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The structure of the mouthparts of the orthorrhaphous Brachycera (Diptera) with special reference to blood-sucking

With 480 text figures

Introduction

The aim of this paper is to clarify the structure of the mouthparts in the orthorrhaphous Brachycera especially the Tabanomorpha from the taxonomic point of view and to establish the presence, absence or reduction of the mandibles in members of Tabanidea (Pelecorhynchidae, Rhagionidae, Athericidae and Tabanidae) whose sister group is the Stratiomyidea (Stratiomyidae, Xylophagidae, Coenomyiidae, etc.), in which no blood-sucking habit is recorded.

The structural diversity of any one part within the family or genus varies considerably in degree with the taxon and this may possibly be true of the mouthparts. The degeneration of mandibles in the lower Brachycera indicates the loss of the blood-sucking habit.

This paper is incomplete and may not be more than a rough sketch because of a number of defects as follows: (1) the material examined is very small in number of genera, species and individuals, (2) in most taxa, the male has not been examined, (3) the microstructure in the apical portions of the labrum and hypopharynx and the minute armature (when present) on the apical portions of lacinia and mandibles may have taxonomic importance, but they are not examined in this paper, (4) the pharyngeal pump and salivary pump are not described partly because they are easily cut off, (5) the theca varies in shape with the taxon but is not described, (6) no attention is paid to the number, length and arrangement of pseudotracheae on the labella, (7) no study is made of the musculature, and so on. However, it is hoped that knowledge is advanced in some respects in the present study and that further investigation will be stimulated.

Techniques and terminology

The head was cut off and put in 10% KOH for 20 hours or so, then in CH_3COOH for 30 minutes or so. After washing it was placed in glycerin on a slide without a cover glass and examined from various angles with a 40–160 times binocular or monocular microscope.

The shape of the labrum, hypopharynx and cibarial pump is described in ventral aspect unless otherwise specified. The length of the mid-distal interlabellar process means that part beyond the dorsal interlabellar plate (or membrane) or pair of processes.

In each species, the illustrations usually consist of the following 4 parts: (1) and (2) labrum, cibarial pump, etc., ventral and lateral views; (3) palpus and lacinia; (4) labium (including labellum and theca), lateral view.

The terminology adopted in this paper is shown in the figures where the abbreviations are as follows.

CL: clypeus (Figs. 2, 10, 14, 38, 42, 46, 160, 417, 424, 425, 464, 465, 473, 476, 478, 479).

CP: cibarial pump (Figs. 1, 2, 9, 10, 13, 14, 37, 38, 41, 42, 45, 134, 135, 147, 148, 159, 160, 183, 184, 187, 188, 232, 233, 336, 337, 408, 409, 413, 414, 416, 417, 424, 425, 428, 429, 436, 437, 464, 465, 468, 469, 472, 473, 475, 476, 478, 479).

DC: dorsal cornu (Figs. 1, 2, 9, 10, 13, 14, 37, 38, 41, 42, 45, 46, 134, 135, 147, 148, 159, 160, 183, 184, 187, 188, 232, 233, 336, 337, 408, 409, 428, 429, 436, 440, 464, 465, 468, 469, 472, 473, 475, 476, 478, 479).

DI: dorso-inner posterior process on labellum (Figs. 474, 477, 480).

E: epipharyngeal endoskeleton (Figs. 473, 476, 479).

H: hypopharynx (Figs. 2, 10, 14, 38, 42, 46, 135, 148, 160, 184, 188, 232, 233, 336, 337, 409, 425, 428, 429, 436, 437, 464, 465, 469, 472, 473, 475, 476, 478, 479).

LC: lacinia (Figs. 15, 41, 42, 43, 136, 149, 161, 185, 190, 234, 338, 359, 368, 411, 422, 426, 430, 434, 438, 446, 470).

LE: labellum (Figs. 8, 12, 16, 40, 44, 48, 65, 137, 150, 162, 186, 191, 204, 235, 331, 339, 407, 412, 423, 427, 431, 435, 439, 443, 471, 474, 477, 480).

LI: labium (Figs. 4, 419).

LR: labrum (Figs. 1, 2, 9, 10, 13, 14, 37, 38, 41, 42, 45, 46, 134, 135, 147, 148, 159, 160, 183, 184, 187, 188, 232, 233, 336, 337, 408, 409, 413, 414, 416, 417, 424, 425, 428, 429, 436, 437, 464, 465, 468, 469, 472, 473, 475, 476, 478, 479).

MA: mandible (Figs. 189, 194, 211, 220, 225, 262, 269, 274, 282, 287, 293, 298, 307, 316, 329, 342, 347, 348, 353, 358, 367, 372, 377, 386, 395, 400, 410).

MI: mid-distal interlabellar process (Fig. 407).

MP: mid-dorso-proximal process on labrum (Figs. 210, 224, 268, 273, 281, 286, 292, 297, 306, 315, 346, 352, 357, 366, 371, 376, 385, 399).

P: palpus (Figs. 3, 7, 136, 149, 161, 415, 418, 426, 430, 434, 438, 446, 470, 473, 476, 478, 479).

P1: palpal segment 1 (Figs. 15, 43, 185, 190, 234, 338, 359, 368, 411, 422).

P2: palpal segment 2 (Figs. 15, 43, 185, 190, 234, 338, 359, 368, 411, 422).

PP: pharyngeal pump (Figs. 1, 2, 10, 14, 37, 38, 134, 147, 148, 159, 160, 183, 184, 187, 188, 232, 233, 336, 337, 409, 414, 428, 429, 436, 464, 465).

SP: salivary pump (Figs. 2, 10, 147, 148, 336, 337, 409, 413, 414, 465).

ST: stipes (Figs. 41, 42, 43).

TH: theca (Figs. 8, 12, 16, 40, 44, 48, 65, 137, 150, 162, 186, 191, 204, 235, 331, 339, 412, 423, 427, 431, 435, 439, 443, 471, 474, 477, 480).

TO: torina (Figs. 10, 13, 14, 38, 42, 46, 159, 160, 183, 184, 214, 215, 424, 428, 429, 436, 448, 449, 464, 469).

TT: tooth on epipharynx (Figs. 472, 473, 476, 479).

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Family Stratiomyidae (Figs. 1–133)

A total of 29 genera and 33 species has been examined.

Labrum varied in shape, i. e. parallel-sided, tapering apically or widest at or near middle, and its apical margin transversely straight or concave but in those members of the subfamily Chiromyzinae examined, it is rounded or pointed according to the genus (or species); hypopharynx varied in shape and rounded or pointed apically; lacinia, when present, stick-like; mandible absent; maxillary palpus varied in shape, 1 or 2-segmented;

cibarial pump longer than wide and usually wider and longer than labrum; labellum longer than theca; mid-distal interlabellar process absent.

Torma large and long and clypeus firmly fused with base of labrum or anterior part of cibarial pump.

Labrum short or comparatively so and often wider than long; hypopharynx usually shorter than and rarely longer than labrum; lacinia (if present) various in length.

Among the lower Brachycera the mouthparts of Stratiomyidae are generally characterized by having a short labrum (although the labrum becomes long in several genera) and by having the torma large and long and the clypeus firmly fused with the base of labrum or anterior part of the cibarial pump.

Subfamily Chiromyzinae (Figs. 1—8)

In *Chiromyza papuae* and *Inopus rubriceps*, the labium is vestigial or short compared with other Stratiomyidae in this paper, the palpus is 1-segmented and the lacinia is absent. In *Chiromyza papuae*, the labrum is not longer than wide and is rounded at the lateral and apical margins, and the cibarial pump is coarctate near the base and beyond the middle. In *Inopus rubriceps*, the labrum is triangular in shape (i. e. pointed at apex).

Chiromyza papuae NAGATOMI & YUKAWA, 1969 (♀) (Figs. 1—4): labrum is not longer than wide, shorter (c. 0.4 times) than cibarial pump, rounded at lateral or anterior margin and appears to be slightly concave at apex; hypopharynx appears to be triangular and tapering apically and does not extend to apex of labrum; cibarial pump wider than labrum, as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and coarctate near base and beyond middle respectively; torma short and much shorter (c. 0.4 times) than cibarial pump [in Figs. 1—2 torma is not marked]; sclerotized base of pharyngeal pump rounded at one side and large; palpus 1-segmented, knob-like, somewhat longer (c. 1.3 times) than wide, not longer than labrum and with long hairs; lacinia appears to be absent; labium short and vestigial; labellum is not longer than labrum and appears to have no pseudotracheae. — Length: labrum 0.12 mm; cibarial pump 0.34 mm.

Chiromyza papuae (♀) is easily distinguished from *Inopus rubriceps* (♀), whose labium is also short, by having the labrum rounded at apical margin and much shorter than cibarial pump, and the cibarial pump coarctate near apex and beyond middle.

Specimen dissected: 1♀ (paratype), Lake Ivipa (Sirunki), 2800—2900 m, NE New Guinea, 15. vi. 1963, J. SEDLACEK.

Inopus rubriceps (MACQUART, 1847) (♀) (Figs. 5—8): labrum longer than wide, shorter (c. 0.7 times) than cibarial pump and triangular in shape (i. e. pointed at apex); hypopharynx shorter than labrum and rounded at antero-lateral margin; cibarial pump longer (c. 1.8 times) than wide and somewhat coarctate just before middle; breadth between dorsal cornua wider than cibarial pump; sclerotized base of pharyngeal pump may be smaller than in *Chiromyza papuae*; palpus 1-segmented, longer (c. 2.5 times) than wide, and about as long as cibarial pump; lacinia appears to be absent; labium short; labellum is about as long as labrum and appears to have no pseudotracheae; theca not sclerotized. Length: labrum 0.16 mm; cibarial pump 0.22 mm.

Inopus rubriceps (♀) is easily distinguished from *Chiromyza papuae* (♀), belonging to Chiromyzinae, by having the labrum rather pointed at apex and distinctly longer than wide, and the cibarial pump more smooth at side.

Specimen dissected: 1♀, Sydney, Australia, 11—13. iii. 1909, HELME Collection.

Subfamily Beridinae (Figs. 9—32)

This subfamily, which includes *Actina*, *Allognosta*, *Beris* and *Chorisops*, is evidently a natural or monophyletic group. But the mouthparts are not very characteristic. The 2 sclerotized spots (if present) of the labellum are subequal in length and width. The palpus is well developed and 2-segmented or practically so (when truly 3-segmented) in *Actina*, *Allognosta* and *Chorisops* but 1-segmented and often rudimental in *Beris*. The hypopharynx was always 1-segmented in the material examined.

Actina jezoensis (MATSUMURA, 1916) (♀) (Figs. 9—12): labrum longer than wide, 0.4 times or so as long as cibarial pump, widest around middle, and with apical margin

not pointed but wide; hypopharynx is longer than wide, shorter than labrum and appears to be rounded at lateral and anterior margins; cibarial pump wider than labrum, about $1\frac{1}{2}$ times as long as wide and bottle-shaped; behind the tube of the pharyngeal pump, there is a large sclerotized part with a thin process; palpus 2-segmented or practically so (true segment 1 short and easily cut off, if present), segment 1 longer than segment 2 and cylindrical, and segment 2 longer than wide and widest near apex; palpus longer than cibarial pump; lacinia appears to be absent; labellum is about twice as long as cibarial pump and has two elongate sclerotized parts which are weakly developed. — Length: labrum 0.12–0.14 mm; cibarial pump 0.30–0.32 mm.

Actina jezoensis (♀) is distinguished from *Chorisops maculiala* (♀) by the following characters: each segment of palpus is more elongate; labellum has two elongate sclerotized parts.

Specimens dissected: 1♀, Kagoshima City, 7. iv. 1968, A. TANAKA; 1♀, Is. Futagami, Ehime Pref., 28. iv. 1957, F. TAKECHI.

Allognosta flavofemoralis PLESKE, 1926 (♀) (Figs. 13–16): labrum much longer (c. 3.6 times) than wide, longer (c. 1.3 times) than cibarial pump, widest around middle, and with apical margin more or less concave; hypopharynx longer than wide, shorter than labrum, triangular (or nearly so) in shape and rather pointed at apex; cibarial pump wider than labrum and breadth between dorsal cornua respectively, somewhat longer (c. 1.2 times) than wide, and bottle-shaped; palpus with 2 segments, each of which is longer than wide, segment 1 cylindrical and segment 2 widest near apex; palpus longer (c. 1.4 times) than cibarial pump; lacinia slightly shorter (c. 0.9 times) than labrum and longer than palpal segment 1; labellum longer (1.7 times or so) than cibarial pump; labellum with 2 elongate sclerotized parts. — Length: labrum 0.36 mm; cibarial pump 0.28 mm.

Allognosta flavofemoralis (♀) may be distinguished from *A. vagans* (♀) by the labrum being longer than the cibarial pump.

The lacinia is present in *Allognosta* but absent in *Actina* and *Chorisops*, in the material of this paper.

Specimen dissected: 1♀, Mt. Wakasugi, Fukuoka Pref., 9. iv. 1959, K. MORIMOTO.

Allognosta vagans (LOEW, 1873) (= *A. sapporensis* MATSUMURA, 1916) (♀) (Figs. 17–20): labrum less than three times (1.9–2.5 times) as long as wide, not longer (0.9 times) than cibarial pump, widest around middle, and with apical margin more or less concave; hypopharynx shorter than labrum, longer than wide, widest near base and rather pointed at apex; cibarial pump much wider than labrum, wider than breadth between dorsal cornua, about as long as wide (0.9–1.0 times), and bottle-shaped; palpus 2-segmented, segment 1 cylindrical and segment 2 widest near apex; palpus longer (1.7–2.1 times) than cibarial pump; lacinia 1.0–1.3 times as long as labrum, and about as long as (1.1 times) palpal segment 1; labellum over twice (2.4–2.7 times) as long as cibarial pump; labellum with 2 elongate sclerotized parts. — Length: labrum 0.19 mm; cibarial pump 0.22 mm.

Allognosta vagans (♀) may be distinguished from *A. flavofemoralis* (♀) by the labrum being less than 3 times as long as wide and not longer than the cibarial pump.

Specimens dissected: 2♀, Kagoshima City, 29–30. v. 1961, A. NAGATOMI.

Beris fuscipes MEIGEN, 1820 (♀) (Figs. 21–24): labrum about as long as wide, much shorter (c. 0.4 times) than cibarial pump, abruptly widened near base and with apical margin transversely straight; hypopharynx longer than wide, about as long as labrum, pointed at apex and widest near base; cibarial pump (without mid-posterior part between dorsal cornua) wider than labrum, narrower than breadth between dorsal cornua, longer (1.5 times or so) than wide and bottle-shaped; a pair of dorsal cornua connected with each other at their bases; near the tube of the pharyngeal pump, there is a small sclerotized part with a process; palpus 1-segmented, elongate oval in shape, longer than wide, and much shorter (c. 0.4 times) than cibarial pump; lacinia absent; labellum longer (c. 1.9 times) than cibarial pump and without sclerotized part. — Length: labrum 0.11 mm; cibarial pump 0.29 mm.

The palpus is 1-segmented and knob-like in *Beris*.

Specimen dissected: 1♀, Narai, Nagano Pref., 25. vii. 1969, A. NAGATOMI.

Beris hirotsumi ŌUCHI, 1943 (♀) (Figs. 25–28): similar to *Beris fuscipes* (♀) but probably distinguished from the latter by the following characters: widened part of labrum more produced laterally; palpus wider than long, much shorter than labrum, and 0.06 to 0.09 times as long as cibarial pump; in 2 specimens dissected, labellum 2.2–2.4 times as long as cibarial pump. — Length: labrum 0.10 mm; cibarial pump 0.28–0.30 mm.

Specimens dissected: 2♀, Mt. Kurino, Kagoshima Pref., 23. v. 1969, K. KUSIGEMATI.

Chorisops maculiala NAGATOMI, 1964 (♀) (Figs. 29–32): labrum not much longer than wide, much shorter (c. 0.4 times) than cibarial pump, widest around middle and with apical margin wide; hypopharynx longer than wide and nearly as long as labrum; hypopharynx rounded except for the pointed mid-apex; cibarial pump wider than labrum, about $1\frac{1}{2}$ (c. 1.6 times) as long as wide, and widest around middle; breadth between dorsal cornua not narrower than cibarial pump; palpus 2-segmented or practically so (true segment 1 is short and easily cut off, if present), segment 1 cylindrical and segment 2 widest around middle; lacinia probably absent; labellum is nearly twice (c. 1.8 times) as long as cibarial pump and appears to have no sclerotized part. — Length: labrum 0.09 mm; cibarial pump 0.23 mm.

Chorisops maculiala (♀) is distinguished from *Actina jezoensis* (♀) by the following characters: each segment of palpus is more stout and labellum appears to have no sclerotized part.

Specimen dissected: 1♀, Kurume City, Fukuoka Pref., 11. vi. 1966, K. KUSIGEMATI.

Subfamily Stratiomyinae (Figs. 33–44)

On the basis of the mouthparts, this subfamily is divided into two groups, of which one contains *Stratiomys* and the other includes *Labostigmia* and *Odontomyia*. The mouthparts of these two groups are very characteristic (or specialized).

In *Stratiomys*, there is a large sclerite between the palpus and hypopharynx and this sclerite represents the lacinia + stipes.

In *Labostigmia* and *Odontomyia*, the breadth between dorsal cornua tapers apically.

Labostigmia obscura (OLIVIER, 1812) (♀) (det. by M. T. JAMES) (Figs. 33–36): labrum much longer than wide, longer (c. 1.3 times) than cibarial pump, tapering apically but with apical margin wide and with antero-lateral corners rounded; hypopharynx over $1\frac{1}{2}$ (c. 0.7 times) as long as labrum, much longer than wide, and with apex rather rounded; cibarial pump wider than labrum and than breadth between dorsal cornua, over twice (c. 2.4 times) as long as wide, and roughly parallel-sided except base and apical part which are narrower; breadth between dorsal cornua gradually tapering apically; dorsal cornu wider apically (in lateral view); palpus appears to be 2-segmented and to be $1\frac{1}{5}$ or so as long as cibarial pump [its outline is not always certain]; lacinia absent; labellum longer (c. 1.6 times) than cibarial pump, very elongate, not pendulous below theca, and the lateral part, which is sclerotized, has numerous, paler, small spots and has a more sclerotized bifurcate line; apical part of each labellum with 11 or so pseudotracheae; clypeus is fused with cibarial pump for a distance which is about $1\frac{1}{2}$ as long as the cibarial pump. — Length: labrum 0.94 mm; cibarial pump 0.71 mm.

Labostigmia obscura (♀) is distinguished from *Nemotelus crenatus* (♀) by having the labrum longer than the cibarial pump, the antero-lateral corner of labrum rounded, and the clypeus fused with the cibarial pump for a distance about $1\frac{1}{2}$ as long as cibarial pump.

Specimen dissected: 1♀, Willow Springs, Howell Co., Montana, 8. vi. 1960, W. T. VAN VELZEN.

Odontomyia garatas WALKER, 1849 (♀) (Figs. 37–40): labrum much longer than wide, shorter (c. 0.8 times) than cibarial pump, roughly parallel-sided (or somewhat wider basally) and with antero-lateral corner rounded; hypopharynx over $1\frac{1}{2}$ (c. 0.7 times) as long as labrum, longer than wide, tapering apically and with apex bluntly pointed or rather rounded; cibarial pump wider than labrum and than breadth between dorsal cornua, longer (c. 2.2 times) than wide, and widest near base; distance between dorsal cornua gradually narrowing apically; dorsal cornu much wider apically from a lateral view; palpus 2-segmented, and segment 2 about twice as long as wide, widest near apex and wider than segment 1 [whose length is not necessarily certain]: palpal segment 2, $1\frac{1}{4}$ or so as long as

cibarial pump; lacinia absent; labellum somewhat longer (c. 1.2 times) than cibarial pump; not very elongate, not pendulous below theca, with lateral surface sclerotized, and with two more sclerotized black parts, of which the basal is rather Y-shaped and the apical is shorter and narrower than the basal and runs obliquely; clypeus is fused with cibarial pump for a distance which is less than $1/2$ as long as cibarial pump. — Length: labrum 0.70 mm; cibarial pump 0.82 mm.

Odontomyia garatas (♀) is distinguished from *Labostigmia obscura* (♀) by having the labrum shorter than the cibarial pump and the labellum stouter.

Specimen dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 4. vii. 1951, A. NAGATOMI.

Stratiomys japonica VAN DER WULP, 1885 (♀) (Figs. 41–44): labrum longer than wide, shorter (c. 0.8 times) than cibarial pump, and roughly parallel-sided; hypopharynx over $1/2$ (0.8 times) as long as labrum, longer than wide, widest near middle, and pointed at apex; cibarial pump wider than labrum and than breadth between dorsal cornua, longer (2.4–2.5 times) than wide, widest near base, and roughly parallel-sided except basal part; breadth between dorsal cornua roughly parallel-sided; in palpus, which is 2-segmented, segment 1 largely desclerotized, and segment 2, 2.5 times or so as long as wide, widest near apex, and much shorter (c. 0.2 times) than cibarial pump; there is a well-defined large sclerotized part between the palpus and hypopharynx and this is lacinia + stipes; labellum about as long as cibarial pump, pendulous below ventral labial stalk, as is usual with other orthorrhaphous Brachycera, not much elongate and with two sclerotized parts, of which the basal is triangular and the apical is very thin and runs obliquely. — Length: labrum 0.81–0.99 mm; cibarial pump 1.07–1.25 mm.

Stratiomys japonica (♀) is characterized by the well-defined large sclerotized part (lacinia + stipes) between the palpus and hypopharynx. It is also distinguished from *Odontomyia garatas* (♀) by the distance between the dorsal cornua not narrowing apically.

Specimens dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 9. vi. 1963, A. NAGATOMI; 1♀, Taniyama, Kagoshima City, 4. ix. 1963, A. NAGATOMI.

Subfamily Nemotelinae (Figs. 45–48)

The mouthparts of *Nemotelus crenatus* (♀) are very similar to those of *Labostigmia obscura* (♀) and *Odontomyia garatas* (♀), both of which belong to the Stratiomyinae, but is distinguished from the latter two by the labrum not being rounded at the antero-lateral corners and by the thinner sclerotized line on the labellum.

Nemotelus crenatus EGGER, 1859 (♀) (det. by R. ROZKOŠNÝ) (Figs. 45–48): labrum much longer than wide, about $1/2$ as long as cibarial pump, and nearly parallel-sided; hypopharynx not less than $1/2$ (c. 0.6 times) as long as labrum, much longer than wide, and with apex bluntly pointed; cibarial pump (with mid-posterior part between dorsal cornua) wider than labrum and than breadth between dorsal cornua, much longer (c. 4.3 times) than wide, narrowest near base and widest at apex; breadth between dorsal cornua gradually tapering apically; dorsal cornu roughly parallel-sided in lateral view; palpus is elongate oval (c. 3.6 times as long as wide), appears to have a small knob and is c. $1/6$ as long as cibarial pump; lacinia absent; labellum about as long as cibarial pump, much elongate, not pendulous below theca, and with a sclerotized thin line which is interrupted at 1 point; clypeus is fused with cibarial pump for a distance about as long as the cibarial pump; a pair of tormae are connected with each other at their apices. — Length: labrum 0.37 mm; cibarial pump 0.71 mm.

Nemotelus crenatus (♀) is distinguished from *Labostigmia obscura* (♀) by having the labrum shorter than the cibarial pump, the antero-lateral corner of labrum not rounded, the clypeus fused with cibarial pump for a distance which is about as long as the cibarial pump, etc.

Specimen dissected: 1♀, Trieste, Italy.

Subfamily Prosopochrysinæ (Figs. 49–69)

The genera of Prosopochrysinæ probably form a natural group, judging from the female genitalia (see NAGATOMI & IWATA, 1978 and 1981), but the mouthparts of this subfamily are not specialized.

The palpus is short and 1 or 2-segmented. The lacinia is absent or usually so. The hypopharynx is 2-segmented in *Euparyphus lagunae*, or has a desclerotized median spot near the apex in *Myxosargus knowltoni* and *Notomyia viridis*. When the labellum has two sclerotized spots, the apical spot is longer and much narrower than the basal.

***Brachycara* sp. (♀)** (Figs. 49–52): labrum somewhat longer than wide, much shorter (c. 0.3 times) than cibarial pump, and widest around middle; hypopharynx shorter and wider than labrum, and tapering apically; cibarial pump wider than labrum, somewhat wider (c. 1.2 times) than breadth between dorsal cornua, much longer (c. 2.3 times) than wide and bottle-shaped; dorsal cornua short and equidistant (parallel-sided); palpus 2-segmented and its segment 2 wider than segment 1, narrower basally, less than twice as long as wide, and c. 1/5 as long as cibarial pump; lacinia absent; labellum longer (c. 1.4 times) than cibarial pump and without sclerotized spot. — Length: labrum 0.11 mm; cibarial pump 0.43 mm.

Brachycara sp. (♀) is distinguished from other species of Prosopochrysinæ in this paper by the short, parallelsided, dorsal cornua.

Specimen dissected: 1♀, Toyohara, Iriomote-jima, South-West Islands, 2. v. 1982, A. NAGATOMI.

***Euparyphus lagunae* COLE, 1912 (♀)** (det. by M. T. JAMES) (Figs. 53–56): labrum longer than wide, c. 1/2 as long as cibarial pump, somewhat tapering apically and with wide apical margin; hypopharynx longer (c. 1.2 times) than labrum, longer than wide, with 2-segments, of which the basal appears to taper apically and the apical is composed of a pair of elongate sclerites; cibarial pump (with median basal part between dorsal cornua) wider than labrum, not wider (c. 0.9 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide, and nearly parallel-sided except base and apex; palpus 1-segmented, c. twice as long as wide, wider apically, and c. 1/5 as long as cibarial pump; lacinia absent; labellum longer (c. 1.7 times) than cibarial pump, membranous and without sclerotized spot. — Length: labrum 0.18 mm; cibarial pump 0.34 mm.

Euparyphus lagunae (♀) is distinguished from the species of *Brachycara*, *Myxosargus*, *Notomyia* and *Raphiocerina* in this paper by the hypopharynx which is 2-segmented and longer than labrum. It is distinguished from *Wallacea tsudai* (♀) by having the labellum without a sclerotized spot and the lacinia absent.

Specimen dissected: 1♀, Oso Flaco Lk, S. L. O. Co., California, 13. vii. 1959, J. R. RUSSELL.

***Myxosargus knowltoni* CURRAN, 1929 (♀)** (det. by M. T. JAMES) (Figs. 57–60): labrum not much longer than wide, c. 1/2 as long as cibarial pump, wider basally, and with wide apical margin; hypopharynx shorter than labrum, not longer than wide, roughly triangular, and with a median desclerotized spot near apex; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and parallel-sided except base; clypeus makes a right angle with the cibarial pump and its apical part is at an angle with the basal part and becomes flat; palpus 1-segmented, about 3 times as long as wide, and nearly 1/2 as long as cibarial pump; lacinia absent; labellum roughly twice (c. 1.8 times) as long as cibarial pump and with 2 sclerotized spots, of which the basal is roughly triangular and the apical is long and narrow. — Length: labrum 0.15 mm; cibarial pump 0.29 mm.

Myxosargus knowltoni (♀) is distinguished from *Raphiocerina hakiensis* (♀) and *Notomyia viridis* (♀) by the clypeus making a right angle with cibarial pump.

Specimen dissected: 1♀, Oso Flaco Lk, S. L. O. Co., California, 13. vii. 1959, P. M. MARSH.

***Notomyia viridis* HINE, 1911 (♀)** (det. by M. T. JAMES) (Figs. 61–65): labrum about as long as wide, about 1/2 as long as cibarial pump, wider basally and with wide apical margin; hypopharynx shorter than labrum, wider than long, triangular, and with a median desclerotized spot near apex; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.4 times) than wide, and bottle-shaped; it is difficult to decide whether the palpus is 1 or 2-segmented and when 2-segmented, segment 1 is desclerotized and a short lacinia is present; "segment 2" of palpus about 3 times as long as wide and 1/3–1/4 as long as cibarial pump; labellum roughly twice (c. 2.2 times) as long as cibarial pump and with 2 sclerotized spots, of which the basal is

wider apically and the apical is longer and narrower than the basal. — Length: labrum 0.13 mm; cibarial pump 0.25 mm.

Notomyia viridis (♀) is distinguished from *Myxosargus knowltoni* (♀) by the clypeus in which the apical part does not make an angle with the basal.

Specimen dissected: 1♀, El Verde, Puerto Rico, 22. i. 1969, H. S. TELFORD.

Raphiocerina hakiensis (MATSUMURA, 1916) (♀) (Figs. 66—69): labrum somewhat longer than wide, about 1/2 as long as cibarial pump, wider basally and with wide apical margin; hypopharynx somewhat shorter than labrum, appears widest near base, pointed at apex, and has a median pale spot; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and roughly parallel-sided except base and apex; clypeus with apical part flat and making an angle with the convex basal part; palpus appears to be 1-segmented, is less than 3 times as wide and c. 1/4 as long as cibarial pump; lacinia appears to be absent; labellum longer (c. 1.9 times) than cibarial pump and without sclerotized spots. — Length: labrum 0.16 mm; cibarial pump 0.32 mm.

Raphiocerina hakiensis (♀) is distinguished from *Myxosargus knowltoni* (♀) by the labellum lacking sclerotized spots and having the angle formed by the clypeus and cibarial pump somewhat acute.

Specimen dissected: 1♀, Nagashima, Izumi-gun, Kagoshima Pref., 21. vii. 1972, A. NAGATOMI.

Subfamily Pachygastrinae (Figs. 70—89)

The genera of Pachygastrinae may not form a natural group. The female genitalia of *Pachygaster* s. lat. (including *Abrosiomyia*) and the male and female genitalia of *Wallacea* are very specialized respectively (see NAGATOMI, 1975 and NAGATOMI & IWATA, 1976).

The palpus is short and 1-segmented in *Abrosiomyia* and *Wallacea* and well developed and 2-segmented in *Craspedometopon*, *Evaza* and *Kolomania* (= *Ouchimyia*). The hypopharynx is 1-segmented in *Evaza* and *Kolomania* but 2-segmented in *Abrosiomyia*, *Craspedometopon* and *Wallacea*. Except for *Evaza japonica*, each of genera and species has two sclerotized spots on labellum and the apical spot is much narrower than the basal.

Abrosiomyia bella NAGATOMI, 1975 (♀) (Figs. 70—73): labrum longer than wide, about as long as cibarial pump [which includes mid-posterior part between dorsal cornua], wider basally and with apical margin transversely straight; hypopharynx is about as long as labrum, longer than wide, wider basally, and its apical part appears to be composed of a pair of sclerotized bars [this is not illustrated in Fig. 70]; cibarial pump somewhat wider than labrum, narrower (c. 0.6 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide, and somewhat narrower anteriorly; palpus 1-segmented, elongate oval, and much shorter than cibarial pump; lacinia not shorter than labrum; labellum longer (c. 1.6 times) than cibarial pump and has two sclerotized parts of which the apical is thin; a pair of tormae are connected with each other at their apices. — Length: labrum 0.15 mm; cibarial pump 0.15 mm.

Abrosiomyia bella (♀) is distinguished from *Wallacea tsudai* (♀) by having the labrum about as long as the cibarial pump and the palpus elongate oval.

Specimen dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 14. vi. 1954, A. NAGATOMI.

Craspedometopon frontale KERTÉSZ, 1909 (♀) (Figs. 74—77): labrum longer than wide, shorter (c. 0.7 times) than cibarial pump [which includes the mid-proximal part of dorsal cornua], wider basally and with apical margin concave; hypopharynx about as long as labrum, longer than wide, wider basally and with two segments, of which the apical is less demarcated; cibarial pump wider than labrum, narrower (c. 0.7 times) than breadth between dorsal cornua, longer (c. 1.5 times) than wide, and bottle-shaped; palpus with segment 2 widest around middle and wider than segment 1, which is cylindrical; total length of palpus about as long as (c. 1.1 times) cibarial pump; lacinia about as long as labrum and longer than palpal segment 1; labellum longer (c. 1.8 times) than cibarial pump and with two sclerotized parts, of which the apical is thin and runs obliquely. — Length: labrum 0.24 mm; cibarial pump 0.37 mm.

Craspedometopon frontale (♀) is distinguished from *Kolomania* (= *Ouchimyia*) *nipponensis* (♀) by the labrum, palpus and mid-proximal part of the dorsal cornua which are longer than in the latter species.

Specimen dissected: 1♀, Kurinodake, Mt. Kirishima, Kagoshima Pref., 25–26. v. 1968, K. KUSIGEMATI.

Evaza japonica LINDNER, 1938 (♀) (Figs. 78–81): labrum somewhat longer (c. 1.2 times) than wide, shorter (c. 0.6 times) than cibarial pump, wider basally, and with wide apical margin; hypopharynx nearly extending to apex of labrum, longer than wide, widest before middle, and with a mid-apical longitudinal desclerotized area; cibarial pump wider (c. 1.3 times) than labrum, about as wide as (c. 0.9 times) breadth between dorsal cornua, longer (c. 1.5 times) than wide, and bottle-shaped; palpus with segment 2 longer and narrower than segment 1, and bluntly pointed; total length of palpus longer (c. 1.3 times) than cibarial pump; lacinia longer than labrum and palpal segment 1 respectively; labellum about twice as long as cibarial pump and without sclerotized part. — Length: labrum 0.24 mm; cibarial pump 0.41 mm.

Evaza japonica (♀) is distinguished from *Kolomania* (= *Ouchimyia*) *nipponensis* (♀) by the elongate palpus, the hypopharynx having a mid-apical longitudinal desclerotized area, and the labellum lacking sclerotized spots.

Specimen dissected: 1♀, Mt. Nyugasa, Nagano Pref., 19. vii. 1963, A. NAGATOMI.

Kolomania (= *Ouchimyia*) *nipponensis* (ÔUCHI, 1940) (♀) (Figs. 82–85): labrum about as long as wide, shorter (c. 0.5 times) than cibarial pump, tapering apically but with wide apical margin; hypopharynx shorter than labrum, longer than wide, wider basally and pointed at apex; cibarial pump not narrower than labrum, narrower (c. 0.7 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide, and widest around middle; palpus cylindrical, segment 1 about as long as wide, and segment 2 about twice as long as wide; total length of palpus shorter (c. 0.6 times) than cibarial pump; lacinia longer (1.8 times or so) than labrum; labellum longer (1.6 times or so) than cibarial pump and with two sclerotized spots, of which the apical is thin and runs obliquely. — Length: labrum 0.13 mm; cibarial pump 0.27 mm.

Kolomania nipponensis (♀) is distinguished from *Craspedometopon frontale* (♀) by the labrum, palpus, and mid-proximal part of dorsal cornua which are shorter than in the latter species.

Specimen dissected: 1♀, Kagoshima City, 20. iv. 1962, A. NAGATOMI.

Wallacea tsudai (ÔUCHI, 1940) (♀) (Figs. 86–89): labrum longer than wide, shorter (c. 0.6 times) than cibarial pump [which includes the mid-proximal part of the dorsal cornua], wider basally and with wide apical margin; hypopharynx about as long as labrum, longer than wide, and with two segments, of which the segment 2 is divided into a pair of elongate bars and the segment 1 is roughly parallel-sided except the apical part which is bluntly pointed; cibarial pump wider than labrum, narrower (c. 0.8 times) than breadth between dorsal cornua, about twice as long as wide, and bottle-shaped; palpus 1-segmented, about twice as long as wide, with apical margin rounded, and about 1/4 as long as cibarial pump; lacinia much longer than palpus and longer (c. 1.3 times) than labrum; labellum less than twice (c. 1.7 times) as long as cibarial pump and with 2 sclerotized parts, of which the apical is much narrower than the basal. — Length: labrum 0.18 mm; cibarial pump 0.29 mm.

Wallacea tsudai (♀) is distinguished from *Abrosiomyia bella* (♀) by the labrum being distinctly shorter than the cibarial pump and the base of the palpus wider than in the latter species.

Specimen dissected: 1♀, Sata, Osumi, Kagoshima Pref., 29. iv. 1962, A. NAGATOMI.

Subfamily Clitellariinae (Figs. 90–97)

In *Clitellaria obtusa* (♂) and *Nigritomyia* sp. (♀), the palpus is well developed and 2-segmented and the labellum has two sclerotized spots, of which the apical is narrower than the basal but not very thin,

Clitellaria obtusa (JAMES, 1941) (♂) (Figs. 90–93) [it must be noted that the mid-proximal part of dorsal cornua is not included in the length of cibarial pump in the following description]: labrum longer than wide, shorter (c. 0.5 times) than cibarial pump, wider basally and with apical margin somewhat concave; hypopharynx shorter than labrum, longer than wide, wider basally and nearly triangular; cibarial pump wider than labrum, as wide as breadth between dorsal cornua, longer (c. 1.7 times) than wide and bottle-shaped; palpus with segment 2 narrower but much longer than segment 1 and with apex bluntly pointed; total length of palpus longer (c. 1.6 times) than cibarial pump; lacinia thin and shorter than segment 2 of palpus; labellum about twice (c. 1.9 times) as long as cibarial pump and with two sclerotized parts of which the apical is much narrower than the basal. — Length: labrum 0.36 mm; cibarial pump 0.69 mm.

Clitellaria obtusa (♂) is distinguished from *Nigritomyia* sp. (♀) by segment 2 of the palpus being bluntly pointed and much longer than segment 1.

Specimen dissected: 1♂, Touya, Hokkaido, 9. vii. 1967, K. KUSIGEMATI.

Nigritomyia sp. (♀) (Figs. 94–97) [it must be noted that the mid-proximal part of the dorsal cornua is included in the length of the cibarial pump and this treatment is usual in this paper]: labrum longer than wide, about 1/3 as long as cibarial pump, and wider basally; hypopharynx shorter than labrum, longer than wide, and widest near base; cibarial pump wider than labrum, not wider (c. 0.8 times) than breadth between dorsal cornua, longer (c. 2.1 times) than wide and bottle-shaped; palpus with segment 2 longer (c. 2.7 times) than wide, roughly equal in length and width to segment 1 and not pointed at apex; total length of palpus about as long as cibarial pump; lacinia shorter than palpus and thin; labellum about twice (c. 1.9 times) as long as cibarial pump and with two sclerotized parts, of which the apical is narrower than the basal. — Length: labrum 0.24 mm; cibarial pump 0.69 mm.

Nigritomyia sp. (♀) is distinguished from *Clitellaria obtusa* (♂) by segment 2 of palpus being not pointed and not longer than segment 1.

Specimen dissected: 1♀, Sesaot 100 m, Lombok, Indonesia, 18. vii. 1973, H. KURAHASHI.

Subfamily *Hermetinae* (Figs. 98–101)

In *Hermetia illucens*, the palpus is reticulate in segment 2 and less sclerotized and not reticulate in segment 1, the hypopharynx is wider than long and with its mid-apex widely and deeply concave, the labellum has two large sclerotized spots, of which the apical is somewhat narrower than the basal but wider than in the genera of *Pachygastrinae* and *Prosopochrysininae* included in this paper.

