctly shorter than 1-P but sometimes subequal, single or branched; 3-P always shorter than 1-P, from 0.25 to about 0.67, and usually branched; 4-7-P all strongly developed, usually all on separate tubercles but those of 5,6-P sometimes fused, 5-P always and 6-P nearly always single; 8-P varied in development, with or without tubercle; prothoracic pleural group normal, 9,10-P single or with a few branches; 12-P nearly always single; 14-P usually single. Mesothorax: hairs 1-4-M relatively weak, without tubercles, 3-M usually longest; 5-M always single, very strong and with tubercle; 6,7-M both very strong and nearly always single, on common tubercle; 8-M very strong and multiple on large tubercle; mesothoracic pleural group normal, 9-M always multiple, 10-M nearly always single, 12-M always single; 13-M always short, multiple or dendritic; 14-M short and multiple to more or less stellate. Metathorax: hairs 1-6-T relatively poorly developed, without tubercles; 5,6-T nearly always single; 7-T very strong, multiple and with large tubercle; 8-T short and dendritic; metathoracic pleural group normal, tubercle with short or long spines, 9-T double to multiple, 10-T

nearly always and 12-T always single; 13-T varied, short dendritic, more or less stellate, or long and single. *Abdomen*: Integument without spicules. Chaetotaxy normal for genus. Hair 1-II minute to large, 1-III-VI usually strongest dorsal hair of its segment and single to multiple, 1-VII very strongly developed and surpassing base of siphon; 3-II-V sometimes strongly developed; 6-I-VI all strong, 6-I, II always branched, 6-III-V single or double, 6-VI always single; 6-VII short, usually dendritic; 7-I similar to 6-I and single or double, 7-II-VI usually all short and multiple, 7-II rarely long and single (*kompi*); 13-I small and with few branches, 13-II,VI,VII short dendritic or multiple, 13-III-V usually strongly developed and subequal to hair 1-III-V; other hairs usually small and weak. *Segment VIII*: Comb varied; scales short, spatulate, apically fringed and in a patch (Bihaicolus Group) or spinelike and in 1 more or less regular row. Hair 1-VIII always multiple, short to moderate; 2,4-VIII long and thin, 4-VIII always and 2-VIII nearly always single; 3-VIII strongly developed, multiple, barbed; 5-VIII moderately strong, usually barbed. *Siphon*: Short to long; index varied from about 2.2 to about 12.0; integumentary sculpturing imbricate, with indistinct to rather conspicuous fine spicules; usually darkened on basal ring; acus present, attached; valves short; tracheae large; stirrup-shaped piece short, simple; median caudal filament apparently not developed. Pecten restricted to basal 0.5; teeth short, broad, with or without denticles or fringes, or elongate, spinelike and with or without marginal fringe. Siphonal hairs 1,1a-S arranged in an irregular double row of 8-16 long, strong, usually multiple barbed ventral tufts and 2 very short multiple accessory tufts, 1 lateral (1ad) and the other subventral (1av); occasionally a third small subventral tuft present; 2-S short, simple, single, arising from membrane distad of sclerotized part of siphon; 6,7,9-S simple and short; 8-S short and branched. *Anal Segment*: Saddle completely ringing segment, short, acus not developed; integument smooth or finely imbricate; spicules when present restricted to caudolateral angle. Gills equal; varied from short and rounded to long, pointed or rounded. Hair 1-X varied, single and moderate or multiple and short; 2-X always strong and branched; 3-X always strong and single; 4-X (ventral brush) strongly developed, hairs all on poorly developed grid without lateral bar, varying from 4-6 pairs, single to multiple.

KEYS TO GROUPS AND SPECIES

ADULTS

(Females of *3a. Panama form*, *14. cerqueirai* and *15. wilsoni* unknown;
8a. Bahia form and *9a. Espirito Santo form* not included)

1. Pleuron pale, whitish to greenish, and without broad diagonal pruinose stripe; dorsocentral bristles strongly developed on disc of mesonotum (Bihaicolus Group) 2
 - Pleuron darkened to near base of coxae and with a broad diagonal pruinose stripe from *ppn* to metapleuron; dorsocentral bristles not developed on disc of mesonotum (Iridescens Group) 9
- Bihaicolus Group
- 2(1). Proboscis about 1.5 of forefemur 2. *guerreroi*
 - Proboscis 1.3 or less of forefemur 3

- 3(2). Hindfemur with light metallic streak very narrow, at least 0.25 of femur length and confluent with light scaling anteriorly and/or posteriorly. **5. infoliatius**
 Hindfemur with short discrete streak, moderately broad, 0.15 or less of femur length and not connected to light scaling anteriorly or posteriorly 4
- 4(3). Males (see also Key to Male Genitalia) 5
 Females (separation of species tenuous) 7
- 5(4). Palpus about 0.33 of proboscis length **3. rausseoi**
 Palpus 0.7 or more of proboscis length 6
- 6(5). Abdominal sternites all uniformly pale scaled **1. bihaicolus**
 Abdominal sternites IV-VII with conspicuous apical dark bands
 **4. metempsythus**
- 7(4). Abdominal sternites IV-VII with distinct apical dark bands; large cibarial teeth more than 8 **4. metempsythus**
 Abdominal sternites all uniformly pale scaled or distal with only a few apical dark scales not forming distinct bands; large cibarial teeth fewer than 6 8
- 8(7). Erect scales of vertex of head yellowish to white; abdominal sternites entirely pale scaled; flange of cibarial bar with conspicuous lobe
 **1. bihaicolus**
 Erect scales of vertex of head dark; abdominal sternites V-VII usually with some apical dark scales; flange of cibarial bar without conspicuous lobe **3. rausseoi**

Iridescens Group

- 9(1). Hindtarsal segment 4 with a broad basal white or whitish ring; upper *stp* with 3 or 4 bristles (*Urichii* Subgroup) 10
 Hindtarsal segment 4 entirely dark scaled; upper *stp* without bristles (*Iridescens* Subgroup) 11

Urichii Subgroup

- 10(9). Males See Key to Male Genitalia
 Females **6. urichii; 7. anduzei**

Iridescens Subgroup

- 11(9). Long slender erect scales present on anterior part of vertex to near orbital bristles; narrow decumbent scales numerous 12
 Anterior part of vertex without erect scales, these confined to posterior part and/or occiput; narrow decumbent scales few or absent 14
- 12(11). Midlobe of scutellum with short broad dark scales in addition to a few linear scales; male labium without long hairs distad of false joint **8. bonnei**
 Midlobe of scutellum with linear or long moderately wide curved scales; male labium with at least 1 pair of long hairs distad of false joint 13

- 13(12). Midlobe of scutellum with linear dark scales; mesonotal vestiture predominantly dark bronzy on disc; male labium with a single pair of long subapical hairs; male palpus entirely dark scaled . . . *9. secundus*
 Midlobe of scutellum with long moderately wide curved pale scales; mesonotal vestiture predominantly light bronzy to dark coppery on disc; male labium with numerous long hairs distad of false joint; male palpus with white scaled line on ventromesal surface . . . *10. iridescens*
- 14(11). Lateral lobe of scutellum with linear scales *11. soperi*
 Lateral lobe with broad scales 15
- 15(14). Females 16
 Males (separation of species tenuous; see Key to Male Genitalia). . . 18
- 16(15). Palpus about 0.45-0.50 of proboscis; a pair of short setae below interorbital bristles *16. kompi*
 Palpus about 0.19-0.22 of proboscis; no setae below interorbital bristles (separation of species very tenuous) 17
- 17(16). Mesonotal and pleural integument black or very dark brown; lower edge of dark part of pleuron sharply marked off on sternopleuron
 *12. babahoyensis*
 Mesonotal and pleural integument light brown to dark brown; lower edge of dark part of pleuron not sharply marked off on sternopleuron *13. antunesi*
- 18(15). A pair of short setae below interorbital bristles *16. kompi*
 No setae below interorbital bristles 19
- 19(18). Mesonotal and pleural integument black or very dark brown; lower edge of dark part of pleuron sharply marked off on sternopleuron
 *12. babahoyensis*
 Mesonotal and pleural integument light brown to dark brown; lower edge of dark part of pleuron not sharply marked off on sternopleuron 20
- 20(19). Lower surface of labium uniformly distinctly whitish from base to near apex *15. wilsoni*
 Lower surface of labium indistinctly pale, usually only on distal part *13. antunesi; 14. cerqueirai*

MALE GENITALIA

(*3a. Panama form* unknown; *8a. Bahia form* and *9a. Espirito Santo form* not included)

1. Lateral plate of phallosome with subapical external spine, its apex without long caudal process; clasper simple, seta *b* in normal position (Bihaiocolus Group) 2
 Lateral plate of phallosome without subapical external spine, its apex developed as a long caudal process; clasper apex modified, seta *b* displaced apically or on a prominent lobe (Iridescens Group) 6

Bihaiocolus Group

- 2(1). Subapical lobe of sidepiece without any indication of a distal division. . 3
 Subapical lobe of sidepiece with distal division represented by at least
 1 specialized seta arising from a process 4
- 3(2). Subapical lobe of sidepiece with more than 30 long setae on stem and
 base of proximal division; distal part of proctiger parallel-sided in dor-
 sal aspect; cercal setae present **5. infoliatius**
 Subapical lobe of sidepiece with about 15 short setae on stem and base
 of proximal lobe; distal part of proctiger tapering in dorsal aspect;
 cercal setae absent **4. metempysytus**
- 4(2). Distal division of subapical lobe of sidepiece relatively broad and with
 2 specialized setae with recurved apex **1. bihaiocolus**
 Distal division of subapical lobe of sidepiece represented by a slender
 fingerlike process with only 1 specialized seta with simple apex . . . 5
- 5(4). Snout of clasper longer than seta *a* (spiniform); specialized setae *a* and *b*
 of proximal division of subapical lobe unequal in size and relatively
 simple, seta *c* not differentiated **3. rausseoi**
 Snout of clasper shorter than seta *a* (spiniform); specialized setae *a* and
b of proximal division of subapical lobe subequal and highly contorted,
 seta *c* differentiated **2. guerreroi**

Iridescens Group

- 6(1). Distal division of subapical lobe of sidepiece distinctly developed and
 widely separated from proximal division, accessory division not de-
 veloped; caudal process of lateral plate of phallosome curved ventrad
 distally; seta *b* of clasper simple, not thickened or flattened (Urichii
 Subgroup) 7
 Distal division of subapical lobe of sidepiece represented by a small
 tubercle or apparently completely absent, accessory division develop-
 ed near base of proximal division; caudal process of lateral plate of
 phallosome straight or curved laterad distally; seta *b* of clasper thick-
 ened or flattened (Iridescens Subgroup) 8

Urichii Subgroup

- 7(6). Distal division of subapical lobe with 4 specialized flattened setae on
 a process and a group of about 6-20 specialized flattened setae proxi-
 mad of process **6. urichii**
 Distal division of subapical lobe with only 1 specialized bristlelike seta
 on digitiform process **7. anduzei**

Iridescens Subgroup

- 8(6). Clasper with strongly differentiated elongate spiculose preapical lobe with
 flattened seta *b*; lateral plate of phallosome without sternal spine . . 9
 Clasper with poorly differentiated broad nonspiculose preapical lobe with
 thickened seta *b*; lateral plate of phallosome with sternal spine . . 11

- 9(8). Accessory division of subapical lobe of sidepiece long columnar and with 4 apical or preapical elongate flattened specialized setae . . . *8. bonnei*
 Accessory division of subapical lobe of sidepiece not columnar and without flattened specialized setae 10
- 10(9). Accessory division of subapical lobe distinctly separated from proximal division, digitiform and with 1 specialized bristlelike apical seta and a few simple setae at base; apicotergal specialized seta of sidepiece not developed *9. secundus*
 Accessory division of subapical lobe very broad and joined to proximal division, with several apical marginal setae; apicotergal specialized seta of sidepiece developed *10. iridescens*
- 11(8). Accessory division of subapical lobe composed of 2 widely separated columnar processes *16. kompi*
 Accessory division of subapical lobe consisting of a single, simple or complex process 12
- 12(11). Accessory division of subapical lobe complex, with large dorsal expanded process 13
 Accessory division of subapical lobe digitiform, without dorsal expansion 14
- 13(12). Sidepiece short, subovate; dorsal process of accessory division of subapical lobe with flattened specialized setae *11. soperi*
 Sidepiece elongate, subcylindrical; dorsal process of accessory division of subapical lobe with very long simple bristles . . . *12. babahoyensis*
- 14(12). Accessory division of subapical lobe without setae *13. antunesi*
 Accessory division of subapical lobe with setae 15
- 15(14). Accessory division of subapical lobe with no more than 16 setae, largely in distal half *14. cerqueirai*
 Accessory division of subapical lobe with at least 24 setae, extending into basal third *15. wilsoni*

PUPAE

(*3a. Panama form* and *8a. Bahia form* unknown;
9a. Espirito Santo form not included)

1. Abdominal hair 2-II laterad of 3-II; hair 3-VI mesad of 1-VI (Bihaicolus Group) 2
 Abdominal hair 2-II mesad of 3-II; hair 3-VI laterad of 1-VI (Iridescens Group) 4
- Bihaicolus Group
- 2(1). Abdominal hairs 6-III-V usually all branched
 *2. guerreroi*; *3. rausseoi*; *4. metempsytus*
 Abdominal hairs 6-III-V usually all single 3

- 3(2). Abdominal hair 5-VI weak, shorter than 4-VI; hair 1-IV about twice as long as 3-IV *1. bihaicolus*
 Abdominal hair 5-VI strong, longer than 4-VI; hair 1-IV subequal to 3-IV *5. infoliatius*

Iridescens Group

- 4(1). Cephalothoracic hair 5-C strong, at least 0.67 of trumpet length (Urichii Subgroup) 5
 Cephalothoracic hair 5-C weak, usually only 0.5 of trumpet length or shorter (Iridescens Subgroup) 6

Urichii Subgroup

- 5(4). Abdominal hair 5-VI relatively weak and short, not extending beyond caudal border of tergite VII *6. urichii*
 Abdominal hair 5-VI very strong and long, extending well beyond caudal border of tergite VII *7. anduzei*

Iridescens Subgroup

- 6(4). Trumpet fusiform, with minute pinna; abdominal hair 9-VIII more than twice as long as paddle *16. kompi*
 Trumpet truncate apically, with normal pinna; abdominal hair 9-VIII at most slightly longer than paddle 7

- 7(6). Trumpet index at least 15.0 *15. wilsoni*
 Trumpet index less than 14.0 8

- 8(7). Trumpet strongly flared apically and with broad meatus . . *14. cerqueirai*
 Trumpet at most only slightly flared apically, meatus moderate . . . 9

- 9(8). Trumpet index 10.0 or more
 *9. secundus; 12. babahoyensis; 13. antunesi*
 Trumpet index less than 8.0 10

- 10(9). Abdominal hair 9-VII weak and without barbs *11. soperi*
 Abdominal hair 9-VII strong and barbed 11

- 11(10). Abdominal hairs 5-IV,V relatively short, not reaching caudal border of next tergite *10. iridescens*
 Abdominal hairs 5-IV,V very long, extending well beyond caudal border of next tergite *8. bonnei*

FOURTH INSTAR LARVAE

(8a. Bahia form and 9a. Espirito Santo form not included)

1. Head hair 9-C short, inconspicuous, normal in position at level of 10-C; comb scales apically fringed, more or less spatulate, and arranged in a patch of 2-5 irregular rows (*Bihaicolus* Group) 2

Head hair 9-C large, conspicuous, near collar; comb scales elongate, spine-like, and arranged in 1 more or less regular row, rarely a few scales displaced into second row (Iridescens Group) 7

Bihaicolus Group

- 2(1). Ventral brush with at least 12 hairs, the majority except the proximal pair usually single. 3
 Ventral brush usually with 10 hairs, rarely with 11, the majority branched 4
- 3(2). Siphonal hair lad-S in proximal half of siphon *3. rausseoi*
 Siphonal hair lad-S in distal half of siphon *3a. Panama form*
- 4(2). Abdominal hairs 6-III-V all single. 5
 Abdominal hairs 6-III-V usually all branched 6
- 5(4). Head hair 6-C single *1. bihaicolus*
 Head hair 6-C double or triple *5. infoliatius*
- 6(4). Anal saddle with unsclerotized area on caudolateral border; metathoracic hair 3-T usually double or triple; abdominal hair 3-III usually single or double *2. guerreroi*
 Anal saddle completely sclerotized on caudolateral border; metathoracic hair 3-T usually with at least 5 branches; abdominal hair 3-III usually at least triple *4. metempysytus*

Iridescens Group

- 7(1). Ventral brush with at least 5 pairs of hairs, usually with 6 pairs; prothoracic hair 8-P similar in development to 7-P, usually double or triple (Urichii Subgroup) 8
 Ventral brush with 4 pairs of hairs, rarely with 9 hairs; prothoracic hair 8-P different in development from 7-P, multiple, weak or stellate (Iridescens Subgroup) 9

Urichii Subgroup

- 8(7). Siphon with at least 7 pairs of ventral tufts, usually with 8 pairs or 15 hairs; abdominal hair 1-IV reaching level of rudimentary spiracle of segment VI *6. urichii*
 Siphon with 6 pairs of ventral tufts; abdominal hair 1-IV shorter, not reaching posterior border of segment V *7. anduzei*

Iridescens Subgroup

- 9(7). Abdominal hair 7-II long, similar in development to 7-I *16. kompi*
 Abdominal hair 7-II short, weak, different in development from 7-I 10
- 10(9). Abdominal hairs 6-III-V apparently all double. *11. soperi*
 Abdominal hairs 6-III-V predominantly single 11
- 11(10). Pecten teeth apparently with distinct marginal denticles *10. iridescens*
 Pecten teeth with indistinct marginal spicules or spinelike 12

- 12(11). Abdominal hair 1-VII single; prothoracic hair 8-P weak, its branches smooth, its basal tubercle small; pecten teeth broad and with indistinct marginal spicules 13
 Abdominal hair 1-VII usually double; prothoracic hair 8-P strong, its branches barbed, its basal tubercle large; pecten teeth largely spinelike 14
- 13(12). Siphon index usually less than 4.0; head hair 1-C very long and slender and curved mesad on apex *8. bonnei*
 Siphon index usually more than 6.0; head hair 1-C shorter, stouter and curved mesad near base *9. secundus*
- 14(12). Siphon index more than 9.0 *15. wilsoni*
 Siphon index less than 6.0 15
- 15(14). Head hair 5-C usually with about 15 branches; 7-C with about 10 branches *14. cerqueirai*
 Head hair 5-C usually with less than 10 branches; 7-C with less than 6 branches 16
- 16(15). Prothoracic hair 8-P usually with 14 or more branches . . . *13. antunesi*
 Prothoracic hair 8-P usually with not more than 12 branches
 *12. babahoyensis*

BIHAICOLUS GROUP

FEMALES. *Head:* Band of broad decumbent scales of vertex complete, narrow or moderately broad; narrow decumbent scales of vertex and occiput very numerous; erect scales very long and numerous, reaching orbital bristles. Proboscis at least as long as forefemur, usually longer, 1.0-1.7. Palpus not more than 0.25 of proboscis. Antenna shorter than proboscis. *Thorax:* Mesonotal integument light brown to black; vestiture of dark bronzy linear, only slightly curved scales sparse throughout, inner dorsocentral line bare to beyond distal half. Scutellar scales all linear as on mesonotum. Anterior acrostichals sometimes developed on disc. Anterior and posterior dorsocentral and prescutellar bristles all well developed and in a continuous line; prescutals present. Pleural integument always light, greenish or whitish. Upper *stp* bristles strong and in a curved row joining lower bristles. *Legs:* Hindtarsus entirely dark scaled. Segments 5 and 4 of foretarsus and midtarsus with an apical field of plantar bristles. *Wing:* Plume scales long and linear, present on R_2 and R_3 as well as on R_s , R_{2+3} and M . *Abdomen:* Pregenital segments subcylindrical; tergites without basal dorsal light bands. *Cibarial Armature:* Denticles of cibarial dome triangular, rounded or trifid.

MALES. General characters as in the females. Proboscis distinctly longer than forefemur. Palpus and antenna shorter than proboscis, former as short as 0.33 (*rausseoi*). Anterior claw of both foretarsus and midtarsus with premedian tooth. Plantar bristles of foretarsus and midtarsus not developed.

MALE GENITALIA. *Segment VIII:* Tergite without median emargination; with 4 or 5 rows of setae. Sternite with 2 incomplete rows of setae distally. *Segment IX:* Tergite largely membranous dorsally; lobes widely separated, more or less

conical. Sternite long but without sclerotized caudal projection between sidepieces. *Sidepiece*: Conical, mesal surface usually concave. Apicosternal process poorly developed. *Subapical Lobe*: Accessory division not developed. Distal division small and approximated to proximal or absent. *Clasper*: Simple, without differentiated head; shorter than sidepiece; only moderately curved dorsad; parallel-sided or slightly tapered to apex. Preapical lobe not developed; seta *a* developed as normal thickened spiniform; seta *b* simple, in normal position. Crest ridged. *Lateral Plate*: Broad; sternal and external spines both developed; caudal process not developed. *Proctiger*: Paraproct sclerotization without mesal sternal lobe.

PUPAE. Cephalothoracic hair 5-C always very strong and at least as long as trumpet. Trumpet short, index usually less than 7.0; pinna always large. Abdominal hair 2-II laterad of 3-II; hair 3-VI mesad of 1-VI; hair 3-II always weak; 1-III always strong and longest hair of segment and 3-III always weak; 5-VI usually weak.

LARVAE. Head capsule with anterior dorsal surface moderately convex so that hairs 5,6-C appear anterior to antennal base in dorsal aspect; integument without sculpturing visible at 100X; hair 9-C normal in development and position near level of 8,10-C; hair 12-C about halfway between antennal base and collar; 14-C near anterior ventral border of head capsule. Maxillary hair 5-MP a simple bristle. Anterior part of prothorax without spicules; prothoracic hair 0-P always short or minute, 8-P varied; mesothoracic hair 14-M very small and dendritic; metathoracic hair 13-T short and multiple. Abdominal hair 1-II short or minute; 3-VI usually moderate, single to quadruple; 11-I with a few branches. Comb scales short, apically fringed, more or less spatulate, and arranged in a patch of 2-5 rows; hair 1-VIII varied in development. Integument of siphon without elongate spicules visible at 100X; pecten teeth scalelike or spinelike; ventral siphonal tufts usually 5 or 6 pairs; siphon index usually less than 4.0. Hair 1-X branched; 2-X with a few subequal branches; ventral brush usually with 5 or 6 pairs of hairs.

DISCUSSION. Nearly every character state listed above for all stages in the diagnosis of the group represents the primitive condition for the subgenus, as determined in the chapter on taxonomic characters. Within the group itself some features show derived states as indicated by their range of expression. The group occupies the northernmost portion of the known distribution of *Carrollia*, extending into southeastern Mexico in the north and with a southern limit in the Amazon Basin.

The group is so compact that there is no justification for dividing it into subgroups. However, solely on the development of the subapical lobe of the male genitalia, 2 phyletic lines may be recognized: the Bihaiolus Complex of 3 species and the Infoliatius Complex of 2 species. This division is supported to some extent by the ornamentation of abdominal sternites III-VII. The unnamed Panama form (sp. 3a), known in the larval stage only, cannot be placed with certainty in either complex at this time.

The Bihaiolus Complex is characterized by the retention of the distal division and a relatively short proximal division in the subapical lobe. These are undoubtedly primitive character states and on this basis as well as the presence of 6 pairs of hairs in the ventral brush of the larva of *rausseoi*, the Bihaiolus Complex can be considered closer to the original stock of *Carrollia* than the Infoliatius Complex. Abdominal sternites III-VII are either light or with only scattered apical dark scales. The Bihaiolus Complex is more northern in distribution, not

reaching the Amazon Basin, but included entirely in its central range is *metempsytytus* of the *Infoliatius* Complex. Two of the species, *guerreroi* and *rausseoi*, are relicts with very restricted known distributions in the coastal range of north-central Venezuela and *bihaicolus* is the dominant derived form with a distribution encompassing the entire range of the complex.

The *Infoliatius* Complex is characterized by the loss of the distal division and the elongation of the proximal division of the subapical lobe, both derived states. Abdominal sternites III-VII have distinct apical dark bands. The distribution of the complex is more southern and the 2 species are completely allopatric; *metempsytytus*, as noted above, occurring entirely within the central range of the *Bihai-colus* Complex, and *infoliatius* occupying an extensive area in the Orinoco Basin, the Guianas and the Amazon Basin. *Culex infoliatius* exhibits more derived states than *metempsytytus*, particularly in the development of the metallic streak on the hindfemur (unique in the group), and in the reduction in the branching of hair 6 on abdominal segments III-V of both the larva and the pupa (shared with *bihaicolus*). On this basis it appears to be the most derived species in the entire *Bihai-colus* Group.

As noted on page 38, the Panama form (sp. 3a) shows some resemblance to *rausseoi* and possibly introgression with *metempsytytus*. This form may prove to be an annectent relict between the 2 complexes or a relict of either complex.

Although male genitalic characters distinguish the 2 complexes and are diagnostic of every species in the group, the separation of the species in other stages is rather tenuous. In the keys to these stages I have had to use diagnostic features rather than phyletic ones as the latter are either not apparent or difficult to interpret.

On external features of the adults, only *guerreroi* and *infoliatius* are readily diagnosed in both sexes and *rausseoi* in the male, as indicated in the key. In the pupal stage, *guerreroi*, *rausseoi* and *metempsytytus* are apparently indistinguishable and the key characters for the separation of *bihaicolus* from *infoliatius* are not entirely reliable. The separation of the fourth instar larvae is equally difficult.

The close resemblance of the adults in external features has been responsible for many misidentifications of *bihaicolus*, *metempsytytus* and *infoliatius* by several investigators in the past.

The group as a whole shows nearly the entire range of breeding sites known for the subgenus. The dominant species (*bihaicolus*, *metempsytytus*, *infoliatius*) have a broad spectrum of breeding sites and the relict ones (*guerreroi*, *rausseoi* and sp. 3a) appear to be restricted to 1 or 2 types. The only records of adults collected in nature are 1 female and 2 males of *bihaicolus*, and 2 males and an unspecified number of females of *infoliatius*, the latter attracted to human or animal bait.

1. *Culex (Car.) bihaicolus* Dyar & Nunez Tovar

Figs. 2,6,9-11

1927. *Culex (Carrollia) bihaicolus* Dyar and Nunez Tovar, 1927:4-5; 1928:91. TYPE: **Lectotype by present designation**, male, 1 of 4 specimens bearing type labels, Ocumare de la Costa [incorrectly Maracay], Aragua, Venezuela, 5 July 1927, M. Nunez Tovar [USNM]. Contrary to the interpretation of Stone and Knight (1957:44) the 4 specimens bearing the blank printed type labels and handwritten labels "Bihai" are un-

doubtedly syntypes which were incorrectly labelled Maracay, the city of residence of Nunez Tovar where they may have been reared from larvae collected in Ocumare de la Costa. That Nunez Tovar was in Ocumare de la Costa on 5 July 1927 is documented by 2 specimens of *Deinocerites melanophylum* Dyar & Knab, 1907 bearing these data (Belkin and Hogue, 1959:434). Other material collected by Nunez Tovar in various localities in Venezuela is similarly mislabelled Maracay in the USNM, including 4 specimens of *D. melanophylum* (loc. cit.).

Culex (Carrollia) bihaicolus of Edwards (1932:221); Galindo, Carpenter and Trapido (1951: 104,105,111,113,126); Levi-Castillo (1952:553; 1953a:35); Galindo and Blanton (1955:73); Vargas (1956:24); Stone and Knight (1957:44); Stone, Knight and Starcke (1959:282); Belkin, Schick and Heinemann (1965:76); Cova Garcia, Sutil and Rausseo (1966a:28,117; 1966b: 42,84,141,233,343); Barreto and Lee (1969:433); Cova Garcia, Sutil and Pulido (1971:205).

Culex (Carrollia) bihaicolus in part of Lane (1939:81; 1953:509).

Culex (Carrollella) bihaicolus of Dyar (1928:284,285,534).

Culex (Carrollella) infoliatius in part of Komp (1936:64; 1956:39).

FEMALE (figs. 6,9). Wing: 3.7 mm. Proboscis: 2.7 mm. Forefemur: 2.2 mm. Abdomen: about 3.2 mm. In general similar to other species of group, especially *guerreroi* and *rausseoi*; diagnostic characters as in the key. General characters as for the group; description based on 18 topotypic and 30 other specimens from Venezuela. **Head:** Band of broad decumbent scales of vertex relatively narrow, scales coppery with bluish to greenish iridescence; narrow decumbent scales yellowish white, very numerous; erect scales yellowish white, concolorous with narrow decumbent scales; lateral patch of scales silvery with light bluish iridescence. Proboscis 1.04-1.23 of forefemur. Labium entirely dark, scales dark brown to black and with bluish green iridescence. Palpus 0.23-0.25 of proboscis; scales similar to those of labium. Antenna 0.89-0.91 of proboscis; torus with 15-20 setae. **Thorax:** Mesonotal integument dark brown, strongly contrasting with light greenish pleuron. Anterior promontory with 2 or 3 bristles; prescutal bristles 5 or 6; all mesonotal bristles dark. Midlobe of scutellum with 6-8 long bristles and numerous dark linear scales. *Apn* with 10-15 bristles; *ppn* with 4 or 5 narrow dark scales and 4-6 posterior bristles; *ppl* bristles 5 or 6; *stp* with about 15 bristles in curved line; *pra* bristles 8-10; *umep* bristles 5. **Legs:** Coxal scales whitish. Forefemur pale scaled to apex of ventral surface and with pale line on dorsal margin extending to about 0.5 from base; without light metallic spot. Midfemur pale scaled at extreme base only, chiefly on posterior surface; light metallic spots small and discrete. Hindfemur pale scaled ventrally on both anterior and posterior surfaces to about 0.5-0.6 from base; light metallic marking elongate, about 0.15 of femur length, discrete, not connected to ventral pale scaling. Knee spots slightly indicated by a few pale scales on apex of all femora. **Abdomen:** Light metallic spots of tergites large, with pale violet iridescence, basal on II-V and submedian on VI, VII; marginal bristles of tergites golden. Sternites uniformly light golden, without apical dark bands or scales; apical bristles golden. **Cibarial Armature:** Cibarial bar with rounded lobe on lateral flange; cibarial teeth 3-5; cibarial dome with trifid denticles. **Genitalia:** Tergite IX with 3 or 4 lateral bristles; insula with 10-15.

MALE (fig. 6). Wing: 3.2 mm. Proboscis: 2.5 mm. Forefemur: 2.0 mm. Abdomen: about 2.5 mm. In general similar to other species of the group; diagnostic characters as in the key. Essentially similar to the female except for sexual differences and more prominent knee spots. Description based on 10 topotypic and 26 other specimens from Venezuela. Palpus 0.76-0.83 of proboscis length; 3 or 4 con-

spicuous bristles on segment 5. Tooth of anterior claw of foretarsus and midtarsus blunt and arising before middle.

MALE GENITALIA (fig. 10). Lobe of tergite IX usually with 4 (3-6) bristles. Sidepiece without scales. Proximal division of subapical lobe with large protuberant base bearing numerous fine apically curved bristles; stem elongate and with only a few bristles; setae *a* and *b* subequal, recurved apically but not contorted. Distal division moderately developed as a rounded lobe with 2 apically recurved thickened setae. Clasper not markedly tapered distally; spiniform longer than snout. Distal part of proctiger narrow, more or less parallel-sided; para-proct crown usually with 4 (3-8) teeth; cercal setae absent.

PUPA (fig. 10). Abdomen: 3.3 mm. Trumpet: 0.65-0.75 mm. Paddle: 0.85-0.95 mm. Very similar to *infoliatius*; diagnostic characters as in the key. General chaetotaxy based on 10 reared specimens from Venezuela. *Cephalothorax*: Pigmentation light yellow; sculpturing weak, without definite pattern. All hairs except 5-C shorter than trumpet; 1(1;1-2) slightly longer than hair 7; 2(2,3;1-3) shorter than hair 3; 3(2;1-2); 4(1,2;1-3) about 0.5 of hair 7; 5(1;1-2) sometimes finely barbed; 6(1,2;1-4) very short; 7(2;1-3); 8(1) longer than hair 9; 9(1-2). *Trumpet*: Distinctly widened distally; index about 4.4 (3.8-6.0); pinna about 0.33. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing weak; hair 10(1,2) longer than hairs 11,12; 11(2;1-3); 12(1;1-2). *Abdomen*: Pigmentation yellow to light brown, anterior mesal areas of tergites III,IV slightly darker; sculpturing moderately developed. Segment I: hair 1 (about 45; 37-48). Segment II: hair 1(6,7;3-8) forked and longest hair of segment; 3(1,1-2); 4(4-6) forked and small; 5(1). Segment III: hair 1(1;1-2) surpassing caudal border of following tergite; 3(1,1-2); 4(3,4;2-5); 5(1,2) shorter than hair 3. Segment IV: hair 1(1;1-2); 3(2,3;2-5) shorter than hair 6; 4(2;1-3), 5(1) strong, always reaching level of rudimentary spiracle VI. Segment V: hair 1(1) longer than hair 6; 3(2;1-2); 4(3,4;3-5); 5(1) strong, always reaching level of rudimentary spiracle VII. Segment VI: hair 1(1) reaching level of rudimentary spiracle VII; 3(1,2;1-3); 4(3;2-4) subequal to hair 3; 5(2,3;2-4) very short. Segment VII: hair 1(1;1-3) longer than hair 4; 3(2,3;1-3) shorter than hair 4; 4(1;1-2); 5(3,4;2-5) subequal to hair 6; 6(4;2-4); 9(3,4;2-7) barbed, subequal to hair 9-VIII. Segment VIII: hair 4(1;1-2) fine, subequal to hair 4-VII: 9(3,4;3-6).

LARVA (fig. 11). Head: 0.95 mm. Siphon: 0.90 mm. Anal Saddle: 0.30 mm. Very similar to *infoliatius*; diagnostic characters as in the key. General chaetotaxy based on 8 reared and 2 other specimens from Venezuela. *Head*: Integument light yellow to brown; collar darkened. Mental plate with 9-11 lateral teeth. Hair 4 (4,5;3-6); 5(7,8;4-8); 6(1); 7(5,6;4-8); 8(1) shorter than hair 7; 9(2,3;2-4) shorter than hair 8; 10(2;1-2); 11(3,4;2-5); 12(1); 14(1;1-2); 15(3,4;2-4). *Antenna*: About 0.33 of head length; hair 1(2,3;1-3). *Thorax*: Prothorax: hair 0(6,7;6-8) minute; 1(1;1-2); 2(1); 3(2;1-2); 4(2); 7(2;2-3); 8(2-3) moderately long, with spike-like barbed branches; 9(1,2;1-3); 10(1;1-2); 11(4,5;2-5); 14(1;1-2). Mesothorax: hair 1(2,3;1-3); 2(2,3;1-4); 3(1;1-2); 4(2,3;1-4); 8(7,8;7-10); 9(6;6-8); 11(1-4); 13(7-9;6-9); 14(11-16). Metathorax: hair 1(2,3;1-3); 2(2;1-2); 3(4,5;3-5); 4(2-3); 6(1;1-2); 7(7-10); 8(6-9;5-10); 9(3-5); 11(2,3;1-3); 13(6-8;6-11). *Abdomen*: Segment I: hair 1(4-6;2-6) very short; 6(2;2-3); 7(1). Segment II: hair 1(2;1-2) very short; 3(2,3;1-3) short; 6(2;2-3). Segment III: hair 1(2-3) long, strong; 3(1-2) moderate; 6(1); 13(3) long, strong and subequal to hair 1. Segment IV: hair 1(2-3) strong, longer than hair 1-III; 3(2-4;2-5) short; 6(1); 13(3) subequal to hair 1. Segment V: hair 1(2-3) strong, usually shorter than hair 1-IV; 3(1;1-2) sub-

equal to hair 1; 6(1); 13(3;3-4) subequal to hair 1. Segment VI: hair 1(2;2-3) very strong, subequal to or longer than hair 1-IV; 6(1). Segment VII: hair 1(2;1-3). *Segment VIII*: Comb scales (29-54) distinctly spatulate and conspicuously fringed; hair 1(2,3;2-4) about 0.5 of hair 2; 3(5-7;5-8); 5(1;1-2) slightly longer than hair 1. *Siphon*: Pigmentation light yellow; sculpturing weak. Index about 2.5-3.0. Pecten teeth (7-10) short, with distinct fringes on ventral margin. Ventral siphonal tufts (10-12) usually triple (3 or 4). *Anal Segment*: Saddle shallowly emarginate laterally; pigmentation light yellow; sculpturing weak except caudo-dorsad. Hair 1(2,3;2-4); 2(5,6;4-7). Ventral brush with 5 pairs of hairs, all usually double (2,1-2). Gills slightly more than 2.0 of dorsal saddle length.

SYSTEMATICS. *Culex bihaicolus* is the dominant widespread species of its complex which includes also the relict *guerreroi* and *rausseoi*. It is interpreted here as the most derived species of the complex because of the reduction in the branching of hair 6 on abdominal segments III-V of both the larva and the pupa (shared with the derived nominate species of the Infoliatius Complex) and the single head hair 6-C of the larva (unique in the group).

The adults of *bihaicolus* are superficially very similar to other species of the group and were often confused with *infoliatius* in the past (see taxonomic references under *infoliatius*). Komp (1936:64; 1956:39) incorrectly synonymized the 2 species. As noted in the key and description, adults of *infoliatius* are readily separated from *bihaicolus* by the long metallic streak on the hindfemur and conspicuous apical dark bands on the abdominal sternites.

The key characters for the separation of the adults of *bihaicolus* from *guerreroi* and *rausseoi* on external features are quite tenuous, except for the male of *rausseoi*. However the male genitalia of the 3 species are very distinct and diagnostic. As indicated above, the pupae and larvae of *bihaicolus* and *infoliatius* are very similar and share a number of derived character states not present in other members of the group. The separation of the species in the pupal stage by the key characters may not be entirely reliable but it appears to be clearcut in the larva.

In the large sample available I have found only a normal range of variation in all stages and have not detected any geographical population differentiation over the wide range of *bihaicolus*. There is also no indication of any significant differences in specimens from the wide variety of breeding sites.

BIONOMICS. *Culex bihaicolus* has an extremely wide range of breeding sites, approached in the subgenus only by that of *urichii*. It is the only species of *Carrollia* breeding in the flower bracts of *Heliconia* and the leaf axils of *Dieffenbachia*. In 47 collections, immature stages have been recorded from the following natural sites: *Heliconia* (5); *Dieffenbachia* (1); fallen leaves, palm spathes and fronds (10); fallen cacao pods and coconut shells (3); treeholes (12); and cut or broken bamboo (8). They were also common in various types of artificial containers (10), including once each in a hole in a cement bridge and in a wooden bowl trap.

Culex bihaicolus is equally catholic in its association with other container-breeding mosquitoes. It has been found with 5 species of *Carrollia*: *metempsytus* (2), *rausseoi* (5), *urichii* (2), *secundus* (1), *bonnei* (1); and with 20 other species: *Aedes* (*H.*) *ioliota* (5), *A.* (*O.*) *fluviatilis* (2), *A.* (*P.*) *daryi* (1), *A.* (*P.*) *impostor* (1); *Anopheles* (*An.*) *eiseni* (4), *An.* (*K.*) *neivai* (2); *Culex* (*Anoed.*) *conservator* (1), *C.* (*C.*) *corniger* (3), *C.* (*C.*) *mollis* (3), *C.* (*C.*) *quinquefasciatus* (1), *C.* (*Microc.*) *kukenan* (2); *Haemagogus* (*S.*) *equinus* (1), *H.* (*S.*) *soperi*; *Limatus asulleptus* (7), *L.* *durhamii* (3); *Orthopodomyia fascipes* (2); *Sabethes* sp. (1); *Toxorhynchites*

sp. (2); *Trichoprosopon (T.) digitatum* (4); *Corethrella* sp. (1).

Although the immature stages are quite common, adults of *bihaicolus* have been rarely collected in nature. I collected a single female flying over a tin can containing immature stages (VZ 141); 2 males from Costa Rica [USNM] may have been obtained also in the adult stage.

DISTRIBUTION (fig. 2). From southeastern Mexico through Central America to Pacific drainage in Ecuador and Caribbean drainage in Colombia and Venezuela at elevations of 30-1600 m.

Material examined: 2,204 specimens; 658 males, 224 females, 909 larvae, 413 pupae; 284 individual rearings (188 larval, 62 pupal, 34 incomplete).

COLOMBIA. *Antioquia*: Providencia, Anori R. valley, C. Porter [UCLA]. *Valle*: Rio Raposo (COL 3) [UCLA].

COSTA RICA. *Cartago*: Atirro (CR 388) [UCLA]. Suiza de Turrialba [USNM]. *San Jose*: San Isidro, T. Aitken [USNM].

ECUADOR. *Esmeraldas*: Quininde, Levi-Castillo [USNM]. *Los Rios*: Balzar, Hanson [UCLA]. Valencia (ECU 112) [UCLA].

GUATEMALA. *Alta Vera Paz*: Trece Aguas (GUA 33) [UCLA].

MEXICO. *Veracruz*: Cordoba (MEX 34,41,42,44) [UCLA]. Rio Metlac (MEX 441,442) [UCLA].

PANAMA. *Darien*: Alturas de Nique (PA 1059) [UCLA]. Cerro Mali (PA 364-366,370,377) [UCLA]. La Laguna (PA 450,451) [UCLA]. Rio Pucro headwaters (PA 375) [UCLA]. Rio Tacarcuna valley (PA 404,431,432,435,436) [UCLA]. *Panama*: Campana, S.J. Carpenter [UCLA]. Cerro Azul (PA 58) [UCLA]. Cerro El Jefe, P. Galindo [UCLA]. Cerro La Victoria, S.J. Carpenter [UCLA].

VENEZUELA. *Aragua*: Choroni, road to (VZ 359) [UCLA]. Guamita, Nunez Tovar [USNM]. Maracay, Nunez Tovar [USNM]. Ocumare del la Costa, Nunez Tovar, type series [USNM]; Ocumare de la Costa, road to (VZ 186,280,310,329) [UCLA]. Rancho Grande (VZ 140,141, 156-158,255,296,303) [UCLA]. Tio Julian, Nunez Tovar [USNM]. Turmero, Nunez Tovar [USNM]. *Carabobo*: Mariara, road to (VZ 246) [UCLA]; Nunez Tovar [USNM]. *Miranda*: Cerro el Pipe (VZ 162) [UCLA].

Additional Record From the Literature

MEXICO. *Chiapas* (Vargas, 1956:24).

2. *Culex (Car.) guerreroi* Cova Garcia, Sutil & Pulido

Figs. 2,9,12,13

1971. *Culex (Carrollia) guerreroi* Cova Garcia, Sutil and Pulido, 1971:203-210. TYPE: *Holotype* male (1677-2) with slides of male genitalia and associated larval and pupal skins, Colonia Tovar, Aragua, Venezuela, date and collector not specified [MDM].

FEMALE (fig. 9). Wing: 3.4 mm. Proboscis: 2.9 mm. Forefemur: 1.9 mm. Abdomen: about 3.1 mm. Differentiated from all other members of the group by the very long proboscis, about 1.5 of forefemur length, otherwise very similar to *rausseoi* and *bihaicolus*. In general similar to *bihaicolus* and differing from it in the following features. Description from 8 topotypic specimens from Venezuela. *Head*: Band of broad decumbent scales of vertex narrowed on midline, scales darker in middle and caudolaterad, white laterally behind orbitals before joining white lateral spot; narrow decumbent scales whitish, less numerous; erect scales all dark. Proboscis 1.53 of forefemur. Palpus 0.17-0.20 of proboscis. Antenna 0.89-0.90 of

proboscis; torus with 6-12 setae. *Thorax*: Pleural integument light green to gray. Anterior promontory with 2-4 bristles; prescutal bristles 2 or 3. *Apn* usually with 10 bristles and 2-4 light scales; *ppn* with 2 or 3 narrow dark scales and 3 or 4 posterior bristles; *stp* with 11 or 12 bristles in curved row and 2 or 3 light scales; *pra* bristles 3-5; *umep* bristles 8-11. *Legs*: Coxal integument light green. Hindfemur more extensively light scaled, to near apex; light metallic marking closer to light scaling of anterior surface but usually not connected to it. *Abdomen*: Marginal bristles of tergites darker, bronzy. Sternites IV-VII with light brown apical scales not forming distinct bands. *Cibarial Armature*: Cibarial bar with narrow lateral flange without lobe; teeth 5 or 6; cibarial dome with triangular denticles. *Genitalia*: Tergite IX with 4 or 5 lateral bristles; insula with about 25.

MALE. Wing: 3.3 mm. Proboscis: 2.9 mm. Forefemur: 1.9 mm. Abdomen: about 3.1 mm. Differentiated from all other members of the group by the very long proboscis, at least 1.5 of forefemur length, otherwise very similar to *rausseoi* and *metempystus*. Essentially similar to the female except for usual sexual differences. Proboscis 1.53-1.70 of forefemur. Palpus 0.53-0.64 of proboscis. Antenna 0.73-0.74 of proboscis. Specimens studied: 6 from the type locality in Venezuela.

MALE GENITALIA (fig. 12). Lobe of tergite IX usually with 6 (4-9) bristles. Sidepiece with scales. Proximal division of subapical lobe with simple broad base bearing numerous fine simple bristles; stem short and with only a few bristles; setae *a* and *b* relatively short and markedly contorted. Distal division developed as a fingerlike process bearing a single saberlike apical seta. Clasper slightly tapered distally; spiniform longer than snout. Distal part of proctiger relatively broad and more or less parallel-sided; paraproct crown usually with 11 (8-11) strong teeth; cercal setae absent.

PUPA (fig. 12). Abdomen: 3.50 mm. Trumpet: 0.75 mm. Paddle: 0.90 mm. Apparently indistinguishable from *rausseoi* and *metempystus*; diagnostic characters from other members of the group as in the key. General chaetotaxy based on 9 specimens from Venezuela. *Cephalothorax*: Pigmentation light yellow to brown; sculpturing moderate. All hairs distinctly shorter than trumpet except 5-C which is subequal; 1(2;2-3) longer than hair 4; 2(2;2-3) subequal to hair 6; 3(2;2-3) longer than hair 6; 4(3;2-5); 5(2,3;2-4); 6(2;1-3); 7(4;3-4) subequal to hair 1; 8(1) longer than hair 9; 9(1,2). *Trumpet*: Moderately widened distally; index about 6.1 (5.0-6.8); pinna about 0.25. Pigmentation light brown. *Metanotum*: Pigmentation yellow to light brown; sculpturing moderate; hair 10(1; 1-2) longer than hairs 11,12; 11(2;1-3); 12(2;1-2). *Abdomen*: Pigmentation yellow to light brown, anterior mesal areas of tergites III-V slightly darker; sculpturing moderate. Segment I: hair 1(25-33). Segment II: hair 1(2,3;1-4) reaching level of rudimentary spiracle III; 3(2;1-2) subequal to hair 5; 4(5,6;3-7) short; 5(1,2). Segment III: hair 1(1,2;1-3) strong and surpassing caudal margin of tergite IV; 3(2;1-2) subequal to hair 5; 4(3,4;2-5) short and forked; 5(2). Segment IV: hair 1(1,2) weak but surpassing level of rudimentary spiracle V; 3(2,3;2-4); 4(2,3) short; 5(1) surpassing level of caudal margin of tergite V. Segment V: hair 1(1) longer than hair 4; 3(2,3) weak but longer than hair 6; 4(3,4;2-4); 5(1) surpassing level of caudal margin of tergite VI. Segment VI: hair 1(1) reaching level of rudimentary spiracle VII; 3(2;1-3); 4(3;3-4) subequal to hair 3; 5(1; 1-3). Segment VII: hair 1(1;1-3) nearly reaching alveolus of hair 4-VIII; 3(2;1-3); 4(2;2-3); 5(3,4) very short; 6(3,4;2-5); 9(3,4;2-4) barbed and subequal to hair 9-VIII. Segment VIII: hair 4(2;1-2); 9(3,4;3-5).

LARVA (fig. 13). Head: 1.00 mm. Siphon: 1.00 mm. Anal Saddle: 0.30 mm. Very similar to *metempsythus*; diagnostic characters as in the key. General chaetotaxy based on 1 reared and 6 whole specimens from Venezuela. *Head*: Integument light yellow to brown; collar darkened. Mental plate with 8-10 lateral teeth. Hair 4(4;2-5); 5(7,8;7-9); 6(2); 7(4,5;4-7); 8(1;1-2) shorter than hair 7; 9(4,5;3-6) very short; 10(2;1-2); 11(4;4-5); 12(2;1-3); 14(1); 15(2-3). *Antenna*: About 0.40 of head length; hair 1(3;2-3). *Thorax*: Prothorax: hair 0(6;5-8) minute; 1(1); 2(1); 3(2;1-2); 4(2;2-3); 7(2;2-4); 8(4,5) strongly developed and barbed; 9(1;1-2); 10(1;1-2); 11(2,3;2-4); 14(1). Mesothorax: hair 1(2-3); 2(2); 3(1); 4(2-3); 6(1;1-2); 8(4,5;4-8); 9(6;5-8); 10(1;1-2); 11(1-2); 13(9-14); 14(8-15). Metathorax: hair 1(3;2-3); 2(2;2-3); 3(3,4;2-4); 4(2-3); 6(1); 7(5,6;4-8); 8(10;8-11); 9(3-5;3-8); 10(1;1-2); 11(1;1-2); 13(8-10). *Abdomen*: Segment I: hair 1(3-5;3-6) very short; 6(3;2-5); 7(1,2;1-3). Segment II: hair 1(3,4;3-5) very short; 3(2;1-2) short; 6(3,4;2-4). Segment III: hair 1(3;2-4) strong and long; 3(1;1-2) long but shorter than hair 1; 6(2;2-3); 13(4;3-5) subequal to hair 1. Segment IV: hair 1(3;3-4) slightly longer than hair 1-III; 3(2;1-3) short; 6(2); 13(3;2-4) shorter than hair 1. Segment V: hair 1(3) subequal to hair 1-IV; 3(1) strong, slightly shorter than hair 1; 6(2;1-3); 13(3-4). Segment VI: hair 1(3) slightly longer than hair 1-III; 6(1-3). Segment VII: hair 1(3). *Segment VIII*: Comb scales (16-39) distinctly spatulate and conspicuously fringed; hair 1(2-3;1-3) strong, barbed and subequal to hair 5; 3(6-8;5-9); 5(2;2-3). *Siphon*: Pigmentation light yellow to brown; sculpturing weak. Index about 2.9-3.1. Pecten teeth (5-10) short, with distinct fringes on distal part of ventral margin. Ventral siphonal tufts (10-12) usually triple (2-4). *Anal Segment*: Saddle with unsclerotized indentation from caudolateral border; pigmentation light yellow; sculpturing weak except caudodorsad. Hair 1(5,6;3-6); 2(4;3-5). Ventral brush with 5 pairs of hairs; all except the 2 proximal pairs usually double (1-2). Gills usually not much more than 2.0 of dorsal saddle length.

