The Female Cibarial Armature of New World *Culex*, Subgenus *Melanoconion* and Related Subgenera with Notes on this Character in Subgenera *Culex*, *Lutzia* and *Neoculex* and Genera *Galindomyia* and *Deinocerites* (Diptera: Culicidae)[1]

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ABSTRACT. A comparative study of the female cibarial armature of New World *Culex*, subgenera *Melanoconion*, *Aedinus*, *Anoedioporpa*, *Belkinomyia*, *Carrollia*, *Micraedes* and *Tinolestes* has been made. In addition, the female cibarial armature of species representing other New World taxa, including subgenera *Culex*, *Lutzia* and *Neoculex* and genera *Galindomyia* and *Deinocerites* was also examined for comparative purposes. The results of this study have shown that the cibarial armature is valuable as a group and subgeneric character and may also provide an excellent diagnostic feature for separating the females of certain species in *Melanoconion* and *Microculex*. The phylogenetic importance of the cibarial armature is discussed.

INTRODUCTION

The taxonomic importance of the female cibarial armature (or buccopharyngeal armature, pharyngeal armature) in the classification of *Anopheles* and *Culex* was first demonstrated by Sinton and Covell (1927) and Barraud and Covell (1928). Since these 2 pioneer studies, several taxonomic works on the above genera, including those of Christophers (1933), Barraud (1934), Edwards (1941), etc., have included the descriptions and figures of this structure in the descriptions of several Oriental and Ethiopian species. Although little or no emphasis has been placed on the use of this character for diagnostic or other taxonomic purposes, an attempt was initiated by Edwards (1941:242-353) to incorporate the brief descriptions and figures of the peculiarity of the

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shape, sizes and number of the cibarial teeth in describing and grouping species and in characterizing various Ethiopian subgenera of *Culex*. Recently, similar attempts have been made by the author (Sirivanakarn 1972, 1976, 1977) to use this character for supporting other relevant taxonomic characters of the adults, male genitalia and immature stages in the diagnosis of species as well as in developing the subgeneric characterization of Oriental *Culex*, subgenera *Eumelanomyia*, *Culex* and *Lophoceraomyia*. These recent studies have substantially shown that the cibarial armature is useful, not only in providing an additional supporting character for the subgeneric or specific diagnosis of the females, but also in determining the relationships between certain Oriental subgenera of *Culex*.

This study is an attempt to investigate the taxonomic importance of the female cibarial armature of New World *Culex*, subgenus *Melanoconion* and closely related subgenera: *Aedinus*, *Anoedioporpa*, *Belkinomyia*, *Carrollia*, *Micraedes*, *Microculex* and *Tinolestes*. It was stimulated by the lack of study and description of this character in nearly all previous taxonomic works. With the exceptions of the revisions by Lane (1953) and more recently by Valencia (1973), in which the cibarial armature of species of *Carrollia* were figured and/or described, virtually nothing is known of this character in *Melanoconion* and all other New World *Culex*. Because of the inherent difficulty in separating the females of most of these *Culex* subgenera due to the absence of distinguishing characters in the adults, it has also become most desirable, in a search for new or additional taxonomic characters, to study and compare in detail the cibarial armature as exhibited by representatives of all these subgenera. The primary purposes of this study were then to describe and figure this character to provide a basis for incorporating these structures in describing species, developing a more comprehensive subgeneric diagnosis and in devising a preliminary scheme of internal classification for *Melanoconion*. To indicate the relationships as might be evident from the similarity in this character between *Melanoconion* and closely related subgenera and other New World taxa, an attempt has also been made to describe and figure this character in the subgenera *Culex*, *Lutzia* and *Neoculex* and the genera *Galindomyia* and *Deinocerites*.

MATERIAL AND METHODS

This study was based on the identified specimens in the collections of the U.S. National Museum (USNM) and additional specimens, especially of subgenera *Aedinus*, *Anoedioporpa*, *Belkinomyia*, *Microculex* and *Tinolestes*, which were kindly loaned to me by Dr. John N. Belkin, Mosquitoes of Middle America Project (MMA), Department of Biology, University of California, Los Angeles. Most of the female specimens used in this study were obtained from reared larvae and pupae in which their identity was determined through association with the corresponding males and immature stages. Some of the species, especially in *Microculex* are still very poorly known and their identification can only be considered tentative. Without the excellent, well curated, reared material of several *Melanoconion* species in the MMA collections which was incorporated

with USNM collections in recent years, this work would not have been possible.

Except for a minor modification, the method used in preparing slides of the cibarial armature essentially follows the recommended procedure of Belkin (1962:75). The heads were removed from the pinned specimens; macerated in 10% KOH for 1 hr, washed in distilled water for 30 min, stained in acid fuchsin for 2 hr, washed in distilled water for 5 min, dehydrated in 70% and 95% ethanol from 5-10 min and after immersed in clove oil for 1-2 hr, the specimens were placed and dissected on a slide under a binocular microscope. The cibarial armature was removed from all other parts of the cibarium, including particularly the cibarial dome, and mounted separately in balsam.

The descriptions and figures of the cibarial armature of most species were based on the examination of at least 2 specimens. Slides were examined under high magnification of a compound microscope with 43X objective. The representative species of various generic and subgeneric taxa and their localities (in parenthesis) are given in the following list.