Hermetia illucens (LINNAEUS, 1758) (♀) (Figs. 98–101): labrum longer than wide, shorter (c. 0.4 times) than cibarial pump, wider basally and with apical margin concave; hypopharynx much shorter than labrum, shorter than wide, with lateral margin rounded, and with mid-apical part widely and deeply concave; cibarial pump wider than labrum, about as wide as (c. 1.1 times) breadth between dorsal cornua, about twice (c. 2.1 times) as long as wide and bottle-shaped; palpus 2-segmented, with segment 1 membranous and shorter and narrower than segment 2 which is reticulate, with apical margin rounded, and longer (c. 1.8 times) than wide; total length of palpus over 1/2 (c. 0.7 times) as long as cibarial pump; lacinia about as long as labrum, and shorter than segment 2 of palpus; labellum longer (c. 1.8 times) than cibarial pump and with 2 large sclerotized parts, of which the basal is not narrower than long. — Length: labrum 0.28 mm; cibarial pump 0.79 mm.

Hermetia illucens (♀) is distinguished from *Chrysoscholorina currani* (♀), whose palpal segment 2 is also reticulate, by the hypopharynx being widely and deeply concave at mid-apex and by the stouter palpus.

Specimen dissected: 1♀, Hyakuna, Okinawa-honto, South-West Islands, 10. iv. 1979, K. KUSIGEMATI.

Subfamily *Sarginae* (Figs. 102–129)

It is evident that the genera of *Sarginae* in this paper form a natural group. But the mouthparts are not very characteristic. Palpus with segment 1 less sclerotized than seg-

ment 2. When the palpus is 1-segmented, the lacinia is distant from the palpus. The labellum is soft and has no sclerotized spots.

Cephalochrysa stenogaster JAMES, 1939 (♂) (Figs. 102–105): labrum longer than wide, much shorter (c. 0.4 times) than cibarial pump (without membranous part between dorsal cornua), nearly parallel-sided and with apical margin concave; hypopharynx wider basally, shorter than labrum, and with apical margin rounded [in Fig. 102, the hypopharynx is not illustrated but the salivary pump is shown]; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.7 times) than wide, and bottle-shaped [pharyngeal pump is probably lost in the specimen dissected]; "segment 2" of palpus longer than wide, shorter than labrum and cylindrical; lacinia longer than segment 2 of palpus, much shorter than cibarial pump, comparatively thick and pointed apically [in Fig. 104, the sclerotized portion between the lacinia and palpus is probably not part of the head capsule but segment 1 of the palpus]; labellum is about twice as long as cibarial pump and appears to have no sclerotized part. — Length: labrum 0.16 mm; cibarial pump 0.39 mm.

Cephalochrysa stenogaster (♂) is distinguished from the 3 species (♀) of *Ptecticus* included in this paper by the sclerotized part between the palpus and lacinia (= probably segment 1 of palpus) being more sclerotized and more elongate.

Specimen dissected: 1♂, Kagoshima City, 27. v. 1961, A. NAGATOMI.

Chrysochloma nipponensis (BIGOT, 1879) (♂) (Figs. 106–109): labrum longer than wide, shorter (c. 0.6 times) than cibarial pump, somewhat wider basally (or roughly parallel-sided) and with apical margin concave; hypopharynx is shorter than labrum and appears to be rounded at apical margin; cibarial pump wider than labrum, not wider (c. 0.9 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide, and bottle shaped; palpus with 2 segments, of which the apical one is narrower and shorter than the basal; total length of palpus shorter than labrum; lacinia much longer than segment 2 of palpus and shorter than labrum, comparatively thick and tapering apically; labellum roughly twice (c. 2.2 times) as long as cibarial pump and has no sclerotized part. — Length: labrum 0.37 mm; cibarial pump 0.66 mm.

Chrysochloma nipponensis (♂) is distinguished from *Sargus metallinus* (♀) by the cibarial pump being less than twice as long as wide, the palpus distinctly two-segmented, and the lacinia much longer than in the latter species.

Specimen dissected: 1♂, Kagoshima City, 28. x. 1961, A. NAGATOMI.

Microchrysa flaviventris (WIEDEMANN, 1824) (♀) (Figs. 110–113): labrum roughly as long as wide (c. 1.1 times), much shorter (c. 0.4 times) than cibarial pump, roughly parallel-sided (except apical portion which is somewhat narrower), with apical margin concave; hypopharynx shorter than labrum and with apical margin rounded; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.8 times) than wide, and roughly parallel-sided or widest around middle; segment 2 of palpus roughly as long as wide and with apical margin rather transversely straight; segment 1 of palpus about as wide as, and longer than segment 2; lacinia longer than segment 2 of palpus, much shorter than cibarial pump, and rounded at apex; labellum is longer (c. 1.8 times) than cibarial pump and may have a small, thin sclerotized part just behind the theca. — Length: labrum 0.13 mm; cibarial pump 0.30 mm.

Microchrysa flaviventris (♀) is characterized by the labrum and segment 1 of the palpus being about as long as wide respectively, among the species of Sarginae considered in this paper.

Specimen dissected: 1♀, Takara-jima, Tokara Islands, South-West Islands, 14. vii. 1964, A. TANAKA.

Ptecticus aurifer (WALKER, 1854) (♀) (Figs. 114–117): labrum longer than wide, shorter (c. 0.5 times) than cibarial pump, widest at base, and with apical margin concave; hypopharynx not longer than wide, much shorter than labrum, and gently convex at apical margin; cibarial pump wider than labrum, not narrower than breadth between dorsal cornua, longer (c. 1.8 times) than wide, and widest around middle; segment 2 of palpus about twice as long as wide and with apical margin rounded; segment 1 of palpus longer than segment 2, wider basally and largely membranous; lacinia longer than segment 2 of palpus, shorter

than cibarial pump, comparatively thick, and tapering apically labellum; longer (c. 2.3 times) than cibarial pump and without large or distinctly sclerotized part. — Length: labrum 0.44 mm; cibarial pump 0.83 mm.

Ptecticus aurifer (♀) may be distinguished from *P. matsumurae* (♀) by the hypopharynx being much less than 1/2 as long as the labrum.

Specimen dissected: 1♀, Senjodake, Nagano Pref., 5. vii. 1963, A. NAGATOMI.

Ptecticus matsumurae LINDNER, 1936 (♀) (Figs. 118–121): similar to *Ptecticus aurifer* except as follows: hypopharynx, which tapers apically and is rounded at apical margin, extending to about 1/2 length of labrum. — Length: labrum 0.24 mm; cibarial pump 0.46 mm.

Specimen dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 18. vii. 1951, A. NAGATOMI.

Ptecticus tenebrifer (WALKER, 1849) (♀) (Figs. 122–125): almost fitting the description of *aurifer* (♀), but hypopharynx [which is not illustrated in Figs. 122–123] extending to about 1/2 (c. 0.6 times) length of labrum, and sclerotized bases of dorsal cornua forming V-shape; in 2 specimens dissected, cibarial pump 1.8–2.0 times as long as wide, segment 2 of palpus 1.8–2.3 times as long as wide, labellum 1.8–2.2 times as long as cibarial pump, and precise outline of segment 1 of palpus not clear. — Length: labrum 0.38–0.39 mm; cibarial pump 0.72–0.76 mm.

Ptecticus tenebrifer (♀) may possibly be distinguished from *P. matsumurae* (♀) by the sclerotized bases of the dorsal cornua forming a V-shape.

Specimens dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 12. vi. 1959, A. NAGATOMI; 1♀, Kagoshima City, 6. v. 1966, A. TANAKA.

Sargus metallinus FABRICIUS, 1805 (♀) (Figs. 126–129): labrum longer than wide, shorter (c. 0.4 times) than cibarial pump and almost parallel-sided; hypopharynx shorter than cibarial pump and rounded at apical margin; cibarial pump wider than labrum, distinctly narrower (c. 0.7 times) than breadth between dorsal cornua, over twice (c. 2.6 times) as long as wide, and roughly parallel-sided (except anterior part which is narrower); palpus, which appears to be 1-segmented, short and inconspicuous as well as lacinia (if present); labellum about twice (c. 1.9 times) as long as cibarial pump and has no sclerotized part. — Length: labrum 0.20 mm; cibarial pump 0.51 mm.

Sargus metallinus (♀) is distinguished from *Chrysochlorina nipponensis* (♂) by having the cibarial pump over twice as long as wide, the palpus 1-segmented or its basal segment not demarcated and the lacinia (if present) much shorter than in the latter species.

Specimen dissected: 1♀, Sapporo, Hokkaido, 12. viii. 1967, K. KUSIGEMATI.

Subfamily Chrysochlorinae (Figs. 130–133)

The palpal segment 2 is reticulate, with segment 1 and lacinia less sclerotized. The palpus is larger than in the genera of Sarginae considered in this paper. The labellum is soft and has no sclerotized spots.

Chrysochlorina currani JIDE, 1966 (♀) (det. by M. T. JAMES) (Figs. 130–133): labrum longer than wide, shorter (c. 0.4 times) than cibarial pump, wider basally or roughly parallel-sided, and with apical margin concave; hypopharynx shorter than labrum and rather heart-shaped; cibarial pump wider than labrum, not narrower (c. 1.1 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide and bottle-shaped; palpus 2-segmented, with segment 1 membranous and segment 2 reticulate, longer than wide, widest near apex, with apical margin rounded, and shorter (c. 0.7 times) than cibarial pump; lacinia shorter than segment 2 of palpus and not (or not strongly) sclerotized; labellum about twice (c. 1.9 times) as long as cibarial pump and has no sclerotized part. — Length: labrum 0.32 mm; cibarial pump 0.77 mm.

Chrysochlorina currani (♀) is distinguished from the genera of Sarginae considered in this paper by segment 2 of the palpus being reticulate and larger in size.

Specimen dissected: 1♀, Avispas [„Avispus“ in NAGATOMI & IWATA, 1981 is not correct], Madre de Dios, Peru, 1–15. x. 1962, L. PENA.

Family Solvidae (= Xylomyidae) (Figs. 134–146)

Three species of the genus *Solva* (s. lat.) have been examined.

Labrum wider basally or nearly parallel-sided and its apical margin transversely straight or more or less concave; hypopharynx roughly turnip-shaped and pointed apically; lacinia stick-like; mandible absent; maxillary palpus 1-segmented and wide in *Solva* (*Macroceromys*) but 2-segmented and narrow in *Solva* (*Solva*); cibarial pump longer than wide and wider and longer than labrum; labellum longer than theca; mid-distal interlabellar process minute (if present).

Torma appears to be small and short.

Labrum longer than wide but shorter than cibarial pump; hypopharynx shorter than labrum; lacinia much shorter than maxillary palpus.

The mouthparts of Solvidae may be distinguished from those of Stratiomyidae by having the clypeus not firmly fused with the labrum or cibarial pump.

Solva (*Macroceromys*) *moiwana* (MATSUMURA, 1915) (♀) (Figs. 134–137): labrum longer than wide, shorter (c. 0.7 times) than cibarial pump, wider basally and with wide apical margin; hypopharynx shorter than labrum and turnip-shaped; cibarial pump wider than labrum, somewhat narrower (c. 0.8 times) than breadth between dorsal cornua, roughly twice (c. 1.8 times) as long as wide and bottle-shaped; palpus 1-segmented, widest near apex, about twice as long as wide and somewhat longer (c. 1.3 times) than cibarial pump; lacinia shorter than labrum; labellum about twice as long as cibarial pump and with 2 large, distinct, sclerotized spots. — Length: labrum 0.41 mm; cibarial pump 0.56 mm.

♂ (Figs. 138): there are almost no differences between the sexes but the palpus (c. 3 times as long as wide) and the hypopharynx are narrower than in ♀. The cibarial pump is about as wide as breadth between dorsal cornua in the male specimen dissected. — Length: labrum 0.41 mm; cibarial pump 0.54 mm.

Solva (*Macroceromys*) *moiwana* is distinguished from the 2 species of *Solva* (*Solva*) considered in this paper by the wide, 1-segmented palpus.

Specimens dissected: 1♀, Masike, Hokkaido, 23. vii. 1964, K. KUSIGEMATI; 1♂, Shimamatsu, Hokkaido, 14. vi. 1967, K. KUSIGEMATI.

Solva (*Solva*) *japonica* FREY, 1960 (♀) (Figs. 139–142): labrum longer than wide, somewhat shorter (c. 0.8 times) than cibarial pump, wider basally and with wide apical margin; hypopharynx shorter than labrum and turnip-shaped; cibarial pump wider than labrum, narrower (c. 0.7 times) than breadth between dorsal cornua, longer (c. 1.8 times) than wide and bottle-shaped; palpus cylindrical, 2-segmented, segment 1 about twice as long as wide, segment 2 about 4 times as long as wide and longer than segment 1; total length of palpus about twice (c. 1.8 times) as long as cibarial pump; lacinia shorter than labrum; labellum over twice (c. 2.3 times) as long as cibarial pump, soft and has no sclerotized spots. — Length: labrum 0.29 mm; cibarial pump 0.35 mm.

♂: almost no differences were found between the sexes, but the palpus may be narrower than in ♀. — Length: labrum 0.23 mm; cibarial pump 0.30 mm.

Solva (*Solva*) *japonica* (♀) is distinguished from *Solva* (*Solva*) *procera* (♀) by having the palpus more slender, the labellum without sclerotized spots, and the dorsal cornu gently curved.

Specimens dissected: 1♀, 1♂, Apodake, Hokkaido, 24. vii. 1964, A. NAGATOMI.

Solva (*Solva*) *procera* (FREY, 1960) (♀) (Figs. 143–146): labrum longer than wide, somewhat shorter (c. 0.8 times) than cibarial pump, wider basally and with wide apical margin; hypopharynx shorter than labrum and pointed at apex [its exact outline is not clear but probably turnip-shaped]; cibarial pump wider than labrum, not wider (c. 0.9 times) than breadth between dorsal cornua, longer (c. 1.7 times) than wide and bottle-shaped; palpus cylindrical, 2-segmented, segment 1 roughly twice (c. 2.2 times) as long as wide, segment 2 roughly 3 times (c. 2.7 times) as long as wide and longer than segment 1; total length of palpus longer (c. 1.5 times) than cibarial pump; lacinia shorter than labrum; labellum longer (c. 1.8 times) than cibarial pump and with 2 large sclerotized spots, of which the apical is nearly as wide as the basal. — Length: labrum 0.41 mm; cibarial pump 0.49 mm.

Solva (Solva) procera (♀) is distinguished from *Solva (Solva) japonica* (♀) by having the palpus stouter, the labellum with sclerotized spots, and the dorsal cornu angulate.

Specimen dissected: 1♀, Iwakikisan, Osaka Pref., 12. v. 1950, S. ITO.

Family Pantophthalmidae (Figs. 147—150)

The female of *Pantophthalmus bellardii* has been examined.

Labrum sagittate; hypopharynx much longer than wide, wider basally and divided into a pair of long sclerites in apical half; lacinia stylet-like [judging from THORPE 1934, fig. 14 the male lacinia of *Pantophthalmus tabaninus* is wider and shorter than in the female and has the apex rounded]; mandible absent; maxillary palpus 2-segmented, log-like, and markedly long; cibarial pump conspicuously long, and parallel-sided; breadth between dorsal cornua somewhat wider than cibarial pump in the female of *P. bellardii*; labellum longer than theca; a mid-distal interlabellar process appears to be absent or practically so.

Torma appears to be small and short.

Labrum comparatively wide but much narrower than long; hypopharynx shorter than labrum; lacinia shorter than labrum and much shorter than segment 1 of palpus.

The mouthparts of Pantophthalmidae may at once be distinguished from the related families by the cibarial pump being 4—5 times as long as wide and the palpus markedly long.

Pantophthalmus bellardii (BIGOT, 1862) (♀) (det. by L. L. PECHUMAN) (Figs. 147—150): labrum longer than wide, much shorter (c. 0.4 times) than cibarial pump, wider basally and bluntly pointed; hypopharynx shorter than labrum, somewhat wider basally and with a median longitudinal desclerotized line in apical half; cibarial pump somewhat wider (c. 1.2 times) than labrum, narrower (c. 0.7 times) than breadth between dorsal cornua, much longer (c. 4.3 times) than wide and roughly parallel-sided; palpus cylindrical, 2-segmented, and each segment 5—6 times as long as wide; total length of palpus about 1 1/2 (c. 1.6 times) as long as cibarial pump; lacinia shorter than labrum; labellum shorter (c. 0.8 times) than cibarial pump and with 2 large sclerotized spots, which are about equal in length and width. — Length: labrum 1.0 mm; cibarial pump 2.4 mm.

Specimen dissected: 1♀, no data [this species is distributed in Central and South America].

Family Rachiceridae (Figs. 151—154)

Only one species of the female *Rachicerus* has been examined.

Labrum shovel-shaped and with a short median process at apex; hypopharynx appears to be willow-leaf shaped and the lacinia is stylet-like; mandible absent; maxillary palpus with 2 segments subequal in width and much longer than wide; cibarial pump about as wide as long; breadth between dorsal cornua about as wide as cibarial pump; labellum longer than theca; there is a long mid-distal interlabellar process.

Torma is rather long, and clypeus may be firmly fused with the labrum and cibarial pump.

Labrum longer than cibarial pump; hypopharynx shorter than labrum; lacinia shorter than labrum.

If a short process at apex of labrum is common to the male and other species of Rachiceridae, this character may become an important family diagnosis. The mouthparts of *Rachicerus* resemble those of *Xylophagus*, but in the latter segment 2 of the palpus is markedly swollen.

Rachicerus sp. (♀) (Figs. 151—154): labrum longer than wide, longer (c. 1.5 times) than cibarial pump, widest near base and with a short mid-apical process [which is included in length of labrum]; hypopharynx is shorter than labrum and appears to be willow-leaf shaped; cibarial pump somewhat wider than labrum, about as wide as breadth between dorsal cornua, about as long as wide (c. 1.1 times), and widest around middle; palpus 2-segmented, cylindrical but pointed at apex, much longer than wide (3 times or so in segment 1, and 5 times or so in segment 2), and segment 2 longer than segment 1; total

length of papus much longer (c. 2.2 times) than cibarial pump; lacinia shorter than labrum; labellum much longer (c. 2.8 times) than cibarial pump, soft and without sclerotized spots; mid-distal interlabellar process c. 1/4 as long as labellum. — Length: labrum 0.41 mm; cibarial pump 0.28 mm.

Specimen dissected: 1♀, Komi, Iriomote-jima, South-West Islands, 21. vii. 1980, A. NAGATOMI.

Family Xylophagidae (Figs. 155–158)

This family contains only one genus. Both sexes of 1 species have been examined.

Labrum rather shovel-shaped; hypopharynx rather willow-leaf shaped; lacinia stylet-like; mandible absent; maxillary palpus with 2 segments longer than wide, of which the apical one is markedly swollen; cibarial pump longer than wide; labellum longer than theca; mid-distal interlabellar process comparatively long.

Torna appears to be small and short, and clypeus is not firmly fused with labrum or cibarial pump.

Labrum much longer than wide; hypopharynx nearly as long as labrum; lacinia somewhat longer than labrum.

The mouthparts of *Xylophagus* resemble those of Solvidae but may be distinguished from the latter by the labrum being about as long as the cibarial pump. *Xylophagus* may be separated from *Rachicerus* by segment 2 of the palpus being markedly swollen.

Xylophagus matsumurai MIYATAKE, 1965 (♀) (Figs. 155–158): labrum longer than wide, subequal (c. 1.1 times) in length to cibarial pump, slightly wider around middle and with rounded apical margin; hypopharynx nearly extending to top of labrum and willow-leaf like; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.4 times) than wide, and widest around middle; palpus with 2 segments, which are subequal in length, with segment 1. 3 times or so and segment 2 about 2 times as long as wide; total length of palpus over twice (c. 2.5 times) as long as cibarial pump; lacinia roughly as long as labrum; labellum longer (c. 1.8 times) than cibarial pump and with 2 sclerotized spots whose ventral borders are connected; mid-distal interlabellar process c. 1/4 as long as labellum. — Length: labrum 0.39 mm; cibarial pump 0.34 mm.

♂: almost no differences are found between the sexes but the palpus is narrower and shorter, and the mid-distal interlabellar process is shorter than in ♀; in 1 ♂ specimen measured, total length of the palpus was 1.9 times as long as the cibarial pump, its segment 1, 4.6 times and segment 2, 2.6 times as long as wide, and the mid-distal interlabellar process 1/5 or so as long as the labellum. — Length: labrum 0.34 mm; cibarial pump 0.33 mm.

Specimens dissected: 1♀, Mt. Soranuma, Hokkaido, 3. vii. 1964, A. NAGATOMI; 1♂, Mt. Soranuma, Hokkaido, 17. vi. 1967, K. KUSIGEMATI.

Family Coenomyiidae (Figs. 159–178)

Five genera and 5 species have been examined.

Labrum long, tapering apically, without tip pointed but with apical transverse margin straight or concave; hypopharynx long, tapering apically and more or less pointed; lacinia stylet-like; mandible absent; maxillary palpus log-like and 1-segmented (in *Arthropeas sibiricum*, segmental number of palpus is 1 or 2 according to individual); cibarial pump longer than wide and shorter than labrum; labellum longer than theca; mid-distal interlabellar process varies in length with genus and species.

Anterior part of cibarial pump is fused with clypeus through a pair of long lateral sclerites (= tormae) in *Anacanthaspis bifasciata japonica*, but the torna may not be very sclerotized in other genera and species considered in this paper.

Labrum longer than cibarial pump; hypopharynx as long as or shorter than labrum; lacinia usually shorter than palpus and as long as or shorter than labrum.

Among the lower Brachycera the mouthparts of Coenomyiidae may be characterized as follows: labrum longer than cibarial pump, and without pointed tip but with the apical transverse margin straight or concave; cibarial pump longer than wide; maxillary palpus log-like and 1-segmented (in some specimens of *Arthropeas sibiricum* the palpus is 2-segmented).

Anacanthaspis bifasciata japonica SHIRAKI, 1932 (♂) (Figs. 159–162): labrum much longer than wide, longer (c. 1.6 times) than cibarial pump, somewhat wider basally and with wide apical margin; hypopharynx nearly extending to top of labrum, tapering apically and pointed; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and widest before middle; palpus 1-segmented (or practically 2-segmented), 6 times or so as long as wide, and longer (c. 1.6 times) than cibarial pump; lacinia shorter than palpus and labrum respectively; labellum with 2 sclerotized spots, both of which are narrow [apical part of labellum is broken off in the specimen dissected]; mid-distal interlabellar process appears to be short; anterior part of cibarial pump is fused with clypeus through a pair of long lateral sclerites (= tormae). — Length: labrum 0.84 mm; cibarial pump 0.52 mm.

One male of this species has been seen and cannot be compared with other genera and species of Coenomyiids in which only the females have been examined. In this species (♂), the torma is long, and the labrum is distinctly narrower than the cibarial pump, and its apical margin is wider than in *Coenomyia basalis* (♀) and narrower than in *Dialysis iwatai* (♀).

Specimen dissected: 1♂, Kanayama, Yamanashi Pref., 30. vi. 1963, T. SAIGUSA.

Arthropeas sibiricum LOEW, 1850 (♀) (det. by E. LINDNER) (Figs. 163–166): labrum much longer than wide, longer (c. 1.5 times) than cibarial pump, wider basally and with wide apical margin; hypopharynx slightly shorter than labrum and tapering apically; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, over twice (c. 2.4 times) as long as wide and widest before middle; palpus 2-segmented (in some individuals 1-segmented) and each segment about 4 times as long as wide; total length of palpus longer (c. 1.8 times) than cibarial pump; lacinia shorter than palpus and labrum respectively; labellum is longer (c. 1.4 times) than cibarial pump and may have 2 thin sclerotized spots, of which the apical is short, less sclerotized and easily overlooked; mid-distal interlabellar process (beyond a pair of processes) long and 1/4 as long as labellum; it appears that the torma is long but not very sclerotized. — Length: labrum 1.0 mm; cibarial pump 0.67 mm.

Arthropeas sibirica (♀) may be distinguished from other Coenomyiids considered in this paper by the cibarial pump being over twice as long as wide.

Specimen dissected: 1♀, Kina, S. Kansu, Ctr. Asien, SVEN HEDINS Exp., Dr. HUMMELT.

Coenomyia basalis MATSUMURA, 1915 (♀) (Figs. 167–170): labrum much longer than wide, somewhat longer (c. 1.2 times) than cibarial pump, tapering apically and with apical margin narrower than in other Coenomyiids of this paper; hypopharynx nearly extending to top of labrum, tapering apically and pointed; cibarial pump appears to be roughly as wide as labrum and breadth between dorsal cornua respectively, is longer (c. 1.7 times) than wide and widest before middle; palpus 1-segmented, wider toward base, 9 times or so as long as wide, and longer (c. 1.6 times) than cibarial pump; lacinia shorter than palpus and labrum respectively; labellum somewhat longer (c. 1.3 times) than cibarial pump and with 2 narrow, not well-defined, sclerotized spots, of which the apical is shorter and runs transversely; mid-distal interlabellar process minute; in Fig. 168, the clypeus is attached to the labrum but the torma appears to be not very sclerotized. — Length: labrum 0.95 mm; cibarial pump 0.77 mm.

Coenomyia basalis (♀) may be characterized by having, a minute mid-distal interlabellar process, and the apical margin of the labrum narrow.

Specimen dissected: 1♀, Mt. Kogane, near Sasayama, Hyogo Pref., 28. v. 1958, K. IWATA.

Dialysis iwatai NAGATOMI, 1953 (♀) (Figs. 171–174): labrum much longer than wide, longer (c. 1.4 times) than cibarial pump, wider basally, and with wide apical margin; hypopharynx extends nearly to top of labrum and appears to be widest near base and to be pointed at apex; cibarial pump appears to be wider than labrum and breadth between dorsal cornua respectively, is longer (c. 1.4 times) than wide and widest around middle; palpus 1-segmented, somewhat wider at apical portion, 5 times or so as long as wide and longer (c. 1.3 times) than cibarial pump; lacinia about as long as palpus and labrum respectively; labellum about twice (c. 2.2 times) as long as cibarial pump and without sclerotized spots; mid-distal interlabellar process 1/5 as long as labellum; in Figs. 171–172,

clypeus is detached off from labrum but torma is long. — Length: labrum 0.47 mm; cibarial pump 0.34 mm.

Dialysis iwatai (♀) is distinguished from other *Coenomysiids* considered in this paper by the longer lacinia (i. e. not shorter than palpus).

Specimen dissected: 1♀, Hakusan, Ishikawa Pref., 31. vii. 1977, A. NAGATOMI.

Odontosabula (= *Stratioleptis*) *gloriosa* MATSUMURA, 1905 (♀) (Figs. 175–178): labrum much longer than wide, longer (c. 1.7 times) than cibarial pump, tapering apically and with wide apical margin; hypopharynx shorter than labrum and tapering apically; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, longer (c. 1.8 times) than wide and widest before middle; palpus 1-segmented, roughly parallel-sided, 6 times or so as long as wide and longer (c. 1.6 times) than cibarial pump; lacinia somewhat shorter than palpus and labrum respectively; labellum longer (c. 1.7 times) than cibarial pump and with 2 narrow, not well-defined sclerotized spots; mid-distal interlabellar process 1/5 or so as long as labellum; torma is long [in Figs. 175–176, torma is situated outside the part of clypeus attached to labrum and is not shown]. — Length: labrum 1.1 mm; cibarial pump 0.65 mm.

Odontosabula gloriosa (♀) is distinguished from *Coenomysia basalis* (♀) by the larger mid-distal interlabellar process.

Specimen dissected: 1♀, Osumi, Kagoshima Pref., 16. v. 1954, O. MIZOGUCHI.

Family Heterostomidae (Figs. 179–182)

This family contains only one monotypic genus. The following diagnosis is based on the female.

Labrum and hypopharynx lanceolate; lacinia stylet-like; mandible absent; maxillary palpus 2-segmented, with segment 2 conspicuously swollen, much longer and wider than segment 1; cibarial pump short but not wider than long; breadth between dorsal cornua as wide as cibarial pump; labellum longer than theca; mid-distal interlabellar process long.

Torma moderately long.

Labrum much longer than cibarial pump; hypopharynx slightly shorter than labrum; lacinia much shorter than palpus but nearly as long as labrum.

The mouthparts of *Heterostomus* resemble those of Rhagionidae but may be characterized by palpal segment 2 being conspicuously swollen.

Heterostomus curvipalpis BIGOT, 1857 (♀) (det. by L. L. PECHUMAN) (Figs. 179–182): labrum much longer than wide, nearly twice (c. 1.8 times) as long as cibarial pump, wider basally and with apex bluntly pointed; hypopharynx slightly shorter than labrum and tapering apically; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, somewhat longer than wide (c. 1.2 times) and widest around middle; in palpus, segment 2, 3 times or so as long as and 2 times or so as wide as its segment 1; total length of palpus 3 times or so as long as cibarial pump; lacinia nearly as long as labrum (c. 0.9 times); labellum longer (c. 2.4 times) than cibarial pump, and with 1 median small paler spot and 1 median transverse suture; mid-distal interlabellar process long, c. 1/4 as long as labellum; torma moderately long [it is not shown in Figs. 179–180]. — Length: labrum 1.4 mm; cibarial pump 0.79 mm.

Heterostomus curvipalpis (♀) is at once distinguished from *Exeretoneura angustifrons* (♀) by having the cibarial pump and labellum shorter, the labrum and hypopharynx longer than in the latter species, and palpal segment 2 longer and wider than segment 1.

Specimen dissected: 1♀, Chile, E. P. REED Collection.

Family Exeretoneuridae (Figs. 183–186)

This family contains only one genus. The female of *Exeretoneura angustifrons* has been examined in this paper.

Labrum and hypopharynx rather shovel-like; lacinia stylet-like; mandible absent; maxillary palpus 2-segmented, with segment 1 cylindrical, longer than wide and than

segment 2, with segment 2 rather elliptical and having apical short process; cibarial pump wider and much longer than labrum and much longer than wide; breadth between dorsal cornua narrower than cibarial pump; labellum much longer than theca; mid-distal interlabellar process short.

Torma moderately long.

Hypopharynx nearly as long as labrum; lacinia about as long as the palpus and labrum respectively.

Exeretoneura contains 4 species from Australia and Tasmania (after PARAMONOV, 1953). It is uncertain whether or not the above-mentioned characters based on female *angustifrons* are common to the male and to other species. The mouthparts of Exeretoneuridae, which resemble those of Stratiomyidae, Solvidae, Rachiceridae and Xylophagidae, may be characterized as follows: palpus with segment 2 shorter and not wider than segment 1, cibarial pump long, breadth between dorsal cornua distinctly narrower than cibarial pump, and labrum wide and comparatively short but narrower than cibarial pump.

MACKERRAS (1925: 547) wrote, "*Exeretoneura maculipennis* MACQ. was present in thousands and was always to be found clinging to grass stems, or flying in a leisurely fashion close to the ground; they were never seen feeding on the flowers where *Trichophthalmas* [belonging to the Nemestrinidae] were so abundant. Their flight is slow and their note is little more than a dull whirring, strikingly different from the loud high-pitched characteristic note of the *Trichophthalmas*. In the mornings they were so lethargic from cold that they could be picked up in the fingers in any quantity. No information is available as to the life history."

Exeretoneura angustifrons HARDY, 1924 (♀) (det. by D. H. COLLESS) (Figs. 183 — 186; the magnification of Fig. 185 is larger than those of Figs. 183, 184 and 186): labrum longer than wide, shorter (c. 0.8 times) than cibarial pump, and with apical margin rounded; apex of labrum may have a short process; hypopharynx nearly as long as labrum and with apical margin rounded; cibarial pump wider than labrum and breadth between dorsal cornua respectively, about twice (c. 1.9 times) as long as wide and widest before middle; in palpus, segment 1 with basal part near lacinia desclerotized and with segment 2 with a short apical process; total length of palpus shorter (c. 0.8 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 2.0 times) than cibarial pump and with a sclerotized spot, which runs longitudinally and narrows at middle; mid-distal interlabellar process short, less than 1/10 (c. 0.08 times) as long as labellum; torma moderately long. — Length: labrum 0.87 mm; cibarial pump 1.1 mm.

Exeretoneura angustifrons (♀) is at once distinguished from *Heterostomus curvipalpis* (♀) by having the cibarial pump and labellum longer, the labrum and hypopharynx shorter than in the latter species, and palpal segment 2 shorter and not wider than segment 1.

Specimen dissected: 1♀, Mt. Corree, A. C. T., Australia, 30. i. 1964, D. H. COLLESS.

Family Pelecorhynchidae (Figs. 187—191)

This family contains only one genus. The female of *Pelecorhynchus nigripennis* has been examined in this paper. MACKERRAS & FULLER (1942) illustrate the female mouthparts of *P. longicaudus* BIGOT, 1857 from Chile and *P. distinctus* TAYLOR, 1918 from Australia.

Labrum lanceolate; hypopharynx, lacinia and mandible stylet-like; maxillary palpus short, cylindrical, 2-segmented, with segment 1 about as long as wide, and with segment 2 having a shallow, wide-mouthed pit or flattened area at apical part; cibarial pump shorter and wider than labrum and longer than wide; labium with labella "large and hatchet-shaped" but much shorter than theca; there is no mid-dorso-proximal process on labrum and no mid-distal interlabellar process at least in *P. nigripennis* (♀).

Torma appears to be small and short.

MACKERRAS & FULLER (1942: 12) say, "The most striking feature of the mouthparts is the reduction of the mandibles of the female. These organs are extremely small in *P. longicaudus* BIGOT (Text-fig. 4), but in *P. elegans* PHIL., also from Chile, and in the majority of the Australian species, they are of the form shown in Text-fig. 5. Occasionally, as in *P. fusconiger* WALK., they are slightly larger."

Hypopharynx shorter than labrum; lacinia as long or shorter than labrum; stipes (= possibly cardo) markedly swollen.

The mouthparts of this family may be characterized by having the stipes considerably swollen and the apical part of the palpus with a shallow wide-mouthed pit or flattened area.

Pelecorhynchus is similar in structure of the mouthparts to *Pseudoerinna* (= *Bequaertomyia*) of Rhagionidae, but may easily be distinguished from the latter by having palpal segment 1 globular, theca much longer than labellum, etc.

MACKERRAS & FULLER (1942: 32) say, "Although the species of *Pelecorhynchus* have been described in various papers as blood-suckers, actually they are exclusively flower feeders. They occur in the vicinity of swamps, soakages, or creek banks in open, sunlit situations, usually in high, mountains or tableland country, and species of the genus *Leptospermum* are practically the only flowers visited in Australia."

Pelecorhynchus nigripennis RICARDO, 1900 (♀) (det. by I. M. MACKERRAS) (Figs. 187–191): labrum much longer than wide, longer (c. 2.5 times) than cibarial pump, wider basally and pointed at apex; hypopharynx shorter than labrum, tapering apically and pointed at apex; cibarial pump wider than labrum, somewhat wider (c. 1.1 times) than breadth between dorsal cornua, longer (c. 1.3 times) than wide, and narrowed at anterior part; mandible thin and slightly shorter (c. 0.9 times) than labrum; palpus with segment 1 globular and segment 2 longer (c. 1.8 times) than wide and wider apically; total length of palpus about as long as cibarial pump; lacinia nearly as long as labrum; labellum somewhat longer (c. 1.1 times) than cibarial pump and with a T-shaped sclerotized spot; stipes and palpus densely covered with long, soft pile. — Length: labrum 2.8 mm; cibarial pump 1.1 mm.

Pelecorhynchus nigripennis (♀) is at once distinguished from *Pseudoerinna jonesi* (♀) (Rhagionidae) as already mentioned.

Specimen dissected: 1♀, Alpine Ck, near Kiandra, N. S. W., Australia, 1. i. 1963, B. MACKERRAS.

Family Rhagionidae (Figs. 192–251)

This family contains 21 genera (NAGATOMI, 1982), of which 12 genera and 13 species have been examined here: *Pseudoerinna* and *Glutops* (Glutopinae); *Austroleptis* (Austroleptinae); *Spania* and *Spaniopsis* (Spaniinae); *Bolbomyia*, *Symphoromyia*, *Atherimorpha*, *Arthroteles*, *Rhagio*, *Arthroceras* and *Chrysopilus* (Rhagioninae). The genera not examined are as follows: *Litoleptis* and *Ptiolina* (Spaniinae); *Alloleptis*, *Rhagina*, *Neorhagio*, *Desmomyia*, *Solomomyia*, *Schizella* and *Stylospania* (Rhagioninae).

No definite subfamily characters are recognizable in the mouthparts.

The males have been seen only in one species of *Bolbomyia*, *Rhagio* and *Chrysopilus* respectively.

Labrum and hypopharynx lanceolate or so (in several genera, apices of labrum and hypopharynx not pointed but rounded or transversely straight from a dorsal or ventral view); lacinia stylet-like; mandible (when present) sword-like; maxillary palpus 1 or 2-segmented (usually 2) and in many genera cylindrical; cibarial pump longer than wide (in *Bolbomyia* wider than long), shorter than (in *Chrysopilus tanakai* longer than) and wider than labrum; breadth between dorsal cornua wider than, narrower than, or as wide as cibarial pump; theca usually shorter than labellum.

There is a mid-dorso-proximal process on the labrum in *Spaniopsis* sp. (♀), *Symphoromyia crassicornis* (♀) and *Symphoromyia melaena* (♀), although it is short [in Fig. 219, it is hidden by the lateral base of labrum and is not shown]. This process appears to be short and inconspicuous (if present) in *Pseudoerinna jonesi* (♀) in which the mandible is present.

Mid-distal interlabellar process absent in *Austroleptis collessi*, *Rhagio yasumatsui* and possibly *Spania kyushuensis*, but it is present in other genera and species considered in this paper.

The torus appears to be small and short or not very sclerotized. But it is moderately long in *Glutops itoi*, *Spania kyushuensis*, *Bolbomyia* sp., and possibly some others.

The mandibles (only in female) are well developed or somewhat reduced in *Pseudoerinna*, *Spaniopsis* and *Symphoromyia* but are not found in other genera examined. The mandibles are as long as or somewhat shorter than labrum.

At least in some species of *Rhagio* and *Chrysopilus* the differences between the sexes appear to be slight in the mouthparts.

Hypopharynx and lacinia are about as long as labrum regardless of the presence or absence of mandibles, but they are sometimes distinctly shorter than the labrum (in *Spania kyushuensis*, *Rhagio yasumatsui*, etc.). Lacinia as long as, longer or shorter than palpus according to genus or species.

In *Arthroteles cinerea*, the labrum, hypopharynx, lacinia and theca become conspicuously long, the hypopharynx and lacinia are distinctly shorter than the labrum which is somewhat shorter than the labium.

The mouthparts of Rhagionidae may hardly be distinguished from those of Athericidae and Tabanidae at family level.