SYSTEMATICS. Several primitive character states and the restricted distribution indicate that *guerreroi* is an ancient relict of the Bihaculus Complex. In the adults the erect scales of the vertex are dark and the proctiger of the male genitalia is short and broad and bears a crown of numerous teeth on the paraproct and the snout of the clasper is short. In the pupa and larva abdominal hair 6-III-V is short and branched, and in the larva head hair 6-C is branched; these character states are shared with *rausseoi* and *metempsythus*. However, it has a derived feature, unique in the subgenus, in the elongation of the proboscis.

Culex guerreroi is readily separated from the other members of the complex and group by the male genitalia. Although the elongation of the proboscis in both sexes is apparently diagnostic of *guerreroi*, there is considerable variation in this character but no overlap with other species of the group in my small sample. I have found no reliable character to separate the pupa of *guerreroi* from those of *rausseoi* and *metempsythus* as there is considerable variation in the chaetotaxy of all 3 species in this stage. The separation of the larvae of *guerreroi* and *metempsythus* on the key characters may be difficult and not entirely reliable as the unsclerotized indentation on the anal saddle of *guerreroi* is quite variable and often obscure and the chaetotaxy of both species shows considerable individual variation.

Although *guerreroi* occurs in the same general area in the coastal range of northcentral Venezuela as *rausseoi*, the 2 species have been found at different elevations, *guerreroi* at 1600-1900 m and *rausseoi* at 1200-1300 m. There may

be an ecological barrier separating the 2 species that is associated with the difference in elevation.

BIONOMICS. The only recorded natural breeding site of *guerreroi* is a tree-hole (type collection). The other 5 known collections of immature stages are all from tin cans, glass jars, a tire, a shoe and a wash basin in a trash dump. Associated with *guerreroi* in these artificial containers were: *Culex* (*C.*) *quinquefasciatus* (1), *C.* (*Lutzia*) *sp.* (1) and *Trichoprosopon* (*Ct.*) *magnum* (1). No adults have been found in nature.

DISTRIBUTION (fig. 2). Known at present only from northcentral Venezuela, at elevations of 1600-1900 m.

Material examined: 66 specimens; 7 males, 10 females, 30 larvae, 19 pupae; 14 individual rearings (4 larval, 7 pupal, 3 incomplete).

VENEZUELA. *Aragua*: Colonia Tovar (VZ 390,394,397-399) [UCLA].

3. *Culex* (*Car.*) *raussei* Cova Garcia, Sutil & Pulido

Figs. 2,9,14,15

1972. *Culex* (*Carrollia*) *raussei* Cova Garcia, Sutil and Pulido, 1972:207-209. TYPE: *Holotype* male (1951-1) with associated larval and pupal skins, Campamento Rangel, Tejerias, Aragua, Venezuela, date and collector not specified [MDM].

FEMALE (fig. 9). Wing: 4.1 mm. Proboscis: 2.9 mm. Forefemur: 2.5 mm. Abdomen: about 2.9 mm. Extremely similar to *bihaicolus* and *metempsychus*; diagnostic characters as in the key. Differing from *bihaicolus* in the following features. Description based on 24 specimens from near type locality in Venezuela. **Head:** Band of broad decumbent scales of vertex broader, scales darker and with deeper blue iridescence; narrow decumbent scales whitish, less numerous; erect scales of vertex dark bronzy to black, those of occiput tan; lateral patch with white scales. Proboscis 1.00-1.20 of forefemur. Palpus 0.20-0.25 of proboscis. Antenna 0.88-0.91 of proboscis; torus with 10-14 bristles. **Thorax:** Anterior promontory with 3 or 4 bristles; prescutal bristles 3 or 4. *Apn* bristles 6-8; *ppn* with 4-6 posterior bristles but without scales; *ppl* bristles 3-6; *stp* with 10-15 bristles in a curved line, often 1 or 2 light scales cephalad of bristles; *pra* bristles 3-6; *umep* bristles 3-6; *lmep* bristle sometimes absent. **Legs:** Knee spots usually more prominent. **Abdomen:** Bristles of tergites and sternites somewhat darker. Sternites V-VII usually with some apical dark scales. **Cibarial Armature:** Cibarial bar without distinct lateral lobe; broad cibarial teeth 5 or 6, alternating with long filamentous spicules. **Genitalia:** Tergite IX with 4-6 lateral bristles; insula with 18-20.

MALE. Wing: 3.0 mm. Proboscis: 2.4 mm. Forefemur: 2.0 mm. Abdomen: about 2.3 mm. Differentiated from all other members of the group by the very short palpus, about 0.33 of proboscis. Essentially similar to the female except for usual sexual differences. Specimens studied: 23 from near type locality in Venezuela.

MALE GENITALIA (fig. 14). Lobe of tergite IX usually with 8 (5-12) bristles. Sidepiece with scales. Proximal division of subapical lobe with simple broad base bearing numerous fine simple bristles; stem short, not markedly differentiated from base and bearing several bristles; setae *a* and *b* not contorted, *a* short and with simple pointed apex, *b* about twice as long and with recurved apex.

Distal division developed as a small fingerlike process bearing a single thickened apical seta with simple attenuate apex. Clasper distinctly tapered distally; spiniform shorter than snout, latter very strongly developed. Distal part of proctiger relatively broad and distinctly rounded apically; paraproct crown usually with 7 (6-8) teeth; cercal setae absent.

PUPA (fig. 14). Abdomen: 3.65 mm. Trumpet: 0.75 mm. Paddle: 0.85 mm. Apparently indistinguishable from *guerreroi* and *metempsytus*; diagnostic characters from other members of the group as in the key. General chaetotaxy based on 10 specimens from Venezuela. **Cephalothorax**: Pigmentation light yellow; sculpturing moderate. All hairs distinctly shorter than trumpet except 5-C which is slightly longer; 1(2;2-4) longer than hair 4; 2(2;2-3) shorter than hair 6; 3(2;2-3) subequal to hair 6; 4(3,4;2-4) longer than hair 7; 6(2;1-3); 8(1,2) longer than hair 9; 9(2;1-2). **Trumpet**: Moderately widened distally; index about 4.1 (3.8-5.0); pinna about 0.25. Pigmentation light brown. **Metanotum**: Pigmentation yellow to light brown; sculpturing moderate; hair 10(2,3;1-3) longer than hairs 11,12; 11(2); 12(2,3;1-3). **Abdomen**: Pigmentation light yellow to brown, anterior mesal areas of tergites III-V darker; sculpturing moderate. Segment I: hair 1(35-60). Segment II: hair 1(8-10;6-10) forked; 3(2;1-2); 4(6,7;3-7) short; 5(2;1-3), subequal to hair 3. Segment III: hair 1(2,3;1-4) strong, reaching caudal margin of tergite IV; 3(2;2-4) longer than hair 6; 4(2,3;1-4); 5(2,3;2-4). Segment IV: hair 1(3,4;2-5) surpassing level of rudimentary spiracle V; 3(3,4;3-9) shorter than hair 6; 4(2;2-3); 5(1;1-2) strong, reaching level of rudimentary spiracle VI. Segment V: hair 1(2,3;1-4) reaching level of rudimentary spiracle VI; 3(3,4;2-5) shorter than hair 6; 4(4-6;2-6) shorter than hair 5; 5(1;1-2) strong, reaching level of rudimentary spiracle VII. Segment VI: hair 1(1;1-2) shorter than hair 6; 3(2;2-4); 4(4,5;3-5) shorter than hair 3; 5(4,5;3-10). Segment VII: hair 1(1,2;1-3); 3(3;2-4) subequal to hair 6; 4(2;2-3), shorter than hair 1; 5(2,3;2-6) very short; 6(4,5;4-6); 9(5,6;3-9) strong, barbed and shorter than hair 9-VIII. Segment VIII: hair 4(2;1-3); 9(8;6-9) strong and barbed.

LARVA (fig. 15). Head: 1.00 mm. Siphon: 0.90 mm. Anal Saddle: 0.25 mm. Very similar to species 3a., Panama form; diagnostic characters as in the key. General chaetotaxy based on 10 reared specimens from Venezuela. **Head**: Integument light yellow to brown; collar brown. Mental plate with 10 lateral teeth. Hair 4(4;3-5); 5(5,6;5-10); 6(2;2-3); 7(6-8;5-8); 8(1;1-2) subequal to 7-C; 9(4,5;3-7) shorter than hair 8; 10(2;1-2); 11(3,4;3-5); 12(2;2-3); 14(1,2;1-3) more distant from anterior border of head capsule than in other species of group; 15(3;2-4). **Antenna**: About 0.4 of head length; hair 1(3,4;2-4). **Thorax**: Prothorax: hair 0(12-14;10-14) short; 1(1); 2(1); 3(1,2;1-3) relatively short; 4(2); 7(2;2-3); 8(4,5;4-6) moderately developed, barbed; 9(1;1-2); 10(1); 11(4;3-4); 14(1). Mesothorax: hair 1(2,3;2-4); 2(2,3;2-5); 3(1); 4(3;2-4); 8(5-7;5-9); 9(5,6;5-7); 11(1); 13(10-18); 14(24-30). Metathorax: hair 1(4,5;2-6); 2(3,4;2-4); 3(5,6;4-7); 4(2,3;2-4); 6(1;1-2); 7(6-9;5-10); 8(10-14); 9(2,3;2-5); 11(2;2-3); 13(8-16). **Abdomen**: Segment I: hair 1(5,6;3-8) minute; 6(2,3); 7(1;1-2). Segment II: hair 1(4-6;3-6) short; 3(2,3;2-4) short; 6(3;2-3). Segment III: hair 1(3,4;3-8) short to moderate; 3(1,2;1-3) longer and stronger than hair 1; 6(2,3;1-4); 13(3,4;3-5) relatively short and weak but longer than hair 1. Segment IV: hair 1(3,4;3-5) moderately long but rather weak; 3(3;3-5) usually forked, relatively short; 6(1,2;1-3); 13(3,4;3-5) subequal to hair 1. Segment V: hair 1(3;2-4) longer than hair 1-IV; 3(1) subequal to hair 1; 6(1); 13(3;3-5) shorter than hair 1. Segment VI: hair 1(3;2-4) subequal to hair 1-IV; 6(1). Segment VII: hair 1(3;3-4). **Segment VIII**: Comb

scales (16-28) only slightly dilated and lightly fringed; hair 1(3;3-4) about 0.5 or less of hair 2; 3(6,7;6-9); 5(3,4;2-4) distinctly longer than hair 1. *Siphon*: Pigmentation light yellow to brown; sculpturing weak. Index about 2.8-3.2. Pecten teeth (3-7) elongate, spinelike and with a few indistinct spicules on ventral margin. Ventral siphonal tufts (10;10-14) usually quadruple (3-5); proximal accessory tuft (1ad) in basal 0.5 of siphon, distal varied in position but seldom subapical. *Anal Segment*: Saddle pigmentation light yellow to brown; sculpturing weak except caudodorsad. Hair 1(4,5;3-6); 2(3,4;3-5). Ventral brush with 6 pairs of hairs all except the proximal single and without barbs. Gills about 3.0 of dorsal saddle length, pointed.

SYSTEMATICS. *Culex rausseoi* is another relict species in the *Bihaicolus* Complex. Its distribution is nearly as restricted as that of *guerreroi* and it possesses all the primitive character states of the latter except for the snout of the clasper which is very strongly developed. Another primitive character state (shared with sp. 3a) is the retention of 6 pairs of hairs in the ventral brush of the larva; the branching of these hairs, however, is reduced. A unique and very striking feature of *rausseoi* is the very short palpus of the male, which is about half as long as in the other species of the group.

Culex rausseoi is readily separated from the other members of the complex and group by the male genitalia. Although the males cannot be confused with any other species of the complex, the females are very similar to *bihaicolus* and *metempsytus* and the key characters may not be completely reliable. The pupa cannot be differentiated from those of *guerreroi* and *metempsytus*. The larva is separated from all described species of the complex and group by the ventral brush but it is superficially very similar to that of the Panama form (sp. 3a).

As noted under *guerreroi*, there is no real sympatry between these 2 species as *rausseoi* occurs at a lower elevation (1200-1300 m) and there may also be an ecological barrier separating them.

BIONOMICS. The immature stages of *rausseoi* have been found only in fallen palm spathes (5) where they were associated with *bihaicolus* (5), *Anopheles (An.) eiseni* (2), *Limatus asulleptus* (1), *Trichoprosopon (T.) digitatum* (1) and *Wyeomyia felicia* (1). No adults have been collected in nature.

DISTRIBUTION (fig. 2). Known at present only from northcentral Venezuela, at elevations of 1200-1300 m.

Material examined: 257 specimens; 39 males, 38 females, 133 larvae, 47 pupae; 46 individual rearings (30 larval, 12 pupal, 4 incomplete).

VENEZUELA. *Aragua*: Campamento Rangel (1951-5) [MDM]. Rancho Grande (VZ 156, 157,255,303,304,311) [UCLA].

3a. *Culex (Car.) sp.*, Panama form

Fig. 2

This form is known from a single collection of larvae in Cerro Mali, Tacarcuna Mts., Darien Province, Panama (PA 929; TC-2) [UCLA]. Nearly all the larvae in this collection have 6 pairs of hairs in the ventral brush, the majority of these being long and simple. In this respect they resemble *rausseoi*, but they differ from this species in having accessory siphonal hair *lad* in the distal half of the siphon and in other details of chaetotaxy. It is very probable that these larvae represent a distinct undescribed species. In the same collection there are 2 indi-

vidual rearings of males (929-107,112) of more or less typical *metempsytyus* and a few larvae with the ventral brush tending toward the condition in the latter, suggesting introgression between the 2 species. This form cannot be placed in either complex at this time. It may prove to be an annectent relict between the 2 complexes or a relict of either complex.

4. *Culex* (*Car.*) *metempsytyus* Dyar

Figs. 2,9,16,17

1921. *Culex* (*Carrollia*) *metempsytyus* Dyar, 1921:154. TYPE: *Lectotype* male, Alajuela, Alajuela, Costa Rica, 4 July 1921, A. Alfaro [USNM, 24863; designation by Stone and Knight, 1957:53].

Culex (*Carrollia*) *metempsytyus* of Bonne and Bonne-Wepster (1925:204); Dyar (1925:176); Edwards (1932:221); Galindo, Carpenter and Trapido (1951:126); Galindo and Blanton (1955:73); Stone and Knight (1957:53); Stone, Knight and Starcke (1959:283); Belkin, Schick and Heinemann (1965:13-14).

Culex (*Carrollella*) *metempsytyus* of Dyar (1928:282-283).

Culex (*Carrollia*) *metempsytyus* in part of Lane (1939:82; 1953:510-511).

FEMALE (fig. 9). Wing: 3.2 mm. Proboscis: 2.3 mm. Forefemur: 1.8 mm. Abdomen: about 2.5 mm. Extremely similar to *bihaicolus* and *rausseoi*; diagnostic characters as in the key. In general similar to *bihaicolus* and differing from it in the following features. Description based on 34 specimens from near type locality in Costa Rica and 16 specimens from Panama. *Head*: Broad decumbent scales of vertex somewhat darker; narrow decumbent scales whitish; erect scales tan to bronzy; lateral patch white. Proboscis 1.08-1.30 of forefemur. Palpus 0.19-0.20 of proboscis. Antenna 0.90-0.95 of proboscis. Torus with 6-10 setae. *Thorax*: Mesonotal integument dark brown to black. Prescutal bristles 2-4. Midlobe of scutellum with 4-6 long bristles. *Apn* with 5-9 bristles; *ppn* with 2 or 3 narrow dark scales and 3 or 4 posterior bristles; *stp* with 8-12 bristles in curved row; *pra* bristles 3 or 4; *umep* bristles 4-6; *lmep* bristle sometimes absent. *Legs*: Light scaling of hindfemur usually more extensive, extending to near light metallic streak on anterior surface but usually not merging with it. Knee spots somewhat more prominent. *Abdomen*: Bristles of tergites and sternites somewhat darker. Sternites IV-VII with conspicuous dark apical bands. *Cibarial Armature*: Cibarial bar without any indication of a lobe on lateral flange; cibarial teeth a series of 10 expanded on apex alternating with thin filamentous processes; cibarial dome with rounded minutely serrate denticles. *Genitalia*: Tergite IX with 2-4 lateral bristles; insula with 16-20.

MALE. Wing: 2.9 mm. Proboscis: 2.1 mm. Forefemur: 1.8 mm. Abdomen: about 2.6 mm. Very similar to *bihaicolus*; diagnostic characters as in the key. Similar to the female except for usual sexual characters. Proboscis 1.09-1.20 of forefemur. Palpus 0.76-0.83 of proboscis. Antenna 0.75-0.76 of proboscis. Specimens studied: 26 from near type locality in Costa Rica and 9 from Panama.

MALE GENITALIA (fig. 16). Lobe of tergite IX usually with 4 (3-8) bristles. Sidepiece without scales. Proximal division of subapical lobe with basal part narrow, not differentiated from very long stem which bears relatively few short bristles; setae *a* and *b* contorted, *b* forked distally. Distal division not developed. Clasper not markedly tapered distally; spiniform and snout subequal. Distal part

of proctiger very narrow and distinctly tapering distally, paraproct crown usually with 5 (4-7) teeth; cercal setae absent.

PUPA (fig. 16). Abdomen: 3.30 mm. Trumpet: 0.60 mm. Paddle: 0.85 mm. Apparently indistinguishable from *raussei* and *guerreroi*; diagnostic characters from other members of the group as in the key. General chaetotaxy based on 10 specimens from Panama. *Cephalothorax*: Pigmentation light yellow; sculpturing moderate. All hairs distinctly shorter than trumpet except 5-C which is slightly longer; 1(2,3) longer than hair 7; 2(3;2-4) subequal to hair 6; 3(2;2-3) subequal to hair 4; 4(3,4;2-4) shorter than hair 7; 5(2,3;2-4); 6(1,2;1-3); 7(3,4;2-5); 8(2;1-2) longer than hair 9; 9(2;2-4). *Trumpet*: Moderately widened distally; index about 6.5 (5.5-7.0); pinna about 0.25. Pigmentation yellow to brown. *Metanotum*: Pigmentation light yellow; sculpturing moderate; hair 10(2;2-3) longer than hairs 11,12; 11(2;2-4); 12(2,3;2-6). *Abdomen*: Pigmentation light yellow, anterior mesal areas of tergites III-V darker; sculpturing moderate. Segment I: hair 1(36-65). Segment II: hair 1(5,6;3-10) surpassing level of rudimentary spiracle III; 3(2,3); 4(6-8;5-10); 5(2;2-3) subequal to hair 3. Segment III: hair 1(1,2) nearly reaching caudal margin of tergite IV; 3(2,3); 4(3,4;3-8); 5(2;2-5) very short. Segment IV: hair 1(1,2;1-3) longer than hair 3; 3(4,5;3-9) subequal to hair 6; 4(2;1-2); 5(1;1-2) moderately long, surpassing caudal margin of tergite V. Segment V: hair 1(1,2;1-4) subequal to hair 4; 3(2,3;1-4) twice as long as hair 1; 4(5,6;5-8); 5(1;1-2) moderately long, surpassing caudal margin of tergite VI. Segment VI: hair 1(1;1-2) longer than hair 4; 3(3,4;2-4); 4(4-6;4-7); 5(3,4;2-6) short. Segment VII: hair 1(2;1-3) subequal to hair 4; 3(4,5;3-6) subequal to hair 6; 4(3,4;2-5); 5(4,5;3-6) very short; 6(6,7;5-8); 9(2,3;2-6) strong, barbed and subequal to hair 9-VIII. Segment VIII: hair 4(2;1-3); 9(3,4;2-6) strong and barbed.

LARVA (fig. 17). Head: 0.85 mm. Siphon: 0.85 mm. Anal Saddle: 0.20 mm. Very similar to *guerreroi*; diagnostic characters as in the key. General chaetotaxy based on 6 reared and 2 whole specimens from Panama. *Head*: Integument light yellow; collar dark brown. Mental plate with 8-10 lateral teeth. Hair 4(3-5;3-7); 5(7-10); 6(2;2-4); 7(7,8;6-10); 8(3,4;3-5) short; 9(4,5;4-6) subequal to hair 6; 10(3;2-4); 11(3;2-4); 12(2,3;2-4); 14(1,2;1-3); 15(3;2-4). *Antenna*: About 0.41 of head length; hair 1(1;1-2). *Thorax*: Prothorax: hair 0(10-18) very short; 1(1); 2(1); 3(2;1-2) relatively short; 4(2;2-3); 7(3;2-4); 8(4,5;2-5) moderate, barbed; 9(1;1-2); 10(1); 11(4,5;3-6); 14(1;1-2). Mesothorax: hair 1(3,4;3-5); 2(2;1-3); 3(1;1-2); 4(5,6;3-7); 8(5,6;4-6); 9(4-5); 11(1); 13(10-15); 14(18-22). Metathorax: 1(3;3-5); 2(3-5;2-5); 3(10-12;8-12); 4(3;1-3); 6(1-2); 7(4,5;3-6); 8(10-12;10-14); 9(1;1-2); 11(1); 13(8;6-10). *Abdomen*: Segment I: hair 1(8-12) minute; 6(2;2-3); 7(1). Segment II: hair 1(4-6;3-6) minute; 3(5-8;3-8) usually short; 6(3;2-4). Segment III: hair 1(3,4;3-6) strong, moderately long; 3(4,5;3-5) weaker and shorter than hair 1; 6(2,3;2-6); 13(2,3;2-4) stronger and longer than hair 1. Segment IV: hair 1(3,4;3-6) strong, slightly longer than hair 1-III; 3(5-8;2-8) usually short; 6(2,3;2-4); 13(3;3-6) subequal to hair 1. Segment V: 1(3;3-5) subequal to hair 1-IV; 3(1,2;1-3) usually slightly shorter than hair 1; 6(2,3;2-4); 13(2-4;2-6) subequal to hair 1. Segment VI: hair 1(1,2;1-3) subequal to hair 1-V; 6(1,2;1-4). Segment VII: hair 1(3,4;3-5) rather short, barely exceeding base of siphon. *Segment VIII*: Comb scales (16-28) moderately spatulate and with distinct marginal fringes; all hairs relatively short; 1(4-6;4-7) about 0.5 or more of hair 2; 2(2;1-3); 3(5,6;4-9); 4(1;1-2); 5(1-2) subequal to hair 1. *Siphon*: Pigmentation light brown; sculpturing weak. Index about 2.2-3.0. Pecten teeth (4-7) spinelike, with distinct fringes on ventral margin. Ventral siphonal tufts (8-10) usually triple (2-

4). *Anal Segment*: Saddle without distinct emargination; pigmentation light brown; sculpturing weak except caudodorsad. Hair 1(4,5;4-6) very short; 2(3,4;2-4). Ventral brush with 5 pairs of relatively short hairs, all except the proximal usually double. Gills sausage-shaped, about 3.5 of dorsal saddle length.

SYSTEMATICS. *Culex metempsychus* differs conspicuously from its close relative, *infoliatius*, in the retention of the primitive character state of branched abdominal hair 6-III-V in both the larva and the pupa (shared with the relict species of the *Bihaicolus* Complex). For this reason I consider it to be closer to the ancestral stock of the *Infoliatius* Complex.

Several authors misidentified adults of *infoliatius* and *metempsychus* in the past (see taxonomic references under *infoliatius*). Although the male genitalia of *metempsychus* and *infoliatius* are very similar, the minor differences used in the key are quite constant and diagnostic. The adults of these 2 species are also readily separated by the hindfemoral markings but some difficulty may be encountered in distinguishing females of *metempsychus* by the key characters from those of *bihaicolus* and particularly *rausseoi*. I have found no reliable characters to separate *metempsychus* from *guerreroi* and *rausseoi* in the pupal stage. As noted under *guerreroi*, the key characters distinguishing the larva of this species from *metempsychus* may not be reliable.

There is a great deal of individual variation in the chaetotaxy of the larva and pupa but I have not found any significant population or ecological differentiation in the large sample from the wide geographical and altitudinal range and the various breeding sites.

Culex metempsychus is apparently completely allopatric from *infoliatius* and its known distribution is entirely within the central part of the range of *bihaicolus*. It has been found breeding in association with *bihaicolus* as well as *sp. 3a*. There is a suggestion of introgression between the latter and *metempsychus*.

BIONOMICS. The recorded breeding sites of *metempsychus* are fallen palm spathes (11), broken or cut bamboo (5), treeholes (2) and wooden bowl traps (2). Associated with *metempsychus* were 3 species of *Carrollia*: *bihaicolus* (2), *sp. 3a* (1) and *bonnei* (1). The other associates included a representation of several container-breeding groups: *Aedes* (*P.*) *homoeopus*, *A. (P.) terrens* (2); *Culex* (*C.*) *molliis* (1); *Haemagogus* (*H.*) *iridicolor* (1); *Limatus asulleptus* (2), *L. durhamii* (1); *Sabethes* sp. (1). All the adults I have seen have been reared and there are no published records of adults collected in nature.

DISTRIBUTION (fig. 2). From Guatemala through Central America to Pacific drainage in central Colombia, at elevations of 30-2000 m.

Material examined: 1,268 specimens; 119 males, 162 females, 714 larvae, 273 pupae; 257 individual rearings (136 larval, 75 pupal, 46 incomplete).

COLOMBIA. *Valle*: Rio Raposo (COL 65) [UCLA].

COSTA RICA. *Alajuela*: Alajuela, A. Alfaro (24863) [USNM]. Rio Barranca N of San Ramon (CR 343) [USNM]. *San Jose*: Lourdes (CR 491,493) [UCLA].

GUATEMALA. *Chimaltenango*: Yepocapa (GUA 136,138) [UCLA].

PANAMA. *Chiriqui*: El Volcan, W.H. Komp [UCLA]. Rio Chiriqui Viejo, W.H. Komp [USNM]. *Darien*: Alturas de Nique (PA 1057) [UCLA]. Cerro Mali (PA 347,355,364,376,377,382,929,931) [UCLA].

5. *Culex* (*Car.*) *infoliatius* Bonne-Wepster & Bonne

Figs. 2,9,18,19

1920. *Culex* (*Carrollia*) *infoliata* Bonne-Wepster and Bonne, 1920:170-171. TYPE: Lectotype

male (4496) with genitalia slide (G.g. 2; BB 690), Dam, Surinam, Jan 1919 [ITH; designation by Belkin, 1968b:16].

Culex (Carrollia) infoliatus of Bonne and Bonne-Wepster (1925:205-207); Edwards (1932:221); Senevet and Abonnenc (1939:125-126; 1958:288-290); Levi-Castillo (1925:553; 1953a:35); Lane (1939:82; 1953:510); Stone, Knight and Starcke (1959:282); Fauran (1961:44); Belkin, Schick and Heinemann (1965:65-66); Cova Garcia, Sutil and Rausseo (1966a:28,115; 1966b:42-44,141,235,344); Belkin (1968b:16).

Culex (Carrollella) infoliatus of Dyar (1928:283-284); Boshell Manrique (1938:416).

Culex (Carrollella) infoliatus in part of Komp (1936:64; 1956:39).

Culex (Carrollia) bihaicolus of Cerqueira (1961:163); Forattini, Rabello and Cotrim (1970:36).

Culex (Carrollia) bihaicolus in part of Lane (1939:81; 1953:509).

Culex (Carrollella) bihaicolus of Antunes (1936:74); Boshell Manrique (1938:416).

Carrollia bihaicolus of Townsend (1934:490).

Carrollella bihaicolus of Martini (1931:217); ~~Morales-Ayala (1971:143).~~

Culex (Carrollia) metempsytyus of Levi-Castillo (1952:533; 1953a:35).

Culex (Carrollia) metempsytyus in part of Lane (1939:82; 1953:510-511).

Culex (Carrollella) metempsytyus of Komp (1936:64); Boshell Manrique (1938:416).

FEMALE (fig. 9). Wing: 3.6 mm. Proboscis: 2.3 mm. Forefemur: 2.1 mm. Abdomen: about 2.1 mm. Differentiated from other species of the group by the very long narrow light metallic streak of the hindfemur and the more extensive pale scaling of this segment. In general similar to *bihaicolus* and differing from it in the following features. Description and measurements based on 4 pinned specimens from French Guiana. *Head*: Broad decumbent scales of vertex darker and with deeper blue iridescence; lateral patch white. Proboscis 1.10-1.20 of forefemur. Palpus about 0.17 of proboscis. Antenna 0.76-0.80 of proboscis; torus with only 4-6 setae. *Thorax*: Mesonotal integument light brown, not as strongly contrasting with pleuron. Anterior acrostichals often developed to near level of scutal angle and rarely distad. Prescutal bristles 3 or 4; all mesonotal bristles lighter. Midlobe of scutellum with only a few scales, sometimes whitish. *Apn* bristles 12-14; *ppn* bristles 3 or 4, absent from upper part; upper *stp* bristles 5, lower 6; *pra* bristles 6-10; upper *mep* bristles 5 or 6. *Legs*: Midfemur extensively pale ventrally on both surfaces. Hindfemur more extensively pale; light metallic streak inconspicuous, very narrow and long, at least 0.25 of femur length, and confluent with the light scaling anteriorly and/or posteriorly. *Abdomen*: Sternites IV-VII with apical band of dark scales. *Cibarial Armature*: Cibarial bar with less conspicuous lobe on lateral flange; cibarial teeth 10 or 11; cibarial dome with rounded denticles. *Genitalia*: Tergite IX with 4 lateral bristles; insula with about 20.

MALE. Wing: 3.5 mm. Proboscis: 2.4 mm. Forefemur: 2.2 mm. Abdomen: about 2.5 mm. Differentiated from other species of the group and from *bihaicolus* by the same features as the female. Proboscis 1.09-1.10 of forefemur. Palpus 0.72-0.77 of proboscis. Antenna 0.85-0.91 of proboscis. Specimens studied: 8 from French Guiana. Measurements from dry specimens.

MALE GENITALIA (fig. 18). Lobe of tergite IX usually with 5 (4-6) bristles. Sidepiece without scales. Proximal division of subapical lobe with simple broad base bearing numerous fine simple bristles; stem elongate, with only a few bristles; setae *a* and *b* subequal, recurved apically but not contorted. Distal division not developed. Clasper not markedly tapered distally; spiniform longer than snout. Distal part of proctiger narrow, more or less parallel-sided; paraproct crown usually with 6 (4-6) teeth; 1 pair of cercal setae present.

PUPA (fig. 18). Abdomen: 3.4 mm. Trumpet: 0.65 mm. Paddle: 0.75 mm. Very similar to *bihaiocolus*; diagnostic characters as in the key. General chaetotaxy based on 10 reared specimens from French Guiana. *Cephalothorax*: Pigmentation light yellow; sculpturing weak, without definite pattern. All hairs distinctly shorter than trumpet except 5-C which is subequal; 1(1;1-2); 2(2,3;1-3) very short; 3(2,3;1-3) about 0.5 of hair 4; 4(2;2-3) subequal to hair 7; 5(2,1-3); 6(1;1-2) subequal to hair 2; 7(2-4); 8(1;1-2) longer than hair 9; 9(1-2). *Trumpet*: Moderately widened distally; index about 6.5 (5.0-6.5); pinna about 0.33. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing weak; hair 10(1-2) longer than hairs 11,12; 11(1-2); 12(1). *Abdomen*: Pigmentation yellow, anterior mesal areas of tergites III,IV slightly darker; sculpturing weak. Segment I: hair 1(26-57). Segment II: hair 1(2-4;2-5) forked and longest hair of segment; 3(1-2) subequal to hair 5; 4(3,4;3-6) short; 5(1;1-2). Segment III: hair 1(1,2) strong, finely barbed, almost reaching caudal margin of tergite IV; 3(1-2) about 0.5 of hair 1; 4(2,3;1-4) short; 5(1,2;1-3) shorter than hair 3. Segment IV: hair 1(1;1-2) slightly longer than hair 3; 3(3,4;2-6); 4(3,4;2-5); 5(1) strong, reaching level of rudimentary spiracle VI. Segment V: hair 1(1;1-2) longer than hair 3; 3(1,2;1-4); 4(3,4;2-6); 5(1) strong, reaching level of rudimentary spiracle VII. Segment VI: hair 1(1;1-2) longer than hair 4; 3(2;1-2); 4(2,3;2-4); 5(1) strong and longer than hair 3. Segment VII: hair 1(1,2;1-3) fine and longer than hair 4; 3(2,3;1-3); 4(1,2;1-3); 5(3;1-4) subequal to hair 6; 6(3,4;1-5); 9(2,3;1-3). Segment VIII: hair 4(1) shorter than hair 1-VII; 9(3;2-5) shorter than paddle.

LARVA (fig. 19). Head: 0.95 mm. Siphon: 0.95 mm. Anal Saddle: 0.25 mm. Very similar to *bihaiocolus*; diagnostic characters as in the key. General chaetotaxy based on 5 reared and 5 other specimens from French Guiana. *Head*: Integument light yellow; collar dark brown. Mental plate with 9,10 lateral teeth. Hair 4(2;2-3); 5(6,7;5-8); 6(2;2-3); 7(6-8;4-8); 8(1;1-2) subequal to hair 7; 9(4;3-4) shorter than hair 8; 10(1;1-2); 11(2,3;1-4); 12(1-2); 14(1;1-2); 15(3;2-4). *Antenna*: About 0.31 of head length; hair 1(2;1-2). *Thorax*: Prothorax: hair 0 (8-10;6-10) minute; 1(1); 2(1); 3(1,2;1-3) relatively short; 4(2;1-2); 7(2;1-3); 8 (3,4;2-4) relatively short and weak; 9(1;1-2); 10(1); 11(3,4;2-4); 12(1); 14(1). Mesothorax: hair 1(2;2-3); 2(2,3); 3(1); 4(2;2-4); 8(7-9;5-9); 9(5,6;4-6); 10(1;1-2); 11(1); 13(8-12); 14(10-19). Metathorax: hair 1(2;1-2); 2(2;1-2); 3(3,4;3-6); 4(3;2-3); 7(6,7;6-9); 8(11,12;9-15); 9(2,3;1-5); 11(1); 13(5,6;5-7). *Abdomen*: Segment I: hair 1(1,2;1-4) minute; 6(2;2-3); 7(1). Segment II: hair 1(1;1-2) minute; 3(2,3) short; 6(2;2-3). Segment III: hair 1(1;1-2) moderate, weak; 3(2;1-2) short; 6(1); 13(2;2-3) stronger and longer than hair 1. Segment IV: hair 1(2;1-3) strong and long; 3(3,4;2-4) short and weak; 6(1); 13(2,3) strong, subequal to hair 1. Segment V: hair 1(2;1-3) strong, shorter than hair 1-IV; 3(1) long, weak; 6(1); 13(2,3) longer than hair 1. Segment VI: hair 1(2;2-3) intermediate in length between hairs 1-IV,V; 6(1). Segment VII: hair 1(2;2-3) stronger and longer than hair 1-IV. *Segment VIII*: Comb scales (31-62) spatulate and conspicuously fringed; hair 1(4,5;4-6) very short, about 0.33 of hair 2; 3(6,7;5-7); 5(1;1-2) more than 2.0 of hair 1. *Siphon*: Pigmentation light yellow to brown; sculpturing weak. Index about 2.7-3.7. Pecten teeth (6-15) short, with conspicuous denticles on ventral margin. Ventral siphonal tufts (10-12) usually quadruple (3-7). *Anal Segment*: Saddle shallowly emarginate laterally; pigmentation light yellow to brown; sculpturing weak, only slightly more prominent caudodorsad. Hair 1(1,2;1-3); 2 (5,6;4-6). Ventral brush with 5 pairs of hairs, all except proximal pair usually triple (2-4). Gills more than 3.0 of dorsal saddle length.

SYSTEMATICS. *Culex infoliatu*s is interpreted here as the derived species of its complex, whose only other member is *metempsytu*s, because of the reduction in the branching of hair 6 on abdominal segments III-V of both the larva and pupa (shared with the nominate species of the *Bihai*colus Complex) and the long metallic streak of the hindfemur of the adults (unique in the group). It is probably the dominant species of the complex as suggested by its wide geographical range.

Adults of *infoliatu*s have been misidentified as *bihai*colus and *metempsytu*s by several authors in the past (see taxonomic references above). However, they are readily distinguished from all members of the group by the ornamentation of the hindfemur. As noted under *metempsytu*s the minor key characters for the differentiation of the male genitalia of these 2 species appear to be reliable. The separation of *metempsytu*s and *bihai*colus in the pupal stage by the key characters may not be entirely reliable but it appears to be satisfactory in the larva.

In the limited sample available I have found no significant population differences in any stage. Although the present distribution of *infoliatu*s appears to be primarily Amazonian, its original center may have been the Guiana Shield with subsequent dispersal into the Amazon and upper Orinoco drainages. The absence of *infoliatu*s from Trinidad is probably real as container-breeding habitats have been very extensively sampled on this island.

BIONOMICS. I have examined collections of immature stages only from the Villavicencio area in Colombia and from Surinam and French Guiana. These were made in treeholes (4), fallen palm spathes (3) and tin cans (2). The only recorded associates were in a tin can in French Guiana: a species of *Carrollia (bonnei)*, *C. (Microc.) ston*ei and *Wyeomyia aporonoma*. Because of the wide distribution of *infoliatu*s, the range of both breeding sites and associates is probably much greater. Antunes (1937:79) reports the capture of 2 males resting on plants in the Villavicencio area and Cerqueira (1961:136) an unspecified number of females attracted to human or animal bait in Manaus, Brazil.

DISTRIBUTION (fig. 2). Amazon and Orinoco basins and the Guianas at elevations up to 600 m.

Material examined: 119 specimens; 29 males, 32 females, 45 larvae, 13 pupae; 6 individual rearings (5 larval, 1 incomplete).

BRAZIL. *Para*: Boa Vista, C.H.T. Townsend [USNM].

COLOMBIA. *Meta*: Retiro, W.H. Komp (KO 10-28) [UCLA]. Restrepo, W.H. Komp (1019, 1025, 1040) [USNM], (KO 31-36, 31-39) [UCLA]. Villavicencio (CV 1002, C-30) [UCLA].

FRENCH GUIANA. *Inini*: Maroni [UCLA]. Saut Tigre (FG 179, 180) [UCLA].

PERU. *Huanuco*: Tingo Maria, Humbleton [USNM].

SURINAM. Dam (BB 621, 739) [USNM]; BB 690, lectotype [ITH].

Additional Records From the Literature

BRAZIL. *Amazonas*: Manaus. *Para*: Santarem (Cerqueira, 1961:136).

ECUADOR. *Napo-Pastaza*: Tena. Ila. Puyo (Levi-Castillo, 1952:553).

FRENCH GUIANA. *Guyane*: Cabassou. Crique Anguille. *Inini*: Balorou. Maroni. St. Elie. St. Nazaire. Saut Canori. Saut Machicou. Saut Tigre (Fauran, 1961:44).

PERU. *Junin*: Chanchamayo (Martini, 1931:217; Morales Ayala, 1971:143).

VENEZUELA. Locality not specified (Anduze, 1941a:17).

IRIDESCENS GROUP

FEMALES. *Head*: Band of broad decumbent scales of vertex very narrow and

sometimes broken on midline (*Urichii* Subgroup) or very broad; narrow decumbent scales of vertex and occiput very numerous to apparently absent; erect scales moderately long to short, from very numerous and reaching orbital bristles to relatively few and restricted to posterior part of vertex and occiput. Proboscis subequal to forefemur or slightly longer. Antenna subequal to proboscis to distinctly longer. *Thorax*: Mesonotal integument dark brown to black, vestiture of dark bronzy to dark golden scales moderate to very dense, scales linear to narrow curved, latter more numerous in prescutellar space; inner dorsocentral line completely scaled or unscaled at anterior end (*Urichii* Subgroup). Scutellar scales linear to broad. Acrostichals absent except a few at anterior promontory. Anterior and posterior dorsocentral bristles absent; prescutellars well developed and numerous (*Urichii* Subgroup) or reduced; prescutals present (*Urichii* Subgroup) or absent. Pleural integument always darkened to near base of coxae and with a broad diagonal pruinose stripe from *ppn* to metapleuron. Upper *stp* bristles absent or a few weak ones not forming curved row to lower bristles (*Urichii* Subgroup). *Legs*: Hindtarsus entirely dark or with a broad basal light ring on segment 4. *Wing*: Plume scales moderately long and narrow but not linear on R_s , R_{2+3} and M ; very broad and not differentiated from squame scales on R_2 and R_3 . *Abdomen*: Pregenital segments more or less distinctly compressed; tergites without (*Urichii* Subgroup) or with basal dorsal light bands. *Cibarial Armature*: Denticles of cibarial dome triangular to rounded.

MALES. General characters as in the females. Proboscis subequal to forefemur or distinctly longer. Antenna and palpus subequal to proboscis or distinctly shorter. Anterior claw of foretarsus with tooth, that of midtarsus with or without a tooth (*Urichii* Subgroup).

MALE GENITALIA. *Segment VIII*: Tergite with median emargination; with 3-6 or more rows of strong setae mixed with scales. Sternite with 1 complete row of setae. *Segment IX*: Tergite more or less strongly sclerotized dorsally; lobes widely separated or approximated, always flattened. Sternite short, poorly sclerotized. *Sidepiece*: Conical to ovoid. Apicosternal process varied. *Subapical Lobe*: Accessory division present or absent. Distal division small and widely separated from proximal or represented by a small protuberance or apparently completely absent. *Clasper*: Complex, with a more or less distinct head differentiated from basal part; shorter to longer than sidepiece; moderately to strongly curved dorsad; shape varied. Preapical lobe always developed and bearing seta *b* which is variously developed; seta *a* developed as normal thickened spiniform or hairlike. Crest ridged or a flat sclerite. *Lateral Plate*: Relatively narrow; external spine not developed; sternal spine present or absent; caudal process always developed. *Proctiger*: Paraproct sclerotization with mesal sternal lobe.

PUPAE. Cephalothoracic hair 5-C varied in development and length. Trumpet varied in length and development of pinna. Abdominal hair 2-II mesad of 3-II; hair 3-VI laterad of 1-VI; hair 3-II usually strong; 1-III always weak and 3-III always strong and longest hair of segment; 5-VI frequently strong.

LARVAE. Head capsule with anterior dorsal surface flattened so that hairs 5,6-C appear posterior to antennal base from dorsal aspect; integument with or without sculpturing visible at 100X; hair 9-C removed caudad to near collar, more or less stellate; 12,14-C varied in position. Maxillary hair 5-MP greatly thickened and brush-tipped. Anterior part of prothorax with or without spicules; prothoracic hairs 0,8-P varied in development; mesothoracic hair 14-M and metathoracic hair 13-T varied in development. Abdominal hair 1-II minute to strong-

ly developed; 3-VI short, dendritic; 11-I dendritic. Comb scales elongate, spine-like and arranged in 1 more or less regular row, rarely a few scales displaced into second row; hair 1-VIII very short, multiple. Integument of siphon with or without elongate spicules visible at 100X; pecten teeth scalelike or spinelike; ventral siphonal tufts 4-8 pairs; siphon index varied. Hair 1-X single or branched; 2-X fan-shaped or asymmetrical; ventral brush varied.

DISCUSSION. Nearly all the character states listed above in the diagnosis of all the stages of the Iridescens Group are derived. However, some primitive features have been retained in several lines of the group. The most significant diagnostic features of the group are indicated in the keys. The group does not occur as far north as the Bihacolus Group and extends southward beyond the Amazon Basin into southern Brazil and adjacent northeastern Argentina.

There are 2 very distinct principal phyletic lines in the group: the compact *Urichii* Subgroup of 2 very similar species and the complex *Iridescens* Subgroup of 9 named species, 2 unnamed forms and possible 2 or 3 additional species. For the diagnostic features and the systematics see the discussions under the respective subgroups.

The 2 subgroups are sympatric in the northern part of the range of the group and only the *Iridescens* Subgroup extends southward of the Amazon Basin.

The group as a whole shows nearly the entire range of breeding sites known for the subgenus in its few widespread species but includes many species or forms with restricted distribution and breeding sites. It has the same range of breeding associates. Only a few adults have been collected in nature, principally in the *Urichii* Subgroup.

URICHII SUBGROUP

FEMALES. Band of broad decumbent scales of vertex very narrow and often broken on midline; narrow decumbent scales of vertex and occiput very numerous; erect scales moderately long, very numerous and extending to orbital bristles. Antenna distinctly longer than proboscis. Mesonotal vestiture moderately dense, all dark, scales largely linear; inner dorsocentral line bare at anterior end; scutellar scales linear; prescutellar bristles well developed; prescutals present; upper *stp* bristles present but not forming continuous row with lower bristles. Metallic spots of femora golden to coppery but with dark violet iridescence, inconspicuous and variable in size; forefemur usually with small preapical spot. Hindtarsal segment 4 with a broad basal white or whitish ring. Abdominal tergites without basal dorsal light bands; metallic spots small.

MALES. Palpus nearly as long as proboscis. Anterior claws of both foretarsus and midtarsus with submedian tooth.

MALE GENITALIA. Median emargination of tergite VIII shallow. Lobes of tergite IX widely separated. Sidepiece conical; without lateral scales; with short setae on mesal surface; apicosternal process poorly developed. Accessory division of subapical lobe not developed; distal division represented by distinct lobe with 1 or more specialized setae near apex of sidepiece. Clasper distinctly shorter than sidepiece, only moderately curved dorsad; preapical lobe poorly developed; seta *b* simple; seta *a* developed as normal thickened spiniform; crest ridged. Lateral plate of phallosome with sternal spine; caudal process curved ventrad apically.

PUPAE. Cephalothoracic hair 5-C strong and usually at least 0.67 of trumpet

length. Trumpet short, index usually less than 7.0; pinna large or moderate.

LARVAE. Integument of head capsule with slight sculpturing visible at 100X, particularly caudad; head hair 12-C about halfway between antennal base and collar; 14-C near anterior ventral border of head capsule. Maxillary hair 5-MP forked near middle. Anterior part of prothorax without spicules; prothoracic hair 0-P always short and dendritic; 8-P similar in development to 7-P and usually double or triple; mesothoracic hair 14-M very small and dendritic; metathoracic hair 13-T single, strong and very long. Abdominal hair 1-II minute. Integument of siphon sparsely covered with elongate spicules visible at 100X; distal pecten teeth very long and slender. Hair 1-X single; 2-X fan-shaped, with numerous branches; ventral brush (4-X) with at least 5 pairs of hairs, usually with 6.

DISCUSSION. The *Urichii* Subgroup is characterized by striking unique derived features. In the adults hindtarsal segment 4 has a broad basal white ring and in the fourth instar larvae prothoracic hair 8-P and metathoracic hair 13-T are thickened. The subgroup also possesses some primitive character states not found even in the *Bihaicolus* Group. In the male genitalia the distal division of the subapical lobe is relatively better developed than elsewhere in the subgenus. In the larvae there is a stronger development of the siphonal hairs and of the ventral brush as well as hair 2-X of the anal segment. In other respects the *Urichii* Subgroup appears to be intermediate between the *Bihaicolus* Group and the *Iridescens* Subgroup. In the adults the inner dorsocentral line is bare; prescutal and upper sternopleural bristles are present; and the anterior claws of both the foretarsus and mid-tarsus are toothed. In the pupae the trumpet is short and cephalothoracic hair 5-C strongly developed.

Because of this mosaic of characters and especially the unique features it is tempting to elevate the subgroup to group rank. However the *Urichii* Subgroup shares with the *Iridescens* Subgroup some basic correlated features in all stages: (1) in the **adults**, darkened pleuron and reduction of dorsocentral bristles; (2) in the **male genitalia**, caudal process on the lateral plate of the phallosome, paraproct sclerotization with mesal sternal lobe, and seta *b* of the clasper displaced; (3) in the **pupae**, position of hair 2 on abdominal segment II and hair 3 on segment VI; and (4) in the **larvae**, position of head hair 9-C and the type and arrangement of the comb scales. The sharing of this combination of characters clearly indicates a single phyletic line for the 2 subgroups and not an independent derivation of each subgroup from a common ancestor with the *Bihaicolus* Group.

The subgroup is very compact. Its 2 component species, *urichii* and *anduzei*, cannot be separated on external characters of the adults and the distinguishing characters of the pupae and larvae are minor ones but apparently quite constant. However male genitalic differences are clear cut.

The *Urichii* Subgroup is known from a wide area extending in the north to Costa Rica and in the south to upper parts of the Amazon Basin in Brazil, Bolivia and Peru. *Culex urichii* occupies the entire range and *anduzei* has a restricted sympatric distribution in the lower Amazon Basin.

The subgroup as a whole shows nearly the entire range of breeding sites and associates known for the subgenus. The dominant *urichii* has been frequently collected and shows a broad spectrum of breeding sites and associates but has not been found in the flower bracts of *Heliconia* or leaf axils of *Dieffenbachia*. On the other hand, immature stages of *anduzei* are known from only a few collections in treeholes, bamboo and tin cans and only a few breeding associates are

known for this species. Adults of both species have been collected in nature and it appears that *urichii* is occasionally attracted to humans.

6. *Culex (Car.) urichii* (Coquillett)

Figs. 3,7,9,20,21

1906. *Melanoconion urichii* Coquillett, 1906a:61. TYPE: *Holotype* female, St. Ann's Valley, Port-of-Spain, St. George, Trinidad, Jan 1906, F.W. Urich [USNM, 9141].
 1942. *Culex (Carrollia) mathesoni* Anduze, 1942:47-49. TYPE: *Holotype* male genitalia only (241), Penon de Parai-tepui, Bolivar, Venezuela, Nov 1940, P. Anduze [FH, 10111; slide 2139]. NEW SYNONYM.

