

Kagoshima University  
Faculty of Agriculture  
Entomological Laboratory  
Kagoshima (Japan)

AKIRA NAGATOMI

## Male genitalia of the lower Brachycera (Diptera)

With 151 text figures

### Introduction

The male genitalia of the lower Brachycera are described and illustrated in this paper, which deals with a total of 37 species belonging to 33 genera and 11 families. In Stratiomyidae and Solvidae (= Xylomyidae), only the family diagnoses are mentioned and species and genus are not treated. For male genitalia of these two families see NAGATOMI & TANAKA (1971) and ROZKOŠNÝ (1973).

The keys presented in this paper cannot be arranged from the phylogenetical point of view. There are no doubt several misinterpretations and hasty generalizations, because the material examined is small.

Several questions are discussed as to the primitive or derivative characters, the positions of some families, etc.

For female genitalia of the lower Brachycera see NAGATOMI & IWATA (1976, 1978) and IWATA & NAGATOMI (1976).

### Techniques and notes

The posterior part of abdomen cut off was put in 10% KOH for 1 or 2 days and then in  $\text{CH}_3\text{COOH}$  for 5 minutes. After washing it was placed in glycerin on a slide having no cover glass and examined from various angles with 80–160 times binocular microscope.

Where the bases of cerci are located beneath tergum 9, tergum 10 is not described and not illustrated because it cannot be seen and may indeed be absent.

### Terminology

The technical term of each part of the genitalia varies considerably with the group of Diptera and also with the author, partly because the homology of each part is difficult to determine.

The following terms are here used in order to be concise and to avoid difficult words.

Aedeagal dorso-anterior plate or a pair of aedeagal dorso-anterior sclerites (= aedeagal [or endophallic] supporting sclerites):

A pair of elongate sclerites situated over base (centre of hypopygium) of dorsal side of anterior bar of aedeagus; the sclerites are partly (at base [centre of hypopygium]) or entirely included in a transparent lobe flattened dorso-ventrally.

Aedeagal [or endophallic] tines:

A pair of long sclerites strongly curved counterclockwise (from base to apex) and situated behind anterior bar of aedeagus; this structure is found in Tabanidae and Athericidae.

Anterior bar of aedeagus (= aedeagal [or endophallic] apodeme):

A part of aedeagus protruded anteriorly and often flattened dorso-ventrally or laterally. The boundary of anterior bar from the posterior part is not necessarily definite, however.

Basistylar dorso-inner anterior processes (= gonocoxal apodeme):

A pair of dorso-inner processes of hypopygium directed anteriorly.

Basistyle: Gonocoxite.

Dististyle: *Gonostylus*.

Dorsal bridge: A bridge between pair of basistylar dorso-inner anterior processes; this is very often fused with the dorsal plate produced posteriorly.

Dorsal plate (in mid posterior part of hypopygium) (= paramere):

This is fused with or developed from dorsal bridge.

“Half-opened umbrella”: A structure enclosing posterior part of aedeagus and similar in shape to half-opened umbrella.

Hypopygium: Here defined as the genitalia excluding terga 9–10, sternum 10, and cerci.

Interbases (= penis valves; accessory structures of aedeagus):

A pair of elongate processes arising from the latero-inner parts of basistyles, and their roots are usually situated between dorsal and ventral surfaces of basistyle.

Mid plate (in mid posterior part of hypopygium):

Situated between dorsal and ventral plates (or interbasis).

Mid-posterior part of hypopygium:

A sclerotized area including interbases and enclosing aedeagus.

Posterior (or postero-sclerotized) part of aedeagus (= aedeagus [excluding its anterior bar], distiphallus):

A sclerotized part connecting with anterior bar of aedeagus and situated behind aedeagal dorso-anterior sclerites. The boundary of posterior part from the anterior bar is not necessarily definite, however.

“Trumpet”: A structure enclosing aedeagus and similar in shape to trumpet.

Ventral lobes (in mid posterior part of hypopygium):

A pair of transparent, oval and minute pilose lobes are seen in some genera of Rhagionidae.

Ventral plate (in mid posterior part of hypopygium) (= aedeagal guide):

At least in some genera of the lower Brachycera, this plate seems to be homologous with the interbases.

#### Abbreviations in Figs. 1–151

*a*: aedeagus; *aa*: anterior bar of aedeagus (= aedeagal apodeme); *adp* or *ads*: aedeagal dorso-anterior plate or sclerite; *at*: aedeagal tine; *b*: basistyle (= gonocoxite); *bdp*: basistylar dorso-inner anterior process (= gonocoxal apodeme); *c*: cercus; *d*: dististyle (= gonostylus); *db*: dorsal bridge; *dp*: dorsal plate (= paramere); *h*: “half-opened umbrella”; *i*: interbasis; *m*: mid plate; *pa*: posterior part of aedeagus; *padp*: antero-lateral projection of dorsal plate; *pal*: antero-lateral projection of ventral lobe; *vpv*: antero-lateral projection of ventral plate; *s9*: sternum 9 (= hypandrium); *s10*: sternum 10; *t*: “trumpet”; *t9*: tergum 9 (= epandrium); *vl*: ventral lobe; *vp*: ventral plate (= aedeagal guide).

#### Key to families of lower Brachycera

- |      |   |   |
|------|---|---|
| 1    | No dorsal and ventral plates enclosing posterior part of aedeagus (= aedeagal sheath), nor aedeagal tines. Pair of interbases is sometimes present in Solvidae . . . (X in Table 1) . . . . .   | 2 |
| —    | Dorsal and ventral plates including interbases and enclosing posterior part of aedeagus (= aedeagal sheath), or pair of aedeagal tines is present . . . . . (Y in Table 1) . . . . .  | 6 |
| 2(1) | Some of the characters mentioned below are lacking . . . . .  | 3 |
| —    | Posterior part of aedeagus is bi-, tri-, or multilobed in a horizontal plane, although it may not be so in Chiromyzinae; tergum 10 well developed and produced posteriorly; dististyle situated at apex of basistyle . Stratiomyidae  |   |
| 3(2) | Basistyle without a dorsal lobe produced inwardly; dorsal bridge between basistyles present or absent . . . . .   | 4 |
| —    | Basistyle with a dorsal lobe produced inwardly and aedeagus situated behind this lobe, and dorsal bridge between basistyles absent; aedeagus gradually tapering posteriorly or divided into dorso-anterior broad and ventro-posterior elongate parts (sometimes ventro-anterior broad and dorso-posterior |   |

- elongate parts); a pair of interbases sometimes present; a pair of basistylar dorso-inner anterior processes absent . . . . . Solvidae
- 4(3) Aedeagal dorso-anterior plate is small or not found; posterior part of aedeagus is simple or sometimes trilobed in a horizontal plane; basistyle thickened or folded into two (dorsal and ventral) pieces . . . . . 5
- Anterior part of aedeagus consisting of dorso-horizontal and ventro-vertical planes, of which the former may correspond to aedeagal dorso-anterior plate but very large and the latter may be identical with anterior bar of aedeagus; posterior part of aedeagus consisting of dorsal and ventral long processes fused with each other at their broad bases; basistyle neither thickened nor folded into two (dorsal and ventral) pieces, and only ventral piece present; pair of basistylar dorso-inner anterior processes conspicuously long, arising near base of dististyle, and forming H-shape together with a band-like dorsal bridge . . . . . Rachiceridae
- 5(4) Dorsal bridge between basistyles absent and pair of basistylar dorso-inner anterior processes conspicuously long . . . . . Pantophthalmidae
- Dorsal bridge present and pair of basistylar dorso-inner anterior processes before dorsal bridge (i.e., distal part of process) vestigial or short . . . Vermileonidae
- 6(1) Mid-ventral surface of hypopygium large and long and its posterior margin (except its mid concavity) higher (horizontally) or almost level with base of dististyle . . . . . 7
- Mid-ventral surface of hypopygium much lower (horizontally) than base of dististyle . . . . . 8
- 7(6) Anterior bar of aedeagus consisting of horizontal and vertical plates, of which the latter is flattened laterally . . . . . Xylophagidae
- Anterior bar of aedeagus not as above . . . . . Vermileonidae (*Vermileo*)
- 8(6) Aedeagal dorso-anterior plate has pair of knob-like processes at anterior margin, although this plate is small, entirely transparent, and may easily be overlooked in *Exeretoneura maculipennis* . . . . . 9
- Aedeagal dorso-anterior plate (if present) does not have pair of knob-like processes, although its lateral parts are strongly sclerotized as usual . . . . 10
- 9(8) Aedeagal dorso-anterior plate very large; anterior bar of aedeagus fan-like in shape; tergum 9 rather flat . . . . . Heterostomidae
- Aedeagal dorso-anterior plate very small; anterior bar of aedeagus like halter in shape; tergum 9 strongly arched . . . . . Exeretoneuridae
- 10(8) Sclerotized parts of dorsal or ventral plate (besides interbases) more extensive in area; pair of aedeagal tines absent (except for *Bolbomyia* having the similar tines) . . . . . 11
- Sclerotized parts of dorsal or ventral plate (except for interbases) absent or slight in area; pair of aedeagal tines present . . . . . 13
- 11(10) Tergum 9 rather flat and without postero-lateral plate developed ventro-inwardly; pair of basistylar dorso-inner anterior processes not extending far beyond anterior margin of hypopygium . . . . . 12
- Tergum 9 strongly arched, and with postero-lateral plate developed ventro-inwardly; pair of basistylar dorso-inner anterior processes extending far beyond anterior margin of hypopygium; sternum 8 with a mid-posterior deep concavity, large, and enclosing hypopygium . . . . . Pelecorhynchidae
- 12(11) In mid-posterior part of hypopygium dorsal plate is broad and with apex not pointed, and ventral plate is folded twice at lateral part and not protruded beneath ventral surface of basistyle; sternum 9 absent and antero-ventral part of hypopygium between basistyles with transversely elongate transparent area near anterior margin . . . . . Coenomyiidae
- Some of the characters not as above . . . . . Rhagionidae
- 13(10) Tergum 9 not divided into pair of sclerites and its anterior margin not concave . . . . . Athericidae
- Tergum 9 divided or not divided into pair of sclerites, and in the latter case its anterior margin deeply concave . . . . . Tabanidae

### Family Stratiomyidae

For male genitalia of Stratiomyidae see the illustrations by ROZKOŠNÝ (1973) and NAGATOMI & YUKAWA (1968, 1969). They are characterized as follows: posterior part of aedeagus is bi-, tri-, or multilobed (in a horizontal plane), although it may not be so in Chironomyzinae; mid-ventral part of hypopygium (between basistyles) is large in area and its posterior margin is higher or not much lower (horizontally) than base of dististyle; tergum 10 well developed and produced posteriorly; there are no dorsal and ventral plates including interbases and enclosing posterior part of aedeagus.

In *Beris* and *Exodontha* there is an elongate stick produced mid-dorsally and anteriorly from aedeagus (see Figs. 87, 90, 96, 100, 104, 112, and 117 by ROZKOŠNÝ 1973), and this stick may possibly be a degenerative root of the anterior bar of aedeagus.

In *Pachygaster* et al., the anterior part of aedeagus is divided into two (dorsal and ventral) lobes (see Figs. 410, 419, 428, 447, and 456 by ROZKOŠNÝ 1973), which might be conditioned secondarily.

The male genitalia of Stratiomyidae are very similar to those of Pantophthalmidae and Vermileonidae but may be distinguished from the latter by having the tergum 10 well developed and produced posteriorly.

### Family Solvidae (= Xylomyidae)

For male genitalia of Solvidae see the illustrations by NAGATOMI & TANAKA (1971) and ROZKOŠNÝ (1973). They are characterized as follows: basistyle with a dorsal lobe produced inwardly, and aedeagus situated behind this lobe; aedeagus gradually tapering posteriorly or divided into dorso-anterior broad and ventro-posterior elongate parts (in *Solva marginata* MEIGEN, ventro-anterior broad and dorso-posterior elongate parts; see Fig. 30 by ROZKOŠNÝ 1973); interbases well developed or entirely absent; sternum 9 present or absent and in the former case, mid-anterior margin deeply concave; tergum 9 with or without pair of postero-lateral flat processes.

The male genitalia of Solvidae vary considerably with species.

### Family Pantophthalmidae (Figs. 1—4)

The male genitalia of Pantophthalmidae may be characterized as follows: base of dististyle situated much before ventral apex of basistyle; mid-ventral surface of hypopygium very long but its posterior margin distinctly lower horizontally than ventral apex of basistyle; basistyle very thickened and aedeagus situated at a very deep sunken place; aedeagus very long (not shorter than hypopygium), with a mid-dorsal sclerotized plate produced anteriorly (which may possibly correspond to aedeagal dorso-anterior plate) and with anterior part divided into dorsal and ventral bars at base of mid-dorsal plate.

They may be distinguished from those of Stratiomyidae and Vermileonidae by the characters shown in the key (couplets 2 and 5).

However, the diagnosis of this family mentioned above are based upon only one species, *Pantophthalmus tabaninus*.

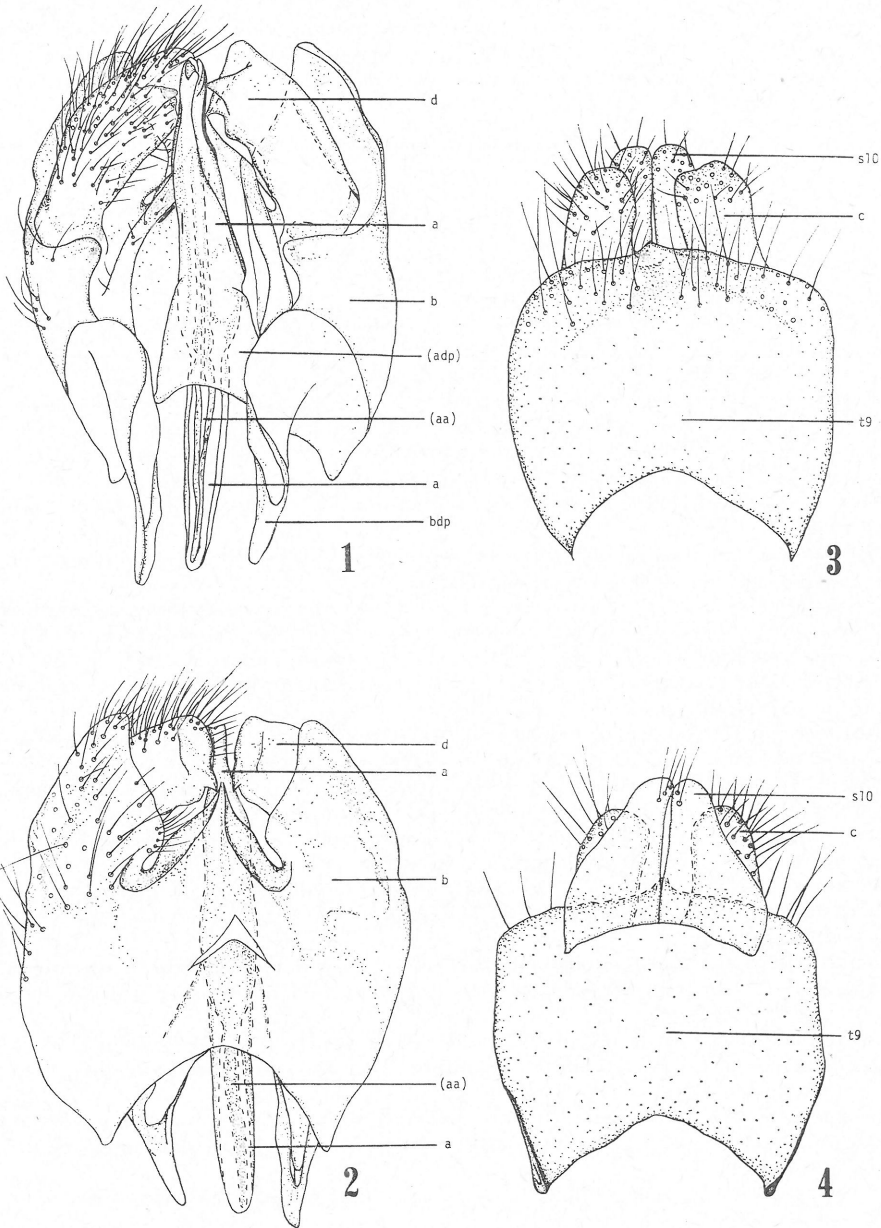
Genus *Pantophthalmus* THUNBERG, 1819. *P. tabaninus* THUNBERG, 1819 (det. by F. C. VAL): Dististyle large, much longer than wide, rather rectangular from a dorsal view, with mid-dorsal dentation before apical portion directed ventrally, with apex still thick vertically, and with dorsal surface (except base) haired.

Basistyle with ventral part produced, triangular in shape, and much longer than dorsal part (so base of dististyle situated much before ventral apex of basistyle), and covered with rather sparse hairs.

Sternum 9 except posterior part fused with basistyle (or mid-ventral part of hypopygium with a V-shaped slit forming posterior part of sternum 9).

Dorsal bridge or mid-postero-dorsal plate of hypopygium (over aedeagus) absent.

Mid-postero-ventral part of hypopygium with median ridge divided by a longitudinal ditch, with apex pointed, and with base entirely fused with basistyle, thickened and ex-



Figs. 1-4. *Pantophthalmus tabaninus* THUNBERG: 1, 3, dorsal view; 2, 4, ventral view.

tending to dorsal part of basistyle; there is a ridge from dorsal part of basistyle to apical portion of mid-ventral part of hypopygium, with short hairs.

Aedeagus long, stick-like in shape, but with a mid-dorsal sclerotized plate produced anteriorly and with anterior part divided into dorsal and ventral bars at base of mid-dorsal plate. Within posterior part of aedeagus there is a median longitudinal tube.

It is possible that mid-dorsal plate corresponds to aedeagal dorso-anterior plate and antero-dorsal bar to anterior bar of aedeagus.

Pair of basistylar dorso-inner anterior processes long.

Tergum 9 not longer than wide, with anterior margin widely concave, and with posterior margin (except middle) haired. Sternum 10 is not shorter than cercus, with apex haired, and appears to be divided by a median line. Cercus longer than wide, with apex not pointed, and with dorsal surface haired except base.

Specimen dissected: 1♂, Ft. Clayton, C. Z., ix. 1944, K. E. FRICK.

### Family Rachiceridae (Figs. 5—14)

The male genitalia of Rachiceridae are very characteristic among those of the lower Brachycera as shown in the key (couplet 4).

Genus *Rachicerus* WALKER, 1854. The diagnosis of *Rachicerus* given below is based upon only two species, namely, *galloisi* and *maai*. Dististyle longer than wide, flattened laterally, and wider apically, and with dorso-apex dentate.

Basistyle neither thickened nor folded into two (dorsal and ventral) pieces, and only ventral piece is present, but apical-inner and apical-outer portions of basistyle developed dorsally into membranes in which base of dististyle is enveloped. In basistyle, ventral surface and apical-inner membrane developed dorsally with hairs.

Sternum 9 absent. Anterior part of hypopygium (or basistyles) divided by a mid desclerotized line.

Mid-posterior part of hypopygium (except for aedeagus) is entirely absent, i.e., there are no dorsal and ventral plates or interbases.

Pair of basistylar dorso-inner anterior processes conspicuously long, arising near base of dististyle, and forming H-shape together with a band-like dorsal bridge. Distal end of this process curved dorsally.

Aedeagus very peculiar in shape and consisting of anterior (before dorsal bridge) and posterior (behind dorsal bridge) parts.

Anterior part of aedeagus consists of dorso-horizontal and ventro-vertical planes. The dorso-horizontal plane may correspond to aedeagal dorso-anterior plate, is nearly hyaline, longer than wide, rather rectangular, flattened dorso-ventrally, with dorsal surface somewhat concave, with antero-lateral part having an elongate triangular process, and with median and posterior areas more transparent. The ventro-vertical plane may correspond to anterior bar of aedeagus, and its apical part is fan-like in shape.

Posterior part of aedeagus consists of dorsal and ventral long processes which are fused with each other at their broad bases. Dorsal process is also fused with dorsal bridge through a membrane.

Tergum 9 large, conspicuously arched dorsally, wider anteriorly, with anterior margin widely and deeply concave, with posterior margin transverse, and with dorsal surface covered with hairs.

Postero-lateral part of tergum 9 is developed ventro-inwardly into a flap. This flap is elongate, tapering posteriorly, with latero-inner margin tucked dorsally, and haired at least at latero-postero-outer part.

Beneath tergum 9 there are a membrane, that is, sternum 10 and a pair of small or inconspicuous membranes which may correspond to cerci. Anterior part of sternum 10 consists of a pair of plates.

*R. galloisi* SÉGUIN, 1948 (Figs. 5—9): In basistyle, apical-outer membrane is smaller dorsally than in *maai*.

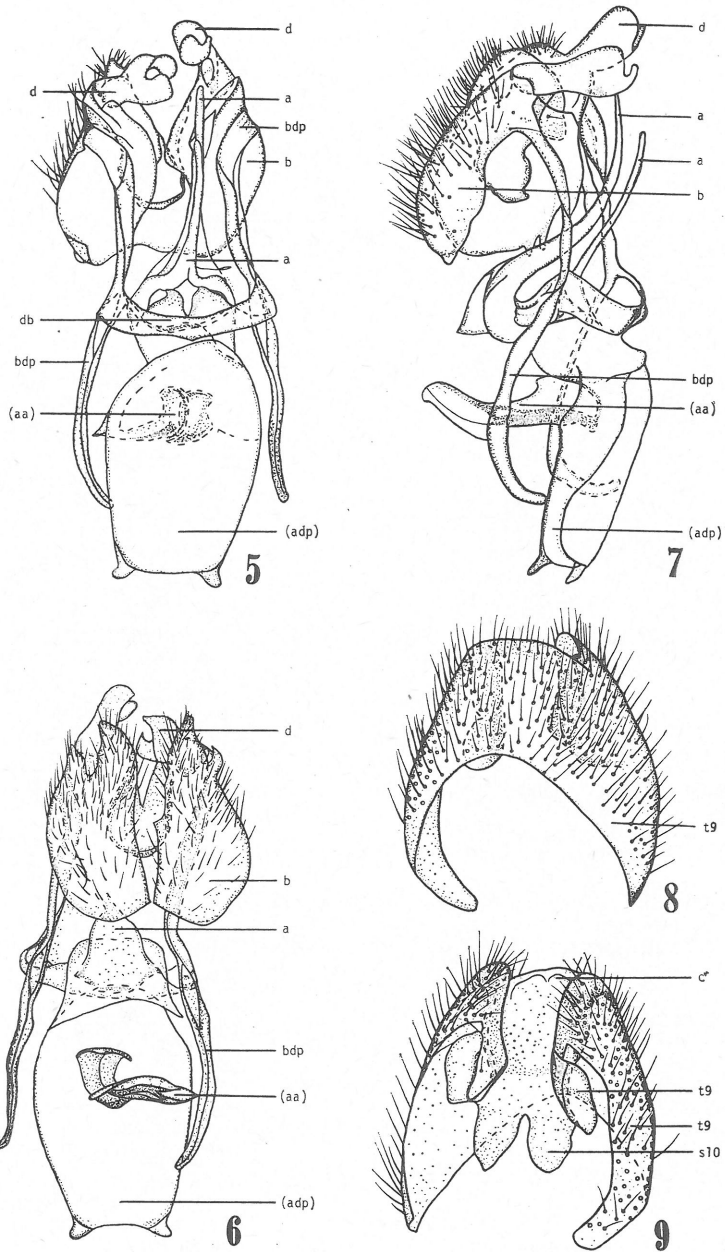
In basistylar dorso-inner anterior processes, anterior portion and area just behind [toward centre of hypopygium] dorsal bridge are not wider than rest.

In posterior part of aedeagus, dorsal and ventral processes are conical, and the latter is wider and longer than the former; broad base of dorsal process wider than that of the ventral; ventral process without any dentation along mid-dorso-longitudinal line of broad base.

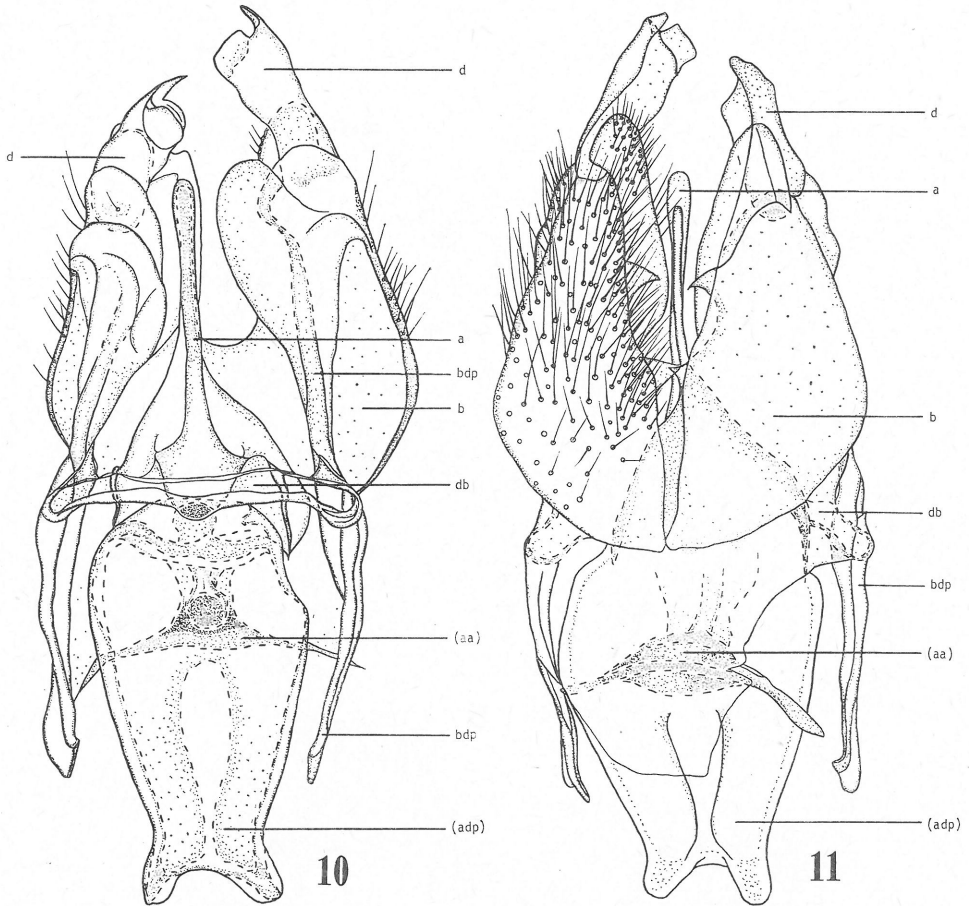
[Sternum 10 broken in the specimen on hand and its shape uncertain].

Cercus haired and its base is located just before posterior margin of tergum 9.

Specimen dissected: 1♂, Toikanpetsu, Hokkaido, 14. viii. 1965, K. KUSIGEMATI.



Figs. 5-9. *Rachicerus galloisi* SÉGUY: 5, 8, dorsal view; 6, 9, ventral view; 7, lateral view.



Figs. 10–11. *Rachicercus maai* NAGATOMI: 10, dorsal view; 11, ventral view.

*R. maai* NAGATOMI, 1970 (Figs. 10–14): In basistyle, apical-outer membrane is longer dorsally than in *galloisi*.

In basistylar dorso-inner anterior processes, anterior portion and area just behind [toward centre of hypopygium] dorsal bridge are wider than the rest.