Pseudoerinna* (= *Bequaertomyia*) *jonesi (CRESSON, 1919) (♀) (Figs. 192–196): labrum much longer than wide, longer (c. 2.1 times) than cibarial pump, wider basally and rounded at apical margin; hypopharynx about as long as labrum, tapering apically and pointed at apex (which may possibly be bifurcate); cibarial pump wider than labrum and about as wide as breadth between dorsal cornua, slightly longer (c. 1.1 times) than wide and roughly parallel-sided; mandible slightly shorter (c. 0.9 times) than labrum; in palpus, which is cylindrical, segment 1, 3 times or so and segment 2, 3.5 times or so as long as wide; total length of palpus twice as long as cibarial pump; lacinia (except basal darker part) slightly shorter (c. 0.9 times) than labrum; labellum longer (c. 2.5 times) than cibarial pump and with 2 darker spots, of which the apical is thin and runs obliquely; mid-distal interlabellar process long, 1/4–1/5 as long as labellum; stipes (= possibly cardo), palpus and theca are densely covered with long, soft pile. — Length: labrum 1.3 mm; cibarial pump 0.63 mm.

Pseudoerinna jonesi (♀) is distinguished from *Glutops itoi* (♀) by having the mandible present and the labrum rounded at the apical margin, and from *Symphoromyia crassicornis* (♀) and *S. melaena* (♀) by the palpus having abundant long, soft pile.

Specimen dissected: 1♀, Phillips Station, Placer Co., California, 22. vii. 1921, F. E. BLAISDELL.

Glutops itoi (NAGATOMI, 1955) (♀) (Figs. 197–200): labrum much longer than wide, longer (c. 2.0 times) than cibarial pump, wider basally and pointed at apex; hypopharynx nearly as long as labrum, tapering apically and rather pointed at apex; cibarial pump wider than labrum and as wide as breadth between dorsal cornua, longer (c. 1.3 times) than wide and roughly parallel-sided; mandible absent; palpus cylindrical, segment 1 about twice (c. 1.8 times) and segment 2 about 5 times (c. 5.4 times) as long as wide; total length of palpus about twice (c. 2.1 times) as long as cibarial pump; lacinia slightly shorter (c. 0.9 times) than labrum; labellum longer (c. 2.1 times) than cibarial pump and with 2 darker spots, of which the apical is much narrower than the basal; mid-distal interlabellar process short and 1/10 or so as long as labellum; torus moderately long [it is not shown in Figs. 197–198]. — Length: labrum 0.62 mm; cibarial pump 0.32 mm.

Glutops itoi (♀) is distinguished from *Pseudoerinna jonesi* (♀), *Symphoromyia crassicornis* (♀) and *S. melaena* (♀) by its lack of mandibles.

Specimen dissected: 1♀, Hanase, Kyoto Pref., 7. vi. 1961, S. ITO.

Austroleptis collessi PARAMONOV, 1962 (♀) (det. by D. H. COLLESS) (Figs. 201–204): labrum much longer than wide, over 3 times (c. 3.6 times) as long as cibarial pump, wider basally and with apical margin transverse; hypopharynx as long as labrum, somewhat tapering apically and with apical margin transverse; cibarial pump wider than labrum and breadth between dorsal cornua respectively, as long as wide and widest around middle; mandible absent; palpus cylindrical, segment 1, 3 times or so and segment 2, 4 times or so as long as wide; total length of palpus over twice (c. 2.4 times) as long as cibarial pump; lacinia as long as labrum; labellum, which is much shorter than theca, longer (c. 1.9 times) than cibarial pump and with 2 narrow darker spots, of which the basal is situated at inner

base of labellum; mid-distal interlabellar process absent; it appears that the torma is long but not very sclerotized. — Length: labrum 0.65 mm; cibarial pump 0.18 mm.

Austroleptis collessi (♀) is characterized among the genera of Rhagionidae (except *Arthroteles*) by having the theca much longer than the labellum and is distinguished from *Arthroteles cinerea* (♀) by having the theca, labrum, hypopharynx and lacinia much shorter than in the latter species.

Specimen dissected: 1♀, 7 m. W. of Maydema, Tasmania, 26. ii. 1967, E. F. RIEK.

Spania kyushuensis NAGATOMI & SAIGUSA, 1982 (♀) (Figs. 205–208): labrum longer than wide and longer (c. 1.6 times) than cibarial pump, wider basally and with apex rather rounded; [the presence of the hypopharynx is not confirmed in specimen dissected]; cibarial pump wider than labrum and breadth between dorsal cornua respectively, as long as wide and widest around middle; mandible absent; palpus 1-segmented, narrowed basally, 4 times or so as long as wide, and over twice (c. 2.6 times) as long as cibarial pump; lacinia shorter than labrum; labellum is longer (c. 2.1 times) than cibarial pump and may have no well-defined darker spot; mid-distal interlabellar process appears to be absent or to be minute (if present); torma moderately long. — Length: labrum 0.14 mm; cibarial pump 0.09 mm.

Spania kyushuensis (♀) is at once distinguished from *Spaniopsis* sp. (♀) by its lack of mandibles, and by having the lacinia much shorter than the palpus and the labrum not more than twice as long as the cibarial pump.

Specimen dissected: 1♀, Kyusuikei (800 m), Mt. Kuju, Oita Pref., Kyushu, 21. v. 1962, T. SAIGUSA.

Spaniopsis sp. (♀) (Figs. 209–213): labrum much longer than wide and much longer (3.5–3.7 times) than cibarial pump, somewhat wider basally and with more sclerotized and bifurcate apex; hypopharynx about as long as labrum, wider basally and pointed at apex; cibarial pump wider than labrum and breadth between dorsal cornua respectively, about as long as wide and narrower anteriorly; mandible as long as labrum; palpus 1-segmented, 5–6 times as long as wide, narrower basally from some angles, and over twice (2.3–2.6 times) as long as cibarial pump; lacinia as long as labrum; labellum longer (2.4 to 2.7 times) than cibarial pump and without well-defined darker spot; mid-distal interlabellar process long, c. 1/3 as long as labellum and spike-like; length of torma uncertain but clypeus not firmly fused with labrum or cibarial pump. — Length: labrum 0.97–1.0 mm; cibarial pump 0.27–0.29 mm.

Spaniopsis sp. (♀) is easily distinguished from *Spania kyushuensis* (♀) by the presence of mandibles, and having the lacinia longer than the palpus, and the labrum over 3 times as long as the cibarial pump; and from *Pseudoerinna jonesi* (♀), *Symphoromyia crassicornis* (♀) and *S. melaena* (♀) by having the palpus 1-segmented and the labrum over 3 times as long as the cibarial pump.

Specimens dissected: 3♀, 0.6 km. S. Park Headquarters, Gibraltar Range Nat. Park, N. S. W., Australia, 22. i. 1978, E. I. SCHLINGER.

Bolbomyia sp. (♀) (Figs. 214–217): labrum much longer than wide, longer (c. 2.2 times) than cibarial pump, tapering apically and pointed at apex; hypopharynx about as long as labrum, wider basally and pointed at apex; cibarial pump about as wide as labrum breadth between dorsal cornua respectively, somewhat shorter (c. 0.8 times) than long and widest around middle; mandible absent; in palpus, which is cylindrical, segment 1 somewhat shorter (0.8 times) than segment 2, and each segment 3 times or so as long as wide; total length of palpus much longer (c. 3.6 times) than cibarial pump; lacinia slightly shorter (c. 0.9 times) than labrum; labellum longer (c. 2.2 times) than cibarial pump and with 2 darker (but not very well-defined) spots; mid-distal interlabellar process short and less than 1/5 (c. 0.13 times) as long as labellum; torma moderately long. — Length: labrum 0.25 mm; cibarial pump 0.11 mm.

♂: almost fits the description of ♀; palpus longer than in ♀, and segments 1 + 2, 4.9 times as long as cibarial pump; lacinia appears to be somewhat shorter than in ♀. [the presence of a hypopharynx is not confirmed in the specimen dissected but probably the same as in ♀]. — Length: labrum 0.28 mm; cibarial pump 0.11 mm.

Bolbomyia sp. (♀) is distinguished from *Spania kyushuensis* (♀) by having the labrum and lacinia longer and the cibarial pump wider than in the latter species, and the palpus 2-segmented.

Specimens dissected: 1♀, 1♂, Karasawa, Mt. Hotaka, Nagano Pref., 10. vii. 1963, A. NAGATOMI.

Symphoromyia crassicornis (PANZER, 1806) (of Japan) (♀) (Figs. 218—222): labrum much longer than wide and longer (c. 1.6 times) than cibarial pump, wider basally and rounded at apex; hypopharynx may be slightly longer than labrum, appears to be somewhat wider basally and to have apical margin transversely straight; cibarial pump somewhat wider than labrum, distinctly narrower than breadth between dorsal cornua, longer (c. 1.3 times) than wide, and somewhat wider posteriorly; mandible as long as labrum; palpus with segment 2 bluntly pointed, 3 times or so as long as wide and about twice as long as segment 1, which is about twice as long as wide; total length of palpus longer (c. 2.0 times) than cibarial pump; lacinia (except basal darker part) about as long as labrum; labellum longer (c. 1.8 times) than cibarial pump and with 2 darker spots, of which the apical may not be well-defined; mid-distal interlabellar process comparatively long and $1/5$ or so as long as labellum; length of torma uncertain but clypeus not firmly fused with labrum or cibarial pump. — Length: labrum 0.51 mm; cibarial pump 0.32 mm.

Symphoromyia crassicornis (♀) and *S. melaena* (♀) are distinguished from *Pseudoerinna jonesi* (♀) by having the pile on the palpus shorter and less dense than in the latter species and the breadth between the dorsal cornua wider than the cibarial pump.

Specimen dissected: 1♀, Renge Oike (2400 m), Nagano Pref., 21. vii. 1955, T. OKUNO.

Symphoromyia melaena (MEIGEN, 1820) (♀) (Figs. 223—227): similar to *S. crassicornis* except as follows: labrum may be longer than in *crassicornis* and c. 1.9 times as long as cibarial pump; mandible shorter than labrum [in specimen dissected, a pair of mandibles are asymmetrical in length and 0.6 or 0.8 times as long as labrum; this asymmetry is probably abnormal]; torma long but parallel-sided (this may be so in *Symphoromyia crassicornis*, ♀); in 1 specimen dissected, palpal segment 2, 3.8 times as long as wide and 1.6 times as long as segment 1, and mid-distal interlabellar process $1/4$ as long as labellum. — Length: labrum 0.63 mm; cibarial pump 0.33 mm.

Specimen dissected: 1♀, Farkasgyepü, Bakony mts. [probably Hungary], 18. vii. 1965, fénycsapoda.

Atherimorpha sp. (♀) (Figs. 228—231): labrum much longer than wide and over twice (c. 2.4 times) as long as cibarial pump, somewhat wider basally and with apex composed of a pair of sclerites which are curved inwardly; hypopharynx nearly extending to top of labrum, rather parallel-sided and with apex rounded; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (c. 1.2 times) than wide and rather parallel-sided; mandible absent; palpus cylindrical, segment 2, 5 times or so as long as wide, about twice as long as segment 1 which is 3 times or so as long as wide; total length of palpus much longer (c. 2.9 times) than cibarial pump; lacinia shorter (c. 0.8 times) than labrum; labellum is longer (c. 2.5 times) than cibarial pump and may have 2 large darker spots (which are not well-defined); mid-distal interlabellar process about $1/6$ (c. 0.18 times) as long as labellum; torma appears to be short. — Length: labrum 0.54 mm; cibarial pump 0.23 mm.

Atherimorpha sp. (♀) is distinguished from *Arthroceras japonicum* (♀) by having the apex of the labrum composed of a pair of sclerites (which are curved inwardly), labrum over twice as long as the cibarial pump and palpus more elongate than in the latter species.

Specimen dissected: 1♀, St. Bernhard, Mt. Hotham (1375 m), Victoria, Australia, 13. vii. 1962, E. S. ROSS & D. O. CAVAGNARO.

Arthroteles cinerea STUCKENBERG, 1956 (♀) (det. by B. R. STUCKENBERG) (Figs. 232—235): labrum extraordinarily long, c. 6.5 times as long as cibarial pump, and tapering apically; hypopharynx shorter than labrum and tapering apically; cibarial pump may be slightly narrower than labrum and slightly wider than breadth between dorsal cornua, is longer (c. 1.7 times) than wide, and appears to be widest before middle; mandible absent; in palpus, segment 2, c. 6 times as long as wide and c. 2 times as long as segment 1 which is nearly twice as long as wide; total length of palpus longer (c. 1.8 times) than cibaria

pump; lacinia shorter (c. 0.8 times) than labrum; labium extraordinarily long and longer (c. 1.4 times) than labrum; labial stalk 10 times or so as long as labellum which is shorter (c. 0.7 times) than cibarial pump and may have one darker line at inner base; mid-distal interlabellar process colorless and inconspicuous (if present); torma short in relation to cibarial pump. — Length: labrum 3.0 mm; cibarial pump 0.46 mm.

Arthroteles cinerea (♀) is distinguished by having the labrum, labial stalk, hypopharynx and lacinia extraordinarily long (the latter two are shorter than the former two) among the Rhagionids.

Specimen dissected: 1♀, Natal, South Africa, iii. 1959, B. R. STUCKENBERG.

Rhagio yasumatsui NAGATOMI, 1972 (♀) (Figs. 236—239): labrum much longer than wide, longer (c. 1.4 times) than cibarial pump, wider basally, and with apex having a short process; hypopharynx is shorter than labrum, appears to be wider basally and is rather pointed at apex; cibarial pump wider than labrum, not narrower than breadth between dorsal cornua, longer (c. 1.7 times) than wide and widest around middle; mandible absent; palpus 1-segmented, widest around middle, bluntly pointed at apex, 4—5 times as long as wide, and longer (c. 1.6 times) than cibarial pump; lacinia shorter (c. 0.8 times) than labrum; labellum is longer (c. 2.1 times) than cibarial pump and may have 2 large darker spots which are not well-defined; mid-distal interlabellar process absent; torma appears to be short. — Length: labrum 0.61 mm; cibarial pump 0.44 mm.

♂ (Figs. 240—243): almost fits the description of ♀; in 1 specimen dissected, labellum less than twice (1.8 times) as long as cibarial pump; palpus widest before middle. — Length: labrum 0.53 mm; cibarial pump 0.41 mm.

Among the Rhagionids considered in this paper, *Rhagio yasumatsui* (♀, ♂) is characterized by having the labrum with a short process at apex. It is easily separated from *Chrysopilus tanakai* by the shapes of the palpus and cibarial pump.

Specimens dissected: 1♀, Mt. Kurino, Kagoshima Pref., 23. v. 1969, K. KUSIGEMATI; 1♂, Sata-misaki, Kagoshima Pref., 29. iv. 1966, A. TANAKA.

Arthroceras japonicum NAGATOMI, 1954 (♀) (Figs. 244—247): labrum much longer than wide, longer (1.4—1.5 times) than cibarial pump, wider basally and with apical margin transversely straight; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, wider (1.2—1.3 times) than breadth between dorsal cornua, longer (c. 1.5 times) than wide, and rather bottle-shaped; mandible absent; palpus cylindrical, segment 2 wider apically, 3 times or so as long as wide, longer (1.4—1.7 times) than segment 1, which is over twice (2.2—2.6 times) as long as wide; total length of palpus longer (1.8 times) than cibarial pump; lacinia slightly shorter (0.9 times) than labrum; labellum longer (1.9 times) than cibarial pump and with 2 sclerotized spots, of which the apical narrow; mid-distal interlabellar process long and 1/4—1/5 as long as labellum; torma appears to be short. — Length: labrum 0.68—0.70 mm; cibarial pump 0.47—0.49 mm.

Arthroceras japonicum (♀) is distinguished from *Glutops itoi* (♀) by having the apex of labrum not pointed but transversely straight.

Specimens dissected: 2♀, Mt. Wanizuka, Miyazaki Pref., 23. v. 1966, A. NAGATOMI.

Chrysopilus tanakai NAGATOMI, 1978 (♀) (Figs. 248—251): labrum longer than wide, shorter (c. 0.8 times) than cibarial pump, wider basally and rather rounded at apex; hypopharynx as long as labrum, somewhat wider basally and rather rounded at apex; cibarial pump wider than labrum, nearly as wide as breadth between dorsal cornua, over twice (c. 2.3 times) as long as wide and narrowed at anterior part; mandible absent; palpus 1-segmented, less sclerotized at base, widest behind middle, 4 times or so as long as wide, and slightly shorter (c. 0.9 times) than cibarial pump; lacinia as long as labrum; labellum slightly longer (c. 1.1 times) than cibarial pump and with 2 darker spots which may not be well-defined; mid-distal interlabellar process short and less than 1/5 (c. 0.15 times) as long as labellum; torma short. — Length: labrum 0.33 mm; cibarial pump 0.43 mm.

♂: in 1 specimen dissected, labrum 0.6 times, palpus 0.7 times, labellum 1.0 times as long as cibarial pump respectively, and cibarial pump 1.1 times as wide as breadth between dorsal cornua. — Length: labrum 0.29 mm; cibarial pump 0.48 mm.

Chrysopilus tanakai (♀, ♂) is characterized by the labrum being shorter than the cibarial pump among the Rhagionids included in this paper.

Specimens dissected: 1♀, 1♂, Mizunodaira, near Teraji-yama, Gifu Pref., 18–21. vii. 1975, A. NAGATOMI.

Family Athericidae (Figs. 252–326)

The following 5 genera and 11 species have been examined: *Atherix* (*basilica* and *ibis*), *Ibisia* (*marginata*), *Suragina* (*caerulescens*, *longipes*, *satsumana* and *yaeyamana*); *Atrichops* (*fontinalis* and *morimotoi*); *Dasyomma* (*caeruleum* from Chile and *maculipennis* from Tasmania). The former 4 genera belong to the Athericinae and the last one to the Dasyommatae. Of the 11 species above, the males of 4 genera and 7 species have been seen.

No definite subfamilial or generic diagnosis is found in the mouthparts among the Athericids considered in this paper.

Labrum lanceolate; hypopharynx, lacinia and mandible stylet-like; maxillary palpus 2-segmented and its basal segment shorter than the elongate apical one; cibarial pump shorter than and as wide as or wider than labrum, longer than wide, parallel-sided or with lateral margin convex outward; labium with labella not shorter than theca.

Dorsal cornu with a ventral process which is absent in *Atrichops fontinalis*, *Atrichops morimotoi* and *Dasyomma maculipennis* (from Tasmania).

Labrum with a mid-dorso-proximal process which is always absent in ♂ and in *Dasyomma maculipennis* (♀) and may be short in *Atherix basilica* (♀) and *Atherix ibis* (♀).

Mid-distal interlabellar process is present.

The length of the torma is not fully examined but the clypeus is not firmly fused with labrum or cibarial pump.

The mandibles are fully developed, reduced, or entirely absent according to species in the female and always absent in the male.

The differences between the female and male mouthparts appear to be slight.

In those species where the female mandibles are fully developed (about as long as labrum), the hypopharynx and lacinia are also well developed, i. e. they are about as long as the labrum and the lacinia is not shorter than the maxillary palpus. It is interesting to note that the matters above hold good for those males in which the mandibles are always absent.

In those species where the female mandibles are reduced (shorter than labrum) or entirely absent, the hypopharynx is always shorter than the labrum and the lacinia is often shorter than the labrum and maxillary palpus, and this also applies to the males.

It is not possible at present to distinguish the Athericidae from other related families on the basis of the mouthparts alone.

Atherix basilica NAGATOMI, 1958 (♀) (Figs. 252–255): labrum much longer than wide, longer (1.7–1.8 times) than cibarial pump, wider basally and pointed at apex; hypopharynx shorter than labrum, tapering apically and pointed; mid-dorso proximal process on labrum short; cibarial pump about as wide as (0.9–1.1 times) labrum, narrower (0.7 to 0.8 times) than breadth between dorsal cornua, much longer (2.7–4.5 times) than wide, and narrower anteriorly; dorsal cornu with a short ventral process [which is not shown in Figs. 253 and 257]; mandible absent; palpus with segment 2 bluntly pointed, c. 6 times as long as wide and c. 3 times as long as segment 1, which is 1½–2 times as long as wide; total length of palpus longer (1.7–1.8 times) than cibarial pump; lacinia shorter (c. 0.5 times) than labrum; labellum longer (1.7–2.0 times) than cibarial pump and with 1 pale transverse band around middle; mid-distal interlabellar process is 1/6–1/7 (0.14–0.17 times) as long as labellum. — Length: labrum 0.57–0.63 mm; cibarial pump 0.33–0.37 mm.

♂ (Figs. 256–259): almost fits the description of ♀, but total length of palpus and labellum are 1.5 times as long as cibarial pump respectively; there are probably no significant differences between sexes, i. e. Figs. 252–255 (♀) and 256–259 (♂). — Length: labrum 0.63 mm; cibarial pump 0.41 mm.

Atherix basilica (♀, ♂) is distinguished from *Atherix ibis* (♀, ♂) by having the apex of the labrum more bluntly pointed, the lacinia about as long as the cibarial pump, and the mandibles absent (in ♀ as well as ♂), and from *Dasyomma maculipennis* (♀, ♂) (from Tasmania) by having the apex of the labrum more bluntly pointed and the palpus less swollen.

Specimens dissected: 2♀, Senjodake, Yamanashi Pref., 16. vii. 1963, A. NAGATOMI; 1♀, 1♂, between Mt. Kisokoma and Narai, Nagano Pref., 26. vii. 1969, A. NAGATOMI.

***Atherix ibis* (FABRICIUS, 1798) (♀)** (Figs. 260–264): labrum much longer than wide, longer (1.7–2.2 times) than cibarial pump, somewhat wider basally and with apex more acutely pointed than in *A. basilica*; mid-dorso-proximal process on labrum short; hypopharynx much shorter (c. 0.4 times) than labrum, willow-leaf shaped and pointed at apex; cibarial pump about as wide as (0.9–1.1 times) labrum, narrower than breadth between dorsal cornua, longer (1.8–2.3 times) than wide, and narrowed at both ends; dorsal cornu with a ventral process [which is not shown in Figs. 261 and 266]; mandible shorter (0.8 to 0.9 times) than labrum; in palpus, segment 2 bluntly pointed, 6 times or so as long as wide, and 3 times or so as long as segment 1 which is 2 times or so as long as wide; total length of palpus longer (2.1–2.4 times) than cibarial pump; lacinia shorter (0.8–0.9 times) than labrum but longer than in *A. basilica*; labellum longer (1.9–2.2 times) than cibarial pump and with 1 transverse pale band around middle; mid-distal interlabellar process long and 1/3 or so (0.29–0.38 times) as long as labellum. — Length: labrum 0.78–0.87 mm; cibarial pump 0.41–0.47 mm.

♂ (Figs. 265–266): almost fits the description of ♀ except as follows: labrum may be shorter than in ♀ and is 1.4–1.6 times as long as cibarial pump; cibarial pump 1.2–1.3 times as wide as labrum; hypopharynx over 1/2 (c. 0.7 times) as long as labrum, tapering apically and pointed; total length of palpus 1.5–1.9 times and labellum 1.6–1.8 times as long as cibarial pump respectively; mid-distal interlabellar process 1/6 or so (0.16–0.18 times) as long as labellum. — Length: labrum 0.63–0.67 mm; cibarial pump 0.42–0.44 mm.

Atherix ibis (♀, ♂) is distinguished from *Atherix basilica* (♀, ♂) by having the apex of the labrum more acutely pointed, the lacinia longer than the cibarial pump, and the mandible of ♀ present. It is very similar to *Suragina caerulea* but the hypopharynx of the former may be shorter than in the latter.

Specimens dissected: 3♀, Naidaijin, Kumamoto Pref., 8. v. 1967, H. SHIMA; 3♂, Sasayama, Hyogo Pref., 25–30. iv. 1959, A. NAGATOMI.

***Ibis marginata* (FABRICIUS, 1781) (♀)** (det. by R. Rozkošný) (Figs. 267–271): labrum much longer than wide, longer (c. 2.3 times) than cibarial pump, somewhat wider basally and pointed at apex; hypopharynx about as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (c. 1.7 times) than wide, and bottle-shaped; dorsal cornu with a large ventral process whose apical portion is colorless; mandible appears to be slightly shorter (c. 0.9 times) than labrum; in palpus, segment 2 bluntly pointed, c. 6 times as long as wide, and c. 5 times as long as segment 1, which is c. 1.5 times as long as wide; total length of palpus longer (c. 2.1 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 1.9 times) than cibarial pump and with 1 heavily sclerotized line starting at inner base and 2 sclerotized spots whose shapes are shown in Fig. 271; mid-distal interlabellar process c. 1/6 as long as labellum. — Length: labrum 0.91 mm; cibarial pump 0.40 mm.

Ibis marginata (♀) is distinguished from *Atherix ibis* (♀) by having the hypopharynx about as long as the labrum, the mid-dorso-proximal process on the labrum long, labellum with 1 heavily sclerotized line starting at inner base, etc. It may be separated from *Suragina satsumana* (♀) by the mandibles which appear to be slightly shorter than the labrum.

Specimen dissected: 1♀, Moravia, Czechoslovakia, 26. vii. 1978, R. ROZKOŠNÝ.

***Suragina caerulea* (BRUNETTI, 1912) (= *Atherix kodamai* NAGATOMI, 1953) (♀)** (Figs. 272–276): labrum much longer than wide, longer (2.2–2.5 times) than cibarial pump, wider basally and pointed at apex; hypopharynx shorter (c. 0.7 times) than labrum, and thin at apical portion; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (1.4–1.9 times) than wide, and bottle-shaped; dorsal cornu with a short, colorless ventral process which may easily be overlooked [and is not shown in Figs. 273 and 278]; mandible somewhat shorter (0.8–0.9 times) than labrum; in palpus, segment 2 widest and strongly curved around middle, bluntly pointed at apex, and much longer than segment 1; total length of palpus (= distance between base and apex) longer (1.9–2.2 times) than cibarial pump; lacinia slightly shorter (c. 0.9 times) than labrum; labellum longer (2.0–2.3 times) than cibarial pump and with 1 paler transverse band

around middle; mid-distal interlabellar process $1/5-1/6$ as long as labellum. — Length: labrum 0.66–0.75 mm; cibarial pump 0.28–0.34 mm.

♂ (Figs. 277–279): similar to ♀ except as follows: hypopharynx longer (0.9 times as long as labrum) and wider (at apical portion) than in ♀; labellum shorter than in ♀ (1.7 times as long as cibarial pump); mid-distal interlabellar process $1/4$ as long as labellum. — Length: labrum 0.61 mm; cibarial pump 0.29 mm.

Suragina caerulescens (♀, ♂) is distinguished from *Atherix ibis* (♀, ♂) by having the hypopharynx narrower (thin at apical portion) and longer than in the latter species.

Specimens dissected: 3♀, Banzan, near Sata, Kagoshima Pref., 20–22. vii. 1965, K. HASHIMOTO; 1♀, Sasayama, Tamba, Hyogo Pref., 28. vi. 1955, A. NAGATOMI; 1♂, Takinoya-mura, Yabu-gun, Tajima, Hyogo Pref., 7. vii. 1952, R. MORIMOTO.

Suragina longipes (BELLARDI, 1861) (♀) (Figs. 280–284): labrum much longer than wide, longer (c. 3.3 times) than cibarial pump, somewhat wider basally and pointed at apex; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (c. 1.6 times) than wide and rather bottle-shaped; dorsal cornu with a long, slender ventral process which is entirely darkened; mandible as long as labrum; in palpus, segment 2 curved and widest around middle, pointed at apex, and much longer than segment 1; total length of palpus longer (c. 2.0 times) than cibarial pump; lacinia about as long as labrum; labellum longer (c. 2.3 times) than cibarial pump and with sclerotized spots whose shapes are shown in Fig. 284; mid-distal interlabellar process $1/5$ or so as long as labellum. — Length: labrum 1.5 mm; cibarial pump 0.46 mm.

Suragina longipes (♀) may be characterized among the Athericids in this paper by the long, slender ventral process on the dorsal cornu.

Specimen dissected: 1♀, Chiapas, 32 km N. of Ocozocoautla, on road to Malpaso, Mexico, 6. x. 1974, D. E. BREEDLOVE & J. A. BREEDLOVE.

Suragina satsumana (MATSUMURA, 1916) (♀) (Figs. 285–288): labrum much longer than wide, longer (c. 2.3 times) than cibarial pump, somewhat wider basally and pointed at apex; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (c. 2.0 times) than wide, and bottle-shaped; mandible as long as labrum; dorsal cornu with a large ventral process which is colorless, may easily be overlooked [and is not shown in Fig. 286]; in palpus, segment 2 curved and widest around middle, pointed at apex, and much longer than segment 1; total length of palpus (= distance between base and apex) longer (c. 1.6 times) than cibarial pump; lacinia about as long as labrum; labellum is longer (c. 1.9 times) than cibarial pump and may have 2 large darker spots which are not well-defined; mid-distal interlabellar process $1/5$ or so as long as labellum. — Length: labrum 1.1 mm; cibarial pump 0.51 mm.

♂ (Figs. 289–290): similar to ♀ except as follows: hypopharynx slightly shorter (c. 0.9 times) than labrum; segment 2 of palpus somewhat narrower than in ♀; lacinia slightly shorter (c. 0.9 times) than labrum; in 1 specimen dissected, labellum 2.2 times as long as cibarial pump, and mid-distal interlabellar process $1/6$ as long as labellum. — Length: labrum 1.0 mm; cibarial pump 0.44 mm.

Suragina satsumana (♀) may be distinguished from *Suragina yaeyamana* (♀) by the breadth between dorsal cornua wider than cibarial pump, if this character is significant. It (♀) may be separated from *Ibis marginata* (♀) by the mandible as long as labrum.

Specimens dissected: 1♀, Takinoya-mura, Yabu-gun, Hyogo Pref., 7. vii. 1952, A. NAGATOMI; 1♂, Tanegashima, Kagoshima Pref., 22. vii. 1961, A. NAGATOMI.

Suragina yaeyamana NAGATOMI, 1979 (♀) (Figs. 291–295): labrum much longer than wide, longer (c. 2.4 times) than cibarial pump, somewhat wider basally and pointed at apex; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and bottle-shaped; dorsal cornu with a large ventral process which is colorless; mandible as long as labrum; in palpus, segment 2 curved and widest around middle [in Fig. 294, it is not so due to different angle], pointed at apex, and much longer than segment 1; total length of palpus longer (c. 1.5 times) than cibarial pump; lacinia about as long as labrum; labellum longer (c. 2.0 times) than cibarial pump and with darker spots as shown

in Fig. 295; mid-distal interlabellar process $1/4-1/5$ as long as labellum. — Length: labrum 0.97 mm; cibarial pump 0.41 mm.

Suragina yaeyamana (♀) may be distinguished from *Suragina satsumana* (♀) by having the breadth between the dorsal cornua as wide as cibarial pump, if this character is significant.

Specimen dissected: 1♀, Iriomote-jima, South-West Islands, 30. iv. 1982, A. NAGATOMI.

Atrichops fontinalis (NAGATOMI, 1958) (♀) (Figs. 296–300): labrum much longer than wide, much longer (c. 2.7 times) than cibarial pump, somewhat wider basally, and with apex narrowed but not pointed and transversely straight; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, as wide as breadth between dorsal cornua, longer (c. 1.4 times) than wide, and bottle-shaped; dorsal cornu without a ventral process; mandible as long as labrum; in palpus, segment 2 tapering apically and pointed, and longer than segment 1 which is longer than wide; total length of palpus longer (c. 2.4 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 2.1 times) than cibarial pump and with 2 dark elongate spots; mid-distal interlabellar process colorless, not pointed but rounded apically (from a dorsal view) and probably $1/6$ or so as long as labellum. — Length: labrum 0.68 mm; cibarial pump 0.25 mm.

♂ (Figs. 301–304): almost fits the description of ♀; labrum appears to be shorter and wider than in ♀ and is 2.5 times as long as cibarial pump; palpus and lacinia appear to be shorter than in ♀ and the former is 2.5 times as long as cibarial pump. — Length: labrum 0.62 mm; cibarial pump 0.25 mm.

Atrichops fontinalis (♀, ♂) and *A. morimotoi* (♀, ♂) may be distinguished from other genera of Athericids considered in this paper by the following set of characters: the dorsal cornu is without a ventral process, the apex of labrum is narrowed but not pointed and transversely straight and the palpus is more slender.

Specimens dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 25. v. 1954, A. NAGATOMI; 1♂, Sasayama, Tamba, Hyogo Pref., 27. vi. 1977, A. NAGATOMI.

Atrichops morimotoi (NAGATOMI, 1958) (♀) (Figs. 305–309): similar to *fontinalis* but palpus may be shorter than in the latter; in 1 specimen measured, the labrum is 2.2 times as long as the cibarial pump; cibarial pump 1.7 times as long as wide; total length of palpus 2.0 times as long as the cibarial pump. — Length: labrum 0.56 mm; cibarial pump 0.25 mm.

♂ (Figs. 310–313): it appears that the labrum is shorter and wider than in ♀ and the palpus and lacinia are shorter than in ♀; the palpus may be shorter than in *fontinalis*; in 3 specimens measured, labrum 2.2–2.4 times as long as cibarial pump, cibarial pump 0.8–1.0 times as wide as breadth between dorsal cornua and 1.3–1.5 times as long as wide, total length of palpus 1.8–2.1 times as long as cibarial pump; labellum 1.8–2.3 times as long as cibarial pump. — Length: labrum 0.46–0.48 mm; cibarial pump 0.19 to 0.22 mm.

Specimens dissected: 1♀, 3♂, Sasayama, Tamba, Hyogo Pref., 27. vi. 1977, A. NAGATOMI.

Dasyomma caeruleum MACQUART, 1840 (♀) (det. by L. L. PECHUMAN) (Figs. 314 to 318): labrum much longer than wide, much longer (c. 3.7 times) than cibarial pump, almost parallel-sided, and with apex narrowed but not pointed and transversely straight; hypopharynx as long as labrum and willow-leaf like; cibarial pump somewhat wider than labrum, narrower than breadth between dorsal cornua, longer (c. 1.8 times) than wide, and parallel-sided (except anterior part which is narrowed); dorsal cornu with a large ventral process; mandible as long as labrum; in palpus, segment 2 bluntly pointed and longer than segment 1 which is longer than wide; total length of palpus much longer (c. 3.1 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 2.3 times) than cibarial pump and with 2 darker elongate spots; theca slightly shorter (c. 0.9 times) than labellum; mid-distal interlabellar process is $1/4$ or so as long as labellum. — Length: labrum 1.3 mm; cibarial pump 0.34 mm.

Dasyomma caeruleum (♀) is at once distinguished from *Dasyomma maculipennis* (♀) by having the mandible, hypopharynx, lacinia and labrum equal in length, apex of labrum not pointed but transversely straight, dorsal cornu with a large ventral process, labrum, cibarial pump and palpus more slender than in the latter species, etc.

Specimen dissected: 1♀, Tregualemo, Chile, 10. xii. 1953, L. E. PENA.

Dasyomma maculipennis HARDY, 1920 (♀) (Figs. 319—322): labrum longer than wide, longer (c. 1.9 times) than cibarial pump, wider basally and with a mid-apical short acute process; labrum without a mid-dorso-proximal process as in ♂; hypopharynx shorter (c. 0.7 times) than labrum, tapering apically and pointed; cibarial pump as wide as labrum and somewhat narrower than breadth between dorsal cornua, longer (c. 2.0 times) than wide, and rather bottle-shaped; dorsal cornu without a ventral process; mandible absent; in palpus, segment 2 bluntly pointed, 4.3 times or so as long as wide, much longer than segment 1; total length of palpus longer (c. 2.1 times) than cibarial pump; lacinia shorter (0.5 times) than labrum; labellum longer (c. 2.2 times) than cibarial pump and with 2 darker elongate spots; theca shorter (c. 0.5 times) than labellum; mid-distal interlabellar process c. 1/5 as long as labellum. — Length: labrum 0.77 mm; cibarial pump 0.41 mm.

♂ (Figs. 323—326): hypopharynx and lacinia shorter than in ♀; in 2 specimens measured, labrum 1.9—2.0 times as long as cibarial pump; hypopharynx 0.5 times as long as labrum; cibarial pump 1.3 times as wide as labrum, 0.8 times as wide as breadth between dorsal cornua, and 1.9—2.0 times as long as wide; total length of palpus 2.1—2.2 times as long as cibarial pump; lacinia 0.4 times as long as labrum; labellum 2.0—2.2 times as long as cibarial pump; theca 0.6 times as long as labellum; mid-distal interlabellar process 1/4 to 1/5 as long as labellum. — Length: labrum 0.76—0.78 mm; cibarial pump 0.38 mm.

Dasyomma maculipennis (♀, ♂) is at once distinguished from *D. caeruleum* (♀) by lacking mandibles, having the hypopharynx and lacinia shorter than the labrum, the ♀ labrum with a midapical acute process (as in ♂); the labrum, cibarial pump and palpus wider than in the latter species, etc. It is separated from *Atherix basilica* (♀, ♂) by having the apex of the labrum more acutely pointed, the cibarial pump about twice as long as wide, and the palpus more robust than in the latter species.

Specimens dissected: 1♀, 2♂, Mt. Field, Tasmania, 25. xii. 1960, J. L. GRESSITT.

Family Tabanidae (Figs. 327—402)

This family contains numerous genera, of which only 9 genera and 12 species have been examined in this paper: Pangoniinae: *Stonemyia* (1 sp.) and *Pangonius* (1 sp.); Chrysopsinae: *Nagatomyia* (1 sp.), *Silvius* (2 spp.) and *Chrysops* (2 spp.); Tabaninae: *Atylotus* (1 sp.), *Tabanus* (2 spp.), *Isshikia* (1 sp.) and *Haematopota* (1 sp.). Thus, it is not possible to discuss fully the diagnosis of Tabanidae concerning the mouthparts. The characters given below are merely based on the material examined.

Labrum lanceolate; hypopharynx lanceolate or stylet-like; lacinia stylet-like; mandible sword or stylet-like; maxillary palpus 2-segmented, and with segment 2 usually longer than segment 1; cibarial pump longer than wide, as wide as or wider than and shorter than labrum; breadth between dorsal cornua as wide as or wider than cibarial pump; theca usually longer than labella.

There is a mid-dorso-proximal process on labrum in the female but it is short and inconspicuous (if present) in *Stonemyia yezoensis* [and possibly in *Nagatomyia melanica*] where the mandibles are reduced.

Mid-distal interlabellar process varies in length with genus and species and it is absent in *Pangonius funebris* (♂) and *Haematopota tristis* (♀).

Length of torus is not fully examined but clypeus is not firmly fused with labrum or cibarial pump.

The mandibles are usually well developed in the female and always absent in the male.

The differences between female and male based on 3 genera (*Stonemyia*, *Chrysops* and *Tabanus*) and 4 species are as follows: labrum distinctly, or more or less shorter or narrower, and cibarial pump longer in ♂ than in ♀; in *Chrysops* and *Tabanus* segment 2 of palpus is much shorter in ♂ than in ♀.

It is usually seen that the labrum is long, hypopharynx and lacinia are as long as labrum, and lacinia is longer than palpus. The mandibles are about as long as labrum in 6 genera examined but shorter than labrum in *Stonemyia yezoensis* and *Nagatomyia melanica*.