Genus *Culex:*

Subgenus *Melanoconion*: *abominator* Dyar and Knab (USA-Texas), *albinensis* Bonne-Wepster and Bonne (French Guiana), *andricus* Root (Brazil), *atratus* Theobald (Jamaica), *bastagarius* Dyar and Knab (Colombia, Venezuela), *batesi* Rozeboom and Komp (Colombia), *caudelli* (Dyar and Knab) (Trinidad), *clarki* Evans (Brazil), *chrysonotum* Dyar and Knab (Panama, Colombia), *conspirator* Dyar and Knab (Panama, Ecuador), *coppenamensis* Bonne-Webster and Bonne (Colombia), *dunni* Dyar (Panama), *eastor* Dyar (French Guiana, Venezuela, Trinidad), *educator* Dyar and Knab (Panama), *egcymon* Dyar (Panama), *elephas* Komp (Panama, Venezuela), *elevator* Dyar and Knab (Panama), *epanastasis* Dyar (Panama, Trinidad), *erraticus* (Dyar and Knab) (USA, Panama, Colombia), *inhibitator* Dyar and Knab (Jamaica, Dominican Republic), *iolambdis* Dyar (Jamaica, USA-Florida), *innovator* Evans (Brazil); *jubifer* Komp and Brown (Panama), *lucifugus* Komp (Colombia), *mistura* Komp and Rozeboom (Colombia), *mulrennani* Basham (USA-Florida), *ocellatus* Theobald (Brazil, Colombia, Venezuela), *ocossa* Dyar and Knab (Panama, Colombia), *opisthopus* Komp (Hondurus, Guatemala), *panocossa* Dyar (Panama, Colombia, Guatemala), *peccator* Dyar and Knab (USA-Arkansas, Louisiana), *pilosus* (Dyar and Knab) (Panama), *portesi* Senevet and Abonnenc (Trinidad), *spissipes* (Theobald) (Trinidad), *sursumptor* Dyar (Colombia, Ecuador), *taeniopus* Dyar and Knab (Panama), *tecmarsis* Dyar (Trinidad), *theobaldi* (Lutz) (Colombia), *trifidus* Dyar (Costa Rica), *unicornis* Root (Venezuela), *vomerifer* Komp (Trinidad), *zeteki* Dyar (Panama, Brazil).

Subgenus *Aedinus*: *amazonensis* (Lutz) (Ecuador, Colombia, Trinidad).

Subgenus *Anoedioporpa*: *conservator* Dyar and Knab (Colombia, Venezuela, *corrigani* Dyar and Knab (Panama).

Subgenus *Belkinomyia*: *eldridgei* Adames and Galindo (Colombia).

Subgenus *Carrollia*: *infoliatus* Bonne-Wepster and Bonne (Colombia), *metempsytus* Dyar (Costa Rica).

Subgenus *Micraedes*: *antillummagnorum* Dyar (Puerto Rico), *bisulcatus* (Coquillett) (Dominican Republic).

Subgenus *Microculex*: *consolator* Dyar and Knab (Trinidad), *hedys* Root (Brazil), *imitator* Theobald (Panama, Trinidad), *inimitabilis* Dyar and Knab (Trinidad), *jenningsi* Dyar and Knab (Panama), *kukenan* Anduze (Venezuela), *lanei* de Oliveira Coutinho and Forattini (Brazil), *pleuristriatus* Theobald (Trinidad, Venezuela), *rejector* Dyar and Knab (Mexico), *restrictor* Dyar and Knab (Costa Rica), *stonei* Lane and Whitman (Trinidad).

Subgenus *Tinolestes*: *latisquama* (Coquillett) (Colombia).

Subgenus *Lutzia*: *allostigma* (Howard, Dyar and Knab) (Peru).

Subgenus *Culex*: *coronator* Dyar and Knab (Colombia), *declarator* Dyar and Knab (Colombia), *nigripalpus* Theobald (Panama).

Subgenus *Neoculex*: *arizonensis* Bohart (USA-Arizona), *derivator* Dyar and Knab (Costa Rica), *territans* Walker (USA-Maryland).

Genus *Galindomyia*: *leei* Stone and Barreto (Colombia).

Genus *Deinocerites*: *cancer* Theobald (Dominican Republic).

MORPHOLOGY AND TERMINOLOGY OF THE FEMALE CIBARIAL ARMATURE

The morphology of the cibarial armature and its relationship with the cibarium and the pharynx in a *Melanoconion* species are shown in Fig. 1A. For an account of the comparative morphology of the cibarium (or buccal cavity of previous usage) and the pharynx in several mosquito genera, consult Sinton and Covell (1927) and Barraud and Covell (1928). The descriptive terminology for the structures associated with the cibarial armature which are used here follows the terminology of Knight and Laffoon (1970).

Morphologically, the cibarial armature is a simple cuticular structure which represents the posterior end of the ventral plate of the cibarium near its junction with the pharynx and pharyngeal pump. The ventral plate of the cibarium is an elongate trough-like structure in which liquid food is accumulated for predigestion before it is passed on to the pharynx and pharyngeal pump. The cibarial armature as viewed from the dorsal aspect is a broad, cup-shaped structure with a lateral extension on both sides to form the lateral flanges. The median portion of the cibarial armature is slightly or strongly concave in the form of a broad bar or the cibarial bar which in *Culex*, *Deinocerites* and certain subgenera of *Anopheles*, bears a transverse row or rows of teeth or the cibarial teeth. Overlying the median portion of the

cibarial bar and teeth is an oval or hemispherical structure which is denticulate or reticulate. This is the cibarial dome of Valencia (1973) or shagreened area of Barraud and Covell (1928) which presumably represents the posterior end of the posterior hard palate of the cibarium. In preparation of the cibarial armature proper, it is important to remove the cibarial dome from the cibarial bar for the detailed study of the cibarial teeth. Within a given subgenus of *Culex*, the form, shape and the number of the cibarial teeth are taxonomically important and are the characters which have been used in this study. The cibarial dome and other related structures have been found to be rather uniform and are, with a few exceptions, excluded from the descriptions of the various types of the cibarial armature.

RESULTS

Since this study has been based largely on a small sample of material, it is not possible to analyse and evaluate the variation in the number of the cibarial teeth which may be encountered in a given species. The verbal descriptive interpretation and the accompanying figures of the form and shape of the cibarial teeth are, however, important and sufficient to illustrate the pattern of development of this structure. In a large subgenus, such as *Melanoconion* and *Microculex* in which several members were examined, various types of cibarial armatures are described. An attempt is made to classify species on the basis of similarity in this character. In the illustrations, only some of the cibarial armatures which are characteristic of the different types or subtypes as interpreted here are figured.