In posterior part of aedeagus, dorsal process wider and longer than the ventral, and not tapering toward apex; broad base of dorsal processes much narrower than that of the ventral; ventral process conical or tapering toward apex, and with a row of 5 (or so) dentations along mid-dorso-longitudinal line of broad base.

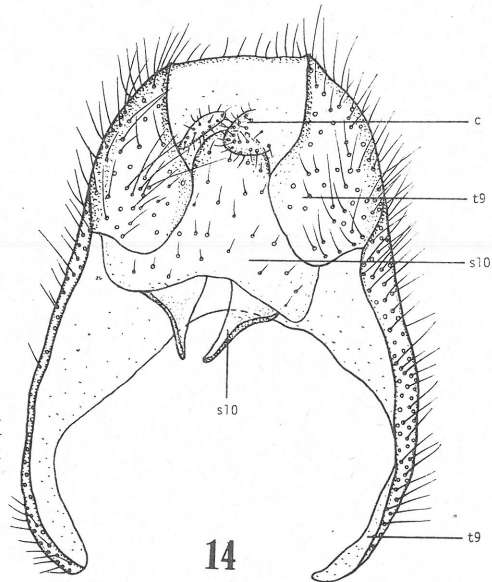
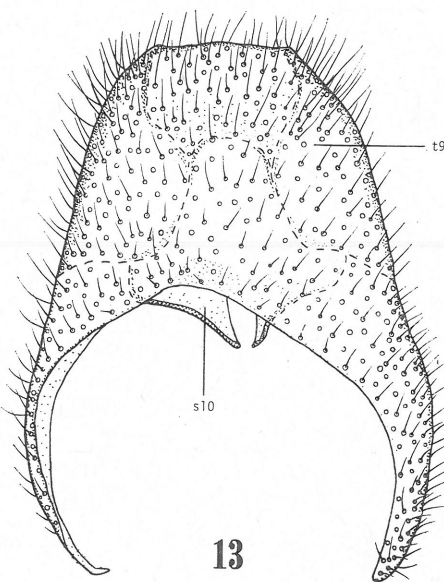
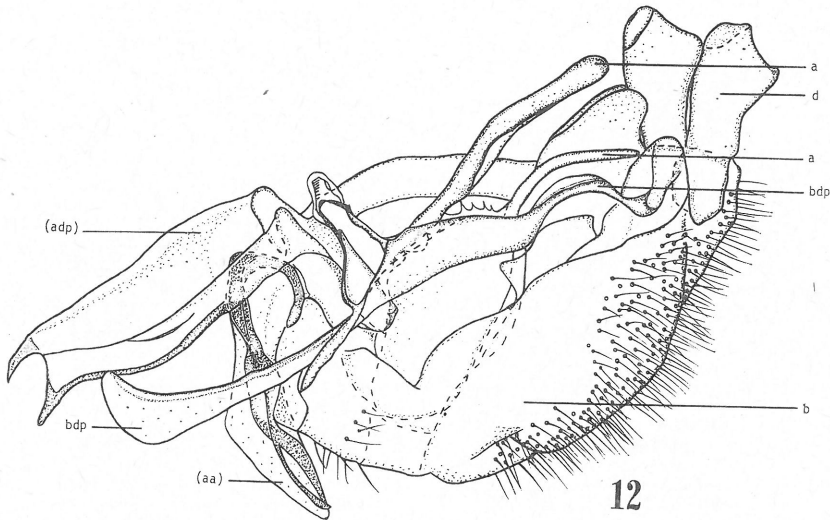
Sternum 10 (including pair of anterior plates, which is elongate triangular in shape) is rather pentagonal, its posterior margin appears to be fused with tergum 9, and the posterolateral margin is longer than antero-lateral margin (i.e., outer margins of pair of plates). Cercus haired and located just behind sternum 10 and distinctly before posterior margin of tergum 9.

Specimen dissected: 1♂, Kienyang Hwangkeng, Fukien, S. China, 22. vi. 1924, T. C. MAA.

#### Family Xylophagidae (Figs. 15–25)

The male genitalia of Xylophagidae (which contain only one genus) are characterized in the key (couplets 1, 6, and 7).





Figs. 12–14. *Rachicerus maai* NAGATOMI: 12, lateral view; 13, dorsal view; 14, ventral view.

For male genitalia of *Xylophagus ater* MEIGEN (known from Europe) see the illustration by HENNIG 1976.

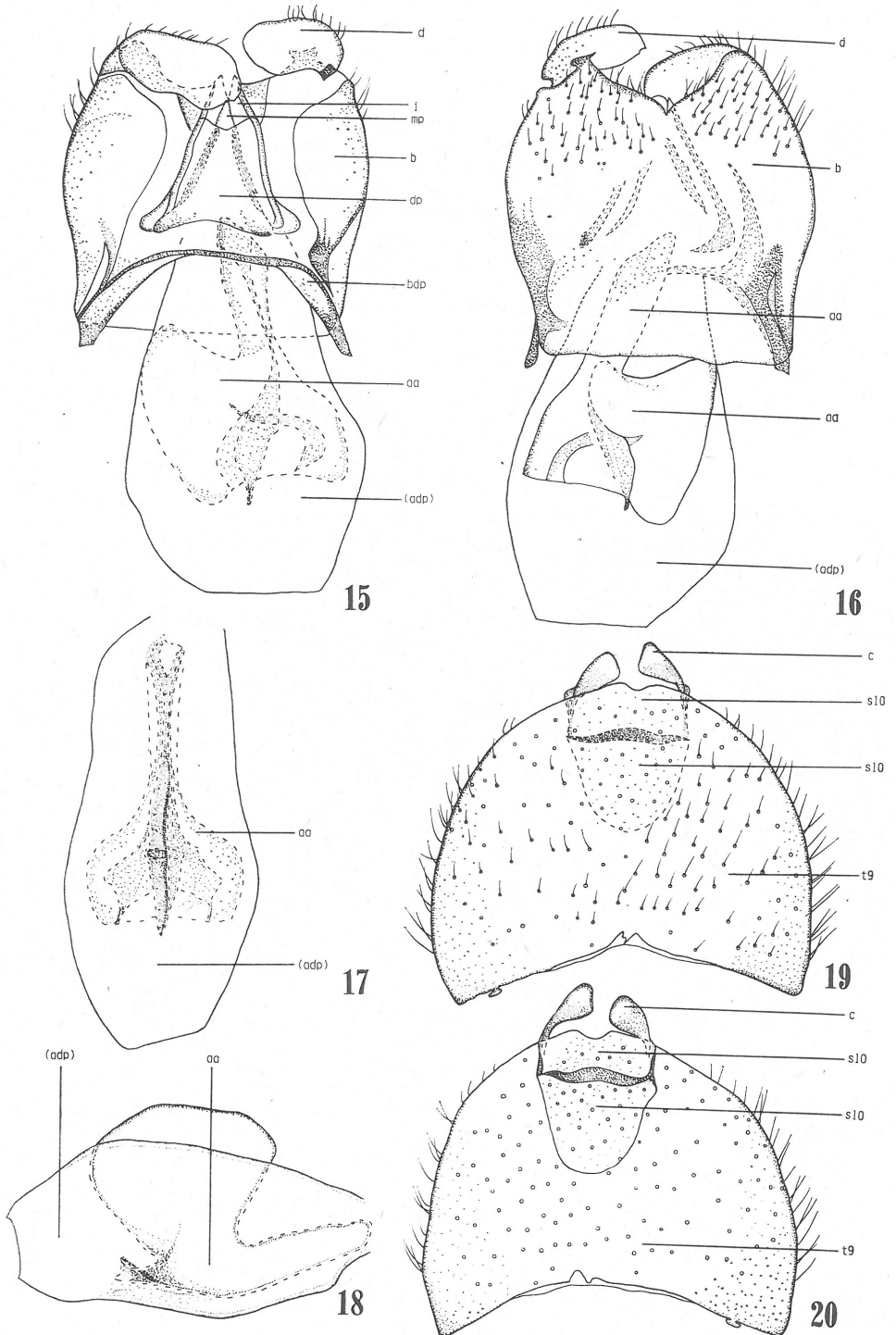
The diagnosis of this genus given below is based upon only two species, namely, *matsumurai* and *sachalinensis*.

Genus *Xylophagus* MEIGEN, 1803. Dististyle small, longer than wide, and with dorsal surface arched and short haired.

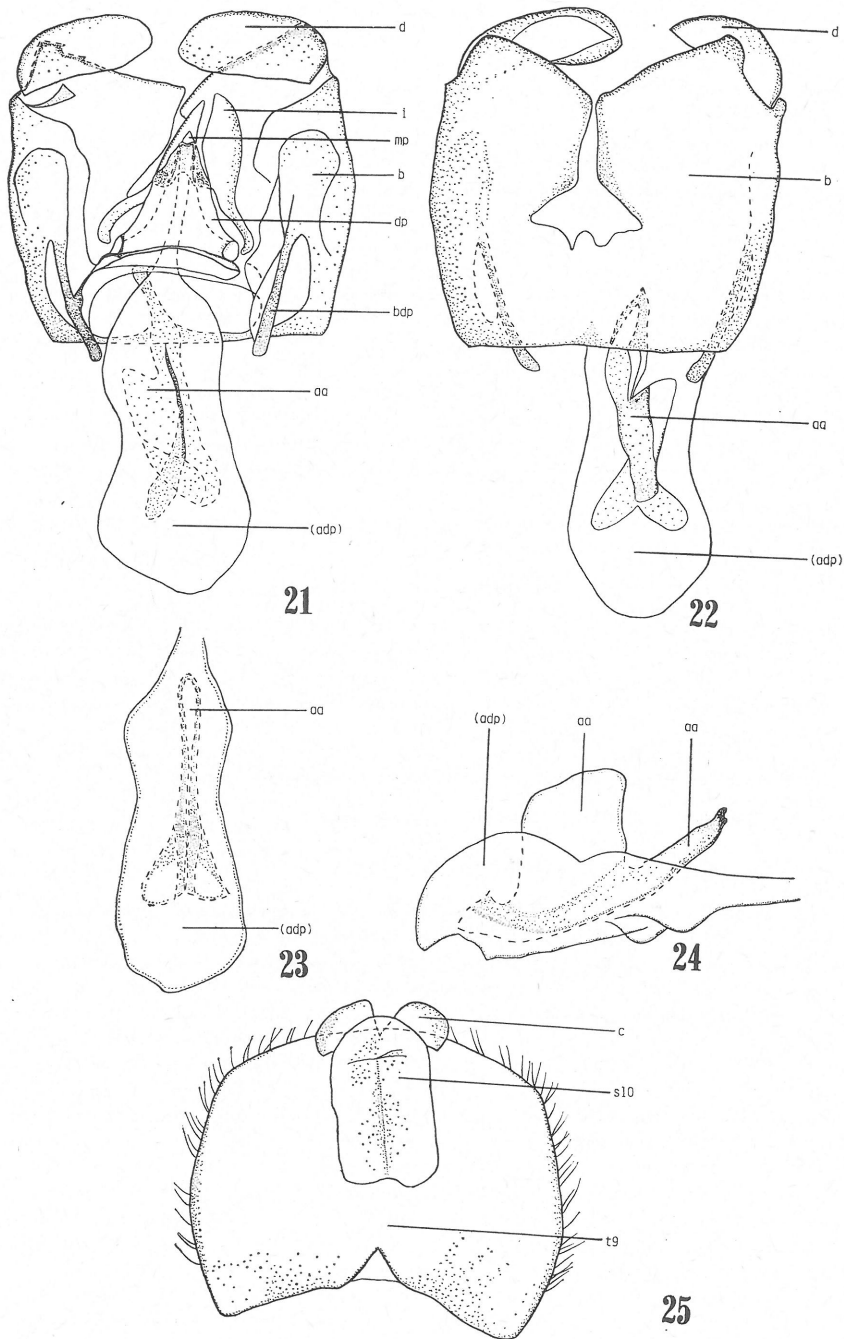
In basistyle, ventral part longer and much wider than dorsal part, and with posterior part rather short haired.

Sternum 9 absent, and ventral part of hypopygium (or basistyle) becoming very large and with a mid-posterior T-shaped desclerotized line.

Mid-postero-dorsal part (between basistyles) consists of the following 3 layers: (a) dorsal



Figs. 15–20. *Xylophagus matsumurai* MIYATAKE: 15, 17, 19, dorsal view; 16, 20, ventral view; 18, lateral view.



Figs. 21–25. *Xylophagus sachalinensis* PLESKE: 21, 23, dorsal view; 22, 25, ventral view; 24, lateral view.

plate, (b) mid plate, and (c) a pair of interbases; dorsal plate tapering apically (= posteriorly) but with apical margin more or less or deeply concave; mid plate with apex pointed and situated behind apex of dorsal plate; interbasis long, with outer margin convex near base, and with apex pointed and situated far behind apex of mid plate; it is undetermined whether apical margin of dorsal plate is folded and connected with mid plate as shown in Fig. 45 by HENNIG (1976).

Posterior part of aedeagus short (if present). Anterior bar of aedeagus consists of horizontal and vertical plates and is entirely covered by a transparent dorsal membrane which may possibly correspond to aedeagal dorso-anterior plate.

Pair of basistylar dorso-inner anterior processes not extending far beyond anterior margin of hypopygium.

Tergum 9 wider than long, with dorsal surface arched and rather short haired, and with anterior margin gently concave. Sternum 10 strongly sclerotized and well demarcated, longer than wide, transversely ridgy or folded near posterior margin, and with ventro-posterior part (behind ridge) covered with minute hairs. Cercus very short, wider than long, and with dorsal surface minute haired.

*X. matsumurai* MIYATAKE, 1965 (Figs. 15–20): Dististyle shorter than in *sachalinensis*. In mid-postero-dorsal part of hypopygium, dorsal plate wider than in *sachalinensis* and its apical margin (which is long) deeply concave. Pair of basistylar dorso-inner anterior processes directed outwardly. In anterior bar of aedeagus, vertical plate much wider apically.

Mid-anterior part of tergum 9 not desclerotized. Sternum 10 narrower anteriorly. Cercus becoming long at inner part.

Specimens dissected: 2 ♂♂, Nukabira, Hokkaido, 7. vii. 1966, K. KUSIGEMATI.

*X. sachalinensis* PLESKE, 1925 (= *X. merus* NAGATOMI et SAIGUSA, 1969) (Figs. 21–25): Dististyle longer than in *matsumurai*. In mid-postero-dorsal part of hypopygium, dorsal plate narrower than in *matsumurai* and its apical margin (which is short) gently concave. Pair of basistylar dorso-inner anterior processes directed somewhat inwardly. In anterior bar of aedeagus, vertical plate parallel-sided.

Tergum 9 with a small mid-anterior desclerotized part. Sternum 10 parallel-sided. Cercus with posterior margin rounded somewhat symmetrically.

Specimen dissected: 1♂, Nukabira, Hokkaido, 2. vi. 1965, H. ONO.

### Family Coenomyiidae (Figs. 26–35)

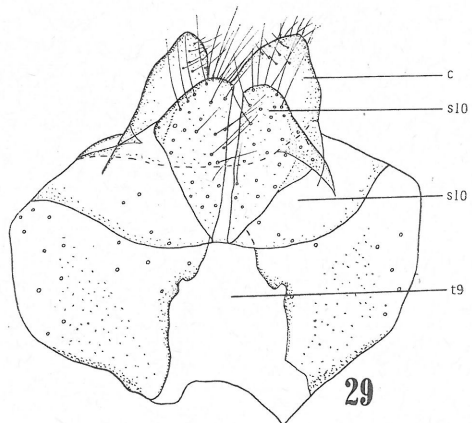
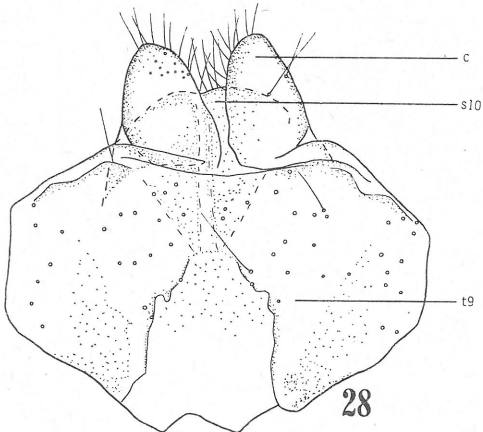
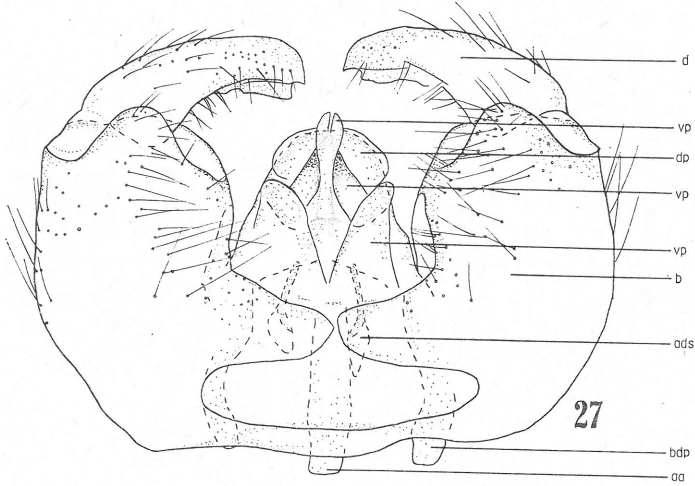
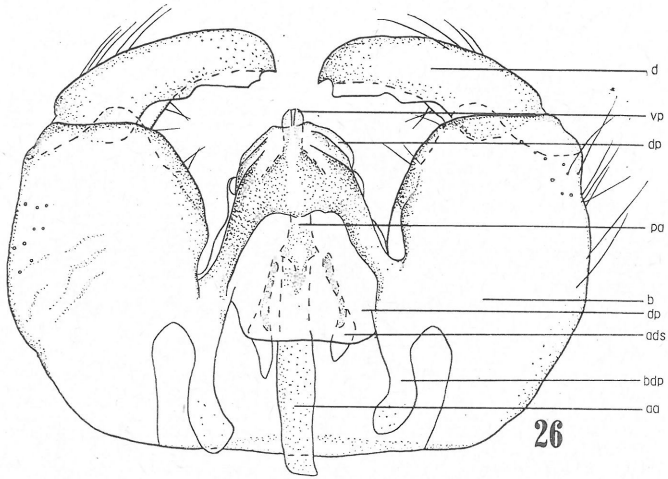
The Coenomyiidae contain five genera, namely, *Anacanthaspis*, *Arthropeas*, *Coenomyia*, *Dialysis*, and *Odontosabula*. The male genitalia of the latter three are illustrated and described here. *Dialysis* is very different from *Coenomyia* in general appearance but their male genitalia (as well as female terminalia) are almost identical with each other.

For systematic position of Coenomyiidae see the discussion in the forthcoming chapter.

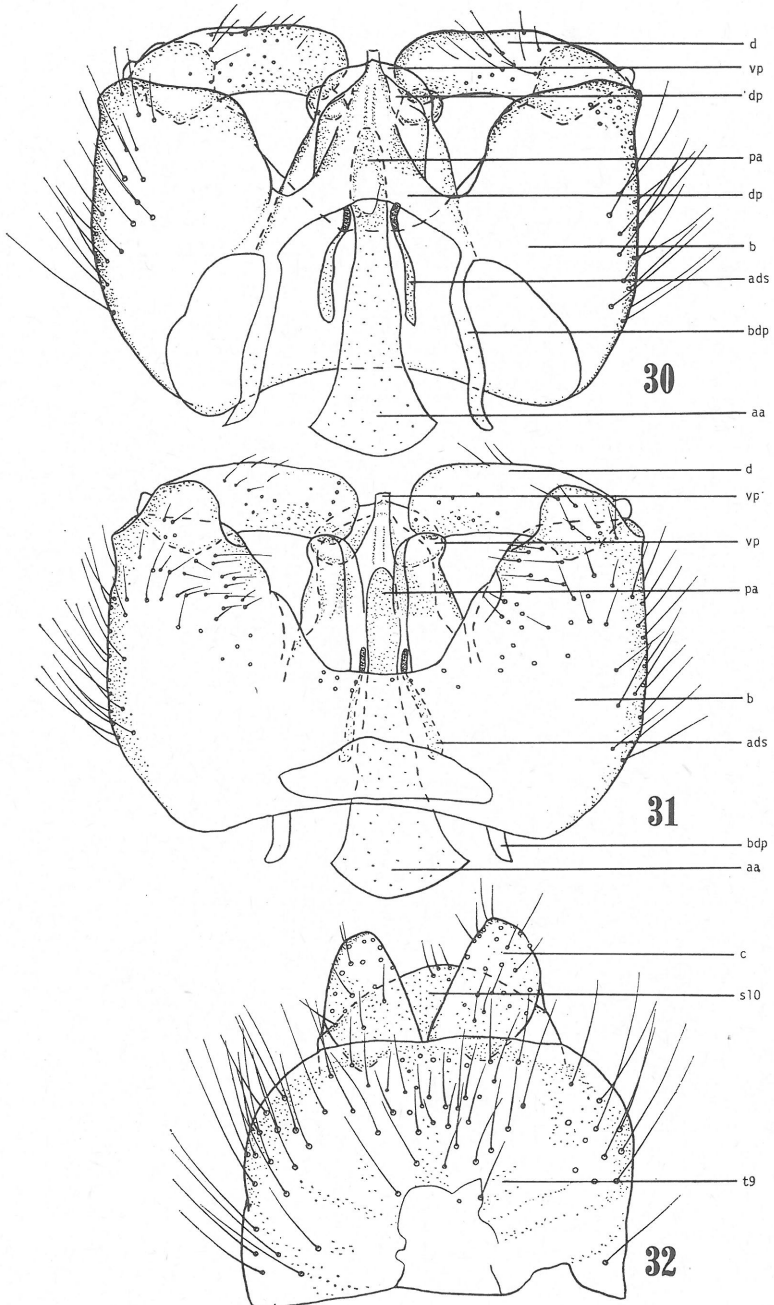
The male genitalia of the genera *Coenomyia*, *Dialysis*, and *Odontosabula* are very similar to those of *Glutops* belonging to Rhagionidae but are distinguished from the latter in the following points: sternum 9 is absent, and antero-ventral part of hypopygium (between basistyles) has a transversely elongate transparent area near anterior margin; basistyle short, broad, and not strongly tapering toward apex; mid-postero-ventral plate of hypopygium folded twice at lateral part and not protruded beneath ventral surface of basistyle. Whereas in *Glutops*, sternum 9 is present; the basistyle is longer than in *Coenomyia*, *Dialysis*, and *Odontosabula* and with ventral surface strongly tapering toward apex, mid-postero-ventral plate of hypopygium not folded but nearly bulged out at antero-lateral part and protruded beneath ventral surface of basistyle.

Dististyle longer than wide, almost parallel sided from some angles. Basistyle short, broad, not strongly tapering toward apex, and with ventro-inner or ventral sclerotized apex convex.

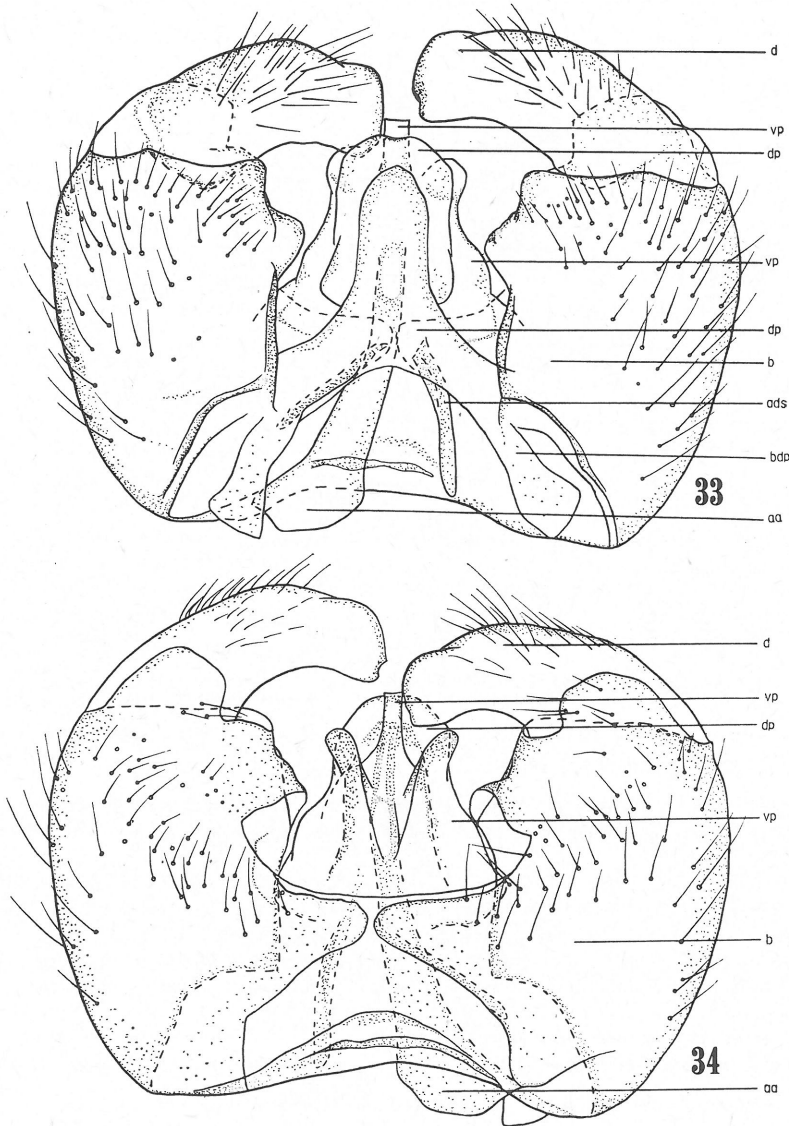
Sternum 9 absent or fused with basistyle and this part (= antero-ventral part of hypopygium between basistyles) with a transversely elongate transparent area near anterior margin.



Figs. 26 – 29. *Coenomyia basalis* MATSUMURA: 26, 28, dorsal view; 27, 29, ventral view.



Figs. 30-32. *Dialysis iwatai* NAGATOMI: 30, 32, dorsal view; 31, ventral view.



Figs. 33–34. *Odontosabula gloriosa* MATSUMURA: 33, dorsal view; 34, ventral view.

Mid-posterior part of hypopygium consists of dorsal and ventral plates. Dorsal plate broad, with apex not pointed, covering posterior portion of aedeagus. In ventral plate, lateral parts folded twice, tapering toward apices, with apical portions forming a tube, while middle part transparent in color and depressed.

Posterior part of aedeagus not short. Anterior bar of aedeagus flattened dorso-ventrally, elongate, almost parallel sided or becoming wider anteriorly (= apically or toward base of abdomen).

Pair of basistylar dorso-inner anterior processes not extending far beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerites long and their basal portions included in a transparent lobe.