In *Nagatomyia melanica* (♀), the labrum short in relating to other genera, lacinia shorter than palpus, and theca shorter than labellum.

In *Pangonius funebris* (δ), the labrum, hypopharynx, lacinia and theca become conspicuously long and labium is longer than labrum.

Subfamily Pangoniinae (Figs. 327—339)

Only 2 genera and 2 species have been examined. In *Pangonius funebris* (δ), the proboscis is conspicuously long. In *Stonemyia yezoensis* (φ , δ), the labrum is nearly 3 (φ) or roughly 2 (δ) times as long as cibarial pump and the palpal segment 2 being narrower than the segment 1.

Stonemyia yezoensis (SHIRAKI, 1918) (φ) (Figs. 327—331): labrum is much longer than wide, longer (2.7—2.9 times) than cibarial pump, wider basally and may have a short median process; mid-dorso proximal process on labrum short and inconspicuous (if present) [in Fig. 328, a membrane is attached to the clypeus and this is not a mid-dorso-proximal process]; hypopharynx about as long as labrum, tapering apically and pointed; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, longer (1.6—1.7 times) than wide, and roughly parallel-sided; mandible shorter (0.6—0.7 times) than labrum; in palpus, segment 2 tapering apically, pointed, 6—7 times as long as wide, 2—3 times as long as segment 1 which is twice as long as wide; total length of palpus longer (2.3—2.4 times) than cibarial pump; lacinia as long as labrum; labellum longer (1.4 times) than cibarial pump and with 2 narrow sclerotized spots; mid-distal interlabellar process $1/3-1/4$ as long as labellum. — Length: labrum 1.7—1.8 mm; cibarial pump 0.61—0.65 mm.

δ (Figs. 332—335): apical portion of labrum is narrower than in φ and may have no median process; cibarial pump longer than in φ ; hairs on palpus longer and denser than in φ ; in 2 specimens dissected, labrum 2.1—2.3 times as long as cibarial pump; cibarial pump 1.3—1.4 times as wide as labrum, 0.9 times as wide as breadth between dorsal cornua, and 2.1—2.3 times as long as wide; in palpus, segment 2, 5—6 times and segment 1, 2—3 times as long as wide respectively; total length of palpus 1.8—1.9 times as long as cibarial pump; labellum 1.0—1.1 times as long as cibarial pump; mid-distal interlabellar process $1/4-1/6$ as long as labellum. — Length: labrum 1.7—1.8 mm; cibarial pump 0.79—0.83 mm.

Stonemyia yezoensis (φ) is distinguished from *Silvius shirakii* (φ) by having the mandible distinctly shorter than the labrum, the labrum over twice as long as the cibarial pump, etc.

Specimens dissected: 3 φ , 2 δ , Mt. Takachiho, Kirishima-yama, Kagoshima Pref., 29. vii. 1962, A. NAGATOMI.

Pangonius funebris MACQUART, 1845 (δ) (Figs. 336—339): labrum, hypopharynx, lacinia and labium conspicuously long; labium longer (c. 1.2 times) than labrum; labrum much longer (c. 5.4 times) than cibarial pump, tapering apically and pointed; hypopharynx nearly as long as labrum, tapering apically and pointed; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, longer (c. 2.2 times) than wide, and roughly parallel-sided (except narrowed anterior part); palpus with segment 2, having a large elliptical flattened apical area, c. 4 times as long as wide, longer (c. 1.4 times) than, and as wide as, segment 1, which is cylindrical, and c. 3 times as long as wide; total length of palpus longer (c. 1.5 times) than cibarial pump; lacinia nearly as long as labrum; labellum shorter (c. 0.6 times) than cibarial pump, much shorter (c. 0.1 times) than theca and without darker spot; mid-distal interlabellar process absent. — Length: labrum 7.0 mm; cibarial pump 1.3 mm.

Pangonius funebris (δ) is easily distinguished from *Arthroteles cinerea* (φ) (Rhagionidae) by having the hypopharynx and lacinia nearly as long as the labrum.

Specimen dissected: 1 δ , Burgaria, 1978, R. ROZKOŠNÝ.

Subfamily Chrysopsinae (Figs. 340—369)

Only 3 genera and 4 species have been examined. In *Nagatomyia melanica* (φ), the labrum, theca and lacinia are short (in relation to other genera) and the mandible is reduced. In the *Silvius* (φ) and *Chrysops* (φ) considered in this paper, the labrum is roughly twice as long as the cibarial pump and more slender than in the Tabaninae (φ) of this paper, and palpal segment 2 is wider than segment 1.

Nagatomyia melanica MURDOCH & TAKAHASI, 1961 (♀) (Figs. 340—344): labrum longer than wide, somewhat longer (c. 1.2 times) than cibarial pump, wider basally and with wide apical margin (which may have a minute mid-apical process); [presence of mid-dorso-proximal process on labrum is not confirmed]; hypopharynx nearly as long as labrum, tapering apically and pointed; cibarial pump wider than labrum and narrower than breadth between dorsal cornua, longer (c. 2.2 times) than wide, and roughly parallel-sided (except narrowed anterior portion); mandible shorter (c. 0.7 times) than labrum; palpus with segment 2 tapering apically and pointed, c. 4 times as long as wide, c. 2 times as long as segment 1, which is swollen and c. 1.5 times as long as wide; total length of palpus longer (c. 1.5 times) than cibarial pump; lacinia about as long as labrum; labellum longer (c. 1.6 times) than cibarial pump, longer (c. 1.9 times) than theca, and with 2 elongate, not well-defined darker spots, of which the basal is shorter and narrower than the apical [these spots are not shown in Fig. 344]; mid-distal interlabellar process short and less than 1/10 (c. 0.05 times) as long as labellum. — Length: labrum 0.86 mm; cibarial pump 0.73 mm.

Nagatomyia melanica (♀) is characterized among the Tabanids considered in this paper as follows: labrum short in relation to other genera, lacinia not longer than palpus, and theca much shorter than labellum.

Specimen dissected: 1♀, Hataganaru, Oginosen, Hyogo Pref., 19—23. vii. 1959, A. NAGATOMI.

Silvius shirakii PHILIP & MACKERRAS, 1960 (♀) (Figs. 345—350): labrum much longer than wide, longer (c. 1.6 times) than cibarial pump, wider basally and with transverse apical margin; hypopharynx somewhat shorter (c. 0.9 times) than labrum, tapering apically and pointed; cibarial pump nearly as wide as labrum and breadth between dorsal cornua respectively, longer (c. 3.1 times) than wide and roughly parallel-sided; mandible as long as labrum; palpus with segment 2 bluntly pointed, c. 4 times as long as wide, c. 2.5 times as long as and wider than segment 1, which is c. 3 times as long as wide; total length of palpus longer (c. 1.5 times) than cibarial pump; lacinia as long as labrum; labellum as long as cibarial pump, shorter (c. 0.7 times) than theca, and with 2 darker spots, of which the apical is wider anteriorly and the basal is small and with a long line running transversely at antero-dorsal part; mid-distal interlabellar process short, and less than 1/10 (c. 0.07 times) as long as labellum. — Length: labrum 1.6 mm; cibarial pump 1.0 mm.

Silvius shirakii (♀) and *Silvius oshimaensis* (♀) are distinguished from *Stonemyia yezoensis* (♀) by having the mandible as long as the labrum, the labrum less than twice as long as the cibarial pump, and segment 2 of palpus wider than segment 1.

Specimen dissected: 1♀, Sumiyo-mura, Amami Oshima, South-West Islands, 15. iv. 1973, H. SUZUKI.

Silvius oshimaensis HAYAKAWA, TAKAHASI & SUZUKI, 1982 (♀) (Figs. 351—355): similar to *shirakii* but the apex of labrum more pointed, hypopharynx shorter and cibarial pump wider than in *shirakii*; in 1 specimen dissected, labrum 1.8 times as long as cibarial pump; hypopharynx distinctly shorter (0.7 times) than labrum; cibarial pump 2.5 times as long as wide; segment 1 of palpus c. twice as long as wide; total length of palpus 1.8 times as long as cibarial pump; labellum 1.2 times as long as cibarial pump; in apical spot on labellum, the anterior part may be narrower than in *shirakii*. — Length: labrum 1.7 mm; cibarial pump 0.93 mm.

Specimen dissected: 1♀, Sumiyo-mura, Amami Oshima, South-West Islands, 23. iv. 1973, H. SUZUKI.

Chrysops japonicus WIEDEMANN, 1828 (♀) (Figs. 356—360): labrum much longer than wide, longer (c. 1.9 times) than cibarial pump [which excludes the mid-proximal part of dorsal cornua], wider basally and bluntly pointed at apex; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump wider than labrum, as wide as or narrower than (0.8—1.0 times) breadth between dorsal cornua, longer (1.8—2.1 times) than wide and bottle-shaped; mandible somewhat longer (c. 1.1 times) than labrum; in palpus, segment 2 elongate elliptical, 3—4 times as long as wide, c. 3.5 times as long as and wider than segment 1, which is longer than wide; total length of palpus longer (1.7 times) than cibarial pump; lacinia as long as labrum; labellum about as long as (1.1 times) cibarial pump, shorter (0.6 times) than theca, and with 2 darker spots which nearly extend to dorsal margin of labellum; mid-distal interlabellar process very short and less than 1/10

(0.03–0.04 times) as long as labellum. — Length (based on 1 specimen): labrum 1.5 mm; cibarial pump 0.79 mm.

♂ (Figs. 361–364): labrum shorter and narrower, segment 2 of palpus much shorter, cibarial pump longer, and hairs on segment 2 of palpus longer than in ♀; in 1 specimen dissected, labrum 1.5 times as long as cibarial pump; hypopharynx somewhat shorter (0.9 times) than labrum; cibarial pump 0.7 times as wide as breadth between dorsal cornua, 2.9 times as long as wide and parallel-sided (except narrowed anterior part); palpus with segment 2, 2.2 times as long as wide, and 1.3 times as long as segment 1; total length of palpus 0.9 times as long as cibarial pump; lacinia 1.1 times as long as labrum; labellum 0.9 times as long as cibarial pump. — Length: labrum 1.2 mm; cibarial pump 0.81 mm.

Chrysops japonicus (♀) and *C. suavis* (♀) may be distinguished from *Silvius shirakii* (♀) and *S. oshimaensis* (♀) by having the labrum narrower than in those species and the cibarial pump bottle-shaped.

Specimens dissected: 1♀, Hiraiwa, Izumi City, Kagoshima Pref., 22. iii. 1964, K. HASHIMOTO; 1♀, Terayama, Kagoshima City, 27. iii. 1966, A. TANAKA; 1♂, Uearata-cho, Kagoshima City, 10. i. 1966, K. KANMIYA.

Chrysops suavis LOEW, 1858 (♀) (Figs. 365–369): there may be no significant difference between *japonicus* and *suavis*, i. e. Figs. 356–360 and Figs. 365–369; in 2 specimens dissected, labrum 2.1 times as long as cibarial pump [which excludes the mid-proximal part of dorsal cornu]; in palpus, segment 2, 2.9–3.6 times as long as segment 1; labellum 0.7 times as long as theca. — Length: labrum 1.9 mm; cibarial pump 0.91–0.93 mm.

Specimens dissected: 1♀, Takeoka, Kagoshima City, 14. v. 1963, K. KUSIGEMATI; 1♀, Toso, Kagoshima City, 16. v. 1963, K. HASHIMOTO.

Subfamily Tabaninae (Figs. 370–402)

Only 4 genera and 5 species have been examined. In these genera and species (♀), the labrum is stouter than in the Pangoniinae (♀) and Chrysopsinae (♀) considered in this paper.

Atylotus horvathi (SZILÁDY, 1926) (♀) (Figs. 370–374): labrum much longer than wide, much longer (2.4–2.6 times) than cibarial pump, wider basally and with transverse apical margin; hypopharynx slightly shorter (0.9 times) than labrum, tapering apically and pointed; cibarial pump wider than labrum, slightly wider (1.1 times) than breadth between dorsal cornua, longer (1.4 times) than wide and bottle-shaped; mandible somewhat longer (c. 1.1 times) than labrum; in palpus, segment 2 swollen at basal part and then tapering apically, 3.6–3.8 times as long as wide, 2.5 times as long as and wider than segment 1, which is longer than wide; total length of palpus about 3 times as long as cibarial pump; lacinia as long as labrum; labellum longer (1.6–1.7 times) than cibarial pump, shorter (0.8 times) than theca, and with 2 darker spots which run toward dorsal margin; mid-distal interlabellar process less than 1/10 (0.03–0.04 times) as long as labellum. — Length: labrum 1.7–2.0 mm; cibarial pump 0.71–0.77 mm.

Atylotus horvathi (♀) may be distinguished from *Haematopota tristis* (♀) by the labrum and palpus longer than in the latter species.

Specimens dissected: 1♀, Nishine, Iwate Pref., 25. vii. 1970, H. HAYAKAWA; 1♀, Kaida Kogen, Nagano Pref., 15. viii. 1964, A. TANAKA.

Tabanus chrysurus LOEW, 1858 (♀) (figs. 375–379): labrum much longer than wide, much longer (c. 2.7 times) than cibarial pump, wider basally and with narrow transverse apical margin; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, longer (c. 1.5 times) than wide and widest around middle; mandible somewhat longer (c. 1.1 times) than labrum; palpus with segment 2 widest before middle, with wide apical transverse margin, 5 times or so as long as wide, 3 times or so as long as and wider than segment 1, which is about twice as long as wide; total length of palpus longer (c. 2.4 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 1.7 times) than cibarial pump, slightly shorter (c. 0.9 times) than theca, and with 3 darker spots, of which the basal may not be very demarcated; mid-distal interlabellar process less than 1/10 (c. 0.03 times) as long as labellum. — Length: labrum 3.7 mm; cibarial pump 1.4 mm.

♂ (Figs. 380–383): labrum narrower, cibarial pump longer, and palpal segment 2 much shorter than in ♀; in 1 specimen dissected, labrum 1.7 times as long as cibarial pump;

hypopharynx 0.9 times as long as labrum; cibarial pump 2.9 times as long as wide; palpal segment 2 elongate oval, 2.1 times as long as wide, 1.1 times as long as segment 1, which is 2.4 times as long as wide; total length of palpus as long as cibarial pump; labellum 1.1 times as long as cibarial pump. — Length: labrum 3.4 mm; cibarial pump 2.0 mm.

Tabanus chrysurus (♀) is characterized by the palpus whose apex is not pointed but transversely wide.

Specimens dissected: 1♀, Gokanoshō, Kumamoto Pref., 21. vii. 1966, K. KANMIYA; 1♂, Mt. Kirishima, Kagoshima Pref., 12. vii. 1963, K. HASHIMOTO.

Tabanus iyoensis SHIRAKI, 1918 (♀) (Figs. 384–388): distinguished from *chrysurus* by having palpal segment 2 shorter and wider than in the latter species and with the apex not transversely wide but pointed; in 1 specimen dissected, the labrum is 2.4 times as long as the cibarial pump; hypopharynx 0.9 times as long as labrum; palpal segment 2 widest near base, bluntly pointed at apex, 3 times or so as long as wide, 2 times or so as long as segment 1; total length of palpus 2.6 times as long as cibarial pump; labellum 1.2 times as long as theca. — Length: labrum 1.6 mm; cibarial pump 0.67 mm.

♂ (Figs. 389–392): distinguished from *chrysurus* by having the labrum, cibarial pump and lacinia shorter than in the latter species; labrum narrower, cibarial pump longer, and palpal segment 2 much shorter than in ♀; labrum pointed at apex; in 1 specimen dissected, labrum 1.5 times as long as cibarial pump; hypopharynx as long as labrum; cibarial pump wider than labrum and 2.6 times as long as wide; palpal segment 2 rounded at apex which may have a short process, 2.2 times as long as wide, 1.2 times as long as segment 1, which is 2 times as long as wide; total length of palpus 1.3 times as long as cibarial pump; labellum 1.3 times as long as cibarial pump and theca respectively. — Length: labrum 1.5 mm; cibarial pump 1.0 mm.

Tabanus iyoensis (♀) may be distinguished from *Atylotus horvathi* (♀) and *Haematopota tristis* (♀) by having palpal segment 2 narrower than in those 2 species.

Specimens dissected: 1♀, 1♂, Mt. Takachiho, Mt. Kirishima, Kagoshima Pref., 1–2. viii. 1959, H. MAEBARA.

Isshikia yajimai MURDOCH & TAKAHASI, 1961 (♀) (Figs. 393–397): labrum much longer than wide, longer (2.1 times) than cibarial pump, wider basally and with narrow transverse apical margin; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump about as wide as labrum and breadth between dorsal cornua respectively, longer (1.5 times) than wide and widest around middle; mandible about as long as (1.0 to 1.1 times) labrum; palpal segment 2 widest near base, pointed at apex, 4.2–4.3 times as long as wide, 2.8–3.1 times as long as and 1.0–1.4 times as wide as segment 2 which is 1.5–1.9 times as long as wide; total length of palpus longer (2.2–2.3 times) than cibarial pump; lacinia as long as labrum; labellum longer (1.5–1.7 times) than cibarial pump, longer (1.1–1.3 times) than theca, and with 2 darker spots; mid-distal interlabellar process less than 1/10 (0.03 times or so) as long as labellum. — Length: labrum 2.0 mm; cibarial pump 0.95–0.97 mm.

Isshikia yajimai (♀) may be characterized among the subfamily Tabaninae of this paper by the following set of characters: the palpus pointed at apex and not much swollen at basal part, and the labrum not much over twice (c. 2.1 times) as long as the cibarial pump.

Specimens dissected: 2♀, Momiki, Gokanoshō, Kumamoto Pref., 19. vii. 1966, A. TANAKA.

Haematopota tristis BIGOT, 1891 (♀) (Figs. 398–402): labrum much longer than wide, longer (c. 2.2 times) than cibarial pump, wider basally and with narrow apical transverse margin; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump roughly as wide as labrum and breadth between dorsal cornua respectively, longer (c. 1.6 times) than wide, and widest around middle; mandible somewhat longer (c. 1.1 times) than labrum; palpal segment 2 swollen at basal part, pointed at apex, about $2\frac{1}{2}$ as long as wide, c. 3 times as long as, and c. 2 times as wide as, segment 1, which is about twice as long as wide; total length of palpus longer (c. 2.4 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 1.6 times) than cibarial pump, longer (c. 1.2 times) than theca, and with 3 darker spots, of which the basal and apical ones may not be well-defined; mid-distal interlabellar process (beyond dorsal interlabellar membrane) absent. — Length: labrum 1.3 mm; cibarial pump 0.61 mm.

Haematopota tristis (♀) may be distinguished from *Atylotus horvathi* (♀) by having the labrum and palpus shorter than in the latter species and from *Isshikia yajimai* (♀) by the palpus being shorter and more swollen than in the latter species.

Specimen dissected: 1♀, Kushiro, Hokkaido, 9. viii. 1967, K. KANMIYA.

Family Vermileonidae (Figs. 403—412)

One species of female *Vermileo* and *Lampromyia* has been examined respectively. It is difficult to characterize this family. In these 2 species, palpal segment 1 is somewhat desclerotized, segment 2 is swollen and has a large hole just, or far, before apex, the mid-distal interlabellar process is present, and the torma is short or rather so.

The mouthparts of *Vermileo comstocki* (♀) resemble those of *Xylophagus matsumurai* (♀) but may be distinguished from the latter by the cibarial pump being more convex on the outward lateral margin. The palpus appears to be different in shape between these 2 species.

Vermileo may be distinguished from the genera of Rhagionidae by having the labrum comparatively short and wide.

The mouthparts of *Lampromyia intermedia* (♀) resemble those of *Arthroteles cinerea* (♀) (Rhagionidae) but may be distinguished from the latter by the labrum which has the apical margin concave and mandibles are present (as a pair of spikes). The palpus is also different in shape between these 2 species.

STUCKENBERG (1960: 227) divided *Lampromyia* into 2 subgenera, namely, *Lampromyia* s. str. (whose type-species is *L. pallida* MACQUART, 1835) and *Vermipardus* (whose type-species is *L. intermedia* STUCKENBERG, 1955), and wrote: "Labium very long and slender, much exceeding the length of the thorax, the labella cylindrical and long, separated from their bases though capable of being pressed together; each labellum contains a large pseudotrachea divided into 2 or 3 branches [Fig. 8 by STUCKENBERG, 1960: 223] [in *Lampromyia* s. str.]; "Labium short and stout, usually not exceeding the length of the thorax; labella short, inconspicuous, subtriangular, fused together for part of their length, containing 6—7 pseudotracheae arising from a common stem [Fig. 7 by STUCKENBERG, 1960: 223] [in *Vermipardus*].

STUCKENBERG (1960: 223—224) also wrote: "The mouthparts of both sexes of all species of *Lampromyia* appear to be adapted for feeding at flowers"; "I have been unable to find any references to the feeding habits of the imago in *Lampromyia* although the biology of the immature stages is so well known."

***Vermileo comstocki* WHEELER, 1918 (♀) (det. by E. I. SCHLINGER) (Figs. 403—407):** labrum longer than wide, somewhat longer (c. 1.2 times) than cibarial pump, and shovel-like; hypopharynx as long as labrum and willow-leaf like; cibarial pump wider than labrum, about as wide as breadth between dorsal cornua, slightly longer (c. 1.1 times) than wide and widest at middle; mandible absent; palpus appears to be 2-segmented, segment 1 narrower and somewhat desclerotized, and segment 2 swollen and with a large hole far before apex; palpus c. $3\frac{1}{2}$ as long as wide, and longer (c. 1.7 times) than cibarial pump; lacinia shorter (c. 0.7 times) than labrum; labellum longer (c. 1.8 times) than cibarial pump, longer (c. 1.9 times) than theca, and with 2 sclerotized spots; mid-distal interlabellar process 1/6 or so (0.18 times) as long as labellum. — Length: labrum 0.27 mm; cibarial pump 0.23 mm.

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

***Lampromyia intermedia* STUCKENBERG, 1955 (♀) (det. by B. R. STUCKENBERG) (Figs. 408—412):** labrum much longer than wide, much longer (c. 4.3 times) than cibarial pump, tapering apically and with apical margin concave; hypopharynx somewhat shorter (c. 0.8 times) than labrum, tapering apically and pointed; cibarial pump roughly as wide as labrum and breadth between dorsal cornua respectively, somewhat longer (c. 1.2 times) than wide, and widest at middle; mandibles present as a pair of spikes and much shorter (c. 0.12 times) than labrum; palpus 2-segmented, segment 1 somewhat desclerotized, segment 2 swollen but much narrower than in *Vermileo comstocki*, about as long as segment

1 and with a large hole just before apex; palpus c. 6 times as long as wide and longer (c. 1.5 times) than cibarial pump; lacinia somewhat shorter (c. 0.8 times) than labrum; labium longer (c. 1.5 times) than labrum; labellum somewhat shorter (c. 0.8 times) than cibarial pump, much shorter (c. 0.14 times) than theca and with 1 longitudinal sclerotized line; mid-distal interlabellar process appears to be c. 1/6 as long as labellum. — Length: labrum 1.7 mm; cibarial pump 0.40 mm.

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

Family Nemestrinidae (Figs. 413–423)

Only 3 genera and 3 species of male Nemestrinidae have been examined. In *Hirmoneura* (belonging to Hirmoneurinae), the mouthparts, except the palpus, are similar to those of male Tabanidae but in *Atriadops* and *Nycterimyia* (which belong to Trichopsidaeinae) the labium is absent or vestigial, the labrum becomes short, and the palpus is peculiar in shape to each genus.

Concerning the genus *Trichophthalma* (belonging to Nemestrininae), MACKERRAS (1925: 494) wrote, "The mouthparts in both sexes have a strong resemblance to those of the male Tabanid, the mandibles being absent or represented by a short spike which is inconstant in its occurrence, while the maxillae, hypopharynx and epipharynx are elongate and stylet-like. The labium and labellae are also precisely similar to the Tabanid."

In *Atriadops javana* (♂) and *Nycterimyia fenestro-inornata* (♂), the size of the torma remains unexamined but the clypeus is not firmly fused with the labrum in the former species and part of the clypeus is rigidly attached to the labrum in the latter.

In *Hirmoneura* sp. (♂), the mid-distal interlabellar process is present, and the torma may be moderately long.

Atriadops javana (WIEDEMANN, 1824) (♂) (Figs. 413–415): labrum longer than wide, shorter (c. 0.6 times) than cibarial pump, rather triangular in shape and with a short dorsal sclerotized plate at apex; [shape of hypopharynx is not distinct in specimen dissected]; cibarial pump wider than labrum, much longer (c. 2.7 times) than wide, and widest near posterior end; outer parts of cibarial pump developed dorsally and a pair of folded parts thus formed widely separated from each other; sclerotized dorsal cornu absent; palpus 1-segmented, long, thin, stick-like, and without long pile; palpus longer (c. 1.6 times) than cibarial pump; lacinia and labium absent. — Length: labrum 0.32 mm; cibarial pump 0.51 mm.

Atriadops javana (♂) is distinguished from *Nycterimyia fenestro-inornata* (♂) by lacking labium; by having the palpus long, thin, and without long pile, labrum longer than wide, and cibarial pump widest near posterior end.

Specimen dissected: 1♂, Ohara, Iriomote-jima, South-West Islands, 6. vii. 1982, K. KUSIGEMATI.

Nycterimyia fenestro-inornata LICHTWARDT, 1912 (♂) (Figs. 416–419): labrum vestigial, as long as wide, much shorter (c. 0.05 times) than cibarial pump, and triangular in shape; hypopharynx absent; cibarial pump wider than labrum, much longer (c. 3.3 times) than wide, and roughly parallel-sided; sclerotized dorsal cornu absent; palpus 1-segmented, much longer (c. 4.4 times) than wide, shorter (c. 0.4 times) than cibarial pump and with long pile; lacinia absent; labellum has long pile, appears to have no pseudotracheae and is much shorter (c. 0.11 times) than cibarial pump. — Length: labrum 0.05 mm; cibarial pump 1.04 mm.

Nycterimyia fenestro-inornata (♂) is distinguished from *Atriadops javana* (♂) by the presence of a labium; having the palpus much shorter than the cibarial pump and with long pile; labrum very short and as long as wide, and cibarial pump parallel-sided.

Specimen dissected: 1♂, Shiratori, Mt. Kirishima, Miyazaki Pref., 25. ix. 1967, J. YUKAWA.

Hirmoneura sp. (♂) (Figs. 420–423): labrum longer than wide, longer (c. 1.3 times) than cibarial pump, tapering apically and bluntly pointed at apex; hypopharynx as long as labrum, tapering apically and pointed; cibarial pump as wide as labrum, somewhat narrower (c. 0.9 times) than breadth between dorsal cornua, longer (c. 2.0 times) than wide, and parallel-sided; dorsal cornu sclerotized only at anterior part and with a short

process directed antero-outwardly; palpus 2-segmented, strongly curved and densely covered with long pile on one side; palpal segment 2, c. 5 times as long as wide and shorter (c. 0.4 times) than segment 1; total length of palpus longer (c. 2.2 times) than cibarial pump; lacinia as long as labrum; labellum longer (c. 1.6 times) than cibarial pump, longer (c. 1.4 times) than theca and with 2 sclerotized longitudinal spots, of which the dorsal is wider than the ventral; mid-distal interlabellar process (beyond dorsal interlabellar membrane) $1/3 - 1/4$ as long as labellum, consisting of 2 parts (broad base and narrow and less sclerotized apex) and with a pair of processes at apex of basal part. — Length: labrum 1.2 mm; cibarial pump 0.93 mm.

Hirmoneura sp. (♂) is easily distinguished from the genera and species of Tabaninae (Tabanidae) examined in this paper by having the palpus long, thin and strongly curved, the labellum longer than the theca, the dorsal cornu with a short process directed antero-outwardly, the labrum comparatively short, etc.

Specimen dissected: 1♂, Kanchanaburi, Thailand, 27–29. xii. 1975, S. SHINONAGA.

Family Acroceridae (Figs. 424–427)

Only 1 species of *Oligoneura* (the subfamily Philopotinae) has been examined.

In *Oligoneura hasegawai* (♀), labrum, hypopharynx, labium and lacinia are conspicuously long; labrum and hypopharynx tapering apically and pointed; lacinia needle-like; mandible absent; palpus 1-segmented, small and thin; cibarial pump gradually narrower posteriorly; clypeus firmly fused with labrum, well demarcated, thick and consisting of 2 tiles; a pair of labella entirely separated from each other even at their dorso-proximal parts; basal part of labial stalk enveloped in a membranous substance; hypopharynx somewhat longer than labrum; lacinia shorter than labrum; labium much longer than hypopharynx; mid-distal interlabellar process is absent.

Judging from Fig. 3C by CRAMPTON (1942), the mouthparts of *Lasia* (Panopinae of Acroceridae) are essentially similar to those of *Oligoneura*. They may be distinguished from those of other families, with a conspicuously long proboscis, by the following set of characters: labrum and hypopharynx pointed at apex and simple; palpus 1-segmented, small and thin.

SCHLINGER (in McALPINE et al., 1981) wrote concerning the Acroceridae, "mouthparts underdeveloped (Figs. 4, 9–11), partially developed (Fig. 8), or well-developed (Figs. 2, 6, 7); shortened partially developed mouthparts usually in form of a simple setose tube about as long as height of head (*Hadrogaster* SCHLINGER, Formosa; *Nipponcyrtus* SCHLINGER, Japan; *Sabroskya*), and usually without palpus or labella; well developed mouthparts forming a proboscis, usually consisting of large clypeus, minute palpus, labrum, hypopharynx, prementum, lacinia and labella; prementum extendable, lengthening to twice normal length (Fig. 7)."

Oligoneura hasegawai SCHLINGER, 1971 (♀) (det. by E. I. SCHLINGER) (Figs. 424 to 427): labrum much longer than wide, much longer (c. 3.5 times) than cibarial pump, tapering apically and pointed; hypopharynx somewhat longer (c. 1.2 times) than labrum, tapering apically and pointed; cibarial pump not wider than labrum, longer (c. 3.5 times) than wide, gradually narrower posteriorly; from a lateral view, cibarial pump widened at posterior end; [dorsal cornu may possibly be fused with cibarial pump]; palpus 1-segmented, not wider than lacinia, shorter (c. 0.4 times) than cibarial pump, and with base desclerotized except a thin axis; lacinia (from tip to base of palpus) slightly shorter (c. 0.9 times) than labrum; labellum longer (c. 1.8 times) than cibarial pump, shorter (c. 0.4 times) than theca and with a number of sclerotized transverse bands, of which some apical ones are developed as short processes. — Length: labrum 3.1 mm; cibarial pump 0.89 mm.

Specimen dissected: 1♀, Sasayama, Tamba, Hyogo Pref., 26. v. 1954, K. NOHARA.

Family Bombyliidae (Figs. 428–439)

It is not possible to give a full diagnosis of the mouthparts of this family. Only 3 genera and 3 species have been examined.

DUSA (1968) contributed to the buccal apparatus in the Bombyliidae but this article has not been seen by us.

The labrum and theca is short in *Anthrax* (the subfamily Anthracinae), long in *Ligyra* (Exoprosopinae) and conspicuously long in *Bombylius* (Bombyliinae).

The torma is situated at or around middle of cibarial pump and the hypopharynx is longer than labrum in these 3 genera. The cibarial pump is several times as long as wide in *Anthrax* and *Ligyra* and less than twice so in *Bombylius*. The palpus is peculiar in shape to each genus.

In the 3 genera and 3 species considered in this paper the mid-distal interlabellar process is well developed and the torma is large and long.

Anthrax sp. (♀) (Figs. 428–431): labrum longer than wide, shorter (0.7 times or so) than cibarial pump, tapering apically and rounded at apex; labrum thick and its dorsal part (except base) (= labrum s. str.) strongly sclerotized; hypopharynx slightly longer (c. 1.1 times) than labrum, bluntly pointed at apex and abruptly narrower at apical half; cibarial pump not wider than labrum, as wide as breadth between dorsal cornua, much longer (c. 3.4 times) than wide and rather rectangular; torma large and its base situated beyond middle (i. e. near posterior end) of cibarial pump; palpus 1-segmented, knob-like, longer (c. 1.9 times) than wide, much shorter (c. 0.2 times) than cibarial pump; lacinia shorter (c. 0.8 times) than labrum; labellum slightly shorter (c. 0.9 times) than cibarial pump, longer (c. 1.6 times) than theca, and with 2 large longitudinal darker spots and 1 small transverse spot above basal longitudinal one; mid-distal interlabellar process 1/7 or so as long as labellum. — Length: labrum 0.76 mm; cibarial pump 1.1 mm.

Anthrax sp. (♀) is at once distinguished from *Ligyra tantalus* (♀) by having the labrum, hypopharynx, palpus and theca much shorter than in the latter species.

Specimen dissected: 1♀, Omotodake, Ishigaki-jima, South-West Islands, 19. viii. 1961, S. UEDA.

Ligyra tantalus (FABRICIUS, 1794) (♀) (Figs. 432–435): labrum much longer than wide, somewhat longer (c. 1.2 times) than cibarial pump [except fused base in dorsal cornua throughout the description of this species], tapering apically and bluntly pointed; hypopharynx longer (c. 1.2 times) than labrum, tapering apically and pointed; cibarial pump wider than (1.2 or 1.3 times) labrum and breadth between dorsal cornua respectively, much longer (c. 4.3 times) than wide, and narrower at both ends; torma large and its base situated at middle of cibarial pump; a pair of tormae connected at apices; palpus 1-segmented, stylet-like, and shorter (c. 0.8 times) than cibarial pump; lacinia slightly shorter (c. 0.9 times) than labrum; labellum shorter (c. 0.6 times) than cibarial pump, shorter (c. 0.7 times) than theca, and with 2 longitudinal, darker, thin, lines at base; mid-distal interlabellar process nearly 1/2 (0.44 times) as long as labellum. — Length: labrum 2.1 mm; cibarial pump 1.8 mm.

Ligyra tantalus (♀) is at once distinguished from *Anthrax* sp. (♀) by having the labrum, hypopharynx, palpus and theca much longer than in the latter species.

Specimen dissected: 1♀, Komidake, Iriomote-jima, South-West Islands, 29. vii. 1961, S. UEDA.

Bombylius major LINNAEUS, 1758 (♀) (Figs. 436–439): labrum (including a terminal process) much longer than wide, much longer (c. 5.0 times) than cibarial pump, rather willow-leaf shaped, and with a terminal thin process; hypopharynx (including a second joint) longer (c. 1.2 times) than labrum, tapering apically and with a second short joint; cibarial pump wider than labrum and than breadth between dorsal cornua, longer (c. 1.9 times) than wide, widest near anterior end, and with a more sclerotized spot at anterior end; torma situated before (i. e. near anterior end) middle of cibarial pump; a pair of tormae connected at apices; palpus 1-segmented, filiform, and as long as cibarial pump; lacinia filiform, and shorter (c. 0.8 times) than labrum; labellum longer (c. 2.6 times) than cibarial pump, shorter (c. 0.5 times) than labrum, and shorter (c. 0.6 times) than theca; base of labial stalk with several folds; mid-distal interlabellar process c. 1/7 as long as labellum. — Length: labrum 5.2 mm; cibarial pump 1.05 mm.

Bombylius major (♀) is easily distinguished from *Arthroteles* (Rhagionidae), *Pangonius* (Tabanidae), *Lampromyia* (Vermileonidae) and *Empis* (Empididae) in this paper by the

labrum having an apical thin process, and the hypopharynx longer than the labrum and with an apical 2nd segment.

Specimen dissected: 1♀, Hachiya-cho, Fukuoka City, 31. iii. 1946, S. NAKAO.

Family Hilarimorphidae (Figs. 440—443)

This family contains only 1 genus. One male specimen of *Hilarimorpha* sp. has been examined.

The mouthparts of *Hilarimorpha* sp. (♂) are very similar to those of *Vermileo comstocki* (♀), but in the former the labellum is less than $1\frac{1}{2}$ as long as the cibarial pump and the theca respectively, the labrum, cibarial pump, and dorsal cornu are shorter than in the latter species, and the palpus has no large hole.

In *Hilarimorpha* sp. (♂), the mid-distal interlabellar process is possibly absent and the torma may be moderately long.

Hilarimorpha sp. (♂) (Figs. 440—443): labrum longer (c. 1.6 times than wide, slightly longer (c. 1.1 times) than cibarial pump, wider basally and rather, rounded at apex; hypopharynx slightly shorter (c. 0.9 times) than labrum [shape of hypopharynx is not grasped in specimen dissected]; cibarial pump somewhat wider than labrum, somewhat narrower than breadth between dorsal cornua, somewhat longer (c. 1.2 times) than wide and bottle-shaped; palpus widest near apex and longer (c. 1.5 times) than cibarial pump [it is undetermined whether the palpus is 1 or 2-segmented]; lacinia stylet-like and somewhat longer (c. 1.2 times) than labrum; labellum longer (c. 1.3 times) than cibarial pump, longer (c. 1.3 times) than theca, and with ventral-outer part sclerotized. — Length: labrum 0.18 mm; cibarial pump 0.16 mm.

Specimen dissected: 1♂, Yosemite National Park, California, 1. viii. 1940, D. E. HARDY.

Family Mydidae (Figs. 444—447)

It is not possible to discuss fully the mouthparts of this family, because only 1 species of female *Nemomydas* (the subfamily Leptomydinae) has been examined in this paper.

ZAITLIN (1978) studied the morphology in the mouthparts of *Mydas clavatus* but the contents of this article are not formally published.

Among the orthorrhaphous Brachycera in this paper, the mouthparts of *Nemomydas gruenbergi* (♀) may be characterized as follows: torma making an acute angle with the cibarial pump and distance between apex of torma and dorsal cornu very short; palpus knob-like and lacinia much longer than palpus.

In *Nemomydas gruenbergi* (♀), a mid-distal interlabellar process appears to be present.

Nemomydas gruenbergi (HERMANN, 1914) (♀) (Figs. 444—447): labrum much longer than wide, somewhat longer (c. 1.2 times) than cibarial pump, wider basally and with apical margin transverse; hypopharynx shorter (c. 0.8 times) than labrum, wider basally and forming a tube at apex; cibarial pump wider than labrum and breadth between dorsal cornua respectively, longer (c. 2.2 times) than wide and bottle-shaped; dorsal cornu short; torma situated at anterior part of cibarial pump; a pair of tormae separated from each other at apices; palpus 1-segmented, rather triangular, as long as wide, and much shorter (c. 0.13 times) than cibarial pump; lacinia stylet-like, shorter (c. 0.7 times) than labrum; labellum about as long as cibarial pump and theca respectively and with numerous fine darker lines; mid-distal interlabellar process short and inconspicuous (if present). — Length: labrum 1.2 mm; cibarial pump 0.99 mm.

Specimen dissected: 1♀, Ishigaki-jima, South-West Islands, 23. vii. 1980, A. NAGATOMI.

Family Therevidae (Figs. 448—463)

Four genera and 4 species of the female Therevidae have been examined. These genera belong to the subfamily Therevinae.