The female cibarial armature of Culex, subgenus Melanoconion and related subgenera

Melanoconion
(Fig. 1A,B; 2,3)

The cibarial armature of *Melanoconion* is diversified, showing a variety of forms, shapes, sizes and numbers of the cibarial teeth. In the majority of species, the cibarial teeth are relatively few, very large, hollow, columnar, with a simple or serrated truncate apex. In a few members, the cibarial teeth are numerous, narrow or flat, distally filamentous, abruptly pointed or apically truncate and widely or closely spaced. The cibarial dome (Fig. 1A,B) in all species examined, except *abominator* and *peccator*, is essentially similar in being oval or hemispherical, relatively small and densely imbricate with numerous denticles. The cibarial dome of *abominator* and *peccator*, is, on the other hand, very large and reticulate, more or less resembling that of *Deinocerites* (Fig. 1C). Based on the characters of the cibarial teeth, the following 5 primary types and 5 secondary subtypes are distinguished:

(1) Typical *Melanoconion* type (Fig. 2, D-L, Fig. 3, A-F). The cibarial bar varies from relatively small or narrow to moderately broad. The cibarial

teeth vary from 3 to 20; they are usually large, or broad, in the form of hollow columns, sometimes narrow, linear with hollow area forming a transparent line on axis and with simple or finely serrate truncate apex. On the basis of the number of the cibarial teeth and the extent of hollow area on its axis, 5 secondary subtypes are distinguished as follows:

(a) *spissipes* subtype (Fig. 2 D-F). The number of cibarial teeth varies from 10 to 16; hollow areas of teeth more or less restricted to base; distal cuticular part of teeth rather broad and strongly pigmented. This subtype was found in the following species: *epanastasis, opisthopus, portesi, spissipes, taeniopus* and *vomerifer*. The differences in the number, size and degree of pigmentation of cibarial teeth as figured for *spissipes* (Fig. 2D), *epanastasis* (Fig. 2E) and *opisthopus* (Fig. 2F) are apparently of specific diagnostic importance.

(b) *erraticus* subtype (Fig. 2 G-L; Fig. 3 A-C). The number of cibarial teeth varies from 6-8; hollow area of teeth usually most prominent, extending from base to apex; distal cuticular portion of teeth vary narrow and lightly pigmented. The species which were examined and found to conform to this subtype include: *atratus, bastagarius, clarki, chrysonotum, conspirator, coppenamensis, dunni, eastor, educator, egcymon, elephas, elevator, erraticus, inhibitator, iolambdis, lucifugus, mistura, mulrennani, sursumptor, tecmarsis, theobaldi, trifidus* and *zeteki*. The characters which have been found to be of diagnostic importance among these species are the number, apical margin and degree of pigmentation of basal part of the cibarial teeth.

(c) *albinensis* subtype (Fig. 3D). The cibarial armature is similarly developed as in the *erraticus* subtype but differs from it in having 13, 14 cibarial teeth. This subtype is distinctive and apparently characteristic of *albinensis*.

(d) *batesi* subtype (Fig. 3E). This subtype is apparently distinctive of *batesi*. The cibarial teeth are numerous, about 20, closely packed, with hollow area forming a narrow transparent line on axis.

(e) *pilosus* subtype (Fig. 3F,G). This subtype exhibits the narrowest cibarial bar of all subtypes and the number of the cibarial teeth is reduced to 3. The characters of the teeth are essentially similar to the *erraticus* subtype. Species which exhibit this subtype include: *andricus, caudelli, innovator, pilosus* and *unicornis*. All of these species are apparently identical in this character.

(2) *ocellatus* type (Fig. 2A). This type is characteristic of *ocellatus* and is rather unique in *Melanoconion*. The cibarial bar is moderately broad, the cibarial teeth are numerous, about 40, in a close-set row, all of which are subequally long, fine and distally filamentous. It differs from the typical *Melanoconion* type in the absence of hollow area on the longitudinal axis of the teeth.

(3) *ocossa* type (Fig. 2B). This type is characteristic of 2 closely related species: *ocossa* and *panocossa*. The cibarial bar is moderately broad, with distinct cuticular thickening in form of an H in median portion: the cibarial teeth are short, rather coarse, about 40, all of which are subequal with swollen and abruptly pointed apex and narrow base; hollow area on axis of teeth absent.

(4) *jubifer* type (Fig. 2C). This type is characteristic of *jubifer*. The cibarial teeth are about 20, all of which are flattened, without hollow area on axis and apically truncate. It is somewhat similar to the *spissipes* subtype of the typical *Melanoconion*.

(5) *abominator* type (Fig. 3H, I). This type is exhibited by 2 closely related species: *abominator* and *peccator*. The cibarial bar is broadest of all *Melanoconion*; the cibarial teeth are numerous, in a close-set row, varying from 40 to 60, all of which are narrow, long, apically pale and truncate and without hollow area on axis.

Aedinus
(Fig. 4A)

The cibarial armature of *amazonensis*, the type species of this subgenus, is strikingly different from most types found in *Melanoconion* in the shape of the cibarial bar and in having numerous, narrow and strongly pigmented cibarial teeth in a bow-shaped row. The number of teeth is about 45; median ones long, lateral ones gradually become shorter towards lateral flanges. The cibarial dome is large, hemispherical and with numerous strong denticles similar to most types of *Melanoconion*.

Anoedioporpa
(Fig. 4C, D)

The cibarial armature as shown by 2 representative species, *conservator* and *corrigani*, of this subgenus are very characteristic and differ from most of the types found in *Melanoconion* in having numerous narrow and fine cibarial teeth which vary from 30 to 40. The cibarial bar is moderate in size and slightly produced in middle. The cibarial dome is essentially as described for the typical *Melanoconion* type. The characteristic cibarial teeth are similar to the *ocellatus* type of *Melanoconion* (Fig. 2A) and the typical *Microculex* type (Fig. 5A-E).

Belkinomyia
(Fig. 4H)

The cibarial armature of *eldridgei*, which is the only representative of this subgenus is exceedingly similar to those of the *spissipes* subtype of *Melanoconion*. The number of the cibarial teeth is about 13, all large, flat, with truncate apex and hollow area largely restricted to proximal or basal portion.