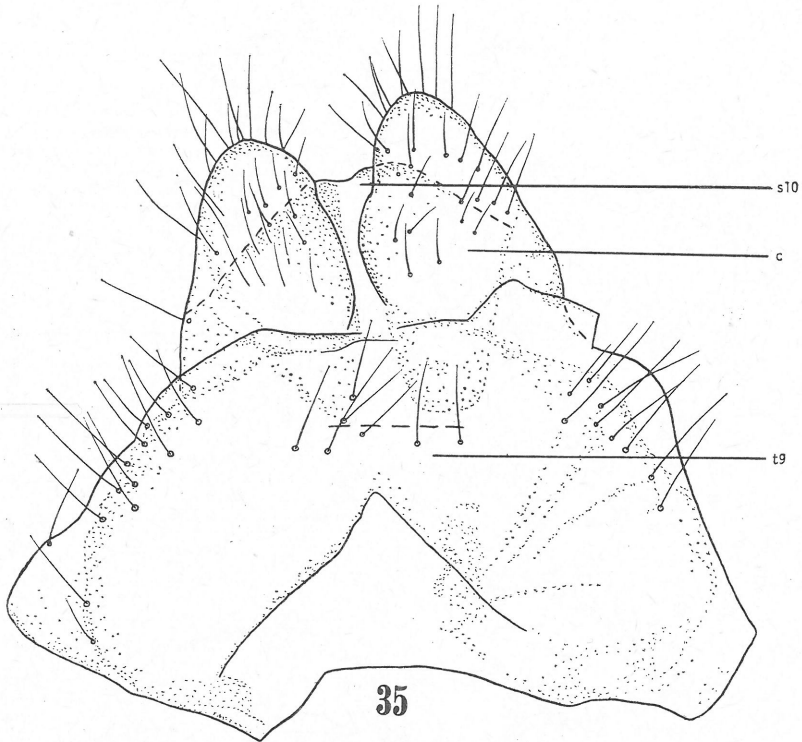


Fig. 35. *Odontosabula gloriosa* MATSUMURA: dorsal view.

Tergum 9 wider than long, with lateral margin convex, and with a large mid-anterior part desclerotized. Sternum 10 divided by a mid desclerotized line. Cercus with apex bluntly pointed or rounded.

Genus *Coenomyia* LATREILLE, 1796. *C. basalis* MATSUMURA, 1915 (Figs. 26–29): Dististyle haired and with 2 short dentations around apical-inner portion which is lamellate. In basistyle, dorso-outer, dorso-apical and ventro-inner parts with hairs.

Mid-postero-dorsal plate (= at least partly dorsal bridge) blackened, except for a large mid-anterior membranous or desclerotized part which is not shorter than posterior sclerotized part.

Anterior bar of aedeagus almost parallel-sided.

Tergum 9 at dorsal surface (except mid-anterior part), sternum 10 and cercus with hairs.

Specimen dissected: 1♂, Mt. Kogane, Tamba, Hyogo Pref., 18. v. 1952, K. TAKEUCHI.

Genus *Dialysis* WALKER, 1850. *D. iwatai* NAGATOMI, 1953 (Figs. 30–32): Dististyle more or less lamellate as a whole, with outer and inner margins smooth, and with dorsal surface haired. In basistyle, latero-outer part and ventro-inner part haired.

Mid-postero-dorsal plate (= at least partly dorsal bridge) is narrower than the ventral plate, and its anterior part is desclerotized, easily overlooked, and much shorter than sclerotized posterior part which is also more or less transparent.

Anterior bar of aedeagus strongly becoming wider anteriorly. Aedeagal dorso-anterior sclerites strongly sclerotized at bases.

Tergum 9 at dorsal surface except mid-posterior part, sternum 10 and cercus with hairs.

Specimen dissected: 1♂, Sasayama, Tamba, Hyogo Pref., 21. vi. 1952, A. NAGATOMI.

Genus *Odontosabula* MATSUMURA, 1905 (= *Stratioleptis* PLESKE, 1925). *O. gloriosa* MATSUMURA, 1905 (= *Stratioleptis pleskei* SÉGUÏ, 1926) (Figs. 33–35): In dististyle, apico-



inner part lamellate, bare, and with 2 indistinct dentations at apices. Dististyle with hairs which are longer at mid-outer part.

Basistyle with hairs which are absent on dorso-inner part (except apical portion) and ventro-basal part.

In mid-posterior part of hypopygium, dorsal plate narrower than the ventral, not blackened, with anterior part (which is short) paler than the rest, and with a broad median longitudinal ridge except for posterior part.

Anterior bar of aedeagus strongly becoming wider anteriorly. Aedeagal dorso-anterior sclerites very long.

Tergum 9 at dorso-lateral and dorso-anterior parts, sternum 10 and cercus with hairs.

Specimen dissected: 1♂, Imuta-ike, Kagoshima Pref., 16. v. 1965, A. TANAKA.

### Heterostomidae fam. nov. (Figs. 36–39)

The genus *Heterostomus* was placed tentatively in Coenomyiidae by NAGATOMI (1977), but the male genitalia may have greater similarity to *Exeretoneura* than to *Coenomyia* et al. It may be more appropriate to erect a new family Heterostomidae (see the discussion in the forthcoming chapter).

For diagnosis of this new family see NAGATOMI (1977).

The male genitalia of *Heterostomus* (as well as *Rachicercus*) may represent the oldest type among those of the lower Brachycera (see the discussion in the forthcoming chapter), and are easily distinguished from those of *Exeretoneura* by the characters shown in the key (couplet 9).

Genus *Heterostomus* BIGOT, 1857. *H. curvipalpis* BIGOT, 1857 (det. by L. L. PECHUMAN): Dististyle with inner apex pointed, dorso-proximal-inner margin strongly concave, and with dorso-outer part (except distal portion) having strong hairs.

Basistyle tapering toward apex, from a dorsal view short, and with dorsal and ventral surfaces (except bases) haired.

Sternum 9 absent or fused with basistyle and this part (antero-ventral part of hypopygium between basistyles) becoming very large and without any transparent area.

Mid-postero-dorsal plate of hypopygium tapering toward apex and transparent but with basal (= anterior) and latero-apical margins darkened (or sclerotized).

Mid-postero-ventral plate (or probably ventral lobe) of hypopygium similar to the dorsal plate in size and shape, transparent in color, and covered with short pale pile.

There is a pair of large triangular plates whose margins are blackened and whose apices are connected with dorsal and ventral plates; it is uncertain whether this is part of dorsal or ventral plate or corresponds to interbasis (= penis valve).

Behind basal margin of dorsal plate (x) a transversely elongate sclerite is present but it is uncertain whether this sclerite is part of dorsal plate and (y) its lateral parts are different in origin from (z) the central.

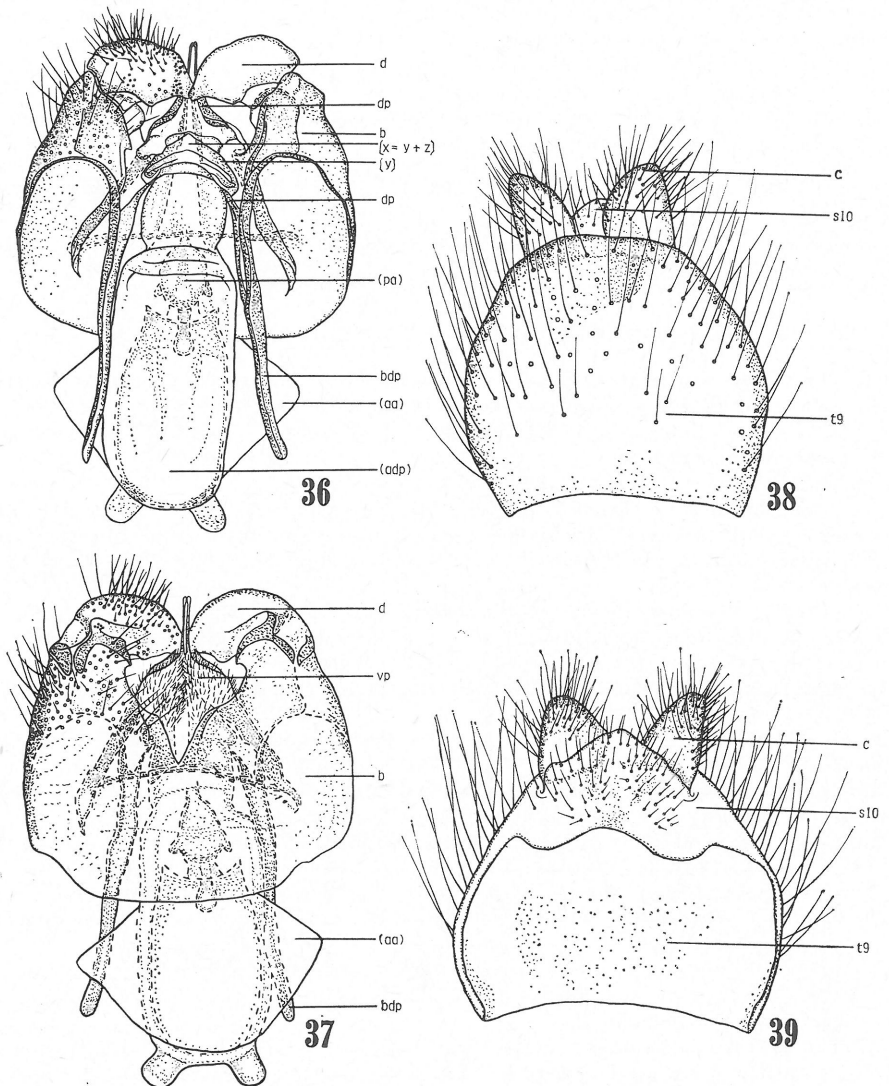
Anterior part of aedeagus is very peculiar in shape and consists of the following parts: (a) a large, rather rectangular transparent bar flattened dorso-ventrally, in which are included (b) large, anterior, rather rectangular sclerite whose anterior margin has a pair of siphon-like knobs directed ventrally, and (c) small, posterior, elliptic sclerites. From (c),(d) a large central fan-like transparent plate develops ventrally, with its mid-proximal part sclerotized and somewhat racket-like in shape, and (e) a pair of lateral small knob-like processes is attached before middle. It is possible that (b) corresponds to aedeagal dorso-anterior plate, (d) to anterior bar of aedeagus, and (c) to posterior sclerotized part of aedeagus.

In distal part of (or behind) aedeagus, there is a pair of large and lateral sclerites tapering toward apices and protruding conspicuously.

The pair of basistylar dorso-inner anterior processes are very long and extend far beyond anterior margin of hypopygium.

Tergum 9 wider than long, widest near anterior margin, with lateral margin convex, and with dorsal surface (except anterior part) strong haired.

Cercus comparatively short, bluntly pointed or with apex rounded according to angles, and strong haired.



Figs. 36–39. *Heterostomus curvipalpis* BIGOT: 36, 38, dorsal view; 37, 39, ventral view.

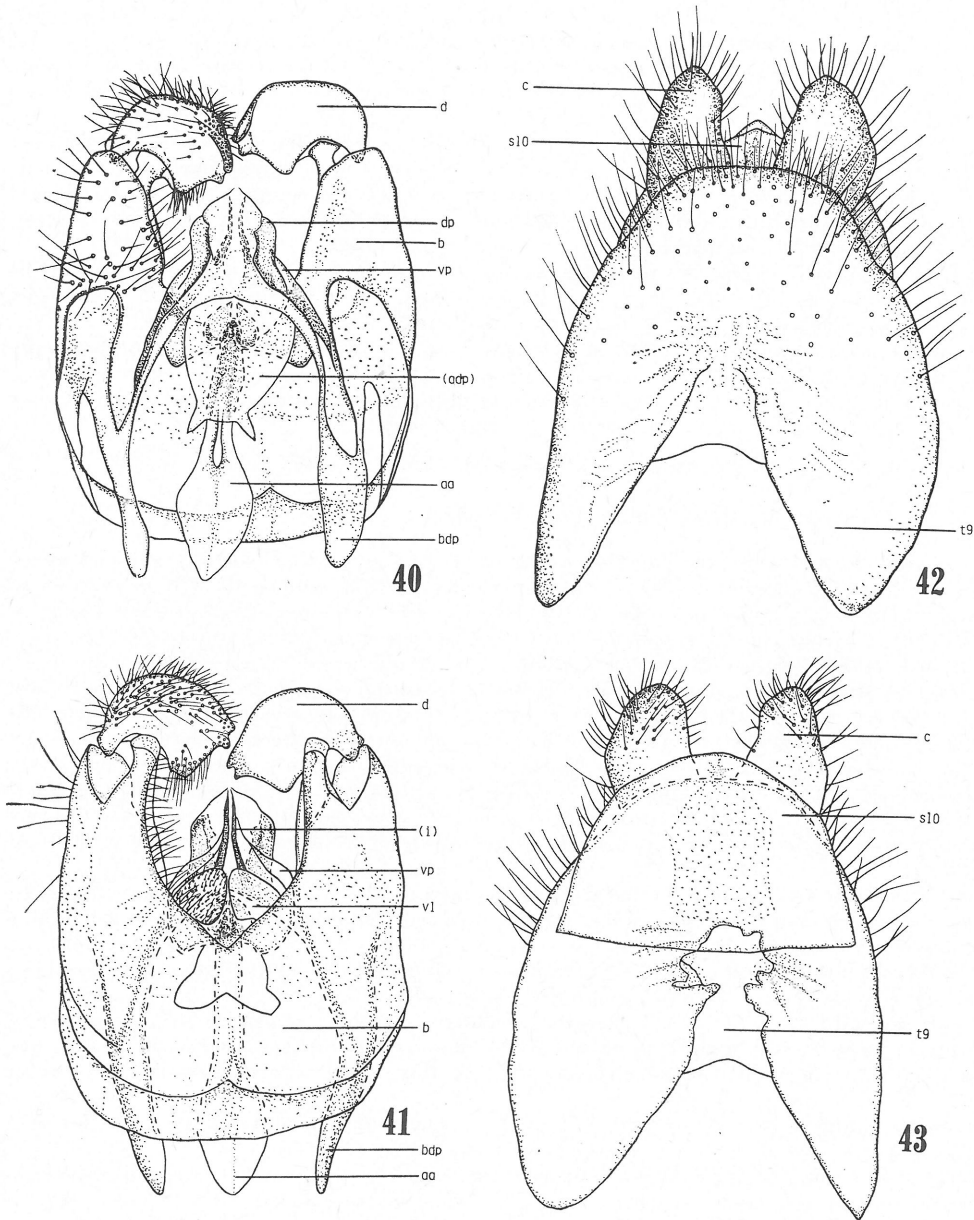
Sternum 10 not divided by a mid-desclerotized line, with posterior part strong haired.

Specimen dissected: 1♂, Angol Chile, 7. xii. 1950, M. FERNANDEZ.

#### Family Exeretoneuridae (Figs. 40–43)

The male genitalia of Exeretoneuridae (which contain only one genus) are most similar to those of *Heterostomus* but are at once distinguished from the latter as shown in the key (couplet 9).

Genus *Exeretoneura* MACQUART, 1846. *E. maculipennis* MACQUART, 1846 (det. by D. H. COLLESS): Dististyle with apex having a pair of dentations, with outer margin strongly curved (convex), and with dorso-proximal-inner margin strongly concave; dististyle covered with black hairs which are dense at mid-inner part. Basistyle from a dorsal view tapering toward apex, and with dorsal surface haired.



Figs. 40–43. *Exeretoneura maculipennis* MACQUART: 40, 42, dorsal view; 41, 43, ventral view.

Sternum 9 absent or fused with basistyle and this part (= antero-ventral part of hypopygium between basistyles) becoming very large and with mid-posterior area desclerotized. (1) Mid-postero-dorsal plate of hypopygium with basal part rather quadrate and apical part triangular, and with lateral area (except triangular part) more strongly sclerotized (darkened). (2) Mid-postero-ventral plate is largely transparent [the outline was not clear in the soecimens dissected]. (3) Mid-postero-ventral lobe much shorter than the dorsal

plate, divided in two, transparent in color, and covered with short pale pile. There are (4) a pair of elongate sclerites between dorsal and ventral plates, tapering posteriorly, pointed at apices, and forming a tube; it is possible that the sclerites correspond to interbases. There is a transverse, wide (from a lateral view) sclerite connecting with the bases of (1), (2), and (3) mentioned above.

Posterior sclerotized part of aedeagus may be absent. Anterior bar of aedeagus consists of the following parts: (a) entirely transparent (easily overlooked), dorsal bar whose anterior margin has pair of knobs, and (b) partly sclerotized ventral bar which is like halter in shape and much longer than dorsal bar. It is almost certain that the dorsal bar is homologous with the aedeagal dorso-anterior plate.

At base of antero-ventral bar of aedeagus there is pair of sclerites which appears to be elongate elliptical in shape. Pair of basistylar dorso-inner anterior processes flattened laterally, long but much shorter and stouter than in *Heterostomus curvipalpis*.

Tergum 9 strongly arched dorsally, widest before middle, with mid-anterior margin deeply concave and mid-anterior part desclerotized, and with postero-dorsal surface haired. Sternum 10 large, with a large mid blackened part. Cercus comparatively short, bluntly pointed or with apex rounded according to angles, and haired.

Specimen dissected: 1♂, 8 miles S. E. of Bronte, Tasmania, 30. i. 1948, KEY, CARNE, and KERR.

#### Family Pelecorhynchidae (Figs. 44–51)

For descriptions and illustrations of male genitalia of the family Pelecorhynchidae (which contain only one genus) see MACKERRAS & FULLER (1942) who dealt with a number of species. They are similar to those of Rhagionidae and Coenomyiidae but may easily be distinguished from the latter two by having the characters in the key (couplet 11).

Genus *Pelecorhynchus* MACQUART, 1850. "The genitalia of *Pelecorhynchus* are more prominent than in related groups. The fifth and following segments of the abdomen show a progressive reduction, and the eighth tergite consists merely of a narrow transverse bar which broadens laterally (Text-figs. 9, 18). . . . The ninth tergite and eighth sternite are large and shield-like, . . . Together they form a globular swelling, open posteriorly, with the cerci and tips of the clasping organs visible between them. The parts enclosed by these two shields consist of the tenth segment and cerci dorsally, and the ninth sternite and gonocoxites, between which lies the aedeagus, ventrally" (after MACKERRAS & FULLER 1942: 16).

The dorsal plate (in mid-posterior part of hypopygium), dorsal bridge, basistylar dorso-inner anterior processes, dorso-apical lobe of basistyle, sternum 9, dististyle, and tergum 9 vary in shape according to species.

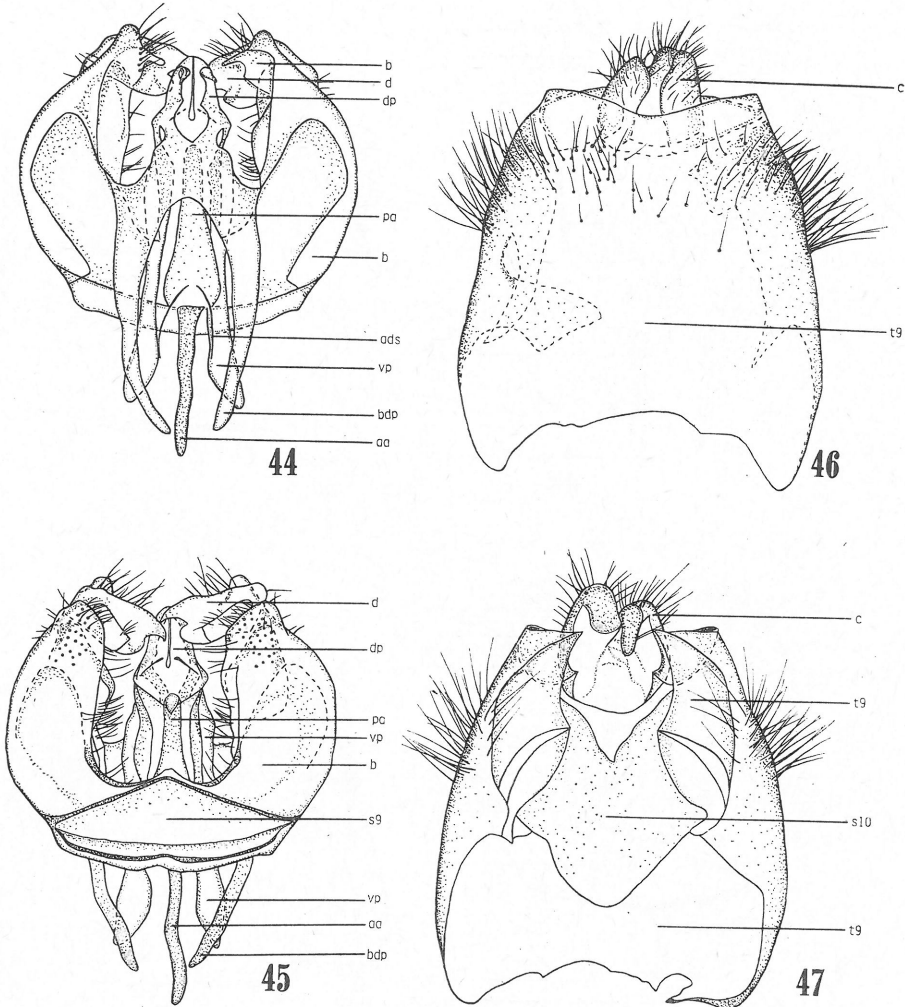
The diagnosis of the male genitalia of *Pelecorhynchus* given below is based upon only two species, namely, *fusconiger alpinensis* and *nigripennis*.

Dististyle pointed at apex and abruptly expanded at base. Basistyle long, with dorsal surface almost equal in length to but narrower than ventral surface, and with ventro-inner surface haired; apex of dorsal surface with lobe developed antero-inwardly and having hairs.

Mid-antero-ventral part of hypopygium short. Sternum 9 desclerotized, much wider than long, and entirely separated from basistyle by suture.

Mid-posterior part of hypopygium consists of dorsal plate and pair of ventral plates (or interbases). Dorsal plate tapering posteriorly, divided into pair of sclerites at posterior part, and with anterior margin U-shaped. In each divided posterior part of dorsal plate, outer margin strongly sclerotized with apex curved dorsally, with base protruded outwardly, and with a dentation developed dorso-inwardly before middle. Pair of ventral plates (or interbases) long and extending far beyond anterior margin of hypopygium, wider at anterior part, and with apex fused with dorsal plate at base of sclerotized outer margin in divided posterior part. It is possible that the ventral plate is H-shaped, i. e., the pair of stripes are connected with each other by a median band (see Fig. 23 by MACKERRAS & FULLER 1942). This is not confirmed in the specimens on hand.

Posterior part of aedeagus long, tapering posteriorly but with apex not pointed. Anterior bar of aedeagus long and stick-like or flattened dorso-ventrally.



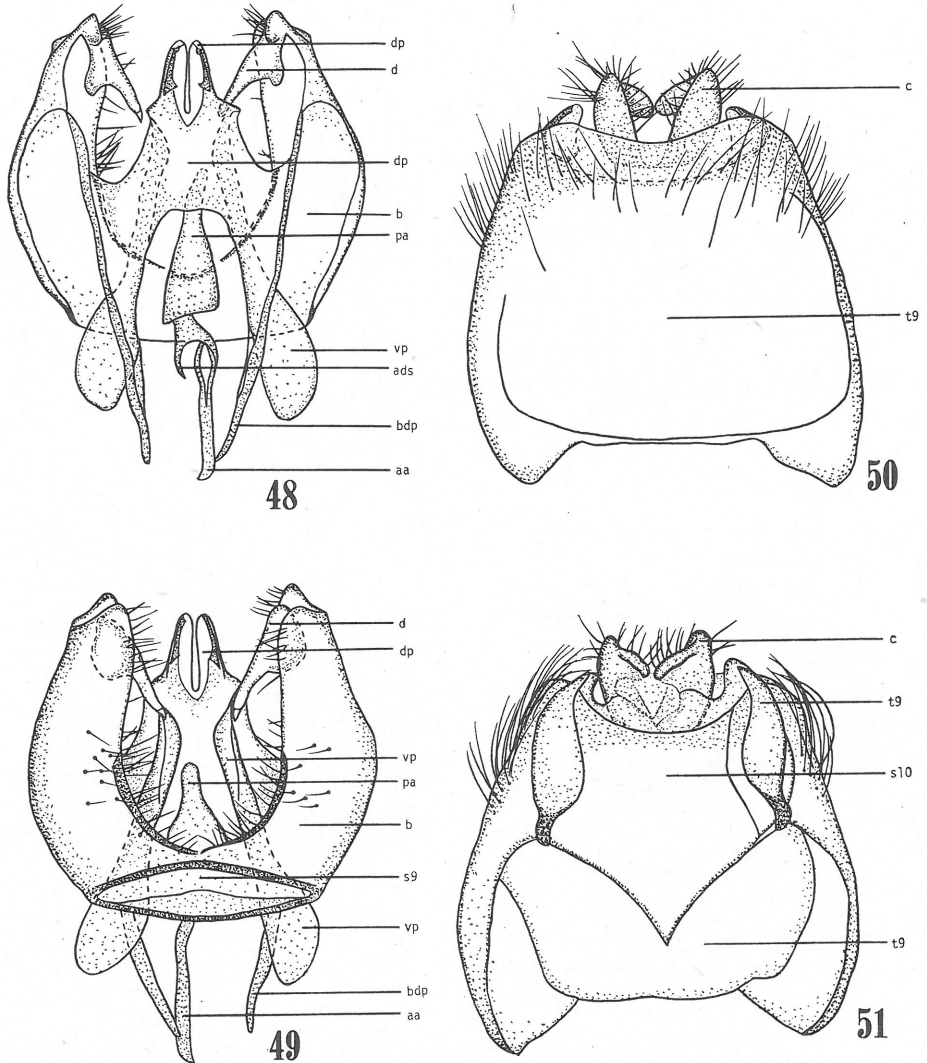
Figs. 44–47. *Pelecorhynchus fusconiger alpinensis* MACKERRAS et FULLER: 44, 46, dorsal view; 45, 47, ventral view.

Pair of long aedeagal dorso-anterior sclerites is present. Pair of basistylar dorso-inner anterior processes long and extending far beyond anterior margin of hypopygium.

Tergum 9 strongly arched dorsally, wider anteriorly, protruded antero-laterally, with posterior margin concave, with each postero-lateral part having a plate developed ventro-inwardly, and with posterior part haired but with posterior rim bare. Sternum 10 large, with anterior part protruded triangularly, and with lateral margin fused with tergum 9. Cercus elongate, twisted postero-inwardly, and with hairs.

*P. fusconiger alpinensis* MACKERRAS et FULLER, 1942 (det. by I. M. MACKERRAS) (Figs. 44–47): Dististyle with outer apex pointed and comparatively short. Dorso-apical lobe of basistyle large and developed into a long, pointed process. Sternum 9 rather triangular in shape.

Anterior part of dorsal plate roughly parallel-sided. Anterior bar of aedeagus stick-like and rather flattened laterally.



Figs. 48–51. *Pelecorhynchus nigripennis* RICARDO: 48, 50, dorsal view; 49, 51, ventral view.

In tergum 9, antero-lateral protruded part small, and postero-lateral plate (developed ventro-inwardly) turned up at antero-inner margin.

Specimen dissected: 1♂, Alpine Ck., near Kiandra, New South Wales, 1. i. 1963, B. MACKERRAS.

*P. nigripennis* RICARDO, 1910 (det. by I. M. MACKERRAS) (Figs. 48–51): Dististyle with outer apex pointed, long, and having a segmentation near tip. Dorso-apical lobe of basistyle small and not developed into a pointed process. Sternum 9 rather elliptical in shape. Anterior part of dorsal plate distinctly wider basally. Anterior bar of aedeagus flattened dorso-ventrally.

In tergum 9, antero-lateral protruded part large, and postero-lateral plate (developed ventro-inwardly) simple.

Specimen dissected: 1♂, Alpine Ck., near Kiandra, New South Wales, 1. i. 1963, B. MACKERRAS.