Culex (Carrollia) urichii of Dyar (1918:108; 1928:283,538); Bonne-Wepster and Bonne (1920:171; 1923:124); Bonne and Bonne-Wepster (1925:197-200); Edwards (1932:221; 1934:663); Komp (1936:64); Boshell-Manrique (1938:416); Kumm and Novis (1938:503,511); Senevet and Abonnenc (1939:128; 1958:290-292); Lane (1939:83; 1953:511-513); Anduze (1941a:17; 1941b:834); Cerqueira (1943:35; 1961:136); Cerqueira and Lane (1944:216-218); Anduze, Pifano and Vogelsang (1947:16); Galindo, Carpenter and Trapido (1951:102,104,105,108,126); Levi-Castillo (1952:553; 1953a:35); Galindo and Blanton (1955:73); Stone and Knight (1957:59); Stone, Knight and Starcke (1959:283); Fauran (1961:44); Mattos and Xavier (1965:280); Belkin, Schick and Heinemann (1965:70-71); Cova Garcia, Sutil and Rausseo (1966a:28,11; 1966b:42,44,84,141,231,344); Barreto and Lee (1969:434); Forattini, Rabello and Cotrim (1970:50); Morales-Ayala (1971:143).

Culex (Carrollella) urichii of Antunes (1937:78).

Carrollella urichii of Martini (1931:217).

Carrollia urichii of Dyar and Knab (1909:101); Urich (1913:528); Howard, Dyar and Knab (1915:464-466).

Mochlostyrax urichii of Dyar (1906:18); Dyar and Knab (1906:223).

Melanoconion urichii of Coquillett (1906b:23); Theobald (1910:455,458).

Culex (Carrollia) mathesoni of Cerqueira and Lane (1944:218-219); Anduze, Pifano and Vogelsang (1947:16); Lane (1953:513); Stone, Knight and Starcke (1959:283); Fauran (1961:44); Cerqueira (1961:136); Belkin, Schick and Heinemann (1965:76); Cova Garcia, Sutil and Rausseo (1966a:28,113; 1966b:141,344); Forattini, Rabello and Cotrim (1970:43).

FEMALE (figs. 7,9). Wing: 4.4 mm. Proboscis: 2.45 mm. Forefemur: 2.5 mm. Abdomen: about 3.6 mm. Apparently indistinguishable from *anduzei*. General characters as for the subgroup; description based on 29 topotypic specimens from Trinidad. *Head*: Band of broad decumbent scales of vertex dark with bluish iridescence; narrow decumbent scales golden; erect scales golden; lateral patch white. Proboscis 0.96-0.98 of forefemur. Labium largely dark scaled, indefinitely paler ventrally. Palpus 0.21-0.22 of proboscis; entirely dark scaled. Antenna 1.06-1.12 of proboscis; torus with 8-10 setae. *Thorax*: Mesonotal and scutellar integument very dark brown; scales dark bronzy; bristles dark bronzy except for some coppery to golden prescutellars. Anterior promontory with 3-6 bristles; prescutals 2 or 3. Midlobe of scutellum with 6-8 long bronzy to coppery bristles, scales bronzy; lateral lobe with 3 long bristles and bronzy scales. Pleuron usually entirely darkened, including all of sternopleuron (lower part sometimes light), meron and metameron; pruinose stripe very broad, greatly widened distally. *Apn* with 5-8 bristles and usually numerous short broad erect black scales; *ppn* with 3 or 4 posterior bristles and several narrow bronzy scales; *ppl* bristles 4-6; *stp* with 1-3 upper bristles and 4-6 lower posterior; *pra* bristles 6 or 7; *umep* bristles 8-11. *Legs*: Coxal integument light, sometimes darkened at base; scales whit-

ish to light golden. Forefemur largely dark scaled; pale scaled at base, more extensively on posterior surface, and on a transverse posterior preapical band which is extended basad dorsally for variable distance; anterior surface usually with a variable metallic spot, often difficult to see. Midfemur light scaled at extreme base, remainder dark scaled but scales along anteroventral margin with golden iridescence and appearing light in some aspect; metallic spots basically golden with deep violet reflections, extremely variable in size and shape and appearing confluent with ventral golden streak. Hindfemur pale scaled except for dark apical band and dorsal margin; metallic spot basically golden with deep violet iridescence, variable in size, located basad of apical dark band. Knee spots barely indicated by a few pale apical scales on femora. Hindtarsal segment 4 with a broad ring of white or whitish scales at base extending at least 0.5 but often up to 0.8 of segment. *Abdomen*: Tergite I with an extensive patch of dark scales. Light metallic spots of tergites basically silver with pale violet iridescence, often small on II,III and subbasal on IV,V; marginal bristles of tergites golden. Sternites golden, IV-VII with black apical bands; apical bristles golden. *Cibarial Armature*: Cibarial bar with moderately developed lobe on lateral flange; cibarial teeth 3-5, very broad; cibarial dome with triangular denticles. *Genitalia*: Tergite IX with 3-5 lateral bristles; insula with 18-20.

MALE. Wing: 4.4 mm. Proboscis: 2.9 mm. Forefemur: 2.5 mm. Abdomen: about 3.8 mm. Indistinguishable from *anduzei* except on genitalic characters. Essentially similar to the female except for usual sexual characters. Proboscis 1.1-1.2 of forefemur. Palpus 0.86-0.89 of proboscis. Antenna 0.98-1.00 of proboscis. Specimens studied: 28 from the type locality in Trinidad.

MALE GENITALIA (fig. 20). Lobe of tergite IX usually with 6 (4-16) bristles. Seta *a* of proximal division of subapical lobe with pointed curved apex; seta *b* weakly dilated apically. Distal division with 2 short apically truncate and 2 long tapered flattened specialized setae on a short broad process and a group of 6-20 flattened saberlike setae proximad of process. Clasper with poorly developed triangular preapical lobe. Distal part of proctiger relatively broad; paraproct crown usually with 3 (2-6) teeth; cercal setae usually 1 pair (1-4).

PUPA (fig. 20). Abdomen: 3.25 mm. Trumpet: 0.65-0.70 mm. Paddle: 0.85 mm. Very similar to *anduzei*; diagnostic characters as in the key. General chaetotaxy based on 10 specimens from Trinidad. *Cephalothorax*: Pigmentation light brown; sculpturing generally moderate but very distinct near trumpet base. All hairs distinctly shorter than trumpet except 5-C which is usually subequal or at least 0.67 of its length; 1(1;1-2); 2(2,3) subequal to hair 6; 3(2;2-3); 4(3,4;2-4) subequal to hair 3; 5(2,3;1-4) barbed; 6(3,4;1-5) subequal to hair 2; 7(2;1-2); 8(1;1-2); 9(1;1-2). *Trumpet*: Moderately to strongly widened distally; index variable, 5.3-7.5; pinna variable, 0.17-0.33. Pigmentation light brown. *Metanotum*: Pigmentation yellow to light brown; sculpturing uneven, moderate; hair 10(2;1-3) longer than hairs 11,12; 11(3,4;2-6); 12(2;1-2). *Abdomen*: Pigmentation yellow to light brown, anterior mesal areas of tergites II,IV darker; sculpturing moderate. Segment I: hair 1(80-115) fan-shaped. Segment II: hair 1(22-38) longer than hair 5; 3(1) strong, reaching level of hair 6-III; 4(8-12;6-12) very short; 5(1,2;1-3) about twice as long as hair 4. Segment III: hair 1(4,5;2-6); 3(1) strong, reaching level of hair 6-IV; 4(3,4;2-5) forked; 5(2,3;1-4) about twice as long as hair 4. Segment IV: hair 1(1,2) subequal to hair 1-V; 3(4,5;3-8); 4(2;1-4); 5(1) strong, surpassing level of rudimentary spiracle VI. Segment V: hair 1(1,2) subequal to hair 1-IV; 3(1;1-2); 4(5,6;3-8); 5(1) strong, surpassing level of rudimentary spiracle

VII. Segment VI: hair 1(1) weak and shorter than hair 6; 3(1,2;1-4) shorter than hair 1; 4(3,4;1-6) shorter than hair 3; 5(1) at most reaching level of rudimentary spiracle VII. Segment VII: hair 1(1;1-2) longer than hair 4; 3(2,3;1-3); 4(2;1-2); 5(4-6;2-6) subequal to hair 6; 6(8-10;5-15) short and dendritic; 9(3,4;3-6) barbed, shorter than hair 9-VIII. Segment VIII: hair 4(1) shorter than hair 1-VII; 9(3,4) shorter than paddle.

LARVA (fig. 21). Head: 0.95 mm. Siphon: 1.25 mm. Anal Saddle: 0.40 mm. Very similar to *anduzei*; diagnostic characters as in the key. General chaetotaxy based on 7 reared and 3 other specimens from Trinidad. *Head*: Integument yellow to brown; collar darkened. Mental plate with 9 or 10 lateral teeth. Hair 4(6,7;5-9); 5(8-10;6-10); 6(2,3;1-4); 7(4,5;4-8); 8(1;1-2) subequal to hair 7; 9(5,6;5-7); 10(3;2-4); 11(3,4;2-5); 12(1); 14(1-2); 15(3;2-4). *Antenna*: About 0.35 of head length; hair 1(3,4;3-6). *Thorax*: Prothorax: hair 0(30-40); 1(1); 2(1); 3(3-4); 4(2); 7(4;3-6); 8(2;2-3); 9(1); 10(1); 11(5,6;4-6); 14(1). Mesothorax: hair 1(1;1-2); 2(2,3;1-3); 3(1); 4(2); 8(12;11-16); 9(10-12;8-12); 11(1); 13(20-50); 14(27-40). Metathorax: hair 1(2;1-4); 2(2;2-3); 3(6,7;5-8); 4(6-8;4-10); 6(1); 7(8,9;6-10); 8(25-50); 9(4;3-5); 11(1); 13(1). *Abdomen*: Segment I: hair 1(1;1-2) minute; 6(2); 7(2). Segment II: hair 1(1;1-3); 3(1) moderate; 6(2). Segment III: hair 1(1) very long, strong; 3(1;1-2) moderate; 6(1); 13(1) subequal to hair 1. Segment IV: hair 1(1) very long, strong and usually slightly longer than hair 1-III; 3(3,4;2-5) short; 6(1); 13(1) subequal to hair 1. Segment V: hair 1(1) subequal to hair 1-III; 3(1) long; 6(1); 13(1) subequal to hair 1. Segment VI: hair 1(1) weak and relatively short; 6(1). Segment VII: hair 1(1) very strong and long, usually reaching middle of siphon. *Segment VIII*: Comb scales (17-22) with lateral fringes distinct at base only; hair 1(8-10;8-16); 3(11,12;9-12); 5(2;2-3). *Siphon*: Pigmentation light brown. Index about 4.0-5.0. Pecten teeth (8-11) with indistinct fringes on ventral margin. Ventral siphonal tufts (14-16) with about 8 branches (6-10). *Anal Segment*: Saddle pigmentation light brown, darkened dorsad. Hair 1(1); 2(12-16). Ventral brush with 6 pairs of hairs, all except the proximal pair usually with at least 16 branches. Gills usually less than 2.0 of dorsal saddle length, tapered.

SYSTEMATICS. *Culex urichii* is very similar to *anduzei*, the other member of the subgroup. I have not been able to separate the 2 species on any external features of the adults. However, the male genitalia are quite distinctive and show no overlap in the key characters. The larvae and pupae are very similar but apparently readily separated by the relatively minor differences used in the keys.

A careful study of the male genitalia of some 80 specimens has revealed that the reduced number of foliaceous setae on the distal division of the subapical lobe, supposedly diagnostic of *mathesoni*, falls well within the wide range of variation exhibited by typical *urichii*. I have therefore synonymized *mathesoni* with *urichii*.

Culex urichii is the dominant species of the subgroup and has the widest known distribution in the subgenus. It might appear therefore that it is the derived species of the subgroup. However, because *urichii* has retained primitive character states in the male genitalia (well developed distal division of the subapical lobe; relatively simple clasper head; cercal setae), pupa (short hair 5-VI) and larva (more numerous and more profusely branched hairs in the siphon and in the ventral brush), I believe that it is closer to the ancestral stock than *anduzei*, which has derived states in these characters.

BIONOMICS. *Culex urichii* has been collected from nearly as wide a range of

natural breeding sites as *bihaicolus*: treeholes (18), broken or cut bamboo (11), fallen leaves and palm spathes (7), fallen nuts (1) and rockholes (1). It has also been frequently found in a wide variety of artificial containers (15) and twice in bamboo traps. Two species of *Carrollia* have been recorded as breeding associates: *bihaicolus* (2) and *bonnei* (3); and 15 other species representing nearly every sympatric group with similar breeding sites: *Aedes* (*H.*) *ioliota* (3), *A. (O.) fluviatilis* (1), *A. (P.) insolitus* (4), *A. (P.) podographicus* (1); *Anopheles* (*An.*) *eiseni* (4); *Culex* (*Anoed.*) sp. (1), *C. (C.) corniger* (1), *C. (C.) mollis* (5), *C. (Mel.)* sp. (1); *Limatus durhamii* (1); *Orthopodomyia albicosta* (1), *O. fascipes* (2); *Sabethes undosus* (3); *Trichoprosopon* (*R.*) *ulopus* (1); *Wyeomyia complosa* (1).

There are more records of *urichii* collected as adults in nature than for any other species of *Carrollia*. I have seen 1 male and 2 females collected by T.H.G. Aitken in Trinidad. Komp (1936:64) reported females attracted to humans in the Villavicencio area in Colombia; Kumm and Novis (1938:503) captured adults attracted to animal bait (agouti) on Marajo Island, Brazil; and Cerqueira (1961: 136) found females on human and animal bait in Manaus, Brazil.

DISTRIBUTION (fig. 3). From central Costa Rica through northern South America to Pacific drainage in Colombia and southern drainages of the Amazon basin in Peru, Bolivia and Brazil, at elevations of 20-800 m.

Material examined: 515 specimens; 120 males, 100 females, 176 larvae, 119 pupae; 96 individual rearings (50 larval, 15 pupal, 31 incomplete).

BRAZIL. Amazonas: Rio Paruari (FM 38) [USNM]. *Para:* near Belem (BRA 38) [UCLA].

COLOMBIA. Antioquia: Providencia, Anori R. valley, C. Porter [UCLA]. *Meta:* Balconcito (KO 1-36) [UCLA]. Bosque Ocoa (C-24, CV 581,1014) [UCLA]. Restrepo, W.H. Komp (565, 566,585,598) [UCLA]; (10-40) [USNM]; (1000) [FH]. Retiro (KO 10-28) [UCLA]. Rio Guacavia, W.H. Komp [UCLA]. Villavicencio, M. Bates (194) [USNM]; (7438,7439) [FH].

COSTA RICA. Puntarenas: Esparta (CR 356) [UCLA].

FRENCH GUIANA. Guyane: Cabassou (FGC 3518,3902) [UCLA]. Cogneau (FGC 3384,3462, 3472) [UCLA]. Le Gallion (FGC 3138,3173,3375,3379) [UCLA]. Rochambeau (FGC 3536) [UCLA]. Matouri (FGC 3382) [UCLA].

PERU. Loreto: Iquitos, R.C. Shannon [USNM].

PANAMA. Canal Zone: Barro Colorado, W.H. Komp [UCLA, USNM]. Madden (PA 707) [UCLA]. *Chiriqui:* El Volcan, W.H. Komp [UCLA]. *Darien:* Morti (PA 948) [UCLA]. *Panama:* Cerro Azul (94-W) [USNM]. Pacora (4897,4942,6992) [UCLA].

SURINAM. Marowijne: Moengo, H.H. Stage [USNM]. *Locality not Specified:* BB 641,642, 666,701 [USNM].

TRINIDAD. Nariva: Charuma Forest (TR 750) [UCLA]. Nariva Swamp, T. Aitken [UCLA]. Tabaquita, T. Aitken [UCLA]. *St. Andrew:* Coryal (TR 492) [UCLA]. Cumaca (TR 782,787, 940,1009,1144) [UCLA]. Guatepajaro road (TR 859) [UCLA]. Oropouche Swamp, T. Aitken [UCLA]. Nestor (TR 475) [UCLA]. Turance, T. Aitken [UCLA]. Valencia old road (TR 1113) [UCLA]. *St. George:* Chaguaramas (TR 49) [UCLA]. Guanapo Heights (TR 1119) [UCLA]. L'Orange road (TR 707) [UCLA]. St. Ann's Valley, F.W. Urich, holotype of *urichii* [USNM, 9141]. St. Pats, T. Aitken [UCLA]. Verdant Vale (TR 676,677,822,1452) [UCLA].

VENEZUELA. Aragua: near Choroni (VZ 315) [UCLA]. Ocumare de la Costa, road to (VZ 310) [UCLA]. Turiamo, W.H. Komp [USNM]. *Bolivar:* Penon de Parai-tepui, P. Anduze, holotype of *mathesoni* [FH]. *Monagas:* Quiriquiri (KO 1-24) [UCLA]. Maturin, W.H. Komp [USNM].

Additional Records From the Literature

BOLIVIA. Beni: Vaca Diez (Cerqueira, 1943:35).

BRAZIL. Amazonas: Manaus (Cerqueira, 1961:136). Rio Maues [FH, 4097] (Cerqueira, 1944: 218). Rio Paruari (Cerqueira, 1944:218). *Goias:* Anapolis, Inhumas (Mattos and Xavier, 1965: 280). *Para:* Currealinho (Cerqueira, 1961:136). Marajo Island (Kumm and Novis, 1938:503).

BRITISH GUIANA. Essequibo River (Edwards, 1934:663).

ECUADOR. *Napo-Pastaza*: Arajuno, Shell-Mera, Tena (Levi-Castillo, 1952:553).

FRENCH GUIANA. *Guyane*: Cabassou, Crique Anguille. Rochambeau (Fauran, 1961:44). *Inini*: Balourou. Saut Canori. St. Elie (Fauran, 1961:44).

PERU. *Huanuco*: Rio Pachitea. *Pasco*: Puerto Bermudez (Martini, 1931:217; Morales-Ayala, 1971:143).

VENEZUELA. *Aragua*: Choroni, Guamitas. Ocumare de la Costa. Rancho Grande (Cova Garcia, 1966b:84). *Bolivar*: Surukum. Uriven (Anduze, 1941b:834). *Monagas*: Caripito, Quiriquire (Cova Garcia, 1966b:84).

7. *Culex (Car.) anduzei* Cerqueira & Lane

Figs. 3,9,22,23

1944. *Culex (Carrollia) anduzei* Cerqueira and Lane, 1944:219-220. TYPE: *Holotype* male, Rio Maues, Amazonas, Brazil, Feb 1937, C. Worontzow [FH, 4099].

Culex (Carrollia) anduzei of Lane (1953:513-514); Stone, Knight and Starcke (1959:282); Cerqueira (1961:136); Forattini, Rabello and Cotrim (1970:35); Belkin, Schick and Heinemann (1971:27); Barata and Cotrim (1972:25-30).

FEMALE (fig. 9). Wing: 4.1 mm. Proboscis: 2.4 mm. Forefemur: 2.4 mm. Abdomen: about 3.2 mm. Apparently indistinguishable from *urichii* on external features. Description and measurements based on 5 pinned specimens from Belem, Brazil. *Head*: Proboscis 1.00-1.18 of forefemur; palpus 0.20 of proboscis. Antenna 1.10-1.18 of proboscis; torus with 10-12 setae. *Thorax*: Anterior promontory with 2-4 bristles; prescutals 2-4. Lateral lobe of scutellum with 3 or 4 bristles. *Apn* with 4-6 bristles, broad scales apparently less numerous than in *urichii*; *ppl* bristles 4; *stp* with 2 upper bristles and 5 or 6 lower posterior; *pra* bristles 6-8; *umep* bristles 6. *Cibarial Armature*: Cibarial bar without lobe on lateral flange; cibarial teeth 5. *Genitalia*: Tergite IX with 2 or 3 lateral bristles; insula with 20-24.

MALE. Wing: 3.5 mm. Proboscis: 2.6 mm. Forefemur: 2.2 mm. Abdomen: about 3.1 mm. Indistinguishable from *urichii* except on genitalic characters. Essentially similar to the female except for sexual characters. Proboscis 1.10-1.18 of forefemur. Palpus 0.92 of proboscis. Antenna 1.01-1.03 of proboscis. Specimens studied: 5 from Belem, Brazil. Measurements from dry specimens.

MALE GENITALIA (fig. 22). Lobe of tergite IX usually with 4 (4-6) setae. Setae *a* and *b* of proximal division of subapical lobe both with dilated recurved apex. Distal division represented only by a digitiform process bearing 1 heavy bristlelike thickened apical seta. Clasper with large broad preapical lobe. Distal part of proctiger relatively narrow; paraproct crown usually with 4 (3-5) teeth; cercal setae usually 2 pairs (1 or 2).

PUPA (fig. 22). Abdomen: 3.20 mm. Trumpet: 0.65 mm. Paddle: 0.70 mm. Very similar to *urichii*; diagnostic characters as in the key. General chaetotaxy based on 9 specimens from Brazil. *Cephalothorax*: Pigmentation light brown; sculpturing moderate. All hairs distinctly shorter than trumpet except 5-C which is subequal; 1(1;1-2); 2(1;1-2) subequal to hair 6; 3(2;1-2); 4(3,4;1-4) longer than hair 3; 5(1,2;1-3); 6(1,2;1-3); 7(2;1-2) twice as long as hair 4; 8(1); 9(1) longer than hair 8. *Trumpet*: Moderately to strongly widened distally; index about 4.0 (3.6-5.0); pinna about 0.33. Pigmentation light brown. *Metanotum*: Pigmentation

yellow to light brown; sculpturing uneven, moderate; hair 10(5,4;1-5); 11(3,4;2-6) shorter than hairs 10,12; 12(1,2;1-3). *Abdomen*: Pigmentation yellow to light brown, anterior mesal areas of tergites III,IV slightly darker; sculpturing moderate. Segment I: hair 1(50-100) fan-shaped. Segment II: hair 1(15-20;14-22) subequal to hair 3; 3(1) strong, reaching level of hair 6-III; 4(3-6;3-8); 5(1,2;1-3) poorly developed. Segment III: hair 1(3-5;2-6); 3(1) strong, reaching level of hair 6-IV; 5(2,3;1-4). Segment IV: hair 1(1,2) longer than hair 1-V; 3(3,4;3-7); 4(2,3); 5(1) strong, surpassing level of rudimentary spiracle VI. Segment V: 1(1,2); 3(1,2) longer than hair 1; 4(4,5;4-6); 5(1) strong, surpassing level of rudimentary spiracle VII but shorter than hair 5-IV. Segment VI: hair 1(1;1-2) shorter than hair 3; 3(2,3;1-4) subequal to hair 4; 4(3,4;2-4); 5(1) strong, surpassing caudal margin of tergite VII. Segment VII: hair 1(1) reaching level of hair 4-VIII; 3(1,2) shorter than hair 5; 4(1,2); 5(4-6;2-6); 6(4-16) short; 9(4,5;3-10) barbed, slightly shorter than hair 9-VIII. Segment VIII: hair 4(1;1-2); 9(4,5;3-5) shorter than paddle.

LARVA (Fig. 23). Head: 1.00 mm. Siphon: 1.00 mm. Anal Saddle: 0.30 mm. Very similar to *urichii*; diagnostic characters as in the key. General chaetotaxy based on 1 reared and 9 other specimens from Brazil. *Head*: Integument light brown; collar darkened. Mental plate with 9 or 10 lateral teeth. Hair 4(4,5;3-6); 5(9,10;8-12); 6(3,4;2-4); 7(6;5-7); 8(1) subequal to hair 7; 9(6-8); 10(2,3;1-3); 11(3;2-4); 12(1); 14(1-2); 15(4,5;3-6). *Antenna*: About 0.30-0.35 of head length; hair 1(3,4;2-6). *Thorax*: Prothorax: hair 0(28-30); 1(1); 2(1); 3(3;2-4); 4(2); 7(4;3-5); 8(2); 9(1); 10(1); 11(3,4;2-4); 14(1). Mesothorax: hair 1(1); 2(3,4;3-6); 3(1); 4(2); 8(8,9;6-14); 9(8,9;7-9); 11(1;1-2); 13(30-38); 14(20-30). Metathorax: hair 1(2;1-2); 2(1-2); 3(4,5;4-6); 4(4-6); 6(1); 7(6,7;5-7); 8(30-40); 9(4,5;3-5); 11(1); 13(1). *Abdomen*: Segment I: hair 1(2;1-2) minute; 6(2); 7(2). Segment II: hair 1(1); 3(1) moderate; 6(2;1-2). Segment III: hair 1(1) long, strong; 3(1) moderate; 6(1); 13(1) subequal to hair 1. Segment IV: hair 1(1) subequal to hair 1-III; 3(2;1-3) shorter than hair 3-III; 6(1); 13(1) subequal to hair 1. Segment V: hair 1(1) subequal to hair 1-III,IV; 3(1) subequal to hair 3-III; 6(1); 13(1) subequal to hair 1. Segment VI: hair 1(1) weak and relatively short; 6(1). Segment VII: hair 1(1) very strong and long but usually not reaching middle of siphon. *Segment VIII*: Comb scales (12-14, rarely 9) with lateral fringes distinct to near apex; hair 1(4,5;3-7); 3(10;8-11); 5(2;1-2). *Siphon*: Pigmentation brown. Index about 3.6-4.2. Pecten teeth (7-10) with indistinct fringes on ventral margin. Ventral siphonal tufts (11-12) with about 7 branches (5-8). *Anal Segment*: Saddle pigmentation light brown. Hair 1(1); 2(10-14). Ventral brush with 5 or 6 pairs of hairs, all except the proximal pair usually with at least 12 branches. Gills more than 2.0 of dorsal saddle length, tapered.

SYSTEMATICS. As noted under *urichii*, the other member of the subgroup, the 2 species are very similar and cannot be separated at this time by any external feature of the adults. There are, however, relatively minor but constant characters distinguishing *anduzei* from *urichii* in the male genitalia, pupae and larvae as indicated in the respective keys.

I am interpreting *anduzei* as the derived species of the group (see *urichii*), and possibly segregated directly from *urichii* in recent times. Its distribution appears to be limited to the lower Amazon Basin where it is completely sympatric with the dominant widespread *urichii*. Nothing is known of the barrier separating the 2 species. Both breed in treeholes and bamboo and have been reported from the same localities but there are no records of the association of these species in the same breeding site.

BIONOMICS. The only reported natural breeding sites of *anduzei* are treeholes (2) and cut or broken bamboo (1) (Barata and Cotrim, 1972:30). The small series of associated adults was reared from a collection in tin cans, where *anduzei* was associated with *Culex (Anoed.)* sp., *Limatus asulleptus* and *Wyeomyia* sp.

Cerqueira (1961:136) reports adults obtained by sweeping in Manaus, Brazil. It appears likely that the collections of males and females of *anduzei* "no solo" by L. Gomes in 2 localities in the State of Para, Brazil (Barata and Cotrim, 1972:30) were also made by sweeping.

DISTRIBUTION (fig. 3). Lower Amazon basin downstream from Manaus, at elevations of 30-50 m.

Material examined: 37 specimens; 6 males, 4 females, 13 larvae, 14 pupae; 9 individual rearings (1 larval, 8 pupal).

BRAZIL. *Amazonas*: Rio Maues, C. Worontzow, holotype [FH]. *Para*: near Belem (BRA 54) [UCLA].

Additional Records From the Literature

BRAZIL. *Amazonas*: Rio Maues (4099-4120) [FH] (Cerqueira and Lane, 1944:220). Manaus (Cerqueira, 1961:136). *Para*: Belem, Benevides, Jacarequara, Sao Domingos do Capim (Barata and Cotrim, 1972:30).

IRIDESCENS SUBGROUP

FEMALES. Band of broad decumbent scales of vertex always broad to very broad; narrow decumbent scales of vertex numerous to apparently absent; erect scales relatively short, either numerous and extending to orbital bristles or few and confined to caudal part of vertex and/or occiput. Antenna subequal to proboscis or slightly shorter. Mesonotal vestiture very dense, with dark scales only or sometimes with light coppery to dark golden scales also; inner dorsocentral line entirely scaled; scutellar scales linear, narrow curved or broad; prescutellar bristles poorly developed and sometimes apparently completely absent; prescutals absent; upper *stp* bristles absent. Metallic spots of femora silvery with light violet iridescence, conspicuous and discrete on midfemur; forefemur apparently always without metallic spot. Hindtarsus entirely dark scaled. Abdominal tergites with more or less distinct basal dorsal light bands.

MALES. Palpus subequal to proboscis or only about 0.72 of its length. Anterior claw of foretarsus only with submedian tooth.

MALE GENITALIA. Median emargination of tergite VIII usually very deep. Lobes of tergite IX moderately to closely approximated. Sidepiece ovoid or conical; with lateral scales; without setae on mesal surface; apicosternal process well developed. Accessory division of subapical lobe variously developed; distal division represented by a small protuberance with 1 or 2 depressions but without specialized setae, or apparently completely absent. Clasper subequal to or shorter than sidepiece, usually strongly curved dorsad; preapical lobe moderately to very strongly developed; seta *b* thickened or flattened; seta *a* developed as a normal thickened spiniform or a simple bristle. Lateral plate of phallosome with or without sternal spine; caudal process straight or curved dorsad or laterad apically.

PUPAE. Cephalothoracic hair 5-C weak and usually less than 0.5 of trumpet length. Trumpet moderate to very long, index 6.8 to nearly 20.0; pinna moderate to minute.

LARVAE. Integument of head capsule appearing smooth at 100X; head hair 12-C distinctly nearer collar than antennal base; 14-C usually nearer posterior tentorial pit than anterior ventral border of head capsule, at most equidistant. Maxillary hair 5-MP not forked. Anterior part of prothorax with spicules; prothoracic hair 0-P usually moderate and more or less stellate; 8-P different in development from 7-P, multiple, weak or stellate; mesothoracic hair 14-M moderate, multiple and sometimes more or less stellate; metathoracic hair 13-T branched, moderate to rather large and somewhat stellate. Abdominal hair 1-II moderate to strong. Integument of siphon appearing smooth at 100X; distal pecten teeth short. Hair 1-X branched, usually multiple; 2-X asymmetrical, with 1 long and 2-4 shorter branches; ventral brush with no more than 4 pairs of hairs.

DISCUSSION. The Iridescent Subgroup exhibits more derived character states in all stages than any other major phyletic line in the subgenus. Only a few of the characters listed in the diagnosis have been retained in the primitive state: (1) ornamentation of the legs, (2) conical sidepiece in some species, (3) branched larval hair 6-III-IV in a few species. The most striking feature shared by all members of the complex are in the male genitalia: (1) loss of the distal division and elaboration of an accessory division in the subapical lobe of the sidepiece and (2) modification of the distal part of the clasper.

The subgroup is very complex and it has not been possible to resolve it satisfactorily largely because of the very limited material of the majority of the species, especially of associated immature stages from Brazil.

I am recognizing 2 primary divisions in the subgroup, the Iridescent Complex and the Antunesi Complex. This division is based largely on male genitalic characters in the development of the head of the clasper and the presence or absence of a sternal spine on the lateral plate of the phallosome. The only supporting character for this division is found in the development of the erect and decumbent scales on the vertex of the head. I have not found any concordant features in the larvae or pupae. The 2 complexes are in general sympatric, with some wide gaps in northeastern Brazil.

The compact Iridescent Complex of 3 named species (*bonnei*, *secundus*, *iridescentis*) and 2 unnamed forms (sp. 8a, Bahia form; sp. 9a, Espirito Santo form) is undoubtedly monophyletic. It is characterized in the male genitalia by a strongly differentiated elongate spiculate lobe on the head of the clasper and its flattened seta *b*, and by the lateral plate of the phallosome without sternal spine. The sidepiece of the male genitalia is short and ovoid. The vertex of the head of the adults has numerous narrow decumbent scales and the erect scales extend to near the orbital bristles. The immature stages do not seem to possess any significant phyletic characters, except perhaps in the development of hair 1-VII of the larvae. The interrelations of the species of the complex are difficult to determine and I have not attempted to do it because of inadequate material of *iridescentis* and sp. 8a and 9a. The central part of the range of the complex is occupied by *bonnei* and sp. 8a which have similar and very distinctive male genitalia. Species 8a may be only an isolated southern population of *bonnei* differing primarily in the scaling of the midlobe of the scutellum but its taxonomic status cannot be determined without additional material of adults and particularly immature stages. *Culex secundus* occupies the northern part of the range and is sympatric with *bonnei* in Colombia on both sides of the Cordillera Central of the Andes; it shows more similarity with *bonnei* than with *iridescentis* in the development of the accessory division of the subapical lobe of the male genitalia and

the unbranched hair 1-VII of the larva. The taxonomic status of the Espirito Santo form, sp. 9a, cannot be determined without additional material. It appears to be related to *secundus* on male genitalic characters and may be nothing more than a widely isolated population of this species. The poorly known *iridescens*, the type species of the subgenus, has a restricted distribution at the southern end of the range of the complex in southern Brazil and adjacent northeastern Argentina. It is sympatric with sp. 9a in the State of Espirito Santo, Brazil. It shows more similarities with *secundus* than with *bonnei* in external features of the adults and in the male genitalia and was probably the earliest segregate from the ancestral form of the complex. Species of the Iridescens Complex utilize a wide range of breeding habitats and have a wide range of associates. Except for 1 male and 1 female of *bonnei* captured in a trap there are no records of adults of this complex collected in nature.

The Antunesi Complex is very diverse and poorly understood. It is characterized in the male genitalia by a poorly differentiated head on the clasper and its unflattened seta *b*, and by the lateral plate of the phallosome with a sternal spine. The sidepiece of the male is either elongate and conical or short and ovoid. The vertex of the head of the adults has only a few or no narrow decumbent scales and the erect scales are confined to its posterior part and/or occiput. The immature stages show a variety of primitive and derived character states in the different species. Most species of the complex appear to have relict distributions and are known only from a few collections. It is very unlikely that the complex is monophyletic as 4 more or less distinct lines may be recognized, each with rather clearcut features. The Kompi line consists of a single species with a unique and bewildering combination of primitive and derived character states in the different stages; *kompi* is only known from the Villavicencio area of Colombia where it is sympatric with 2 species of the Antunesi line. The Babahoyensis and Soperi lines, each with a single species, have superficially similar accessory divisions of the subapical lobe of the male genitalia but differ conspicuously in the shape of the sidepiece, scaling of the scutellum and in the immature stages. The 2 lines have moderately wide distributions but occupy opposite ends of the range of the complex: *babahoyensis* in the north in Nicaragua, Costa Rica and Ecuador and *soperi* in southern Brazil and adjacent northeastern Argentina. The species of the Antunesi line are obviously closely related because of similarity in external features of adults, in male genitalia and larval and pupal characters. There are at least 3 species in this line, all apparently rare and with relict or disjunct distributions; *cerqueirai* is known from a single collection in northwestern Panama; *wilsoni* from 2 widely separated localities in the Villavicencio area of Colombia and the State of Espirito Santo in Brazil; *antunesi* from Costa Rica, Panama and Colombia, from French Guiana and from the States of Espirito Santo and Rio de Janeiro in Brazil. As noted under the respective species, it is possible that the northern populations of *antunesi* and *wilsoni* are not conspecific with the typical southern populations and that there are 2 or 3 additional species in the Antunesi line. Species of the Antunesi Complex appear to be almost entirely restricted to breeding in bamboo but there is 1 record of *babahoyensis* from a treehole. The breeding associates of the complex are also limited. The only record of an adult captured in nature is for *soperi*.

It appears from the above considerations that early in the evolution of the Iridescens Subgroup there was a separation into several phyletic lines, only 1 of which, the Iridescens Complex, was really successful and is now dominant. The

remaining lines, constituting the Antunesi Complex, are now largely relict although in the past some of them, especially the Antunesi line and possibly the Soperi-Babahoyensis lines, had wide distributions.

8. *Culex* (*Car.*) *bonnei* Dyar

Figs. 4,9,24,25

1921. *Culex* (*Carrollia*) *bonnei* Dyar, 1921:155. TYPE: *Lectotype* male (BB 550), Ganssee, Surinam, date not specified, C. Bonne and J. Bonne-Wepster [USNM, 24862; designation by Stone and Knight, 1957:44]. Reduced to synonymy with *iridescens* by Bonne-Wepster and Bonne (1920:170); resurrected to specific rank by Antunes and Ramos (1939:381).

Culex (*Carrollia*) *bonnei* of Lane (1953:500-502); Stone and Knight (1957:44); Senevet and Abonnenc (1958:288); Stone, Knight and Starcke (1959:282); Cerqueira (1961:156); Fauran (1961:44); Belkin, Schick and Heinemann (1965:65); Forattini, Rabello and Cotrim (1970:36).

Culex (*Carrollia*) *bonnei* in part of Antunes and Ramos (1939:381-383); Lane and Whitman (1943:397).

Culex (*Carrollia*) *secundus* of Levi-Castillo (1953a:35).

Culex (*Carrollia*) *secundus* in part of Barata and Cotrim (1972:23-24).

Culex (*Carrollella*) *secundus* in part of Komp (1936:64; 1956:39).

Culex (*Carrollia*) *iridescens* of Bonne-Wepster and Bonne (1920:170); Bonne and Bonne-Wepster (1925:200-203); Komp (1936:64; 1956:39); Antunes (1937:78); Kumm and Novis (1938:503,511); Senevet and Abonnenc (1939:123-124,126,129,132); Levi-Castillo (1953a:35).

Culex (*Carrollia*) *iridescens* in part of Edwards (1932:221); Stone, Knight and Starcke (1959:283).

Culex (*Carrollella*) *iridescens* in part of Dyar (1928:280-281,538).

Carrollia *iridescens* in part of Peryassu (1908:34,44,167-169,343).

FEMALE (fig. 9). Wing: 2.7 mm. Proboscis: 1.9 mm. Forefemur: 1.8 mm. Abdomen: about 2.5 mm. Very similar to *iridescens* and *secundus*; diagnostic characters as in the key. Differing from *secundus* primarily in the following features. Description based on 2 specimens from Surinam, 2 from French Guiana, 3 from Colombia and 9 from Ecuador. *Head*: Broad decumbent scales of vertex sometimes all pale. Proboscis 1.05-1.08 of forefemur. Palpus 0.20-0.21 of proboscis. Antenna 0.94-1.05 of proboscis; torus with 3-5 setae. *Thorax*: Mid-lobe of scutellum with numerous short broad dark bronzy scales in addition to a few linear scales. Sternopleuron dark below level of coxae, usually completely. *Apn* with 6-8 bristles; *ppn* bristles 3 or 4; *stp* with 4-6 lower posterior bristles; *pra* bristles 4 or 5; *umep* bristles 6-8. *Legs*: Forecoxal scale patch without dark scales. Forefemur with a longer pale streak on posterior surface, sometimes to near apex. *Abdomen*: Dorsal basal tergal light bands less developed, usually only on VI,VII, small and dingy white. *Cibarial Armature*: Lobe of lateral flange poorly developed; 4 median cibarial teeth; cibarial dome larger and with triangular denticles. *Genitalia*: Tergite IX with 4-6 lateral bristles; insula with 20.

MALE. Wing: 3.2 mm. Proboscis: 2.3 mm. Forefemur: 2.0 mm. Abdomen: about 2.5 mm. Very similar to *iridescens* and *secundus*; diagnostic characters as in the key. Essentially similar to female except for usual sexual differences. Differing from *secundus* primarily in the following features. Proboscis 1.15 of forefemur; pale scaling of labium not as white; long subapical bristles not developed. Palpus 0.78-0.84 of proboscis. Antenna 0.86-0.90 of proboscis. Specimens studied: 3 from Surinam, 6 from French Guiana, 4 from Colombia and 2 from Ecuador.

MALE GENITALIA (fig. 24). Lobes of tergite IX separated by distance sub-

equal to width of 1 lobe at base; each lobe usually with 5 (3-7) bristles. Sidepiece ovoid; apicotergal seta strongly developed. Accessory division of subapical lobe not joined to proximal division, long columnar and with 4 apical or preapical elongated flattened specialized setae. Proximal division elongate, curved, with 2 or 3 simple bristles distally; setae *a* and *b* with dilated apex with recurved sharp point, seta *a* longer. Distal division represented by a small protuberance. Clasper subequal to sidepiece length; strongly curved dorsad; with long slender basal stem and strongly modified head; with a prominent outer preapical curvature and a long spiculose inner preapical lobe; crest apparently represented by a flat sclerite; basal (lower) spicules of preapical lobe very long and hairlike, distal (upper) spicules short; snout moderate; seta *a* developed as a normal thickened spiniform, seta *b* flattened, foliform. Lateral plate of phallosome without sternal spine. Distal part of proctiger broad and rounded apically; paraproct crown usually with 4 (3-5) teeth; cercal setae usually 2 pairs (1-3).

PUPA (fig. 24). Abdomen: 3.15 mm. Trumpet: 0.55 mm. Paddle: 0.70 mm. Very similar to *iridescens*; diagnostic characters as in the key. General chaetotaxy based on 7 specimens from French Guiana. *Cephalothorax*: Pigmentation light yellow to brown; sculpturing weak, without definite pattern. All hairs shorter than trumpet and moderately developed, 1,4,5-C subequal, 7-C the longest; 1(1,2); 2(2); 3(2;1-2); 4(2;1-4); 5(2;1-4); 6(2;1-3) shorter than hair 2; 7(2;1-4); 8(2;1-2) shorter than hair 1; 9(2;1-2). *Trumpet*: Nearly uniform in width; index 6.8-7.8; pinna small. Pigmentation yellow to brown. *Metanotum*: Pigmentation yellow to dark brown; sculpturing uneven, moderate; hair 10(2,3;2-4); 11(2,3;2-5); 12(2,3;1-3) longer than others. *Abdomen*: Pigmentation light yellow to brown, anterior mesal areas of tergites II-IV slightly darker; sculpturing weak to moderate. Segment I: hair 1(70-110) fan-shaped. Segment II: hair 1(7;7-12) distinctly longer than hair 5; 3(1) strong, surpassing level of rudimentary spiracle III; 4(6,7); 5(2;1-3). Segment III: hair 1(4;3-4); 3(1) strong, surpassing level of rudimentary spiracle IV; 4(2,3;2-5); 5(2,3;1-3). Segment IV: hair 1(2;2-5); 3(4-6); 4(1;1-2); 5(1) strong, surpassing level of rudimentary spiracle VI. Segment V: hair 1(2;1-3) subequal to hair 3; 3(2;2-3); 4(5,6); 5(1) strong, surpassing level of rudimentary spiracle VII. Segment VI: hair 1(1;1-2); 3(3;1-3); 4(4;2-5); 5(1) strong, surpassing caudal margin of tergite VII. Segment VII: hair 1(1); 3(1;1-2); 4(2;1-2); 5(4;3-5) subequal to hair 6; 6(6;4-7); 9(5;5-7) barbed. Segment VIII: hair 4(2;1-2); 9(8;7-14) sometimes secondarily branched, distinctly shorter than paddle.

LARVA (fig. 25). Head: 0.95 mm. Siphon: 0.95 mm. Anal Saddle: 0.35 mm. Very similar to *secundus*; diagnostic characters as in the key. General chaetotaxy based on 7 reared specimens from French Guiana. *Head*: Integument light yellow to brown; collar dark brown. Mental plate with 9 or 10 lateral teeth. Hair 4(6;3-8); 5(9,10;7-12) with or without barbs; 6(2); 7(4-7) not barbed; 8(1); 9(8,9;6-9); 10(1-2); 11(5); 12(1); 14(2); 15(2;2-3). *Antenna*: About 0.42 of head length; hair 1(3;3-4). *Thorax*: Prothorax: hair 0(10-18) very short; 1(1); 2(1); 3(2;2-3); 4(2;1-2); 7(3;3-4); 8(3-8) short and weak; 9(1;1-2); 10(1); 11(1); 14(1). Mesothorax: hair 1(3;3-4); 2(1); 3(1); 4(2;1-2); 8(5,6;3-7); 9(6;5-6); 11(1); 13(16-20); 14(7,8;6-9). Metathorax: hair 1(3,4;2-4); 2(1); 3(3,4;2-4); 4(3-5;3-7); 5(2,3;2-4); 6(1); 7(6-8;4-8); 8(12-20); 9(5,6;3-6); 11(1); 13(2-4) variable in development. *Abdomen*: Segment I: hair 1(4,5;3-5) very short; 6(2); 7(2). Segment II: hair 1(1-2) moderate; 3(1;1-2) longer than hair 1; 6(2;1-2). Segment III: hair 1(1) moderate, longer than hair 1-II; 3(1) longer than hair 1; 6(1); 13

(2;1-3) longer and stronger than hair 1. Segment IV: hair 1(1) longer than hair 1-III; 3(2) shorter than hair 1; 6(1); 13(2;1-2) shorter but stronger than hair 1. Segment V: hair 1(1) longer and stronger than hair 1-IV; 3(1) strong but slightly shorter than hair 1; 6(1); 13(2;2-3) shorter than hair 1. Segment VI: hair 1(1) subequal to hair 1-III; 6(1). Segment VII: hair 1(1). *Segment VIII*: Comb scales (12-16) with lateral fringes indistinct; hair 1(6;5-6); 3(7-9); 5(3,4;2-4). *Siphon*: Pigmentation light brown. Index about 2.8-3.5. Pecten teeth (9-13) broad, with indistinct fringes on ventral margin. Ventral siphonal tufts (10-12) usually with 4 or 5 branches (3-6). *Anal Segment*: Saddle shallowly emarginate laterally; pigmentation light yellow to brown. Hair 1(3,4;2-5); 2(3,4;2-4). Ventral brush with 4 pairs of hairs, majority usually with 4 or 5 branches (3-7). Gills about 2.0 of dorsal saddle length; tapered.

SYSTEMATICS. *Culex bonnei* differs conspicuously from the other 2 members of the Iridesccens Complex, *secundus* and *iridesccens*, in the unique development of the accessory division of the subapical lobe of the male genitalia and in the presence of short broad scales on the midlobe of the scutellum of the adults. The pupa appears to be more like *iridesccens* than *secundus* while the reverse is true of the larva. I interpret *bonnei* as the most derived and dominant recent species of the complex. It occupies the central and most extensive part of the distribution of the Iridesccens Complex but has a broad sympatric area with *secundus* in the west. It also has the widest range of breeding sites.

The only significant variation I have noted is in the color of the broad scales of the midlobe of scutellum which are black in the typical populations in the Guianas and brown in the outlying populations.

Culex bonnei has been frequently confused in the past with the other 2 members of the complex as indicated in the taxonomic references and its incorrect synonymy with *iridesccens* by the Bonnes. Recently Barata and Cotrim (1972:23-24) included a population of *bonnei* in the description of the pupa of their "*secundus*" (see sp. 9a, Espirito Santo form).

Closely related to *bonnei*, and possibly merely a disjunct differentiated population, is sp. 8a from the State of Bahia in Brazil. It differs from typical *bonnei* in lacking short broad scales on the midlobe of the scutellum.

BIONOMICS. *Culex bonnei* has been reported from a wider range of breeding sites than the other 2 species of the Iridesccens Complex: broken or cut bamboo (4), treeholes (4), fallen palm spathes (5), fallen cacao pod (1), fallen fruit (1), artificial containers, largely metal (6) and from an unspecified trap. Four species of *Carrollia* have been recorded as breeding associates: *bihaicolus* (1), *metempsytus* (1), *infoliatu*s (2) and *urichii* (2); and 8 other species: *Anopheles (An.) eiseni* (3); *Culex (C.) mollis* (1), *C. (Microc.) stonei* (1); *Limatus asulleptus* (4), *L. durhamii* (4); *Orthopodomyia fascipes* (1); *Sabethes undosus* (1); and *Wyeomyia aporonoma* (1). There is 1 record of adults collected in nature, 1 male and 1 female in a trap (probably Malaise) in Ecuador.

DISTRIBUTION (fig. 4). The Guianas, northern Amazon basin to State of Maranhao in Brazil, upper Orinoco basin and Pacific drainage in central Colombia, at elevations of 30-500 m.

Material examined: 695 specimens; 124 males, 148 females, 260 larvae, 162 pupae; 67 individual rearings (25 larval, 36 pupal, 6 incomplete).

BRAZIL. *Para*: Aura Reserve (BRA 3) [UCLA]. Igarape do Catu (BRA 5) [UCLA].

COLOMBIA. *Boyaca*: Remolinos, Finca Primavera (COB 56) [UCLA]. *Meta*: Restrepo (258, 259,261,280; KO 10-1,1041) [UCLA]. Retiro (KO 10-21,10-28) [UCLA]. Rio Guacavia (KO 31-

34) [UCLA]. Villavicencio (CV 1012,1014,1017,1018; C-30; 566,597) [UCLA, USNM]. *Valle*: Rio Raposo (COL 2-4,6,34,44,65) [UCLA].

ECUADOR. *Napo-Pastaza*: Isla Pompeya (ECU 21) [UCLA]. Rio Napo (ECU 8) [UCLA].

FRENCH GUIANA. *Guyane*: Cogneau (FGC 3462,3472) [UCLA]. La Chaumiere (FGC 3577) [UCLA]. Rochambeau (FGC 3536) [UCLA]. Stoupan (FGC 3288) [UCLA]. *Inini*: Saut Tigre (FG 179,180) [UCLA].

SURINAM. *Suriname*: Gansee, lectotype [USNM]. *Locality not Specified*: (4097,4098) [UCLA]; (BB 525) [USNM].

Additional Records From the Literature

BRAZIL. *Maranhao*: Imperatriz, Acailandia (Barata and Cotrim, 1972:25) [FH]. *Para*: Curralinho (Cerqueira, 1961:156). Marajo Island (Kumm and Novis, 1938:511).

FRENCH GUIANA. *Guyane*: Crique Anguille (Fauran, 1961:44). *Inini*: Saut Tigre. St. Elie. St. Nazaire (Fauran, 1961:44).

8a. *Culex (Car.) sp., Bahia form*

Fig. 4

Culex (Carrollia) bonnei of Forattini, Rabello and Cotrim (1970:36).

Culex (Carrollia) bonnei in part of Antunes and Ramos (1939:383); Lane and Whitman (1943:397).

The 3 males and 3 females from Curipipe and Piraja, Bahia, Brazil, I have examined differ from typical *bonnei* in having long moderately wide curved pale scales (as in *iridescens*) instead of short broad dark ones on the midlobe of the scutellum. The genitalia of 2 males are similar to those of typical *bonnei*. The larva of this population is unknown to me but may have been included by Antunes and Ramos (1939:381-382) with specimens from Colombia in their description of *bonnei*. The pupa has not been described.