Carrollia
(Fig. 4E, F)

The cibarial armature of *Carrollia* as figured in several species by Valencia (1973) and as shown here strongly resembles that in the *erraticus* subtype of typical *Melanoconion*, particularly in having a large hollow area occupying most of proximal and distal portions of the cibarial teeth. The number of teeth varies from 4 to 10, all large, strongly flattened, with spiny or finely serrate truncate apex. The latter features as shown in *metempsytus* and *infoliatus* (Fig. 4E, F) are apparently very diagnostic of these species.

Micraedes
(Fig. 4B)

The cibarial armature of *antillummagnorum* and *bisulcatus* of *Micraedes* are most distinctive in having a very broad cibarial bar and the most numerous and fine cibarial teeth in a close-set row. The number of teeth is about 60 or more. They are apparently similar to *Anoedioporpa* and typical *Microculex*. The cibarial dome is large, oval-shaped, with rather coarse denticles as in *Melanoconion*.

Microculex
(Fig. 5A-H)

The cibarial armature in *Microculex* exhibits an overlap with those in *Anoedioporpa*, *Micraedes* and certain types found in *Melanoconion*. The cibarial dome is essentially similar to most *Melanoconion*. They can be separated into 3 types as follows:

(1) Typical *Microculex* type (Fig. 5A-E, H). This type is shown by several or perhaps the majority of species in the subgenus. It is characterized by the presence of numerous fine teeth, which are evenly narrow or lanceolate, fine tipped or blunt, with or without narrow hollow area on axis at bases. The number of teeth varies from 30-50. The species which exhibit this type are: *hedys*, *immitator*, *inimitabilis*, *jenningsi*, *kukenan*, *lanei*, *pleuristriatus*, *rejector* and *stonei*. This type of cibarial armature apparently resemble those of *Anoedioporpa*, *Micraedes* and the *ocellatus* type of *Melanoconion*. On the basis of the number, size, apex and extent of hollow area on axis of the cibarial teeth, it can be differentiated into 2 or perhaps more subtypes. These are:

(a) *stonei* subtype (Fig. 5A, C, E). This subtype has narrow, simple, sharply pointed cibarial teeth, resembling that of the *ocellatus* type of *Melanoconion*. Some examples are *stonei*, *jenningsi*, *inimitabilis*, *kukenan* and *rejector*.

(b) *imitator* subtype (Fig. 5B, D, H). This has coarser, apically

serrated cibarial teeth, as exhibited by *imitator*, *lanei*, *hedys* and *pleuristriatus*.

(2) *restrictor* type (Fig. 5G). This type is apparently characteristic of *restrictor*. The cibarial teeth are numerous, about 25, resembling typical *Microculex* type, but they are evenly flattened with truncate apex and without hollow area on axis. This type is apparently more similar to that of *Anoedioporpa* than to other species of *Microculex*.

(3) *consolator* type (Fig. 5F). This type is characteristic of *consolator*. It differs from the other 2 *Microculex* types in the presence of 10-12 cibarial teeth which are large, columnar, and apically truncate with hollow area restricted to basal portion. It more or less resembles the *spissipes* subtype of *Melanoconion*, but the cibarial teeth are relatively narrower and shorter.

Tinolestes
(Fig. 4G)

The cibarial armature of *latisquama*, which is the only known representative of *Tinolestes*, strongly resembles the *spissipes* subtype of *Melanoconion* more than any others among all of the closely related *Culex* subgenera. The cibarial bar is moderately broad. There are 14 cibarial teeth, all large, flattened, apically truncate, with hollow area more or less restricted to basal portion. The cibarial dome is essentially similar to the typical *Melanoconion* type.

The female cibarial armature of other New World taxa

Lutzia
(Fig. 6A)

The cibarial armature of *Culex*, subgenus *Lutzia* is characterized by a broad, medially produced cibarial bar with elongate lateral flanges. The cibarial teeth are about 28, all of which are short, small, deeply rooted with abruptly pointed apex. The cibarial dome is small, thin, dumbbell shaped, poorly sclerotized, with numerous minute rounded tubercles, as figured in subgenus *Culex* (Fig. 1D). Species examined: *allostigma*.

Culex
(Fig. 1D; 6C, D)

The New World species of *Culex*, subgenus *Culex*, which have been examined are essentially similar to the old world *Culex (Culex)* and *Lutzia* in the small, poorly sclerotized cibarial dome (Fig. 1D) and in the broad cibarial bar. The cibarial teeth vary from 20 to 30. They are short or moderately long, deeply rooted with abruptly pointed apex. Species examined include: *coronator*, *declarator* and *nigripalpus*.

Neoculex
(Fig. 6B)

The cibarial armature of *Neoculex* has a relatively narrow cibarial bar. There are 20-24 cibarial teeth. These are fine, narrow, moderately long and distally tapered into a sharp point. The cibarial dome is similarly developed as in *Lutzia* and *Culex*. The only New World member of this subgenus is *derivator*. It apparently exhibits similarity in this character to two other Nearctic members: *arizonensis* and *territans*.

Genus *Galindomyia*
(Fig. 6E)

The cibarial armature of *leei*, which is the single representative of the genus *Galindomyia*, strongly resembles those of *Belkinomyia*, *Tinolestes* and *spissipes* subtype of *Melanoconion*. There are about 12 cibarial teeth, all subequal, broad, columnar, apically truncate with hollow area more or less restricted to proximal or basal portion. The cibarial dome is essentially as described for the typical *Melanoconion* type and most of its related subgenera.

Genus *Deinocerites*
(Fig. 1C; 6F)

The cibarial armature of *Deinocerites*, as exhibited by *cancer*, the type species of the genus, is very well developed. The cibarial bar is very broad, strongly concave and slightly produced in the middle. The cibarial teeth are about 40, all subequal, flattened, apically truncate or blunt. The cibarial dome is large, broad heart-shaped and strongly reticulate, somewhat similar to the *abominator* type of *Melanoconion*.