Family Rhagionidae (Figs. 52—127)

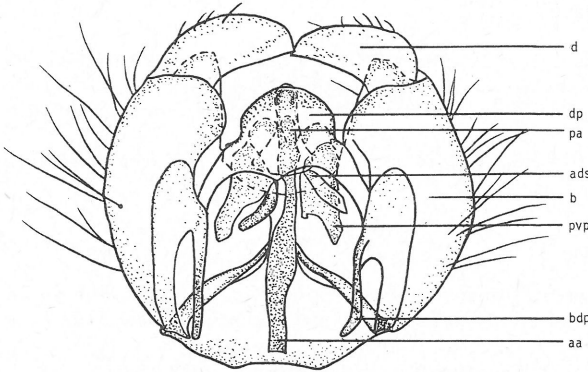
The male genitalia of Rhagionidae are distinguished from those of Coenomyiidae and Pelecorhynchidae by the characters shown in the key (couplets 11—12).

The genera in this paper are arranged according to the supposed phylogenetic relationships proposed by NAGATOMI (1982).

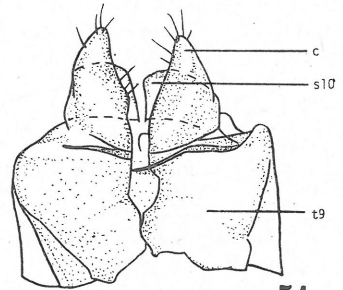
The genera *Desmomyia*, *Litoleptis*, and *Stylospania* are not examined and not included in the key below.

Key to genera of Rhagionidae

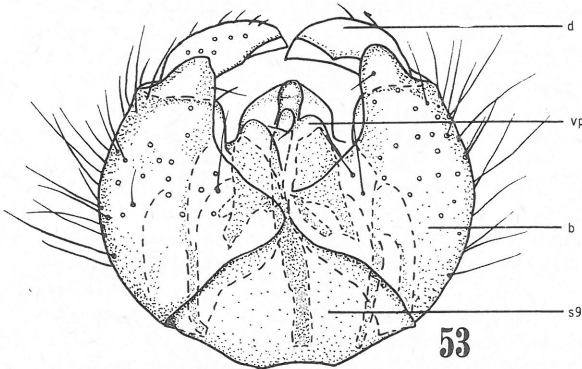
- 1 Pair of basistylar dorso-inner anterior processes present; anterior bar of aedeagus not spoon-like in shape; dorsal and ventral plates usually fused with each other . . . . . 2
- Pair of basistylar dorso-inner anterior processes absent; anterior bar of aedeagus like a spoon in shape; dorsal and ventral plates distant from each other at apical and lateral margins; dorsal plate like a conical tube; ventral plate divided but not transparent . . . . . *Austroleptis*
- 2(1) Pair of basistylar dorso-inner anterior processes long or thin (when short) 3
- Pair of basistylar dorso-inner anterior processes short and pointed at apex, but wide; hypopygium wider than long; area corresponding sternum 9 short; basistyle almost parallel-sided; mid-posterior part of hypopygium long, narrow and pointed at apex; in aedeagus, posterior part not shorter than anterior bar which is stick-like and thin . . . . . *Alloleptis*
- 3(2) Mid-posterior part of hypopygium (in one or all of dorsal, ventral, or mid plate) tapering posteriorly and usually pointed . . . . . 4
- Mid-posterior part of hypopygium not pointed but broadly rounded, although an elevated tube present on ventral plate near posterior margin; ventral plate bulging out at antero-lateral parts but not folded twice or without a flat area at postero-lateral parts; sternum 9 complete and bulging out . . . . . *Glutops*
- 4(2) Mid plate not as below or absent . . . . . 5
- Mid plate a turnip-shaped, situated behind ventral plate and beneath dorsal plate (from a dorsal view) . . . . . *Pseudoerinna*
- 5(4) Pair of basistylar dorso-inner anterior processes shorter and thin; basistyle comparatively short and in certain angles almost parallel-sided . . . . . 6
- Pair of basistylar dorso-inner anterior processes longer or not thin; basistyle comparatively long and tapering posteriorly (except for *Rhagina*) . . . . . 8
- 6(5) Dorsal plate without a trumpet . . . . . 7
- Dorsal plate with a trumpet protruded dorsally . . . . . *Spaniopsis*
- 7(6) In ventral plate, antero-lateral part not protruded into basistyle and postero-lateral part becoming a distinct flat area; anterior bar of aedeagus stick-like and tapering anteriorly . . . . . *Ptiolina*
- In ventral plate, antero-lateral part protruded into basistyle and postero-lateral part without a flat area or with an indistinct flat area; anterior bar of aedeagus flattened laterally and wider anteriorly . . . . . *Spania*
- 8(5) Anterior bar of aedeagus like a stick or flattened laterally . . . . . 9
- Anterior bar of aedeagus like a trigonal prism, wider anteriorly, and with a mid-ventral sclerotized stripe . . . . . *Bolbomyia*
- 9(8) Sternum 9 bulged out, i.e., basistyle partly covered by margin of sternum 9 10
- Sternum 9 (if present) not as above . . . . . 12
- 10(9) Dorsal plate tapering posteriorly and pointed or bluntly so at apex; mid plate is absent but posterior part of aedeagus is encircled by a plate which is shaped like a half-opened umbrella and which is broken along a longitudinal mid-ventral line . . . . . 11
- Dorsal plate not pointed but transverse apically; mid plate very long and pointed . . . . . *Arthroteles*



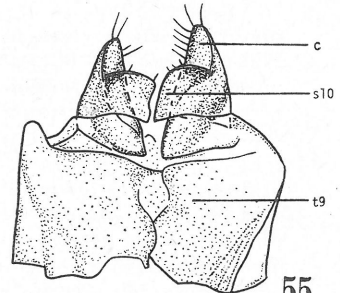
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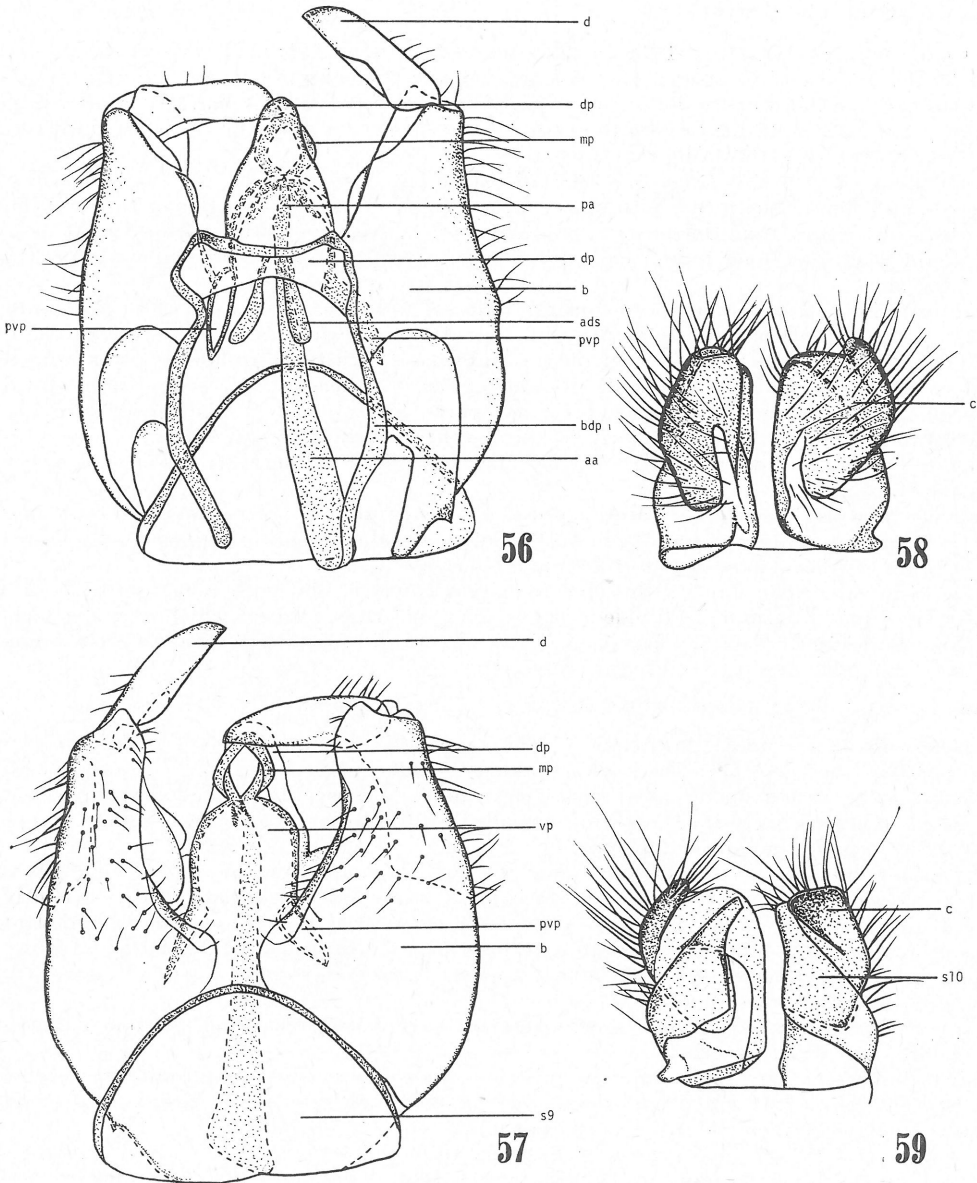


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Figs. 52-55. *Glutops itoi* (NAGATOMI): 52, 54, dorsal view; 53, 55, ventral view.

- 11(10) Dorsal plate acutely pointed apically; ventral plate not narrower than the dorsal and pentagonal or so in shape; sternum 9 short and not swollen . . . . . *Atherimorpha*
- Dorsal plate bluntly pointed apically (as in *Rhagio*); posterior portion of ventral plate narrower than the dorsal and pointed at apex; sternum 9 long and conspicuously swollen . . . . . *Neorhagio*
- 12(9) Pair of ventral lobes (which are transparent and minute pilose) present (in *Symphoromyia* the lobe may be missed unless carefully examined) . . . . . 13
- Pair of ventral lobes absent . . . . . 14
- 13(12) Hypopygium (excepting dististyle) not wider than long; mid-posterior part of dorsal plate protruding and forming a tube, together with ventral plate which is not protruded anteriorly mentioned below . . . . . *Arthroceras*
- Hypopygium (excepting dististyle) wider than long, dorsal plate is U-shaped band and its mid part connects with ventral plate whose root is composed of a pair of long, triangular parts protruding anteriorly . . . . . *Symphoromyia*
- 14(12) Apical portion of dorsal plate not pointed acutely and wider than that of ventral plate; ventral plate not protruding antero-laterally . . . . . 15
- Apical portion of dorsal plate pointed acutely as well as that of ventral plate; ventral plate protruding antero-laterally . *Chrysopilus*, *Schizella* and *Solomomyia*





Figs. 56-59. *Pseudoerinna fuscata* SHIRAKI: 56, 58, dorsal view; 57, 59, ventral view; it must be noted that tergum 9 is removed in Figs. 58 and 59.

- 15(14) Basistyle shorter than in *Rhagio*; anterior bar of aedeagus flattened laterally; posterior part of aedeagus is encircled by a plate like a half-opened umbrella *Rhagina*
- Basistyle longer than in *Rhagina*; anterior bar of aedeagus stick-like; "half-opened umbrella" encircling posterior part of aedeagus appears to be absent (it is necessary to examine more material to see whether or not these distinguishing characters between *Rhagina* and *Rhagio* are significant) *Rhagio*

## Subfamily Glutopinae

Genus *Glutops* BURGESS, 1878 (= *Tamayura* NAGATOMI 1955). NAGATOMI & SAIGUSA (1970) described and illustrated the male genitalia in 3 species of *Glutops*, namely, *esakii*, *itoi* and *semiformis*, but the following corrections must be made: for Fig. 10 read *itoi* (not *esakii*) and for Fig. 12 read *esakii* (not *itoi*). It must be noted that the dististyle differs in shape with the view from different angles.

*G. itoi* (NAGATOMI, 1955) (Figs. 52–55): Dististyle longer than wide, with outer surface convex and short haired, but with inner surface flat and bare (or nearly so). In basistyle, ventral part longer than dorsal part, pointed at apex, connected with each other at mid-posterior part, and long haired except for base. Sternum 9 complete and more or less bulging out.

Mid-posterior part of hypopygium consists of dorsal and ventral plates, both of which are fused with each other at posterior margin. Dorsal plate broad and with posterior margin rounded. Ventral plate (or ventral plate + interbases) with antero-lateral parts bulged out, with a large mid-posterior hole (in which apex of aedeagus is present) whose apical margin elevated, and with latero-proximal parts (or interbases) blackened (strongly sclerotized) and protruded anteriorly (beneath ventral surface of basistyle).

Posterior part of aedeagus long. Anterior bar of aedeagus long, stick-like, and rather flattened laterally.

Pair of basistylar dorso-inner anterior processes comparatively narrow and not extending beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior darkened sclerites is large and its basal portion is included in a transparent lobe.

Tergum 9 wider than long, with anterior margin concave, and with a mid-posterior desclerotized part. Sternum 10 divided into a pair of sclerites, each of which is rather rectangular and minute haired. Lateral margin of sternum 10 fused with cercus. Cercus large, rather triangular in shape, and with hairs.

Specimen dissected: 1♂, Kyusuikei, Mt. Kujuu, Kyushu, 19. v. 1963, T. SAIGUSA.

Genus *Pseudoerinna* SHIRAKI, 1932 (= *Bequaertomyia* BRENNAN, 1935). *P. fuscata* SHIRAKI, 1932 (Figs. 56–59): Dististyle tapering apically, with inner apex pointed, with margins more or less smooth, and with short, thin pile especially at dorso-basal portion. Basistyle comparatively long, tapering apically, and with hairs at ventral surface except base. Sternum 9 large and complete.

Mid-posterior part of hypopygium consists of dorsal, mid, and ventral plates. Dorsal plate strongly concave vertically except for latero-basal parts and apical part which is bluntly pointed. Ventral plate minute pilose except for sclerotized lateral margins, rounded at posterior margin and protruded latero-anteriorly beneath basistyle. Mid plate is a turnip-shaped, has a mid large hole, and its base appears to be composed of a pair of plates and to be fused with ventral plate.

Posterior part of aedeagus not short. Anterior bar of aedeagus long, flattened dorso-ventrally, and wider anteriorly.

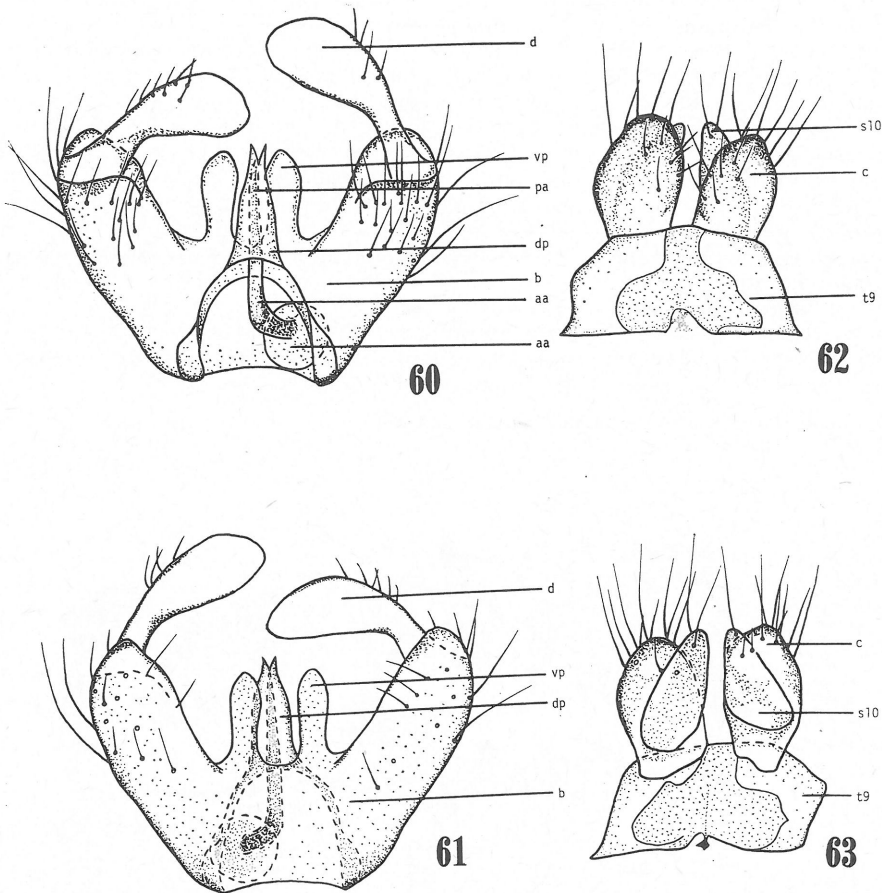
Pair of basistylar dorso-inner anterior processes does not extend beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior darkened sclerites is large and distinct and appears to be included in a transparent lobe.

Tergum 9 (see Fig. 8b in NAGATOMI & SAIGUSA 1970) wider than long, more or less rectangular, and with hairs along dorso-posterior margin. Tergum 10 fused with cercus and with a median broad desclerotized part. Sternum 10 widely divided into a pair of sclerites which are elongate triangular in shape, covered with short black pile, and fused with tergum 10 at antero-outer part. Cercus wider posteriorly, with postero-outer part bent ventro-inwardly, and with long hairs at dorsal surface.

Specimen dissected: 1♂, Marunuma, Gumma Pref., 29. vii. 1958, S. HISAMATSU.

## Subfamily Austroleptinae

Genus *Austroleptis* HARDY, 1920. *A. spec.* (Figs. 60–63): Dististyle long, with outer and inner margins strongly curved, with apical portion (from dorsal or ventral view) ex-



Figs. 60–63. *Austroleptis* spec.: 60, 62, dorsal view; 61, 63, ventral view.

panded, and with dorsal surface (except apical portion) haired. Basistyle almost parallel sided from a dorsal view, and with hairs (except anterior part). Sternum 9 absent or entirely fused with basistyle.

Mid-posterior part of hypopygium consists of dorsal and ventral plates which are not fused with but apart from each other. Dorsal plate, which encloses aedeagus, elongate and gradually tapering posteriorly and pointed at apex, forming a tube. Ventral plate shorter than dorsal plate and divided into a pair of lobes which are cylindrical and hollow (with base open and with apex closed).

Posterior part of aedeagus long. Anterior bar of aedeagus a spoon-like in shape, and not extending far beyond anterior margin of hypopygium.

Pair of basistylar dorso-inner anterior processes absent. Dorsal bridge is U-shaped, i.e., a pair of longitudinal narrow sclerites run from antero-inner part of hypopygium to dorsal plate. Pair of aedeagal dorso-anterior sclerites appears to be absent.

Tergum 9 wider than long and more or less trapezoid. Sternum 10 is widely divided into a pair of sclerites which are pointed and have hairs at apices. Cercus large, longer than wide, haired except anterior part, and with posterior margin rather rounded.

Specimen dissected: 1♂, Pueroto Ayson, Aysen-Chile, 24–26. i. 1961, FENA.

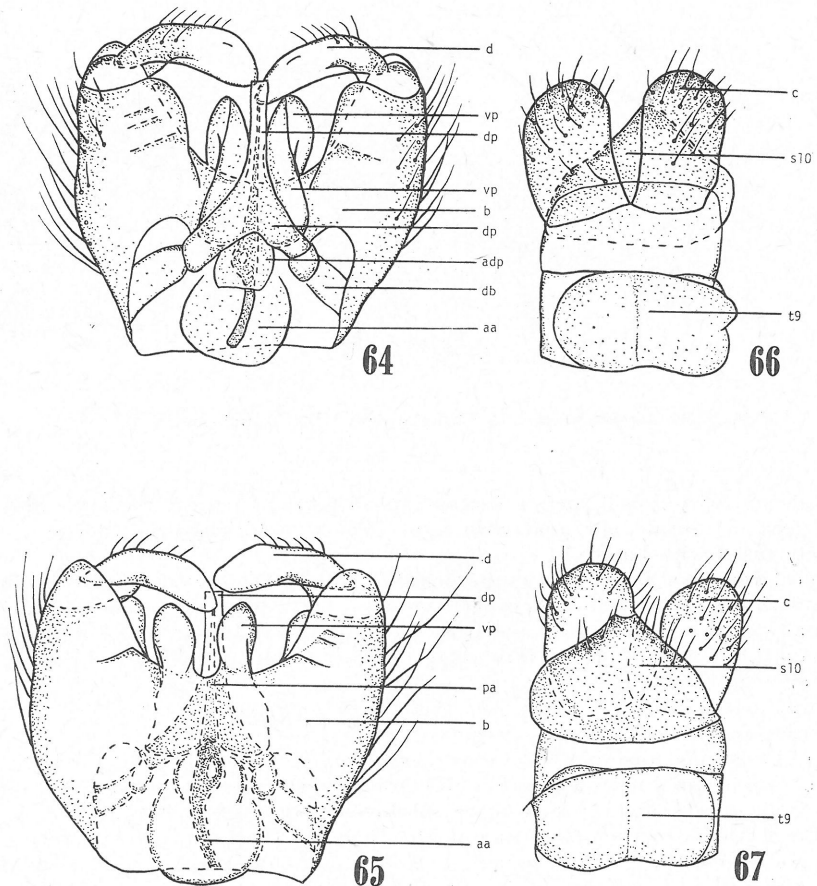
*A. rhyphoides* HARDY, 1920 (det. by G. H. HARDY) (Figs. 64—67): Similar to sp. from Chile except as follows. In dististyle, apical portion not as expanded as in spec. from Chile. Pair of basistyles less divergent from each other than in spec. from Chile. Mid-ventral part of hypopygium (corresponding to sternum 9) longer than in sp. from Chile.

In dorsal plate, basal part more abruptly wider than in sp. from Chile. In ventral plate, a pair of lobes (beyond mid-ventral margin of hypopygium) circular in shape from a lateral view; dorso-anterior part of ventral plate (which is not divided) protruded more deeply into hypopygium (where it connects with dorsal plate). Dorsal bridge not U-shaped and not extending to antero-inner part of hypopygium but in each basistyle a bridge is present between dorsal plate and basistyle.

Aedeagal dorso-anterior plate circular in shape and transparent except sclerotized lateral margins (this appears to be absent in spec. from Chile). In anterior bar of aedeagus, "head" of spoon larger than in spec. from Chile.

Tergum 9 more or less rectangular. Sternum 10 with a median desclerotized line narrow and indistinct and with hairs at posterior border except lateral parts. In cercus, posterior margin rounded but more gentle in curve than in spec. from Chile.

Specimen dissected: 1♂, Mt. Wellington, Tasmania, G. H. HARDY.



Figs. 64—67. *Austroleptis rhyphoides* HARDY: 64, 66, dorsal view; 65, 67, ventral view.

## Subfamily Spaniinae

Genus *Spaniopsis* WHITE, 1914. *S. spec.* (Figs. 68–72): Dististyle long, conical, and twisted. Basistyle short, almost parallel-sided, and with ventral surface haired. Sternum 9 absent or fused with basistyle; mid-ventral part of hypopygium long and with posterior part having long hairs.

Mid-posterior part of hypopygium consisting of dorsal and ventral plates, and a pair of ventral lobes. Dorsal plate elongate and composed of (1) basal broad, (2) median narrow, and (3) apical broad parts, and (3) with a trumpet protruded dorsally. Ventral plate tapering posteriorly, pointed at apex, and with lateral and dorsal surfaces fused with dorsal plate. Ventral lobe transparent, minute pilose, divided into two parts (which connect with each other), and fused with dorsal plate at base. Base of dorsal plate develops antero-ventrally.

Posterior part of aedeagus not pointed or appears to be absent. Anterior bar of aedeagus short, stick-like, and thinner anteriorly.

Pair of basistylar dorso-inner anterior processes thin, tapering apically and not extending to antero-ventral margin of hypopygium. Pair of aedeagal dorso-anterior sclerites is large and distinct, and appears to be almost included in a transparent lobe.

Tergum 9 large, wider than long, wider at anterior part, with anterior margin widely and deeply concave, and with dorso-posterior margin haired. [Sternum 10 broken off and not examined]. Cercus wider than long, rather elliptical, haired, and with an elongate dorsal lobe developed postero-outwardly.

Specimen dissected: 1♂, 0.6 km S. Park Headquarters, Gibraltar Range Nat. Park, 3206 m, New South Wales, Australia, 22. I. 1978, E. I. SCHLINGER.

Genus *Spania* MEIGEN, 1830. *S. kyushuensis* NAGATOMI et SAIGUSA (in press) (Figs. 73–76): Dististyle long, with inner margin having a gentle concavity, and with apex rounded. Basistyle short and broad, with sides almost parallel, and with hairs except base. Sternum 9 absent and mid-antero-ventral part of hypopygium large in area.

Mid-posterior part of hypopygium consists of dorsal and ventral plates whose lateral margins are fused with each other. In dorsal plate, anterior and posterior parts making an acute angle and the latter tapering posteriorly and pointed at apex. In ventral plate, lateral parts more sclerotized, antero-lateral parts protruded into basistyle, and anterior part bulging out. It is undetermined whether postero-lateral part of ventral plate has a flat area. Pair of ventral lobes is present as in *Spaniopsis* but this may easily be overlooked unless carefully examined.

Posterior part of aedeagus appears to be very short or absent. Anterior bar of aedeagus flattened laterally and wider anteriorly.

Pair of basistylar dorso-inner anterior processes is thin and does not extend to antero-ventral margin of hypopygium. Pair of aedeagal dorso-anterior sclerites is present (the degree of inclusion by transparent lobe remains uncertain).

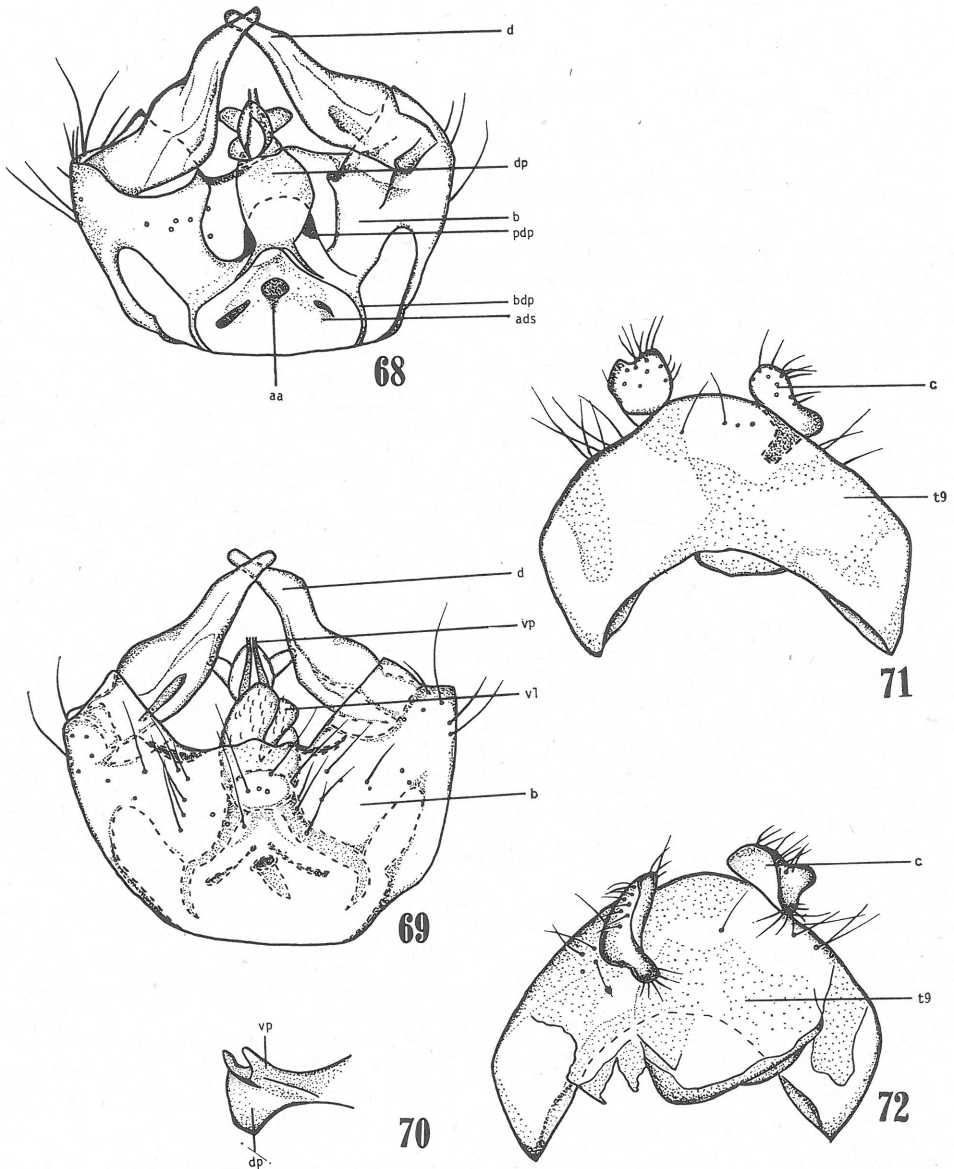
Tergum 9 much wider than long, wider anteriorly, rather trapezium, and with posterior margin having short hairs. Sternum 10 much wider than long and with lateral margin fused with tergum 9. Cercus triangular, longer than wide, and with dorsal surface haired.