This form may be only an isolated population of *bonnei*, possibly with some introgression with *iridescens*. However, its taxonomic status cannot be determined without examination of additional material of adults and careful study of the immature stages. The latter were reported from treeholes by Antunes and Ramos (1939:382).

9. *Culex (Car.) secundus* Bonne-Wepster & Bonne

Figs. 1,4,8,9,26,27

1920. *Culex (Carrollia) secunda* Bonne-Wepster and Bonne, 1920:170-171. TYPE: Canal Zone, Panama; number of specimens and type not indicated in original description; 2 probable male syntypes (Brug ledger numbers 4117 and 4118) labelled *secundus* not located in ITH collection by Belkin (1968:20) [LU, possibly misplaced in ITH]. Additional material from same series available in USNM for neotype designation.

Culex (Carrollia) secundus of Dyar (1923:179; 1925:176); Bonne and Bonne-Wepster (1925:203-204); Edwards (1932:221); Lane (1939:82-83; 1953:506-508); Galindo, Carpenter and Trapido (1951:104,105,108,110,111,126); Levi-Castillo (1952:553; 1953a:35); Barreto and Reyes (1955:64); Galindo and Blanton (1955:73); Stone, Knight and Starcke (1959:283); Belkin, Schick and Heinemann (1965:56); Belkin (1968b:20); Barreto and Lee (1969:434).

Culex (Carrollia) secundus in part of Forattini, Rabello and Cotrim (1970:47).

Culex (Carrollella) secundus of Dyar (1928:281-282,538); Komp (1936:64); Patino Camargo (1937:245); Boshell Manrique (1938:416).

Culex (Carrollella) secundus in part of Komp (1936:64; 1956:39).

Culex (Carrollia) iridescens in part of Busck (1908:70); Dyar (1918:108).

Carrollia iridescens in part of Howard, Dyar and Knab (1912:figs. 10,113; 1915:462-464).

FEMALE (figs. 1,8,9). Wing: 2.8 mm. Proboscis: 1.9 mm. Forefemur: 1.8 mm. Abdomen: about 2.1 mm. Very similar to *bonnei* and *iridescens*; diagnostic characters as in the key. General characters as for the subgroup; description based on 4 specimens from Panama and the Canal Zone and 25 specimens from Costa Rica. *Head*: Broad decumbent scales of vertex golden or whitish on disc, dark along orbital bristles on midline in front; narrow decumbent scales very sparse, golden; erect scales very numerous, light golden, present on anterior part of vertex to orbital bristles where they are proclinate and longer than on posterior part and occiput; lateral patch yellowish to whitish. Proboscis 1.02-1.05 of forefemur; labium entirely dark scaled. Palpus 0.19-0.20 of proboscis; entirely dark scaled. Antenna 1.00-1.05 of proboscis; torus with 4-6 setae. *Thorax*: Mesonotal and scutellar integument blackish; scales dark bronzy except for dark coppery around prescutellar space; bristles bronzy. Anterior promontory with 2 or 3 bristles; prescutellar bristles 4-6. Midlobe of scutellum with 4 long bristles and dark coppery linear to narrow curved scales; lateral lobe with 3 long bristles and similar scales. Pleuron darkened to level of base of coxae; *ppl*, meron and metameron dark, lower part of *stp* usually not darkened. *Apn* with 3-6 bristles; *ppn* bristles 3-5; *ppl* bristles 3 or 4; *stp* with 4 or 5 lower posterior bristles; *pra* bristles 5 or 6; *umep* bristles 5 or 6. *Legs*: Coxal integument light, except usually extreme base of midcoxa; forecoxal scale patch with dark scales distally, base with light golden scales. Forefemur predominantly dark scaled; light at base, more extensively on lower posterior surface. Midfemur predominantly dark scaled; light on extreme base and on posterior ventral streak not reaching the middle; metallic spots well marked. Hindfemur dark scaled dorsally and on apical ring which is extended as a streak on posterior surface to about 0.5 from base; ventral light golden scaling extending about halfway dorsad on anterior surface and joining the long preapical metallic streak; sometimes a poorly differentiated submedian metallic spot or streak also present and joined to ventral light scaling. Knee spots faintly indicated by a few pale scales on apices of femora. *Abdomen*: Tergites III-VII with extremely variable basal dorsal transverse white or whitish bands not reaching light metallic spots; sometimes a few basal whitish scales on midline of tergite II. Light metallic spots small on II-IV, subbasal on V; marginal bristles of tergites very sparse, very light golden. Sternites largely light scaled, proximal silvery, distal light golden; IV-VII with apical dark bands; bristles pale golden. *Cibarial Armature*: Cibarial bar with narrow elongate lateral flange without lobe; 3 broad median cibarial teeth, without alternating filamentous spicules; cibarial dome small, denticles largely rounded. *Genitalia*: Tergite IX with 1 or 2 lateral bristles; insula with 15-22.

MALE. Wing: 2.8 mm. Proboscis: 2.1 mm. Forefemur: 1.9 mm. Abdomen: about 2.7 mm. Very similar to *bonnei* and *iridescens*; diagnostic characters as in the key. Essentially similar to the female except for usual sexual differences. Proboscis 1.10 of forefemur; labium dark scaled dorsally, entirely white scaled on ventral surface distad of false joint and on a short median streak proximad of joint; a large ventral patch of long hairs distad of basal bristles; a pair of very long hairs ventrally before apex, preceded by shorter hairs. Palpus 0.88 of pro-

boscis; dark scaled throughout. Antenna 1.00 of proboscis. Specimens studied: 2 from Panama and the Canal Zone and 22 from Costa Rica.

MALE GENITALIA (fig. 26). In general very similar to *bonnei*; differing primarily in the following conspicuous features. Lobes of tergite IX more prominent and separated by less than width of 1 lobe. Sidepiece without differentiated apicotergal seta. Accessory division of subapical lobe much smaller, digitiform and with 1 specialized bristlelike apical seta and a few simple setae at base. Setae *a* and *b* of proximal division broader, more strongly recurved; seta *a* less than 0.5 of seta *b*. Distal division completely absent. Preapical lobe of clasper with very short basal (lower) spicules and very long hairlike distal (upper) spicules; seta *a* longer and seta *b* shorter, transparent and very difficult to see. Paraproct crown usually with 3 (2-4) teeth.

PUPA (fig. 26). Abdomen: 2.60 mm. Trumpet: 0.60 mm. Paddle: 0.60 mm. Apparently indistinguishable from *antunesi* and *babahoyensis*; diagnostic characters from other members of the subgroup as in the key. General chaetotaxy based on 10 specimens from Panama. *Cephalothorax*: Pigmentation yellow to brown; sculpturing weak, without definite pattern. All hairs shorter than trumpet, 1,3-5,8,9-C subequal, 7-C the longest; 1(2); 2(2;2-4) subequal to hair 6; 3(1;1-2); 4(3;1-4); 5(3;1-4); 6(2,3;1-3); 7(3;1-4); 8(2;1-3) shorter than hair 1; 9(1;1-2). *Trumpet*: Nearly uniform in width; index usually 10.4 (10.2-11.0); pinna small. Pigmentation brown. *Metanotum*: Pigmentation yellow to light brown; sculpturing uneven, weak; hair 10(3;2-4) slightly longer than others; 11(3;2-4); 12(2;2-3). *Abdomen*: Pigmentation light yellow to brown, more or less uniform; sculpturing moderate. Segment I: hair 1(94-120) fan-shaped. Segment II: hair 1(8;6-14) subequal to hair 5; 3(1;1-4); 4(4,5;3-6); 5(2;1-3). Segment III: hair 1(4;2-8) slightly longer than hair 5; 3(1) strong, surpassing level of rudimentary spiracle IV; 4(2,3;2-4); 5(3,4;2-4). Segment IV: hair 1(4;2-4) subequal to hair 3; 3(4-6;4-8); 4(1) subequal to hair 6; 5(1) strong, surpassing level of rudimentary spiracle VI. Segment V: hair 1(2;2-5) subequal to hair 3; 3(1;1-2); 4(6;4-8) shorter than hair 3; 5(1) strong and long but not reaching caudal margin of tergite VII. Segment VI: hair 1(1;1-2); 3(2;1-3); 4(4;2-6); 5(1) reaching level of alveolus of hair 9-VII, considerably shorter than hairs 5-IV,V. Segment VII: hair 1(1); 3(1;1-2); 4(2;1-2); 5(3,4;1-4) very small; 6(6;4-12) short; 9(3;3-5) barbed. Segment VIII: hair 4(1;1-2); 9(7;5-9) barbed, subequal to paddle length.

LARVA (fig. 27). Head: 0.85 mm. Siphon: 1.25 mm. Anal Saddle: 0.30 mm. Very similar to *bonnei*; diagnostic characters as in the key, not entirely reliable. General chaetotaxy based on 4 reared and 6 other specimens from Panama and Canal Zone. *Head*: Integument light yellow; collar dark brown. Mental plate with 9 or 10 lateral teeth. Hair 4(6-8;5-8); 5(8-10) barbed; 6(2,3;2-4); 7(5,6;4-8) without barbs; 8(1;1-2) subequal to hair 7; 9(9,10;7-11); 10(2;1-3); 11(5,6;4-6); 12(1); 14(2,3;2-4); 15(2). *Antenna*: About 0.45 of head length; hair 1(3;2-3). *Thorax*: Prothorax: hair 0(10-14) moderate; 1(1); 2(1); 3(3;2-4); 4(2;1-2); 7(3;2-4); 8(6-12) weak; 9(1); 10(1-2); 11(2;1-2); 14(1). Mesothorax: hair 1(3,4;3-5); 2(1); 3(1); 4(1-2); 8(6;5-7); 9(5,6;4-6); 11(1;1-2); 13(10-20); 14(4-6;2-8). Metathorax: hair 1(3;2-4); 2(1;1-2); 3(5,6;4-6); 4(4,5;3-5); 5(2;1-4); 6(1); 7(6-8;4-9); 8(11-20); 9(4;4-7); 11(1); 13(3,4;3-7). *Abdomen*: Segment I: hair 1(4,5;4-6) very short; 6(2); 7(2;1-2). Segment II: hair 1(1;1-2) short and weak; 3(1-2) longer than hair 1; 6(2). Segment III: hair 1(1;1-2) moderate; 3(1) longer than hair 1; 6(1); 13(2;1-2) subequal or shorter than hair 1. Segment IV: hair 1(1) subequal to hair 1-III or shorter; 3(1,2;1-3) shorter than hair 1; 6(1;1-2); 13(2;1-3) shorter than

hair 1. Segment V: hair 1(1) stronger and longer than hair 1-IV; 3(1) shorter than hair 1; 6(1); 13(2;1-3) shorter than hair 1. Segment VI: hair 1(1) shorter than hair 1-III; 6(1). Segment VII: hair 1(1). *Segment VIII*: Comb scales (11-18) with indistinct fringes to apex; hair 1(6-8;6-10); 2(1;1-2); 3(9-11;6-11); 5(2,3;2-4). *Siphon*: Pigmentation light brown. Index about 6.0-7.5; distal part of siphon often sharply narrowed and upturned. Pecten teeth (10-16) short and with indistinct fringe on ventral margin. Ventral siphonal tufts usually 10(8-12) and mostly with 6 or 7 branches (3-8). *Anal Segment*: Saddle shallowly emarginate laterally; pigmentation light yellow to brown. Hair 1(4,5;2-6); 2(3;3-4). Ventral brush usually with 4 pairs of hairs, majority usually with more than 6 branches (4-10). Gills about 2.0 of dorsal saddle length; tapered.

SYSTEMATICS. *Culex secundus* in several respects is intermediate between *iridescens* and *bonnei*, the other 2 members of the Iridescens Complex. In the male genitalia, the accessory division of the subapical lobe is more strongly differentiated from the proximal division than in *iridescens* and may be interpreted as an intermediate step toward the condition in *bonnei*. Its larva is very similar to that of *bonnei* but its pupa differs from the other 2 species of the complex in the more elongate trumpet. The scales of the midlobe of the scutellum of the adults are linear, a primitive character state. I interpret *secundus* as an early offshoot of the ancestral stock of the Iridescens Complex which has undergone considerable change recently but may have been the stock from which *bonnei* arose in the more distant past. These 2 species are now broadly sympatric in Colombia without any indication of introgression.

The siphon index is more variable in *secundus* than in the other 2 species but I have found no geographical or ecological correlations for this variation.

Culex secundus has been generally recognized as a distinct species since the original description by the Bonnes.

Apparently closely related to *secundus* on similar male genitalic features is sp. 9a, Espirito Santo form (see). Because of the extremely wide separation of this population in Brazil from the known distribution of typical *secundus* in northwestern South America and Central America and because of some differences in the larva and pupa, it is probably a distinct species. Barata and Cotrim (1972: 18-25) treated this form and a population of *bonnei* as "*secundus*".

BIONOMICS. *Culex secundus* appears not to have as wide a range of breeding sites as its close relative, *bonnei*. It has been found primarily in cut or broken bamboo (19) and fallen leaves, palm spathes and fronds (10) but has also been recorded from fallen monkey-pods (2), an unspecified artificial container (1) and from a ground seepage (1). Two species of *Carrollia* have been recorded as breeding associates, *bihaiocolus* (1) and *cerqueirai* (1) and 11 other species: *Culex* (*C.*) *chidesteri* (1), *C. (C.) corniger* (1); *Haemagogus* (*S.*) *spgazzinii falco* (1); *Limatus asulleptus* (4), *L. durhamii* (5); *Trichoprosopon* (*T.*) *digitatum* (4), *T. (T.) pallidiventer* (4); *Toxorhynchites* (*L.*) sp. (1); *Sabethes undosus* (1); *Wyeomyia aponoma* (2), *W. arthrostigma* (1). There is no record of adults collected in nature.

DISTRIBUTION (fig. 4). From Costa Rica through Panama to Colombia and Ecuador, including upper Orinoco drainage in Colombia and upper Amazon drainage in Ecuador, at elevations of 15-1700 m.

Material examined: 768 specimens; 175 males, 163 females, 264 larvae, 166 pupae; 123 individual rearings (71 larval, 49 pupal, 3 incomplete).

COLOMBIA. *Antioquia*: Providencia, Anori R. valley, C. Porter [UCLA]. *Caldas*: La Plata (COM 48,49) [UCLA]. *Huila*: Santa Leticia (COL 18) [UCLA]. *Meta*: Bosque de San Jose,

W.H. Komp [USNM]. Restrepo (KO 1028,1032,3134,3137,3738; 233,584,10-2,10-4,1027,1037, 31-36) [UCLA, USNM]. Retiro, W.H. Komp [USNM]. *Santander*: Yarima (COB 74) [UCLA]. *Valle*: Rio Raposo (COL 18,21,23,72,74,78) [UCLA]. *Locality not Specified*: W.H. Komp [USNM].

COSTA RICA. *Heredia*: Finca La Selva (CR 412) [UCLA]. Puerto Viejo (CR 191) [UCLA]. *Limon*: Westfalia (CR 72) [UCLA].

PANAMA. *Bocas del Toro*: Almirante (PA 259) [UCLA]. Filon (PA 187) [UCLA]. Quebrada Grande (PA 654) [UCLA]. *Canal Zone*: Barro Colorado, Dyar and Shannon [USNM]; Galindo [USNM]. Cano Saddle (P69) [USNM]. Erwin Island (P22) [USNM]. Fort Clayton (C 257) [UCLA]. Fort Gulick, S.J. Carpenter [UCLA]. Madden Forest (PA 840) [UCLA]. Tabernilla, A. Busck (99,166) [USNM]; A.H. Jennings (399,401,448,451) [USNM]. *Locality not specified*, A.H. Jennings [USNM]. *Darien*: Alturas de Nique (PA 1059) [UCLA]. La Laguna (PA 449) [UCLA]. Tacarcuna (GG 113, PA 446) [UCLA]. *Panama*: Upper Pequini (PA 939,940) [UCLA].

Additional Records From the Literature

ECUADOR. *Napo-Pastaza*: Arajuno. Puyo. Shell-Mera (Levi-Castillo, 1952:553).

9a. *Culex (Car.) sp., Espirito Santo form*

Fig. 4

Culex (Carrollia) secundus of Lane and Whitman (1943:394-396).

Culex (Carrollia) secundus in part of Forattini, Rabello and Cotrim (1970:47); Barata and Cotrim (1972:18-25).

In the recent description of "*secundus*" from Brazil by Barata and Cotrim (1972: 18-23) 2 populations were included, from Sao Joao de Petropolis in the State of Espirito Santo and from near Imperatriz in the State of Maranhao. In my opinion neither population can be assigned to *secundus*. The descriptions of the adults, male genitalia, larva and pupa appear to be based primarily on the population from Espirito Santo, described earlier in all stages by Lane and Whitman (1943: 394-396) with illustrations of the male genitalia and head and terminal segments of the larva. The adults were reared from a collection in bamboo but it is not known if the association of the stages was through individual rearings. As described and figured in both papers the male genitalia of this population appear to be extremely similar to those of typical *secundus* but there are a number of differences in the external features of the adults as well as the larva and pupa from this species. A decision as to the taxonomic status of this population cannot be made without careful reexamination of the existing material and study of additional specimens, particularly of immature stages. Although it is possible that it is only a relict isolated population of *secundus*, the fact that it is widely separated from the main populations of this species by *bonnei* suggests that it is a distinct species.

The material from the State of Maranhao included by Barata and Cotrim in "*secundus*" appears to be typical *bonnei*, judging by the description and figures of the pupa.

10. *Culex (Car.) iridescens* Lutz

Figs. 4,28,29

1904. *Carollia iridescens* Lutz, 1904:16. *Nomen nudum*.

1905. *Carrollia iridescens* Lutz, 1905:81-82. TYPE: *Neotype* male with genitalia on slide (222), Serra da Cantareira, Sao Paulo, Brazil, Apr 1938, M. Sanchez, E. Coimbra and H. Guimaraes [FH, 953; designation by Antunes and Ramos, 1939:380-381].

Culex (Carrollia) iridescens of Antunes and Ramos (1939:374-381); Lane (1939:82; 1953:498-500); Lane and Whitman (1943:394); Senevet and Abonnenc (1958:288); Cova Garcia, Sutil and Rausseo (1966a:28,115; 1966b:42-43,141,231,344); Belkin (1968b:16); Forattini, Rabello and Cotrim (1970:42); Belkin, Schick and Heinemann (1971:27-28).

Culex (Carrollia) iridescens in part of Edwards (1932:221); Stone, Knight and Starcke (1959:283).

Culex (Carrollella) iridescens in part of Dyar (1928:280-281).

Carrollella iridescens in part of Lutz (1921:163); Shannon (1931a:8).

Carrollia iridescens in part of Theobald (1907:207-209); Peryassu (1908:34,44,167-169,343); Surcouf and Gonzalez-Rincones (1911:144); Lutz (1919:164).

Carollia iridescens of Blanchard (1905:634).

FEMALE. Wing: 3.5 mm. Proboscis: 2.4 mm. Forefemur: 2.3 mm. Abdomen: about 2.8 mm. Very similar to *bonnei* and *secundus*; diagnostic characters as in the key. Differing from *secundus* primarily in the following features. Description and measurements based on 2 pinned neoparatypes from Brazil. **Head:** Broad decumbent scales of vertex dark golden anteriorly in the middle, whitish caudad and laterally. Proboscis 0.98-1.04 of forefemur. Palpus 0.16 of proboscis. Antenna 0.95 of proboscis. **Thorax:** Mesonotal vestiture denser, from dorsal aspect appearing largely light coppery to dark golden with narrow dark bronzy sides. Midlobe of scutellum with dense vestiture of long, moderately wide curved light golden scales, occasionally a few shorter broader scales. Meron not darkened. *Apn* with 3-6 bristles; *ppl* bristles 4 or 5; *stp* with 3-5 lower posterior bristles; *pra* bristles 4 or 5. **Legs:** Forecoxal scale patch without dark scales. Forefemur more extensively pale on lower anterior surface and with posterior pale scaling nearly reaching apex. Midfemur pale on lower anterior surface to level of submedian metallic spot which may be connected; posterior surface pale to near apex. Hindfemur with less extensive dark scaling on posterior surface. **Abdomen:** Dorsal basal tergal light bands on III-VII much broader, whiter and very conspicuous; tergite II with a similar basal whitish band. Metallic spots larger and more conspicuous on II-IV. Bristles of tergites and sternites longer. **Cibarial Armature and Genitalia:** Not studied.

MALE. Wing: 3.4 mm. Proboscis: 2.5 mm. Forefemur: 2.5 mm. Abdomen: about 2.6 mm. Very similar to *bonnei* and *secundus*; diagnostic characters as in the key. Essentially similar to the female except for usual sexual differences. Differing from *secundus* primarily in the following features. Proboscis 1.00-1.04 of forefemur; labium white scaled both ventrally and dorsally proximad of false joint; dark scaled distad on dorsal surface; distal ventral surface largely pale scaled but darkened toward apex and with numerous long hairs throughout. Palpus 0.92 of proboscis; segment 3 with conspicuous ventromesal line of white scales. Antenna 0.92 of proboscis. Specimens studied: 2 pinned neoparatypes from Brazil.

MALE GENITALIA (fig. 28). In general very similar to *bonnei* and *secundus*; differing from the former in the following conspicuous features. Lobes of tergite IX more prominent and separated by less than width of I lobe; each lobe with 4-12 bristles. Accessory division of subapical lobe very broad and joined to proximal division, with several (7) simple marginal setae. Setae *a* and *b* of proximal division strongly dilated apically, seta *a* longer than seta *b*. Preapical lobe of clasper with shorter basal (lower) spicules. Distal part of proctiger apparently narrower and tapering apically.

PUPA (fig. 28). Abdomen: 3.20 mm. Trumpet: 0.55 mm. Paddle: 0.65 mm. Very similar to *bonnei* and *soperi*; diagnostic characters as in the key. General chaetotaxy based on 1 specimen from Brazil. *Cephalothorax*: Pigmentation light yellow to brown; sculpturing weak. All hairs shorter than trumpet, weak or moderate, 5,7-C subequal, 1-C the longest; 1(2); 2(2,3); 3(2) longer than hairs 2,4,6; 4(3); 5(3,4); 6(2); 7(2,3); 8(2) shorter than hair 9; 9(missing). *Trumpet*: Nearly uniform in width; index 6.1; pinna small. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing uneven, weak; hair 10(2); 11(2); 12(1) longer than others. *Abdomen*: Pigmentation light yellow, anterior mesal areas of tergites II-IV slightly darker; sculpturing weak. Segment I: hair 1(88-90) fan-shaped. Segment II: hair 1(3) subequal to hair 3; 3(1) moderate, reaching level of rudimentary spiracle III: 4(4,5); 5(1). Segment III: hair 1(1); 3(missing); 4(3); 5(1,2). Segment IV: hair 1(1); 3(5); 4(1); 5(1) surpassing level of rudimentary spiracle V but not reaching caudal margin of tergite. Segment V: hair 1(1) subequal to hair 1-IV; 3(1); 4(5); 5(1) subequal to hair 5-IV. Segment VI: hair 1(1) small; 3(2); 4(2,3) shorter than hair 3; 5(1) short, about 0.5 of hair 5-V. Segment VII: hair 1(1) longer than hair 3; 3(1,2); 4(2); 5(6,7) very short; 6(5); 9(4) barbed. Segment VIII: hair 4(1,2); 9(missing).

LARVA (fig. 29). Head: 0.90 mm. Siphon: 1.25 mm. Anal Saddle: 0.35 mm. Apparently differentiated from other members of the subgroup primarily by the distinct marginal denticles of the pecten teeth. General chaetotaxy based on 1 reared specimen from Brazil and Antunes and Ramos (1939). *Head*: Integument light yellow; collar brown. Mental plate with 9 or 10 lateral teeth. Hair 4(7-11) unusually long; 5(6,7;6-9) barbed; 6(2); 7(8); 8(1) subequal to hair 7; 9(8,9); 10(1,2); 11(9); 12(1); 14(4); 15(1,2). *Antenna*: About 0.36 of head length; hair 1(2,4). *Thorax*: Prothorax: hair 0(11,12) relatively long, stellate; 1(1); 2(1); 3(3); 4(2); 7(3,4); 8(12,16) strong and stellate; 9(1); 10(missing); 11(2); 14(1). Mesothorax: hair 1(5); 2(2); 3(1); 4(3); 8(6,7); 9(5,6); 11(2); 13(12,16) relatively long; 14(11,12) long and stellate. Metathorax: hair 1(3,4); 2(2); 3(5); 4(6); 5(3); 6(1); 7(6,7); 8(20,22); 9(5,6); 11(2); 13(10,11) long and stellate. *Abdomen*: Segment I: hair 1(4) short; 6(2); 7(2). Segment II: hair 1(1,2) strong and long; 3(2,3) short; 6(2). Segment III: hair 1(1) very long and strong; 3(1) moderately long; 6(1); 13(3) much shorter than hair 1. Segment IV: hair 1(1, 2) subequal to hair 1-III; 3(3) short; 6(1); 13(3) subequal to hair 13-III. Segment V: hair 1(1) longer than hair 1-III,IV; 3(1) long; 6(1); 13(3) subequal to hair 13-III,IV. Segment VI: hair 1(1,2) moderate and weak; 6(1). Segment VII: hair 1(2). *Segment VIII*: Comb scales (14,16) without lateral fringes; hair 1(6); 3(8); 5(5,6). *Siphon*: Pigmentation light brown. Index about 4.0. Pecten teeth (14,18) short, with distinct denticles on ventral margin. Ventral siphonal tufts (10) with 5-7 branches. *Anal Segment*: Saddle pigmentation light yellow. Hair 1(5,6); 2(4,5). Ventral brush with 4 pairs of hairs, all missing. Gills less than 2.0 of dorsal saddle length, slightly tapered.

SYSTEMATICS. *Culex iridescens*, the type species of *Carrollia*, is interpreted here as the earliest derivative of its complex, which includes also *bonnei* and *secundus*. In the male genitalia it has the primitive type of accessory division of the subapical lobe that is poorly differentiated from the proximal division. The larva also has a primitive feature in the branched hair 1-VII. The pupa is very similar to the other species of the complex and is similar to *bonnei* in the retention of the short trumpet. The scaling of the midlobe of the scutellum in both sexes is intermediate between the primitive state in *secundus* and the highly

derived one in *bonnei*. However, external features of the males show considerable departure from the primitive states in the white scaling of the palpus and the development of long hairs distad of the false joint of the labium (shared with *secundus*). Overall, *iridescens* appears to be much more closely related to *secundus* than to *bonnei*. Its limited range is at the southern extremity of the distribution of the complex, opposite to that of *secundus*. In the northern part of this range it is sympatric with sp. 9a, which is undoubtedly related to *secundus*.

In the very limited material of *iridescens* I have examined no significant variation is apparent. The key characters for the pupa and larva may not be reliable as they are both based on a single specimen.

BIONOMICS. I have seen adults of *iridescens* reared from cut or broken bamboo (2) and a treehole (1) only, but Forattini (1965:34) states that this species breeds also in bromeliads, flower bracts, fallen leaves, artificial containers and ground pools. I have seen no records of breeding associates or adults collected in nature.

DISTRIBUTION (fig. 4). Coastal and Parana drainages in Brazil southward from State of Espirito Santo to State of Parana at elevations of 50-100 m.

Material examined: 7 specimens; 3 males, 2 females, 1 larva, 1 pupa; 1 individual larval rearing.

BRAZIL. Parana: Locality not specified (12148) [BH]. *Sao Paulo:* Perus, Agua Fria (1171-11) [USNM]. Serra da Cantareira (1173) [USNM]; M. Sanchez, E. Coimbra and H. Guimaraes, neotype [FH].

Additional Records From the Literature

BRAZIL. Espirito Santo: Sao Joao de Petropolis [FH, 3828] (Forattini, Rabello and Cotrim, 1970:42). *Guanabara:* Rio de Janeiro [FH, 3827] (Forattini, Rabello and Cotrim, 1970:42); Estrada Dona Castorina; Alto da Boa Vista (Antunes and Ramos, 1939:381). *Parana:* near Porto Mojoli (Lutz, 1919:164). *Sao Paulo:* Perus, Agua Fria [FH, 953-971] (Forattini, Rabello and Cotrim, 1970:43). Serra da Cantareira [FH, 972,973] (Forattini, Rabello and Cotrim, 1970:43).

11. *Culex (Car.) soperi* Antunes & Lane

Figs. 5,30,31

1937. *Culex (Carrollia) soperi* Antunes and Lane, 1937:21-23. TYPE: *Holotype* male (886) with associated genitalia on 2 slides (99,100), Perus, Sao Paulo, Brazil, 23 Apr 1937 [FH, 721].

Culex (Carrollia) soperi of Antunes and Lane (1938:1037); Antunes and Ramos (1939:383-385); Lane and Whitman (1943:393-394); Lane (1953:503-505); Senevet and Abonnenc (1958:287-288); Stone, Knight and Starcke (1959:283); Casal and Garcia (1968:97-98); Forattini, Rabello and Cotrim (1970:48); Stone (1970:165); Belkin, Schick and Heinemann (1971:28).

FEMALE. Wing: 3.1 mm. Proboscis: 1.9 mm. Forefemur: 2.0 mm. Abdomen: about 2.6 mm. Very similar to *antunesi*, *babahoyensis* and *kompi*; mesonotal vestiture very similar to *iridescens*; diagnostic characters as in the key. In general as described for *secundus*, differing primarily in the following features. Description and measurements based on 1 dry specimen from Teresopolis, Brazil, supplemented by original description of Antunes and Lane (1937:21-22). **Head:** Broad decumbent scales of vertex yellowish to tan; narrow decumbent scales apparently absent; erect scales golden yellow, short, confined to posterior part of vertex and occiput, sometimes a few short ones on disc of vertex but distant from or-

bital line; lateral patch yellowish white. Proboscis 0.95 of forefemur; labium slightly paler ventrally. Palpus 0.21 of proboscis. Antenna 0.97 of proboscis. *Thorax*: Mesonotal vestiture very dense, light coppery to dark golden, lighter in posterior part. Midlobe of scutellum with short broad pale scales; lateral lobe with linear scales. Meron not darkened. A few broad pale scales in front of lower posterior bristles of *stp*. *Legs*: Forecoxal scale patch without dark scales. Forefemur more extensively pale on anterior surface and pale to apex on posterior surface. Midfemur pale on lower anterior surface to near level of submedian metallic spot; posterior surface pale to apex. Hindfemur with dark scaling more restricted, absent from base of dorsal margin; light scaling extending ventrally on both anterior and posterior surface to near apex. Tibiae and basal tarsal segments indistinctly paler ventrally. *Abdomen*: Dorsal basal tergal light bands on III-VII much broader, yellowish; tergite II with a smaller basal yellowish band. Metallic spots larger and more conspicuous on II-IV. Sternite IV with only a few dark scales apically not forming a band. *Cibarial Armature and Genitalia*: Not studied.

MALE. Wing: 3.1 mm. Proboscis: 2.4 mm. Forefemur: 2.1 mm. Abdomen: about 2.4 mm. Very similar to *antunesi*, *babahoyensis*, *cerqueirai*, *komp*i and *wilsoni*; Diagnostic characters as in the key. Essentially similar to the female and differing from *secundus* in the same general features. Proboscis about 1.1 of forefemur; labium without distinct white scaling but paler at base dorsally and ventrally and beyond false joint to before apex ventrally, without any long hairs. Palpus 0.91 of proboscis; without white scales on segment 3. Antenna 0.9 of proboscis. Only 1 dry specimen studied, from Perus, Brazil.

MALE GENITALIA (fig. 30). In general as described for *antunesi* but differing conspicuously in the following features. Lobes of tergite IX more prominent and more approximated. Sidepiece short, ovoid; apicotergal setae 2, weakly developed. Setae *a* and *b* of proximal division of subapical lobe both short and with broadly expanded, distinctly ribbed distal part; seta *c* shorter. Accessory division with a digitiform bare ventral portion from base of which projects a very large dorsal lobe with expanded apex bearing numerous flattened setae acuminate apically and some simple setae on more ventral part. Distal part of proctiger relatively broad and rounded; paraproct crown with 3 or 4 teeth; cercal setae 2 or 3.

PUPA (fig. 30). Abdomen: 3.05 mm. Trumpet: 0.53 mm. Paddle: 0.63 mm. Very similar to *bonnei* and *iridescens*; diagnostic characters as in the key. General chaetotaxy based on 1 specimen from Brazil. *Cephalothorax*: Pigmentation light yellow; sculpturing uneven, weak. All hairs shorter than trumpet; 3-5,8-C subequal; 1(2); 2(2) shorter than hair 6; 3(2); 4(2,3); 5(3); 6(3); 7(2,3); 8(2); 9(1). *Trumpet*: Nearly uniform in width; index 7.1; pinna small. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing uneven, weak; hairs subequal, 10(1); 11(1); 12(2). *Abdomen*: Pigmentation light yellow, anterior mesal area of tergites II-IV slightly darker; sculpturing moderate. Segment I: hair 1(145-150) fan-shaped. Segment II: hair 1(6,8) slightly longer than hair 5; 3(1) not reaching level of rudimentary spiracle III; 4(3) very short; 5(2). Segment III: hair 1(3) short; 3(1) surpassing level of rudimentary spiracle IV; 4(1) subequal to hair 6; 5(3) short. Segment IV: hair 1(1); 3(8,10) dendritic; 4(1); 5(1) surpassing level of rudimentary spiracle V. Segment V: hair 1(2) longer than hair 6; 3(2); 4(4,5) shorter than hair 1; 5(1) surpassing level of rudimentary spiracle VI. Segment VI: hair 1(1,2); 3(1); 4(5) subequal to hair 6; 5(1) weak, not reaching level of rudimentary spiracle VII. Segment VII: hair 1(2) forked, sub-

equal to hair 4; 3(1); 4(2,3); 5(2) shorter than hair 6; 6(2,3); 9(4) short, weak and without barbs. Segment VIII: hair 4(1); 9(9,10) barbed, distinctly shorter than paddle.

LARVA (fig. 31). Head: 0.80 mm. Siphon: 1.36 mm. Anal Saddle: 0.45 mm. In general similar to *iridescens* but resembling *kompi* in the development of abdominal hairs 6-III-VI. General chaetotaxy based on 1 reared specimen from Brazil and the original description. *Head*: Integument light yellow; collar dark brown. Mental plate with 8 or 9 lateral teeth. Hair 4(10-12); 5(8-10); 6(2-4); 7(5,6); 8(2) longer than hair 7; 9(7,8); 10(1); 11(6,8); 12(1); 14(3,4); 15(2). *Antenna*: About 0.40 of head length; hair 1(2-5). *Thorax*: Prothorax: hair 0(7,12) relatively long; 1(1); 2(1); 3(4) relatively short; 4(2); 7(6); 8(16,18) very strong, stellate and with very large tubercle; 9(1); 10(2,3); 11(1); 14(1). Mesothorax: hair 1(4); 2(3,4); 3(1,2); 4(3); 8(5,6); 9(4,5); 11(1); 13(16,18); 14(10) moderately long and stellate. Metathorax: hair 1(4); 2(2); 3(1,3); 4(6); 5(1); 6(1); 7(6); 8(24, 26); 9(4,5); 11(1); 13(9,10) moderately long and stellate. *Abdomen*: Segment I: hair 1(6,8) short; 6(2); 7(2). Segment II: hair 1(3) strong and long; 3(2) short; 6(2,3). Segment III: hair 1(2,3) strong and long; 3(1) moderate; 6(2); 13(4) subequal to hair 1. Segment IV: hair 1(3) subequal to hair 1-III; 3(2) moderate; 6(2); 13(3,4) subequal to hair 1. Segment V: hair 1(2) longer than hair 1-IV; 3(1) long; 6(2); 13(5,6) subequal to hair 13-IV. Segment VI: hair 1(1) weak; 6(2). Segment VII: hair 1(2) very strong and long. *Segment VIII*: Comb scales (14) relatively short and without fringes; hair 1(4,6); 3(4,6); 5(4). *Siphon*: Pigmentation light brown. Index about 4.4. Pecten teeth (7-16) very short and with fine fringes on ventral margin. Ventral siphonal tufts (7-11) with variable number of branches (4-9). *Anal Segment*: Saddle pigmentation yellow. Hair 1(4,5); 2(3). Ventral brush with 4 pairs of hairs, all with 4 or 5 branches. Gills shorter than dorsal saddle length, tapered.

SYSTEMATICS. The ovoid sidepiece of the male genitalia of *soperi* is a derived character found elsewhere in the Antunesi Complex only in *kompi* but is characteristic of the entire Iridescens Complex. The accessory division of the subapical lobe superficially resembles that of *babahoyensis* but is more strongly differentiated. The linear scaling of the midlobe of the scutellum of the adults is a primitive state not known elsewhere in the complex. The branching of hair 6 on abdominal segments III-V is another primitive feature, retained in the complex only in *kompi*. The pupa also has retained a primitive short trumpet, unique in the complex. I interpret *soperi* as an ancient segregate as the southern extremity of the distribution of the Antunesi Complex with possible affinity with the more advanced *babahoyensis* which occupies the northernmost part of the range. The features shared by *soperi* and *kompi* were probably derived independently but the similarity with *iridescens* may be due to introgression with sympatric members of the Iridescens Complex.

Because of the very limited material of *soperi* I have seen, variation in this species could not be determined and it is possible that the diagnostic characters of the larva and pupa, based on single specimens, may not be entirely reliable.

BIONOMICS. Immature stages of *soperi* have been recorded only from cut or broken bamboo (Antunes and Ramos, 1939:385). The original collection of 1 male and 2 females was obtained from human bait (Antunes and Lane, 1937: 22) and 1 adult was netted over grass in Argentina (Casal and Garcia, 1968:97).

DISTRIBUTION (fig. 5). Coastal and Parana drainages southward from State of Espirito Santo in Brazil to Province of Misiones in northern Argentina, at elevations below 200 m.

Material examined: 5 specimens; 2 males, 1 female, 1 larva, 1 pupa; 1 individual larval rearing.

BRAZIL. *Rio de Janeiro*: Terezopolis (27866-1) [BH]. *Sao Paulo*: Perus, Agua Fria (1171-14) [USNM]; holotype [FH].

Additional Records From the Literature

ARGENTINA. *Misiones*: Mato Quemado (Casal and Garcia, 1968).

BRAZIL. *Espirito Santo*: Sao Joao de Petropolis (Lane and Whitman, 1943). *Sao Paulo*: Perus [FH, 721-723; 974-981] (Forattini, Rabello and Cotrim, 1970:48).

12. *Culex (Car.) babahoyensis* Levi-Castillo

Figs. 5,9,32,33

1953. *Culex (Carrollia) babahoyensis* Levi-Castillo, 1953a:35 (January). *Nomen nudum*.

1953. *Culex (Carrollia) babahoyensis* Levi-Castillo, 1953b:92-94 (July); 1953c:161-163 (Aug.).
TYPE: *Holotype* male genitalia on slide, Hacienda "Mora", Juan Montalvo, Los Rios, Ecuador, R. Levi-Castillo [USNM, 61639].

Culex (Carrollia) babahoyensis of Stone and Knight (1957:58); Stone, Knight and Starcke (1959:282); Belkin, Schick and Heinemann (1965:21-22).

FEMALE (fig. 9). Wing: 2.4 mm. Proboscis: 1.7 mm. Forefemur: 1.5 mm. Abdomen: about 2.3 mm. Not distinguishable with certainty from *antunesi*; very similar to *kompi* and *soperi*; diagnostic characters as in the key. In general as in *secundus*, differing primarily in the following features. Description based on 10 topotypic and 5 other specimens from Ecuador and 8 from Nicaragua. *Head*: Broad decumbent scales of vertex appearing largely pale from above except usually darkened near orbital bristles, and largely dark from anterior aspect except for a few light ones caudad; narrow decumbent scales usually completely absent; erect scales golden yellow, short, confined to posterior part of vertex and occiput, sometimes a few short ones on disc of vertex but distant from orbital line; lateral patch yellowish white. Proboscis 1.06-1.13 of forefemur; labium slightly paler ventrally. Palpus 0.20-0.21 of proboscis. Antenna 1.00-1.06 of proboscis; torus with 6-10 setae. *Thorax*: Integument of mesonotum and pleuron black to very dark brown. Mesonotal vestiture moderately dense, dark coppery to bronzy, usually paler in and around prescutellar space. Midlobe of scutellum with moderately long broad scales, usually concolorous with scales of prescutellar space; lateral lobe with longer broad scales concolorous with those of midlobe or often dark bronzy to black. Lower edge of dark part of pleuron sharply marked in a straight line, lower part of *stp* usually not infuscated; meron not darkened. A few broad pale scales in front of lower posterior bristles of *stp*. *Legs*: Coxal integument usually whitish; scale patches silvery or with slight yellowish tinge; forecoxal scale patch without dark scales. Forefemur with pale scaling of anterior surface extending to about 0.25 or more. Midfemur light scaled to about 0.25 on anterior surface and usually to near apex on posterior. Hindfemur light at base to at least 0.25; posterior light scaling more extensive. *Abdomen*: Dorsal basal tergal light bands yellowish, usually present only on V-VII but often at least indicated by some pale scales on IV and rarely on III. Metallic light spots larger and more conspicuous on II-IV. Sternites V-VII only with apical dark bands, a few dark apical scales sometimes present on IV. *Cibarial Armature*: Ci-

barial bar with 4 broad median teeth; cibarial dome with triangular denticles. *Genitalia*: Tergite IX with 2-4 lateral bristles; insula with 20-26.

MALE. Wing: 2.3 mm. Proboscis: 1.8 mm. Forefemur: 1.7 mm. Abdomen: about 2.1 mm. Very similar to *antunesi*, *cerqueirai*, *komp*, *soperi* and *wilsoni*; diagnostic characters in key not entirely reliable except for *soperi*. Essentially similar to the female and differing from *secundus* and *soperi* by the same general features. Proboscis 1.1-1.2 of forefemur; labium more or less uniformly dark scaled dorsally and with a narrow light scaled line from base to near apex ventrally. Palpus 0.78-0.83 of proboscis; without white scales on segment 3. Antenna 0.9 of proboscis. Specimens studied: 2 topotypic and 3 others from Ecuador, 4 from Costa Rica and 4 from Nicaragua. Measurements from dry specimens.

MALE GENITALIA (fig. 32). In general as described for *antunesi* but differing conspicuously in the following features. Lobe of tergite IX usually with 3 bristles (1-4). Setae *a* and *b* of proximal division of subapical lobe much narrower, subequal and not contorted; seta *c* a simple bristle. Distal division process more prominent and slender. Accessory division very strongly developed, broad at base and with a greatly expanded apex covered with numerous long simple bristles projecting dorsad of proximal division. Seta *a* of clasper a simple bristle.

PUPA (fig. 32). Abdomen: 2.50 mm. Trumpet: 0.50 mm. Paddle: 0.35 mm. Apparently indistinguishable from *antunesi* and *secundus*; diagnostic characters from other members of the subgroup as in the key. General chaetotaxy based on 10 specimens from Ecuador. *Cephalothorax*: Pigmentation light yellow; sculpturing weak, without definite pattern. All hairs shorter than trumpet, 2,6-9-C subequal, 5-C the longest; 1(2;1-2) shorter than hair 3; 2(2;2-3); 3(3;2-3); 4(3;2-4); 5(3;2-6); 6(3;1-3); 7(2;2-3); 8(2;1-4); 9(2;2-4). *Trumpet*: Nearly uniform in width; index about 12.0 (11.0-13.7); pinna small. Pigmentation yellow to brown. *Metanotum*: Pigmentation yellow to dark brown, sculpturing weak; hairs subequal, 10(2,3); 11(3;2-5); 12(2;2-4). *Abdomen*: Pigmentation light yellow, anterior mesal areas of tergites II-IV slightly darker; sculpturing very weak. Segment I: hair 1(40-64) fan-shaped. Segment II: hair 1(3,4;3-9) longer than hair 5; 3(1) surpassing level of rudimentary spiracle III; 4(3,4;2-5); 5(2;1-2). Segment III: hair 1(2,3;2-5); 3(1) surpassing level of rudimentary spiracle IV; 4(1,2); 5(3;2-4). Segment IV: 1(2,3;1-5); 3(5,6;4-8); 4(1,2); 5(1,2) surpassing caudal margin of tergite V. Segment V: hair 1(1) longer than hair 3; 3(1,2); 4(4,5;4-6); 5(1) surpassing level of rudimentary spiracle VII. Segment VI: hair 1(1,2;1-3); 3(1;1-2); 4(4;3-4); 5(1) surpassing level of rudimentary spiracle VII. Segment VII: hair 1(1;1-2) longer than hair 3; 3(1,2); 4(2); 5(2;1-4) shorter than hair 6; 6(4,5;1-6); 9(2,3;2-4) poorly developed, shorter than hair 1. Segment VIII: hair 4(1;1-2); 9(7,8;5-10) barbed, subequal to paddle.

LARVA (fig. 33). Head: 0.80 mm. Siphon: 1.25 mm. Anal Saddle: 0.30 mm. Very similar to *antunesi* and *cerqueirai*; diagnostic characters as in the key. General chaetotaxy based on 8 reared and 2 other specimens from Ecuador. *Head*: Integument light yellow to brown; collar dark brown. Mental plate with 8 or 9 lateral teeth. Hair 4(8-10;7-10); 5(8-10;7-11); 6(3-5); 7(4,5;3-5); 8(1;1-2) subequal to hair 7; 9(8-11;8-13); 10(1;1-2); 11(6-9); 12(1); 14(3,4;2-4); 15(1;1-2). *Antenna*: About 0.50 of head length; hair 1(3;2-5); *Thorax*: Prothorax: hair 0(10-12) relatively long; 1(1); 2(1); 3(2,3); 4(2); 7(3;2-4); 8(10,11;6-12) moderately long, strong and stellate; 9(2;1-2); 10(2;2-3); 11(1); 14(1). Mesothorax: hair 1(4;3-5); 2(2;1-3); 3(1); 4(2,3;2-4); 8(4,5;4-6); 9(4-6;4-7); 11(1); 13(11-20); 14(10-16) mod-

erately long and stellate. Metathorax: hair 1(3,4;3-5); 2(2;1-2); 3(4;4-6); 4(4,5; 3-5); 5(1); 6(1); 7(5-7;4-8); 8(11-24); 9(4,5); 11(1); 13(6-9) moderately long and stellate. *Abdomen*: Segment I: hair 1(6-8) short; 6(2;2-3); 7(2;2-3). Segment II: hair 1(1;1-2) strong and long; 3(2;1-2) short; 6(2;2-3). Segment III: hair 1(1,2; 1-3) strong and long; 3(1) long but shorter and weaker than hair 1; 6(1;1-2); 13(1-3;1-4) subequal to hair 1. Segment IV: hair 1(1,2;1-4) shorter and weaker than hair 1-III; 3(2;1-2) relatively short, weaker than hair 3-III; 6(1;1-2); 13(2, 3;1-4) subequal to hair 1. Segment V: hair 1(1;1-2) very long and strong; 3(1) subequal to hair 3-IV; 6(1;1-2); 13(2-4;1-5) subequal to hair 13-IV. Segment VI: hair 1(1) weak and relatively short; 6(1;1-2). Segment VII: hair 1(2;1-2) very strong and long. *Segment VIII*: Comb scales (8-12) long, fringes restricted to base; hair 1(4-6;4-8); 3(7-11); 5(3;3-5). *Siphon*: Pigmentation light yellow to brown. Index about 4.1-5.5. Pecten teeth (7-15) moderately long and without fringes. Ventral siphonal tufts (8-10) mostly with 5 or 6 branches (4-8). *Anal Segment*: Saddle pigmentation light yellow to brown. Hair 1(5,6;4-8); 2(4;3-4). Ventral brush with 4 pairs of hairs, all usually with 5-7 branches (3-7). Gills shorter than dorsal saddle length, tapered.

SYSTEMATICS. The accessory division of the subapical lobe of the male genitalia of *babahoyensis* is superficially very similar to *soperi* but is less differentiated and the sidepiece itself is of the primitive conical type as in all other members of the Antunesi Complex except *kompi* and *soperi*. In all other respects *babahoyensis* has derived character states when compared with *soperi*: (1) broad scales on the midlobe of the scutellum of the adults, (2) elongate trumpet in the pupa and (3) unbranched hair 6 on abdominal segments III-V of the larva. I have not been able to separate the pupa from *antunesi* or from *secundus* of the Iridesccens Complex and the larva is very similar to *antunesi* and *cerqueirai*. I am tentatively treating *babahoyensis* as a separate phyletic line in the Antunesi Complex but it is possible that this species is really related to *soperi* and the derived features it shares with the Antunesi line have been developed either independently or through introgression. *Culex babahoyensis* occupies the northernmost part of the range of the complex where it is partially sympatric with *antunesi* and *cerqueirai* of the Antunesi line but has not been found breeding in the same sites.

To date *babahoyensis* has not been collected in Panama. I found no significant differences between the topotypic population from Ecuador and the northern populations in Nicaragua and Costa Rica. In all of these there is an unusually great variation in the siphon index and pecten teeth of the larva.

BIONOMICS. The immature stages of *babahoyensis* have been found only in broken or cut bamboo (3) and in treeholes (1). The only associated species in these breeding sites were *Trichoprosopon (T.) digitatum* (4); *Toxorhynchites (L.)* sp. (1); and *Corethrella* sp. (2). According to Levi-Castillo (1953c:163) females of *babahoyensis* "bite readily during the day and are observed specially at the sunny spots in the jungle." This is the only record of a species of *Carrollia* biting man.

DISTRIBUTION (fig. 5). Known at present only from Caribbean drainages in Nicaragua and Costa Rica and the Pacific Guayas River basin in Ecuador, at elevations below 200 m.

Material examined: 169 specimens; 15 males, 24 females, 90 larvae, 40 pupae; 38 individual rearings (21 larval, 13 pupal, 4 incomplete).

COSTA RICA. *Heredia*: Finca La Selva, Puerto Viejo de Sarapiquí (CR 423) [UCLA].

ECUADOR. *Guayas*: Empalme (ECU 119) [UCLA]. *Los Ríos*: Hacienda Mora, Juan Montalvo

(ECU 125) [UCLA]; Levi-Castillo, holotype [USNM]. Valencia (ECU 114-A) [UCLA]. NICARAGUA. *Zelaya*: Cricket, Rio Escondido (NI 57) [UCLA].