DISCUSSION AND SUMMARY

The results from the above comparative study have shown that the female cibarial armature is important in the taxonomic study of New World *Culex*, subgenus *Melanoconion* and related subgenera. The diversity in the development of the cibarial teeth and the distribution of similar or different types of the cibarial armature as shown by the representatives of these *Culex* subgenera have been found to be significant in interpreting the relationships, in grouping species as well as in developing a scheme of internal classification for *Melanoconion* and *Microculex*. A number of the distinct types of the cibarial armature as exhibited by some members of the latter 2 subgenera have also been found to provide excellent specific diagnostic characters of the females. Further study and detailed analysis of the variation in the number and special modifications of the cibarial teeth of several species in the *spissipes* and *erraticus* subtypes of *Melanoconion* and in the typical *Microculex* type as interpreted above appear to be most rewarding in a search for their specific differences.

Except for a few or more overlaps in the types of the cibarial armature between or among the members of *Melanoconion* and related *Culex* subgenera, the general pattern and the trend of development of the cibarial teeth are apparently significant in support of the present subgeneric classification of these complex subgenera of New World *Culex*. In the subgenera *Aedinus*, *Anoedioporpa*, *Belkinomyia*, *Carrollia*, *Micraedes*, *Tinolestes* and in the majority of species of *Microculex*, the cibarial armature is very characteristic and is important as a subgeneric character. In *Melanoconion*, the cibarial armature of the majority of species appears to conform to a single major type or the typical *Melanoconion* type as indicated above. This type is significant and is apparently the most characteristic of the subgenus. Other derivations or departures from this type, including a number of the subtypes (*pilosus*, *albinensis*, *batesi*) which were differentiated from the typical *Melanoconion* type; the *abominator*, *ocellatus*, *ocossa* and *jubifer* types have been found only in a few members and are at most of group importance. Some of these minor types such as the *batesi*, *abominator* and *ocellatus* also appear to be significant in indicating the relationships between *Melanoconion*, *Anoedioporpa*, *Microculex* and other subgenera. Of special interest is the concordance between the grouping of species in the *spissipes* subtype (*spissipes*, *epanastasis*, *opisthopus*, *portesi*, *taeniopus* and *vomerifer*) based on the cibarial armature as shown here and the grouping of these species by Galindo (1969) in the *taeniopus* or *spissipes* group on the basis of the male genitalia and larval characters.

In addition to the group and subgeneric importance, other evidence from the comparative morphology of the cibarial armature have also been found to be important in indicating the relationships between *Melanoconion* and other *Culex* subgenera, including also genera *Galindomyia* and *Deinocerites*. Although these relationships are evident in the morphology of the male genitalia, adult external characters and the immature stages as discussed in general by previous authors (Edwards 1932, Belkin and Hogue 1959, Berlin 1969, Adames 1971, Valencia 1973), further evidence from the cibarial armature has been found to be even more illuminating in the interpretation of the detailed relationships. Possibly of phylogenetic importance are the relationships as shown by the similarity of the cibarial teeth in (1) the *spissipes* subtype of *Melanoconion*, *Belkinomyia*, *Tinolestes* and genus *Galindomyia*; (2) the *erraticus* and *batesi* subtypes of *Melanoconion*, *Carrollia* and certain members of the typical *Microculex* and (3) the *ocellatus* type of *Melanoconion*, *Anoedioporpa*, *Micraedes* and typical *Microculex*. These relationships seem to suggest that the most primitive stocks of these New World taxa are probably the members of subgenus *Melanoconion*. Further evidence also seem to indicate the close relationship of *Melanoconion* stocks (including related subgenera) with the genus *Deinocerites* and the remote affinity between all of these New World taxa and the subgenera *Culex*, *Lutzia* and *Neoculex*. These relationships are evident in the morphology of the cibarial domes and the development of the cibarial teeth which are shared by the *Melanoconion* stocks and *Deinocerites* and the striking differences of these characters from those found in the Old or New World subgenera *Culex*, *Lutzia* and *Neoculex*.

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Fig. 1 MORPHOLOGY OF CIBARIAL ARMATURE

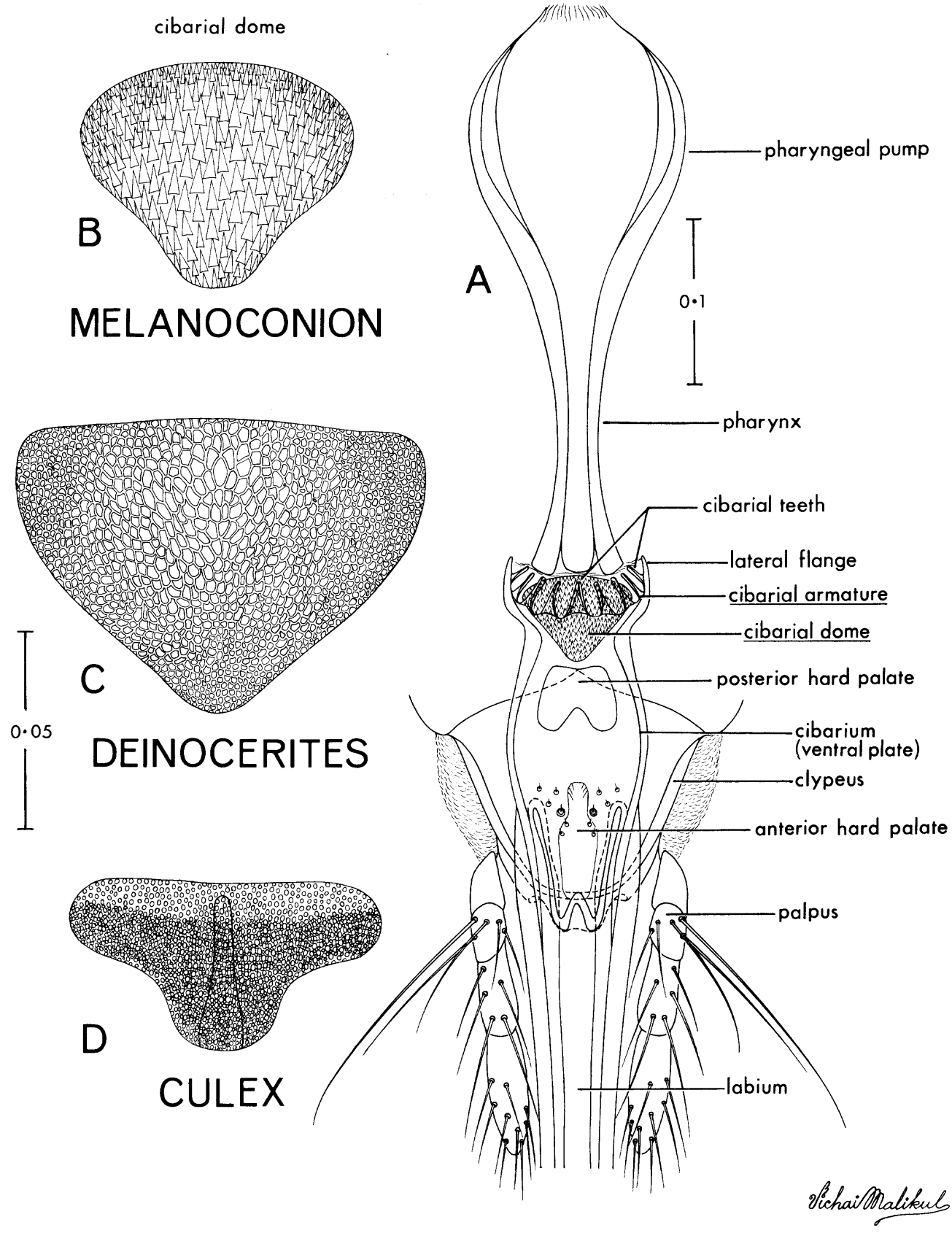
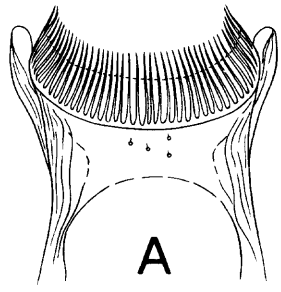
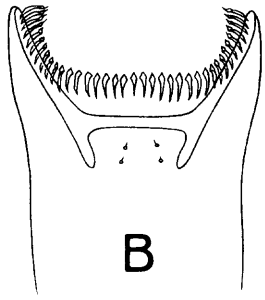