Specimen dissected: 3♂♂, Inunaki-tôge, Wakamiya-cho, Fukukoa Pref., 9. v. 1968, T. SAIGUSA.

Genus *Ptiolina* ZETTERSTEDT, 1842. *P. spec.* (Figs. 77–80): Dististyle long, with outer and inner margins almost parallel-sided, and with apex rounded. Basistyle rather short, with posterior portion somewhat narrower, and with hairs except base. Sternum 9 absent or fused with basistyle, mid-antero-ventral part of hypopygium large in area.

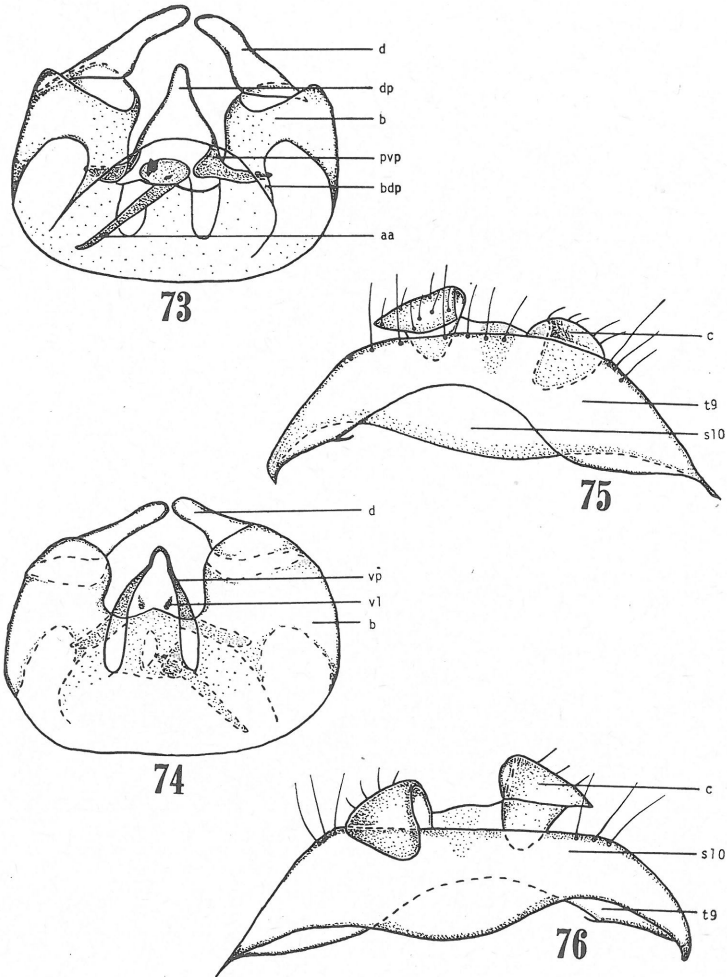
Mid-posterior part of hypopygium consists of dorsal and ventral plates whose lateral margins are fused with each other. Dorsal plate (or dorsal plate + dorsal bridge) tapering posteriorly and pointed at apex. In ventral plate, anterior part bulging out but postero-lateral part becoming a flat area tapering posteriorly and pointed at apex, and antero-lateral part not protruded into basistyle.

In aedeagus, posterior part not so short and making an acute angle with anterior bar. Anterior bar of aedeagus stick-like, but curved (dorsal surface concave) and tapering anteriorly.



Figs. 68–72. *Spaniopsis* spec.: 68, 71, dorsal view; 69, 72, ventral view; 70, apical portions of ventral and dorsal plates, lateral view.

Pair of basistylar dorso-inner anterior processes is thin and does not extend to anterior margin of mid-antero-ventral part of hypopygium. Pair of aedeagal dorso-anterior sclerites is present (the degree of inclusion by transparent lobe remains uncertain). Tergum 9 wider than long, with mid-anterior part deeply concave, and with postero-dorso-lateral part having some hairs. Tergum 10 well developed, rather rectangular, wider than long, and with dorso-posterior part haired. Sternum 10 rather rectangular, wider than long, with posterior margin having a pair of small convexities with some hairs, and with a mid-longitudinal transparent line. Lateral margin of sternum 10 fused with that of



Figs. 73–76. *Spania kyushuensis* NAGATOMI et SAIGUSA (1982): 73, 75, dorsal view; 74, 76, ventral view; it must be noted that Figs. 73–76 were based on two individuals (73–74 and 75–76 belong to the same specimen respectively).

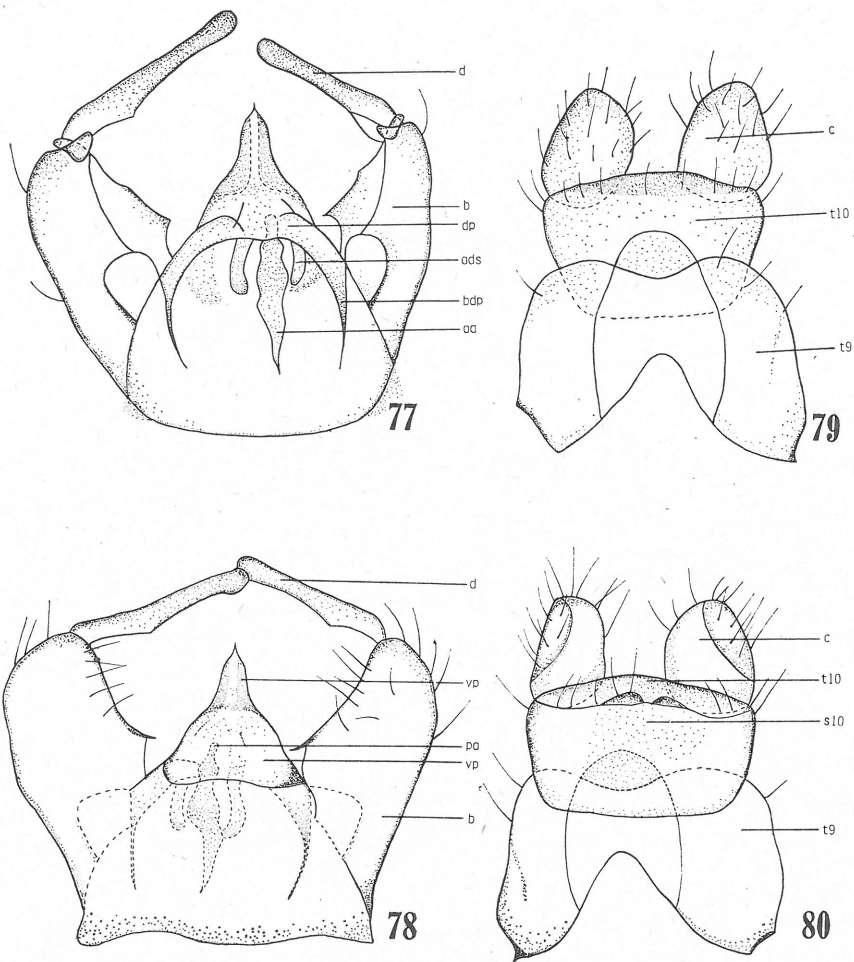
tergum 10. Cercus rather trapezoid, wider than long, but with inner margin gently curved and not angular, and with dorsal surface haired.

Specimen dissected: 1♂, Mt. Inunaki, Fukuoka Pref., 3. vi. 1965, T. SAIGUSA.

Subfamily **Rhagioninae**

Genus *Bolbomyia* LOEW, 1850 (= *Cekendia* SZILÁDY, 1934). *B. spec.* (Figs. 81–86): Dististyle conical, with outer margin convex, and with basal part from an outer or posterior view becoming much wider. Basistyle tapering posteriorly, with dorsal and ventral surfaces roughly equal in length and shape, and with hairs except base. Sternum 9 separated from basistyle by suture which is incomplete at posterior part.

Mid-posterior part of hypopygium consists of dorsal and ventral plates whose lateral margins are fused with each other and form a hole at apices. Dorsal plate (or dorsal plate + dorsal bridge) tapering posteriorly, much sclerotized laterally, and with a blackened (or strongly sclerotized) spot at side near base. Ventral plate almost equal in length and shape



Figs. 77–80. *Ptiolina* spec.: 77, 79, dorsal view; 78, 80, ventral view.

to dorsal plate but with postero-lateral part folded twice, and with anterior part protruded laterally and having strongly sclerotized apex not pointed but transverse.

Posterior part of aedeagus is very long. Along posterior part of aedeagus, there is a pair of long tines curved markedly whose bases are widened (from a lateral view) and connect with each other at ventral surface of aedeagus. Anterior bar of aedeagus like a trigonal prism, wider anteriorly, and with a mid-longitudinal ventral sclerotized stripe.

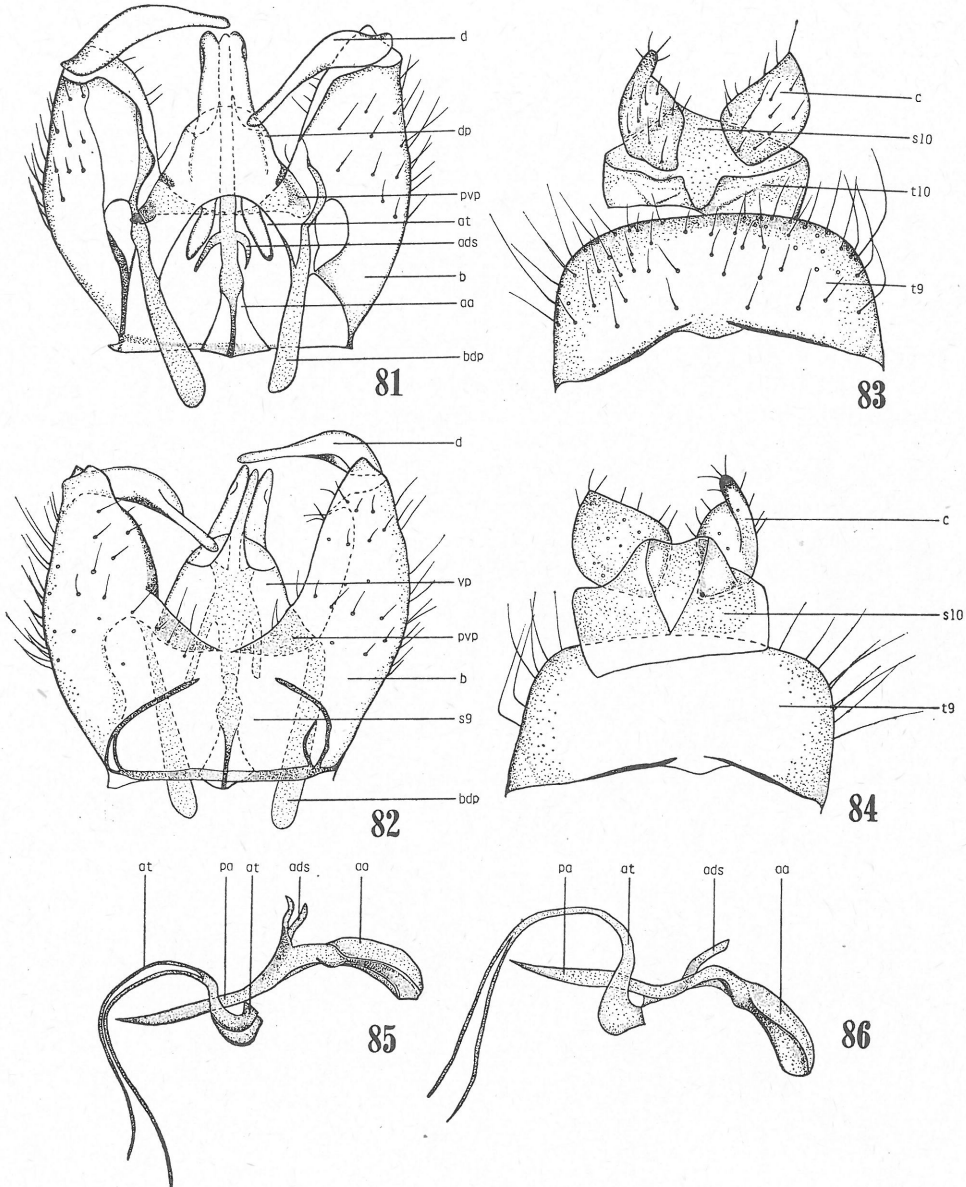
Pair of basistylar dorso-inner anterior processes wider anteriorly, long but not extending far beyond anterior margin of sternum 9. Pair of aedeagal dorso-anterior sclerites is rather thin but distinctly branches off from aedeagus.

Tergum 9 much wider than long, more or less rectangular, and with dorsal surface except anterior part strong haired. Sternum 10 wider than long, and wider anteriorly. Cercus rather rectangular (when flattened) and haired.

Specimen dissected: 4♂♂, Karasawa, Mt. Hodaka, Nagano Pref., 10. vii. 1963, A. NAGATOMI.

Genus *Alloleptis* NAGATOMI et SAIGUSA (1982). *A. tersa* NAGATOMI et SAIGUSA (1982) (Figs. 87–91): Hypopygium wider than long. Dististyle cylindrical, long, and roughly parallel-sided, and with hairs. Basistyle comparatively narrow and almost parallel-sided

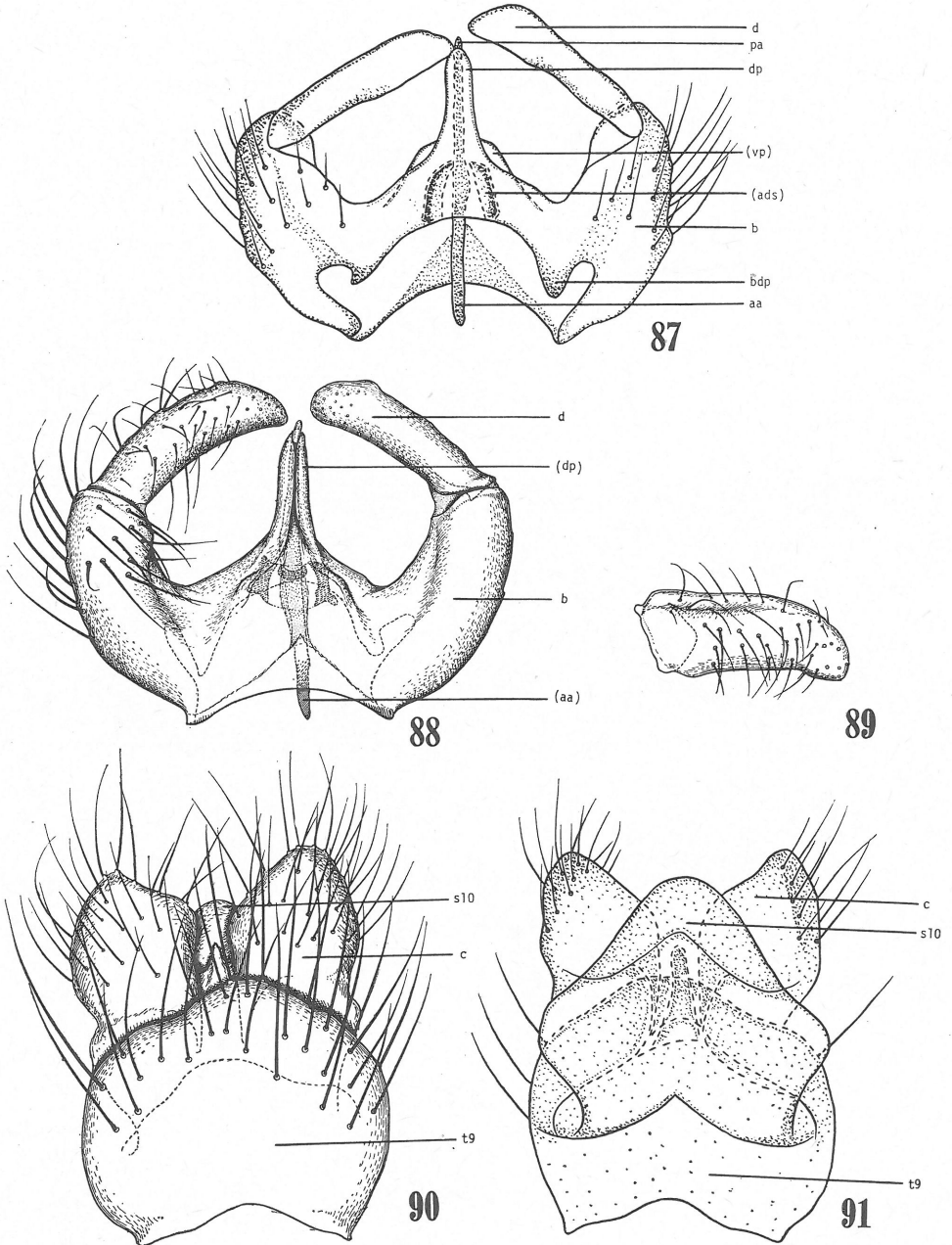




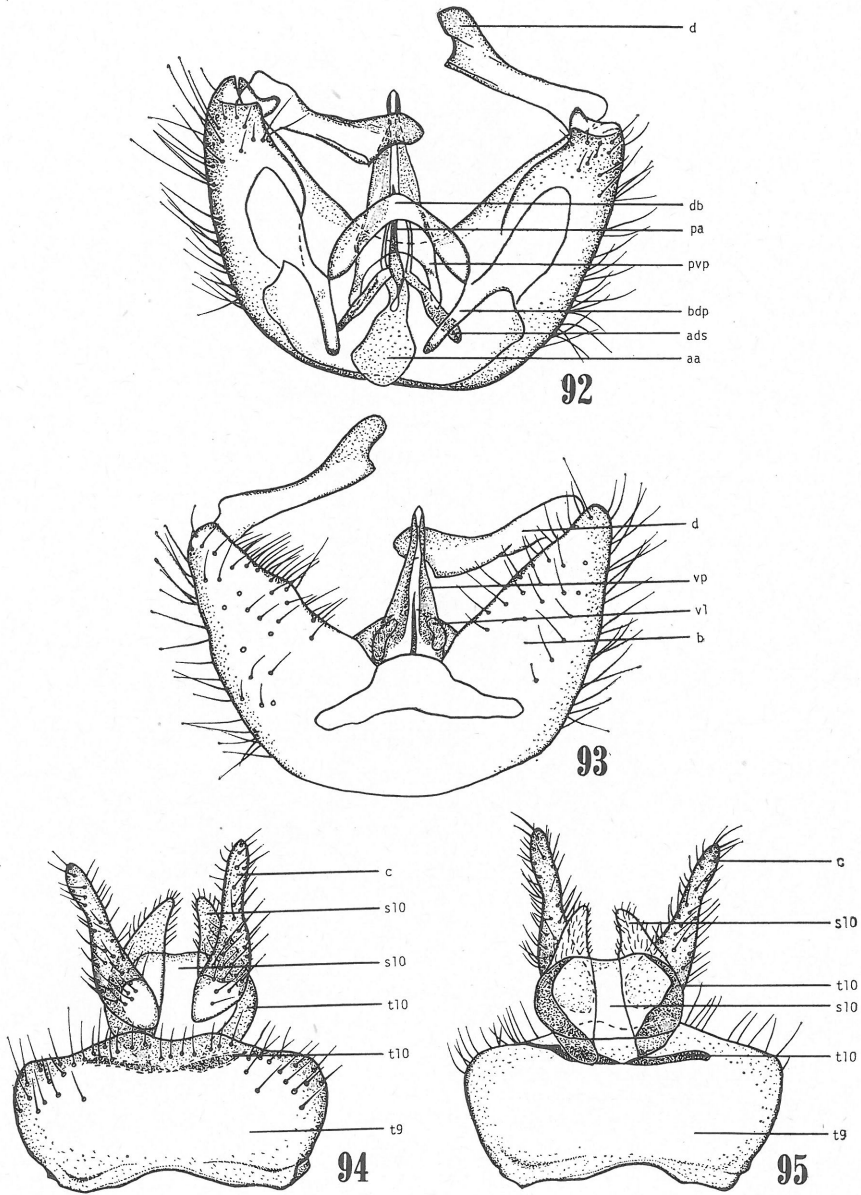
Figs. 81–86. *Bolbomyia* spec.: 81, 83, dorsal view; 82, 84, ventral view; 85, ventro-lateral view; 86, lateral view.

and with hairs (except basal part). Sternum 9 absent and area corresponding to sternum 9 not long.

Mid-posterior part of hypopygium is long, narrow and pointed at apex but it is uncertain whether this part is composed of dorsal and ventral plates or dorsal plate only and if the latter case is correct the ventral plate will be confined to basal part (there is a ventral ridge whose apical margin is concave at middle, but this ridge can be seen from some angles and not well illustrated in Fig. 88).



Figs. 87–91. *Alloleptis tersa* NAGATOMI et SAIGUSA: 87, 90, dorsal view; 88, 91, ventral view; 89, dististyle, outer view (upper is dorsal).

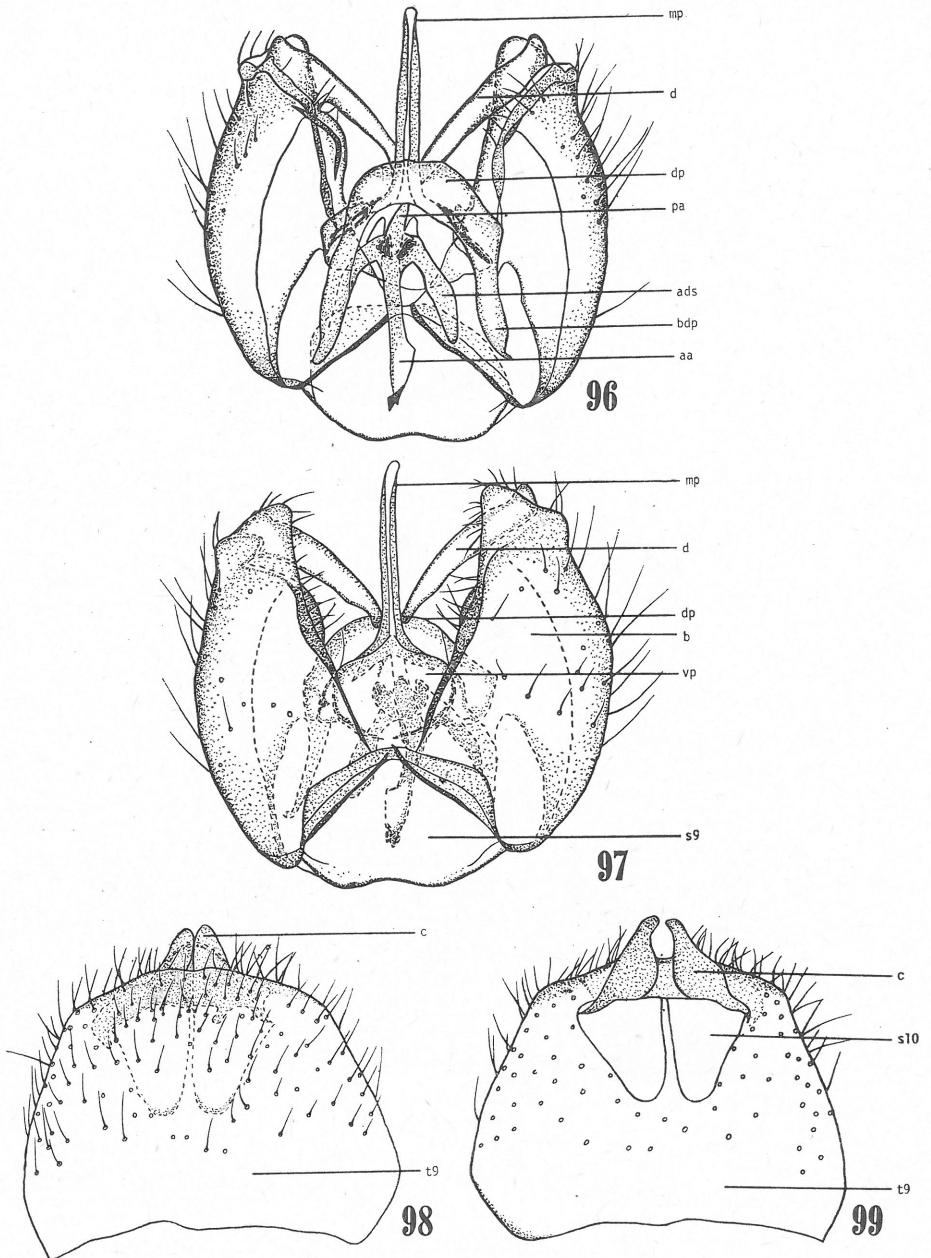


Figs. 92–95. *Symphoromyia crassicornis* PANZER: 92, 94, dorsal view; 93, 95, ventral view.

Posterior part of aedeagus very long and not shorter than its anterior bar. Pair of distinct sclerites is present alongside aedeagus and it is probable that the sclerites are not the vestigial aedeagal tines but aedeagal dorso-anterior sclerites. Anterior bar of aedeagus stick-like and thin.

Pair of basistylar dorso-inner anterior processes short, pointed at apex and not thin but wide. Dorsal bridge is U-shaped.

Tergum 9 wider than long, with anterior margin shallowly concave, posterior margin rounded, and posterior part haired. Sternum 10 about as wide as long, widest near middle,



Figs. 96–99. *Arthroteles cinerea* STUCKENBERG: 96, 98, dorsal view; 97, 99, ventral view.

with posterior margin bluntly pointed, and with anterior margin concave at middle. Cercus large, haired, and with outer margin longer than inner margin.

Specimen dissected: ♂ (holotype), Pulu-pulu (1500–1800 km), 20 km N. W. of Rantepao, Celebes, 9–16. v. 1966, R. STRAATMAN.