13. *Culex (Car.) antunesi* Lane & Whitman

Figs. 5,9,34,35

1943. *Culex (Carrollia) antunesi* Lane and Whitman, 1943:389-392. TYPE: Holotype male, Sao Joao de Petropolis, Vale do Canaa, Espirito Santo, Brazil, Apr or May 1940, L. Whitman [BH].
1955. *Culex (Carrollia) manaensis* Floch and Fauran, 1955:3-5. TYPE: Holotype male with genitalia slide (909) and associated pupal skin, Boeuf Mort, Haute Mana, French Guiana [PIG]. NEW SYNONYM.

Culex (Carrollia) antunesi in part of Lane (1953:505-506); Senevet and Abonnenc (1958:287); Stone, Knight and Starcke (1959:282); Forattini, Rabello and Cotrim (1970:35); Belkin, Schick and Heinemann (1971:27).

Culex (Carrollia) manaensis of Stone, Knight and Starcke (1959:283); Fauran (1961:44).

Culex (Carrollella) iridescens in part of Komp (1936:64; 1956:39).

Culex (Carrollia) iridescens in part of Busck (1908:70).

Carrollia iridescens in part of Howard, Dyar and Knab (1915:462-464).

Culex (Carrollela) secundus in part of Dyar (1928:281-282).

Culex (Carrollia) secundus in part of Dyar (1925:176).

FEMALE (fig. 9). Wing: 2.5 mm. Proboscis: 1.8 mm. Forefemur: 1.6 mm. Abdomen: about 2.0 mm. Very similar to *kompi* and *soperi*; diagnostic characters as in the key. Indistinguishable with certainty from *babahoyensis* and differing from *secundus* and *soperi* in the same features as described for the former. Possibly differing from *babahoyensis* in the following indefinite variable features. Description based on 27 specimens from the Canal Zone and Panama. *Head*: Decumbent scales of vertex sometimes somewhat lighter. Proboscis 1.1 of forefemur; ventral surface of labium usually somewhat lighter. Palpus 0.19-0.22 of proboscis. Antenna 0.97-1.00 of proboscis. *Thorax*: Integument of mesonotum and pleuron usually dark to moderate brown; lower edge of dark part of pleuron not as sharply demarcated, lower part of sternopleuron usually infuscated; light part of pleuron usually somewhat darker. *Legs*: Coxal integument and scales more yellowish. *Abdomen*: Tergites III,IV often with very narrow dorsal basal dingy bands. *Cibarial Armature*: Without apparent significant differences. *Genitalia*: Tergite IX with 1 or 2 lateral bristles.

MALE. Wing: 2.4 mm. Proboscis: 2.0 mm. Forefemur: 1.8 mm. Abdomen: about 2.1 mm. Very similar to *babahoyensis*, *cerqueirai*, *kompi*, *soperi* and *wilsoni*; diagnostic characters in the key not entirely reliable except for *soperi*. Apparently indistinguishable from *cerqueirai* except on genitalic characters. Essentially similar to the female and differing from *secundus* and *soperi* by the same general features. Proboscis 1.1 of forefemur; labium more or less uniformly dark scaled dorsally and indistinctly paler ventrally but without white scaled line. Palpus 0.8 of proboscis; without white scales on segment 3. Antenna 0.95 of proboscis. Specimens studied: 1 from Mangaratiba, Brazil, and 28 from the Canal Zone and Panama.

MALE GENITALIA (fig. 34). Lobes of tergite IX moderately separated; each lobe usually with 4 (2-6) bristles. Sidepiece conical; 1 or 2 apicotergal setae differentiated; apicosternal process strongly developed. Proximal division of subapi-

cal lobe slender, almost uniform from near base; seta *a* short and strongly expanded and contorted distally; seta *b* longer and usually less expanded and contorted distally; seta *c* developed as a thickened sinuous bristle. Distal division represented as a short broad protuberance with 2 depressions. Accessory division developed as a simple bare, long digitiform process arising sternally near base of proximal division. Clasper shorter than sidepiece; moderately curved dorsad; with moderate differentiation of head but without conspicuous dorsal curvature or inner preapical lobe; crest represented by transverse ridges; snout prominent; seta *a* more or less spiniform or simple, seta *b* thickened. Lateral plate of phallosome with a distinct sternal spine (rarely double). Distal part of proctiger elongate and narrowed to apex; paraproct crown usually with 3 (2 or 3) teeth; cercal setae usually 1 pair (1 or 2).

PUPA (fig. 34). Abdomen: 2.70 mm. Trumpet: 0.55 mm. Paddle: 0.50 mm. Apparently indistinguishable from *babahoyensis* and *secundus*; diagnostic characters from other members of the group as in the key. General chaetotaxy based on 5 specimens from Panama. *Cephalothorax*: Pigmentation light yellow; sculpturing weak, without definite pattern. All hairs shorter than trumpet, weak; 1,3, 5-C longer, subequal; 1(2;1-2); 2(2;1-3) longer than hair 6; 3(2,3;2-4); 4(5,6;4-6) shorter than hair 7; 5(3;2-4); 6(3,4) short; 7(4;4-6); 8(3) shorter than hair 9; 9(2;2-3). *Trumpet*: Slightly widened distally; index about 11.0 (10.0-12.0); pinna small. Pigmentation yellow to light brown. *Metanotum*: Pigmentation yellow to light brown; sculpturing weak; hair 10(3,4) slightly longer than others; 11(3,4;2-4); 12(2,3;2-4). *Abdomen*: Pigmentation light yellow, anterior mesal areas of tergites II-IV slightly darker; sculpturing weak. Segment I: hair 1(56-84). Segment II: hair 1(7-9;5-10) slightly longer than hair 5; 3(1) often finely barbed, nearly reaching caudal margin of tergite III; 4(3;2-3); 5(5). Segment III: hair 1(3,4); 3(1) often finely barbed, nearly reaching caudal margin of tergite IV; 4(2,3); 5(4;2-5). Segment IV: hair 1(4,5;3-5); 3(6;6-8); 4(2,3;1-3); 5(1) often barbed, nearly reaching level of rudimentary spiracle VI. Segment V: hair 1(2,3;2-5); 3(1) about 2.0 of hair 6; 5(1) often barbed, nearly reaching level of rudimentary spiracle VII. Segment VI: hair 1(1) weak; 3(2;1-2); 4(4;4-5); 5(1) weak, subequal to hair 6. Segment VII: hair 1(1,2;1-3) subequal to hair 4; 3(1;1-2); 5(2,3) very short; 6(6;4-6) subequal to hair 5; 9(2,3;2-4) shorter than tergite VIII. Segment VIII: hair 4(2;1-2); 9(7,8) barbed, slightly longer than paddle.

LARVA (fig. 35). Head: 0.75 mm. Siphon: 1.30 mm. Anal Saddle: 0.35 mm. Very similar to *babahoyensis* and *cerqueirai*; diagnostic characters as in the key. General chaetotaxy based on 3 reared and 3 other specimens from Panama. *Head*: Integument light yellow to brown; collar dark brown. Mental plate with 9 lateral teeth. Hair 4(8-10); 5(7-10;6-12); 6(3-5;2-5); 7(4,5;4-6); 8(1,2) subequal to hair 7; 9(8,9;6-9); 10(1;1-2); 11(8,9;6-10); 12(1); 14(2,3); 15(2;1-2). *Antenna*: About 0.46 of head length; hair 1(3). *Thorax*: Prothorax: hair 0(12-14;10-14) relatively long; 1(1); 2(1); 3(3); 4(2); 7(3;2-3); 8(14-18) strongly developed, stellate; 9(1;1-2); 10(2,3); 11(1); 14(1). Mesothorax: hair 1(4,5;4-6); 2(2;1-2); 3(1); 4(2); 8(4-6); 9(4-7); 11(1); 13(8-24); 14(10-13) moderately long and stellate. Metathorax: hair 1(4,5;3-6); 2(2); 3(5;4-6); 4(5,6;5-8); 5(1); 6(1); 7(7,8;5-9); 8(18-30); 9(5,6;5-7); 11(1); 13(6-8;6-9) moderately long but weak. *Abdomen*: Segment I: hair 1(4-8) minute; 6(2); 7(2). Segment II: hair 1(1) moderately long; 3(1;1-3) short and weak; 6(2-3). Segment III: hair 1(1;1-2) strong and long; 3(1;1-2) long but weak; 6(1); 13(1;1-2) subequal to hair 1. Segment IV: hair 1(1;1-2) subequal to hair 1-III; 3(2) weak; 6(1); 13(2;1-2) subequal to hair 13-III. Seg-

ment V: hair 1(1) slightly longer than hair 1-III,IV; 3(1) long and strong; 6(1); 13(2-3) weaker and much shorter than hair 13-IV. Segment VI: hair 1(1) short and weak; 6(1). Segment VII: hair 1(2;1-2) very strong and long. *Segment VIII*: Comb scales (4-7) long and with fringes at base only; hair 1(9;9-12); 3(10-12); 5(3-5). *Siphon*: Pigmentation light brown. Index about 4.1-5.2. Pecten teeth (4-7) short and without fringes. Ventral siphonal tufts (9-10) usually with 8 or 9 branches (5-9). *Anal Segment*: Saddle pigmentation light brown. Hair 1(6-8); 2 (3-5). Ventral brush with 4 pairs of hairs with 4-10 branches. Gills slightly longer than dorsal saddle length, tapered.

SYSTEMATICS. I have seen only 1 specimen, a male without associated immature stages, from the southern topotypic population of *antunesi*. The genitalia of this specimen I cannot distinguish from those of the northern populations in Costa Rica, Panama and Colombia or from that of the holotype of *manaensis* from French Guiana.

The immature stages described above are associated with males of the northern population, including *manaensis* (pupa only). They differ conspicuously from the larva and pupa described and figured by Lane and Whitman (1943:389-392) which they state were associated with the holotype of *antunesi*. The extremely long trumpet of this pupa and the long siphon of this larva are of the type I found associated with a male from Colombia with genitalia apparently indistinguishable from those of *wilsoni* as described and figured by these authors in the same publication (Lane and Whitman, 1943:393). At the end of the description of *antunesi*, Lane and Whitman (1943:392) state that immature stages of *antunesi*, *wilsoni*, *secundus* (= sp. 9a), *iridescens* and *soperi* were all collected by L. Whitman in bamboo internodes in Sao Joao de Petropolis. I believe that an error was made in associating the skins with the adults and that the larva and pupa Lane and Whitman described as *antunesi* were really those of *wilsoni*. This interpretation leaves topotypic *antunesi* without associated larva and pupa as no subsequent associations of immature stages have been made for this population.

Therefore, my assignment of the northern populations to *antunesi* and the synonymy of *manaensis* of the Central population is based entirely on the similarity in the male genitalia and is tentative only.

The adults of the Antunesi line, which includes also *cerqueirai* and *wilsoni*, are extremely similar on external features and their separation from the unrelated *babahoyensis* is very difficult. Females are known only for *antunesi* but it is possible that I have included either or both *cerqueirai* and *wilsoni* among the specimens of *antunesi* from Panama. The males of *antunesi* and *cerqueirai* cannot be separated from each other and their distinction from *wilsoni* is probably not reliable. On male genitalic features *antunesi* is easily distinguished from the other 2 species by the lack of setae on the accessory division of the subapical lobe and the development of the specialized setae of the proximal division. The pupa is intermediate between *cerqueirai* and *wilsoni* in the length of the trumpet and easily separated from both on key characters but I have not found any characters to distinguish it from those of the unrelated *secundus* and *babahoyensis*. The larva has a much shorter siphon than *wilsoni*, a character it shares with *cerqueirai* from which it is separated by fewer branches in head hairs 5,7-C; again the similarity with *babahoyensis* is very great and its diagnosis from this species is tenuous.

The known distribution of *antunesi*, as interpreted here, is widely disjunct. The scattered northern populations are far removed from the central one in French

Guiana and the latter from the relatively compact southern ones in the States of Espirito Santo and Rio de Janeiro in southern Brazil.

As noted above, I have found no differences between the northern populations which are represented by a fair sample from Panama and the single male and its associated pupa from the central population. Of the southern topotypic population I have seen only 1 male. Because superficially similar forms with practically identical disjunct distributions in other phyletic lines of the Iridescentes Subgroup are obviously distinct species (see Iridescentes Complex), there is a strong possibility that my interpretation of *antunesi* is incorrect and that 2 or 3 distinct species are involved. The problem can be resolved only after adequate material of the central and southern populations is available for an analysis of differences.

BIONOMICS. The immature stages of both northern and southern populations of *antunesi* have been found only in cut or broken bamboo (5). In the north the known associates are 1 species of *Carrollia* (*secundus*), *Limatus durhamii* (1), *Sabethes* sp. (1), *Toxorhynchites* (*L.*) sp. (1), *Trichoprosopon* (*T.*) *digitatum* and *Wyeomyia* sp. (1). The southern populations of this species may be associated with sp. 9a (reported as *secundus*), *iridescens*, *soperi* and *wilsoni* (Lane and Whitman, 1943:392).

DISTRIBUTION (fig. 5). Widely disjunct; typical southern populations in coastal drainages in States of Espirito Santo and Rio de Janeiro, Brazil; northern populations in Costa Rica, Panama, upper Orinoco drainage in Colombia and French Guiana, at elevations of 50-500 m.

Material examined: 80 specimens; 34 males, 26 females, 10 larvae, 9 pupae; 8 individual rearings (5 larval, 3 pupal).

BRAZIL. *Rio de Janeiro*: Mangaratiba [BH].

COLOMBIA. *Meta*: Villavicencio (C-19,102) [UCLA].

COSTA RICA. *Puntarenas*: Villa Neily (CR 167) [UCLA].

FRENCH GUIANA. *Inini*: Boeuf Mort, Haute Mana, E. Abonnenc [PIG].

PANAMA. *Canal Zone*: Empire, A.H. Jennings [USNM]. Tabernilla, A.H. Jennings [USNM]; A. Busck [USNM]. *Colon*: Portobelo (P82-3) [USNM]. *Darien*: Paya Camp (GG 1-160,105, 107) [UCLA]. Pucro (GG 109) [UCLA].

Additional Record From the Literature

BRAZIL. *Espirito Santo*: Sao Joao de Petropolis [FH, 4095] (Forattini, Rabello and Cotrim, 1970:35).

14. *Culex* (*Car.*) *cerqueirai* Valencia, n.sp.

Figs. 5,36,37

TYPE: *Holotype* male (PA 654-104) with slides of genitalia and associated pupal skin, Quebrada Grande, Bocas del Toro, Panama, 11 Apr 1964 [USNM].

FEMALE. Unknown. Probably very similar to *antunesi* and *babahoyensis*; possibly included in some of the material identified in this study as *antunesi*.

MALE. Wing: 2.4 mm. Proboscis: 1.9 mm. Forefemur: 1.5 mm. Abdomen: about 2.2 mm. Very similar to *babahoyensis*, *kompi*, *soperi* and *wilsoni*; diagnostic characters in the key not entirely reliable except for *soperi*. Apparently indistinguishable from *antunesi* except on genitalic characters. General features as described for the females of *babahoyensis* and *antunesi* and differing from *secundus* and *soperi* in similar characters. Description and measurements based

on pinned holotype. *Head*: Broad decumbent scales of vertex largely pale except for a narrow line of dark scales caudad of orbital bristles and on midline in front; narrow decumbent scales apparently absent; erect scales as in *babahoyensis*; lateral patch yellowish white. Proboscis about 1.3 of forefemur; labium more or less uniformly dark scaled dorsally and with a narrow indefinite light scaled line from before false joint to near apex. Palpus about 0.8 of proboscis; without white scales on segment 3. Antenna about 0.8 of proboscis. *Thorax*: Integument of mesonotum and pleuron dark brown. Mesonotal and scutellar scaling essentially as in *babahoyensis* except for shorter lighter broad scales on lateral lobe of scutellum. Lower edge of dark part of pleuron not sharply marked off on *stp*, lower part of *stp* strongly infuscated; meron not darkened except lightly on extreme base. *Legs*: Coxal integument and scaling yellowish white; forecoxal scale patch without dark scales. Femoral scaling essentially as in *babahoyensis* but light scaling slightly less extensive. *Abdomen*: Tergites III-VII with distinct dorsal basal light bands. Metallic light spots essentially as in *babahoyensis*. Sternites III-VII with distinct apical dark bands.

MALE GENITALIA (fig. 36). In general as described for *antunesi* and differing only in the following few conspicuous features. Setae *a* and *b* of proximal division of subapical lobe subequal, more or less crescentic and with sharp point. Accessory division removed cephalodorsad from base of proximal division and with about 12 recurved bristles in distal half. Seta *a* of clasper simple.

PUPA (fig. 36). Abdomen: 2.70 mm. Trumpet: 0.40 mm. Paddle: 0.50 mm. Apparently differing from all other members of the subgroup by the flared trumpet with large pinna. General chaetotaxy based on 1 specimen from Panama. *Cephalothorax*: Pigmentation light yellow; sculpturing very weak; without definite pattern. All hairs shorter than trumpet, 1,4,6,7,9-C subequal; 1(2); 2(2) very short; 3(3,4) shorter than hair 5; 4(1); 5(3) weak; 6(1); 7(2); 8(1) stouter than hair 9; 9(2). *Trumpet*: Strongly widened distally; index about 10.0; pinna large, about 0.25. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing weak; hair 10(1) longer than others; 11(2); 12(2). *Abdomen*: Pigmentation light yellow throughout; sculpturing weak. Segment I: hair 1(35-45) weak. Segment II: hair 1(2) longer than hair 5; 3(1) surpassing level of rudimentary spiracle III; 4(2); 5(1). Segment III: hair 1(3,4); 3(1) surpassing level of rudimentary spiracle IV; 4(1,2), 5(2). Segment IV: hair 1(2); 3(2); 4(1); 5(1) reaching caudal margin of tergite V. Segment V: hair 1(2); 3(1) slightly longer than hair 6; 4(2); 5(1) reaching level of alveolus of hair 6-VI. Segment VI: hair 1(1) weak but longer than hair 6; 3(2) subequal to hair 5; 4(3,4); 5(1). Segment VII: hair 1(1) longer than hair 9; 3(1); 4(2); 5(2) short; 6(4) subequal to hair 5; 9(2) weak, subequal to hair 4. Segment VIII: hair 4(2) about 0.5 of tergite length; 9(missing).

LARVA (fig. 37). Head: 0.90 mm. Siphon: 1.15 mm. Anal Saddle: 0.35 mm. Very similar to *antunesi* and *babahoyensis*; diagnostic characters as in the key. Association with male and pupa presumptive only; general chaetotaxy based on 5 whole larvae from Panama. *Head*: Integument light yellow; collar dark brown. Mental plate with 9 or 10 lateral teeth. Hair 4(10;9-12); 5(12-16;10-16) without barbs; 6(4,5;3-6); 7(10-12;8-12) without barbs; 8(2) relatively short; 9(10-12;9-14); 10(2;1-2); 11(8-10;4-10); 12(1); 14(3;2-3); 15(2-3). *Antenna*: About 0.44 of head length; hair 1(2,3;2-4). *Thorax*: Prothorax: hair 0(12-16) short; 1(1); 2(1); 3(4;2-4); 4(2); 7(4;4-5); 8(10-14) moderately long but strongly barbed; 9(1); 10(2); 11(1); 14(1). Mesothorax: hair 1(3;3-6); 2(1-2); 3(1); 4(2); 8(5,6;4-

6); 9(5-8); 11(1); 13(16-20); 14(11-20) moderate, stellate, Metathorax: hair 1 (3;2-3); 2(1-2) subequal to hair 6; 3(3,4;3-6); 4(3;2-3); 5(1); 6(1); 7(6;6-7); 8 (19-24); 9(4-6); 11(1); 13(5-12) moderately long but weak. *Abdomen*: Segment I: hair 1(6-8) minute; 6(2); 7(2-3). Segment II: hair 1(1) moderately long and strong; 3(1) shorter and weaker than hair 1; 6(2). Segment III: hair 1(1;1-2) strong and long; 3(1) moderately long but weak; 6(1;1-2); 13(1-3) subequal to hair 1. Segment IV: hair 1(1;1-2) subequal to hair 1-III; 3(1) subequal to hair 3-III or weaker; 6(1;1-2); 13(1;1-3) subequal to hair 13-III. Segment V: hair 1 (1) slightly longer and stronger than hair 1-IV; 3(1) moderately long but rather weak; 6(1); 13(1-4) shorter than hair 13-IV. Segment VI: hair 1(1) weak and relatively short; 6(1). Segment VII: hair 1(2) strong. *Segment VIII*: Comb scales (5-12) sharply pointed and without fringes; hair 1(4-9); 3(9-11); 5(3-4) without barbs. *Siphon*: Pigmentation light brown. Index about 3.6-4.4. Pecten teeth (4-7) sharply pointed, moderately long and with ventral marginal spicules at base only. Ventral siphonal tufts (7-8) with about 8 branches (7-9). *Anal Segment*: Saddle pigmentation light brown. Hair 1(5-7); 2(3-5). Ventral brush with 4 pairs of hairs, all usually with about 5 branches (3-6). Gills slightly longer than dorsal saddle length, tapered.

SYSTEMATICS. *Culex cerqueirai* is apparently a relict species in the Antunesi line which includes *wilsoni* in addition to the nominate species. It has a peculiar combination of features of *antunesi* and *wilsoni*. The single known adult, the holotype male, cannot be separated from *antunesi* on external features. The male genitalia are very similar to *wilsoni* but differ from it in the small number and restricted distribution of setae on the more slender accessory division of the sub-apical lobe and in the shorter, broader and crescentic setae *a* and *b* of the proximal division. The associated pupa is differentiated from the other members of the line by a relatively short, strongly flared trumpet but is more like *antunesi* than *wilsoni*.

The association of the larva with the holotype is presumptive only and complicated by an apparent error in mixing material from 2 collections in the field, made in the same locality, PA 654 from broken or cut bamboo and PA 657 from flower bracts of *Heliconia*. The holotype was originally labelled 657-101 and the larvae 654. I am confident that both came from collection 654 because there were similar errors made with other species in these 2 collections, typical *Heliconia* breeders being included in the collection from bamboo and vice versa. Therefore, I have relabelled the holotype as 645-104. The larva I am tentatively associating with the holotype of *cerqueirai* is very similar to those of *antunesi* and *babahoyensis* but is distinguished from both by the more profuse branching of head hairs 5-C and 7-C.

Culex cerqueirai is known from a single locality in the Bocas del Toro Province of Panama within the range of the northern populations of *antunesi* but not associated with the latter.

BIONOMICS. As noted in the section on systematics, the presumed larva of *cerqueirai* is not definitely associated with the pupa from which emerged the male holotype. I am confident however they all came from the same collection in cut or broken bamboo where they were associated with a species of *Carrollia (secundus)*, *Sabethes undosus*, *Wyeomyia aporonoma* and *W. arthrostigma*. No adults other than the single male are known.

DISTRIBUTION (fig. 5). Known only from the type locality, at an elevation of 10-20 m.

Material examined: 16 specimens; 1 male, 1 pupa, 14 larvae; 1 individual pupal rearing.

PANAMA. *Bocas del Toro*: Quebrada Grande (PA 654) [UCLA].

15. *Culex* (*Car.*) *wilsoni* Lane & Whitman

Figs. 5,38,39

1943. *Culex* (*Carrollia*) *wilsoni* Lane and Whitman, 1943:393. TYPE: *Holotype* male, Sao Joao de Petropolis, Vale do Canaa, Espirito Santo, Brazil, Apr 1940, L. Whitman [LU].

Culex (*Carrollia*) *wilsoni* of Lane (1953:506); Stone, Knight and Starcke (1959:283); Forattini, Rabello and Cotrim (1970:50); Belkin, Schick and Heinemann (1971:28).

Culex (*Carrollia*) *antunesi* in part of Lane and Whitman (1943:389-392).

Culex (*Carrollia*) *iridescens* in part of Komp (1936:64; 1956:39).

FEMALE. Unknown. Probably very similar to *antunesi* and *babahoyensis*; possibly included in some of the material identified in this study as *antunesi*.

MALE. Wing: 2.8 mm. Proboscis: 2.0 mm. Forefemur: 1.8 mm. Abdomen: about 1.9 mm. Very similar to *antunesi*, *babahoyensis*, *cerqueirai*, *komp* and *soperi*; diagnostic characters in the key probably not entirely reliable except for *soperi*. General features as described for the females of *babahoyensis* and *antunesi* and differing from *secundus* and *soperi* in similar characters. Description and measurements based on 2 dry specimens from Colombia. *Head*: Broad decumbent scales of vertex either all whitish or whitish and yellow with a few dark scales on midline in front; a few yellowish narrow decumbent scales; erect scales as in *babahoyensis*; lateral patch whitish. Proboscis about 1.1 of forefemur; labium more or less uniformly dark scaled dorsally and with a conspicuous ventral line of whitish scales. Palpus about 0.8 of proboscis; without white scales on segment 3. Antenna about 0.75 of proboscis. *Thorax*: Integument of mesonotum and pleuron light brown. Mesonotal scaling denser than in *babahoyensis*, paler in pre-scutal space. Scutellum with shorter, paler scales on midlobe and lateral lobe. Lower edge of dark part of pleuron not sharply marked off on *stp*; lower part of *stp* slightly infuscated; meron not darkened. More numerous, conspicuous and longer broad scales near lower posterior *stp* bristles. *Legs*: Coxal integument and scaling yellowish white; forecoxal scale patch without dark scales. Femoral scaling essentially as in *babahoyensis*. *Abdomen*: Broken off; apparently with larger light metallic markings on proximal segments than in *babahoyensis*; basal tergal light bands present at least on IV-VII; sternites with apical dark bands at least on IV-VII.

MALE GENITALIA (fig. 38). In general as described for *antunesi*; very similar to *cerqueirai* and differing from it primarily in the following features. Setae *a* and *b* of proximal division of subapical lobe more nearly equal, much narrower and not crescentic. Accessory division broader, less digitiform, somewhat expanded distally and usually with about 30 setae extending to at least basal third.

PUPA (fig. 38). Abdomen: 2.80 mm. Trumpet: 0.75 mm. Paddle: 0.45 mm. Differing from all other known species of subgenus by the very long and narrow trumpet. General chaetotaxy based on 3 specimens from Colombia. *Cephalothorax*: Pigmentation light yellow; sculpturing weak. All hairs shorter than trumpet, 1,5-7-C subequal, 3-C the longest; 1(2); 2(2;1-2) shorter than hair 6; 3(1-4); 4(1-4); 5(3-5); 6(2;1-2); 7(2-4); 8(2-4) shorter than hair 9; 9(1-2). *Trumpet*: Near-

ly uniform in width; index about 17.0 (15.0-18.7); pinna very small. Pigmentation light brown. *Metanotum*: Pigmentation light yellow; sculpturing weak; hair 10(2-3) longer than the others; 11(1-5); 12(1-3). *Abdomen*: Pigmentation more or less uniformly yellow; sculpturing weak. Segment I: hair 1(80-120). Segment II: hair 1(6-10) subequal to hair 5; 3(1) barbed, not reaching caudal margin of tergite III; 4(2-6); 5(1-4). Segment III: hair 1(4-5); 3(1) barbed, surpassing caudal margin of tergite IV; 4(1-3); 5(2-5). Segment IV: hair 1(2-4); 3(3-8); 4(1); 5(1) extremely long, surpassing level of rudimentary spiracle VII. Segment V: hair 1(2-5) reaching level of rudimentary spiracle VI; 3(1-2) shorter than hair 1; 4(5-6); 5(1) very long, reaching tergite VIII. Segment VI: hair 1(1-2); 3(1-2) subequal to hair 1; 4(2-5); 5(1) shorter than hair 6. Segment VII: hair 1(1-2) reaching alveolus of hair 4-VIII; 3(1-2); 4(1-2); 5(2-4) subequal to hair 6; 6(2-8); 9(3-5) barbed, less than 0.5 of hair 9-VIII. Segment VIII: hair 4(1-2) weak; 9(5-9) barbed, distinctly longer than paddle.

LARVA (fig. 39). Head: 0.85 mm. Siphon: 2.10 mm. Anal Saddle: 0.36 mm. In general similar to *antunesi*, *babahoyensis* and *cerqueirai*, but readily differentiated by the very long siphon. General chaetotaxy based on 1 associated skin, 1 skin and 2 whole larvae from Colombia. *Head*: Integument light yellow to brown; collar dark brown. Mental plate with 8 or 9 lateral teeth. Hair 4(8,9; 8-11); 5(8-16); 6(2,3;2-4); 7(5,6;5-8) relatively short and without barbs; 8(1) longer than hair 7; 9(12;10-12); 10(1); 11(6-8;5-8); 12(1); 14(3,4); 15(2,3). *Antenna*: About 0.44 of head length; hair 1(2,3;1-3). *Thorax*: Prothorax: hair 0(10-18) short; 1(1); 2(1); 3(2-6); 4(2); 7(3,4); 8(6-12) strong and barbed; 9(1); 10(2); 11(1,2); 12(1;1-2); 14(1). Mesothorax: hair 1(3-8); 2(1,2); 3(1); 4(1); 8(4;4-8); 9(4-6); 11(1); 13(14-20); 14(8-12) moderately long and stellate. Metathorax: hair 1(3,4;3-5); 2(1,2); 3(4-6); 4(3-7); 5(1,2;1-3); 6(1); 7(4-8;4-9); 8(12-20); 9(2-5); 11(1); 13(5,6) very long but with weak branches. *Abdomen*: Segment I: hair 1(6-10) minute; 6(2); 7(2). Segment II: hair 1(1;1-2) long and rather strong; 3(1; 1-2) short; 6(2). Segment III: hair 1(1) very long and strong; 3(1) long but thin; 6(1); 13(1,2) subequal to hair 1. Segment IV: hair 1(1;1-2) subequal to hair 1-III but stronger; 3(1;1-2f) moderate, shorter than hair 3-III; 6(1); 13(1) subequal to hair 13-III. Segment V: hair 1(1) subequal to hair 1-IV; 3(1) subequal to hair 3-III; 6(1); 13(1-3) subequal to hair 13-III,IV. Segment VI: hair 1(1) weak, moderate; 6(1). Segment VII: hair 1(1) very strong and long. *Segment VIII*: Comb scales (10-10) very narrow and without fringes; hair 1(5-10); 3(7-12); 5(3;2-4) without barbs. *Siphon*: Pigmentation light brown. Index about 9.7-12.0. Pecten teeth (10-16) moderately long, sharp and without fringes. Ventral siphonal tufts (7-8) usually with about 4 or 5 uneven branches (4-7). *Anal Segment*: Saddle pigmentation light brown. Hair 1(2-8); 2(3,4). Ventral brush with 4 pairs of hairs with variable number of branches (4-8). Gills very narrow from base, about 3.0 of dorsal saddle length.

SYSTEMATICS. My assignment of the population of the Antunesi line from the Villavicencio area in Colombia, described above, to *wilsoni* is tentative as it is based only on similarity in male genitalia. Even this is tenuous as I had no access to the type material of *wilsoni*, whole holotype is apparently lost, and had to rely entirely on the original description and figures.

On external features the males of this population agree with the description of topotypic *wilsoni* in the whitish scaling of the ventral surface of the labium, a character distinguishing them from the other 2 members of the line, *antunesi* and *cerqueirai*. Females are not known for either population but may be included among the specimens from Panama I have identified as *antunesi*. The male geni-

talia of the 2 populations I cannot distinguish. They are very similar to those of *cerqueirai* but are readily differentiated from the latter by the characters given in the diagnosis above.

Associated by individual rearings with the male from the Villavicencio population are a pupa and larva which show general similarity with the immature stages ascribed to *antunesi* by Lane and Whitman (1943:390-392). As indicated under *antunesi*, I believe that the latter association was in error and these immature stages are actually those of topotypic *wilsoni*. The pupae of both populations differ from those of the other species of the line as well as all species of *Carrollia* in the very long trumpet and the larvae are unique in the very long siphon.

The only 2 known populations of *wilsoni* are extremely widely disjunct. The topotypic population has been collected only once near Sao Joao de Petropolis in the State of Espirito Santo in southern Brazil within the range of topotypic *antunesi*. The northern population is known from 4 collections in 3 localities in the Villavicencio area of Colombia, within the range of the northern populations of *antunesi*.

The conspecificity of these 2 populations is by no means conclusively established. There appear to be some differences in the larvae and pupae in the 2 populations and an examination of the male genitalia of the topotypic population may reveal details not apparent in the figures and description which may distinguish this population. Because in the Iridescens Complex and in the Soperi-Babahoyensis lines superficially similar forms with widely disjunct northern and southern distributions are clearly distinct species, there is a strong probability that this is also the case with the 2 populations of *wilsoni*. However, without adequate material of either population, I refrain from separating the northern population as a distinct species at this time.

BIONOMICS. The adults of the northern population of *wilsoni* were all reared from immature stages collected in cut or broken bamboo (3) without recorded associates. Lane and Whitman (1943:392) state that the 3 males of the type series, the only specimens recorded from the southern population, were also reared from a collection in bamboo where they may have been associated with 1 or more of the following species of *Carrollia*: *antunesi*, sp. 9a (reported as *secundus*), *soperi* and *iridescens*.

DISTRIBUTION (fig. 5). Widely disjunct; typical southern population in State of Espirito Santo, Brazil; northern population in Colombia in the vicinity of Villavicencio in upper part of Orinoco basin; at elevations of 400-500 m.

Material examined: 12 specimens; 3 males, 6 larvae, 3 pupae; 2 individual rearings (1 larval, 1 incomplete).

COLOMBIA. *Cundinamarca*: La Union (KO 10-43) [UCLA]. *Meta*: Bosque de Ocoa (1006-2, 1022-2) [UCLA]. Villavicencio (65) [UCLA].

Additional Record From the Literature

BRAZIL. *Espirito Santo*: Sao Joao de Petropolis [FH, 4096] (Forattini, Rabello and Cotrim, 1970:50).

16. *Culex* (*Car.*) *kompi* Valencia, n.sp.

Figs. 5,40,41

TYPES: *Holotype* male (8) with genitalia slide (720111-1) and associated larval skin, Salinas,

Restrepo, Meta, Colombia, 22 Aug 1935, W.H. Komp [USNM]. *Allotype* female (KO 10-42-3) with associated larval skin, same data as holotype [USNM]. *Paratypes*: 2 IM (KO 10-30-1,2), 1 M (KO 1042), 1 F (KO 10-30), 2 IF (7,9), 3 I (4,5,6), same data as holotype [UCLA, USNM].

FEMALE. Wing: 2.4 mm. Proboscis: 1.8 mm. Forefemur: 1.7 mm. Abdomen: about 2.2 mm. Differentiated from all other members of the subgroup by the very long palpus and 2 short setae below the interorbital bristles. Very similar to *antunesi*, *babahoyensis* and *soperi*; differing from *secundus* in the same general features. Description and measurements based on 2 pinned specimens from Colombia. **Head:** Broad decumbent scales of vertex largely pale yellowish, only a narrow band of darker scales along orbital bristles; a few light yellowish narrow decumbent scales present; erect scales light yellowish, as in *babahoyensis*; lateral patch light yellowish. Two short setae below interorbital bristles. Proboscis about 1.1 of forefemur; labium uniformly brown. Palpus 0.45-0.50 of proboscis. Antenna 0.94 of proboscis. **Thorax:** Integument of mesonotum and pleuron dark brown; lower edge of dark part of pleuron not sharply demarcated on sternopleuron; latter infuscated; meron not infuscated. Mesonotal vestiture denser and paler posteriorly than in *babahoyensis*, more similar to that of *secundus*. Prescutellar bristles weaker and less numerous. Scutellar lobes with shorter broad scales, all pale. More numerous, conspicuous and longer broad scales near lower posterior *stp* bristles; a few broad scales near *umep* bristles sometimes present. **Legs:** Coxal integument and scales more yellowish than in *babahoyensis*. Femora essentially as in *babahoyensis*. **Abdomen:** Dorsal basal tergal light bands whitish, distinct on III,IV but smaller than on V-VII. Metallic light spots essentially as in *babahoyensis*. Sternites as in *babahoyensis*, more silvery white rather than yellowish. **Cibarial Armature and Genitalia:** Not studied.

MALE. Wing: 2.4 mm. Proboscis: 1.8 mm. Forefemur: 1.7-1.9 mm. Abdomen: about 2.0 mm. Very similar to *antunesi*, *babahoyensis*, *cerqueirai*, *soperi* and *wilsoni*; diagnostic characters in the key not entirely reliable except for *soperi*. Essentially similar to the female and differing from *secundus* and *soperi* by the same general features. Proboscis about 1.2 of forefemur; labium more or less uniformly dark scaled dorsally, ventral surface pale to whitish distad of false joint. Palpus 0.72-0.78 of proboscis; without white scales on segment 3. Antenna 0.82 of proboscis. Specimens studied: 4 from Colombia. Measurements from dry specimens.

MALE GENITALIA (fig. 40). In general as described for *antunesi* but differing very conspicuously from it and other species of the subgroup in the following features. Lobes of tergite IX very large and closely approximated; each lobe usually with 5 (4 or 5) bristles. Sidepiece ovoid; apicotergal seta not differentiated. Proximal division with narrow strongly curved stem; setae *a* and *b* flattened and expanded, *a* shorter and with recurved point, *b* with forked apex; seta *c* a simple bristle. Accessory division composed of 2 widely separated, long, slender columnar processes; ventral process arising from base of proximal division and with 2 simple subapical bristles, 5 apical flattened modified setae, 3 narrow and pointed and 2 moderately dilated; dorsal process widely separated at base from ventral, stem with sigmoid curvature, apex with 2 or 3 long, curved differentiated bristles. Clasper strongly curved dorsad apically; setae *a* and *b* both thickened, spiniform; snout very prominent. Paraproct crown with 2 very short blunt teeth; cercal setae usually 1 pair (1 or 2), very short.

PUPA (fig. 40). Abdomen: 1.55 mm. Trumpet: 0.40 mm. Paddle: 0.35 mm. Unique in the subgenus in the development of the trumpet and abdominal hair

9-VIII. General chaetotaxy based on 4 unassociated skins from Colombia. *Cephalothorax*: Pigmentation light yellow, sculpturing very weak. All hairs shorter than trumpet except 1,4,9-C which are about the same length; 1(1) longer than hair 7; 2(2;1-2) longer than hair 6; 3(2) slightly longer than hair 4; 4(1,2) longer than hair 7; 5(3,4;3-5); 6(1); 7(1,2;1-3); 8(3;2-3) shorter than hair 9; 9(1). *Trumpet*: Fusiform; index about 9.0 (8.6-10.0); pinna minute. Pigmentation light brown. *Metanotum*: Pigmentation light yellow, sculpturing very weak; hair 10(2;1-2) subequal to hairs 11,12; 11(2); 12(1,2;1-3). *Abdomen*: Pigmentation light yellow; sculpturing very weak. Segment I: hair 1(120-190). Segment II: hair 1(10-16) surpassing level of rudimentary spiracle III; 3(1); 4(4,5;4-6); 5(2;1-2) shorter than hair 3. Segment III: hair 1(1;1-2) surpassing level of rudimentary spiracle V; 3(1); 4(1); 5(1;1-3) short. Segment IV: hair 1(1) longer than hair 3; 3(4,6;4-8) longer than hair 6; 4(1); 5(1;1-2) nearly reaching caudal margin of tergite V. Segment V: hair 1(1) subequal to hair 4; 3(1) about 3.0 of hair 1; 4(3,4;3-6); 5(1) nearly reaching rudimentary spiracle VI. Segment VI: hair 1(1) subequal to hair 4; 3(1); 4(1); 5(1). Segment VII: hair 1(1) shorter than hair 4; 3(1;1-2) subequal to hair 6; 4(1); 5(1); 6(1); 9(1) weak, shorter than hair 9-VIII. Segment VIII: hair 4(1); 9(2) extremely long, about 0.5 of abdomen, without barbs.

LARVA (fig. 41). Head: 0.85 mm. Siphon: 0.95 mm. Anal Saddle: 0.35 mm. Unique in the subgenus in the development of abdominal hair 7-II. General chaetotaxy based on 6 associated and 3 other skins from Colombia. *Head*: Integument light yellow; collar dark brown. Mental plate with 8-10 lateral teeth. Hair 4(8-10); 5(10-12;8-17); 6(2;2-3); 7(7,8;6-8) not barbed; 8(2;1-2) much shorter than hair 7; 9(8-10;7-12); 10(1); 11(4;2-5); 12(1); 14(3;3-4); 15(2;1-3). *Antenna*: About 0.41 of head length; hair 1(2-4;1-4). *Thorax*: Prothorax: hair 0(8-14) minute; 1(1); 2(1) relatively short; 3(2;2-3) relatively very short; 4(2); 6(1;1-2); 7(2-4;2-5); 8(6-12) short but on distinct tubercle; 9(1;1-2); 10(1;1-2); 11(1;1-3); 12(1;1-2); 14(1). Mesothorax: hair 1(3;1-3); 2(2;1-3); 3(1,2;1-3); 4(3;2-3); 7(1;1-2); 8(2;2-6); 9(2-4;2-5); 11(1); 13(8-20); 14(6-16) short and weak. Metathorax: hair 1(2-4); 2(2); 3(3); 4(2-4); 7(3-5;2-5); 8(10-18); 9(2,3;2-6); 11(1); 13(2,3;2-4) very long and strong. *Abdomen*: Segment I: hair 1(3-4) minute; 6(2;2-4); 7(2). Segment II: hair 1(2;2-3) long and strong, subequal to hair 1-III; 3(1) short; 6(2;2-3); 7(2;2-3) very strong, subequal to hair 7-I. Segment III: hair 1(2;2-3); 3(1;1-2) moderate; 6(2); 13(3;2-3) subequal to hair 1. Segment IV: hair 1(2,3) subequal to hair 1-II,V; 3(1,1-2) shorter than hair 3-III; 6(2); 13(2,3) subequal to hair 1. Segment V: hair 1(2,3); 3(1) moderate; 6(2); 13(3) subequal to hair 1. Segment VI: hair 1(1) weak and short; 6(2). Segment VII: hair 1(3) relatively short. *Segment VIII*: Comb scales (4-7) moderately long, sharp and without fringes; hair 1(3-8); 3(6-8;5-8); 5(2,3). *Siphon*: Pigmentation light yellow. Index about 2.9-3.3. Pecten teeth (6-11) moderate, sharp and without fringes. Ventral siphonal tufts (8-9) mostly with 5 branches (4-8). *Anal Segment*: Saddle pigmentation light yellow. Hair 1(4,5;3-6); 2(3;3-4). Ventral brush with 4 pairs of hairs, all usually with 3 branches (2-4). Gills less than 2.0 of dorsal saddle length, tapered.

SYSTEMATICS. *Culex kompi* is a relict species with a bizarre combination of a few apparently primitive and a multitude of unique derived character states and cannot be confused with any other species of *Carrollia* in any stage. However it appears to be related to the other phyletic lines in the Antunesi Complex in general features of the adults, male genitalia and larva. The pupa is so different from other species of *Carrollia* that superficially it does not appear to belong to the subgenus and my tentative association of this stage with the adult and larva may be incorrect.

Culex kompi resembles *soperi* in a derived feature (ovoid sidepiece in the male genitalia) which is characteristic of all members of the Iridesccens Complex. This may indicate phyletic relationship, introgression with a sympatric member of the Iridesccens Complex or completely independent origin. The apparently primitive character of branched hair 6-III-V of the larva shared by these 2 species may have also arisen as a result of such introgression. All these alternatives lead to the conclusion that *kompi* probably originated early in the evolution of the Iridesccens Subgroup at the time of separation of the Iridesccens and Antunesi Complexes. *Culex kompi* could be segregated as a separate complex but because of the similarity in general features with other lines of the Antunesi Complex I am retaining it in this complex. I believe that the above-mentioned annectent features of *kompi* as well as its unique derived features (female palpus; larval hair 7-II; pupal chaetotaxy and trumpet) may have arisen as a result of introgression.

BIONOMICS. All the adults of *kompi* were reared from collections of immature stages in broken or cut bamboo (3) without record of associated species.

DISTRIBUTION (fig. 5). Known only from the vicinity of Villavicencio, Colombia, in upper part of Orinoco basin, at elevations of 450-500 m.

Material examined: 22 specimens; 4 males, 4 females, 9 larvae, 5 pupae; 6 individual rearings (larvae and adults only).

COLOMBIA. *Meta:* Restrepo, Salinas (KO 10-30,10-42) [UCLA, USNM]. Villavicencio, M. Bates [USNM].