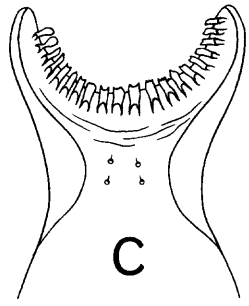
Fig. 2 MELANOCONION



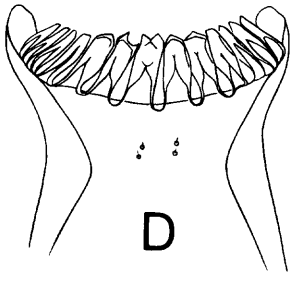
ocellatus



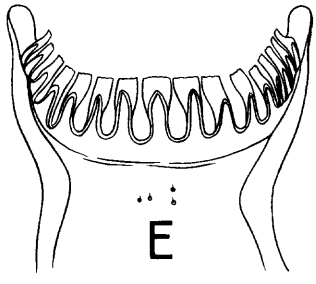
ocossa



jubifer



spissipes



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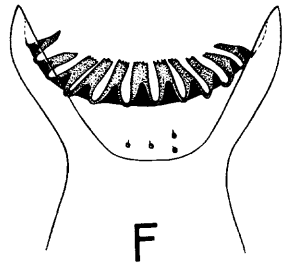
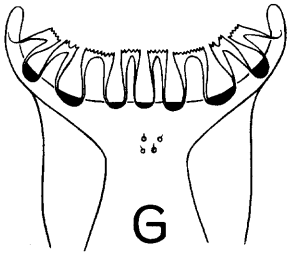
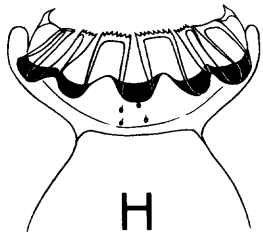


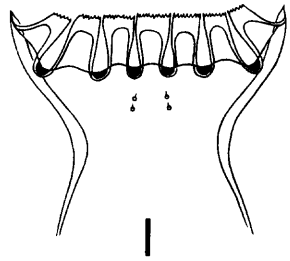
opisthopus



erraticus



chrysonotum



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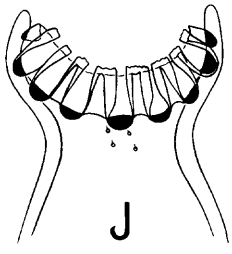

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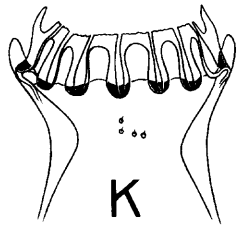

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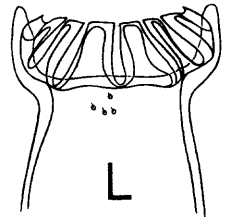