Labrum tapering apically but its apical margin transversely straight or concave; hypopharynx tapering apically and rounded at apex; mandible absent; lacinia stylet-like;

maxillary palpus much longer than wide, cylindrical and 1-segmented (in some other genera, e. g. *Phycus* and *Henicomysia*, the palpus is 2 segmented [after IRWIN & LYNEBORG, 1980]); cibarial pump longer than wide; labellum longer than theca.

A pair of large tormae present but not connected with each other at their apices.

Labrum not much longer than cibarial pump; hypopharynx about as long as labrum; lacinia shorter than labrum and palpus respectively.

Mid-distal interlabellar process present.

The mouthparts of Therevidae are similar to those of Coenomyiidae and may be difficult to distinguish from the latter, although the systematic positions of these 2 families are evidently very distant.

Among the Asilomorpha, the mouthparts of Therevidae may generally be characterized by the following set of features: palpus cylindrical and much longer than wide; labrum with apical margin transversely straight or concave; labrum not much longer than cibarial pump, which is longer than wide, and hypopharynx about as long as labrum.

Dialineura albata (COQUILLET, 1898) (♀) (Figs. 448—451): labrum longer than wide, longer (c. 1.3 times) than cibarial pump, wider basally and with apical margin transverse; hypopharynx about as long as labrum, wider basally and with apex rounded; cibarial pump not narrower than labrum and breadth between dorsal cornua respectively, longer (c. 1.7 times) than wide, and widest around middle; palpus 1-segmented, cylindrical, 6 times or so as long as wide, and longer (c. 1.4 times) than cibarial pump; lacinia shorter (c. 0.8 times) than labrum; labellum longer (c. 1.8 times) than cibarial pump, longer (c. 2.2 times) than theca, and with 2 darker longitudinal spots; [length of mid-distal interlabellar process is not measured]. — Length: labrum 0.56 mm; cibarial pump 0.42 mm.

Dialineura albata (♀) may be distinguished from *Dichoglena sapporensis* (♀) by the finer, denser, pile on the palpus and the narrower posterior end of the cibarial pump.

Specimen dissected: 1♀, Osumi-ogawara, Kagoshima Pref., 22. iv. 1962, A. NAGATOMI.

Dichoglena sapporensis (MATSUMURA, 1916) (♀) (Figs. 452—455): very similar to *Dialineura albata* (♀) but may be distinguished from the latter by the pile on the palpus being stouter but sparser and the posterior end of cibarial pump widener; in the specimen dissected the labellum is 1.6 times as long as the cibarial pump and 1.8 times as long as the theca; the mid-distal interlabellar process is c. 1/2 as long as the labellum and needle-like. — Length: labrum 0.66 mm; cibarial pump 0.47 mm.

Specimen dissected: 1♀, Soranuma-dake, Hokkaido, 26. vi. 1965, K. KUSIGEMATI.

Irwinella sp. (♀) (Figs. 456—459): labrum longer than wide, longer (c. 1.4 times) than cibarial pump, wider basally and with apex not pointed but transversely wide; hypopharynx about as long as labrum, wider basally and with apex rounded; cibarial pump not narrower than labrum, narrower than breadth between dorsal cornua, longer (c. 2.1 times) than wide, and widest around middle; a pair of sclerotized dorsal cornua connected with each other at posterior part of cibarial pump; palpus 1-segmented, cylindrical, c. 6 times as long as wide, and longer (c. 1.4 times) than cibarial pump; lacinia shorter (c. 0.7 times) than labrum; labellum longer (c. 1.5 times) than cibarial pump, longer (c. 2.0 times) than theca, with 2 darker spots, of which the basal is T-shaped; mid-distal interlabellar process c. 1/4 as long as labellum. — Length: labrum 0.56 mm; cibarial pump 0.41 mm.

Among the 4 genera and 4 species of Therevids considered in this paper, *Irwinella* sp. (♀) may be characterized as follows: a pair of strongly sclerotized dorsal cornua connected with each other within the cibarial pump and the basal sclerotized spot on the labellum distinctly T-shaped.

Specimen dissected: 1♀, Shikanoshima, Fukuoka Pref., 23. v. 1975, K. KANMIYA.

Thereva major MATSUMURA, 1905 (♀) (Figs. 460—463): labrum longer than wide, about as long as cibarial pump, wider basally and with apical margin strongly concave; hypopharynx about as long as labrum, wider basally and rounded at apex; cibarial pump not narrower than labrum, about as wide as breadth between dorsal cornua, longer (c. 2.0 times) than wide and widest around middle; dorsal cornu directed more outward than in other species of this paper; palpus 1-segmented, 5 times or so as long as wide, slightly shorter (c. 0.9 times) than cibarial pump, and with a large hole at apex; lacinia shorter

(c. 0.7 times) than labrum; labellum longer (c. 1.2 times) than cibarial pump, longer (c. 1.8 times) than theca, and with 2 darker longitudinal spots; mid-distal interlabellar process very thin at apical portion and is not exactly measured but probably c. 1/2 as long as labellum. — Length: labrum 0.68 mm; cibarial pump 0.64 mm.

Among the Therevids considered in this paper, *Thereva major* (♀) may be characterized as follows: dorsal cornu directed outward and cibarial pump not shorter than palpus and nearly as long as labrum.

Specimen dissected: 1♀, Sapporo, Hokkaido, 3. vii. 1965, K. KUSIGEMATI.

Family Asilidae (Figs. 464—467)

Only 1 species of *Scylaticus* (the subfamily Dasypogoninae) has been examined in this paper. But MELIN (1923) described and illustrated the mouthparts of 8 genera (*Leptogaster*, *Dioctria*, *Lasiopogon*, *Cyrtopogon*, *Laphria*, *Asilus*, *Pamponerus* and *Dysmachus*) and 8 species and TANAKA (1967) dealt with 4 genera (*Promachus*, *Laphria*, *Cyrtopogon* and *Leptogaster*) and 4 species.

The mouthparts of Asilidae may easily be distinguished from those of other families by having the hypopharynx with a "bristly covering" at the dorsal surface (except tip and basal portion), the labrum distinctly shorter than the hypopharynx, and the labium entirely sclerotized and without a constriction or membranous part between the labella and theca.

Scylaticus sayano (♀), has the torma branching and the mid-distal interlabellar process present. These 2 features may be common to other genera and species of Asilids.

Scylaticus sayano NAGATOMI, 1982 (♀) (Figs. 464—467): labrum longer than wide, a bout as long as cibarial pump, tapering apically and pointed; labrum membranous except for a pair of axes; hypopharynx longer than labrum, somewhat wider at basal part and pointed at apex; cibarial pump wider than labrum, narrower than breadth between dorsal cornua, longer (c. 1.8 times) than wide, and wider posteriorly; dorsal cornu short and with a short process directed anteriorly; torma branching; palpal segment 2 longer (c. 3.3 times) than wide, longer (c. 1.3 times) and narrower (c. 0.8 times) than segment 2, which is longer (c. 1.9 times) than wide; total length of palpus slightly shorter (c. 0.9 times) than cibarial pump; lacinia longer (c. 1.3 times) than labrum and shorter (c. 0.8 times) than hypopharynx; labium longer (c. 1.6 times) than cibarial pump and about as long as hypopharynx; labellum with 2 paler transverse bands, of which the basal is larger; mid-distal interlabellar process (beyond a pair of longitudinal sclerites) is an equilateral triangle (from a dorsal view) and less than 1/10 (c. 0.04 times) as long as labium (not labellum). — Length: labrum 0.94 mm; cibarial pump 0.89 mm.

Specimen dissected: 1♀, Yoshino, Ishigaki-jima, South-West Islands, 10. viii. 1978, A. NAGATOMI.

Family Empididae (Figs. 468—471)

Only the male of 1 species of *Empis* (subfamily Empidinae) has been examined in this paper. KRYSOTPH (1961) studied the mouthparts of a number of genera. BLETCHELY (1954) and TANAKA (1967) treated of those of 1 species in *Empis* and *Syneches* respectively.

CHVÁLA (1983a) raised the previous subfamilies to families and discussed the mouthparts. It must be referred but has not been seen at present by us.

In *Empis seminitida* (♂), the labrum is articulate and its apical short articulation consists of 3 acute processes, of which the median one is shorter than the lateral, is less sclerotized and may easily be overlooked; the dorsal cornua are long and the breadth between them is gradually narrower posteriorly; a pair of long tormae are present but these may not be connected with each other at their apices; a pair of labella entirely separated from each other even at their dorso-proximal parts; mid-distal interlabellar process appears to be present; there is a 2-segmented membrane attached to the labial stalk.

The mouthparts in most of the Empididae may easily be distinguished from those of other families by the following characters: "According to KRYSOTPH (1961), in most

empidids the prolonged labrum-epipharynx consists of three longitudinal plates, a median labral and paired lateral. Each lateral plate bears apically a well sclerotized blade. The apex of the labrum-epipharynx is therefore tridentate. These three apical projections are analogous to the prestomal teeth in Cyclorrhapha" (after MATSUDA, 1965: 248).

Empis seminitida FREY, 1955 (♂) (det. by T. SAIGUSA) (Figs. 468—471): labrum much longer than wide, much longer (c. 5.4 times) than cibarial pump, wider basally and tridentate at apex; hypopharynx is about as long as labrum, rather parallel-sided but may be wider at base and before apex and is pointed at apex; cibarial pump not narrower than labrum and breadth between dorsal cornua respectively, longer (c. 2.0 times) than wide and widest around middle; palpus 1-segmented, cylindrical, 11 times or so as long as wide, and longer (c. 1.4 times) than cibarial pump; lacinia needle-like and shorter (c. 0.8 times) than labrum; labellum longer (c. 1.7 times) than cibarial pump and shorter (c. 0.4 times) than theca, mid-distal interlabellar process probably less than 1/10 (c. 0.07 times) as long as labellum (if present). — Length: labrum 1.7 mm; cibarial pump 0.32 mm.

Empis seminitida (♂) is easily distinguished from *Oligoneura hasegawai* (♀) (Acroceridae) by having the labrum tridentate at apex, hypopharynx not longer than labrum, labella and theca much shorter than in the latter species, etc.

Specimen dissected: 1♂, Kitadake, Yamanashi Pref., 19. viii. 1978, T. SAIGUSA.

Family Dolichopodidae (Figs. 472—480)

CREGAN (1941) studied the mouthparts of a number of genera in this family. TANAKA (1967) treated those of 2 species in 2 genera (*Dolichopus* and *Sciapus*). The following notes are based on 3 genera and 3 species here examined (*Diostracus*, subfamily Hydrophorinae; *Dolichopus*, Dolichopodinae; *Sciapus*, Sciapodinae).

Labrum tapering apically and pointed or rounded at apex from a ventral view; ventral part of labrum (= epipharynx) with 1 or several pairs of teeth at the surface and with an endoskeleton, that is, a bar deeply produced into the space covered with cibarial pump and clypeus; labrum membranous at apical and lateral parts and with a pair of outer borders strongly sclerotized and connected with each other behind membranous apical part of labrum; hypopharynx pointed at apex and roughly triangular; lacinia absent; mandible absent; maxillary palpus 1-segmented, flat and often wider apically; cibarial pump longer than wide, and longer than hypopharynx; labellum not longer than theca; a long sclerotized dorso-inner bar present on each labellum and running posteriorly.

Clypeus fused with cibarial pump by a strongly or weakly sclerotized part whose postero-proximal point is situated at or around the middle of the cibarial pump.

Labrum shorter or not much longer than cibarial pump; hypopharynx not longer than labrum.

Mid-distal interlabellar process absent.

An endoskeleton from the epipharynx controls the distance between the apices of a pair of teeth, and when the former is directed anteriorly (= dorsally), the latter becomes wide.

The proboscis of Dolichopodidae is usually short but often (e. g. in some species of *Conchopus* TAKAGI, 1965) becomes very long. The labella in *Melandieria* ALDRICH are "highly sclerotized and mandibuliform (fig. 11)" (after ROBINSON & VOCKEROTH in McALPINE et al., 1981; for detail see SNODGRASS, 1922).

The mouthparts of Dolichopodidae are peculiar in several respects and some of the distinguishing family characters may be as follows: the presence of complex armature on the ventral surface of labrum (= epipharynx) from which 1 large endoskeleton arises, and that of a long inner-dorso-posterior process on each labellum.

Diostracus antennalis TAKAGI, 1968 (♀) (det. by T. SAIGUSA) (Figs. 472—474): labrum longer than wide, longer (c. 1.2 times) than cibarial pump, wider and circular at basal part and rounded at apical margin; labrum with 2 pairs of long, strongly sclerotized teeth, of which the apical pair is not shorter than the basal; hypopharynx strongly sclerotized, shorter than labrum, rather triangular and pointed at apex; cibarial pump narrower than labrum, as wide as breadth between dorsal cornua, longer (c. 1.5 times) than wide, and

widest at middle; dorsal cornu short and wider posteriorly (from a lateral view); clypeus fused with cibarial pump by a plate whose postero-proximal part is situated behind middle (i. e. near posterior end) of cibarial pump; palpus widest behind middle, rounded apically, longer (c. 2.1 times) than wide, and shorter (c. 0.8 times) than cibarial pump; labellum (from apex to ventral base) longer (c. 1.6 times) than cibarial pump, about as long as theca, and with a heavily sclerotized long dorsal line; a long dorso-inner posterior bar (in labellum) with a short process directed postero-ventrally far before apex. — Length: labrum 0.70 mm; cibarial pump 0.57 mm.

Diostracus antennalis (♀) is easily distinguished from *Dolichopus plumipes* (♂) and *Sciapus nebulosus* (♀) by having the cibarial pump much less than twice as long as wide, labrum with 2 pairs of long teeth of which the apical pair is not shorter than the basal, etc.

Specimen dissected: 1♀, Gokanoshō, Kumamoto Pref., 2. viii. 1975, T. SAIGUSA.

Dolichopus plumipes (SCOPOLI, 1763) (♂) (det. by T. SAIGUSA) (Figs. 475–477): labrum longer than wide, shorter (c. 0.6 times) than cibarial pump, widest near base and then tapering apically and pointed; labrum with a pair of short ventral teeth; hypopharynx shorter than labrum, triangular and pointed at apex; cibarial pump wider than labrum and breadth between dorsal cornua respectively, longer (c. 2.1 times) than wide, and widest around middle; dorsal cornu short; cibarial pump fused with clypeus before middle (i. e. near anterior end) of the former; palpus rounded apically, longer (c. 2.0 times) than wide, shorter (c. 0.6 times) than cibarial pump and with 1 apical bristle; labellum (from apex to ventral base) shorter (c. 0.8 times) than cibarial pump and slightly shorter (c. 0.9 times) than theca. — Length: labrum 0.53 mm; cibarial pump 0.34 mm.

Dolichopus plumipes (♂) is easily distinguished from *Sciapus nebulosus* (♀) by the labrum having 1 pair of ventral teeth and the palpus being much longer than wide.

Specimen dissected: 1♂, Oteinuma, Hokkaido, 1. viii. 1967, T. SAIGUSA.

Sciapus nebulosus (MATSUMURA, 1916) (♀) (det. by T. SAIGUSA) (Figs. 478–480): labrum longer than wide, shorter (c. 0.8 times) than cibarial pump, triangular and pointed at apex; in labrum, there are 2 pairs of ventral teeth fused with each other at their bases and the apical pair is shorter than the basal; hypopharynx shorter than labrum, triangular and pointed at apex; cibarial pump as wide as labrum and breadth between dorsal cornua respectively, longer (c. 2.0 times) than wide, and widest around middle; dorsal cornu longer than in *Dolichopus plumipes* (♂); clypeus fused with cibarial pump by a plate whose postero-proximal part is situated at middle of cibarial pump; palpus wider apically, slightly longer (c. 1.1 times) than wide, and shorter (c. 0.5 times) than cibarial pump; labellum (from apex to ventral base) as long as cibarial pump and slightly shorter (c. 0.9 times) than theca (measured along lateral margin). — Length: labrum 0.41 mm; cibarial pump 0.51 mm.

Sciapus nebulosus (♀) is easily distinguished from *Dolichopus plumipes* (♂) by the labrum having 2 pairs of ventral teeth and the palpus being about as long as wide.

Specimen dissected: 1♀, Gokanoshō, Kumamoto Pref., 2. viii. 1975, T. SAIGUSA.

Discussion

1. General morphology of mouthparts and feeding mechanism in Diptera

The reader must consult the works by SNODGRASS (1935) and MATSUDA (1965) on the matters titled above. Besides these two contributions, there are many sources and syntheses, i. e. BECHER (1882), PETERSON (1916), CRAMPTON (1942), SNODGRASS (1944), HOYT (1952), GRENIER (1959), OLDROYD (1970), HENNIG (1973), McALPINE (in McALPINE et al., 1981), etc.

As to particular species of the orthorrhaphous Brachycera, there are several articles, e. g. BLETCHLY (1954) on *Empis livida* (Empididae), BLETCHLY (1955) on *Rhagio scolopacea* (Rhagionidae), BONHAG (1951) on *Tabanus sulcifrons* (Tabanidae), CHASSAGNARD & TSACAS (1973) on *Chrysopilus auratus* (Rhagionidae) and *Vermileo vermileo* (Vermileonidae), GOUIN (1950) on *Odontomyia* (= *Eularia*) sp. (Stratiomyidae), GOUIN (1958) on *Chrysochroma bipunctatum* (Stratiomyidae), ROSS (1940) on *Symphoromyia atripes* (Rhagionidae), SNODGRASS (1935) on *Tabanus atratus* (Tabanidae), and WHITEFIELD (1925) on *Machimus atricapillus* (Asilidae).

MELLIN (1923), KRYSSTOPH (1961) and CREGAN (1941) studied the mouthparts of Asilidae, Empididae and Dolichopodidae respectively, treating of a number of genera.

A detailed account was also given by TANAKA (1967) on the mouthparts of some entomophagous Diptera, i. e. Asilidae, Empididae, Dolichopodidae and Ephydriidae.

The contents of the literature are not repeated here.

2. Suborder characters of mouthparts in Diptera

The members of the suborder Nematocera are mostly distinguished from the orthorrhaphous Brachycera and cyclorrhaphous Brachycera by the maxillary palpus which is pendulous and generally 4 or 5 segmented ("in *Aedes* and some genera of Cecidomyiidae, there are only one or two joints") (after VERRALL, 1909: 3).

The maxillary palpus is porrect and is 1 or 2 (sometimes 3) segmented in orthorrhaphous Brachycera.

MATSUDA (1965: 250–251) states, "While in Nematocera and [orthorrhaphous] Brachycera the mouthparts are directly continuous with the head capsule, they are suspended from the head via a membranous area in Cyclorrhapha and the proboscis is usually divided into three parts (fig. 104A), the basiproboscis or the rostrum, medioproboscis or the haustellum, and the distiproboscis or the labella which has been described. The last two parts correspond to the proboscis in the Nematocera [and the orthorrhaphous Brachycera]. The rostrum is suspended by the rostral membrane at the lower part of the head and is continuous with the base of the haustellum. The rostral membrane is doubly folded when the haustellum is at rest."

Thus the members of the cyclorrhaphous Brachycera may be distinguished from the other two suborders by the presence of a membranous rostrum.

3. Family characters of mouthparts in orthorrhaphous Brachycera

The structure of the mouthparts in Stratiomyidae is at least generally very different from that in Tabanidae, but those in the families between Stratiomyidae and Tabanidae may be intermediate. It may not be easy to determine the families of the lower Brachycera on the basis of the mouthparts alone.

The mouthparts of the Nemestrinidae (except those genera with a vestigial proboscis) are similar to those of the Tabanidae, the Hilarimorphidae to the Vermileonidae (*Vermileo*), and the Therevidae to the Coenomyiidae. There may possibly be definite family characters in the Acroceridae, Bombyliidae and Mydidae but these have not yet been determined due to the paucity of material.

On the other hand, structure of the mouthparts may be characteristic of the Asilidae, Empididae (or Empidoidea in the sense of CHVÁLA, 1983a) and Dolichopodidae respectively. In each of these 3 groups, most of the members suck blood from other insects.

4. Classification of orthorrhaphous Brachycera

For phylogenetic relationships among the families of orthorrhaphous Brachycera see HENNIG (1973), NAGATOMI (1977) and McALPINE et al. (1981) and for those among the Rhagionid genera refer to NAGATOMI (1982). It is not necessarily certain that the Nemestrinidae, Acroceridae, Bombyliidae and Hilarimorphidae form a natural unit and that they are closer phylogenetically to the Asilomorpha than to the Tabanomorpha. The Vermileonidae was put near the Rhagionidae, Tabanidae, etc. by NAGATOMI (1977) but placed near the Asilidae, Therevidae, etc. by TESKEY in McALPINE et al. (1981). The genera *Austroleptis*, *Glutops* and *Pseudoerinna* (= *Bequaertomyia*) were placed in the Rhagionidae by NAGATOMI (1982) but their positions are not necessarily definite.

It has now been shown that the study of the adult mouthparts is of little value in solving these problems. A careful study of larval characters and of the internal anatomy of both the adult and immature stages may help in establishing precise relationships.

5. Systematic position of *Nemotelus* (Stratiomyidae)

The genus *Nemotelus* has usually been referred to the subfamily Clitellariinae but was placed in the Nemotelinae by McFADDEN (1967), HENNIG (1973) and JAMES in McALPINE

et al. (1981), and in the Prosopochrysinae by NAGATOMI & IWATA (1981). It has been shown in this paper that the mouthparts of *Nemotelus* resemble those of *Odontomyia* and *Labostigmina*, both of which evidently belong to the Stratiomyinae. It may easily be seen that the mouthparts of these 3 genera are not generalized but specialized. If their resemblance has not resulted from convergence but is due to synapomorphy, then *Nemotelus* is closer phylogenetically to *Odontomyia* and *Labostigmina* than to the genera of Prosopochrysinae, i. e. *Brachycara*, *Euparyphus*, *Myxosargus*, *Notomyia*, *Raphiocerina*, etc. and moreover, it may be appropriate to unite the Prosopochrysinae with the Stratiomyinae.

As criteria for the subfamily assignment of *Nemotelus*, there are the wing venation (by which *Nemotelus* is put in Clitelliariinae), larval characters (Nemotelinae), the structure of the female terminalia (Prosopochrysinae) and mouthparts (Stratiomyinae). Putting all accounts together, *Nemotelus* is tentatively relegated to the Nemotelinae in this paper.

6. Sexual dimorphism of mouthparts in lower Brachycera

In a few species of Solvidae, Xylophagidae, Rhagionidae, Athericidae and Tabanidae, the mouthparts of both sexes have been examined in this paper.

The mandibles and the mid-dorso-proximal process on the labrum are always absent in males, while they are present in females of some genera and families.

Apart from these two structures, the differences between the sexes are absent or at least slight in the genera and families examined. However the male palpal segment 2 is much shorter than the female in *Chrysops* and *Tabanus* (Tabanidae).

The male palpus is also narrower than the female in *Solva moiwana*, *Solva japonica*, *Xylophagus matsumurai* and *Suragina satsumana*. It is shorter than the female in *Xylophagus matsumurai* but longer than the female in *Bolbomyia* sp. (Rhagionidae).

The male hypopharynx is shorter than the female in *Atherix ibis*, *Suragina satsumana* and *Dasyomma* sp. but longer in *Suragina caerulea*. The male lacinia is shorter than the female in *Suragina satsumana* and *Dasyomma* sp.. These 3 genera and 4 species belong to Athericidae.

The male labrum is shorter or narrower than the female and the male cibarial pump is longer than the female in 3 genera (*Stonemyia*, *Chrysops* and *Tabanus*) and 4 species of Tabanidae.

As to *Tabanus sulcifrons*, BONHAG (1951) wrote, "The maxilla of the male differs considerably from that of the female [on p. 140]" and "The feeding mechanisms of the male is similar to that of the female except that the muscles are not as well developed, the mandibles and their muscles are completely absent, and the mechanics of protraction and retraction of the galeal stylet [= lacinia] of the maxilla has been considerably modified [on p. 153]." The differences in question are well shown in Fig. 14 by BONHAG (1951: 196).

7. Origin of mandibles in Diptera

The mandibles are present at least in some genera of the following families: Blephariceridae, Tanyderidae, Psychodidae, Ceratopogonidae, Simuliidae, Chironomidae, Culicidae, Chaoboridae, Dixidae, Pelecophrynidae, Rhagionidae, Athericidae, Tabanidae, Vermileonidae and Nemestrinidae, although the functional or well developed mandibles are not known in Dixidae, Pelecophrynidae, Vermileonidae and Nemestrinidae (chiefly after DOWNES, 1971).

The presence of mandibles is confined to the females. By way of a few exceptions, "PETERSON has found them [= mandibles] in the males of two species of *Simulium*; Wesché has recorded their occurrence (as abnormalities) in a few male mosquitoes; and JOBLING describes them in males of *Culicoides pulicaris*" (see CRAMPTON, 1942: 32).

The mandibles are entirely absent in the cyclorrhaphous Brachycera and many families of the orthorrhaphous Brachycera, i. e. Stratiomyidae, Xylophagidae, Asilidae, Therevidae, Empididae, Dolichopodidae, etc.

It may be of interest to quote below several long passages on the origin of mandibles.

MACKERRAS & FULLER (1942: 27) wrote, "Well-developed mandibles occur only in the females of Tabanidae and of the blood-sucking Rhagionid genus, *Spaniopsis*. All other Tabanoidea known to us lack them, or at most have vestigial spikes. Nevertheless, they

must have been present in the ancestral Tabanoids, for it is inconceivable that such organs should re-develop when once they had been lost. *Pelecorhynchus* shows the stages in their reduction."

Later, MACKERRAS (1954: 441) wrote, "It is probable that the ancestors of the Chrysopinae and Tabaninae became associated mainly with the vertebrates, those of the Pangoniinae mainly with the ancestors of the flowering plants, but that both associations developed independently more than once in the family, as they did in related families (for example, blood-sucking in the rhagionid genera *Spaniopsis* and *Symphoromyia*, flower-haunting in Pelecorhynchidae and Nemestrinidae), and one may have given place to the other in the evolution of individual genera. In modern Pangoniinae, some females feed only on blood, some only on nectar, and some on both."

OLDROYD (1964: 101—102) mentioned, "Most female horse-flies have kept both methods of feeding, sugar and blood, but loss of mandibles has occurred rather sporadically throughout the more primitive genera, and in a few of more advanced evolution. This gives an impression that the family might have started out as flower-feeders and later taken to blood sucking, but in DOWNES' [1958] view all these Brachycera were originally blood-suckers. In any event Tabanidae that have lost the mandibles have declined on a fully carbohydrate diet, and of course have been unable to resort to bloodsucking because they have no means of piercing the skin. The bloodsucking groups in contrast, have flourished."

DOWNES (1971: 240) mentioned, "the complexity of the mandibulate blood-sucking mouthparts, so similar in detail in the different families, is clearly incompatible with a repeated evolution of these structures, some significant differences in certain families notwithstanding. It is necessary to insist on this, because a number of dipterists have taken the reduced form as primitive and have proposed that mandibulate biting mouthparts have originated several times, and even on more than one occasion within a single family (see DOWNES 1958a). General morphologists, however, have never doubted that the mouthparts of these blood-sucking Diptera are homologous with those of typical insects, and specifically that they are derivable from those of the rather closely related order Mecoptera (SNODGRASS 1935; IMMS 1944; MATSUDA 1965)."

DOWNES (1971: 241) continued to mention, "Elongate probing and apically armoured mouthparts, adapted to cut through a skin and imbibe fluid or semi-fluid material, go back therefore to the origin of the Diptera."

In the material of Tabanidae in this paper, the mandibles are fully developed except for *Stonemyia* and *Nagatomyia*, definitely primitive genera, where the mandibles are small in relating to other parts. It is clear in these 2 genera that the mandibles are not in the process of enlargement but in the state of reduction. This shows one of the examples where "some of the characters of the primitive creature are [often] specialized considerably" (after NAGATOMI, 1981: 405).

It is concluded that the mandibulate biting mouthparts are plesiomorphic and have originated only once.

8. Mid-distal interlabellar process

There is a median process directed anteriorly between the labella (see Fig. 407 of *Vermileo comstocki*; refer also to Fig. 5 by Ross (1940) on *Symphoromyia atripes* and Fig. 9 by BONHAG (1951) on *Tabanus sulcifrons*). This process is widely distributed in the orthorrhaphous Brachycera but is absent in the Stratiomyidae, Pelecorhynchidae, Acroceridae (*Oligoneura*), Dolichopodidae and possibly Solvidae, Pantophthalmidae and Hilarimorphidae. It is also absent in the following genera: *Austroleptis* and *Rhagio* (Rhagionidae), *Pangonius* (Tabanidae), *Atriadops* and *Nycterimya* (Nemestrinidae).

Contrary to the mandibles, this process is present in the male.

The process is knife-like or sometimes possibly rather needle (or spike) like and varies in length with the genus and species. In *Scylaticus sayano* (Asilidae), the process is harpoon-like.

There is no doubt that the absence of this process indicates the specialized state.

There is a dorsal interlabellar membrane (or plate) situated at the base of the mid-distal interlabellar process and this structure may vary with the taxon but is not studied in this paper.

9. Mid-dorso-proximal process on labrum

There is a median process on the dorso-proximal part of the labrum in Rhagionidae, Athericidae and Tabanidae. It is always absent in the male and evidently associated with the mandibulate biting mouthparts.

The process appears to be absent in *Pelecorhynchus nigripennis* (Pelecorhynchidae) but is present in *Symphoromyia melaena* (Rhagionidae), *Atherix ibis* (Athericidae), *Ibisia marginata* (Athericidae) and *Suragina caerulescens* (Athericidae). In these 5 species, the mandibles are distinctly reduced or appear to be slightly so according to the species [the presence of the process is not confirmed in *Nagatomyia melanica* (Tabanidae) whose mandibles are reduced].

The process is absent in *Dasyomma maculipennis* (from Tasmania) (Athericidae) but present in *Atherix basilica* (Athericidae). In these 2 species, the mandibles are entirely lacking.

On the other hand, the process is always present in those species whose mandibles are fully developed.

Thus, the process is or was concerned with the mechanism of taking blood.

10. Armature on mandibles, lacinia, labrum and hypopharynx

SNODGRASS (1944) and DOWNES (1971) illustrated a well developed armature on (1) mandibles, (2) lacinia, (3) labrum and (4) hypopharynx in Culicidae [on (2)], Psychodidae and Ceratopogonidae [on (1)–(4)], and Simuliidae [on (1)–(2)], all of which are mandibulate biting flies belonging to Nematocera. БОННАГ (1951) illustrated the mandible with minute teeth and the lacinia with armature in *Tabanus sulcifrons*. The lacinia with armature is also shown by ROSS (1944) in *Symphoromyia atripes*, and by MELIN (1923) in Asilidae.

The armature on these organs is not illustrated in this paper, simply because it cannot be seen through the 40–160 times microscope. In *Silvius shirakii* the teeth on the mandible are comparatively large and are shown in Fig. 348. Thus, the armature in question, which may have taxonomic importance, remains to be investigated.

11. Union between clypeus and labrum (or cibarial pump) and size of torma

There is a pair of tormae which arises from the ventro-lateral base of the labrum or the lateral part of the cibarial pump and is inserted in the clypeus. The torma is usually more sclerotized than the clypeus. There are the following two conditions: (1) the torma is large and long and the clypeus between a pair of tormae is firmly fused with the labrum and cibarial pump; (2) the clypeus is easily detached or broken off in the dissection of the specimen, and this seems to be due to one or more of the following reasons: (a) the torma is small and short or not very sclerotized, (b) a pair of tormae are not convergent at their apices but widely separated, and (c) the clypeus is weaker or less sclerotized than in the first condition. Unfortunately the size and function of the tormae remain undetermined precisely in the species considered in this paper, especially those of the second condition.

There may be cases where a definite line cannot be drawn between the first and second conditions. It must be noted that the torma cannot be seen when it is concolorous with, or not darker than, the clypeus.

The first condition is seen in the Stratiomyidae, Rachiceridae, *Anacanthaspis* of Coenomyiidae, Acroceridae, Bombyliidae, Mydidae, Therevidae, Asilidae and Empididae. Except for the Rachiceridae and Coenomyiidae, the families above are generally more advanced than the other families having the second condition. However, the first condition is perhaps generalized.

There may be a third condition in which the torma disappears but the clypeus is widely fused with the cibarial pump. This may be seen in the cyclorrhaphous Brachycera (= Muscomorpha) and seems to be the most specialized. The Dolichopodidae of the Asilomorpha may possibly belong in this category. It is possible that each of the second and third conditions derives directly from the first condition.

12. Features of biting mouthparts in Tabanidea

The biting mouthparts are found in several genera of Rhagionidae, Athericidae and Tabanidae among Tabanidea. From the material examined in this paper, the biting mouth-

parts of Tabanidea may be characterized as follows: the mandibles, hypopharynx, lacinia and labrum are well developed and they are about equal in length, the labrum is longer than the cibarial pump, and there is a mid-dorso-proximal process on the labrum and a mid-distal interlabellar process.

With loss of the biting habit, change may occur in the following sequence: (1) mandibles become shorter than the labrum and is finally absent, (2) the hypopharynx or lacinia, or both, become shorter than the labrum, and (3) the labrum becomes shorter than the cibarial pump.

Sometimes the hypopharynx may become shorter than the labrum before the reduction of mandibles (e. g. in *Silvius oshimaensis*, Figs. 351–355).

Also, the hypopharynx, lacinia and labrum may become extraordinarily long for nectar feeding (e. g. in *Pangonius funebris*, Figs. 336–339).

13. Blood-sucking habit of Rhagionidae

There are 21 genera of Rhagionidae (NAGATOMI, 1982), of which only *Spaniopsis* (of Australia and Tasmania) and *Symphoromyia* (of North America and central Asia) are known as blood-suckers.

For sources of the blood-sucking records in *Spaniopsis* see BLETCHLY (1955: 789). PARAMONOV (1962: 139) characterized this genus as "Blood-sucking flies." The blood-sucking habit is probably common to all members of this genus.

A number of species of North American *Symphoromyia* are well known as blood-suckers (see e. g. TURNER, 1974 and HOY and ANDERSON, 1978), and the victims attacked are "man, livestock, and game animals." There are 3 species of the European *Symphoromyia* (of which *crassicornis* was also recorded from central Asia and Japan). CHVÁLA (1983b) published a paper whose abstract is as follows: "Biting of man by *Symphoromyia* (Rhagionidae) snipe-flies in the mountains of Central Asia is the first record from the Palaearctic region. Females of *S. spitzeri* sp. n. (Uzbekistan, Tadzhikistan) actively suck blood and have fully developed mouthparts with functional mandibles. *S. spitzeri* is compared with the European *S. crassicornis* PANZ. which is a non-biting species with reduced, non-functional mandibles." The mandibles are well developed in "*Symphoromyia crassicornis*" of Japan which may be distinct specifically from true *crassicornis*. Field observations on blood-sucking may still be forthcoming in the Japanese form.

In *Pseudoerinna* (= *Bequaertomyia jonesi* (of N. America), it appears that the mandibles are slightly reduced and the mid-dorso-proximal process on the labrum is absent.

The mandibles are entirely absent in the following genera: *Arthroceras*, *Arthroteles*, *Atherimorpha*, *Austroleptis*, *Bolbomyia*, *Chrysopilus*, *Glutops*, *Rhagio* and *Spania*.

Thus, in Rhagionidae blood-sucking is restricted in number of genera and species, compared with Tabanidae and Athericidae.

14. Blood-sucking habit of Athericidae

The Athericidae itself and its blood-sucking habit are not well known. The members of the Athericidae were included in Rhagionidae but STUCKENBERG (1973) separated them from the latter. The Athericidae seems to be more similar phylogenetically to Tabanidae than to Rhagionidae (STUCKENBERG, 1973; NAGATOMI, 1977).

There are several definite records of blood-sucking as follows: *Suragina bivittata* BEZZI, 1926 of South Africa: owl (after STUCKENBERG & YOUNG, 1973); *Suragina longipes* BELLARDI, 1861 of Mexico: man and horse (after KNAB, 1912); *Suragina satsumana* MATSUMURA, 1916 of Japan: cattle (after ABE, MURAI & ISHIKAWA, 1955); *Atrichops crassipes* MEIGEN, 1820 of Europe: frog (after DESPORTES, 1942); *Atrichops fontinalis* NAGATOMI, 1958 of Japan: frog (after NAGATOMI, 1962); *Atrichops morimotoi* NAGATOMI, 1953 of Japan: frog (after NAGATOMI, 1962).

MALLOCH (1932: 222 & 230) wrote, "PHILIPPI recorded *Trichopalpus obscurus* [PHILIPPI, 1865] [which is probably a synonym of *Dasyomma (Dasyomma) caeruleum* MACQUART, 1840 of S. Chile] as a blood-sucker" and "This [= *Dasyomma (Trichopalpomysia) cinerascens* PHILIPPI, 1865 of Chile] is the specimen referred to in the preliminary discussion in this paper when mention is made of KNAB's record of the biting habits of members of the family. I can see no reason to doubt REED's identification."

F. W. EDWARDS (in MALLOCH, 1932: 200) mentioned, "We observed this habit [of blood-sucking] in two or three species, but unfortunately no exact record was kept of the observations. *D. caeruleum* and *D. humeralis* [= *D. (Dasyommima) humerale* MALLOCH, 1932 of S. Chile] were taken on an ox used as bait for blood-sucking flies in the forest at Castro."

The present paper shows that the mandibles are well developed in *Dasyomma caeruleum* but entirely absent in *Dasyomma maculipennis* from Tasmania. It is certain that the presence or absence of the blood-sucking habit varies with the species in *Dasyomma*.

NAGATOMI (1962) revealed that a blood-meal is not needed for the development of the ovary in *Atherix ibis* (widely distributed in Europe, Siberia and Japan) and *Suragina caerulea* (= *Atherix kodamai*) (distributed in Burma, Nepal, India and Japan). The present paper shows that the mandibles are reduced in *A. ibis* and *S. caerulea* and entirely absent in *Atherix basilica* of Japan.

NAGATOMI (1979: 173) mentioned, "all of the individuals [of *Suragina yaeyamana* NAGATOMI, 1979 of Yaeyama Islands (near Formosa)] I collected (1 ♂, 46 ♀) flew about my head, although any of them did not bite me." This habit is not observed in *Suragina satsumana* of Japan. The mandibles of these 2 species are well developed and blood-sucking is evident in *satsumana* and probable in *yaeyamana*.

The blood-sucking habit is not definitely recorded in *Ibisia marginata* distributed in Europe and the mandibles of this species appear to be slightly reduced. But field observations on blood-sucking may still be forthcoming in this species.

STUCKENBERG & YOUNG (1973) observed that a number of African and Oriental species of *Suragina* had "a dark red or blackish, hardened mass in the abdomen suggestive of ingested blood." This is true of the Oriental *Atrichops*, which the senior author has examined.

It is highly probable that almost all species of *Atrichops* and most species of *Suragina* are blood-suckers.

15. Blood-sucking habit of Tabanidae

The blood-sucking habit is well known and widely distributed in female Tabanidae and the victims attacked seem to be predominantly mammals, but there are records of *Tabanus* on crocodiles, lizards, and turtles and a report of *Chrysops* on birds (crows) (DOWNES, 1958, 1971).