Genus *Symphoromyia* FRAUENFELD, 1867. *S. crassicornis* PANZER, 1806 (Figs. 92–95): Dististyle more or less flattened dorso-ventrally, with outer margin concave, with inner

margin strongly convex, and with apex pointed. Basistyle tapering toward apex and haired, but inner part and dorso-inner part (except apical portion) bare. Sternum 9 absent or fused with basistyle but mid-antero-ventral part of hypopygium with an posterior desclerotized band.

Mid-posterior part of hypopygium consists of dorsal and ventral plates, and a pair of minute haired, transparent, small ventral lobes. Dorsal plate (or dorsal plate + dorsal bridge) is U-shaped band and its mid part connects with ventral plate. Ventral plate long, pointed at apex, and divided by a mid-longitudinal transparent line, and the root of ventral plate composed of a pair of long, triangular parts protruding anteriorly and connected with each other near base of united part of ventral lobes.

Posterior part of aedeagus long. Along each side of posterior part of aedeagus (and just behind aedeagal dorso-anterior sclerite) there is a thin and rather long sclerite. Anterior bar of aedeagus flattened laterally, and becoming wider anteriorly.

Pair of basistylar dorso-inner anterior processes does not extend far beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerites large and distinct and at least its anterior part not included in a transparent lobe.

Tergum 9 much wider than long, with anterior margin concave, and with posterior margin having a pair of small convexities near middle, and with dorso-posterior part haired. Tergum 10 divided into a pair of sclerites, each sclerite elongate, tapering posteriorly, and with posterior part fused with sternum 10, with a transverse row of hairs at anterior part; just before this sclerite there is another sclerite which is transversely elongate and which may also belong to tergum 10. Sternum 10 wider than long, with lateral part darker than the middle, and with postero-lateral part having a large process which is elongate triangular and is covered with hairs. Cercus long, with posterior part narrower than anterior part and pointed at apex, haired, and with dorso-posterior part having 2–3 bristles.

Specimen dissected: 1♂, Mt. Wakasugi, Fukuoka Pref., 12. v. 1962, T. SAIGUSA.

Genus *Arthroteles* BEZZI, 1926. *A. cinerea* STUCKENBERG, 1956 (det. by B. R. STUCKENBERG) (Figs. 96–99): Dististyle long, rather conical, with apex bluntly pointed. Basistyle long, with ventral surface longer than the dorsal and its inner apex bluntly pointed, and with dorsal surface (except base and inner part) and ventral surface (except base) haired. Sternum 9 bulging out and connected with basistyle except anterior margin.

Mid-posterior part of hypopygium consists of dorsal and ventral plates whose apical margins are widely separated from each other, and a long median tube whose lateral margins are sclerotized. Dorsal plate (or dorsal bridge) like a saddle (from a posterior view of hypopygium), short and with posterior (= apical) margin transverse. Ventral plate rather circular in outline, arched, and transparent. Dorsal and ventral plates connect with each other at their latero-basal parts. A median tube very long, gently curved (dorsal margin concave), and independent of ventral plate. It is possible that median tube corresponds to interbases.

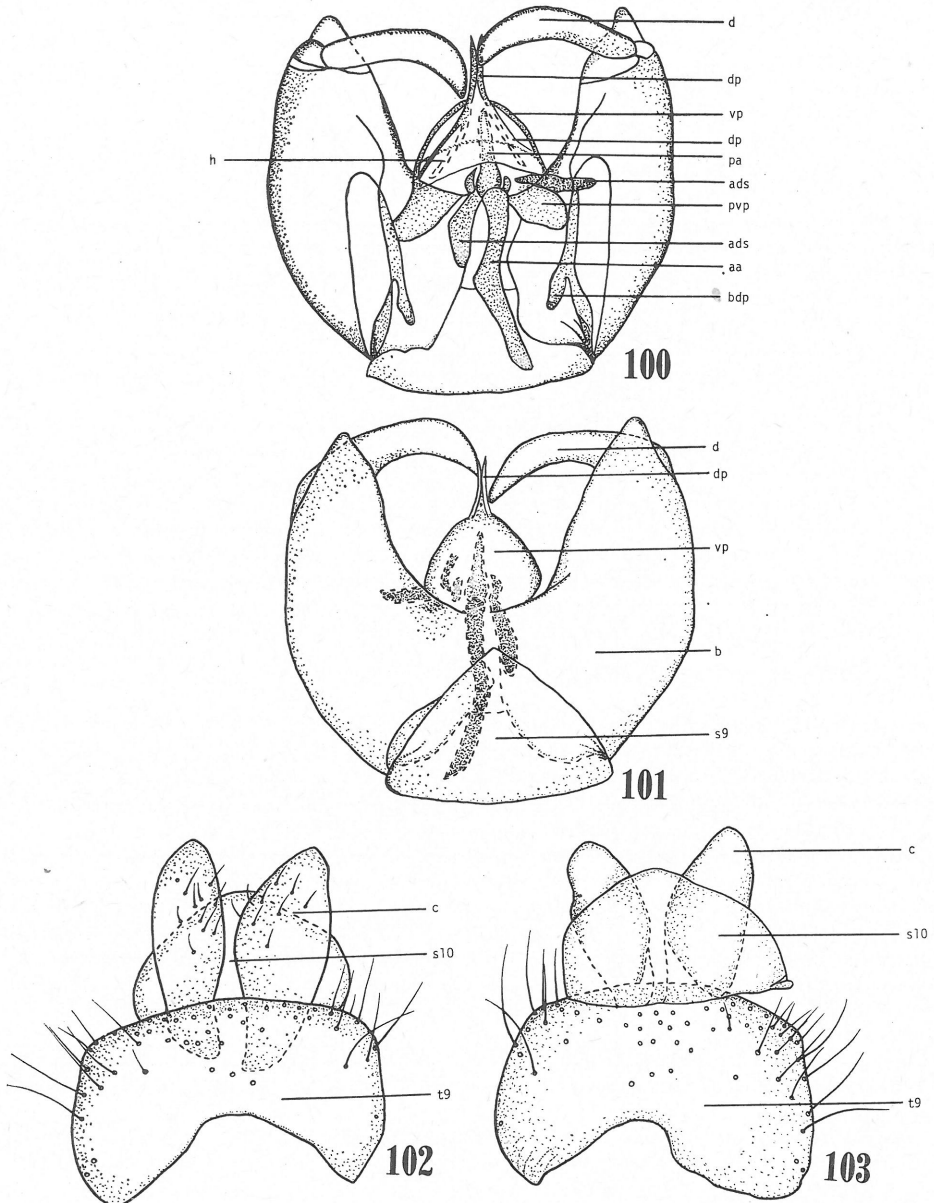
Posterior part of aedeagus short. Along each side of posterior part of aedeagus (and just behind aedeagal dorso-anterior sclerite) there is a short sclerite. Anterior bar of aedeagus flattened laterally.

Pair of basistylar dorso-inner anterior processes tapers apically and does not extend beyond anterior margin of sternum 9. Pair of aedeagal dorso-anterior sclerites is large and distinct, and only its base is included in a transparent lobe.

Tergum 9 wider than long, wider at anterior part, and haired on dorsal surface except anterior part. Sternum 10 large, widest at base of cercus, and divided by a mid-longitudinal desclerotized line. Cercus short haired and with postero-outer parts curved ventro-inwardly.

Specimen dissected: 1♂, Cathedral Peak, Forestry Reserve, Natal, Drakensberg, South Africa, iii. 1959, B. R. & P. T. STUCKENBERG.

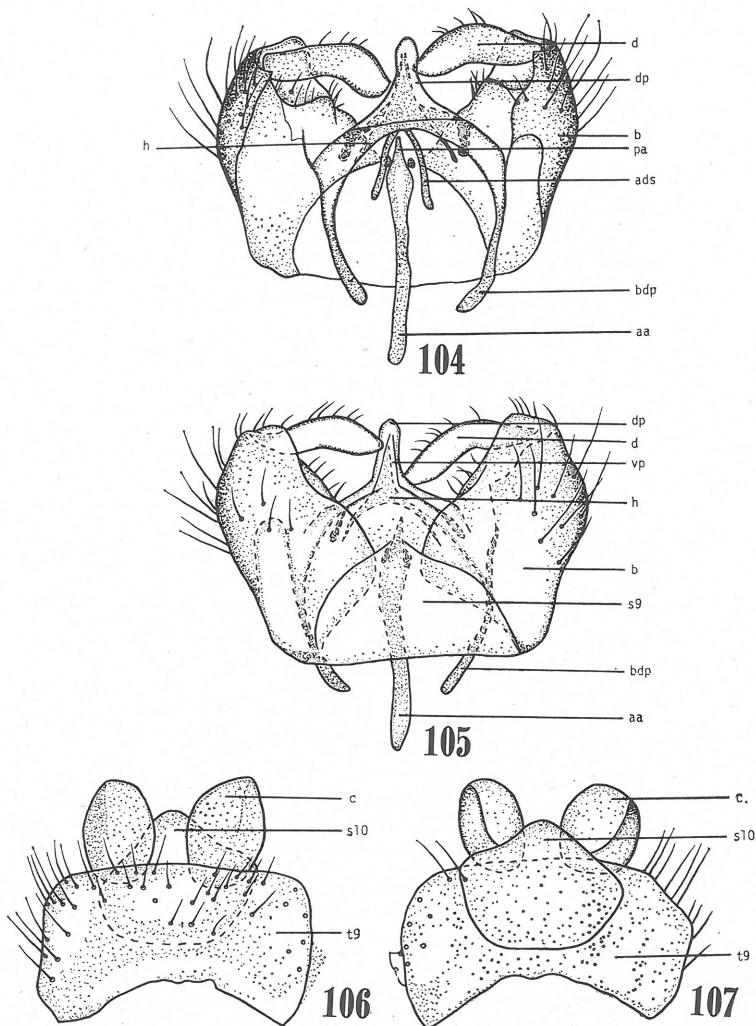
Genus *Atherimorpha* WHITE, 1915, *A. spec.* (= probably *corpulenta* PARAMONOV, 1962) (Figs. 100–103): Dististyle rather conical, with outer margin convex, and with inner margin concave. Basistyle with basal part very wide, and with ventro-inner apex pointed. Basistyle haired but base and dorso-inner part (except apical portion) bare. Sternum 9 is



Figs. 100–103. *Atherimorpha* spec.: 100, 102, dorsal view; 101, 103, ventral view.

semicircular in shape, independent and only its lateral parts are fused with basistyles. Basistyles are widely separated from each other and their antero-ventro-inner parts are covered by sternum 9.

Mid-posterior part of hypopygium consists of dorsal and ventral plates whose lateral and posterior margins are fused with each other. Dorsal plate (or dorsal plate + dorsal bridge) more or less bulging out at anterior part, tapering posteriorly and pointed at apex. Ventral plate more or less pentagonal in shape and transparent except sclerotized margin which is broken both at mid-posterior and mid-anterior points; antero-lateral parts of ventral



Figs. 104–107. *Rhagina* spec.: 104, 106, dorsal view; 105, 107, ventral view.

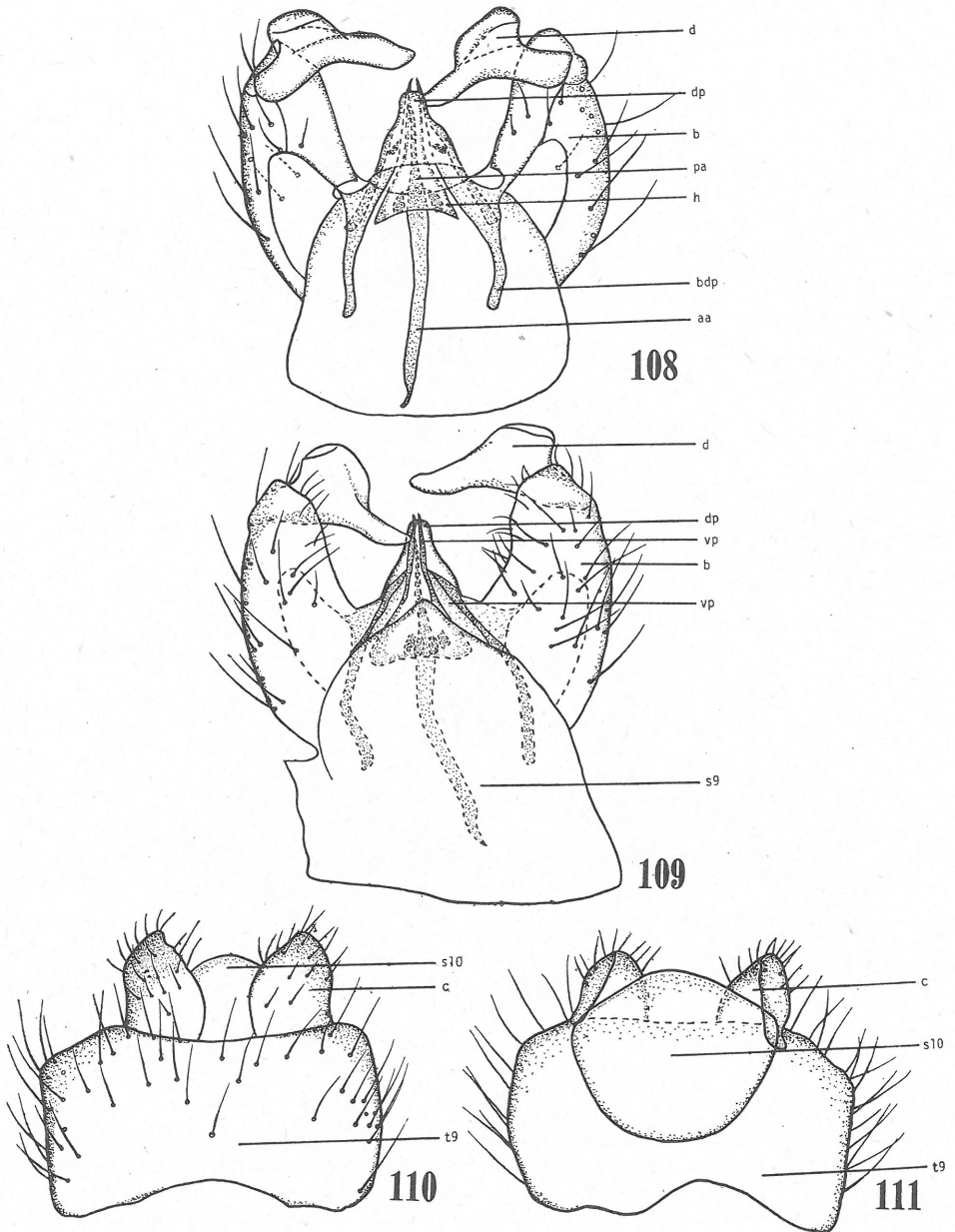
plate protruded anteriorly beneath ventral surface of basistyle. It is possible that posterior protruded part of dorsal plate corresponds to interbases.

Posterior part of aedeagus not short. Along each side of posterior part of aedeagus (and just behind aedeagal dorso-anterior sclerites) there is a short sclerite. Posterior part of aedeagus is encircled by a plate which is like a half-opened umbrella in shape and is broken along a longitudinal mid-ventral line (this may be so of a mid-dorsal line). Anterior bar of aedeagus stick-like in shape.

Pair of basistylar dorso-inner anterior processes does not extend beyond anterior margin of sternum 9. Pair of aedeagal dorso-anterior sclerites is large and distinct and appears to be entirely included in a transparent lobe.

Tergum 9 wider than long, with anterior margin widely concave, and with lateral and posterior parts of dorsal surface haired. Sternum 10 wider than long, rounded at posterior margin, and with a small concavity at middle of anterior margin. Cercus longer than wide, and with posterior part short haired.

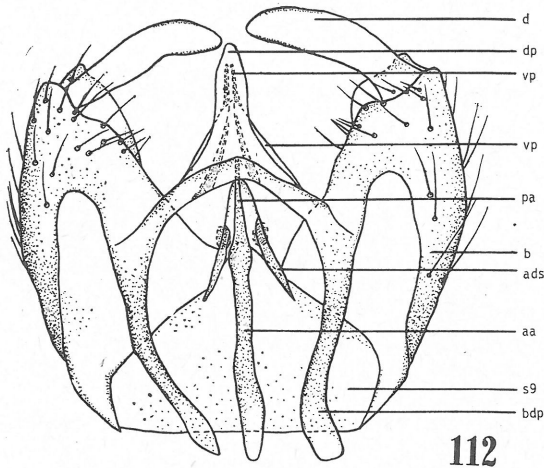
Specimen dissected: 2♂♂, Buoya Mts., Australia, 19. xi. 1967, J. and M. SEDLACEK.



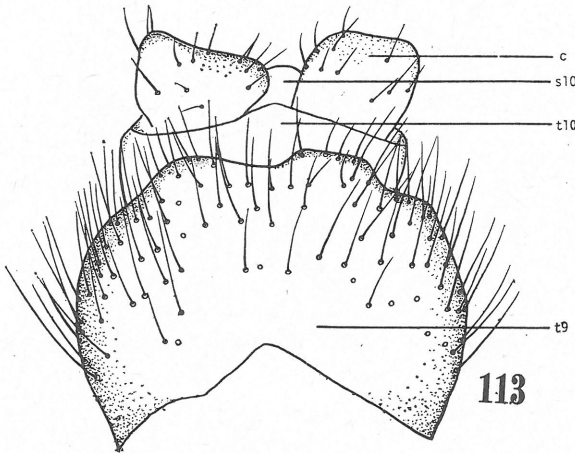
Figs. 108–111. *Neorhagio* spec.: 108, 110, dorsal view; 109, 111, ventral view.

Genus *Rhagina* MALLOCH, 1932. *R.* spec. (Figs. 104–107): Dististyle elongate, with outer and inner margins more or less curved but roughly parallel-sided, with apex pointed or rounded according to the view from different angles, and with outer surface haired. Basistyle broad, with hairs except base, and with dorsal surface distinctly narrower than the ventral. Sternum 9 entirely separated from basistyle by suture. Mid-posterior part of hypopygium consists of dorsal and ventral plates which appear to be fused with each other at latero-proximal and apical parts. Dorsal plate (or dorsal plate +





112



113

Figs. 112–113. *Rhagio yasumatsui* NAGATOMI, dorsal view.

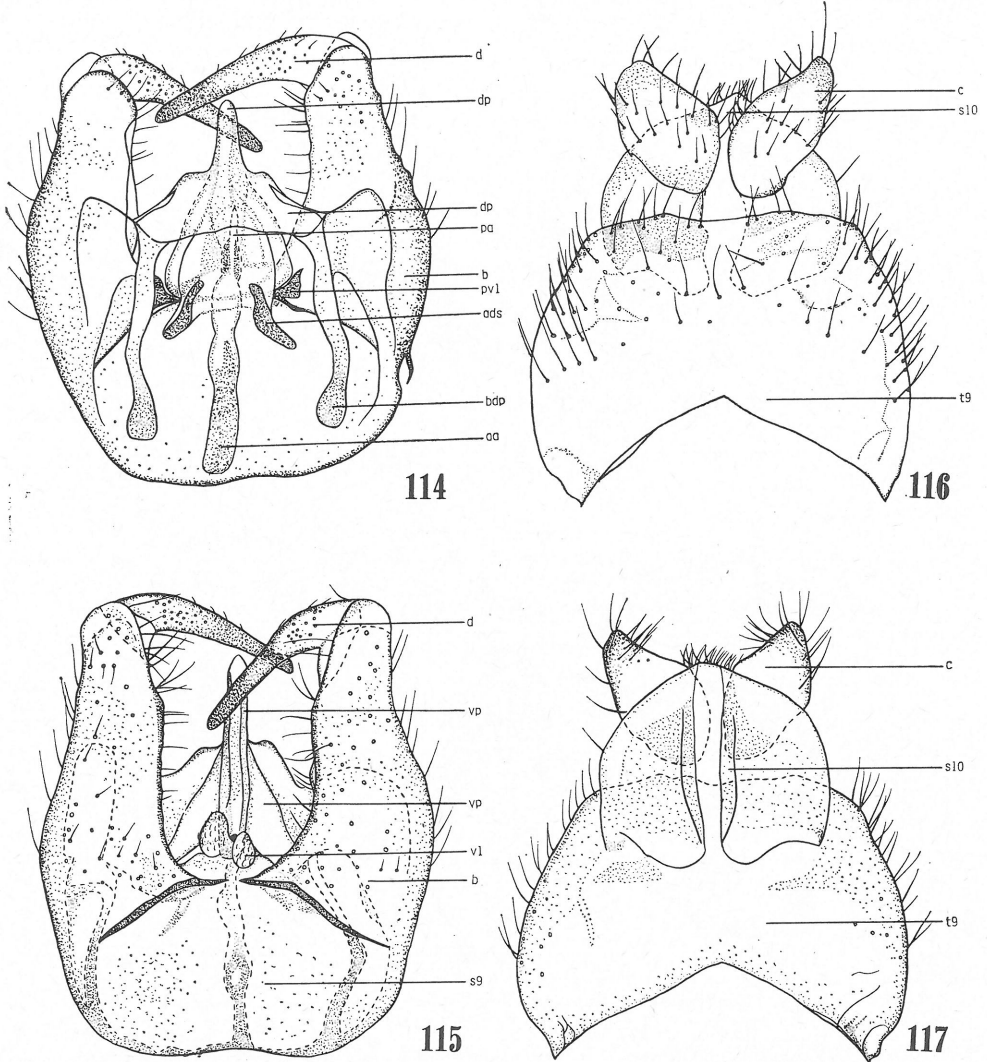
dorsal bridge) (except anterior part) tapers posteriorly, has an apex rather rounded, and appears to form a tube by itself. Ventral plate divided by a median transparent line, with posterior part protruded; and with apex pointed.

Posterior part of aedeagus, which is short, is encircled by a plate which is like a half-opened umbrella in shape. Along ventral side of posterior part of aedeagus there is a pair of sclerites which are short and weak and may easily be overlooked. Anterior bar of aedeagus flattened laterally.

Pair of basistylar dorso-inner anterior processes is comparatively narrow and does not extend far beyond anterior margin of sternum 9. Pair of aedeagal dorso-anterior sclerites rather thin but distinct (the degree of inclusion by a transparent lobe remains to be uncertain). Tergum 9 much wider than long, with anterior margin widely concave, and with posterior and lateral parts haired. Sternum 10 convex at posterior margin and rather pentagonal. Cercus rather trapezoid, with outer part curved ventro-inwardly, and fine haired.

Specimen dissected: 2♂♂ Mt. Tjemere (400–1400 m), Cirebon, Java, 19–25. xi. 1973, S. SHINONAGA & H. SHIMA.

Genus *Neorhagio* LINDNER, 1924. If true *Neorhagio* is identical with *Atherimorpha*, “*Neorhagio*” in this paper may represent a new genus (see NAGATOMI 1982).

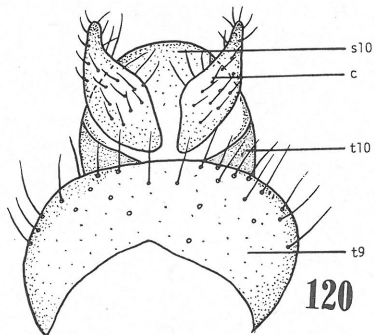
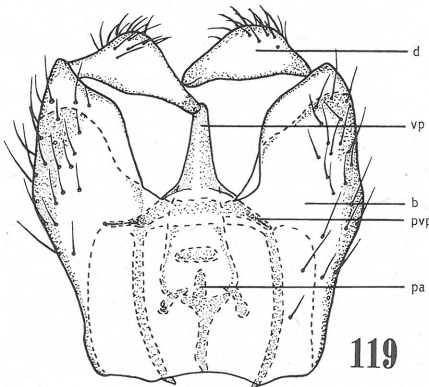
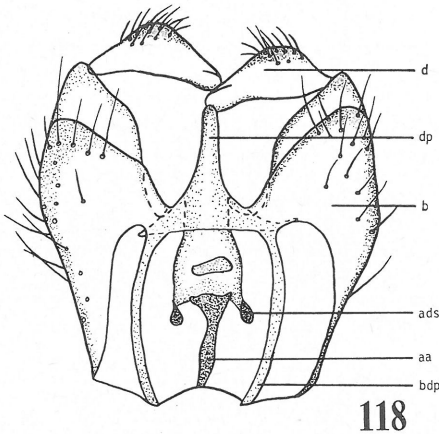


Figs. 114–117. *Arthroceras japonicum* NAGATOMI: 114, 116, dorsal view; 115, 117, ventral view.

*N. spec.* (Figs. 108–111): Dististyle beak-like and with a broad knob at mid-outer surface. In basistyle, ventral surface pointed at apex and longer than the dorsal. Basistyle (except base) with strong hairs which become short and weak on inner surface. Sternum 9 large, swollen and produced anteriorly.

Mid-posterior part of hypopygium consists of dorsal and ventral plates, both of which are fused with each other at base of lateral margin. Dorsal plate protruding posteriorly but rounded at apex which forms a tube by itself as in *Rhagio*. Ventral plate consists of basal broad and apical narrow parts of which the latter is pointed at apex forming a tube.

There is a plate like a half-opens umbrella which encloses posterior part of aedeagus and which is broken or transparent at mid-ventral line but sclerotized at mid-dorsal line (= X). Posterior part of aedeagus is short, although it looks long in Fig. 108 where it connects with X. Along each side of posterior part of aedeagus, there is a short sclerite. Anterior bar of aedeagus very long and its anterior about half flattened laterally and wider anteriorly.



Figs. 118–120. *Solomomyia gressitti* NAGATOMI: 118, 120, dorsal view; 119, ventral view.

Pair of basistylar dorso-inner anterior processes not short but ending far before the margin of sternum 9. Pair of aedeagal dorso-anterior sclerites appears to be absent.

Tergum 9 wider than long and more or less rectangular, and with strong hairs at dorsal surface except narrow anterior part. Sternum 10 rather pentagonal in shape. Cercus with outer part curved ventro-inwardly and with hairs at dorsal surface except base.

Specimen dissected: ♂, Chiapas-Oaxaca border 21 km W. Rizo de Oro along ridge SE. of Cerro Baul (1615 m), Mexico, 6. IX. 1972, CAROLYN MULLINEX.

Genus *Rhagio* FABRICIUS, 1775 (= *Leptis* FABRICIUS, 1805). *R. yasumatsui* NAGATOMI, 1972 (Figs. 112–113): Dististyle gently curved, with outer and inner margins roughly

parallel-sided, but with apex bluntly pointed. Basistyle rather short, with hairs except base, and with ventral part having a short projection at base of dististyle. Sternum 9 large, and basistyles entirely separated from each other.

Mid-posterior part of hypopygium consists of dorsal and ventral plates, both of which are fused with each other at lateral margin which is nearly transparent and not demarcated. Dorsal plate protruding posteriorly and forming a tube at apex by itself. Ventral plate also protruding posteriorly, divided by a median longitudinal transparent line, and with apex consisting of 4 needle-like sclerotized parts forming a minute tube. Apical portion of dorsal plate broader than that of ventral plate and not pointed acutely.

Posterior part of aedeagus short. Along each side of posterior part of aedeagus (and behind aedeagal dorso-anterior sclerite) there is a short sclerite. Anterior bar of aedeagus stick-like. Pair of basistylar dorso-inner anterior processes is long but does not extend far beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerites is long and entirely included in a transparent lobe.

Tergum 9 wider than long, with anterior margin widely concave, and with strong hairs except narrow anterior part. Sternum 10 rather pentagonal in shape. Cercus wider than long, rectangular, and with fine hairs.

Specimen dissected: 1♂, Iso, Kagoshima City, 8. v. 1965, A. TANAKA; 1♂, Sata-misaki, Kagoshima Pref., 29. iv. 1966, A. TANAKA.