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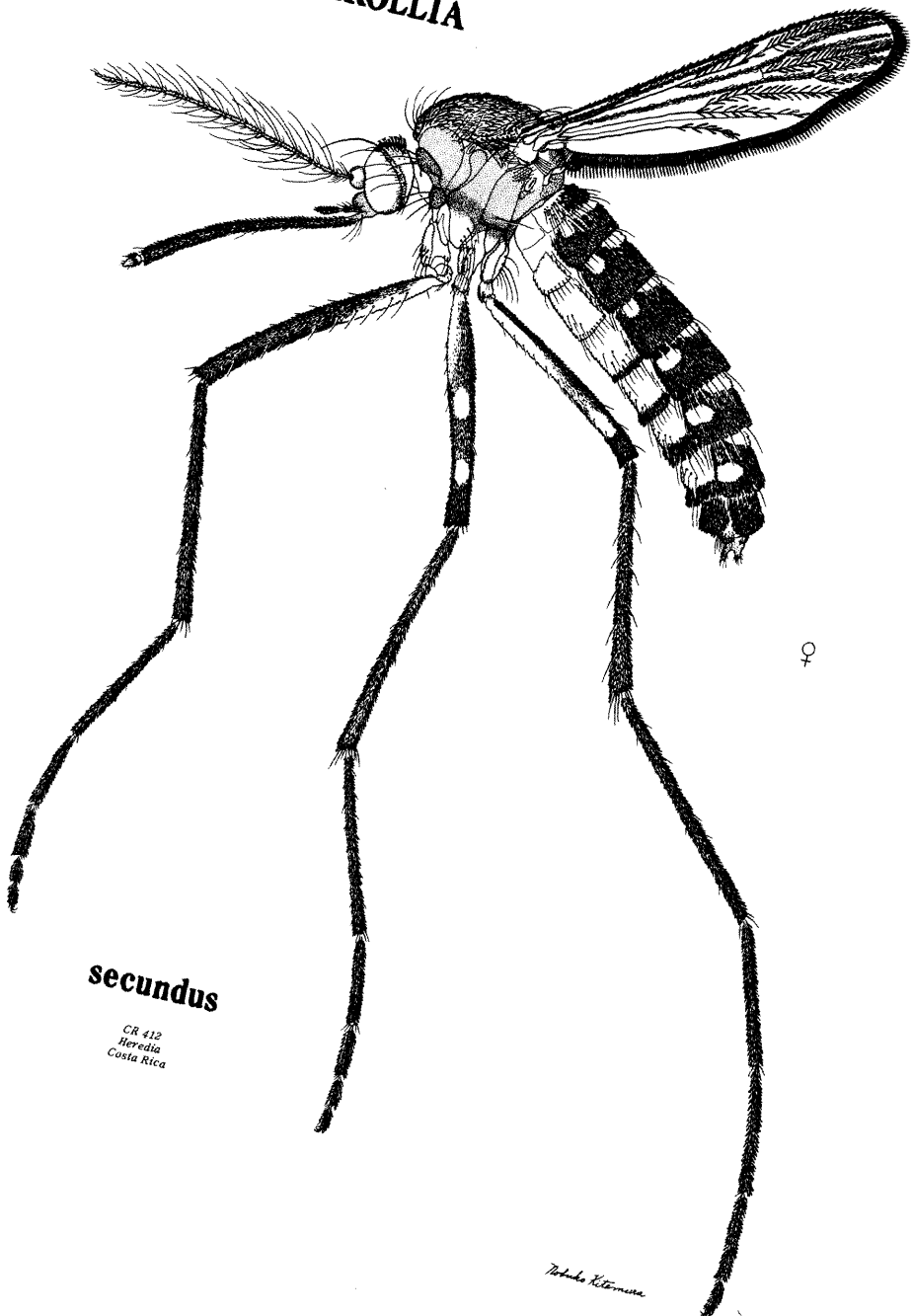
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FIGURES

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7. *Culex (Car.) urichii*; male and female heads and claws; female thorax, wing, legs and genitalia
8. *Culex (Car.) secundus*; male and female heads and claws; female thorax, wing, legs and genitalia
9. *Culex (Car.)*; female cibarial armatures
10. *Culex (Car.) bihaicolus*; male genitalia and pupa
11. *Culex (Car.) bihaicolus*; larva
12. *Culex (Car.) guerreroi*; male genitalia and pupa
13. *Culex (Car.) guerreroi*; larva
14. *Culex (Car.) rausseoi*; male genitalia and pupa
15. *Culex (Car.) rausseoi*; larva
16. *Culex (Car.) metempsythus*; male genitalia and pupa
17. *Culex (Car.) metempsythus*; larva
18. *Culex (Car.) infoliatus*; male genitalia and pupa
19. *Culex (Car.) infoliatus*; larva
20. *Culex (Car.) urichii*; male genitalia and pupa
21. *Culex (Car.) urichii*; larva
22. *Culex (Car.) anduzei*; male genitalia and pupa
23. *Culex (Car.) anduzei*; larva
24. *Culex (Car.) bonnei*; male genitalia and pupa
25. *Culex (Car.) bonnei*; larva
26. *Culex (Car.) secundus*; male genitalia and pupa
27. *Culex (Car.) secundus*; larva
28. *Culex (Car.) iridescens*; male genitalia and pupa
29. *Culex (Car.) iridescens*; larva
30. *Culex (Car.) soperi*; male genitalia and pupa
31. *Culex (Car.) soperi*; larva
32. *Culex (Car.) babahoyensis*; male genitalia and pupa
33. *Culex (Car.) babahoyensis*; larva
34. *Culex (Car.) antunesi*; male genitalia and pupa
35. *Culex (Car.) antunesi*; larva
36. *Culex (Car.) cerqueirai*; male genitalia and pupa
37. *Culex (Car.) cerqueirai*; larva
38. *Culex (Car.) wilsoni*; male genitalia and pupa
39. *Culex (Car.) wilsoni*; larva
40. *Culex (Car.) kompi*; male genitalia and pupa
41. *Culex (Car.) kompi*; larva

Fig. 1

CARROLLIA



secundus

CR 412
Heredia
Costa Rica

Walter Kitchener

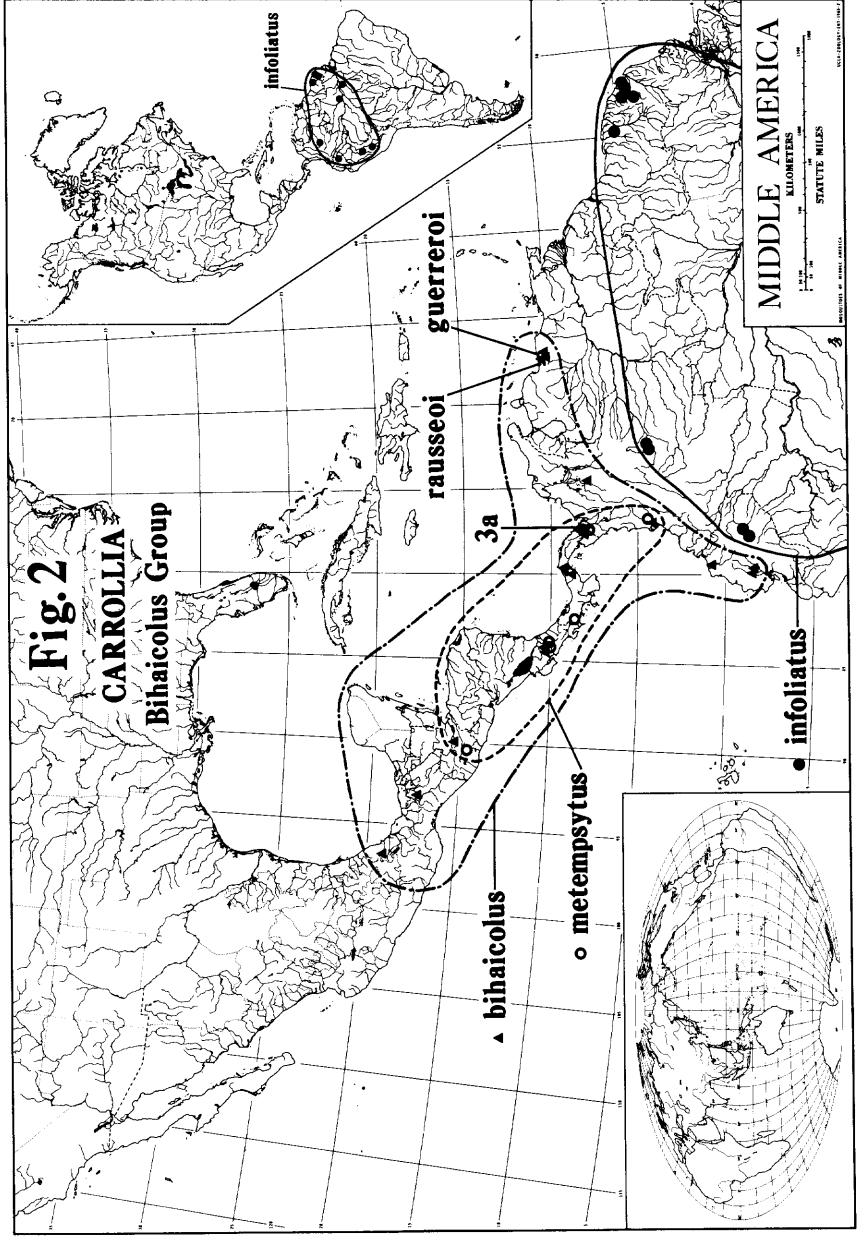
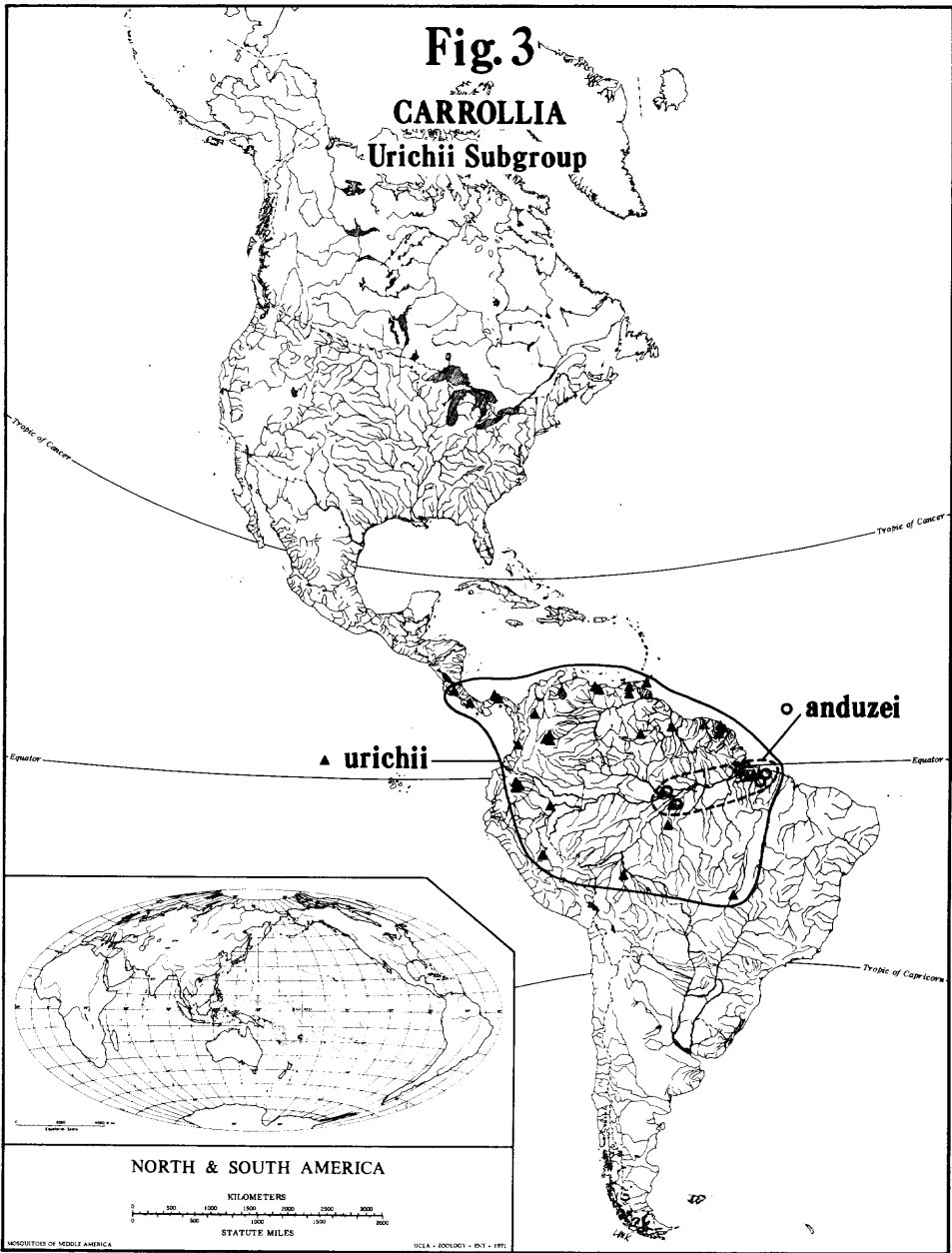


Fig. 3

CARROLLIA
Urichii Subgroup



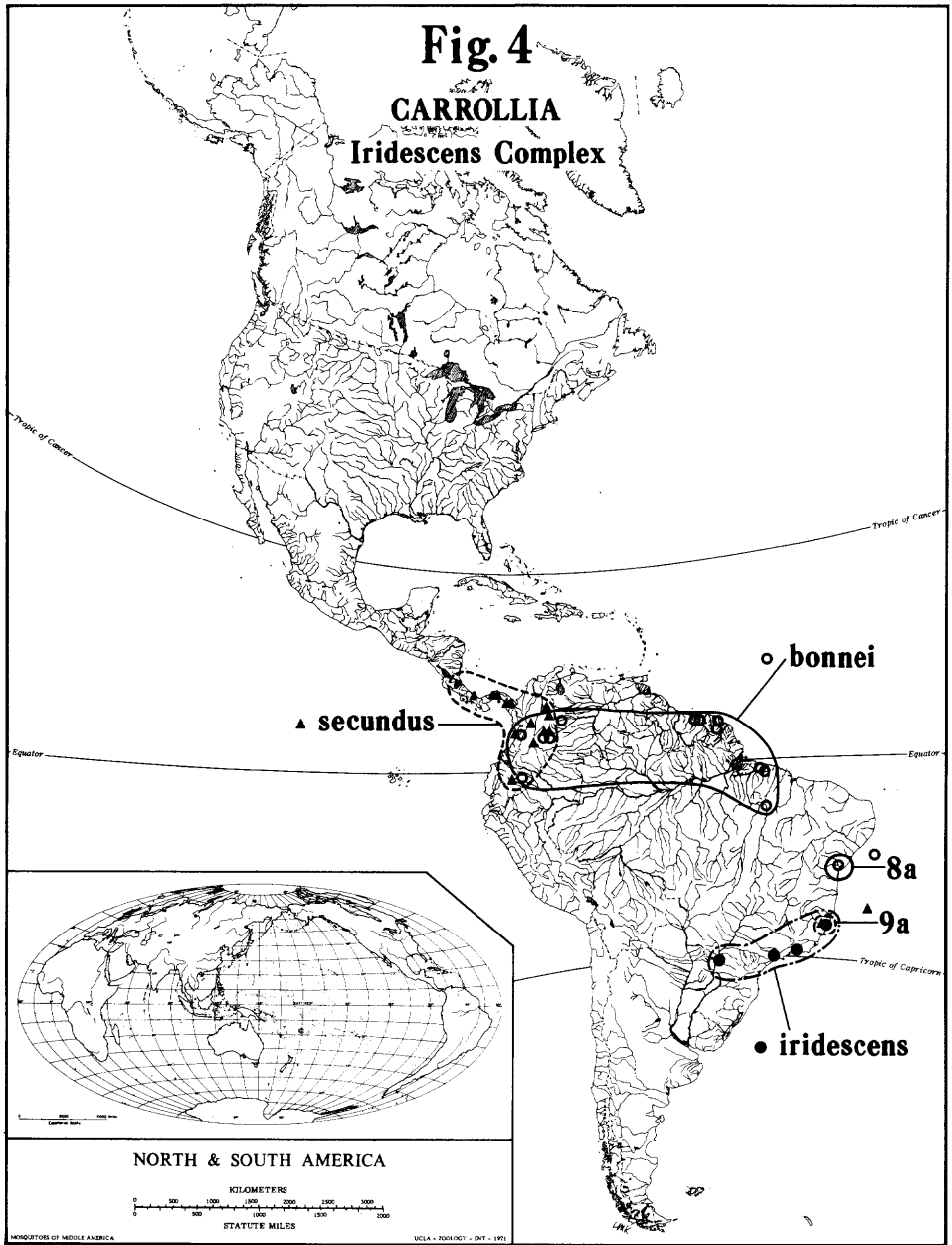


Fig. 5

CARROLLIA
Antunesi Complex

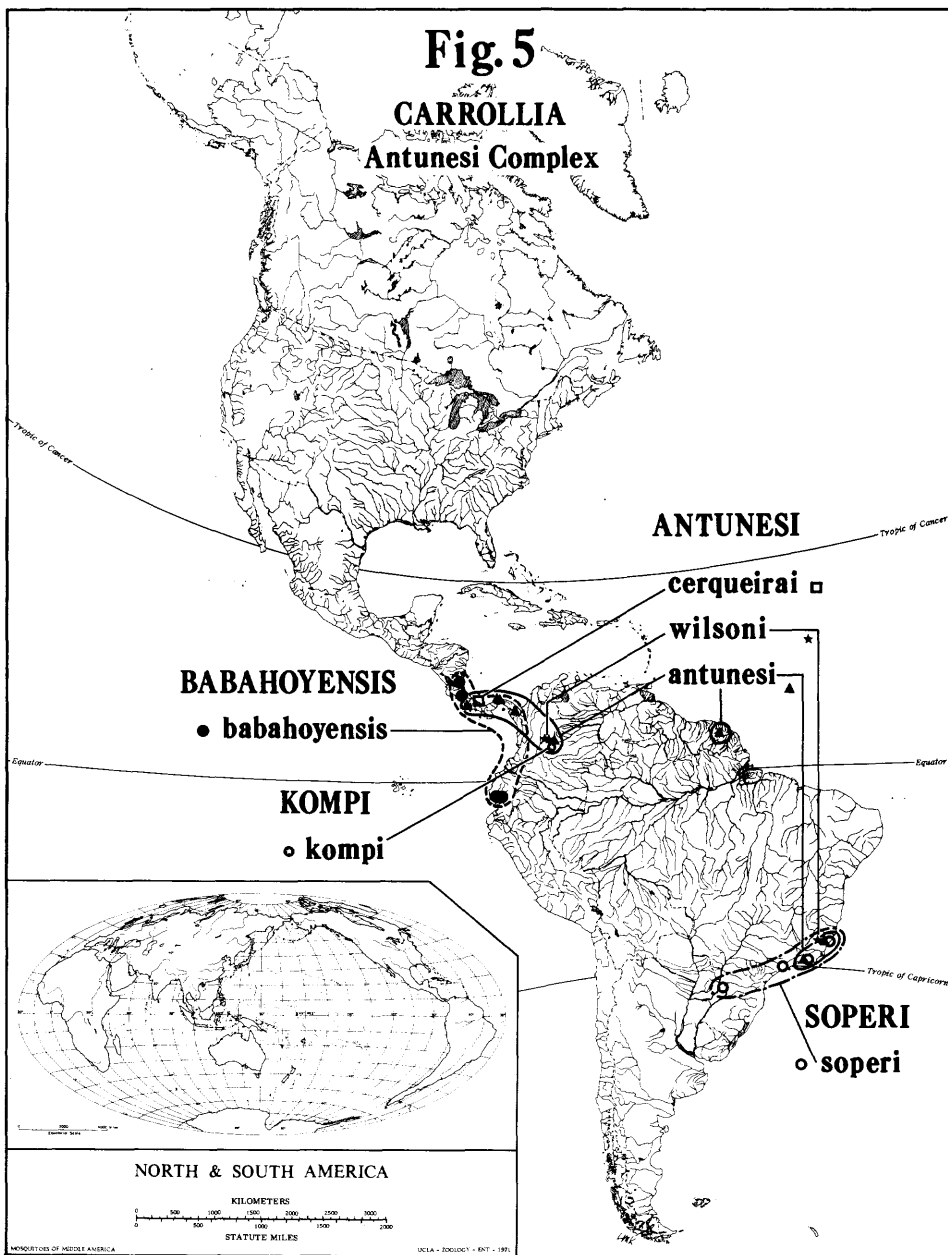
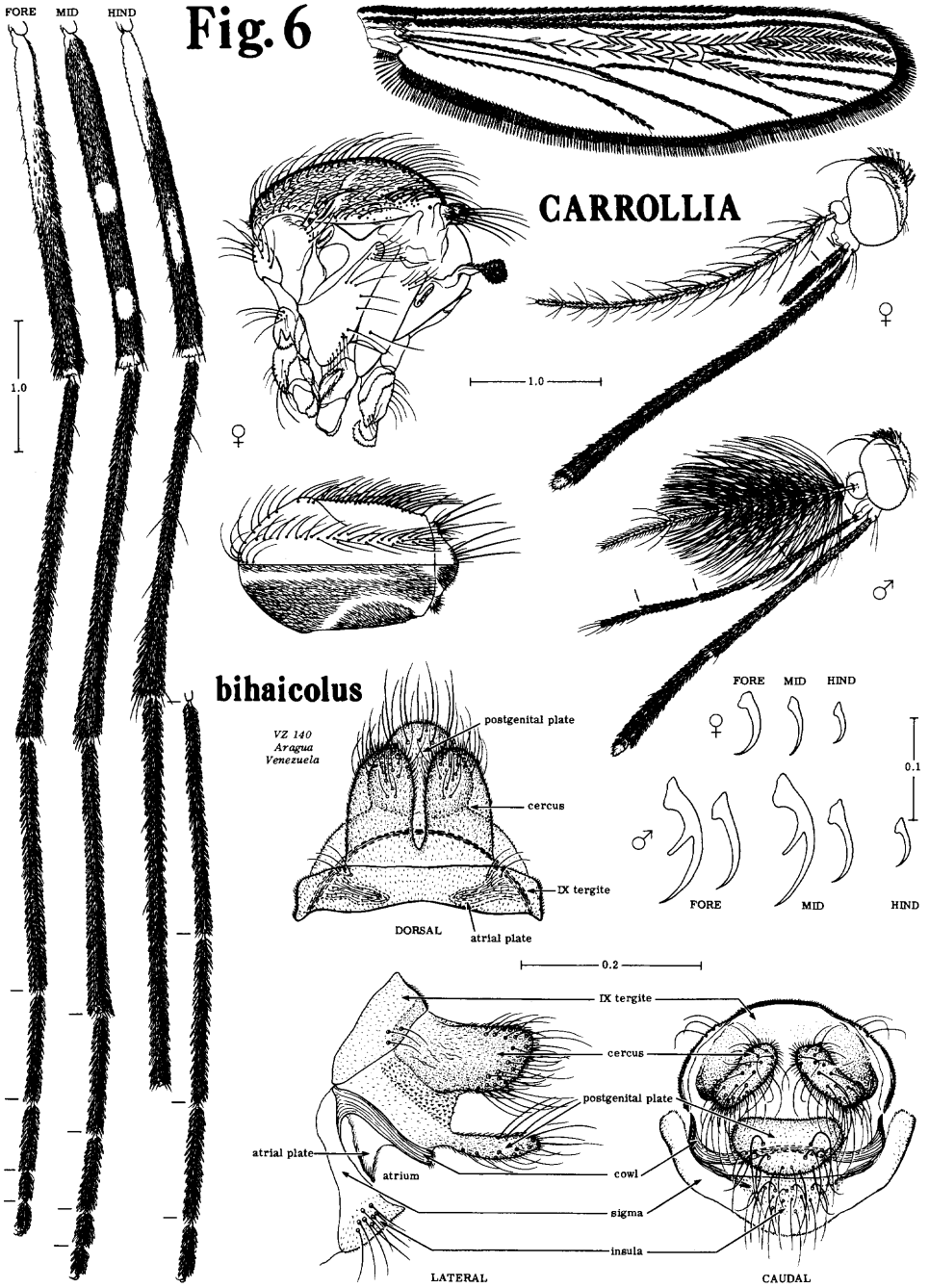


Fig. 6



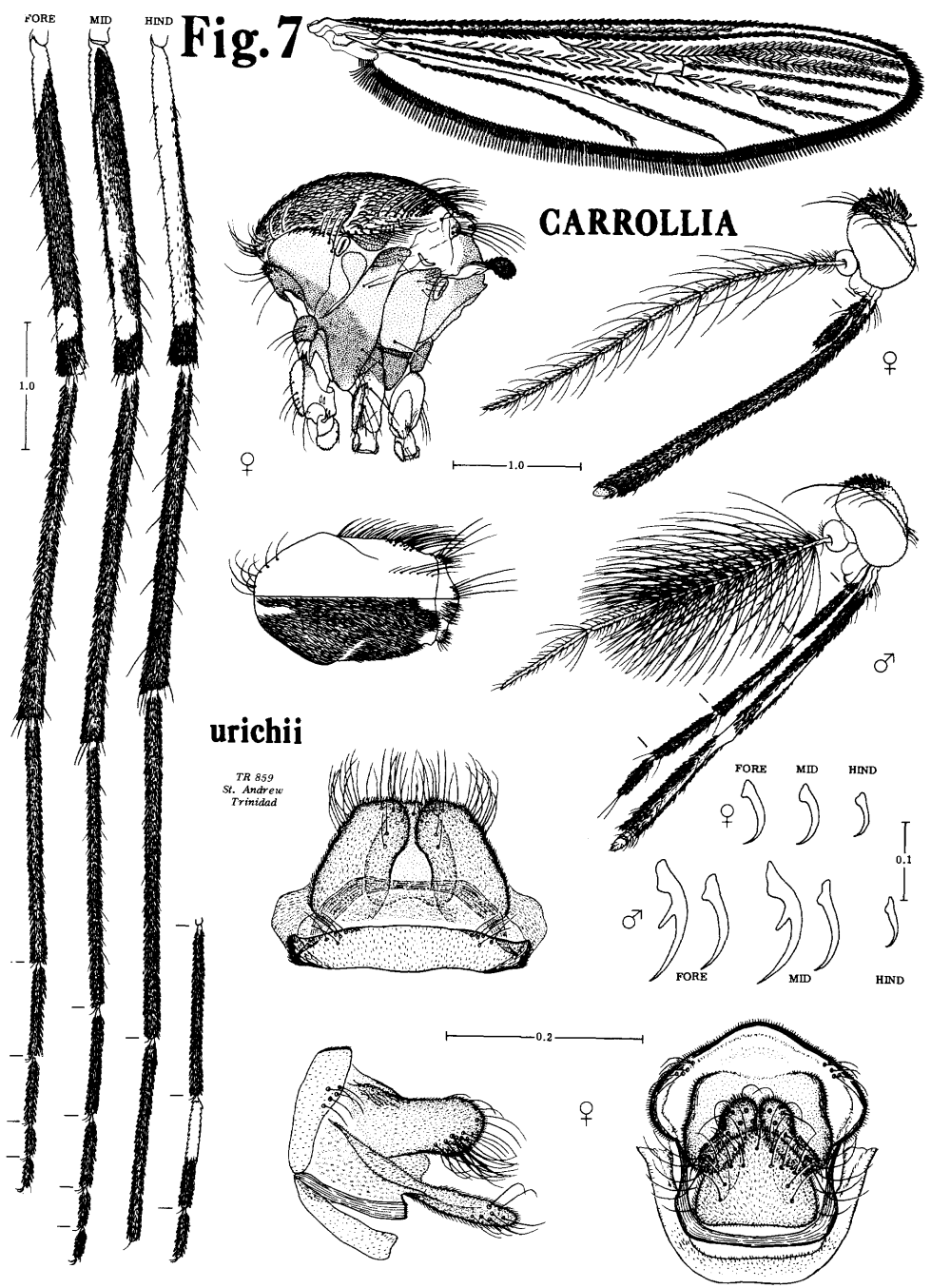


Fig. 8

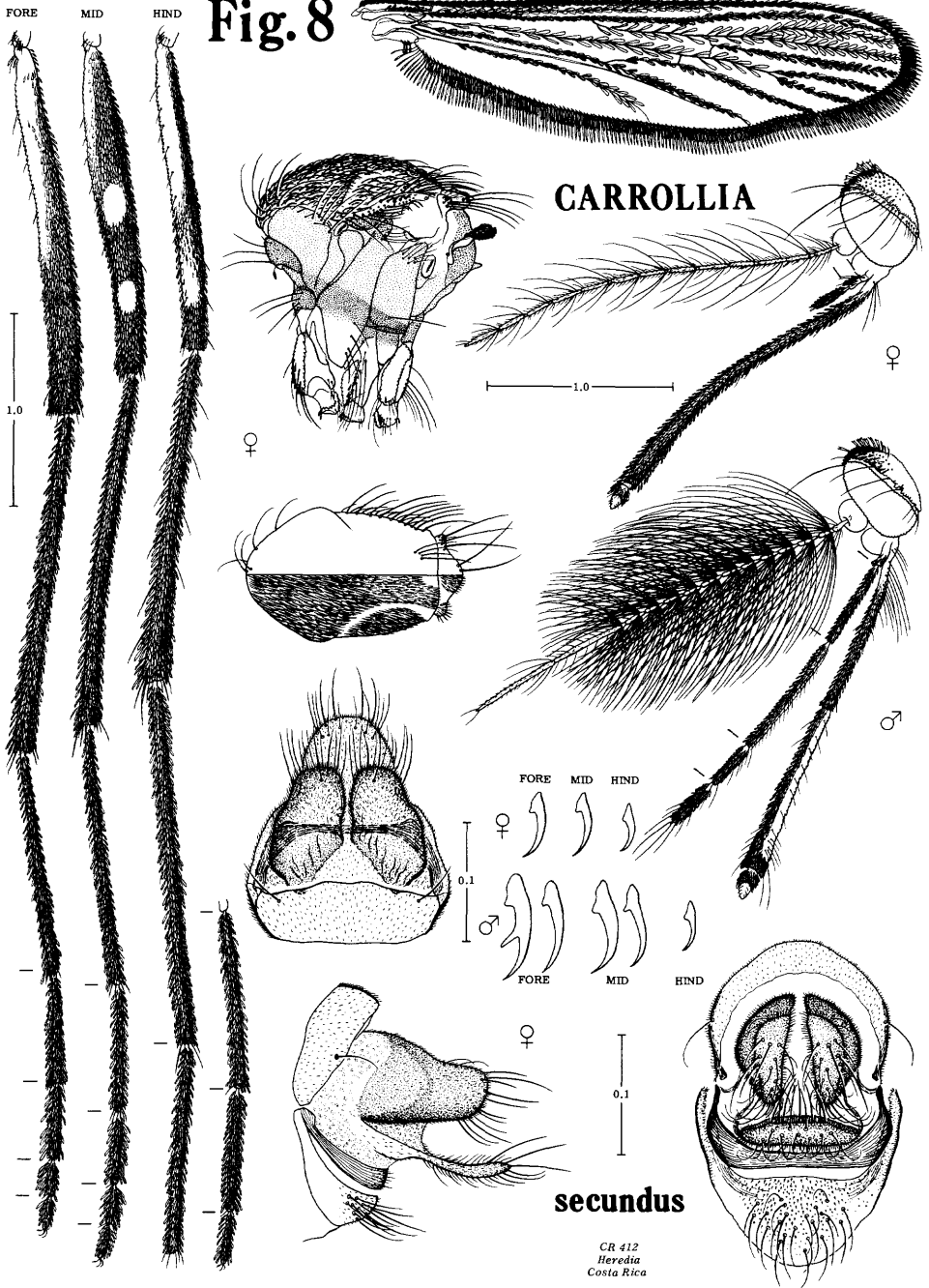
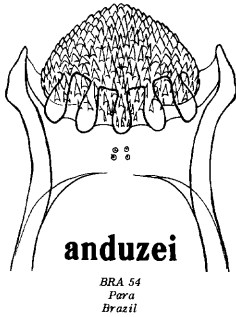
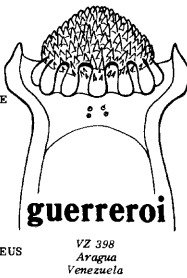
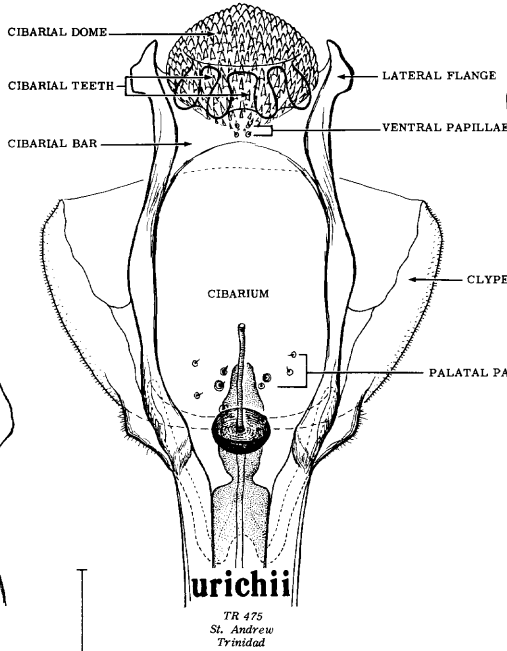
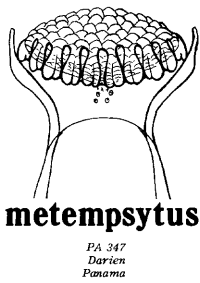
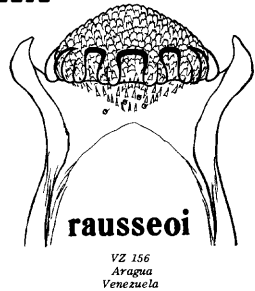
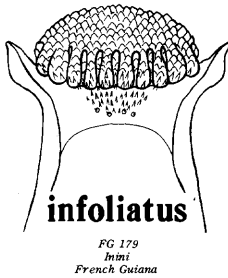
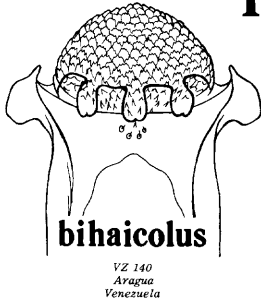


Fig. 9

CARROLLIA



0.1

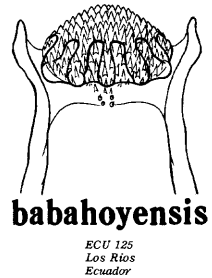
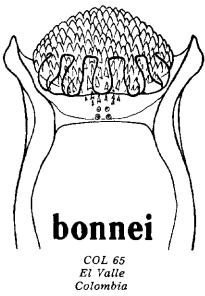
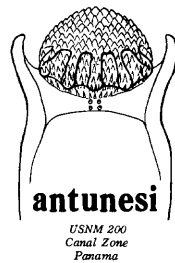
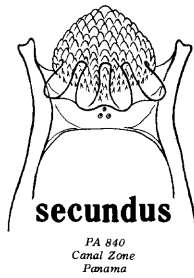
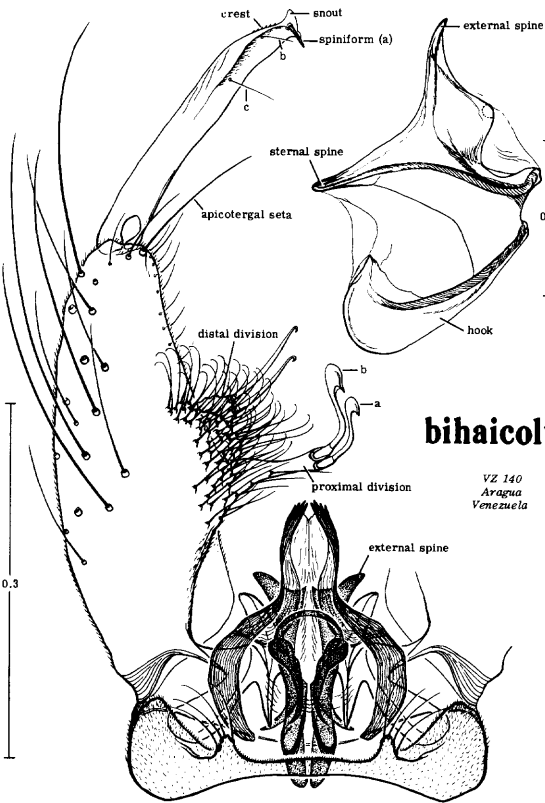
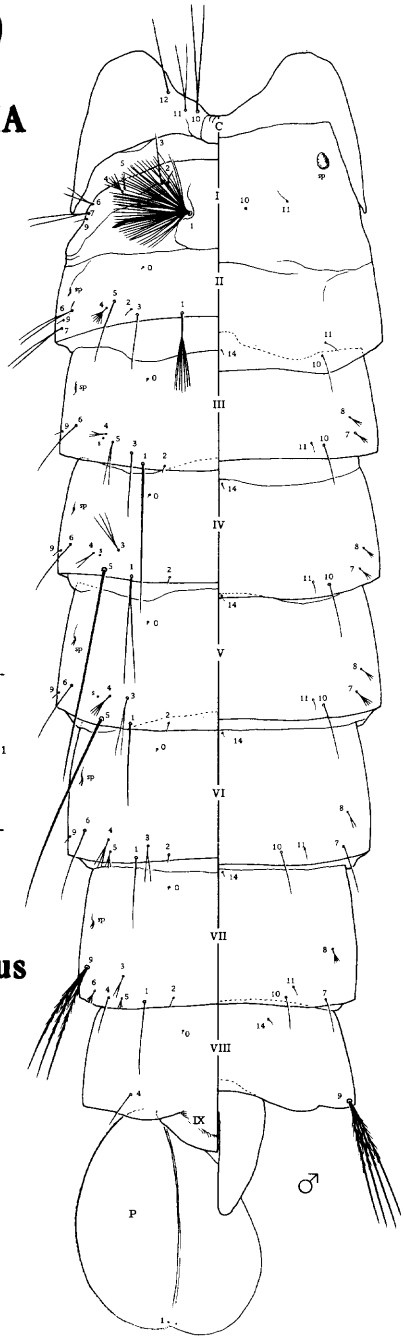
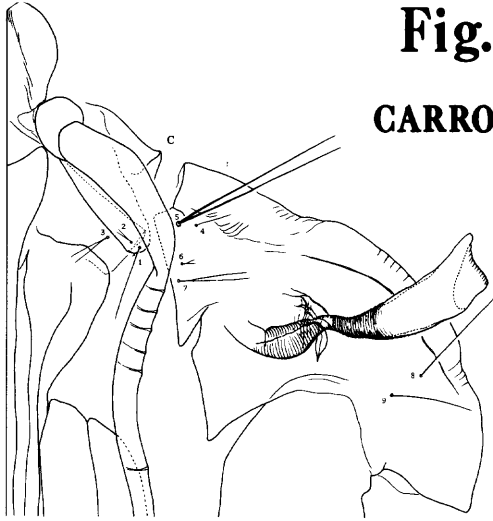


Fig. 10

CARROLLIA



bihaicolus

VZ 140
Aragua
Venezuela

Fig. 11

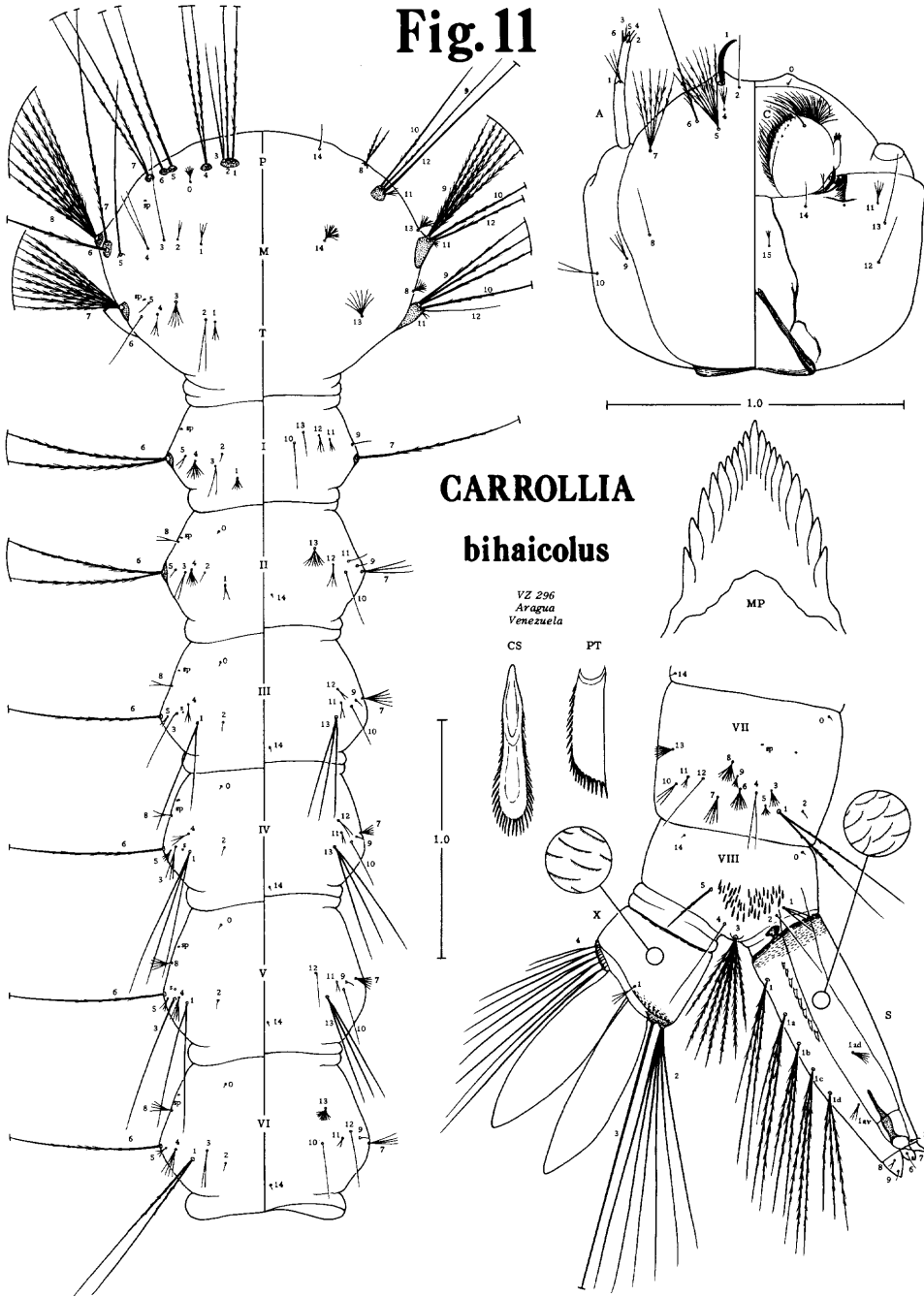
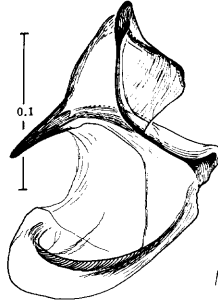
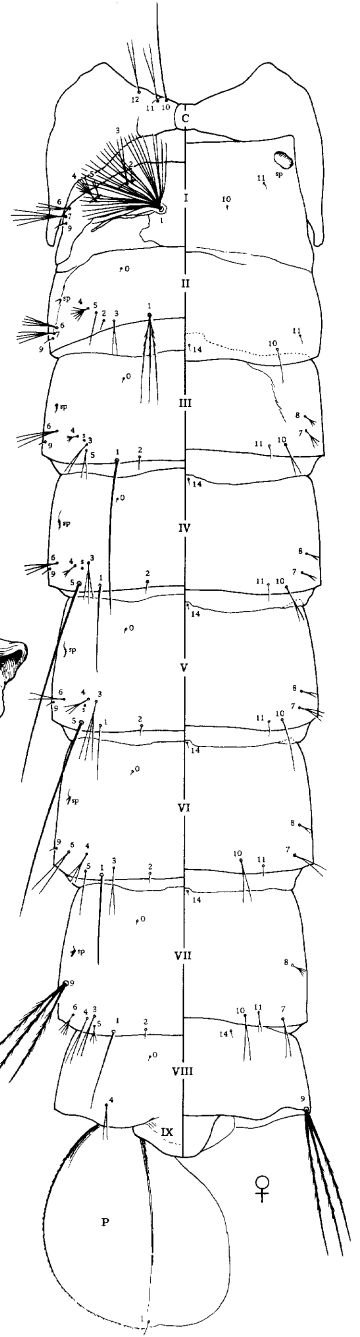
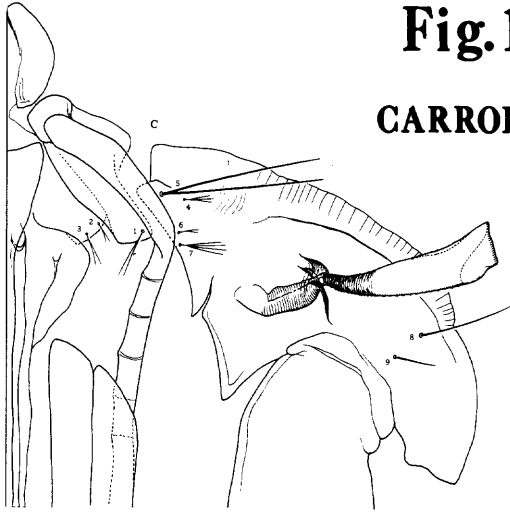


Fig.12

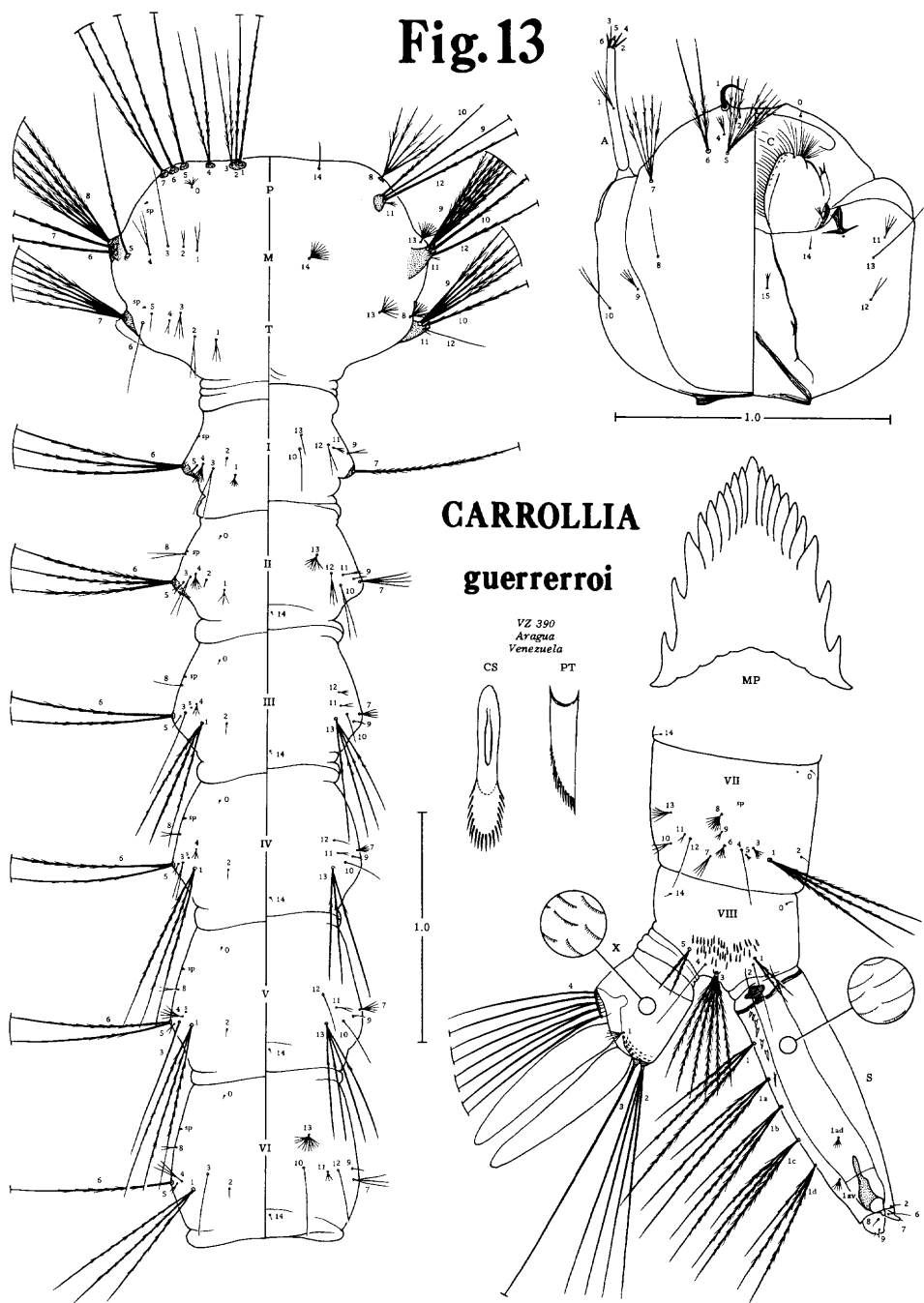
CARROLLIA



guerrerroi

VZ 394
Aragua
Venezuela

Fig.13



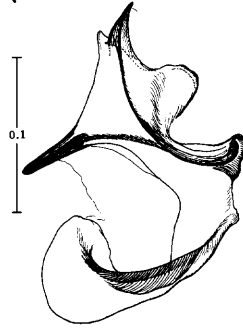
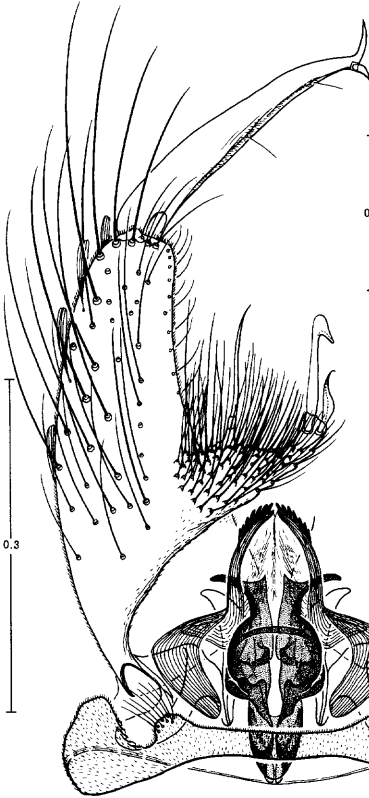
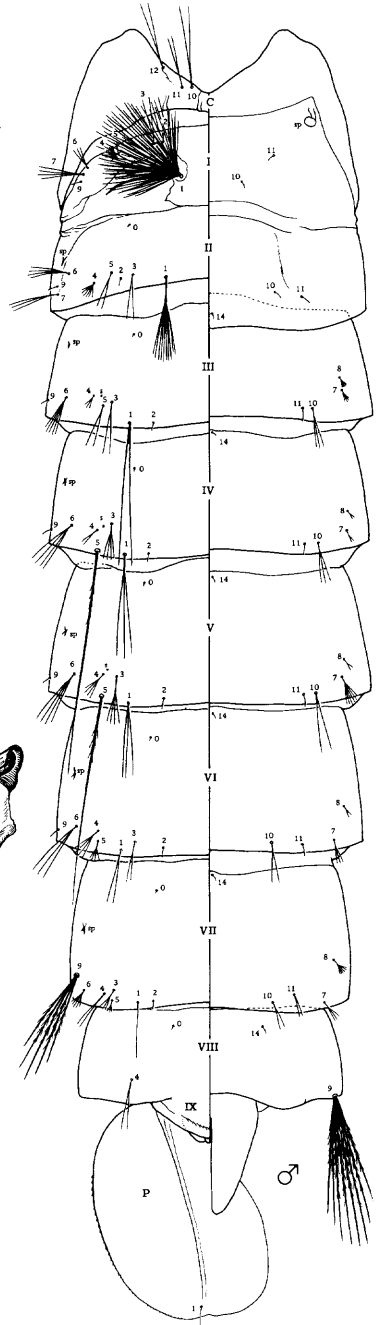
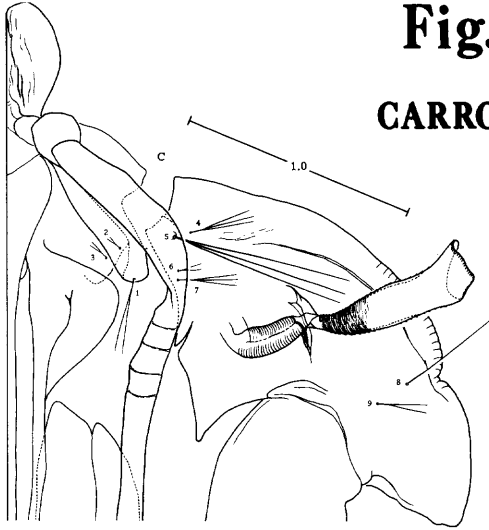
CARROLLIA
guerrierroi