conspirator

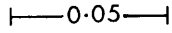

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Fig. 3 MELANOCONION

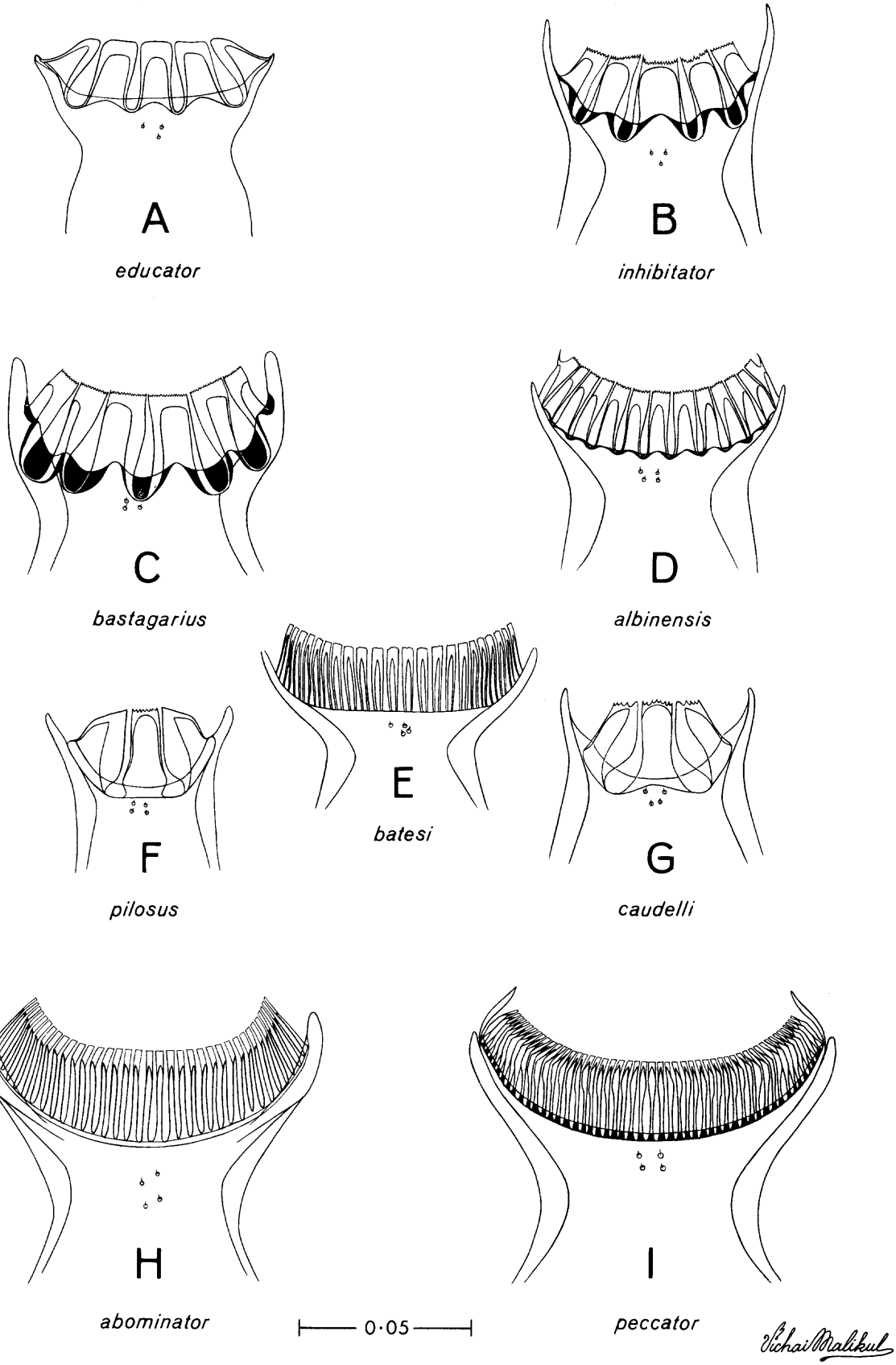


Fig. 4

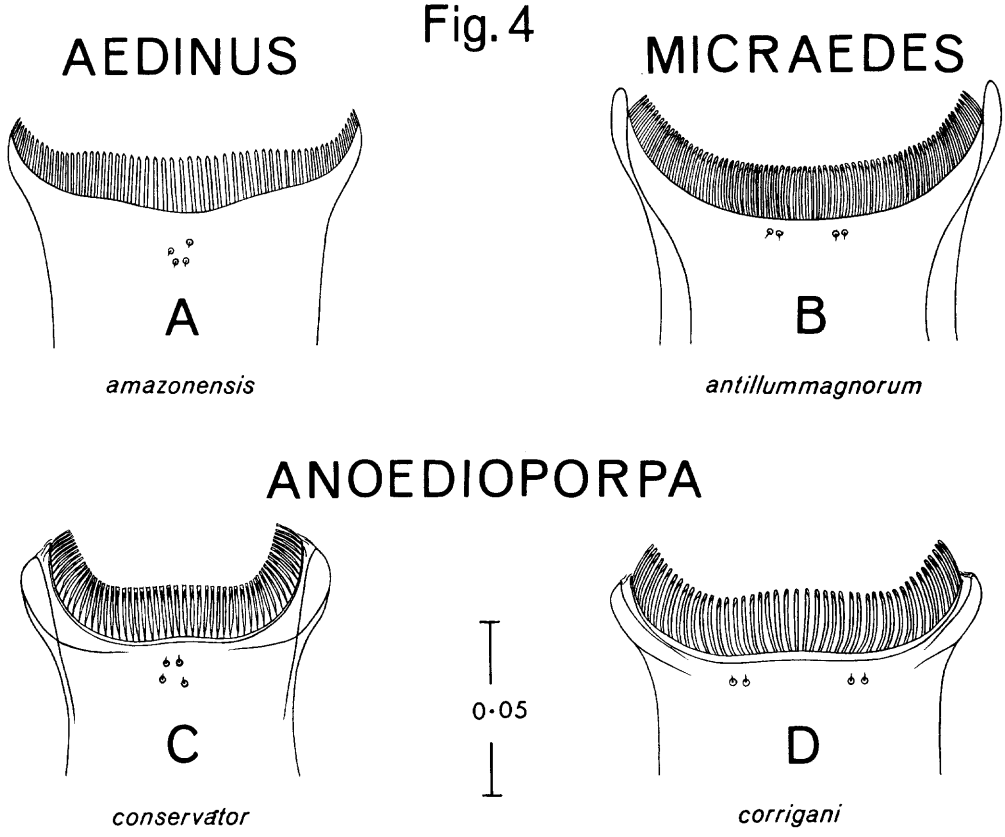
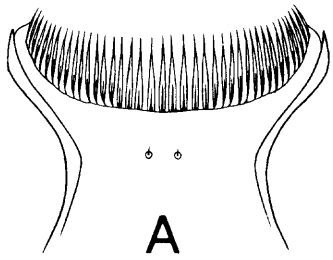

AEDINUS
MICRAEDES
A
B
amazonensis
antillummagnorum
ANOEDIOPORPA
C
0·05
D
conservator
corrigani
CARROLLIA
E
F
metempsytus
infoliatus
TINOLESTES
BELKINOMYIA
G
H
latisquama
eldridgei
Vichai Malikul