Genus *Arthroceras* WILLISTON, 1886 (= *Ussuriella* PARAMONOW, 1929; *Pseudocoenomyia* ŌUCHI, 1943). *A. japonicum* NAGATOMI, 1954 (Figs. 114–117): Dististyle long, conical, and short haired. Basistyle long, tapering toward apex, longer haired. Sternum 9 large, fused with basistyle at anterior part, and with a desclerotized line along or near posterior margin.

Mid-posterior part of hypopygium consists of dorsal and ventral plates and a pair of ventral lobes. Dorsal plate broad, with postero-lateral parts convex, and with mid-posterior part protruding, fusing with ventral plate, and forming a tube. Ventral plate narrower than dorsal plate, divided by a median transparent line, and with mid-posterior part protruding. Ventral lobe divided in two, transparent, protruding along base of ventral plate, with apex (!) (= antero-lateral projection) blackened, and with base (!) oval and minute pilose.

Posterior part of aedeagus not short. In anterior bar of aedeagus, apical part flattened laterally, dilated, and rather rounded in shape (from a lateral view).

Pair of basistylar dorso-inner anterior processes is long but does not extend beyond anterior margin of hypopygium and has apex wider and rounded. Pair of aedeagal dorso-anterior sclerites is large and distinct and its basal portion is included in a transparent lobe.

Tergum 9 wider than long, with anterior margin deeply concave, and with posterior part haired. Tergum 10 well developed and fused with sternum 10 at lateral and posterior margins and forming a bag. Sternum 10 with a median broad longitudinal ditch. Cercus large, tapering postero-outwardly, and with hairs.

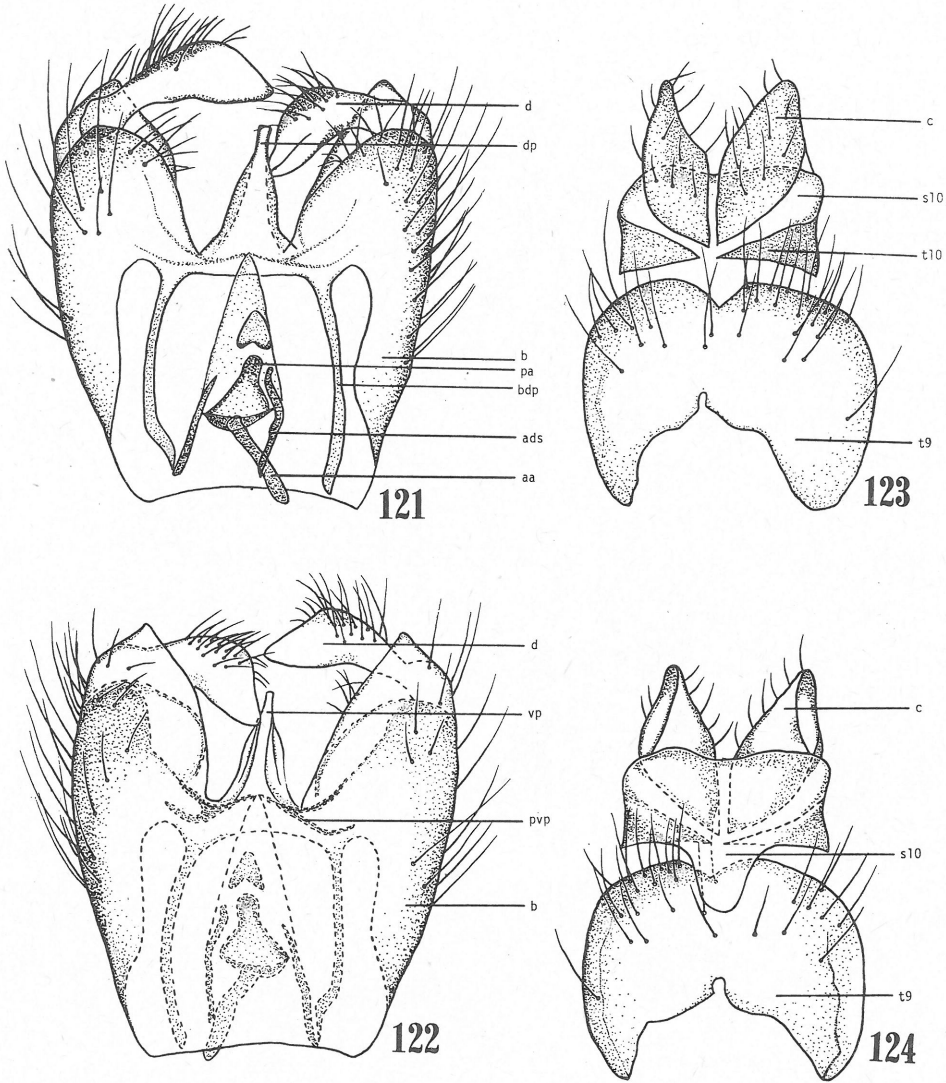
Specimen dissected: 1♂, Gozaishi, Komukawa, Yamanashi Pref., 3. vi. 1960, T. SAIGUSA.

Genus *Solomomyia* NAGATOMI (1982). *S. gressitti* NAGATOMI (1982) (Figs. 118–120): From a dorsal (or ventral) view, dististyle widest at middle, with outer margin strongly curved and inner margin nearly straight, and with mid-outer part strong haired. In basistyle, ventral surface pointed at apex and longer than the dorsal. Basistyle haired at outer part. Sternum 9 absent (fused with basistyle).

Mid-posterior part of hypopygium consists of dorsal and ventral plates, which are fused with each other, forming a tube, and pointed at apex. Root of ventral plate protruding antero-laterally.

In aedeagus, anterior bar and posterior part, both of which are short, making an acute angle, and the latter is wider anteriorly (or basally). Just behind posterior part of aedeagus there is an elliptical sclerite.

Pair of basistylar dorso-inner anterior processes long and comparatively narrow. Pair of aedeagal dorso-anterior sclerites distinct.

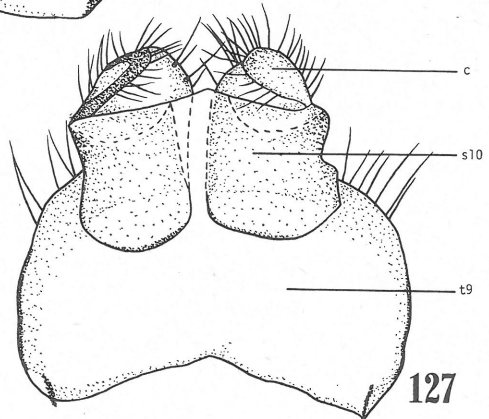
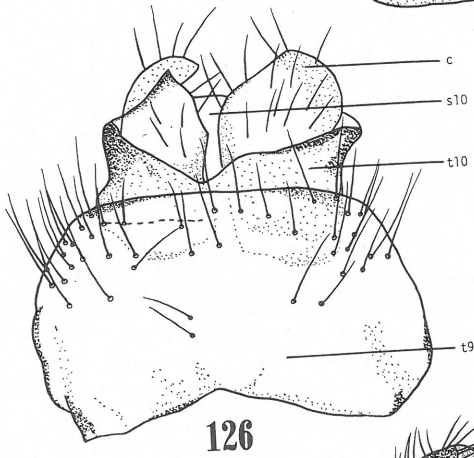
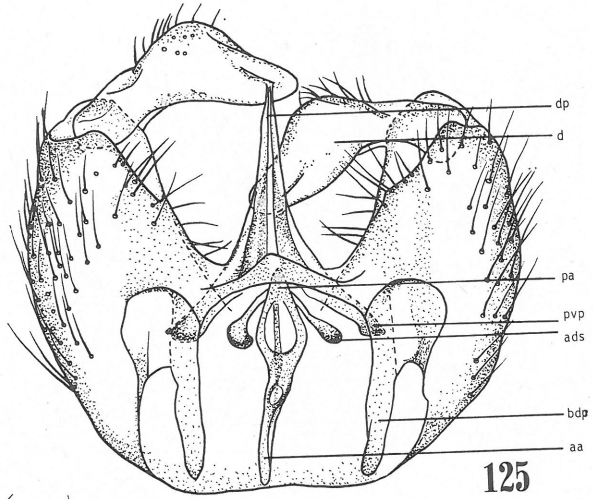


Figs. 121 – 124. *Schizella furcicornis* BEZZI: 121, 123, dorsal view; 122, 124, ventral view.

Tergum 9 with posterior margin rounded and anterior margin widely and deeply concave. Tergum 9 with hairs at posterior margin of dorsal surface. Tergum 10 widely divided into a pair of sclerites which are triangular in shape. Sternum 10 with posterior (and lateral) margin rounded. Cercus (from a dorsal view and not flattened) elongate, widest near middle, pointed at apex and haired at dorsal surface.

Specimen dissected: 1♂, Molao, Santa Ysabel, Solomon Islands, 29. vi. 1960, C. W. O'BRIEN.

Genus *Schizella* BEZZI, 1917. *S. furcicornis* BEZZI, 1917 (Figs. 121 – 124): Similar to the description of *Solomomyia gressitti* except as follows: Hairs on dististyle and basistyle may be more extensive in area. Area corresponding to sternum 9 more long. Just behind posterior part of aedeagus there is a triangular sclerite. Anterior bar of aedeagus is longer than in *Solomomyia gressitti*. Sternum 10 rectangular but mid-anterior part produced



Figs. 125–127. *Chrysopilus ditissimis* BEZZI: 125, 126, dorsal view; 127, ventral view.

forward. Cercus pointed at apex from a dorsal (or ventral) view but rounded at posterior margin from a lateral view, and with inner margin longer than the outer (which does not include anterior margin running obliquely).

Specimen dissected: 1♂, Mt. Mayon, 16 km NW of Lagaspi (1900–2000 m), Albay Prov., Philippines, 13. v. 1962, H. M. TORREVILLAS.

Genus *Chrysopilus* MACQUART, 1826. *C. ditissimis* BEZZI, 1912 (Figs. 125–127): Dististyle from a dorsal (or ventral) view widest at middle, with outer surface (except base and apex) haired. In basistyle, ventral part longer than dorsal part, and with inner apex more or less pointed, basistyle haired but mid-antero-ventral part (of hypopygium) and dorso-inner part (except apical portion) bare. Sternum 9 absent or entirely fused with basistyle but mid-antero-ventral part of hypopygium with a large desclerotized area at posterior part.

Mid-posterior part of hypopygium is long and pointed at apex and consists of dorsal and ventral plates which are fused with each other at lateral margins. Both of dorsal and ventral plates divided by a mid-longitudinal transparent line. Ventral plate protrudes antero-laterally, is blackened at its roots, and may correspond to interbases.

Posterior part of aedeagus short. In anterior bar of aedeagus, which is stick-like in shape, posterior (proximal) broad part makes an acute angle with anterior (distal) narrow part.

Pair of basistylar dorso-inner anterior processes does not extend beyond anterior margin of hypopygium. Dorsal bridge narrow and connected with dorsal plate at middle. Pair of aedeagal dorso-anterior sclerites is large and entirely included in a transparent lobe.

Tergum 9 wider than long, with anterior margin widely and gently concave, with lateral margin convex, and with posterior portion haired. Tergum 10 divided into two parts whose outer margins are fused with sternum 10. Sternum 10 wider than long, almost rectangular, and with a mid-longitudinal desclerotized line. Cercus with outer apical part more or less twisted and with hairs.

Specimen dissected: 1♂, Sekinomiya, Yabu-gun, Hyogo Pref., 18. vi. 1953, A. NAGATOMI.

### Family Athericidae (Figs. 128–131)

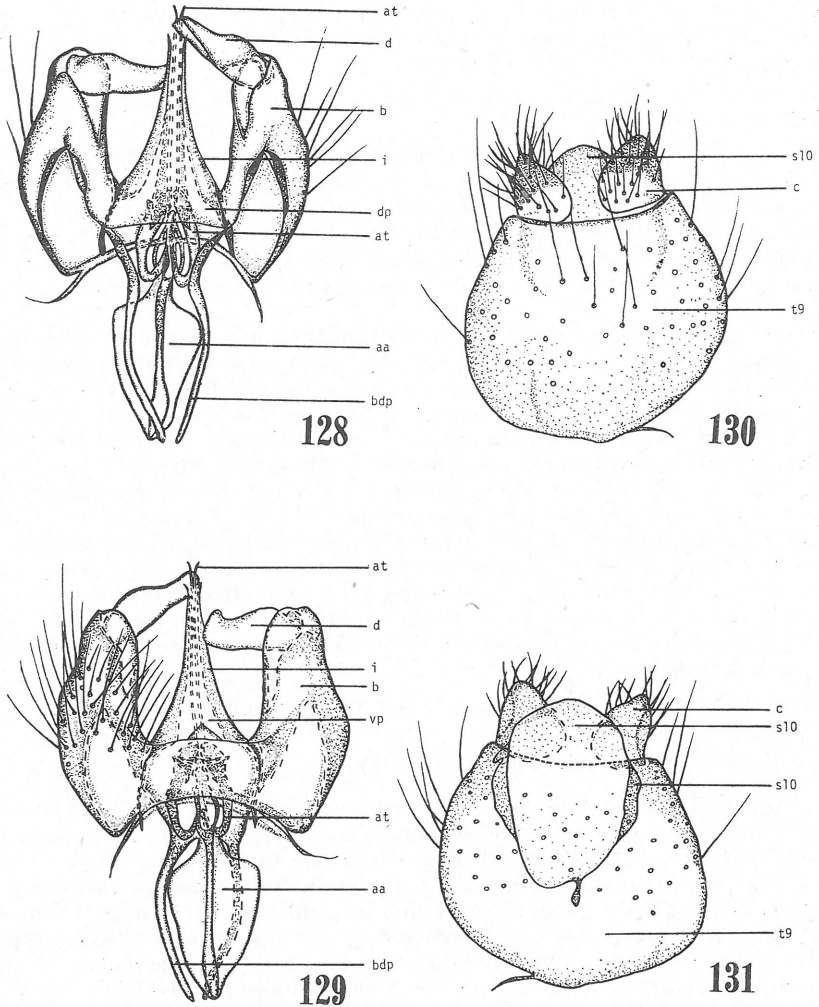
For male genitalia of the Athericidae see STUCKENBERG (1973) (who illustrated the genus *Suragina*) and NAGATOMI (1979) (the genera *Atherix*, *Suragina*, and *Atrichops*). The genera *Atherix*, *Suragina*, and *Atrichops*, all of which belong to the subfamily Athericinae, may easily be separated from the members of the family Tabanidae by having the following characters: dorsal bridge large; dorsal and ventral plates between interbases absent (although aedeagal tines appear to be enclosed by a transparent membrane). But the genus *Dasyomma* of the subfamily Dasyomminae here illustrated has the male genitalia without the characters mentioned above. Thus the male genitalia of Athericidae are very similar to those of Tabanidae, although they may be distinguished from each other as shown in the key (couplet 13). It appears that the posterior part of aedeagus is present or longer in Tabanidae but absent or shorter in Athericidae.

The male genitalia of Athericidae and Tabanidae are characterized among the lower Brachycera by having the aedeagal tines, i.e., a pair of long sclerites, which are strongly curved (counterclockwise from base to apex) at basal portion and situated behind anterior bar of aedeagus.

#### Subfamily Dasyomminae

Genus *Dasyomma* MACQUART, 1840. *D. flava* HARDY, 1933 (det. by D. H. COLLESS) (Figs. 128–131): Dististyle tapering posteriorly or parallel-sided according to the view from different angles, and with outer apex angulate. Basistyle comparatively long, widest before middle, and with hairs at ventral surface. Sternum 9 absent and mid-antero-ventral part of hypopygium short.

Mid-posterior part of hypopygium is long, tapering posteriorly, and consists of pair of interbases, which is more sclerotized, and dorsal and ventral plates between interbases. Dorsal bridge absent or fused with dorsal plate.



Figs. 128—131. *Dasyomma flava* HARDY: 128, 130, dorsal view; 129, 131, ventral view.

Posterior part of aedeagus appears to be absent or very short. Anterior bar of aedeagus like a trigonal prism and with a mid-ventral sclerotized line.

Pair of basistylar dorso-inner processes conspicuously long. Pair of aedeagal dorso-anterior sclerites is distinct but the degree of inclusion by a transparent lobe is uncertain.

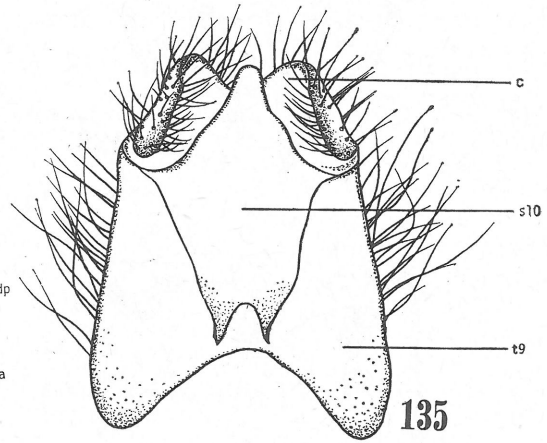
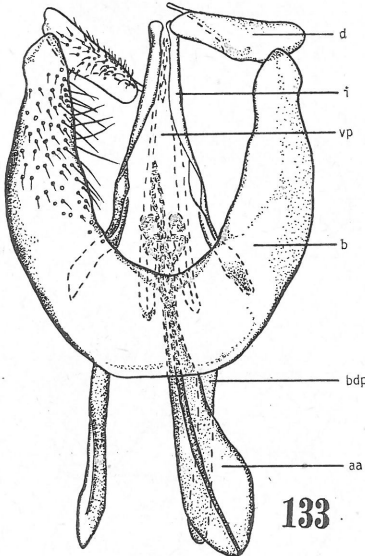
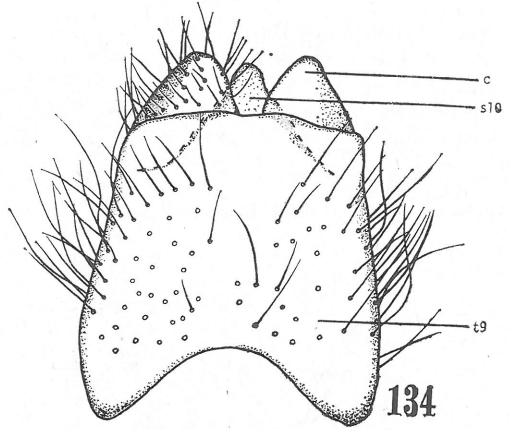
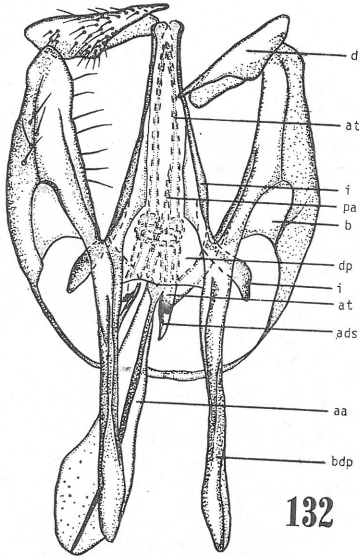
Tergum 9 with lateral margins convex, with anterior margin not concave, with posterior margin nearly transverse, and with hairs except anterior part. Sternum 10 with posterior margin rather gently convex and with lateral part having a sclerotized elongate piece. Cercus wider than long, with posterior margin rather rounded, and with dorsal surface haired.

Specimen dissected: 1♂, Belmore Falls, New South Wales, Australia, 23. i. 1963, D. H. COLLESS.

#### Family Tabanidae (Figs. 132—142)

For male genitalia of Tabanidae "see the many figures given by MACKERRAS 1954, 1955, and subsequent papers, and by BONHAG 1951, and BROMLEY, 1926" (after STUCKENBERG 1973: 658).





Figs. 132–135. *Stonemyia yezoensis* (SHIRAKI): 132, 134, dorsal view; 133, 135, ventral view.

They are very similar to those of *Athericidae* but may be distinguished from the latter as shown in the key (couplet 13).

A key to the subfamilies is cited, and 3 genera and 3 species are taken below as examples.

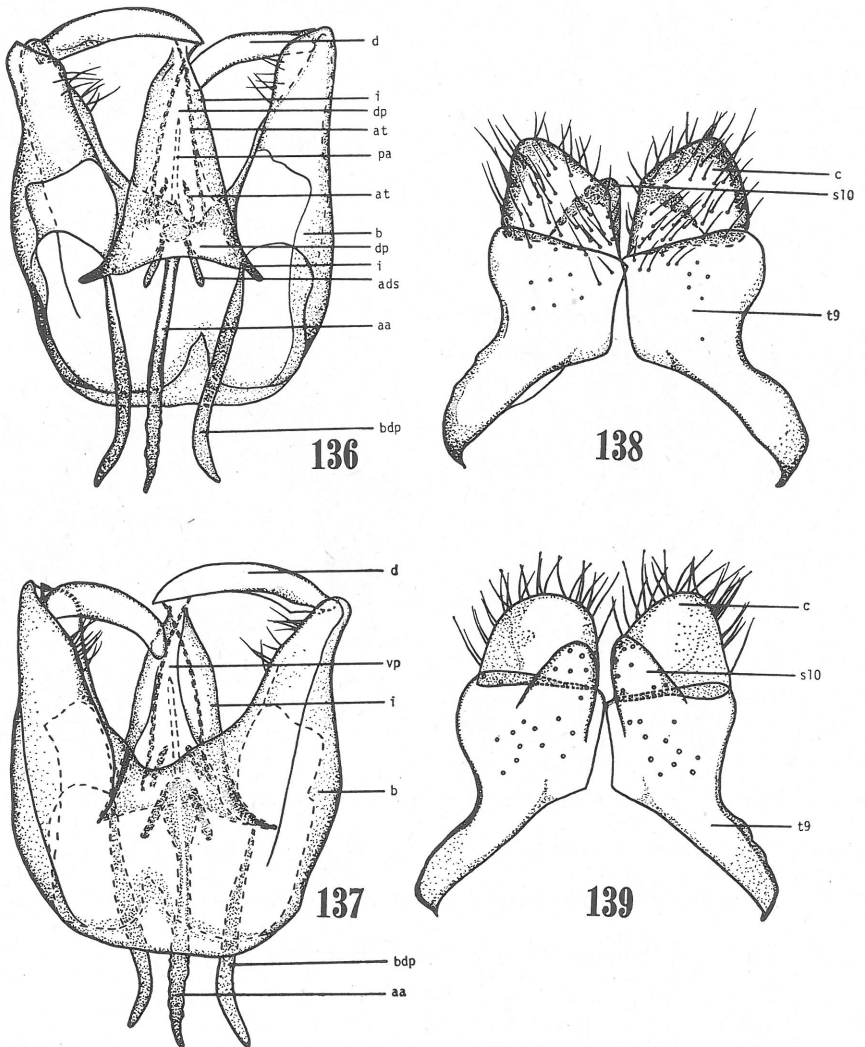
**Key to subfamilies of *Tabanidae* (after MACKERRAS 1956)**

- 1. "Ninth tergite entire, large and shield-like" . . . . . *Pangoniinae* . . . . . 2
- "Ninth tergite divided, the halves approximated" . . . . . 3
- 2. "Style (= dististyle) bifid" . . . . . *Pangoniini*
- "Style simple" . . . . . *Scionini*

3. "Style pointed" . . . . . Chrysopsinae  
 — "Style truncate" . . . . . Tabaninae

Subfamily Pangoniinae

Genus *Stonemyia* BRENNAN, 1935. *S. yezoensis* (SHIRAKI, 1918) (Figs. 132–135): Dististyle bifid, i.e., apical portion divided into dorsal and ventral parts, of which the former longer and narrower than the latter (which is lamellate) and pointed at apex. Dististyle (except base and apex) haired. Basistyle long and with longer and shorter hairs along ventro-inner and dorso-inner margins (except bases and apices) respectively. Sternum 9 absent and mid-antero-ventral part of hypopygium short. Mid-posterior part of hypopygium tapers posteriorly and consists of pair of sclerotized interbases, and dorsal and ventral transparent membranes between interbases.



Figs. 136–139. *Chrysops japonicus* WIEDEMANN: 136, 138, dorsal view; 137, 139, ventral view.

Posterior part of aedeagus is long [its end was uncertain in location in specimen on hand]. Anterior bar of aedeagus like trigonal prism and with a median sclerotized ventral line. Pair of basistylar dorso-inner anterior processes wider at apical portion than at the middle, very long, and extending far beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerites is long and distinct but the degree of inclusion by a transparent lobe was uncertain.

Tergum 9 wider anteriorly, widely concave at anterior margin, and with long hairs at dorsal surface except anterior and posterior parts. In sternum 10, posterior part triangular in shape and anterior part longer than wide, tapering anteriorly, with anterior margin concave, and with antero-lateral part more sclerotized. Cercus wider than long, covered with hairs which are longer at dorsal surface, and with lateral part curved ventro-inwardly.

Specimen dissected: 1♂, Mt. Takachiho, Kirishima, Kagoshima Pref., 29. vii. 1962, A. NAGATOMI.

#### Subfamily Chrysopsinae

Genus *Chrysops* MEIGEN, 1803. *C. japonicus* WIEDEMANN, 1828 (Figs. 136–139): Dististyle long, with outer and inner margins gently curved and roughly parallel-sided, and with apex pointed. Basistyle long, strongly tapering posteriorly, and with inner-apical portion haired. Sternum 9 absent and mid-antero-ventral part of hypopygium long. Mid-posterior part of hypopygium is long, tapers posteriorly, and consists of dorsal and ventral plates, and a pair of interbases, all of which are fused with one another (interbases more sclerotized).

Posterior part of aedeagus appears to be long [but its end was uncertain in location in specimen on hand]. Anterior bar of aedeagus long and stick-like.

Pair of basistylar dorso-inner anterior processes extends far beyond anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerite is long but the degree of inclusion by a transparent lobe was uncertain.

Tergum 9 divided in two and in each sclerite anterior part running antero-laterally, tapering anteriorly, and with one short acute process directed postero-inwardly at terminal point; tergum 9 with hairs along posterior margin. Sternum 10 divided in two by a mid-desclerotized line and each sclerite haired, tapering posteriorly but with apex rounded. Cercus haired at dorsal and ventral surfaces, wider than long, and with posterior margin rounded.

Specimens dissected: 1♂, Kaseda, Kagoshima Pref., 14. iii. 1964, K. HASHIMOTO; 1♂, Terayama, Kagoshima City, 27. iii. 1966, A. TANAKA.

#### Subfamily Tabaninae

Genus *Tabanus* LINNAEUS, 1758. *T. flavimediodes* SHIRAKI, 1918 (Figs. 140–142): Dististyle situated not at apex but dorsal surface of basistyle. Dististyle roughly parallel-sided, with inner margin longer than the outer, and with dorso-outer part at apex having a triangular process. Basistyle long, with inner part at or near middle having a few pile. Sternum 9 absent and mid-antero-ventral part of hypopygium very long.