VZ 390
Aragua
Venezuela

1.0

Fig. 14

CARROLLIA



rausseoi

VZ 156
Aragua
Venezuela

Fig. 15

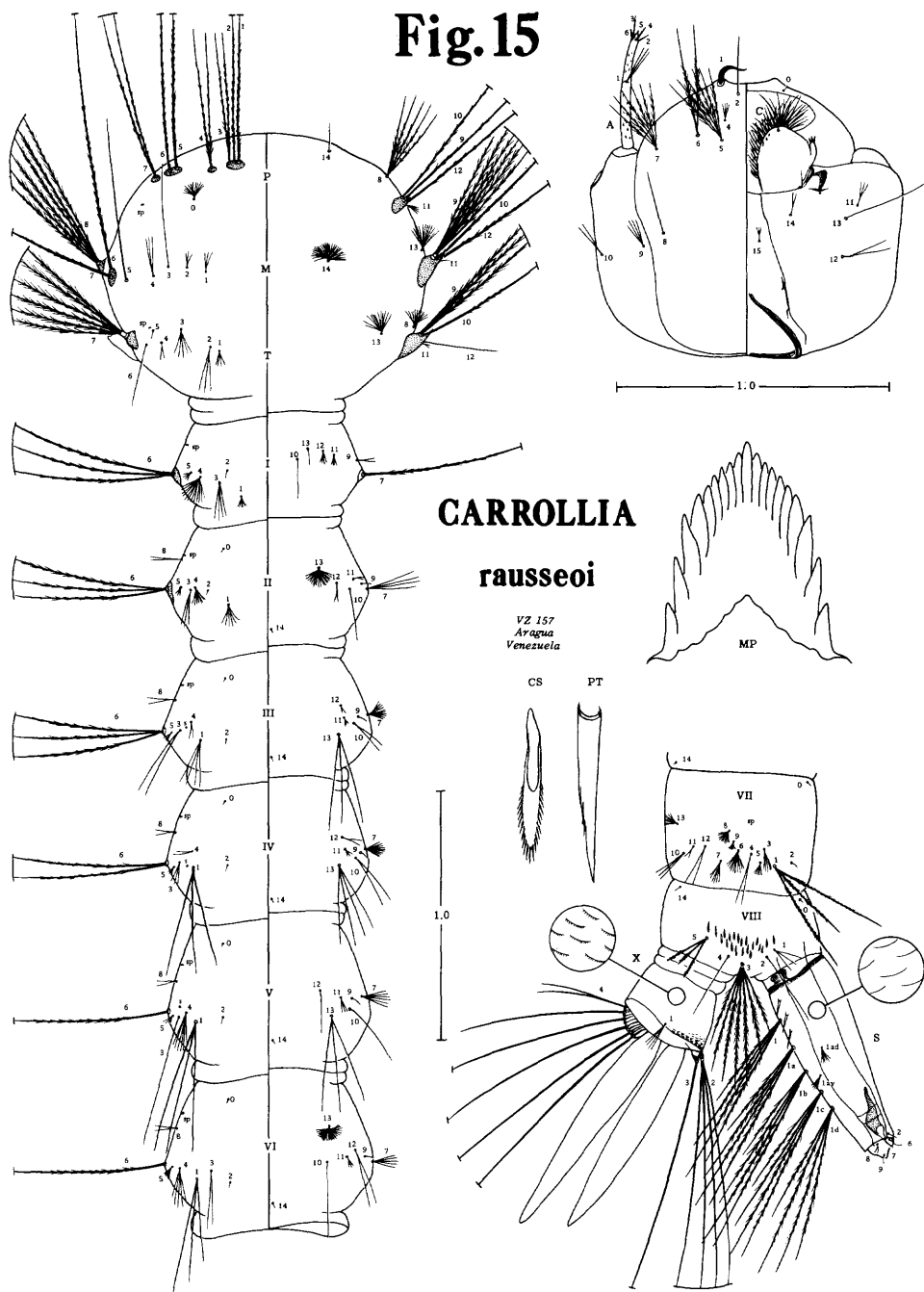


Fig. 16

CARROLLIA

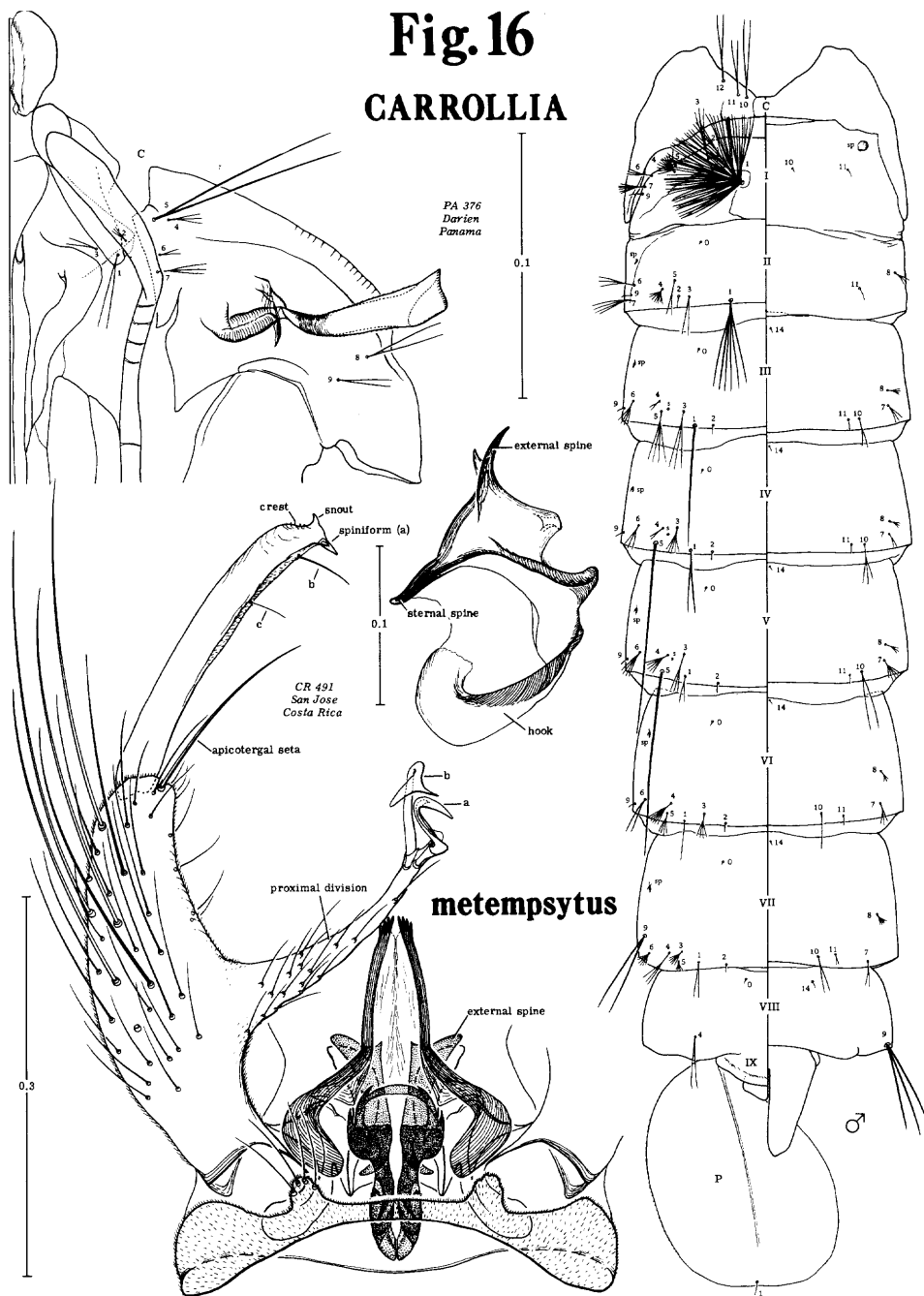
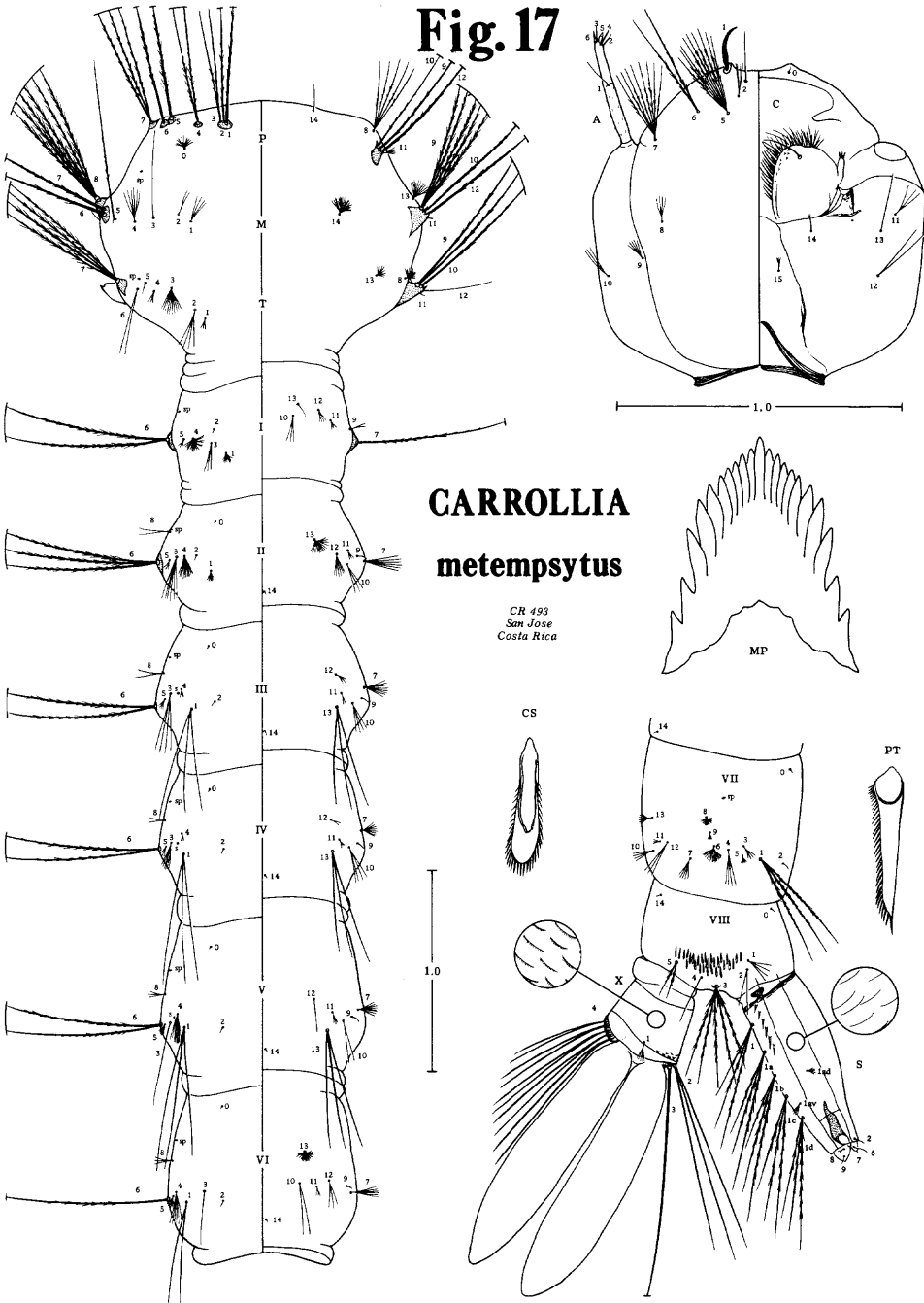


Fig. 17



CARROLLIA
metempyus

CR 493
San Jose
Costa Rica

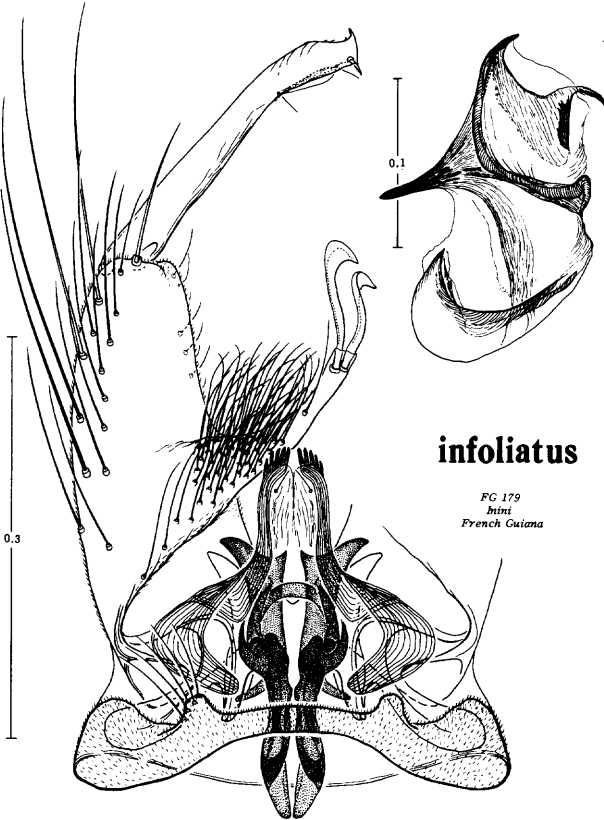
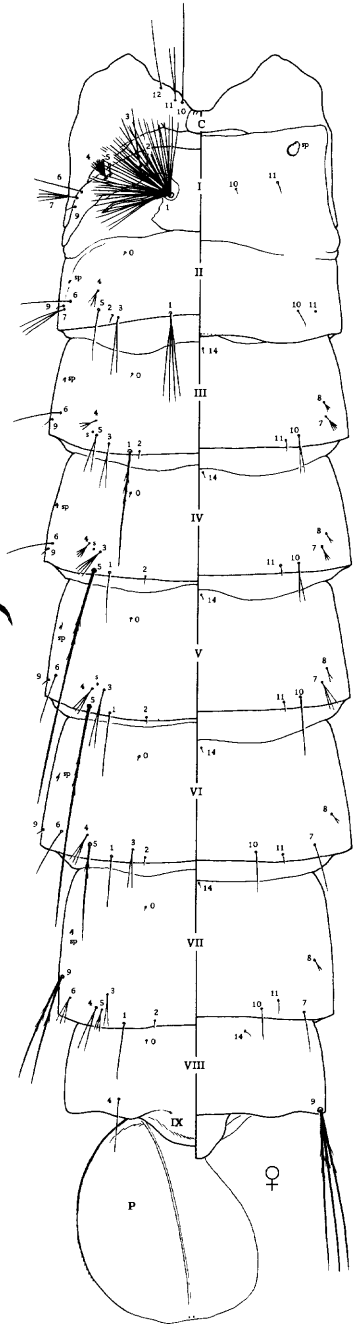
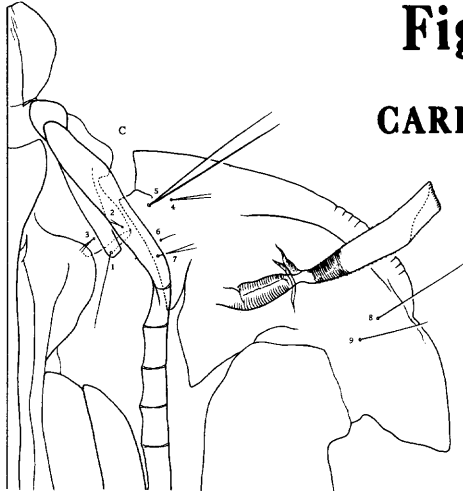
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Fig. 18

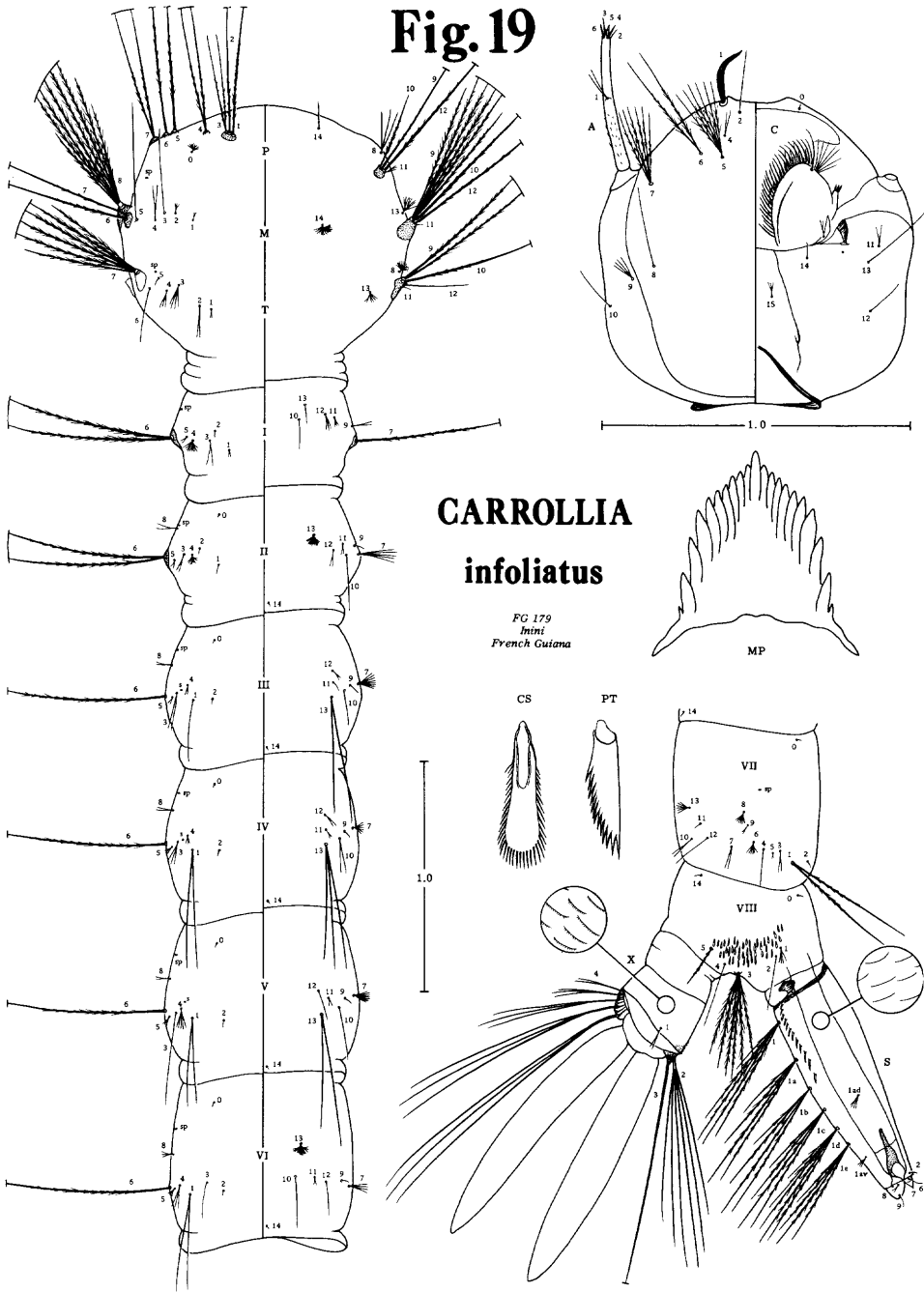
CARROLLIA



infoliatus

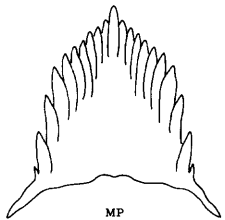
FC 179
Mimi
French Guiana

Fig. 19



CARROLLIA
infoliatum

FG 179
Inini
French Guiana



1.0

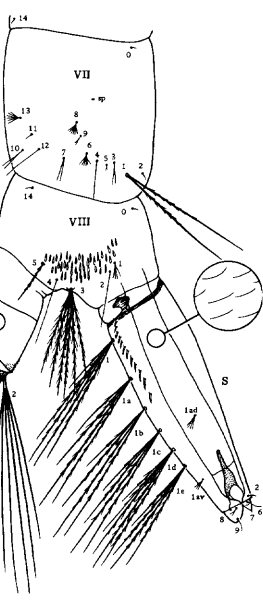
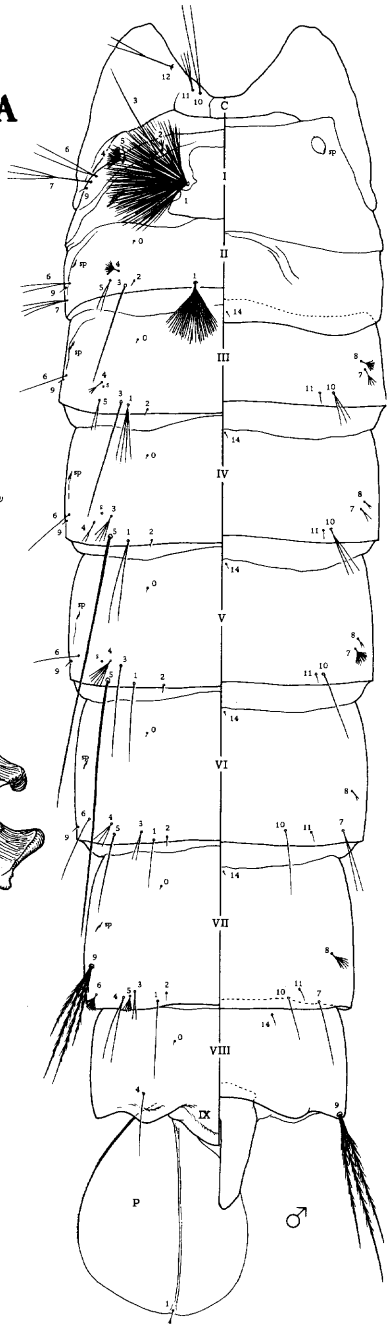
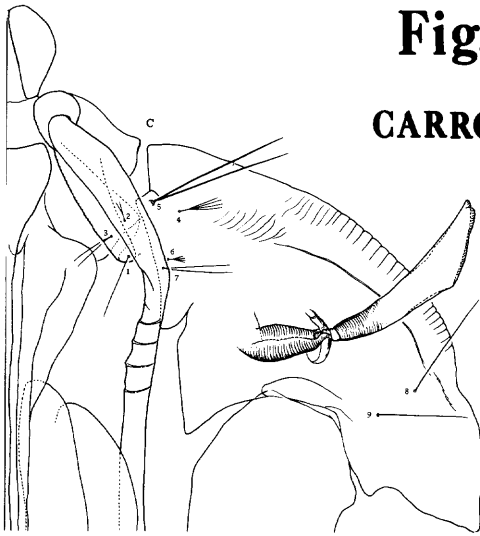
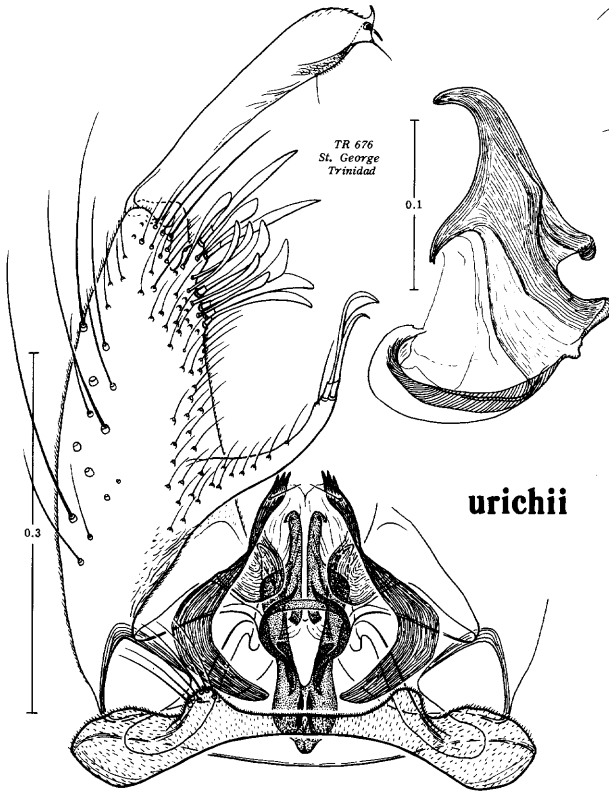


Fig. 20

CARROLLIA



TR 859
St. Andrew
Trinidad



TR 676
St. George
Trinidad

urichii

Fig. 21

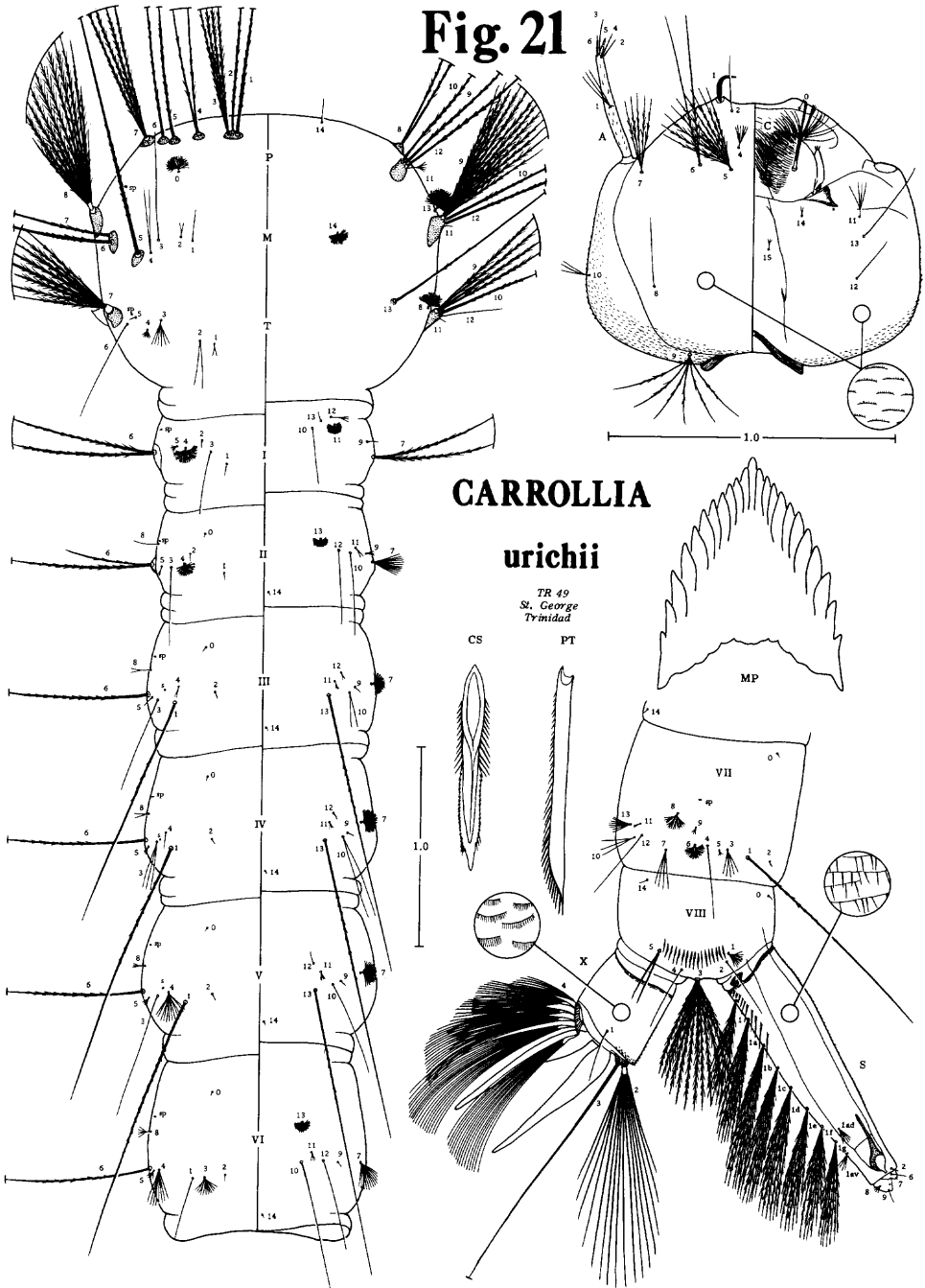


Fig. 22
CARROLLIA

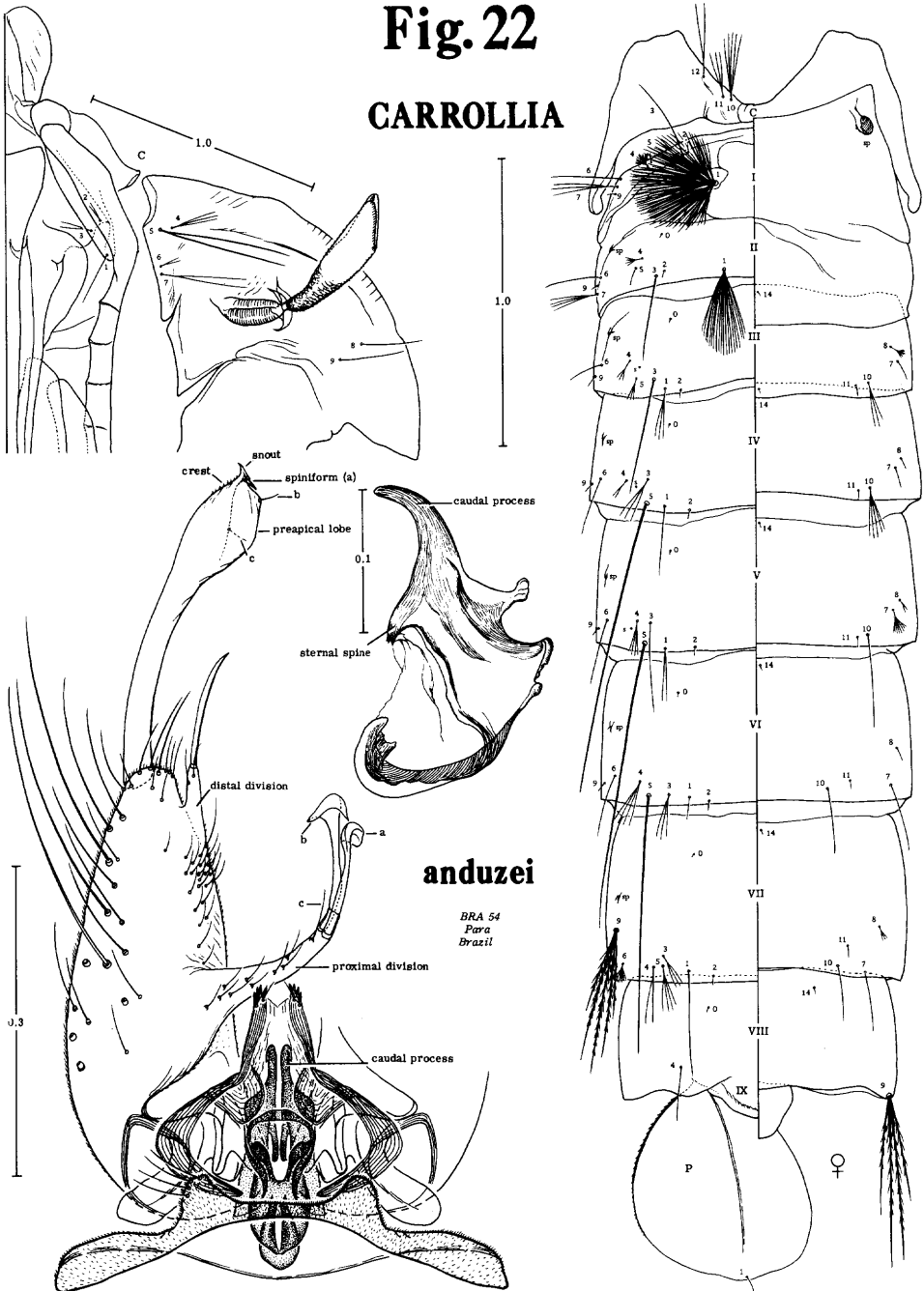
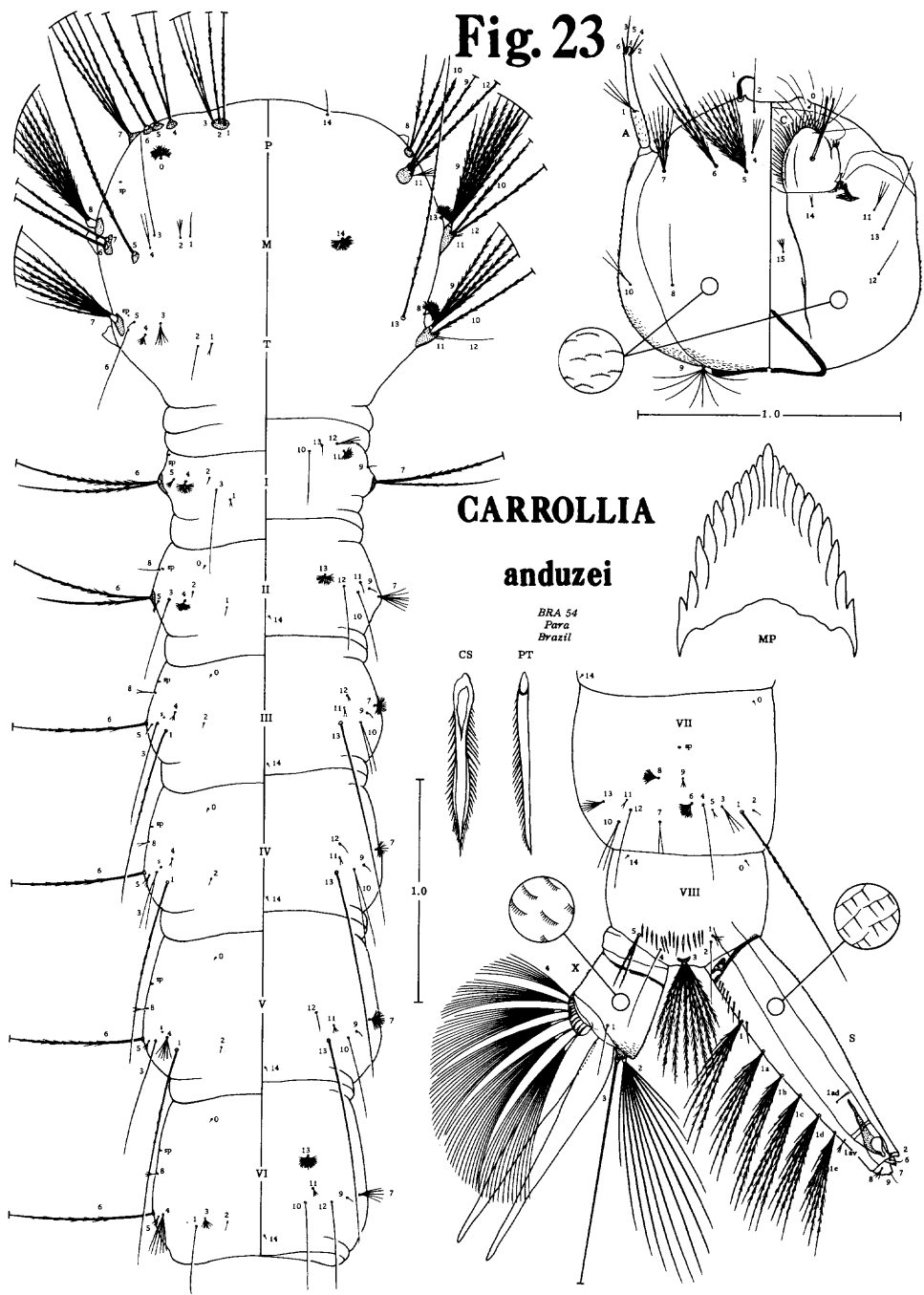


Fig. 23



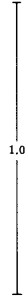
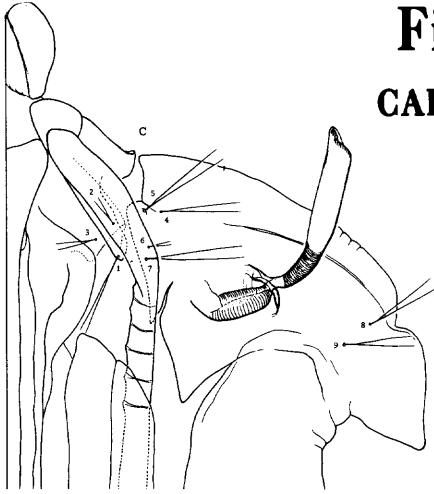
CARROLLIA

anduzei

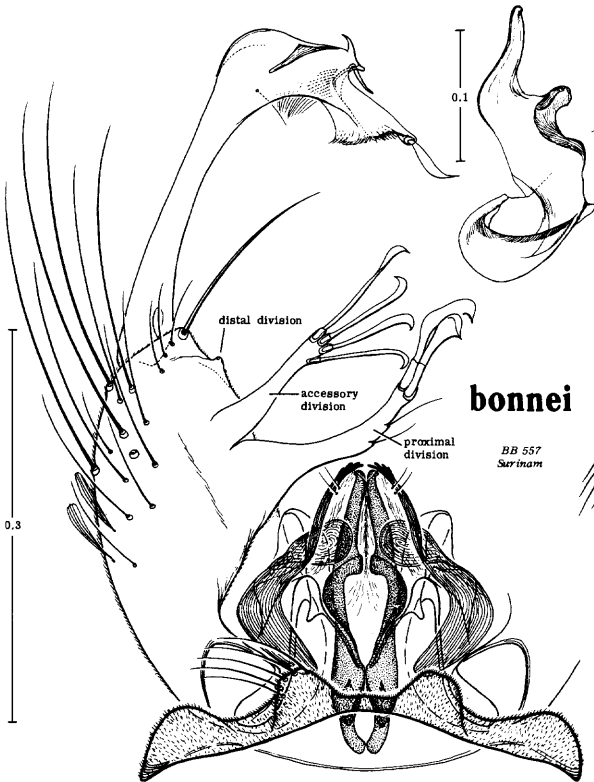
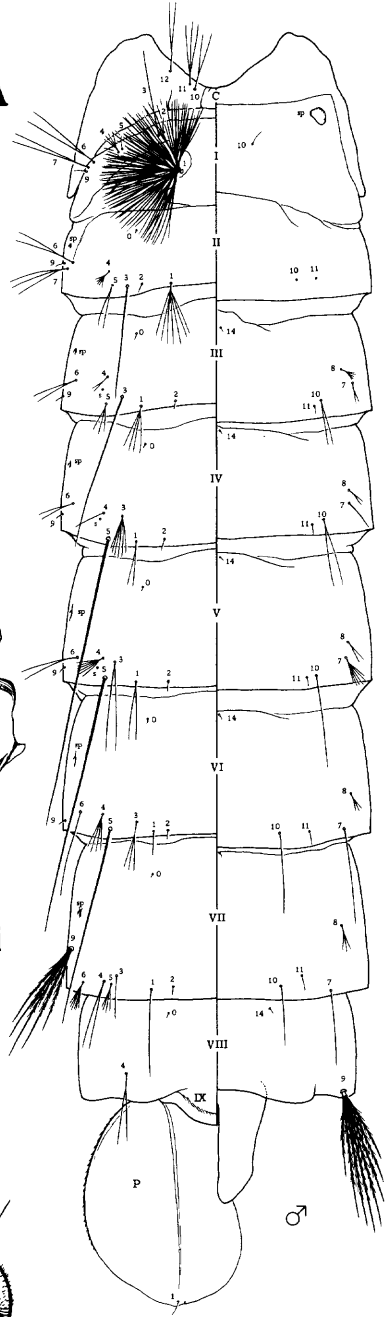
BRA 54
Para
Brazil

Fig. 24

CARROLLIA



FG 179
Inbit
French Guiana



bonnei

BB 557
Seriram

Fig. 25

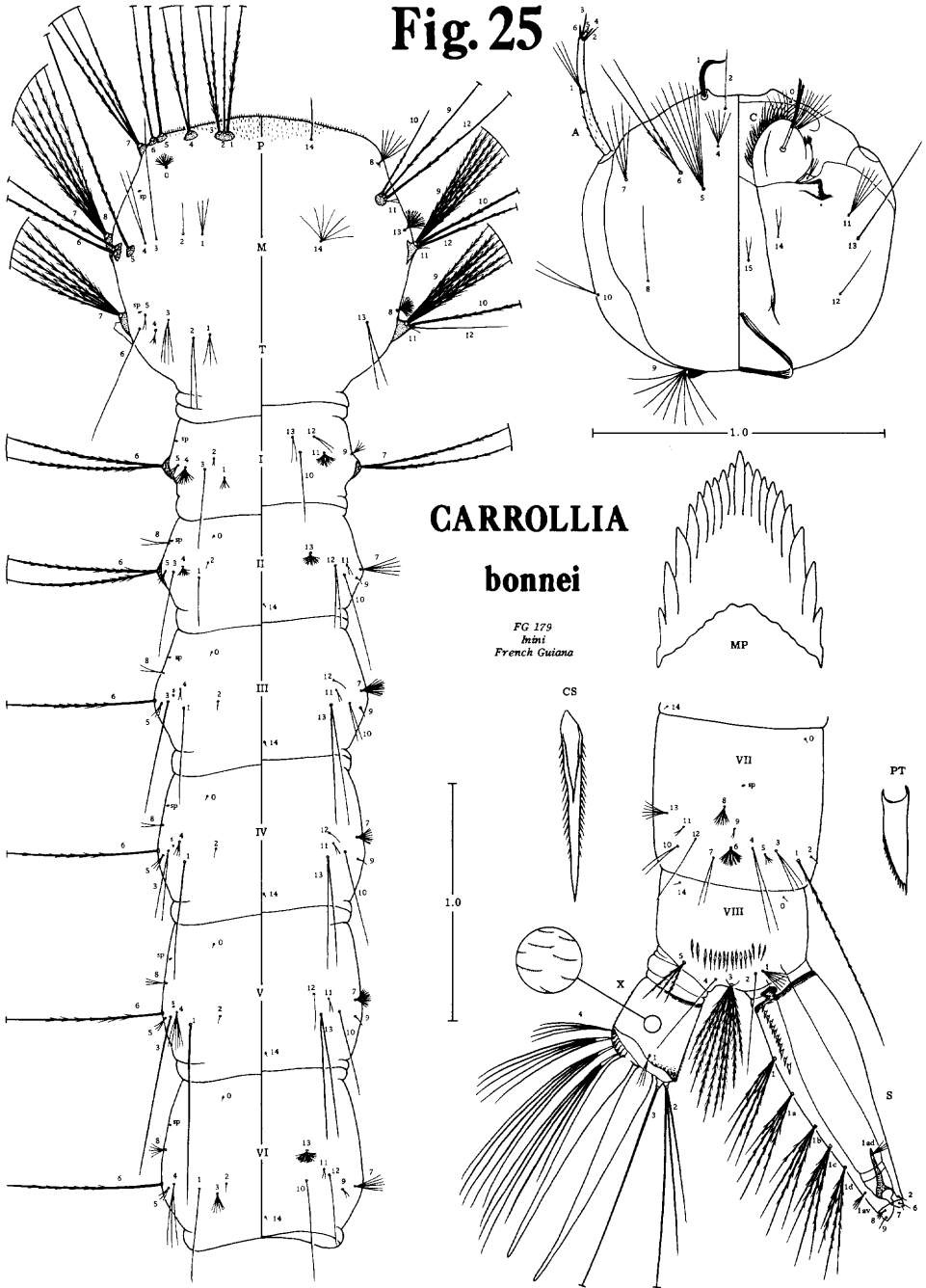


Fig. 26

CARROLLIA

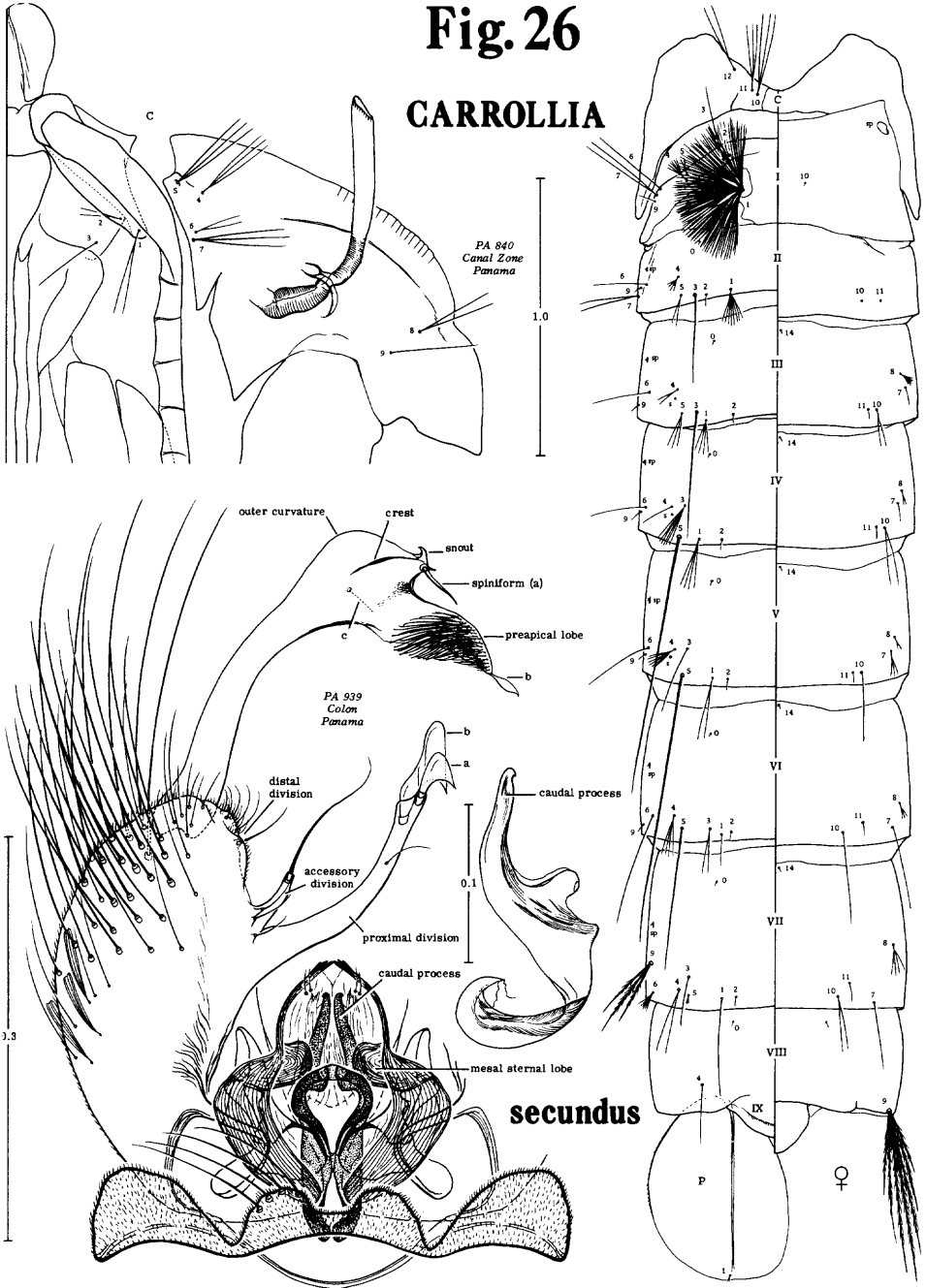
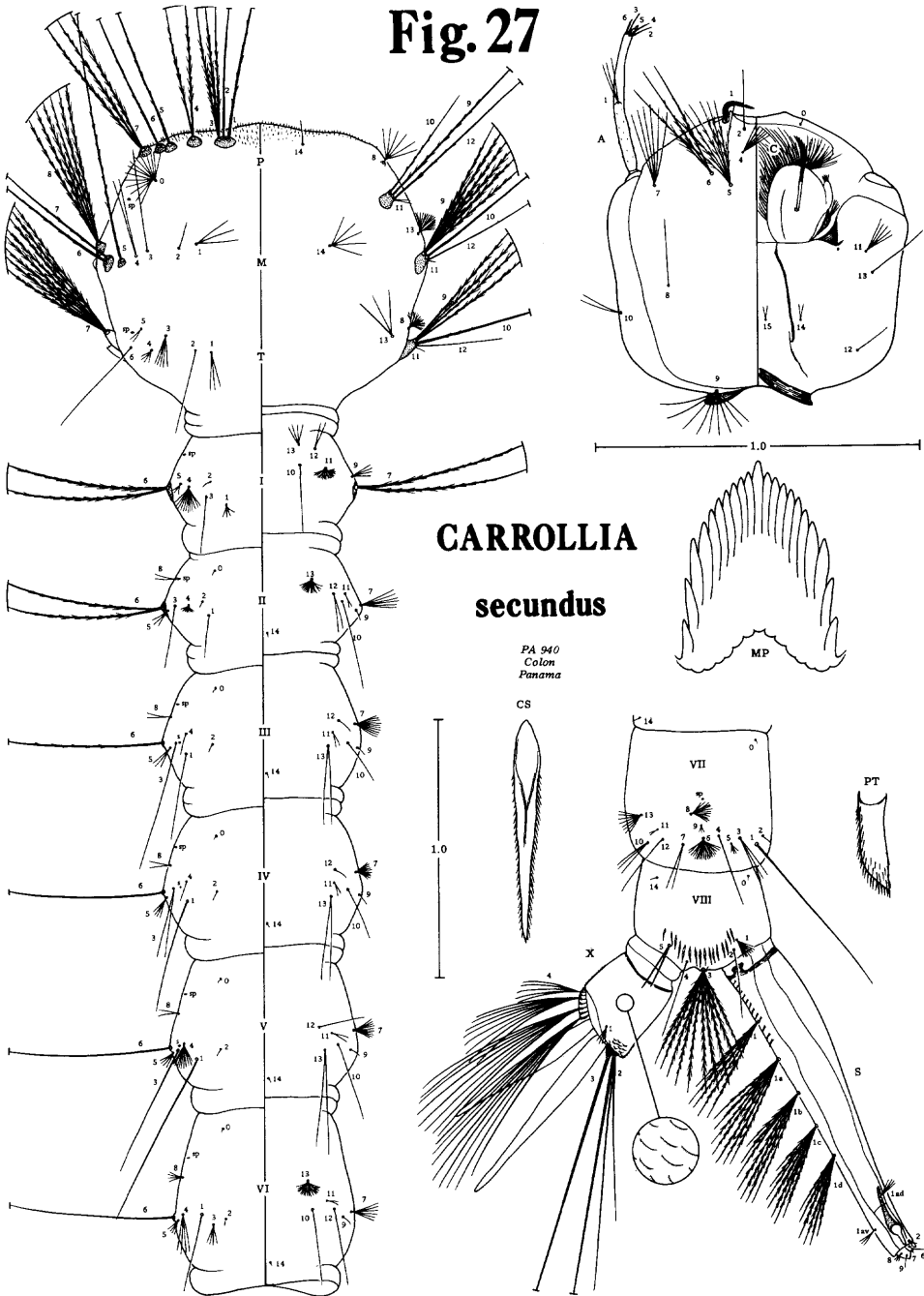