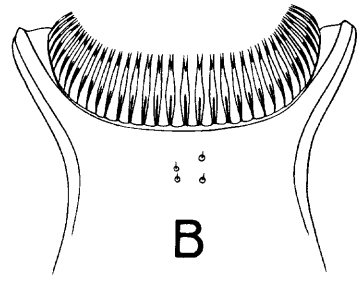
Fig. 5

MICROCULEX



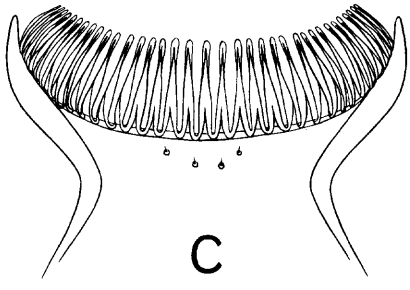
A

stonei



B

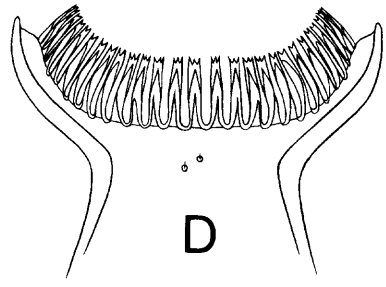
lanei



C

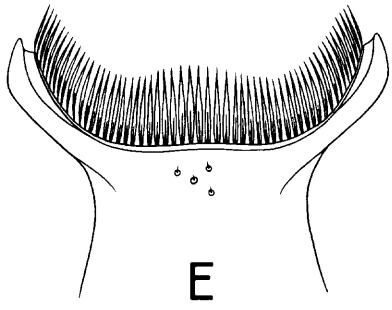
jenningsi

0·05



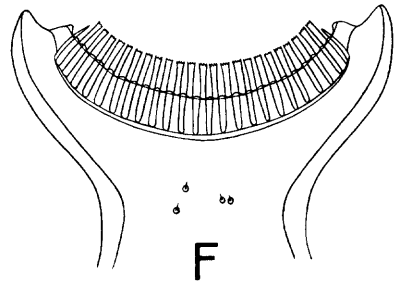
D

imitator



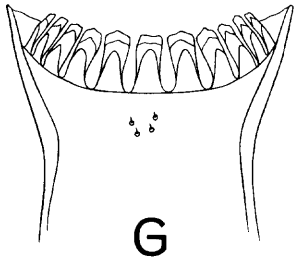
E

inimitabilis



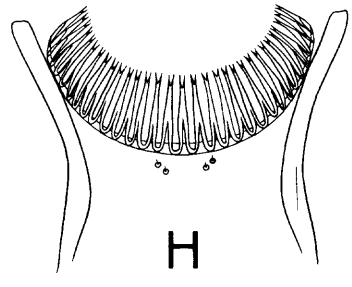
F

restrictor



G

consolator



H

pleuristriatus

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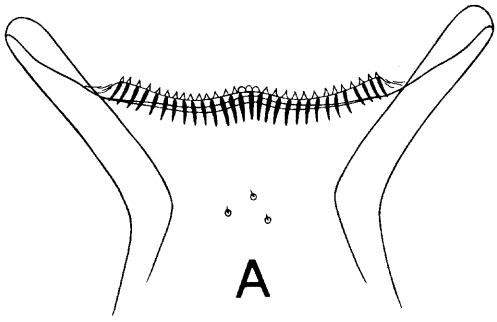
Fig. 6

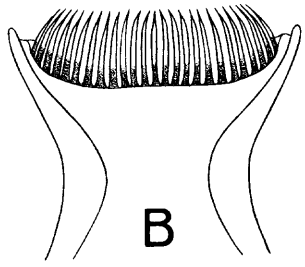
LUTZIA



A

allostigma

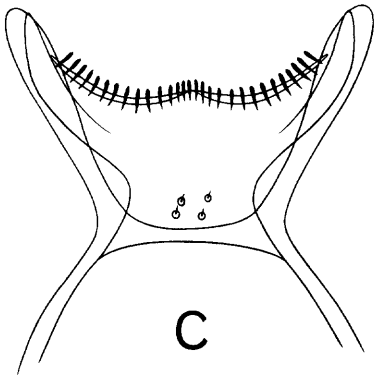
NEOCULEX



B

derivator

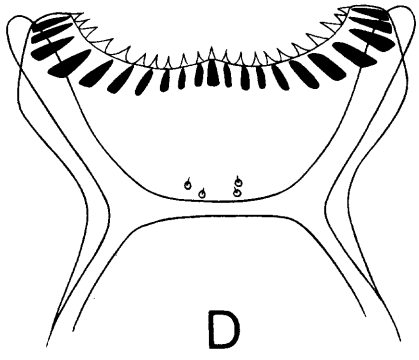
CULEX



C

nigripalpus

0·05



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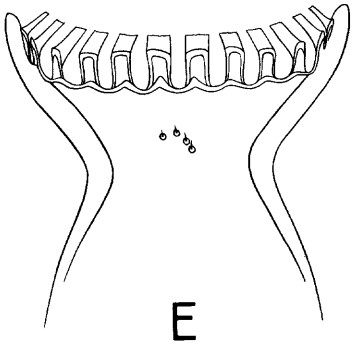
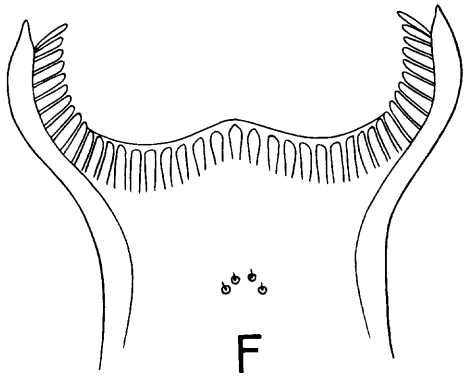
GALINDOMYIA



E

leei

DEINOCERITES



F

cancer

Richai Malikul