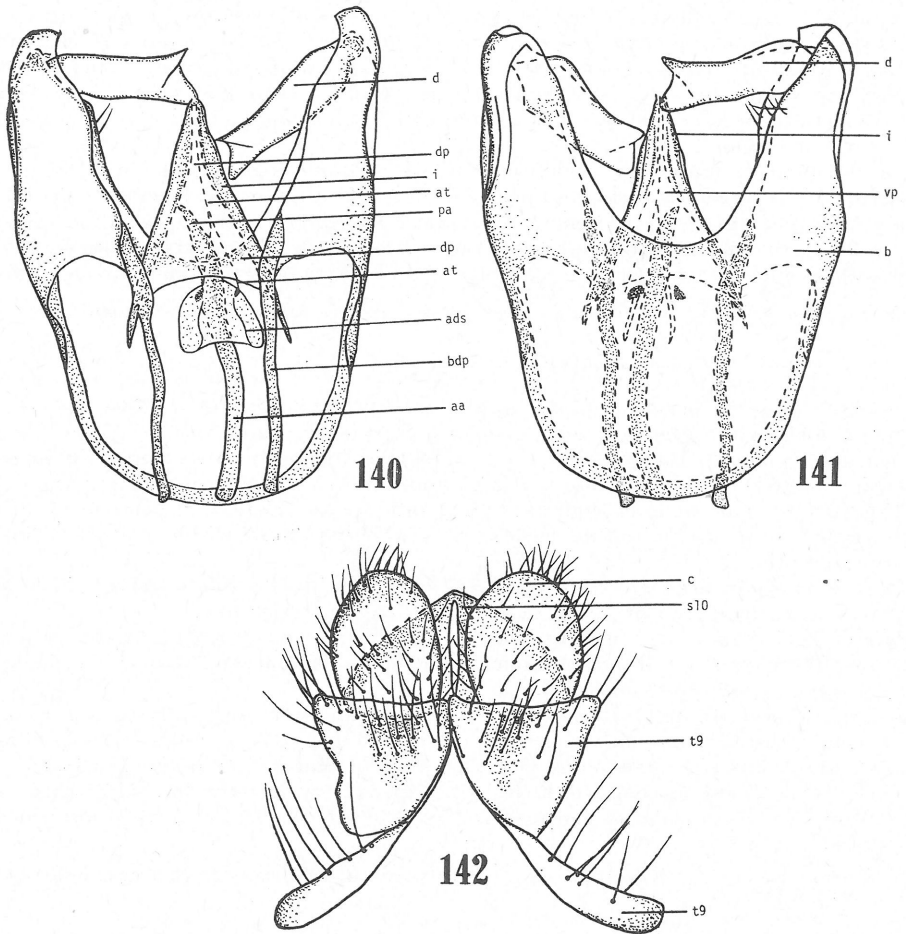
Mid-posterior part of hypopygium tapers posteriorly, and consists of dorsal and ventral plates, and pair of interbases, all of which are fused with one another (interbases more sclerotized).

Posterior part of aedeagus appears to be not long but was uncertain in exact length. Anterior bar of aedeagus long and stick-like.

Pair of basistylar dorso-inner anterior processes is long but does not extend anterior margin of hypopygium. Pair of aedeagal dorso-anterior sclerites is thin, long, and distinct but the degree of inclusion by a transparent lobe was uncertain.

Tergum 9 divided in two, and in each sclerite anterior part running antero-laterally, wider anteriorly, and with hairs along outer margin, while posterior part roughly triangular in shape and with hairs at dorso-posterior portion. Sternum 10 haired, large, with posterior part semicircular in shape, and divided by a mid-desclerotized line. Cercus about as long as wide, with posterior margin rounded, and with hairs at dorsal and ventral surfaces.

Specimen dissected: 1♂, Toso, Kagoshima City, 14. v. 1964, K. HASHIMOTO.



Figs. 140–142. *Tabanus flavimedioides* SHIRAKI: 140, 142, dorsal view; 141, ventral view.

#### Family Vermileonidae (Figs. 143–151)

The male genitalia of Vermileonidae are similar to those of Stratiomyidae, Pantophthalmidae and Xylophagidae by having the mid-ventral surface of hypopygium (except mid-posterior concavity) higher (horizontally) or almost level with base of dististyle, but are easily distinguished from the latter three as shown in the key (couplets 2, 5, and 7).

Only two species, i.e., *Vermileo comstocki* and *Lampromyia intermedia* are treated in this paper, so the reader must consult the work by STUCKENBERG (1960) who illustrated and described in detail the male genitalia of the genus *Lampromyia*, dealing with a number of species.

“The terminal abdominal structures of the male are extremely useful for distinguishing species, species-groups and subgenera in *Lampromyia*, . . .” (after STUCKENBERG 1960: 225). The aedeagus, dorsal bridge, concavity at mid-postero-ventral margin of hypopygium, dististyle, tergum 9, etc. vary considerably in shape with the species at least in *Lampromyia*. For example, “Aedeagus nearly always with a pair of lateral accessory processes” in *Lampromyia* (s. str.), while “Aedeagus a simple, tubular organ without lateral accessory processes” in *Lampromyia* (*Vermipardus*) (after STUCKENBERG 1960: 227);

tergum 9 about twice as long as greatest width in some species (see Figs. 37 and 42 by STUCKENBERG, 1960); etc.

The genus *Vermileo* may be distinguished from *Lampromyia* by having anterior bar of aedeagus. In *Lampromyia* anterior bar of aedeagus is vestigial (if present).

Genus *Vermileo* MACQUART, 1834. *V. comstocki* WHEELER, 1918 (det. by E. I. SCHLINGER) (Figs. 143–146): Dististyle conical and curved. In basistyle, dorsal surface tapering posteriorly, pointed at apex, and with a bridge (extending to ventro-posterior margin of hypopygium) before dististyle, while ventral surface not divided in two but forming one sheet and longer than the dorsal surface. Sternum 9 absent.

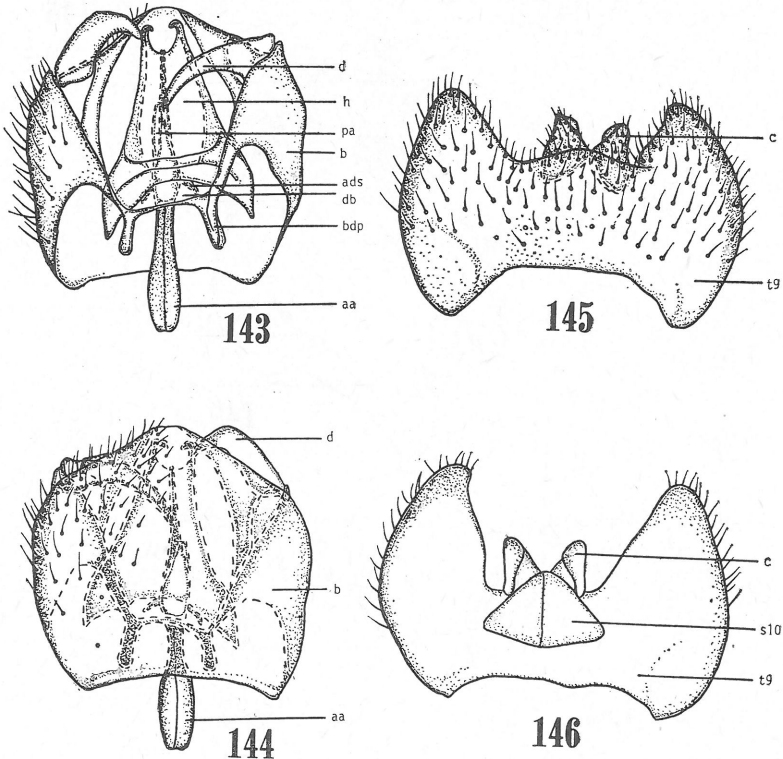
There is a half-opened umbrella between basistyles. This structure encloses posterior part of aedeagus, and its latero-apical margins and mid-dorsal longitudinal line are more sclerotized, and with dorsal surface strongly concave. Dorsal bridge transparent (except for anterior margin) and its posterior part is fused with umbrella mentioned above.

In aedeagus, posterior part about 1/2 as long as anterior bar which is roughly stick-like from a lateral view, wider somewhat anteriorly from a dorsal or ventral view, and more sclerotized along mid-ventral and lateral lines.

Pair of basistylar dorso-inner anterior processes short. Pair of aedeagal dorso-anterior sclerites is distinct and appears to be entirely included in a transparent lobe.

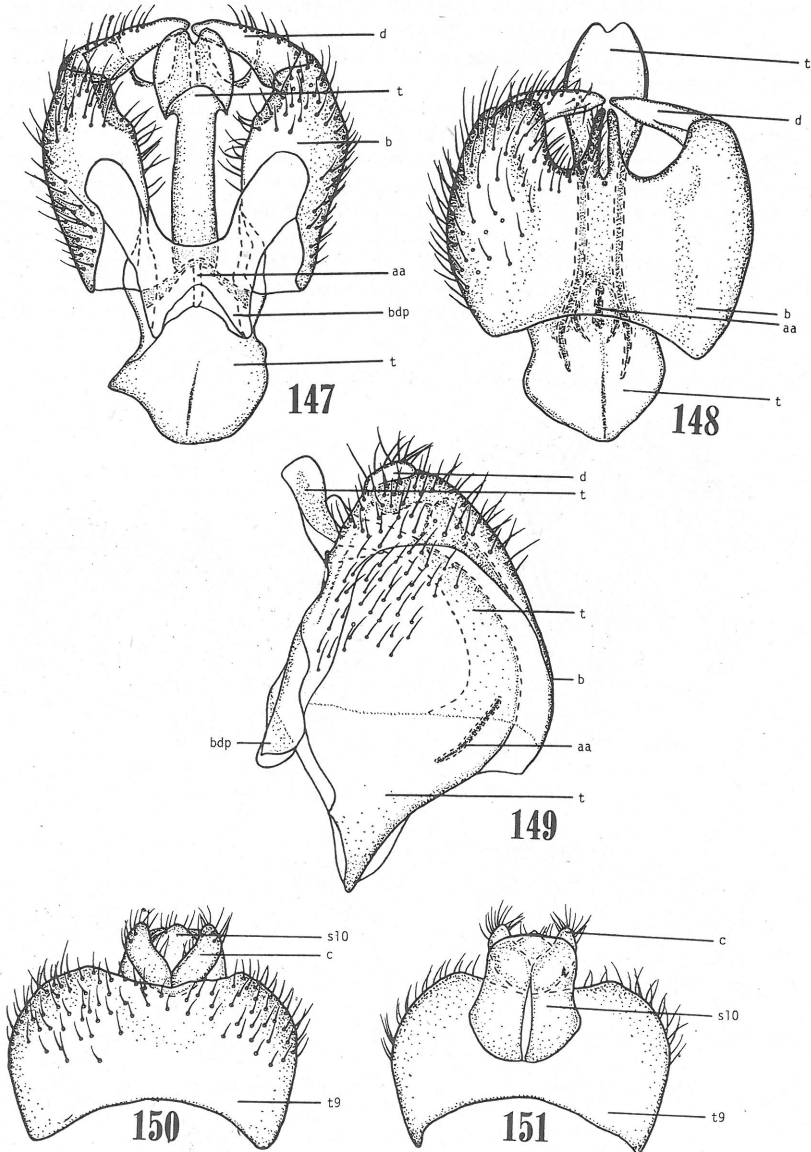
Tergum 9 wider than long, with anterior and posterior margins widely and deeply concave, and its mid-anterior and mid-posterior margins long and transverse. Dorsal surface (except anterior part) of tergum 9 with short hairs. Sternum 10 is small, appears to be divided by a desclerotized mid-line into two parts which are triangular in shape. Cercus small, triangular in shape (from a lateral view), twisted at apical portion, and with hairs which are short and indistinct.

Specimen dissected: 1♂, Donner Pass, Nevada Co., California, 4. vii. 1962, J. POWELL.



Figs. 143–146. *Vermileo comstocki* WHEELER: 143, 145, dorsal view; 144, 146, ventral view.

Genus *Lampromyia* MACQUART, 1835. *L. intermedia* STUCKENBERG, 1955 (det. by B. R. STUCKENBERG) (Figs. 147–151): Dististyle tapering apically, pointed or rather transverse at apex according to the view from different angles, and haired except dorso-apical part. In basistyle, dorsal surface widest at or behind middle, and haired, while ventral surface not divided in two but forming one sheet, with posterior margin concave but having a pair of long processes at middle, and with posterior part haired. A bridge between dorsal and ventral surfaces is present near dististyle. Sternum 9 absent.



Figs. 147–151. *Lampromyia intermedia* STUCKENBERG: 147, 150, dorsal view; 148, 151, ventral view; 149, lateral view.

Between basistyles there is a large trumpet which may not be aedeagus itself. The trumpet strongly arched ventrally, with antero-ventral part extending far beyond hypopygium and having a mid-longitudinal sclerotized line, and with posterior part having a labellum. Inside trumpet there is a small sclerotized stick which may be anterior bar of aedeagus. Pair of basistylar dorso-inner anterior processes is short and a bridge is present between them. Pair of aedeagal dorso-anterior sclerites is not found.

Tergum 9 wider than long, with lateral margins convex, with anterior and posterior margins concave and with dorsal surface except anterior part haired. Sternum 10 with posterior part rectangular and with anterior part wider than the posterior, having anterior margin rounded, and having mid-longitudinal desclerotized line. Cercus rather trapezoid (from a lateral view), with outer margin longer than the inner, and with dorsal surface haired.

Specimen dissected: 1♂, Grahamstown, South Africa, x. 1958, B. R. STUCKENBERG.

Discussion

1. Primitive or derivative characters in male genitalia

It is very difficult to determine which type of character is primitive or derivative in male genitalia. I venture to conclude and arrange the genera of the lower Brachycera whose male genitalia are supposed to undergo a change from old to new fashion, i.e., from I to IV in Table 1.

Table 1.  
Types of male genitalia in lower Brachycera supposedly undergoing a change from old to new fashion, i. e., from I to IV

	I	II	III	IV
(1)	.....		(X) <i>Stratiomys</i> .....	(X) <i>Pachygaster</i> et al.
(2)	.....		(Y) <i>Solva</i>	
(3)	.....		(X) <i>Pantophthalmus</i>	
(4)	(X) <i>Rachicerus</i>			
(5)	.....		(Y) <i>Xylophagus</i>	
(6)	.....			(Y) <i>Coenomyia</i> et al.
(7)	(Y) <i>Heterostomus</i>			
(8)	.....	(Y) <i>Exeretoneura</i>		
(9)	.....		(Y) <i>Pelecorhynchus</i>	
(10)	.....	(Y) <i>Austroleptis</i> [et <i>Alloleptis</i> ]	(Y) [several general]..	(Y) <i>Rhagio</i> et <i>Chrysopilus</i>
(11)	.....		(Y) <i>Dasyomma</i> .....	(Y) <i>Atherix</i> et al.
(12)	.....		(Y) <i>Stonemyia</i> .....	(Y) <i>Tabanus</i> et al.
(13)	.....	(Y) <i>Vermilio</i>	(X) <i>Lampromyia</i>	

Notes. (X) & (Y): see couplet 1 of the key; (1): Stratiomyidae; (2): Solvidae; (3): Pantophthalmidae; (4): Rachiceridae; (5): Xylophagidae; (6): Coenomyiidae; (7): Heterostomidae; (8): Exeretoneuridae; (9): Pelecorhynchidae; (10): Rhagionidae; (11): Athericidae; (12): Tabanidae; (13): Vermilionidae; (1) & (2): Stratiomyoidea; (3)–(8): Xylophagoidea; (9) & (10): Rhagionoidea; (11) & (12): Tabanoidea; (1)–(8): Stratiomyoidea; (9)–(12): Tabanoidea.

In *Rachicerus* and *Heterostomus*, the anterior part of aedeagus consists of a very large dorso-horizontal lobe and a ventral or ventro-vertical plate, in which the former may correspond to aedeagal dorso-anterior plate, while in other genera the aedeagal dorso-anterior plate is very small or often absent.

In *Pachygaster* et al. anterior part of aedeagus is divided into two lobes, while in *Stratiomys* et al. and *Solva* it is not, and in this case the type of *Pachygaster* et al. may be advanced.

In *Exeretoneura*, *Xylophagus*, and *Coenomyia* et al. the male genitalia of the last one seem to be specialized.

In *Austroleptis*, the mid-posterior part of hypopygium consists of the dorsal and ventral plates which are not fused with but apart from each other, the dorsal plate like a conical tube, and the anterior bar of aedeagus very peculiar (like a spoon) in shape. Thus the male genitalia of *Austroleptis* is very different from those of other Rhagionid genera.

Among the genera of Rhagionidae the male genitalia of *Rhagio* and *Chrysopilus* become simpler, i.e., ventral lobe, mid plate and half-opened umbrella (enclosing posterior part of

aedeagus) absent, dorsal and ventral plates and anterior bar of aedeagus not complicated in structure, posterior part of aedeagus short, sternum 9 (if present) not bulging out, etc.

In *Dasyomma* the large dorsal bridge is absent and the structure of mid-posterior part of hypopygium is similar to that of Tabanidae.

In *Stonemyia* anterior bar of aedeagus is like a trigonal prism as in the genera of Athericidae.

In *Vermileo* a distinct anterior bar of aedeagus is present. In *Lampromyia* a small sclerotized stick, inside trumpet between basistyles, may correspond to anterior bar of aedeagus. If so, the type of male genitalia of *Lampromyia* is thought to be apomorphic.

(1) The tergum 9 is strongly arched in the genera *Rachicerus*, *Xylophagus*, *Exeretoneura*, and *Pelecorhynchus* but rather flat in *Pantophthalmus*, *Coenomyia* et al., *Heterostomus*, *Rhagio* et al. etc., and among the former four genera (2) the postero-lateral part of tergum 9 is developed ventro-inwardly into a plate or flap in *Rachicerus* and *Pelecorhynchus* but not in *Xylophagus* and *Exeretoneura*. It is questionable whether these two characters are plesiomorphic or are developed in each group of the lower Brachycera independently of the phylogenetic relationship. The former view seems to be more probable.

## 2. Homology of aedeagus or structures near aedeagus among different families

There are several questions as follows: (1) "half-opened umbrella" (enclosing posterior part of aedeagus) in *Vermileo* or dorsal plate (forming a tube) in *Austroleptis* is homologous with that in *Atherimorpha*, *Neorhagio* and *Rhagina* or median tube in *Arthroteles*; (2) "half-opened umbrella" in *Vermileo* is homologous with "trumpet" (between basistyles) in *Lampromyia*, that is to say, anterior bar of aedeagus in *Vermileo* is homologous with a small sclerotized stick inside "trumpet" in *Lampromyia*; (3) elongate stick produced mid-dorsally and anteriorly from aedeagus (see Figs. 87, 90, 96, 100, 104, 112 and 117 by Rozkošný, 1973) in *Beris* and *Exodontha* is homologous with anterior bar of aedeagus; (4) aedeagus in Stratiomyidae, Solvidae and Pantophthalmidae is homologous with "half-opened umbrella" (or "trumpet") in Vermileonidae and Rhagionidae or dorsal plate in *Austroleptis* and median tube in *Arthroteles*.

The matter in (2) is almost certain and those in (1), (3) and (4) are not deniable. If (4) is correct and the "half-opened umbrella" is not the part of aedeagus, the aedeagus in Stratiomyidae, Solvidae and Pantophthalmidae will be not homologous but analogous with that in other families strictly speaking. When the (1)–(4) above are accepted as a fact, the following supposition can be made: the structures (including aedeagus) between basistyles in Stratiomyidae, Solvidae and Pantophthalmidae are more specialized than in *Vermileo*. Perhaps the structures in question are advanced in two ways roughly speaking, that is, the posterior part (including "half-opened umbrella") of aedeagus becomes atrophied with the development of dorsal and ventral plates or the anterior bar of aedeagus becomes degenerate.

## 3. Intermediate characters between family diagnoses

The male genitalia of the lower Brachycera are peculiar to each family but strictly speaking there may not be a clear divide between some families.

A pair of aedeagal tines is found only in Athericidae and Tabanidae. But STUCKENBERG (1973: 655) stated: "[In Rhagionidae] the aedeagus contains no endophallic [= aedeagal] tines like those characteristic of the other two groups [= Athericidae and Tabanidae], a difference at once apparent in preparations. What appear to be precursor conditions can however be demonstrated; careful study has shown that in some species (*Rhagio scolopaceus*, fig. 8, and some South African and Australian species of *Atherimorpha*) there is a pair of very small, weak, curved rods that arise at a subapical [near center of hypopygium] swelling on the endophallic apodeme [= anteriorbar of aedeagus]. These are situated at the same place at which the tines are attached, and have the same special relationship with the endophallic sclerites (es) [= aedeagal dorso-anterior sclerites]; however, their smallness and weakness, and relationship with other parts of the aedeagus, indicate that they cannot function in the same way as the tines. In *Chrysopilus* species there is a pair



of minute, microsetose sclerites immediately posterior to the distal [toward center of hypopygium] end of the endophallic apodeme; these appear to be comparable in their sensory nature and position to the microsetose apex of the endophallic tines, adjacent to the endophallic hilt in the athericiform genera and tabanids."

In *Bolbomyia* spec. illustrated and described in this paper, a pair of tines is found along the posterior part of aedeagus, and this structure may be homologous with the aedeagal tines. If so, the difference of male genitalia between Rhagionoidea (Pelecorhynchidae and Rhagionidae) and Tabanoidea (Athericidae and Tabanidae) is not profound.

The male genitalia of *Dasyomma* (Athericidae) are very similar to those of *Stonemyia* (Tabanidae), so a rather slight character can be given in the key (couplet 13).

Among Rhagionidae, the male genitalia of *Austroleptis* is peculiar. But the male genitalia of *Alloleptis* will be similar to those of *Austroleptis*, granting that the mid-apical part of hypopygium is composed of dorsal plate only and ventral ridge corresponds to ventral plate.

#### 4. Systematic positions of some families or genera

A classification of the lower Brachycera was proposed by NAGATOMI (1977), and one of the aims of this paper is to verify it. There is nothing worthy of special modification, but the systematic positions of several taxa may have to be reconsidered after examination of male genitalia.

Each family of the lower Brachycera is peculiar in male genitalia and may be at once distinguished from one another except for Coenomyiidae which are very similar to Rhagionidae, although the genera of Coenomyiidae, which are almost identical with one another in male genitalia, may easily be separated from each genus of Rhagionidae, which may be characteristic in the details of male genitalia.

The Coenomyiidae will be put in the superfamily including Rhagionidae upon the examination of male genitalia alone. But the larvae of the genera *Rachicerus*, *Xylophagus* and *Coenomyia* are very similar to one another and very different from the genera of Tabanoidea, i.e., *Pelecorhynchus*, *Rhagio* et al., *Atherix* et al., and *Tabanus* et al.

"Larvae of Xylophagidae [= *Rachicerus*, *Xylophagus* and *Coenomyia*] are among the most distinctive of the Diptera with their darkly sclerotized, sharply conical head capsule and sclerotized plates on one or more thoracic segments and (or) on the terminal abdominal segment. These areas contrast strongly in colour with the whitish integument elsewhere (Figs. 34–36). The head is permanently exerted." (after ТЕСКЕУ 1976: 35). Whereas in the larvae of Rhagionidae (as well as Pelecorhynchidae, Athericidae, Tabanidae and Vermileonidae) the head capsule is slightly sclerotized and retractile within thorax and the body has no sclerotized plate.

If Coenomyiidae are closer to Rhagionidae than to Xylophagidae, the larval diagnosis mentioned above becomes meaningless phylogenetically. It is probable that a similarity of male genitalia between Coenomyiidae and Rhagionidae is superficial and the result of convergence.

*Heterostomus* is closer in male genitalia to *Exeretoneura* than to *Coenomyia* et al. and a new family Heterostomidae is erected in this paper.

The male genitalia (as well as female terminalia) of *Austroleptis* are very peculiar and it may be appropriate to create a new family Austroleptidae. But I cannot help much hesitation in creating such a number of new families. So I still put *Austroleptis* in Rhagionidae.

#### 5. Validity of small families

There are a number of small families such as Rachiceridae, Xylophagidae, Heterostomidae, Exeretoneuridae and Pelecorhynchidae. If Solvidae are separated from Stratiomyidae, and Athericidae from Tabanidae, the small families above must be recognized in order to keep the balance.

However, it may be better from a practical point of view to reduce Rachiceridae, Coenomyiidae, Heterostomidae and Exeretoneuridae to the subfamilies of Xylophagidae, although the male genitalia of these groups are very different from one another.

### Conclusions

- (1) To determine the phylogenetical relationships in the lower Brachycera is difficult on the basis of the male genitalia alone, because the male genitalia often vary considerably within the same natural unit, e.g., Xylophagoidea (Rachiceridae, Xylophagidae, Coenomyiidae, Heterostomidae and Exeretoneuridae); Vermileonidae; Spaniinae (Rhagionidae); Rhagio-group (Rhagionidae) (*Atherimorpha*, *Arthroteles*, *Neorhagio*, *Rhagina* and *Rhagio*); etc.
- (2) It is difficult to determine which type of character is primitive or derivative in male genitalia, although a supposition is made and shown in Table 1.
- (3) Perhaps the structures (including aedeagus) between basistyles are advanced in two ways, that is, the posterior part (including "half-open umbrella") of aedeagus becomes atrophied with the development of dorsal and ventral plates or the anterior bar of aedeagus becomes degenerate.
- (4) The male genitalia of the lower Brachycera are peculiar to each family but strictly speaking there may not necessarily be a clear divide between some families, i.e., Rhagionidae and Athericidae; Athericidae and Tabanidae.
- (5) No special modification to NAGATOMI (1977) on the classification of lower Brachycera seems to be necessary upon the examination of male genitalia, but *Heterostomus* may be more similar to *Exeretoneura* than to *Coenomyia* et al. and Heterostomidae are erected as a new family.
- (6) The male genitalia of *Austroleptis* and those of *Bolbomyia* are peculiar among Rhagionidae but these two genera especially the latter seem to fall within this family.
- (7) A number of small families must be recognized in order to keep the balance but it may be better from a practical point of view to reduce Rachiceridae, Coenomyiidae, Heterostomidae and Exeretoneuridae to the subfamilies of Xylophagidae, although the male genitalia of these groups are very different from one another.

### Summary

The male genitalia of the lower Brachycera are described and illustrated, dealing with a total of 37 species and 33 genera. Keys to 13 families of the lower Brachycera and 18 genera of the Rhagionidae are presented but are not arranged from the phylogenetical point of view. To determine the phylogenetical relationships on the basis of the male genitalia alone is difficult. — Several questions are discussed as to the primitive or derivative characters, homology of aedeagus or the structures near aedeagus, intermediate characters between families, systematic positions of some families, and the validity of small families.

### Zusammenfassung

Die männlichen Genitalien der niederen Brachycera werden beschrieben und abgebildet, wobei insgesamt 37 Arten und 33 Gattungen behandelt werden. Bestimmungstabellen für 13 Familien von niederen Brachycera und 18 Gattungen von Rhagionidae werden vorgelegt, aber nicht nach phylogenetischen Gesichtspunkten angeordnet. Es ist schwierig, die phylogenetischen Beziehungen allein auf der Grundlage der männlichen Genitalien zu bestimmen. — Es werden mehrere Fragen erörtert im Hinblick auf die ursprünglichen oder abgeleiteten Merkmale, die Homologie des Aedeagus oder der Strukturen nahe dem Aedeagus, Zwischenmerkmale zwischen Familien, die Stellung einiger Familien im System und die Gültigkeit kleiner Familien.

### Резюме

На основе 37 видов и 33 родов описываются и иллюстрируются низшие Brachycera. Приводятся ключи 13 семейств низших Brachycera и 18 видов Rhagionidae, которые, однако, не систематизируются с филогенетической точки зрения. Трудно определить филогенетическое отношение исключительно на основе мужских гениталий. — Обсуждаются различные вопросы относительно примитивных или производных признаков, гомологии аedeagus или структур вблизи аedeagus, межсемейственных признаков, систематических положений некоторых семейств и валидности мелких семейств.

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