"The Australian Pangoniini include the most primitive Tabanidae. Most are low-flying insects, which do not suck blood." (MACKERRAS, 1956b: 408).

"[In the Australian Scionini of the subfamily Pangoniinae], many of the species suck blood, but some appear to feed only on flowers, chiefly *Leptospermum*." (MACKERRAS, 1960: 1).

The mandibles are entirely lacking in the females of the following genera: *Tabanotelum* (Diachlorini), *Thaumastocera* and *Sphecodemyia* (Rhinomyzini), and *Coenoprosopon* and *Therevopungonia* (Pangoniini) (MACKERRAS, 1956a: 394–395).

"species of *Scaptia* which did not suck blood had mandibles as large as those that did," (MACKERRAS, 1956a: 394). But in this context the following statement by MACKERRAS (1960: 8) seems to be interesting: "The females of some species—notably *Scaptia maculiventris* in the southern highlands of New South Wales—seem to divide their attention between blood-sucking and feeding on the nectar of flowers, but a few, of which *S. patula* in the commonest, do not appear to suck human blood at all. I would have said the same of *S. auriflua*, but LEE, DYCE, and O'GOWER (1957, Table 10) list it as feeding on man at Colo Vale." The mouthparts of *Scaptia patula* are well developed (see Fig. 6 by MACKERRAS & FULLER, 1942: 11), but it is certain that this species has either acquired the blood-sucking habit occasionally, or entirely lost it, quite recently.

HAYAKAWA (1980) tested the presence or absence of blood-sucking in a total of 9 genera and 59 species of Japanese Tabanidae, i. e. *Stonemyia* (1 sp.), *Nagatomyia* (1), *Silvius* (1), *Chrysops* (6), *Hybomitra* (8), *Atylotus* (4), *Tabanus* (32), *Isshikia* (2) and *Haematopota* (4). The material, whose wings (except basal one-third) were cut off, was put on the inner surface of rabbit ear 4 days after emergence in the laboratory. No success in blood-sucking was seen in 8 species, i. e. *Stonemyia yezoensis*, *Nagatomyia melanica*, *Silvius matsumurai*, *Tabanus daishoji*, *T. hyugaensis*, *T. masamitsui*, *T. otsurui* and *Tabanus* sp., of which the last 5 belong to *Tabanus iyoensis* group.

Of the *Tabanus iyoensis* group (in Japan) other than the 5 species mentioned above, no oviposition takes place without previous blood-sucking in *humilis* but the first oviposition is possible in *iyoensis*, *kotoshoensis* and *sapporoensis* without an initial blood-meal (HAYAKAWA, 1980).

Unfortunately the mouthparts have not yet been examined in *Silvius matsumurai* and the 5 species of the *T. iyoensis* group in question.

According to the field observation of HAYAKAWA (in pers. commu. August 1, 1983), no blood-sucking habit is found in *Silvius shirakii* and *Silvius oshimaensis*. In these 2 species, the mandibles are well developed but the hypopharynx is shorter than the labrum.

For the relationship between host preference and the size and shape of the mouthparts in some Tabanids, see LALL & DAVIES (1971).

16. Decisive proof of presence or absence of blood-sucking habit in lower Brachycera

As discussed in the foregoing sections, it is evident that the species, whose mandibles are shorter than the labrum, are no longer able to suck blood. This is probably so in the species whose mandibles are well developed but whose hypopharynx or lacinia is shorter than the labrum. On the other hand, some of the species, whose mandibles, hypopharynx, lacinia and labrum are equal in length, may not be blood-suckers, since this may occur when the habit in question was lost quite recently. So, the following procedures are necessary for the final determination of the blood-sucking habit: (1) field observation (STUCKENBERG & YOUNG, 1973), (2) the examination of stomach contents and ovary development (NAGATOMI, 1962), and (3) the test in the laboratory (e.g. to place the fly in question on the inner surface of a rabbit ear) (HAYAKAWA, 1980).

17. Ages of blood-sucking genera in each family of the lower Brachycera

The blood-sucking genera *Spaniopsis* and *Symphoromyia* are definitely older than *Rhagio* and *Chrysopilus* which are non-biting and seem to be more advanced among Rhagionidae. On the other hand, mandibles are not found in the following primitive genera of Rhagionidae considered in this paper: *Arthroceras*, *Atherimorpha*, *Bolbomyia* and *Glutops*.

Among *Atherix*, *Suragina* and *Atrichops* of the Athericidae, it is uncertain which genus is old or young. NAGATOMI (1962) thought that *Atherix* is the most advanced and *Atrichops* the most primitive, but the grounds proposed may be superficial and sounder bases must be found. On the other hand, *Dasyomma* seems to be more primitive than *Atherix*, *Suragina* and *Atrichops*. Within *Dasyomma*, the mandibles are found to be well developed in one species from Chile but are entirely absent in another from Tasmania.

In Tabanidae, the non-biting genera are more primitive on the whole as already mentioned.

Thus, there are many primitive genera having specialized or apomorphic (= nonbiting) mouthparts and a number of advanced genera having generalized or plesiomorphic (= mandibulate biting) mouthparts. But this is not strange, granting that the two citations below are correct.

"The heart of the matter is whether the change in question was reversible or not. The spur formula must be interpreted not as characteristic of any family, but within one generic group or one genus, and if so, the reversibility may become less probable" (NAGATOMI, 1981: 405). This concerns the numbers of the tibial spurs in the lower Brachycera but may hold good for the mouthparts, and:

"some of the characters of the primitive creature are [often] specialized considerably" (NAGATOMI, 1981: 405).

18. Oldest type of mouthparts in orthorrhaphous Brachycera

NAGATOMI (1981) discussed some characters of the lower Brachycera and the grounds for recognition of plesiomorphy or apomorphy but omitted to mention one of the important grounds which is treated here in relation to the mouthparts.

A complex or massive homologous structure occurring sporadically in some genera or families will generally be plesiomorphic, because it seems difficult to believe that such a

structure can develop several times independently. A good example of this is the development of mandibles repeatedly mentioned in this paper.

A number of families of the orthorrhaphous Brachycera have a pair of large and long tormae with the clypeus between them firmly fused with the labrum and the cibarial pump (Stratiomyidae, Rachiceridae, *Anacanthaspis* of Coenomyiidae, Acroceridae, Bombyliidae, Mydidae, Therevidae, Asilidae and Empididae). Perhaps this condition is plesiomorphic, although it may not be found in those present day genera having mandibulate mouthparts.

The cibarial pump varies considerably in length according to sex and species within the genus *Tabanus*. But it appears that the cibarial pump elongates generally in company with the reduction of the labrum and the short cibarial pump is a plesiomorphic condition at least in the lower Brachycera.

The oldest type of mouthparts in the orthorrhaphous Brachycera is proposed to be as follows: labrum lanceolate, hypopharynx, lacinia and mandibles stylet-like, and equal in length; mid-dorso-proximal process on labrum and mid-distal interlabellar process both present; maxillary palpus multi-segmented (2 or more) and not swollen but simple; cibarial pump as long as or somewhat longer than wide and shorter than labrum; torma probably large and long; theca shorter than labellum as in *Spaniopsis* and *Symphoromyia* or in the genera of Athericidae.

Exeretoneura and *Heterostomus* seem to be the most primitive genera among the lower Brachycera but their mouthparts are thought to be specialized as follows: mandibles absent; torma becoming small and short; in *Heterostomus* the maxillary palpus is conspicuously swollen; in *Exeretoneura* the labrum is short and wide, the cibarial pump is very long and palpal segment 1 is much larger than segment 2.

Among the genera (which are illustrated in this paper) of the Asilomorpha, the most generalized mouthparts are seen in *Hirmonneura* (Nemestrinidae), *Hilarimorpha* (Hilarimorphidae) and the genera of Therevidae, and the most specialized mouthparts are seen in the genera of Dolichopodidae.

19. Conspicuously long proboscis in orthorrhaphous Brachycera

The conspicuously long proboscis is found in *Arthroteles* (Rhagionidae), *Lampromyia* (Vermileonidae), and several genera of Tabanidae, Nemestrinidae, Acroceridae, Bombyliidae, Mydidae, Apioceridae, Empididae and Dolichopodidae. Thus, the length of the proboscis varies considerably with the genus within the same family.

The following genera have been examined in this paper: *Arthroteles* (Rhagionidae), *Pangonius* (Tabanidae), *Lampromyia* (Vermileonidae), *Bombylius* (Bombyliidae), and *Empis* (Empididae). In these genera, the labial stalk, labrum, hypopharynx and lacinia become conspicuously long.

The conspicuously long proboscis is thought to be specialized, apparently for nectar feeding, and to occur independently of phylogenetic relationship.

It is also found sporadically in the Nematocera and the cyclorrhaphous Brachycera, as in the orthorrhaphous Brachycera, for nectar feeding or blood sucking. In *Elephantomyia* (Tipulidae) and *Gnoriste* (Mycetophilidae), the clypeus or anteclypeus becomes conspicuously long (judging from Figs. 3–4 by CRAMPTON, 1942).

20. Vestigial proboscis in orthorrhaphous Brachycera

A vestigial proboscis means the loss or reduction of the labium in which the mouthparts must necessarily be nonfunctional. From a total of 87 genera and 103 species, a vestigial proboscis has been found in the following 3 genera and 3 species: *Chiromyza papuae* (Stratiomyidae) and *Atriadops javana* and *Nycterimyia fenestro-inornata* (Nemestrinidae). In these 3 species, the lacinia is absent and the palpus is 1-segmented but varies considerably in length according to the species. In *Nycterimyia fenestro-inornata*, the labrum is also vestigial.

There is no doubt that the vestigial proboscis occurs secondarily, resulting from the disuse of mouthparts.

Concluding remarks

(1) The mouthparts have been examined and illustrated in a total of 22 families, 87 genera and 103 species, most of which belong to the lower Brachycera (= Tabanomorpha). The number of the genera and species examined in each family is as follows: Stratiomyidae, 29 (33 spp.); Solvidae, 1 (3 spp.); Pantophthalmidae, 1 (1 sp.); Rachiceridae, 1 (1 sp.); Xylophagidae, 1 (1 sp.); Coenomyiidae, 5 (5 spp.); Exeretoneuridae, 1 (1 sp.); Heterostomidae, 1 (1 sp.); Pelecorhynchidae, 1 (1 sp.); Rhagionidae, 12 (13 spp.); Athericidae, 5 (11 spp.); Tabanidae, 9 (12 spp.); Vermileonidae, 2 (2 spp.); Nemestrinidae, 3 (3 spp.); Acroceridae, 1 (1 sp.); Bombyliidae, 3 (3 spp.); Hilarimorphidae, 1 (1 sp.); Mydidae, 1 (1 sp.); Therevidae, 4 (4 spp.); Asilidae, 1 (1 sp.); Empididae, 1 (1 sp.); Dolichopodidae, 3 (3 spp.). The last 9 families belong to orthorrhaphous Brachycera other than the lower Brachycera, that is, the Asilomorpha.

(2) It is difficult to find any definite family characters in the mouthparts among most taxa of the orthorrhaphous Brachycera. But the mouthparts may be diagnostic in the Pantophthalmidae, Asilidae, Empididae and Dolichopodidae. However, it must be noted that the species or genera examined in this paper are few in Acroceridae, Bombyliidae and Mydidae and none in Scenopinidae and Apioceridae.

(3) The mouthparts are very similar in form in the different taxa. The mouthparts of some Stratiomyidae may vary with genus and species and may have taxonomic value, although specific or generic characters are still inadequate, simply because the material examined is small in number of species and individuals.

(4) *Nemotelus* is very similar in the structure of mouthparts to *Odontomyia* and *Labostigmia*, both of which evidently belong to the Stratiomyinae, than to the genera of Prosopochrysinæ. *Nemotelus* is relegated to the Nemotelinae in this paper.

(5) As is well known, the palpus is the most variable taxonomic feature among the mouthparts.

(6) It was asserted by DOWNES (1971) that the mandibulate biting mouthparts go back to the origin of the Diptera. This view is supported in this paper.

(7) It is newly found that *Pseudoerinna* (= *Bequaertomyia*) *jonesi* of N. America (Rhagionidae) has mandibles which appear to be slightly reduced and *Lampromyia intermedia* of S. Africa (Vermileonidae) has vestigial mandibles.

(8) Among the Athericidae, mandibles are fully developed, reduced, or entirely absent according to genus and species. This is also true in the Rhagionidae and Tabanidae.

(9) Among the Tabanidae examined, *Stonemyia yezoensis* (of Japan) and *Nagatomyia melanica* (of Japan) have reduced mandibles. These 2 species certainly have no blood-sucking habit.

(10) The biting mouthparts of Tabanidea (Pelecorhynchidae, Rhagionidae, Athericidae and Tabanidae) may be characterized as follows: mandibles, hypopharynx, lacinia and labrum are well developed and, they are equal in length and the labrum is longer than, the cibarial pump. There is a median process on the dorso-proximal part of the labrum in Rhagionidae, Athericidae and Tabanidae and it is associated with mandibulate biting mouthparts.

(11) The blood-sucking habit is discussed for the Rhagionidae, Athericidae and Tabanidae, in which the first has a much lower ratio of blood-sucking genera and species, in relation to the last two.

(12) Some of the species, whose mandibles, hypopharynx, lacinia and labrum are equal in length, may not be blood-suckers, since this may occur when the habit in question was lost quite recently. The following procedures are necessary for the final establishment of the habit: (a) field observation, (b) examination of stomach contents and ovary development, and (c) the laboratory test (e. g. to place the fly in question on a rabbit's ear).

(13) The oldest type of mouthparts is found in the orthorrhaphous Brachycera.

(14) The mouthparts of Nemestrinidae (except for genera with the proboscis vestigial) are similar to those of Tabanidae, the Hilarimorphidae to Vermileonidae (*Vermileo*) and the Therevidae to Coenomyiidae. These 3 families have generalized mouthparts among the Asilomorpha, whereas the most specialized mouthparts in the Asilomorpha are seen in the Dolichopodidae.

Zusammenfassung

Es werden die Mundwerkzeuge der orthorrhaphen Brachycera (Tabanomorpha und Asilomorpha) aus taxonomischer Sicht und unter spezieller Berücksichtigung des Blutsaugens untersucht. Von 22 Familien werden insgesamt 87 Gattungen und 103 Arten abgehandelt, überwiegend niedere Brachycera (Tabanomorpha).

Summary

The mouthparts of the orthorrhaphous Brachycera (= Tabanomorpha and Asilomorpha) have been examined from the taxonomic point of view, giving special emphasis on blood-sucking and treating a total of 22 families, 87 genera and 103 species, most of which belong to the lower Brachycera (= Tabanomorpha).

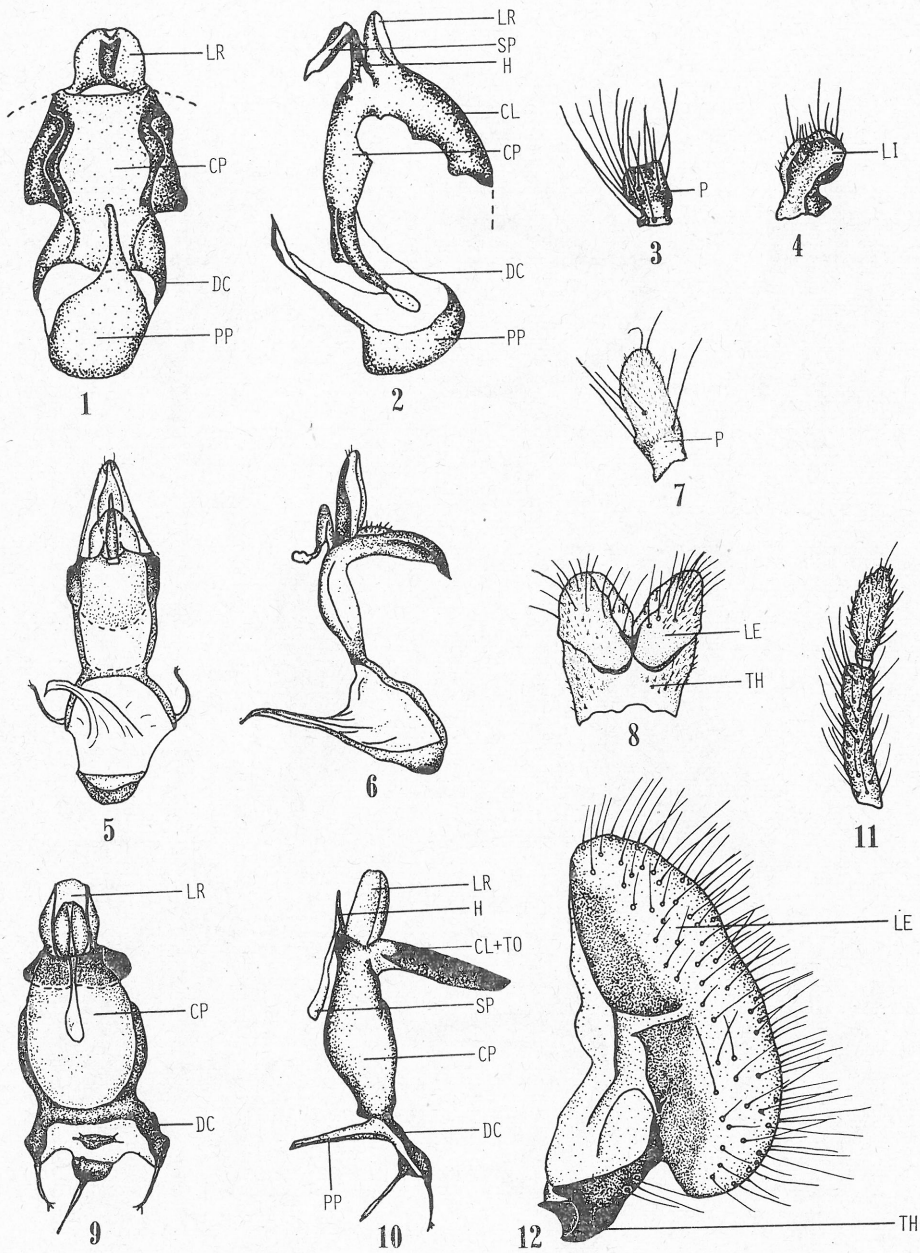
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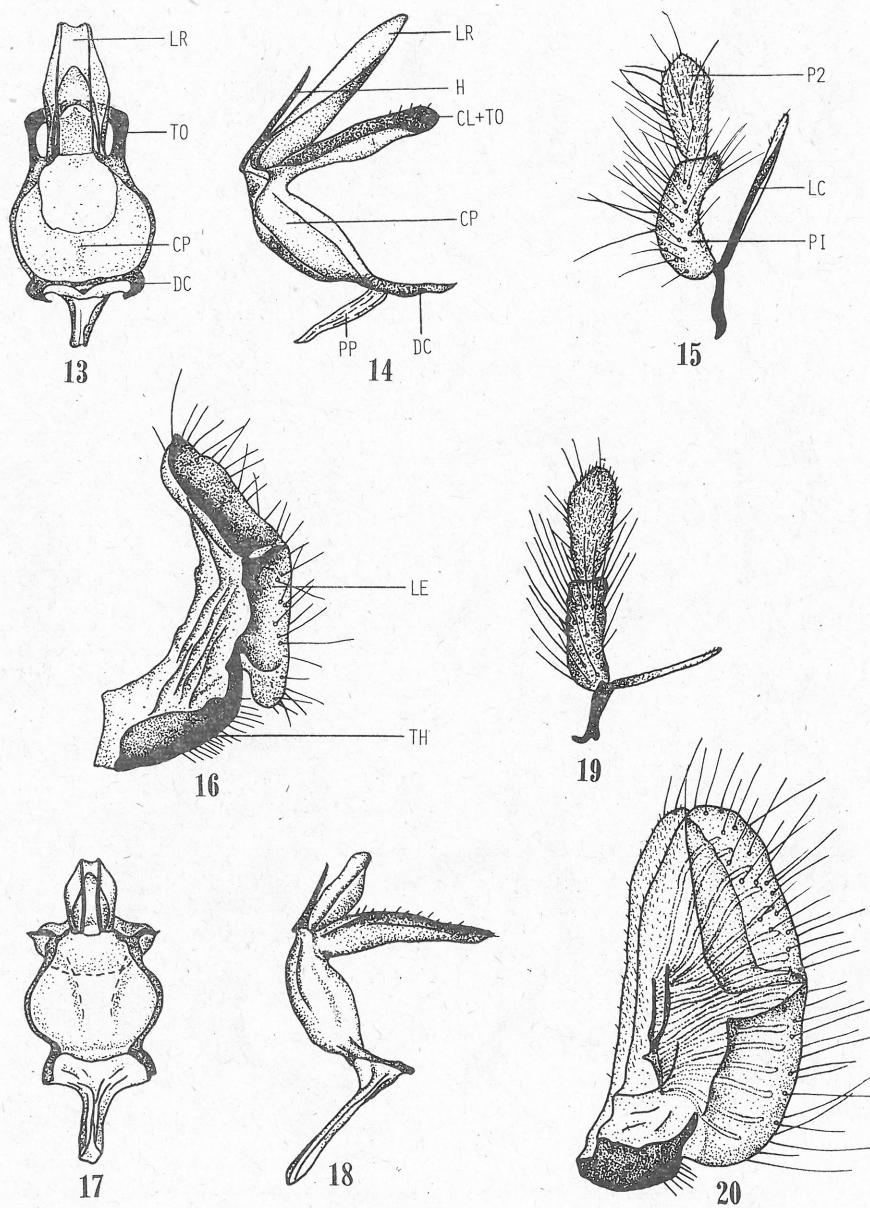
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Anhang

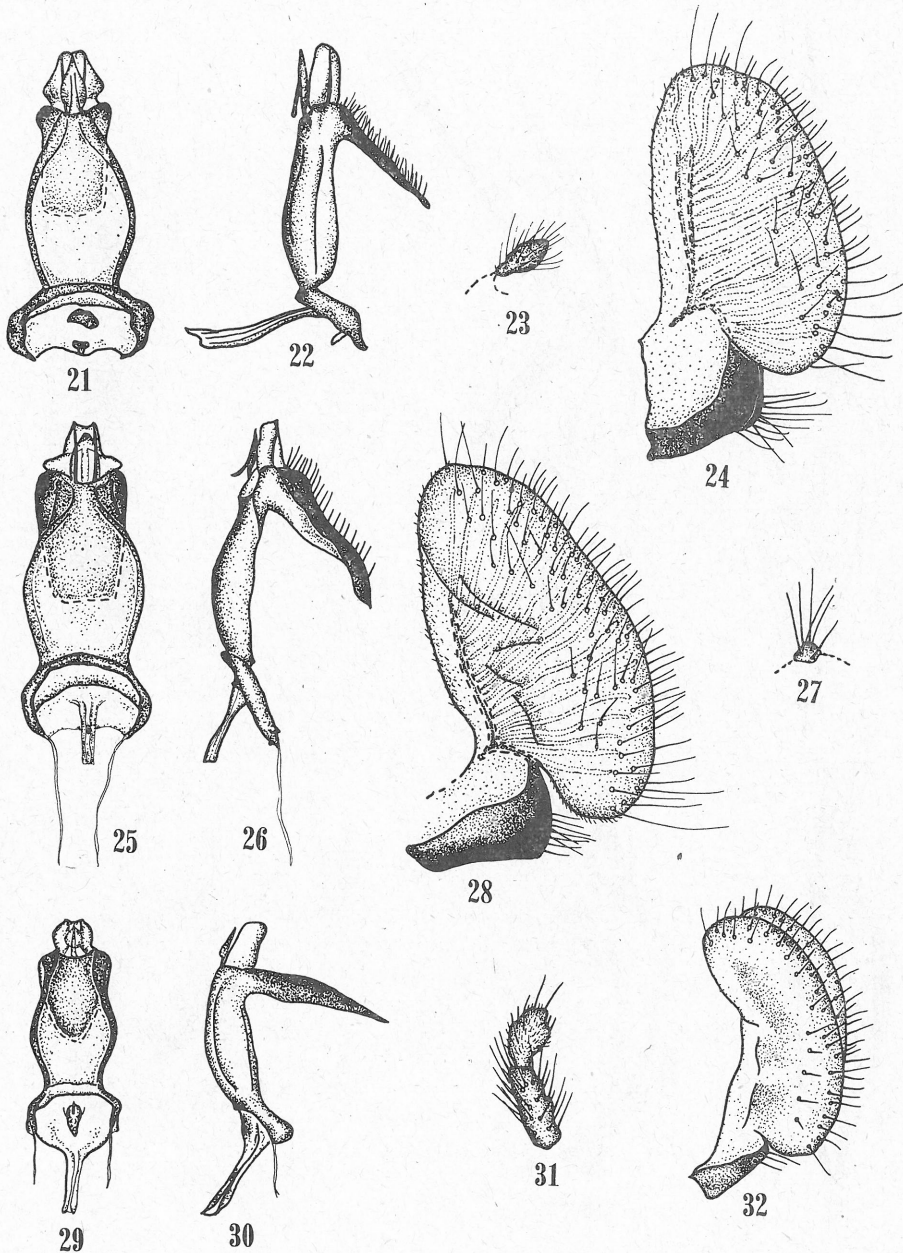
Bildtafeln mit den Figuren 1-480



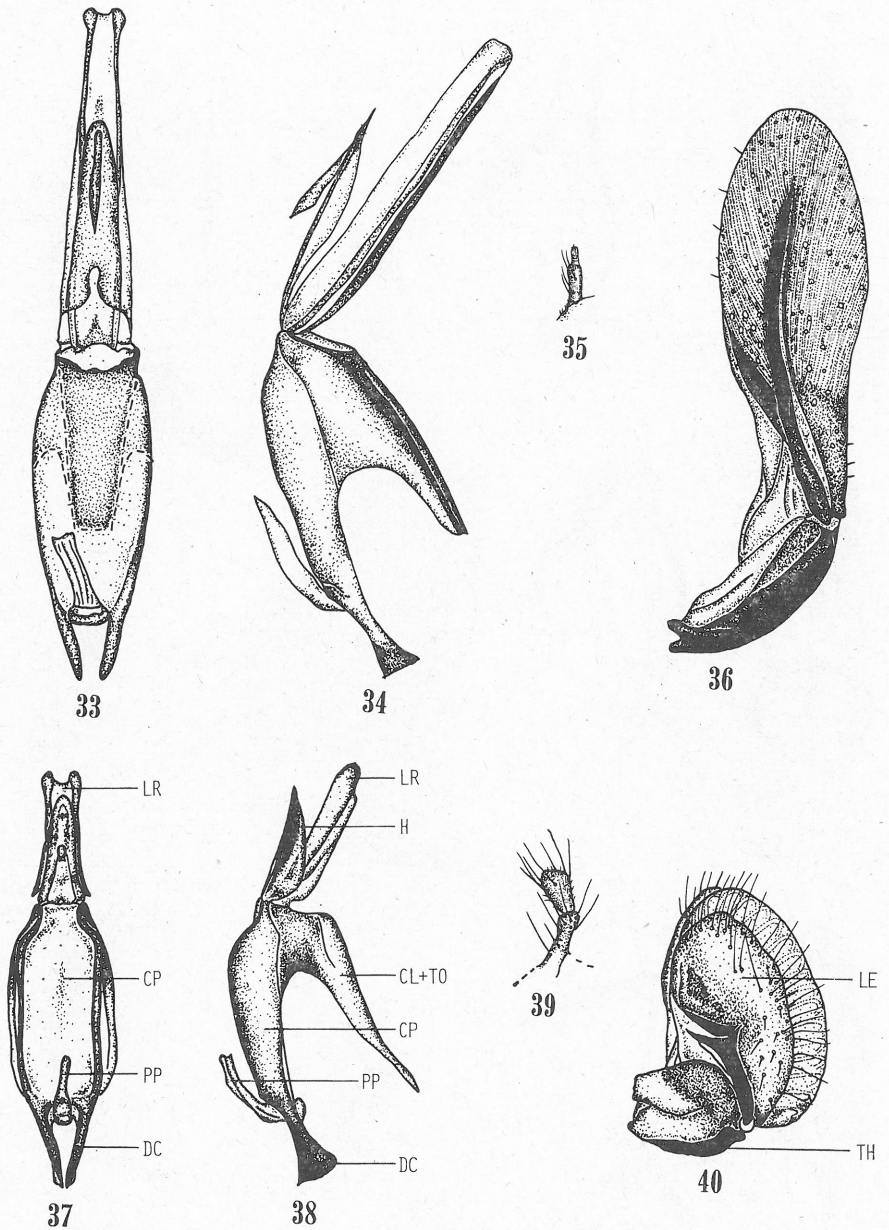
Figs. 1-4. *Chiromyza papuae*, ♀. Figs. 5-8. *Inopus rubriceps*, ♀ (8: ventral view). Figs. 9-12. *Actina jezoensis*, ♀.



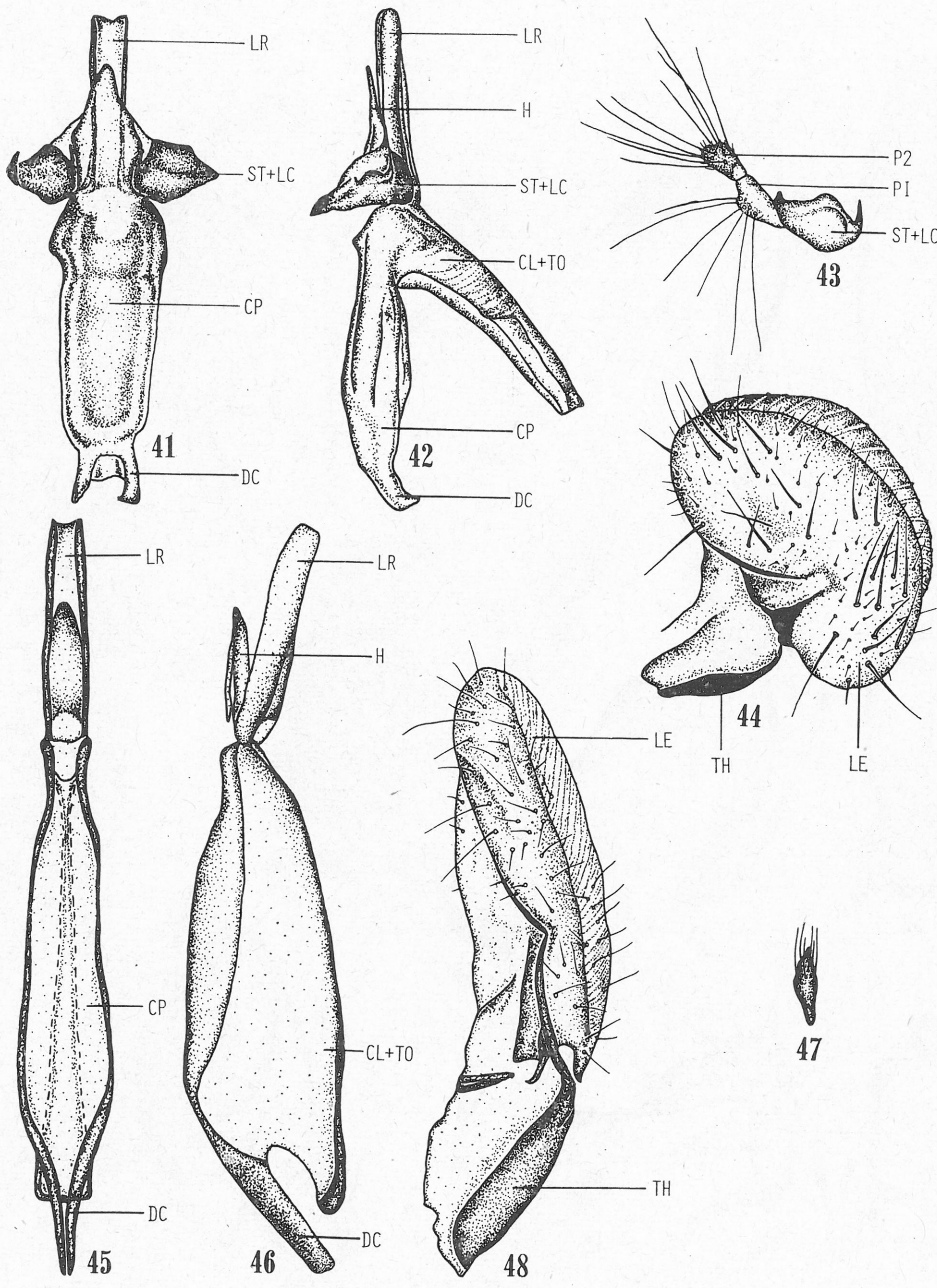
Figs. 13–16. *Allognosta flavofemoralis*, ♀. Figs. 17–20. *Allognosta vagans*, ♀ (20: based on 2nd specimen).



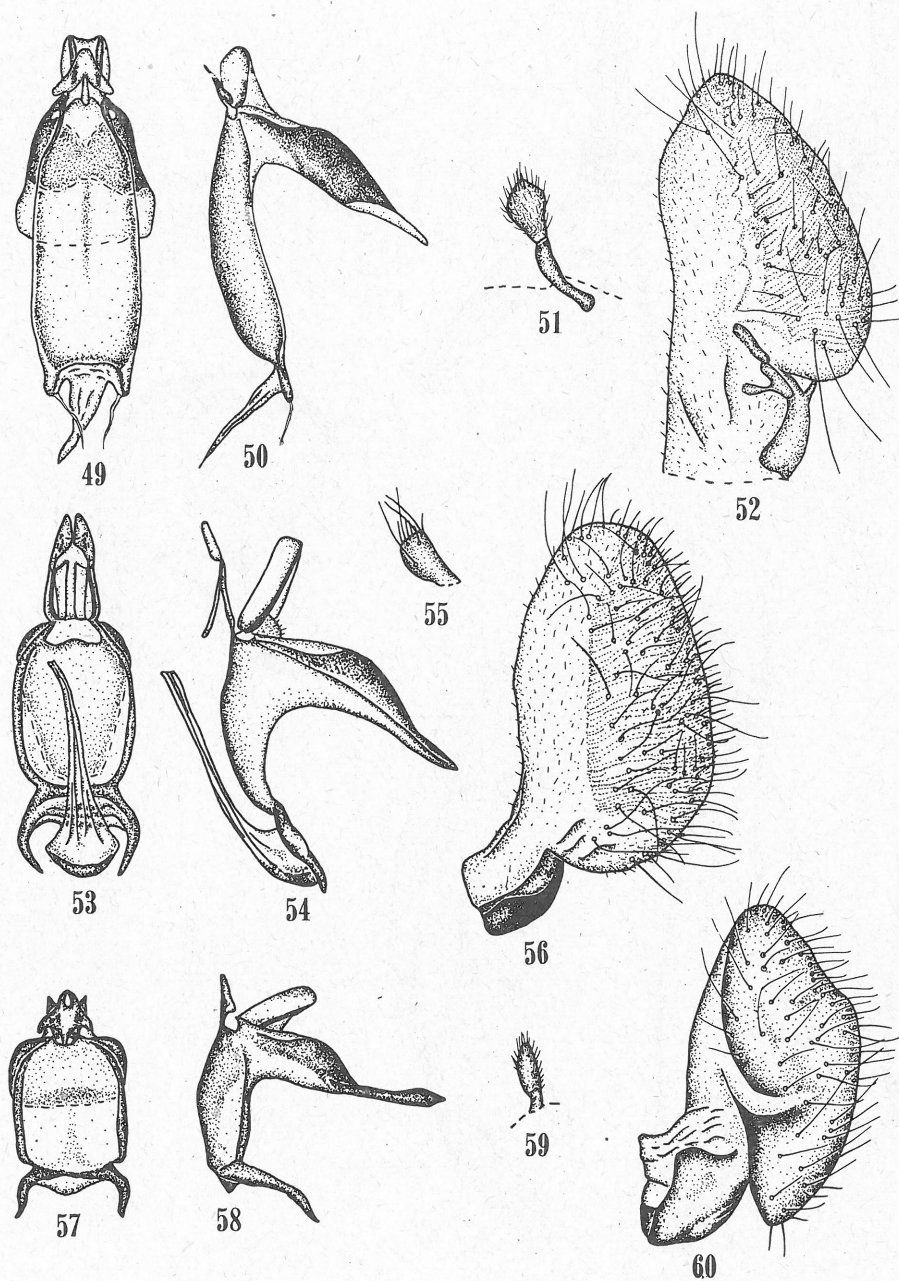
Figs. 21—24. *Beris fuscipes*, ♀. Figs. 25—28. *Beris hiotsui*, ♀. Figs. 29—32. *Chorisops maculiala*, ♀.



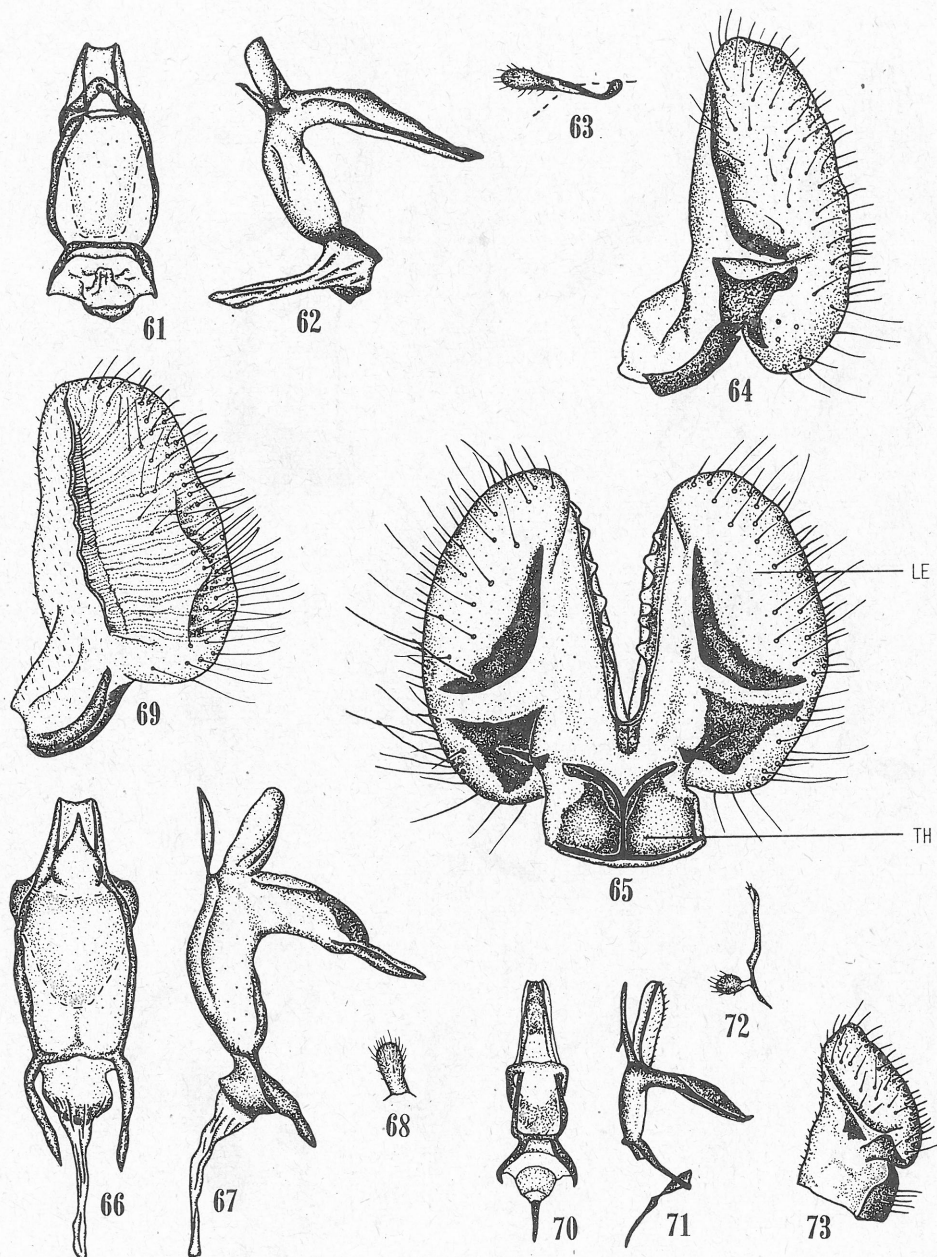
Figs. 33–36. *Labostigmina obscura*, ♀. Figs. 37–40. *Odontomyia garatas*, ♀.