Fig. 27



CARROLLIA

secundus

PA 940
Colon
Panama

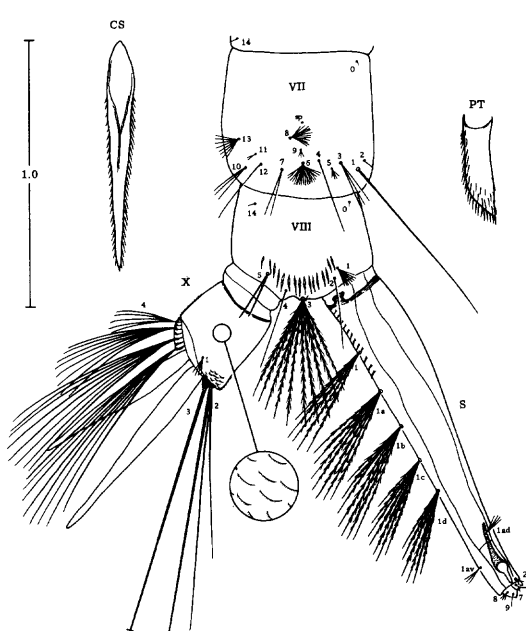


Fig. 28

CARROLLIA

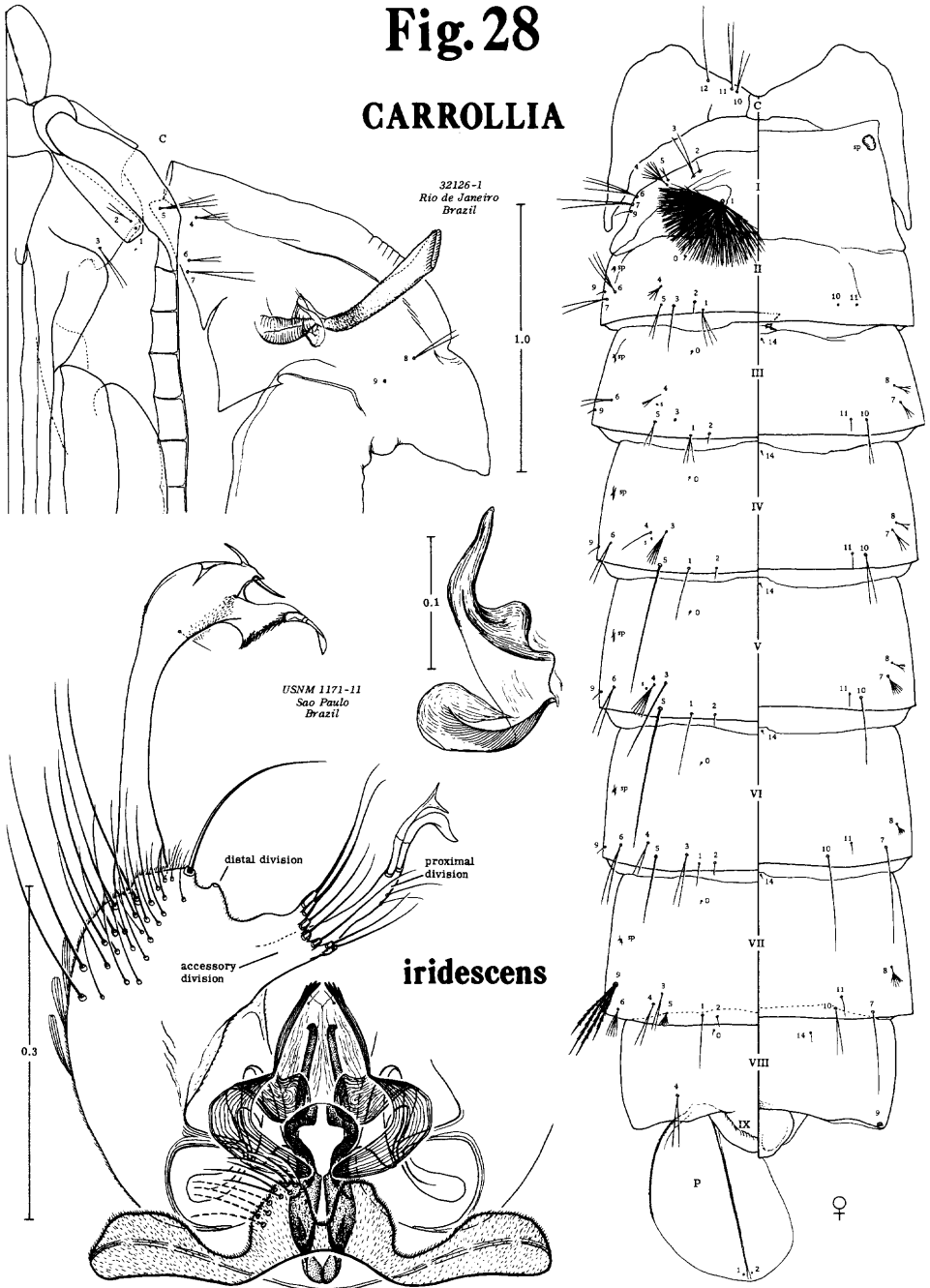


Fig. 29

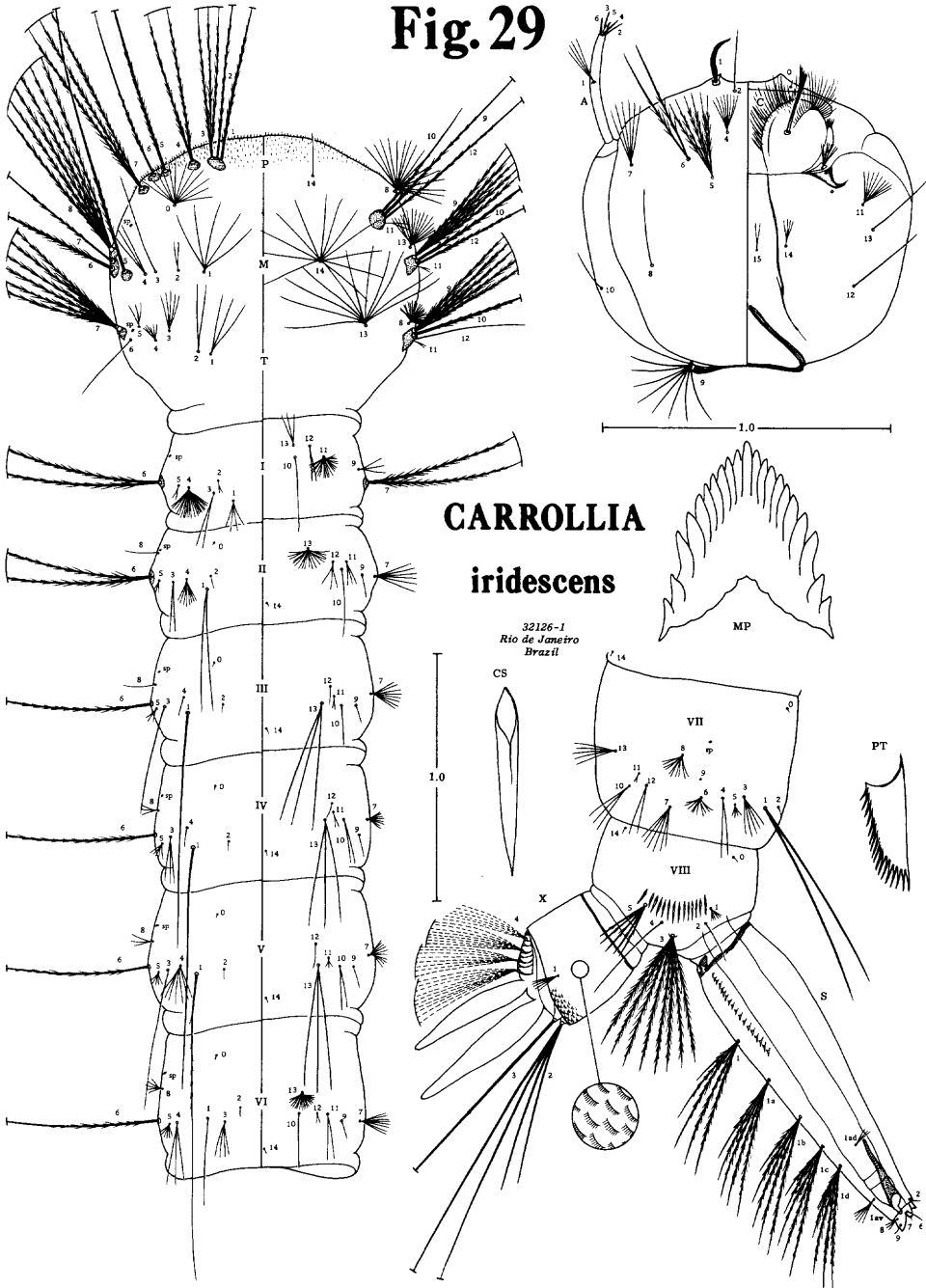
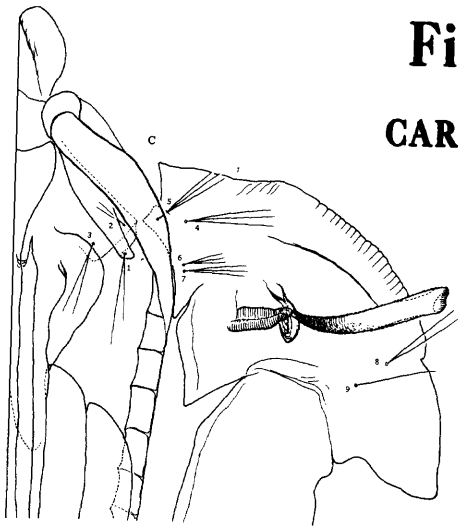
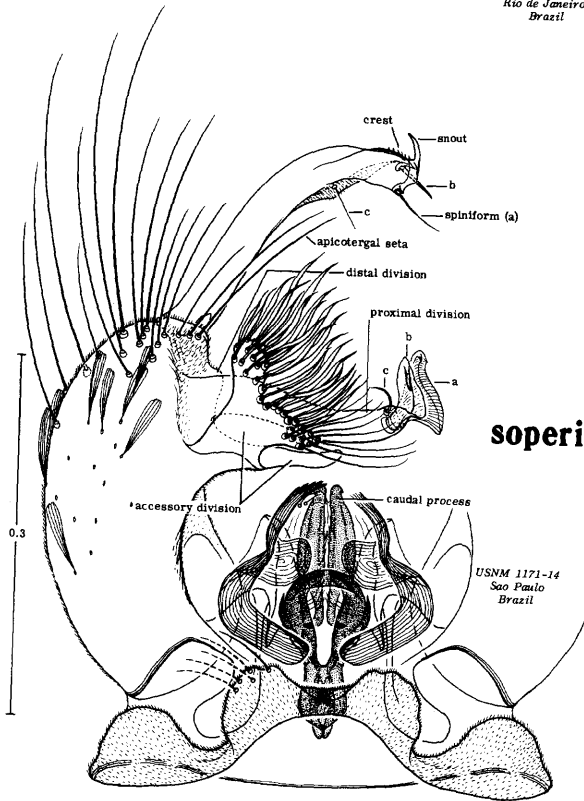
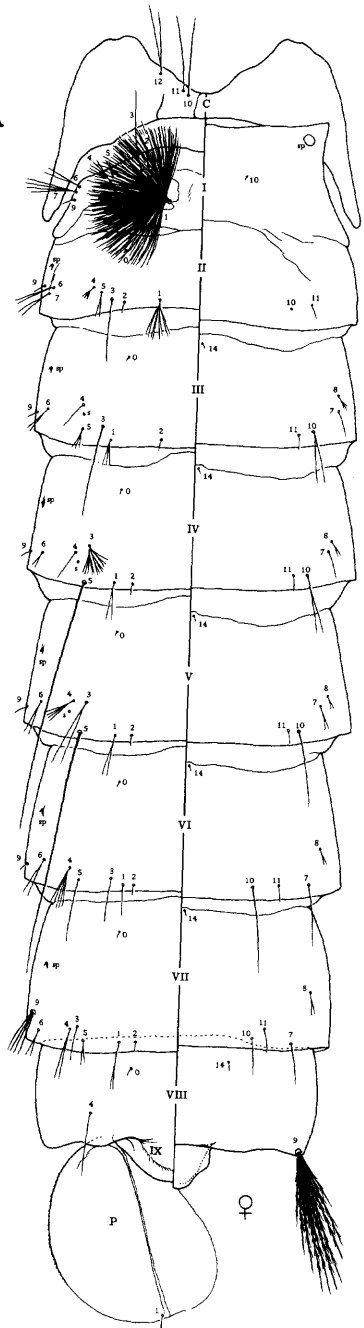


Fig. 30
CARROLLIA



1.0

27866-1
Rio de Janeiro
Brazil



soperi

USNM 1171-14
Sao Paulo
Brazil

Fig. 31

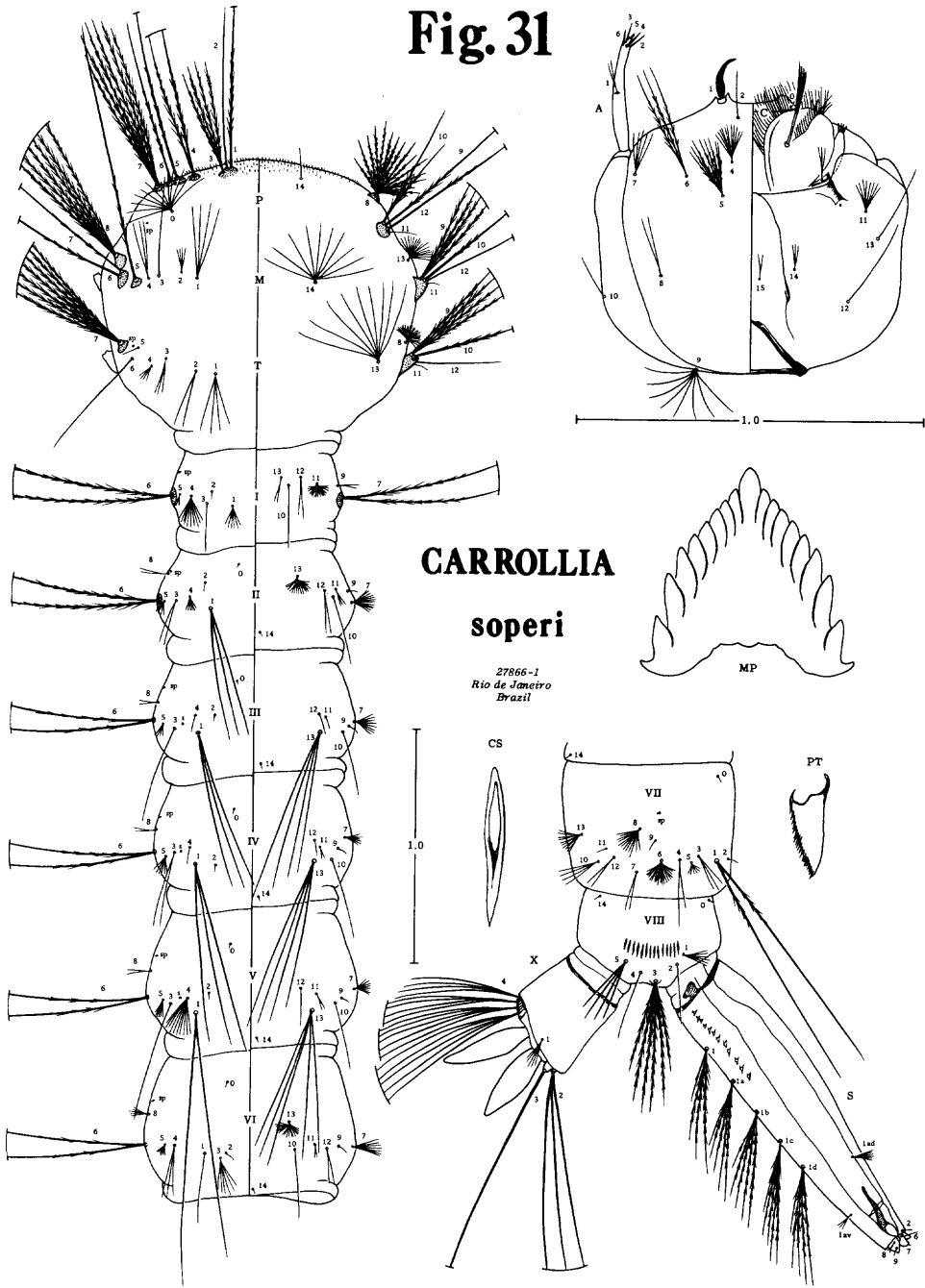


Fig. 33

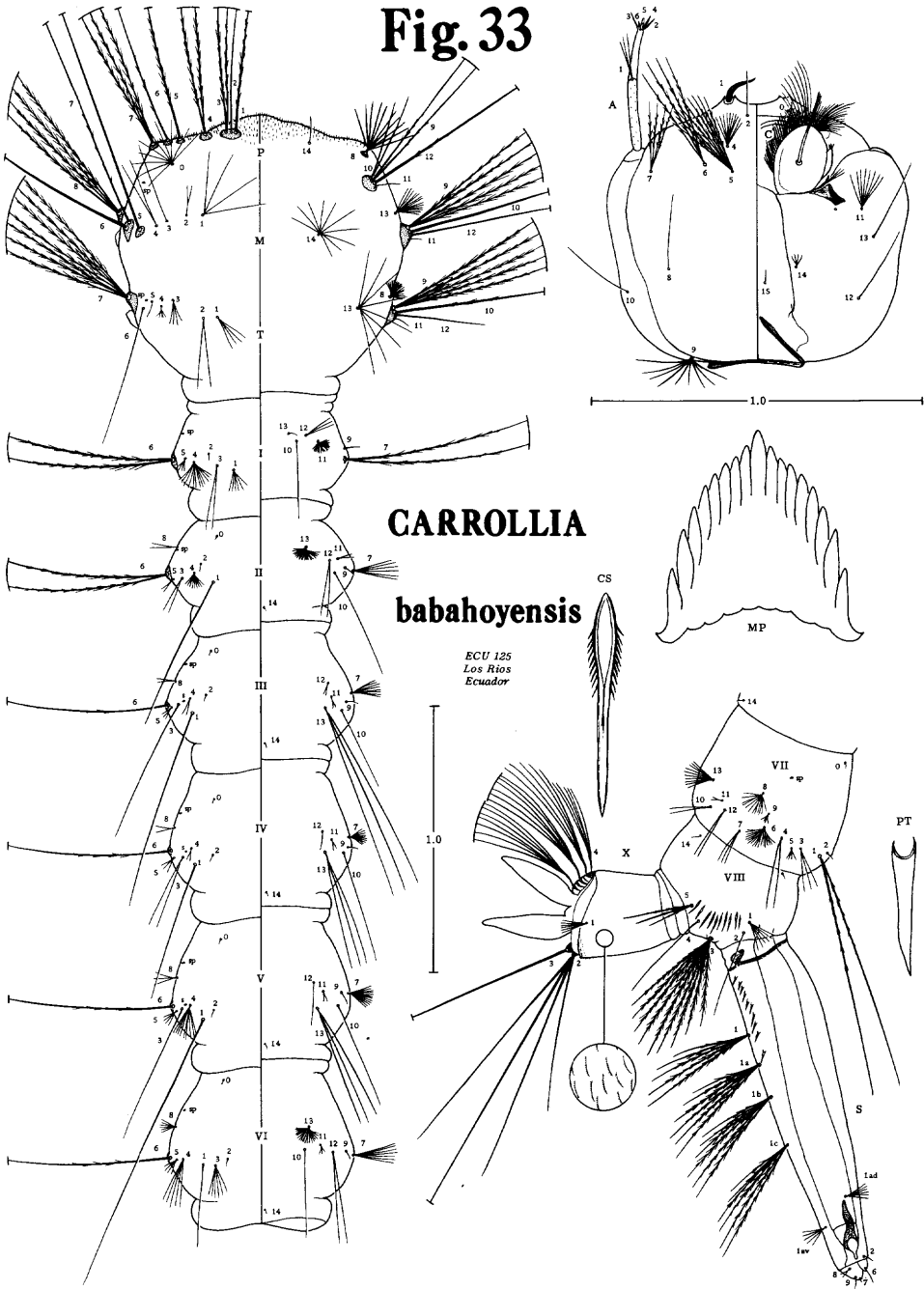


Fig. 34
CARROLLIA

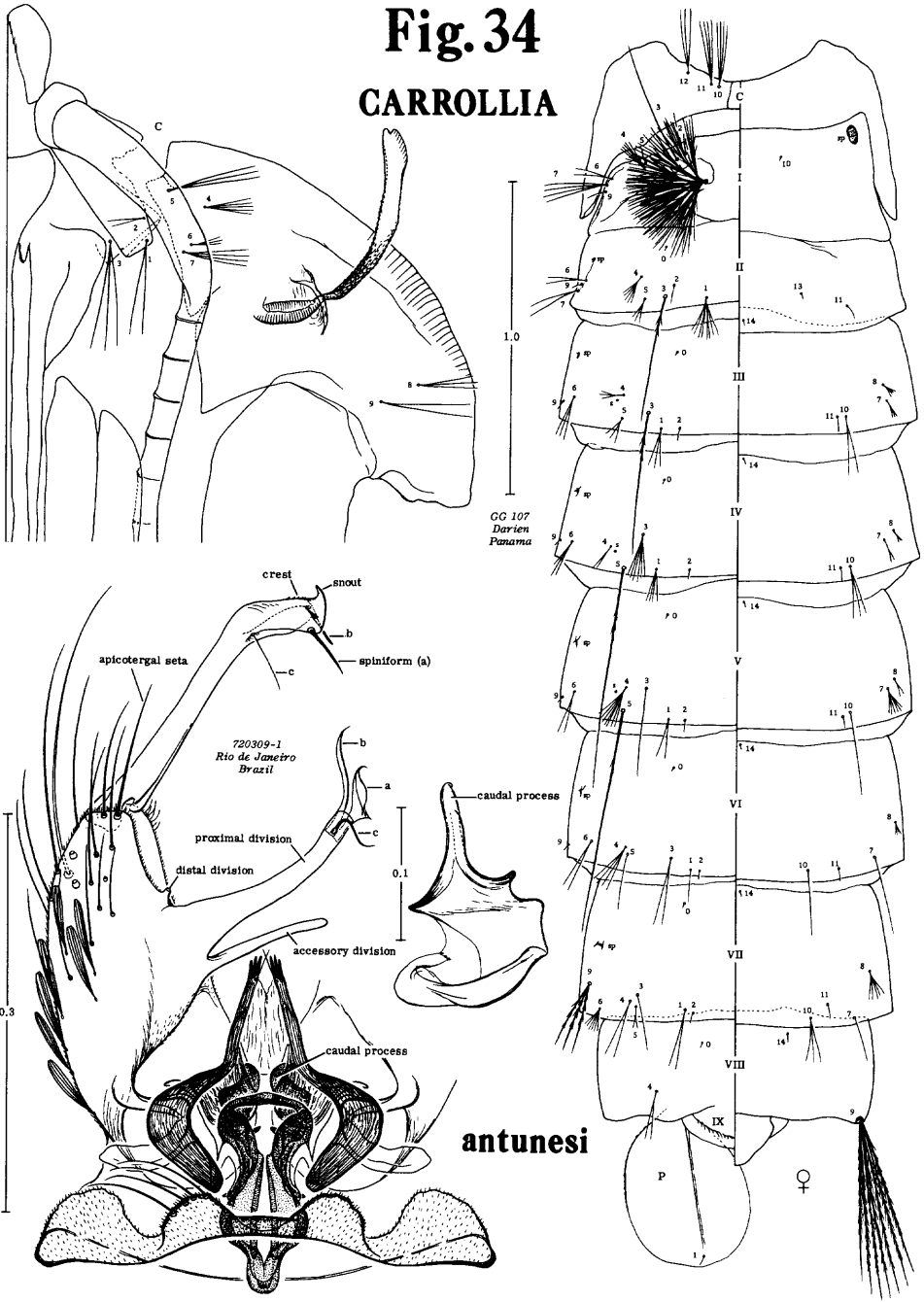


Fig. 35

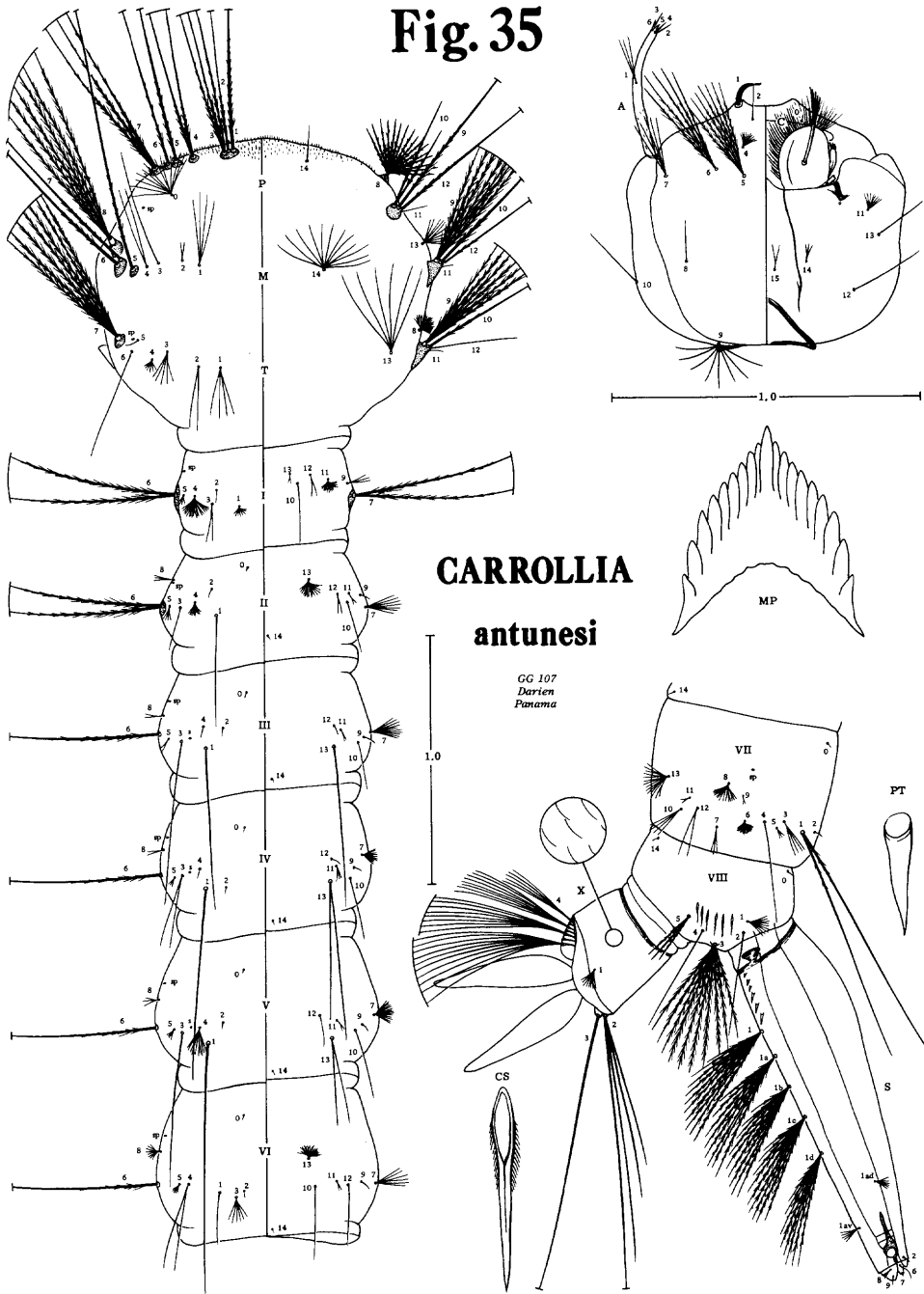
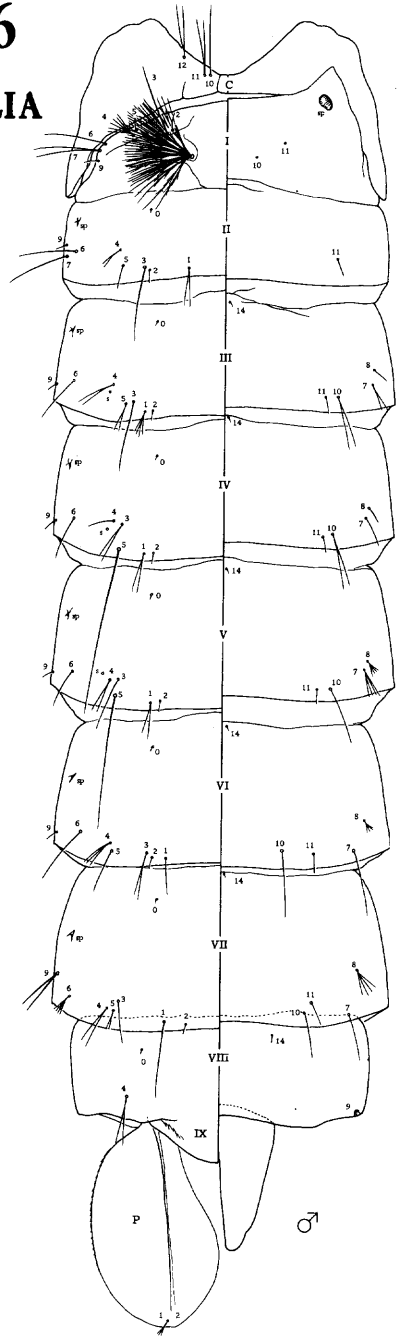
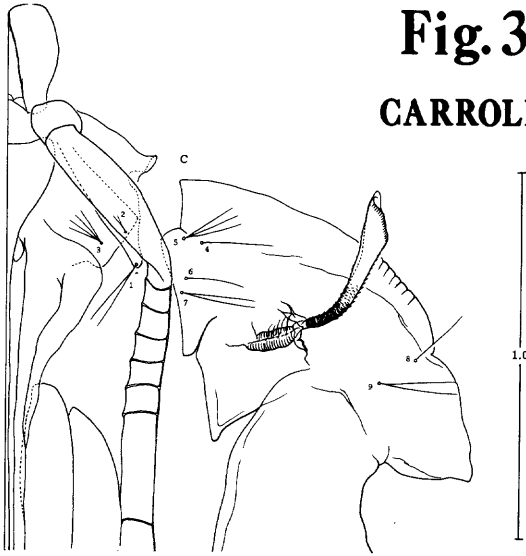


Fig. 36
CARROLLIA



cerqueirai

PA 654
Boca del Toro
Panama

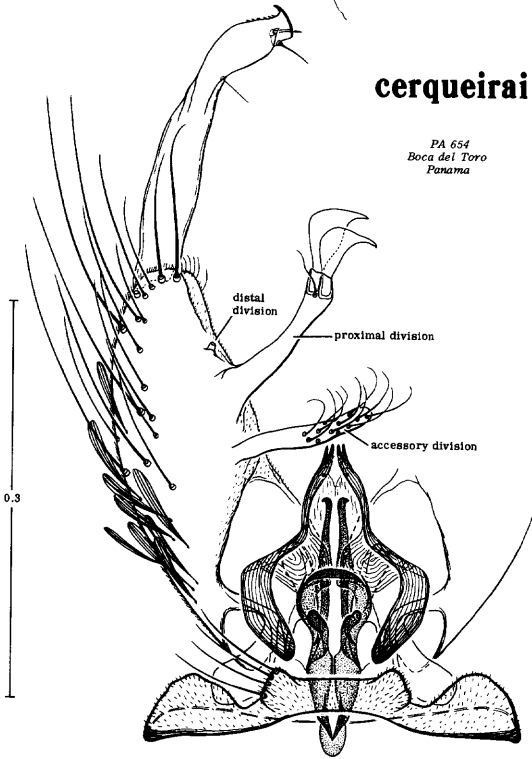


Fig. 37

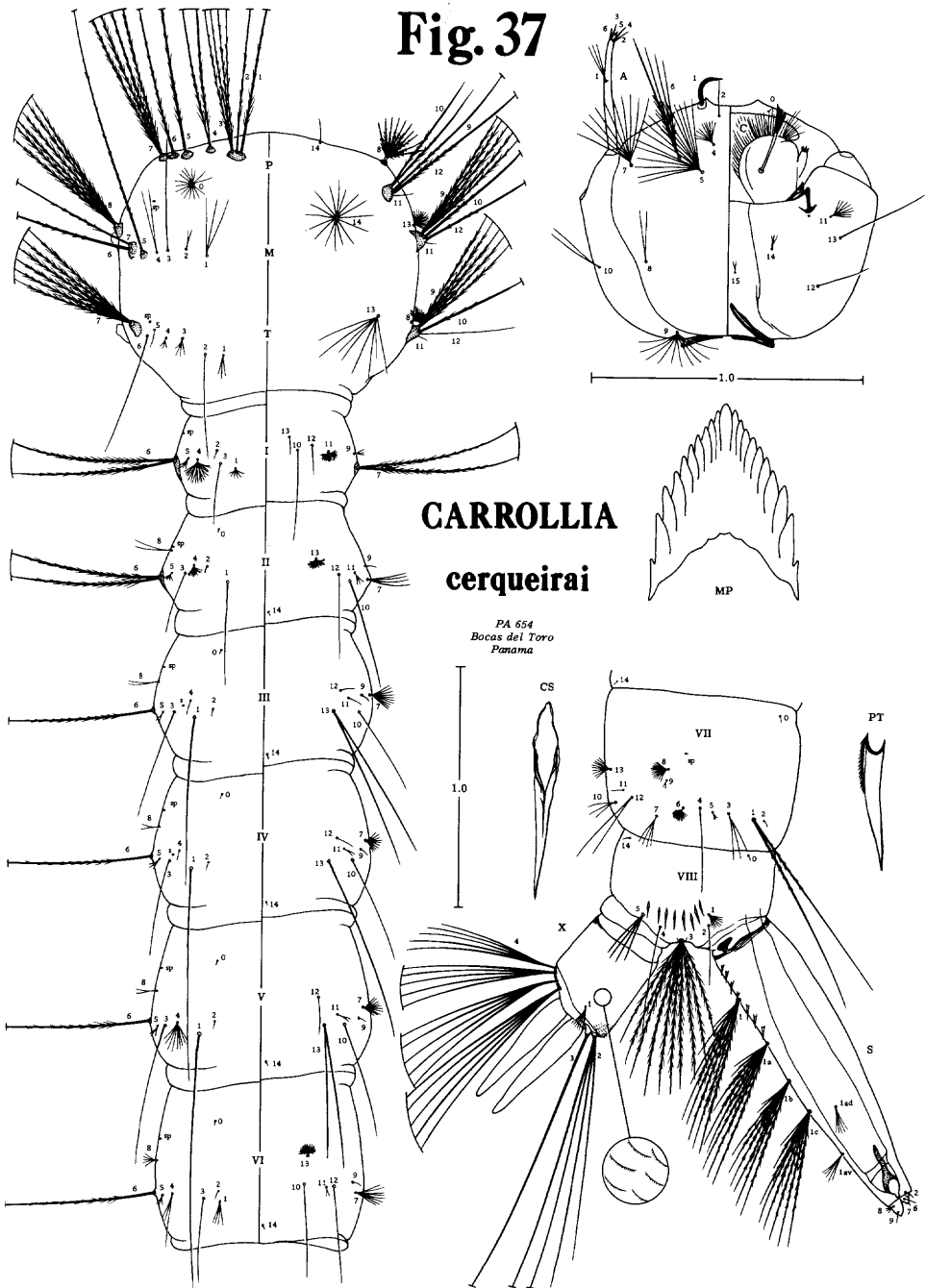


Fig. 38

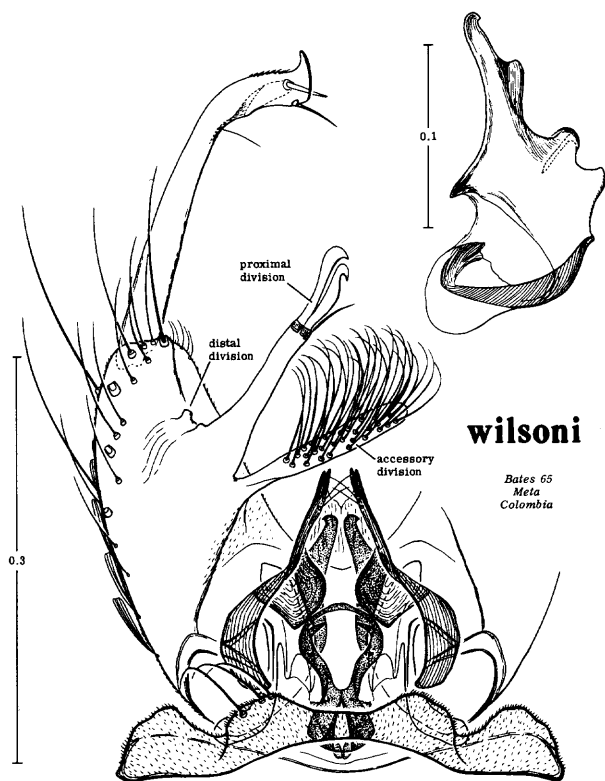
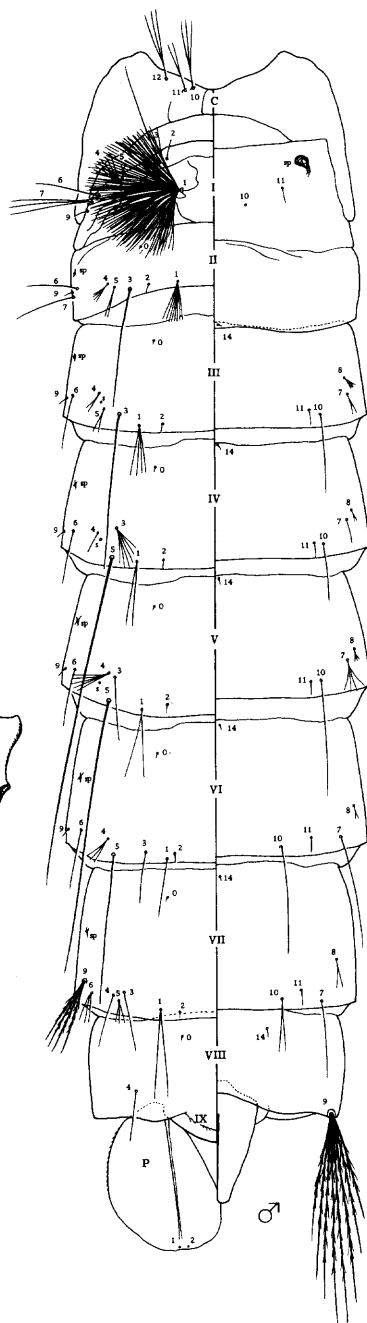
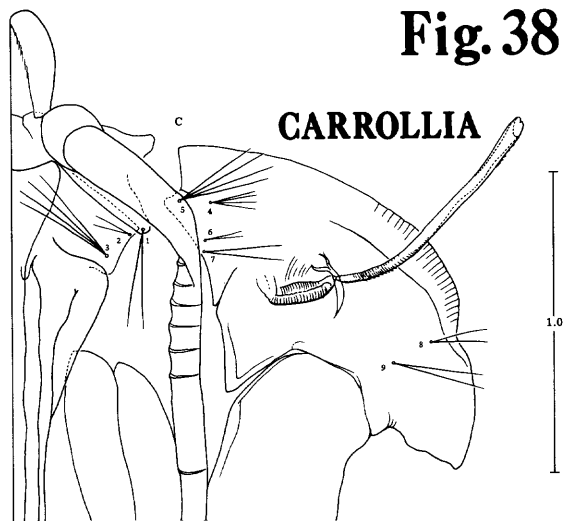


Fig. 39

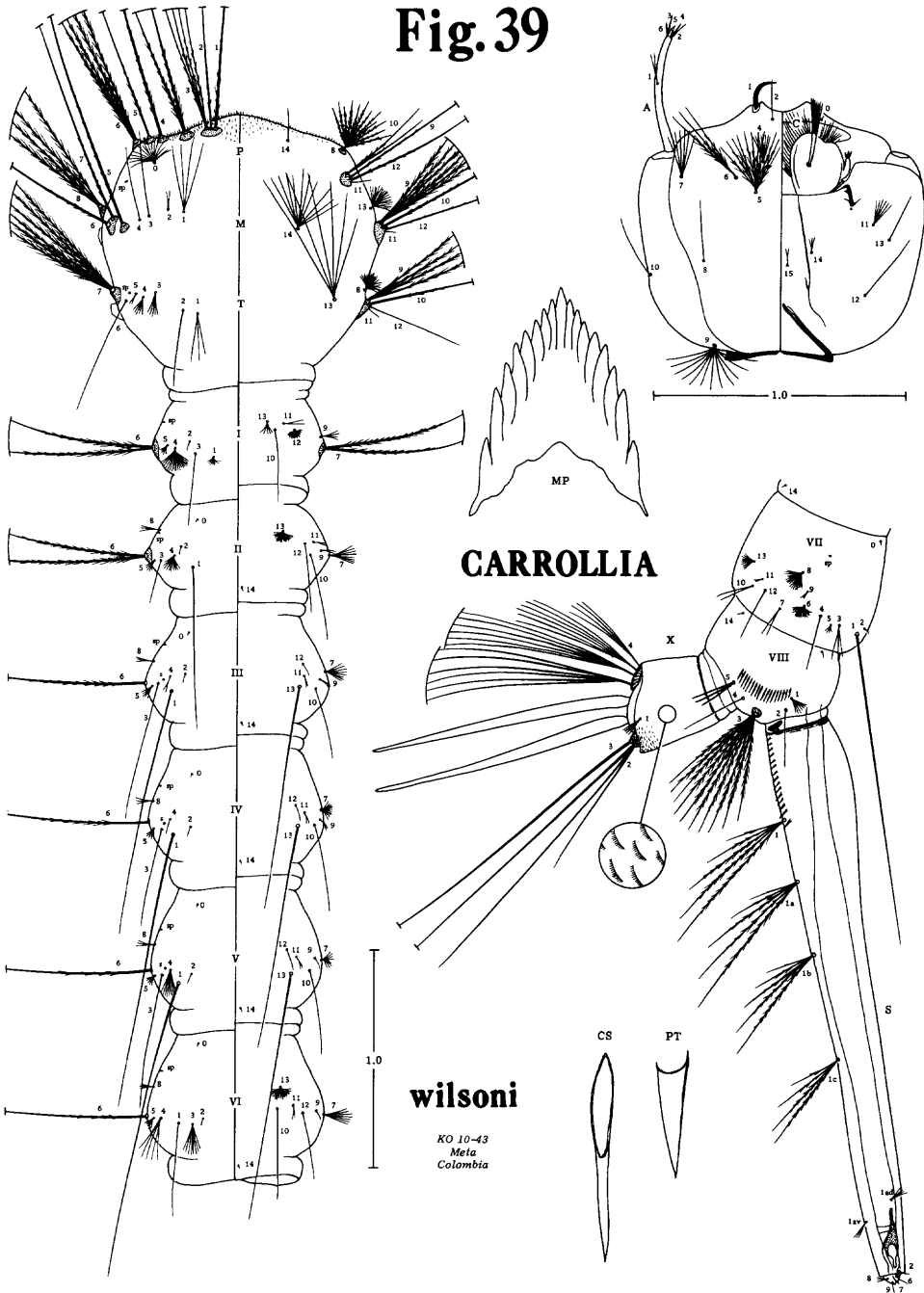
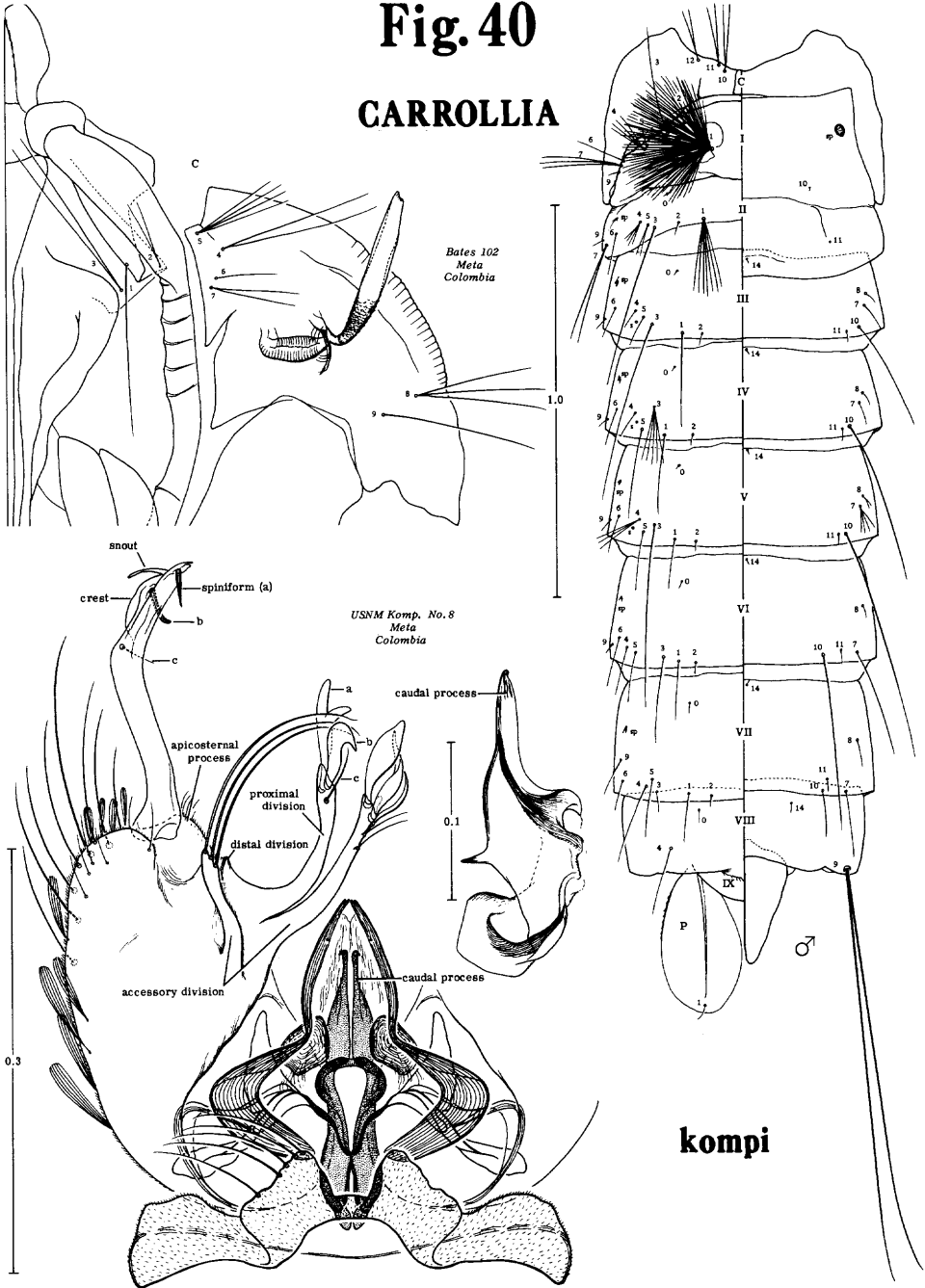


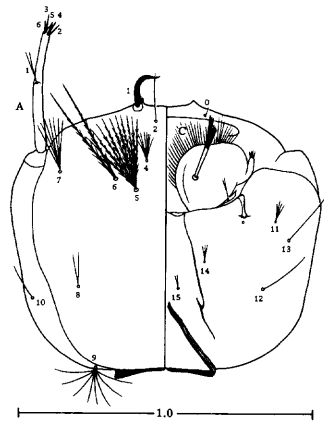
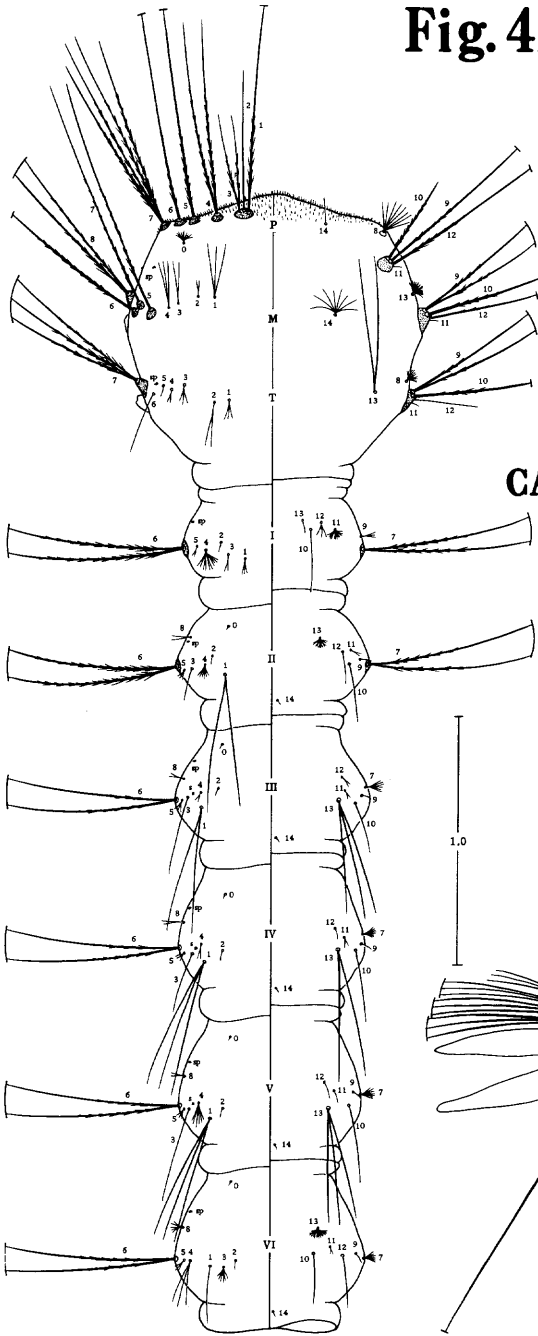
Fig. 40

CARROLLIA



kompi

Fig. 41



CARROLLIA

kompi

KO 10-30
Meta
Colombia

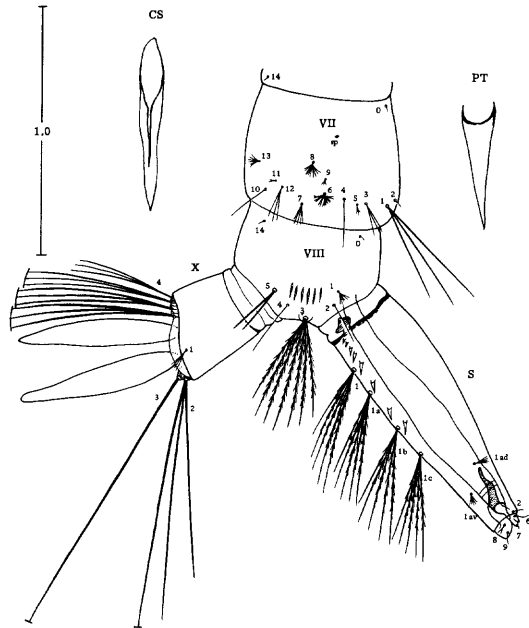
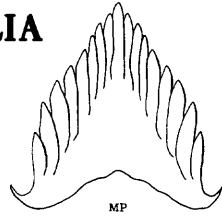


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	BIHAICOLUS					IRIDESCENS													
						Uri.		Iridescens											
	1. <i>bihaiicolus</i>	2. <i>guerrerroi</i>	3. <i>rausseoi</i>	3a. Panama	4. <i>metempsychytus</i>	5. <i>infoliatus</i>	6. <i>urichii</i>	7. <i>anduzei</i>	8. <i>bonnei</i>	8a. Bahia	9. <i>secundus</i>	9a. Esp. Santo	10. <i>iridescens</i>	11. <i>soperi</i>	12. <i>babahoyensis</i>	13. <i>antunesi</i>	14. <i>cerqueirai</i>	15. <i>wilsoni</i>	16. <i>kompi</i>
MEXICO																			
Pacific																			
Atlantic	★																		
GUATEMALA																			
Pacific					★														
Atlantic	★																		
BRIT. HONDURAS																			
EL SALVADOR																			
HONDURAS																			
Pacific																			
Atlantic																			
NICARAGUA																			
Pacific																			
Atlantic															★				
COSTA RICA																			
Pacific	★				★		★											★	
Atlantic	★									★					★				
PANAMA																			
West					★		★			★							★		
Central	★						★			★						★			
East	★		★	★			★			★						★			
ECUADOR																			
Pacific	★														★				
Amazon					★	★		★		★									
COLOMBIA																			
Pacific	★				★				★	★									
Caribbean	★						★			★									
Orinoco-Amazon					★	★		★		★						★		★	★
VENEZUELA																			
Caribbean	★	★	★				★												
Orinoco					★		★												
TRINIDAD							★												
GUIANAS					★	★		★									★		
BRAZIL																			
Amazon					★	★	★	★											
Other									★		★	★	★			★		★	
ARGENTINA														★					
PERU					★	★													
BOLIVIA						★													

French Guiana

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