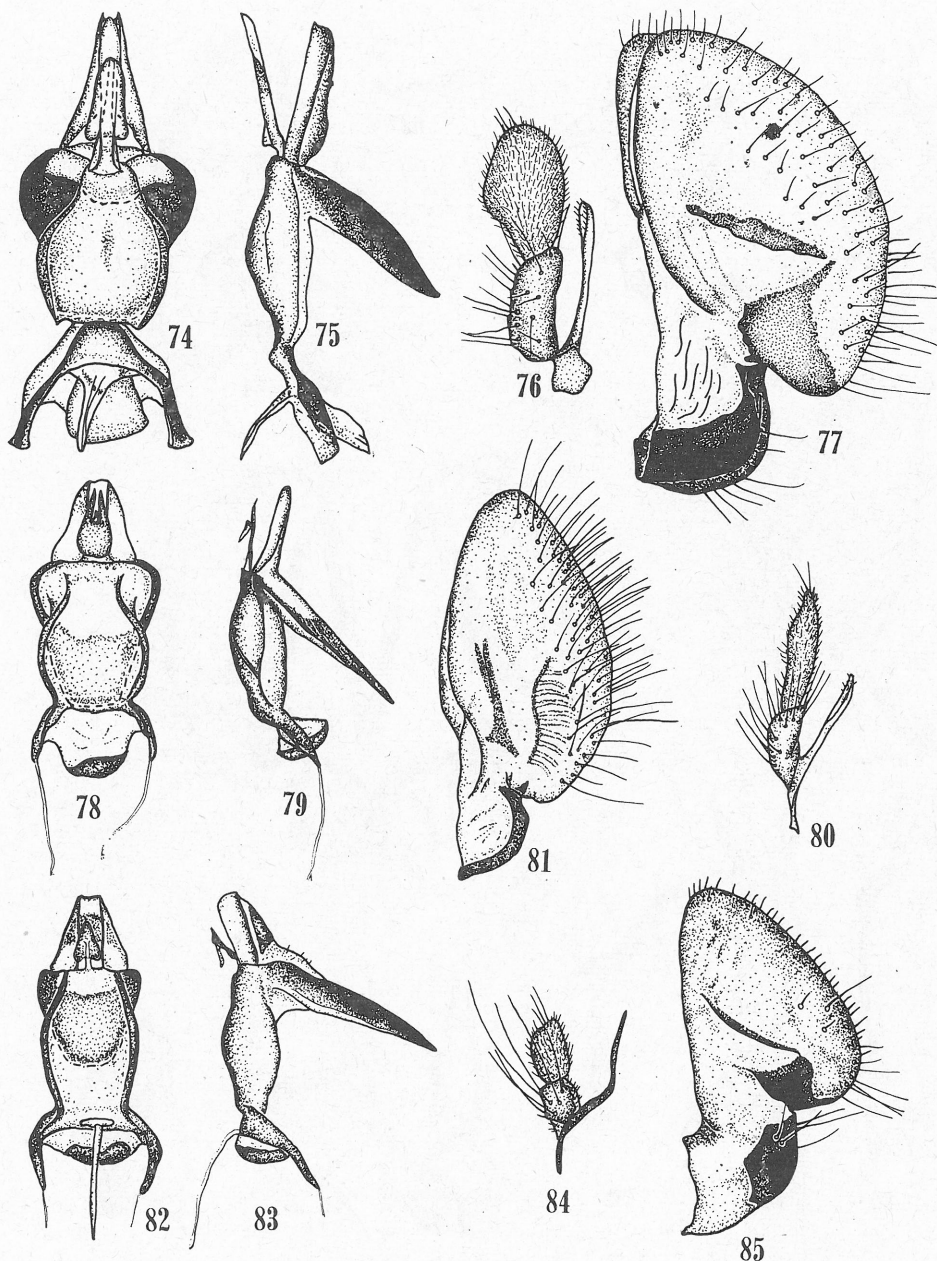
Figs. 41–44. *Stratiomys japonica*, ♀. Figs. 45–48. *Nemotelus crenatus*, ♀.



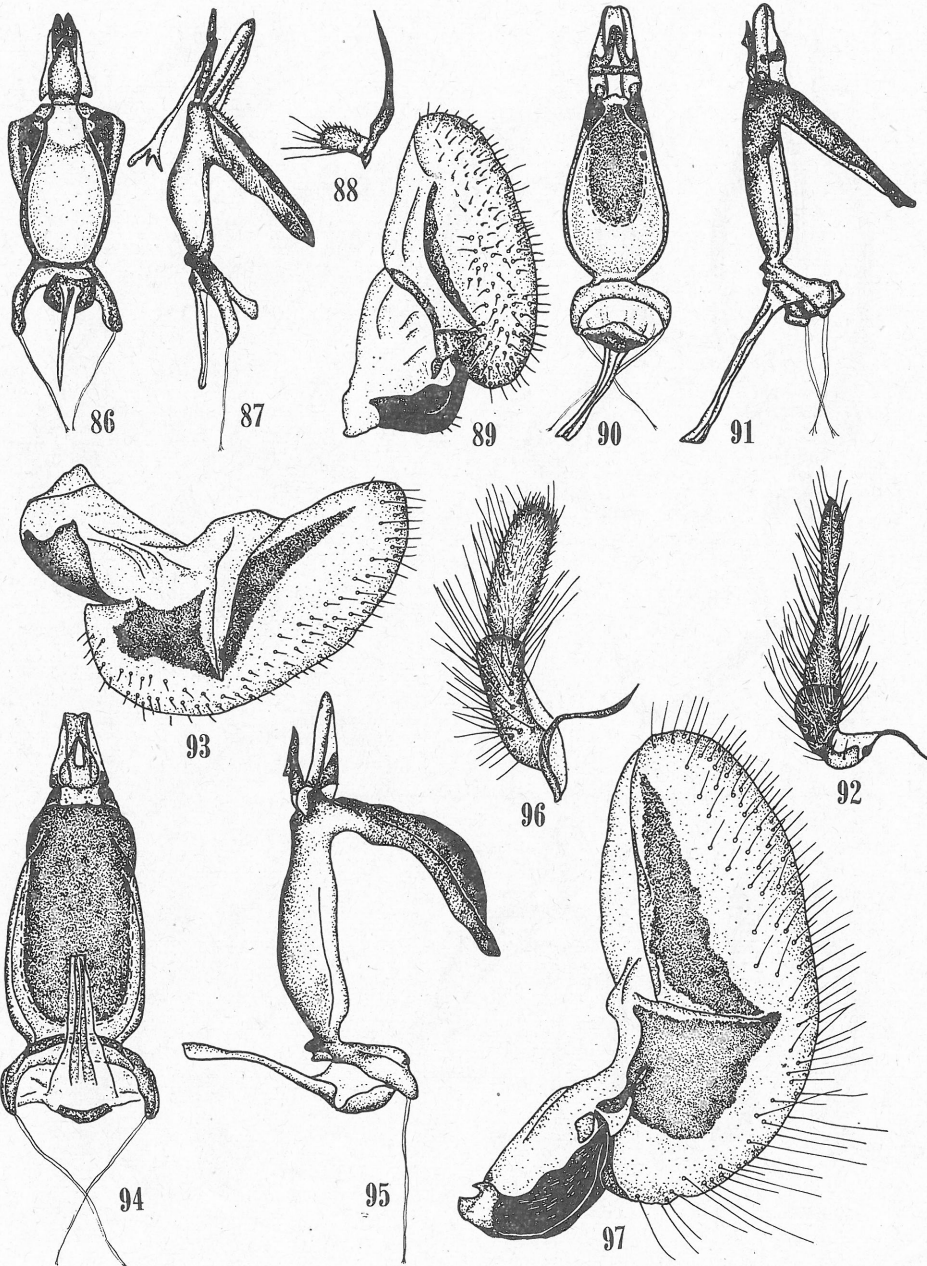
Figs. 49–52. *Brachycara* sp., ♀. Figs. 53–56. *Euparyphus lagunae*, ♀. Figs. 57–60. *Myxosargus knowltoni*, ♀.



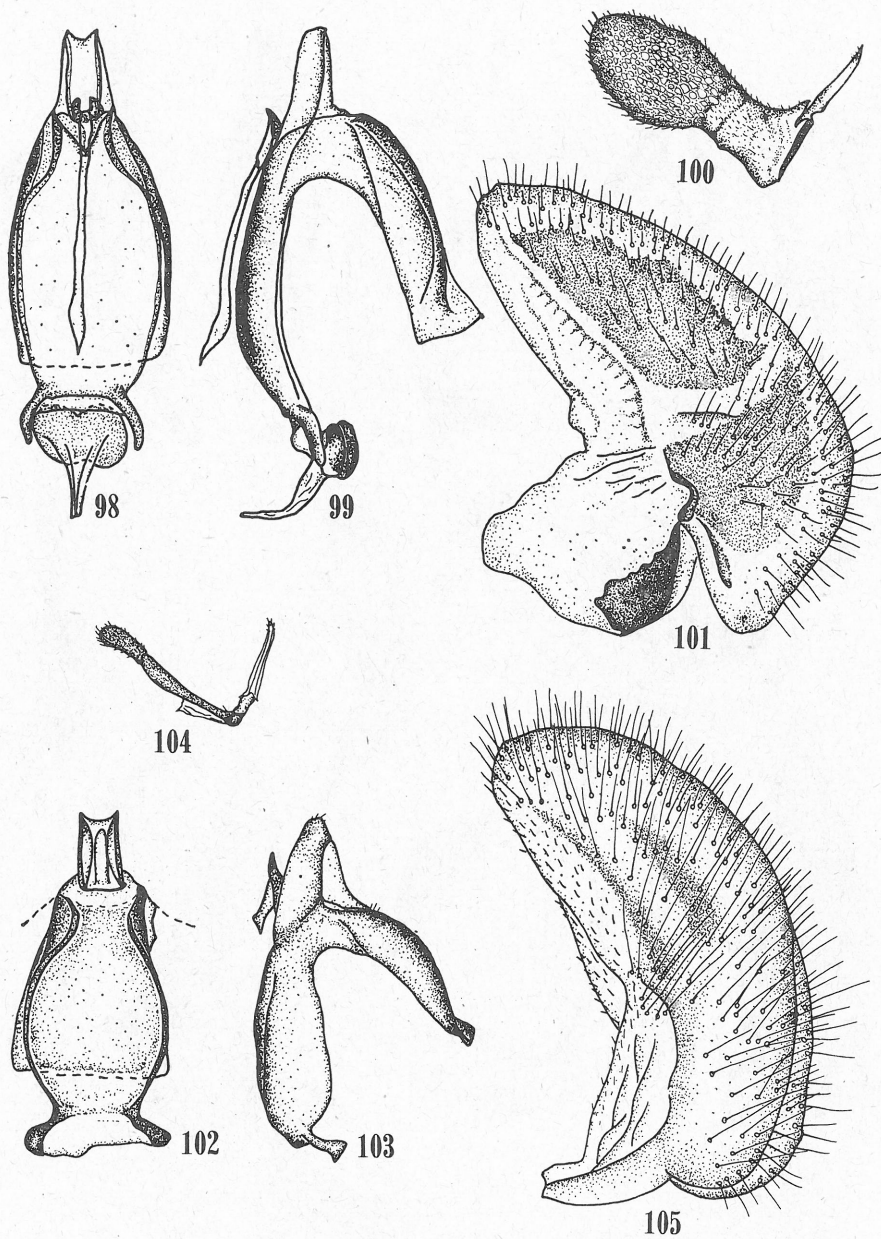
Figs. 61—65. *Notomyia viridis*, ♀ (65: dorsal view). Figs. 66—69. *Raphiocerina hakiensis*, ♀. Figs. 70—73. *Abrosiomyia bella*, ♀.



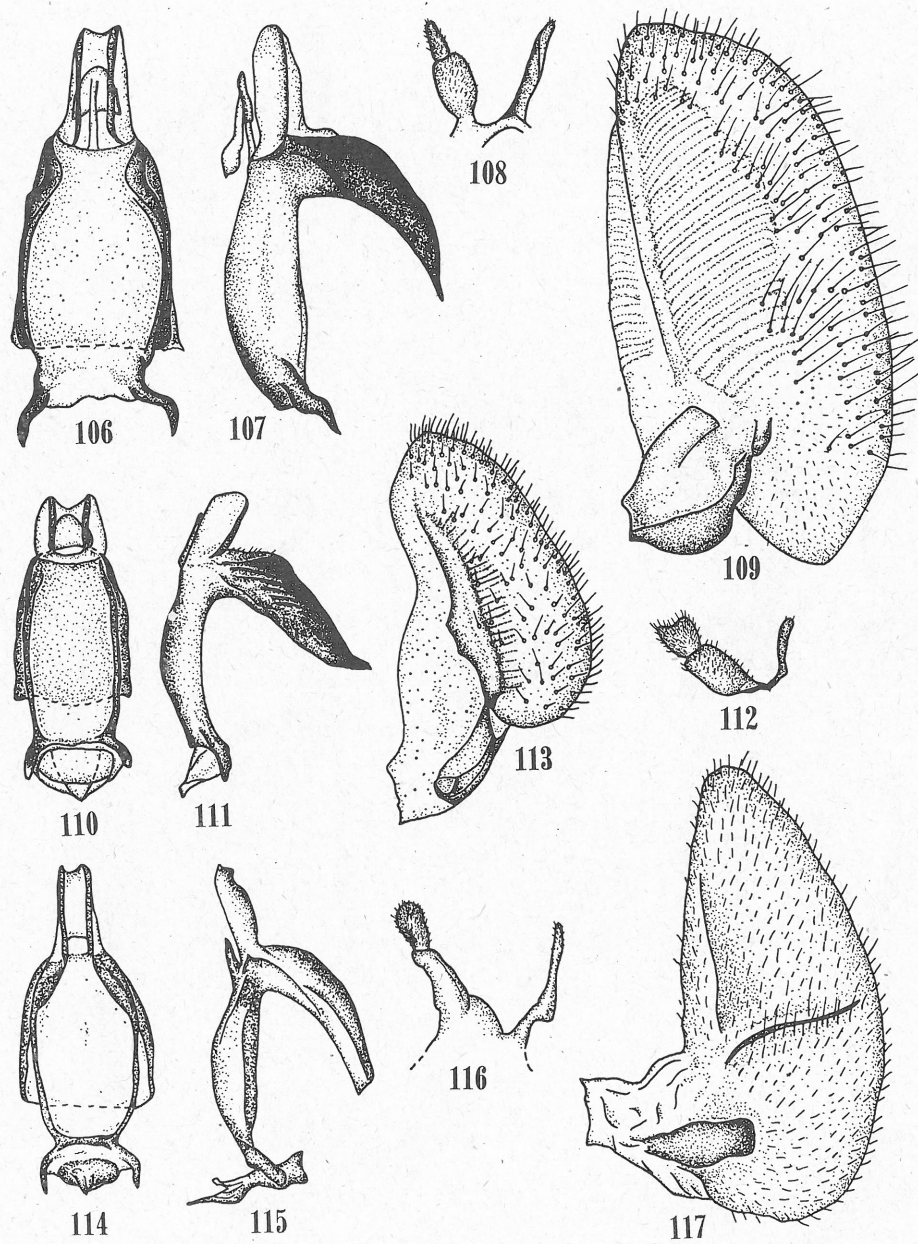
Figs. 74-77. *Craspedometopon frontale*, ♀. Figs. 78-81. *Evaza japonica*, ♀. Figs. 82-85. *Kolomania nipponensis*, ♀.



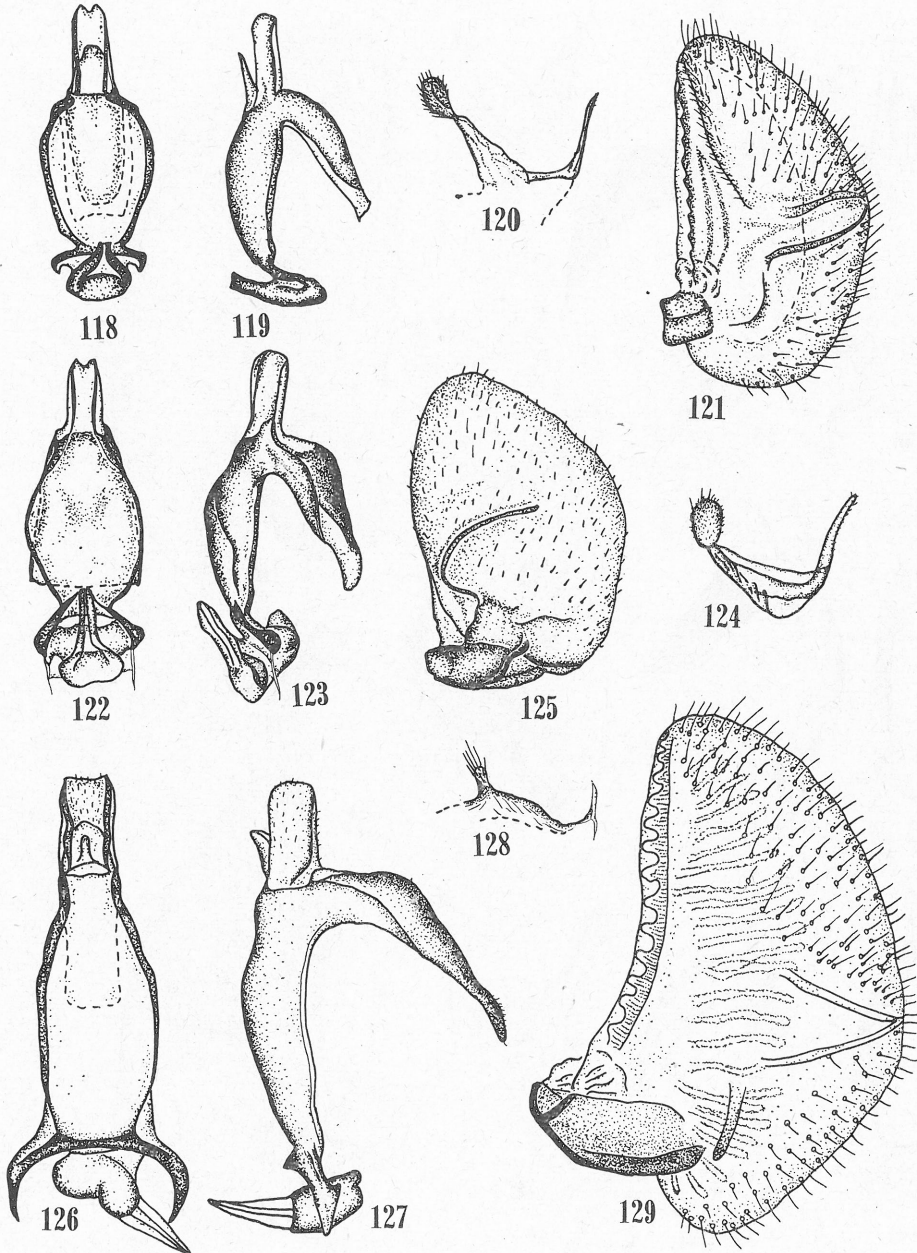
Figs. 86—89. *Wallacea tsudai*, ♀. Figs. 90—93. *Clitellaria obtusa*, ♂. Figs. 94—97. *Nigritomyia* sp., ♀.



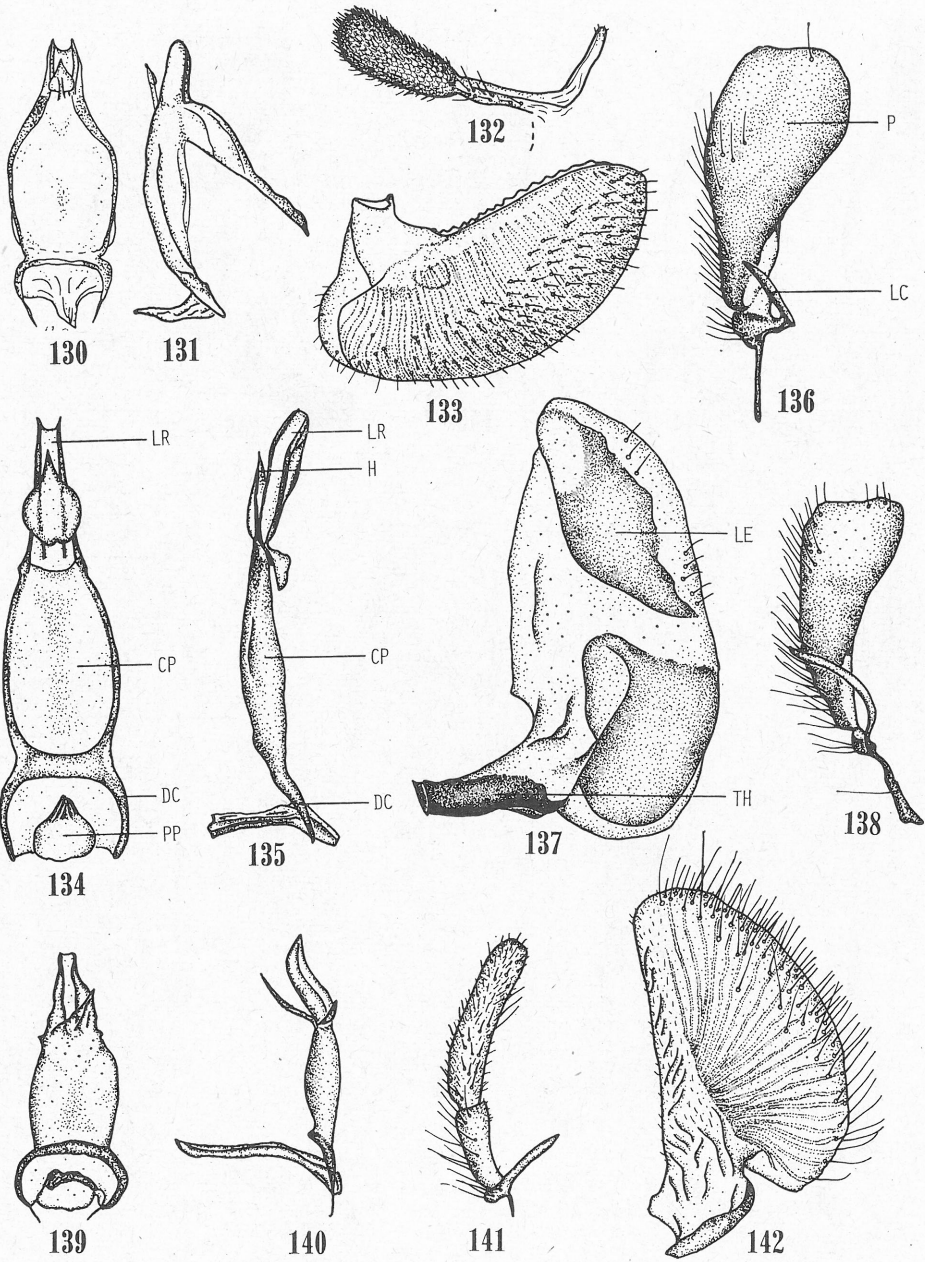
Figs. 98–101. *Hermetia illucens*, ♀. Figs. 102–105. *Cephalochrysa stenogaster*, ♂.



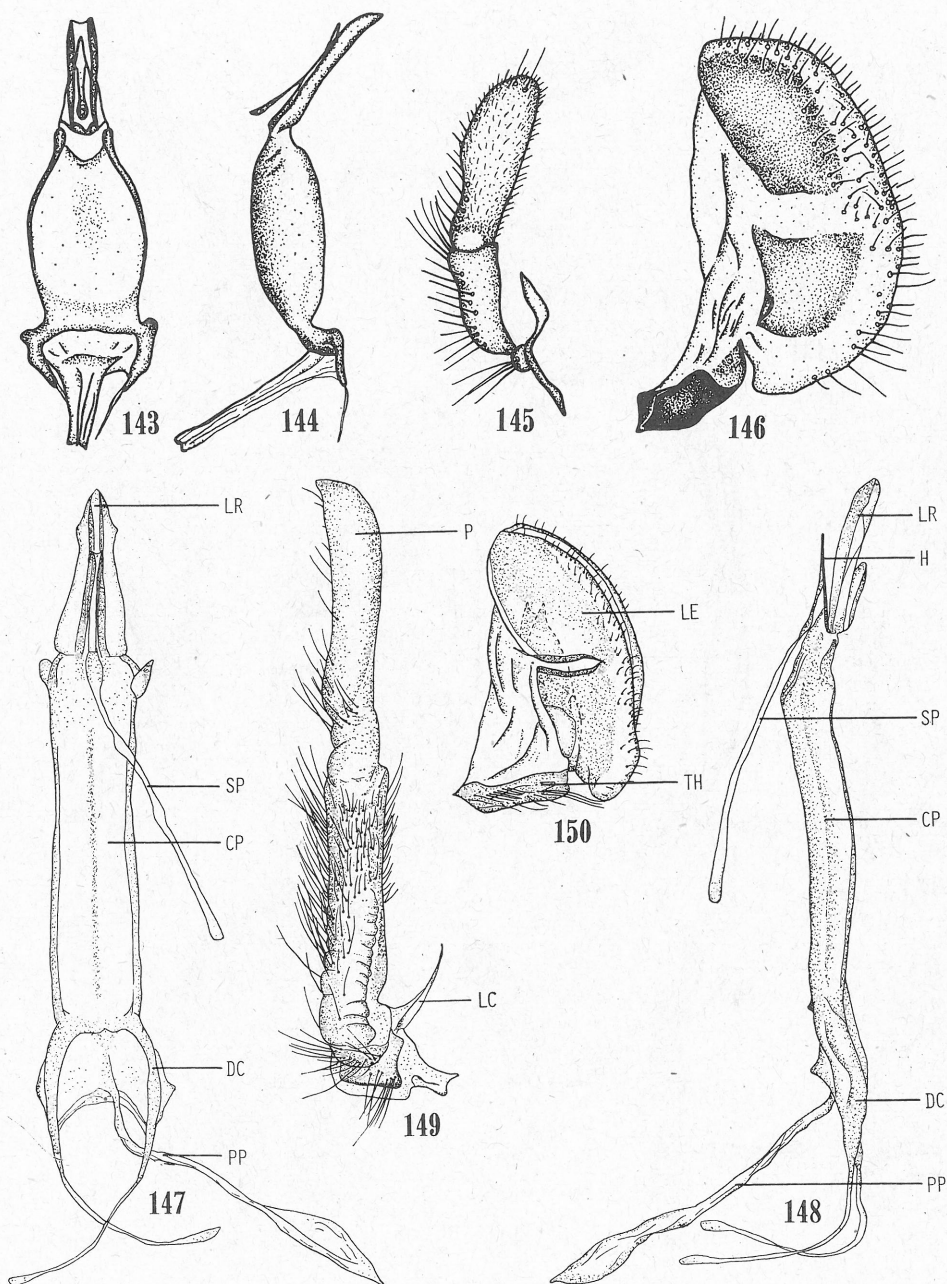
Figs. 106–109. *Chrysochloma nipponensis*, ♂. Figs. 110–113. *Microchrysa flaviventris*, ♀. Figs. 114–117. *Plecticus aurifer*, ♀.



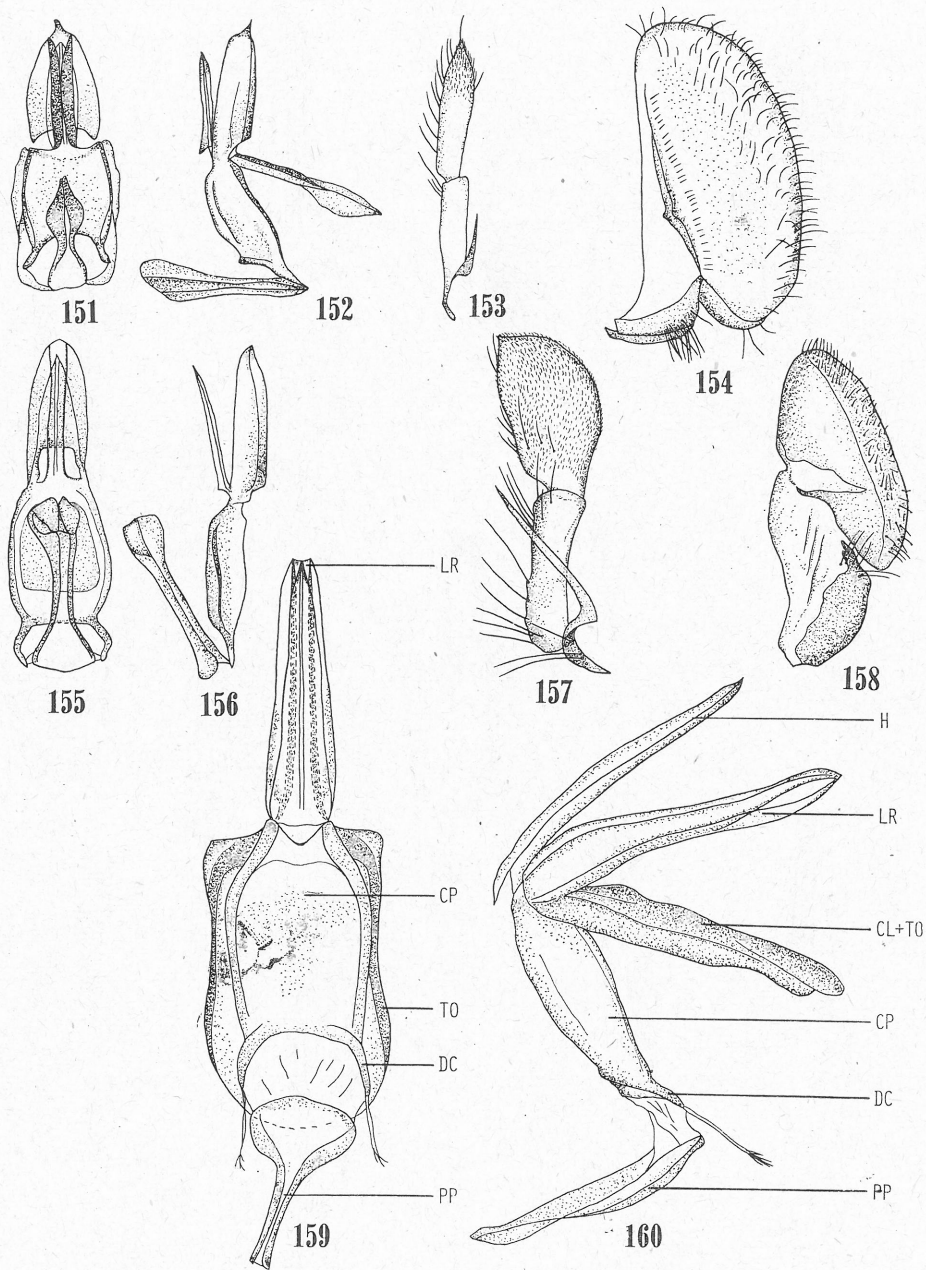
Figs. 118–121. *Plecticus matsumurae*, ♀. Figs. 122–125. *Plecticus tenebrifer*, ♀. Figs. 126–129. *Sargus metallinus*, ♀.



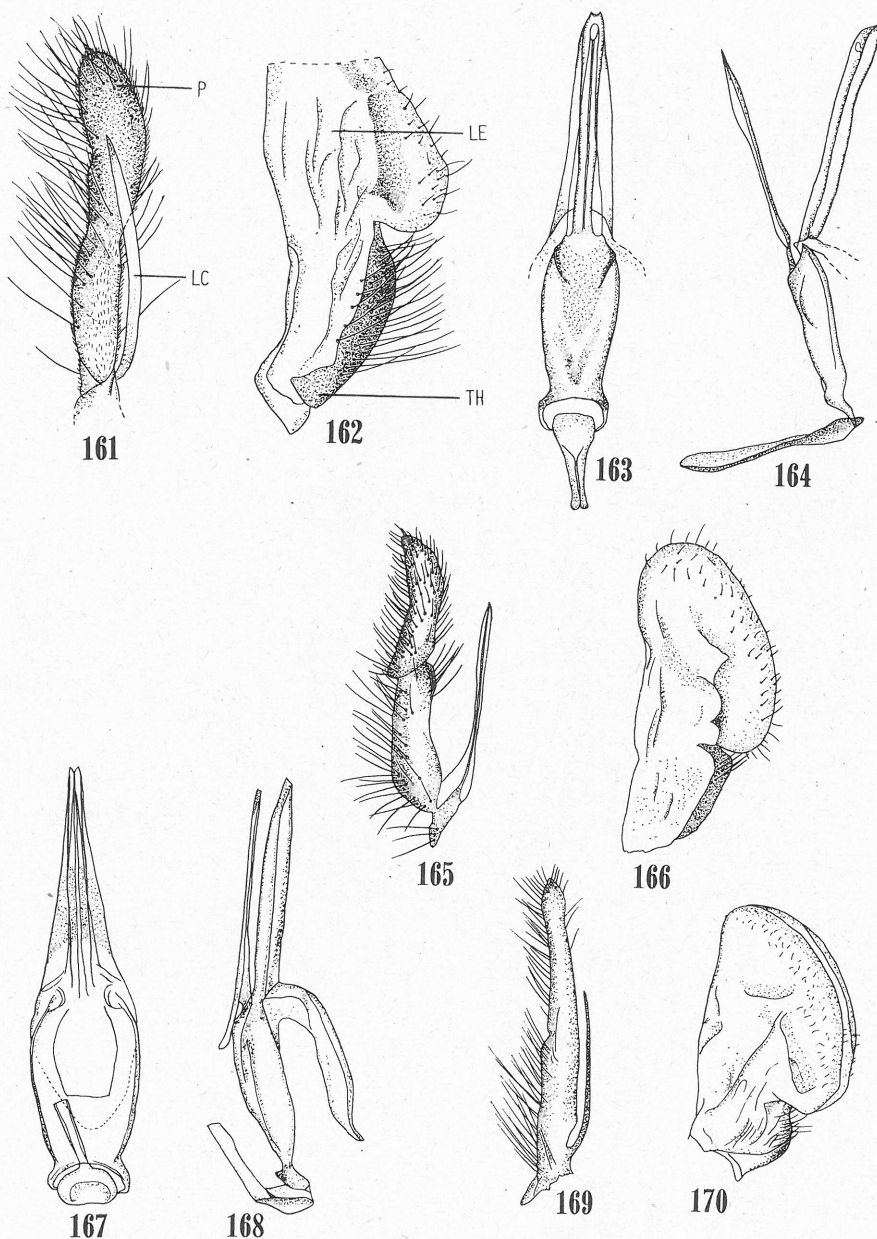
Figs. 130–133. *Chrysochlorina currani*, ♀. Figs. 134–138. *Solva (Macroceromys) moiwana* (134–137: ♀; 138: ♂). Figs. 139–142. *Solva (Solva) japonica*, ♀.



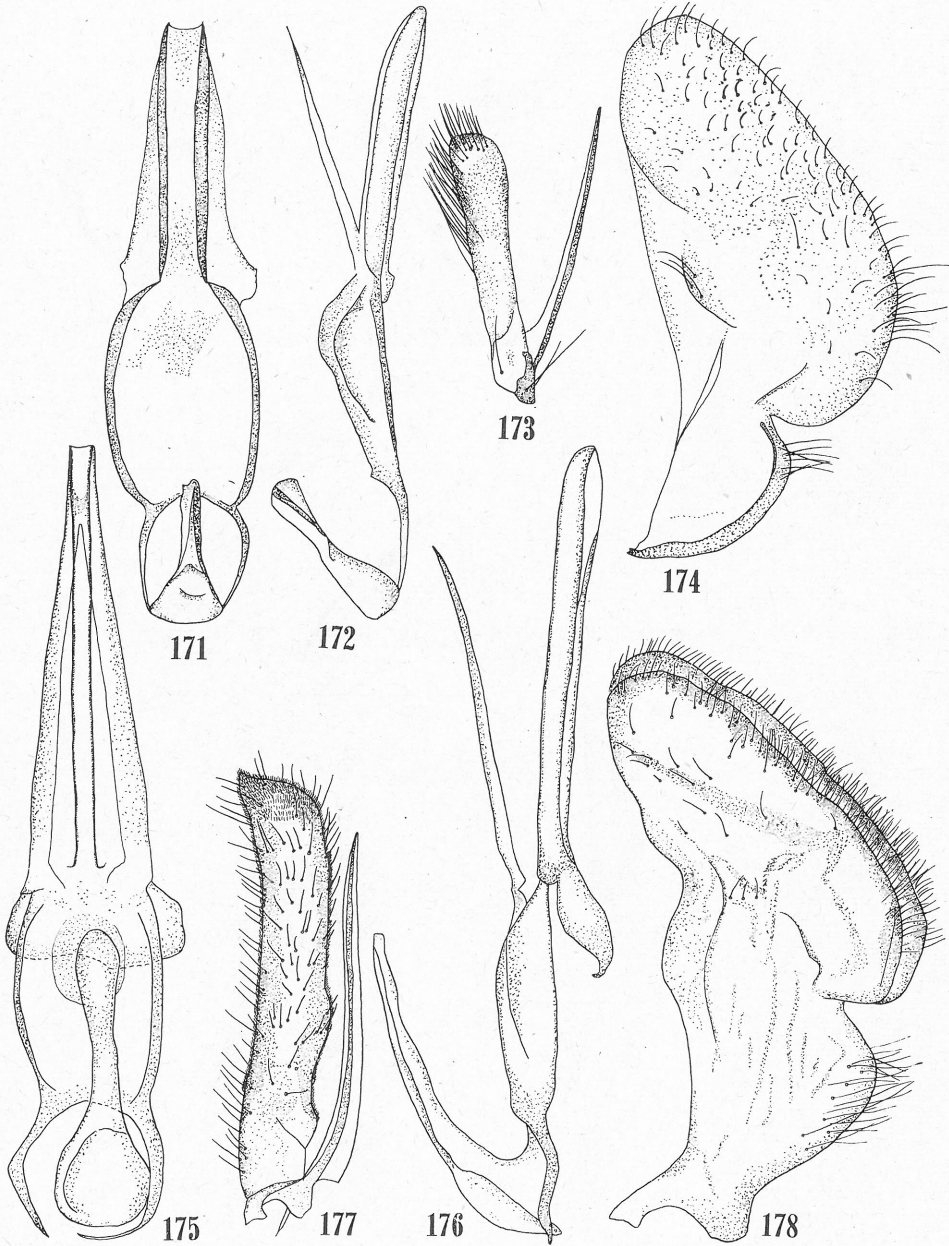
Figs. 143–146. *Solva (Solva) procera*, ♀. Figs. 147–150. *Pantophthalmus bellardii*, ♀.



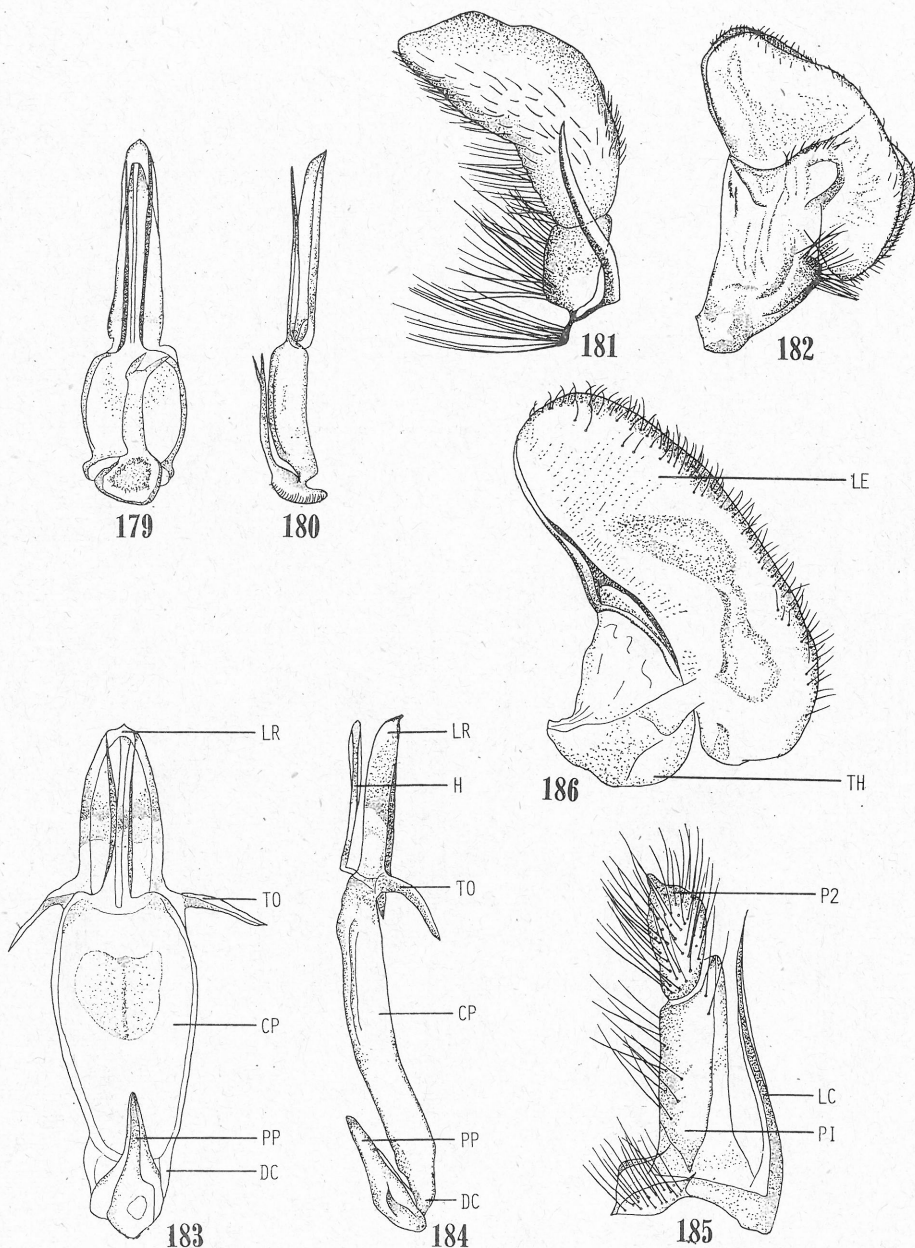
Figs. 151–154. *Rachicerus* sp., ♀. Figs. 155–158. *Xylophagus matsumurai*, ♀. Figs. 159–160. *Anacanthaspis bifasciata japonica*, ♂.



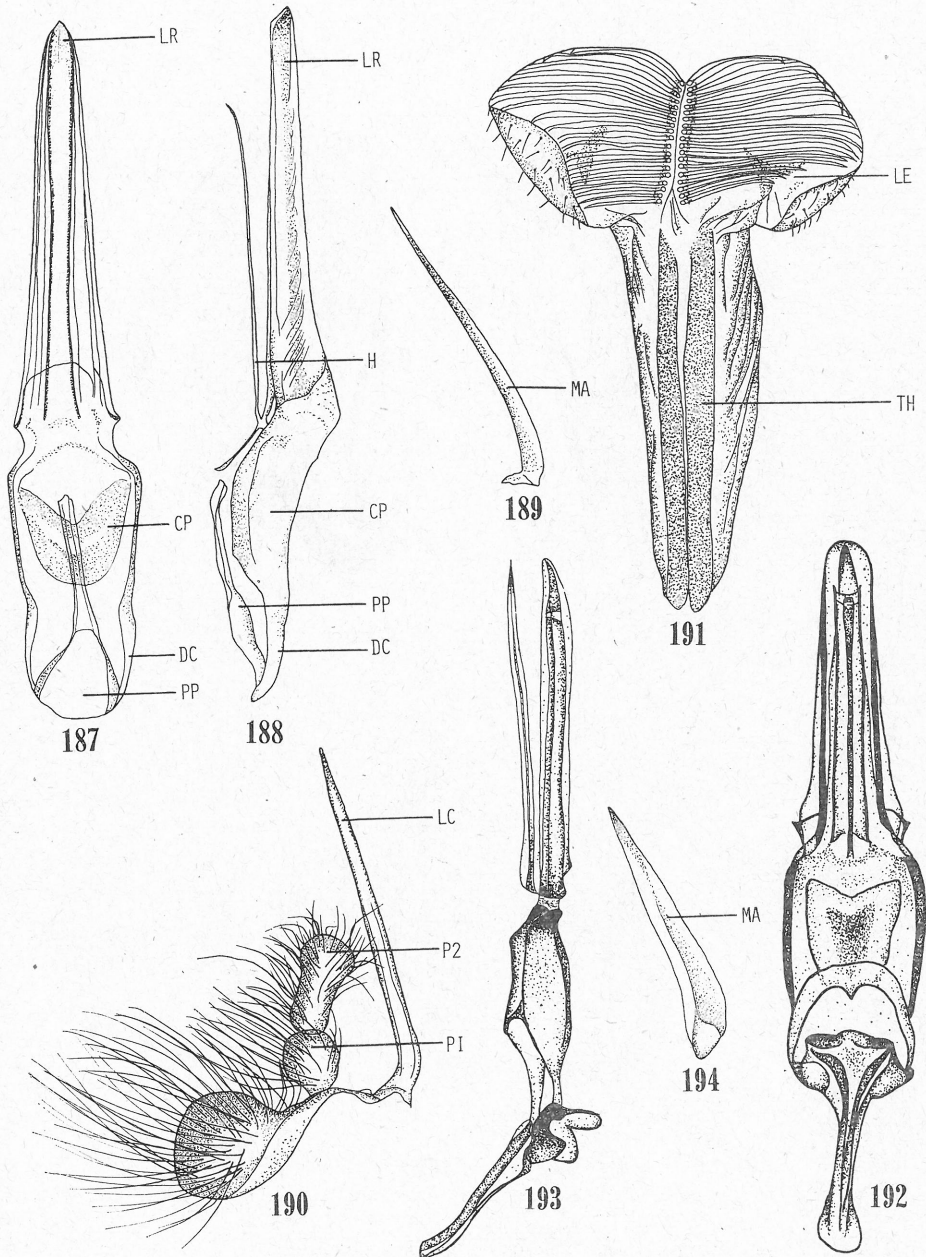
Figs. 161–162. *Anacanthaspis bifasciata japonica*, ♂. Figs. 163–166. *Arthropeas sibiricum*, ♀. Figs. 167–170. *Coenomyia basalis*, ♀.



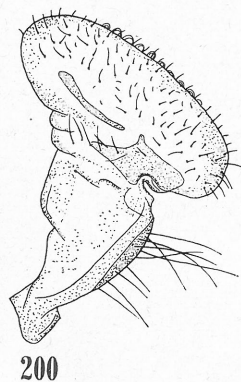
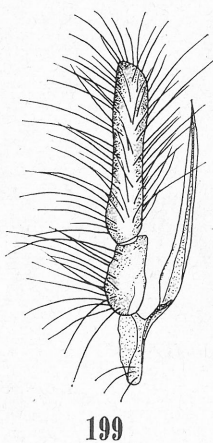
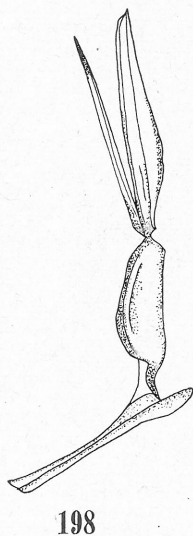
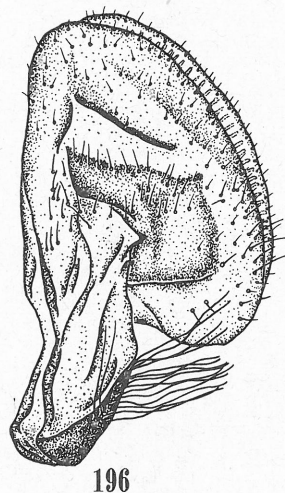
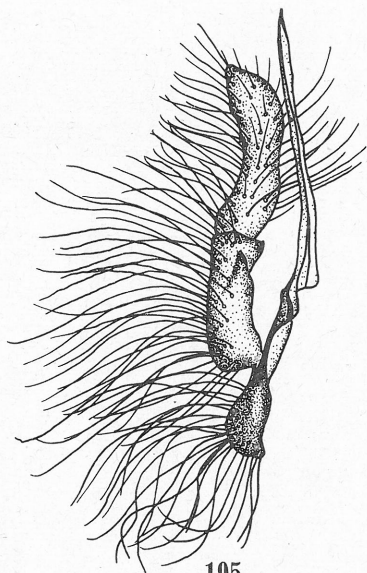
Figs. 171–174. *Dialysis iwatai*, ♀. Figs. 175–178. *Odontosabula gloriosa*, ♀.



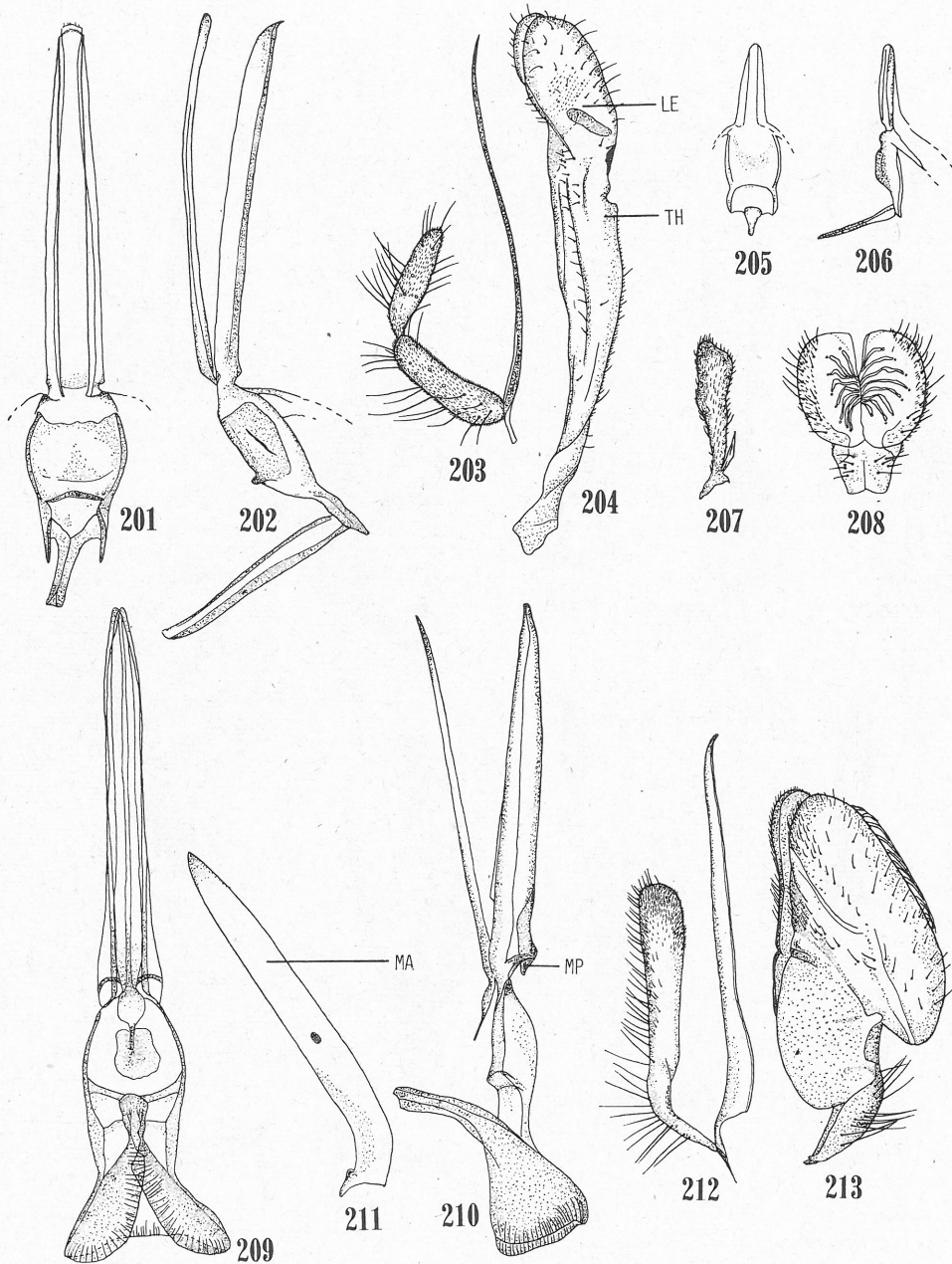
Figs. 179–182. *Heterostomus curvipalpis*, ♀. Figs. 183–186. *Exeretoneura angustifrons*, ♀ (185: larger in magnification than in 183, 184 & 186).



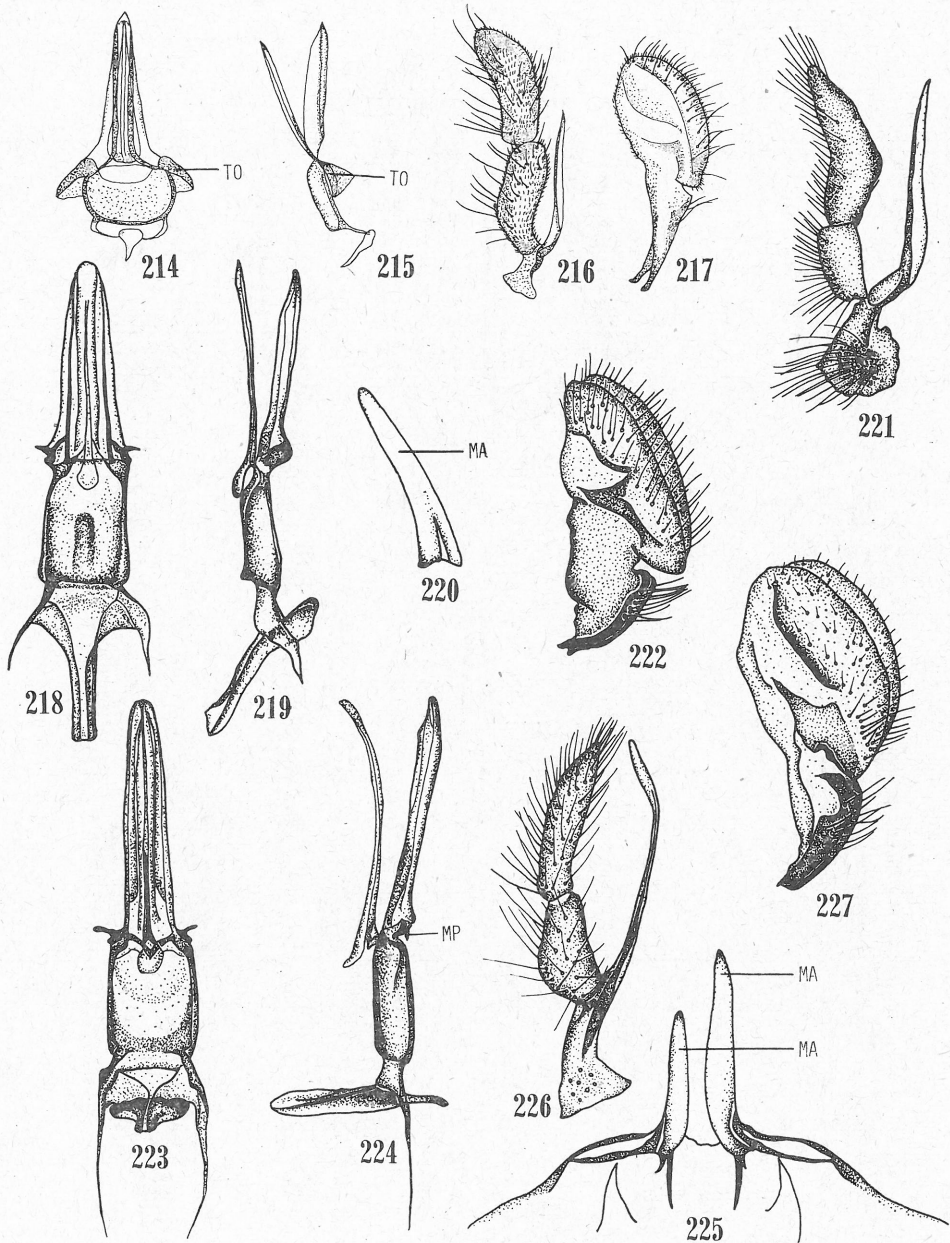
Figs. 187–191. *Pelecorhynchus nigripennis*, ♀ (191: ventral view). Figs. 192–194. *Pseudoerinna jonesi*, ♀.



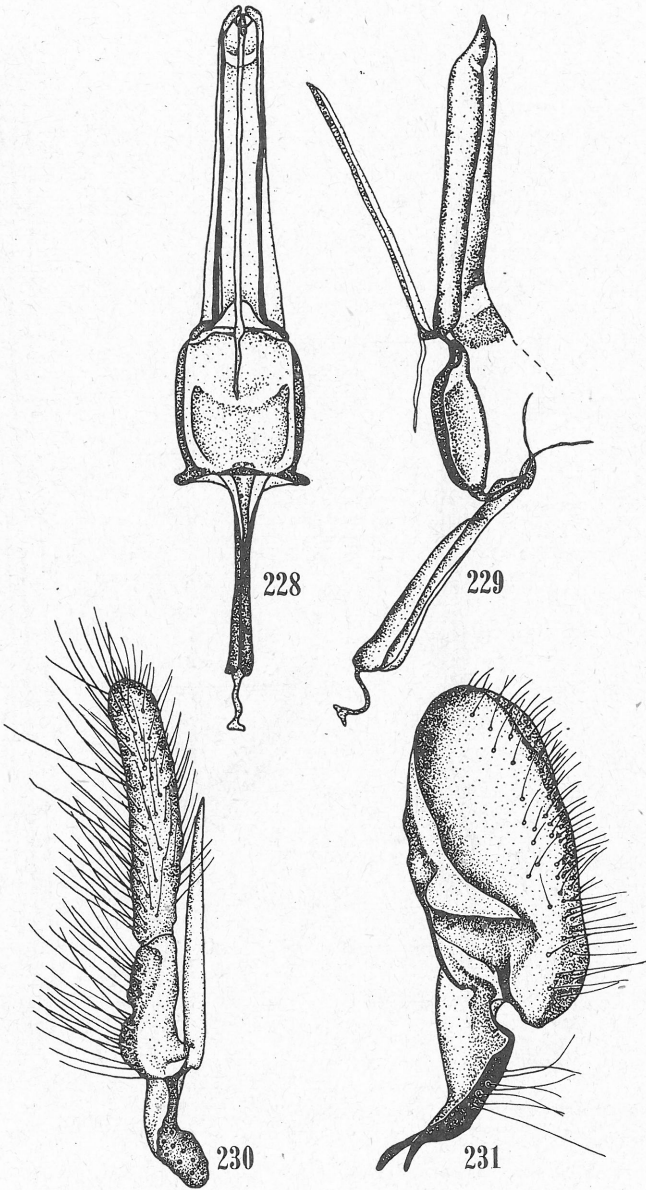
Figs. 195–196. *Pseudoerinna jonesi*, ♀. Figs. 197–200. *Glutops itoi*, ♀.



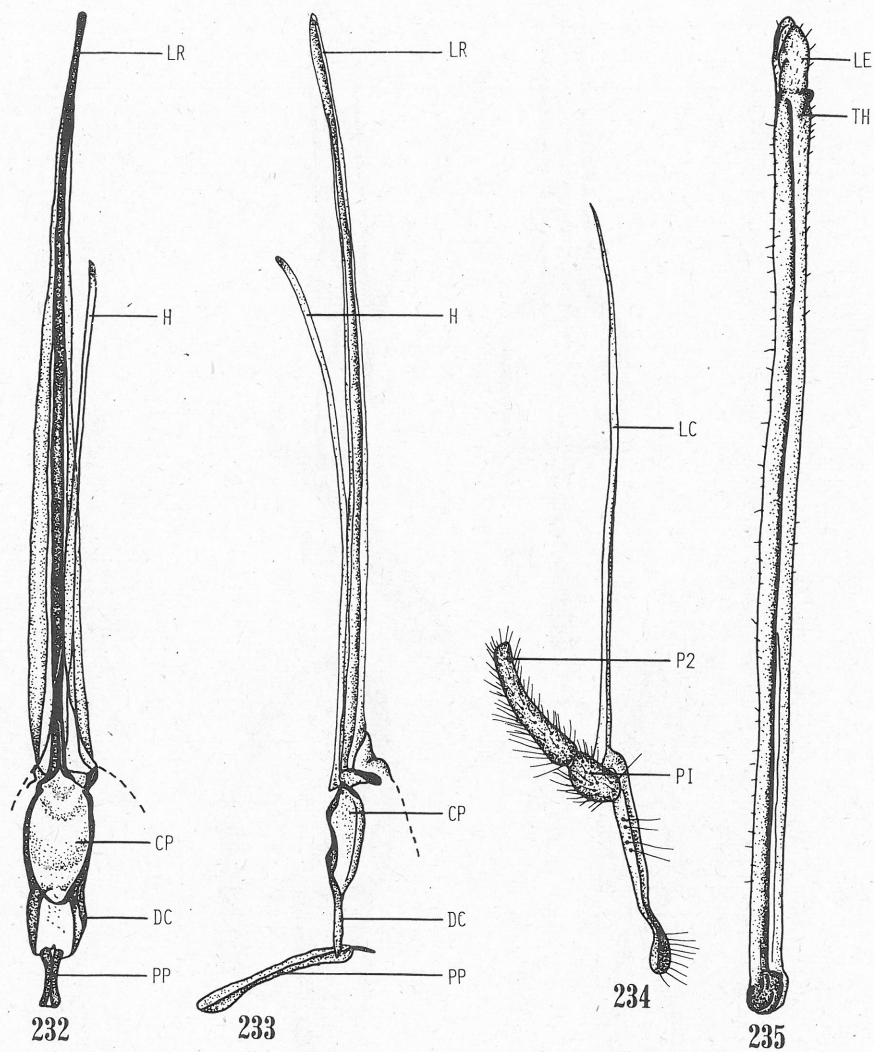
Figs. 201–204. *Austroleptis collessi*, ♀. Figs. 205–208. *Spania kyushuensis*, ♀ (208: ventral view). Figs. 209 to 213. *Spaniopsis* sp., ♀.

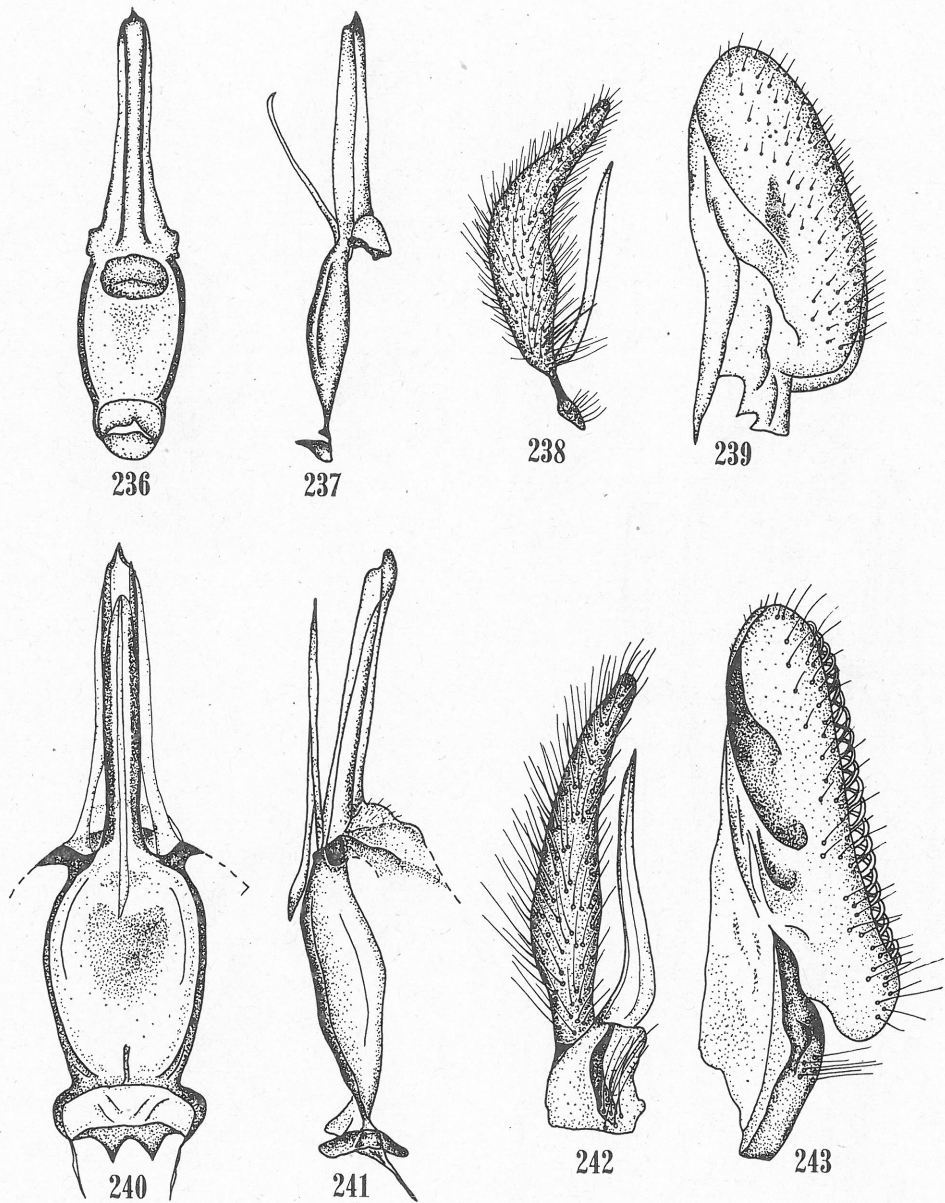


Figs. 214–217. *Bolbomyia* sp., ♀. Figs. 218–222. "*Symphoromyia crassicornis*", ♀ of Japan. Figs. 223–227. *Symphoromyia melaena*, ♀.

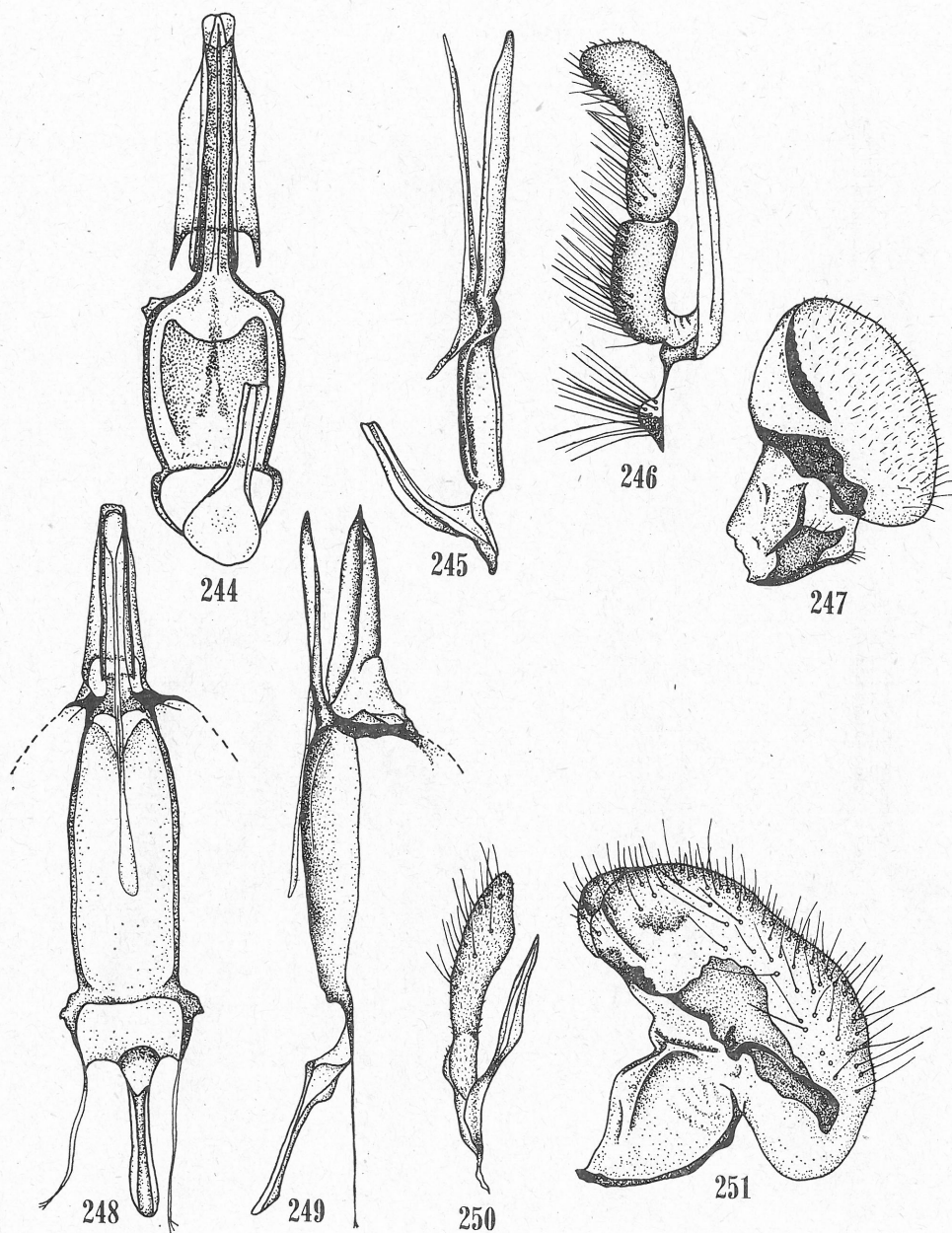


Figs. 228–231. *Atherimorpha* sp., ♀.

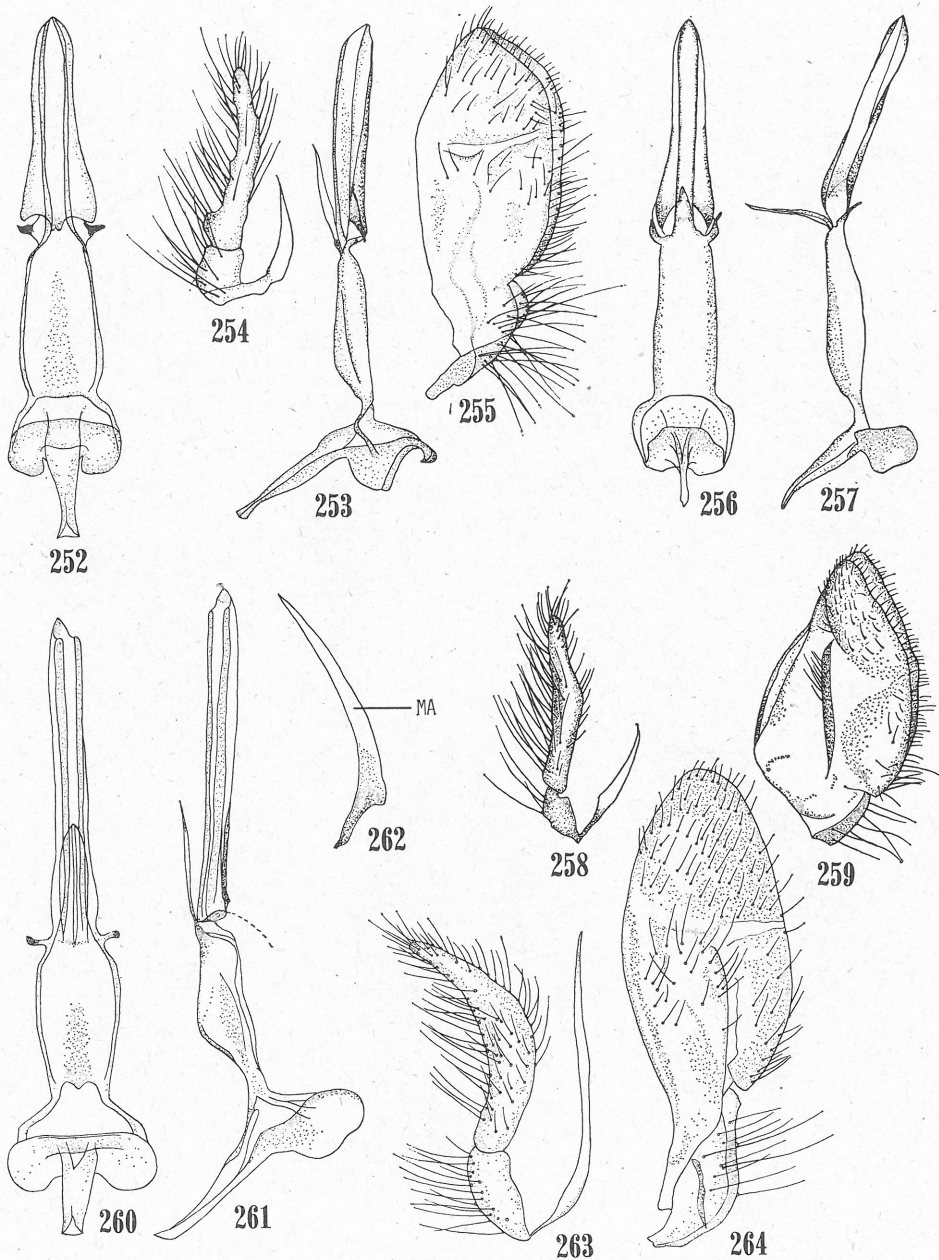
Figs. 232–235. *Arthroteles cinerea*, ♀.



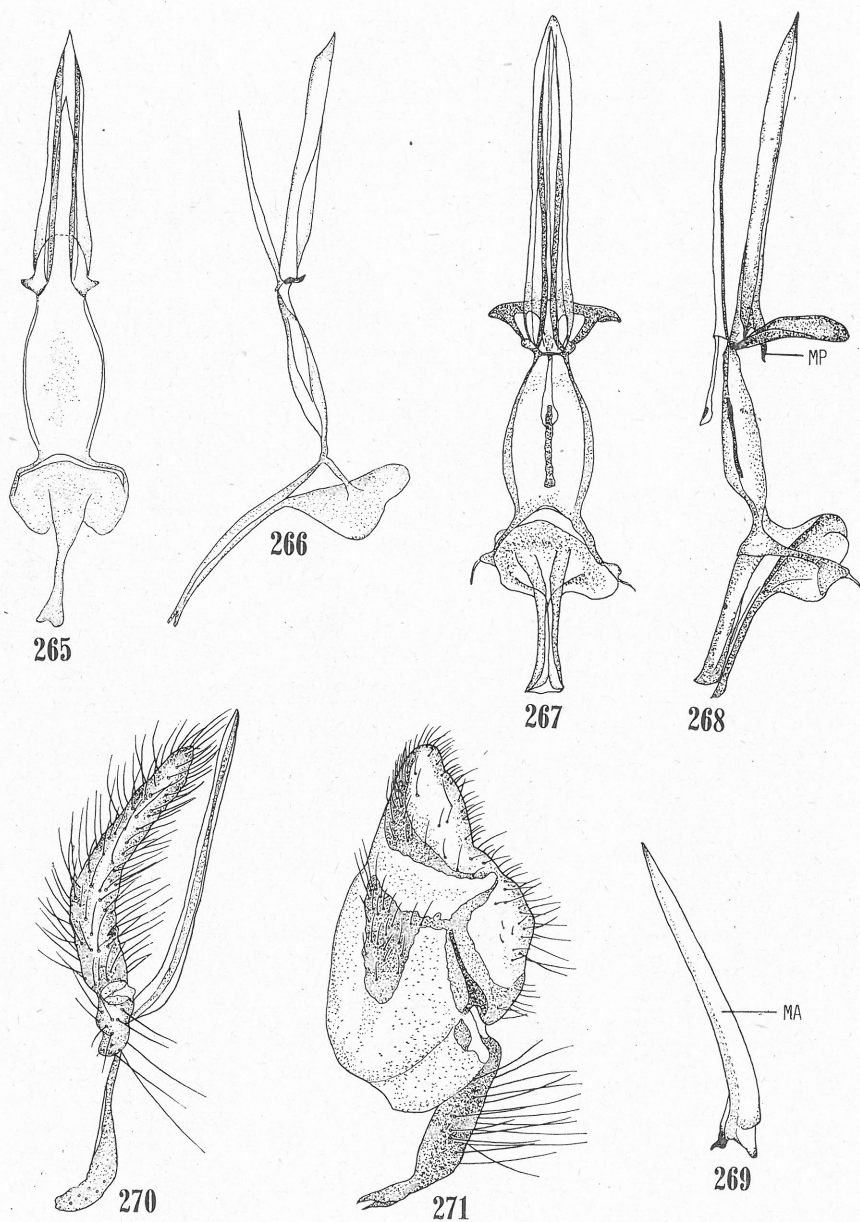
Figs. 236–243. *Rhagio yasumatsui* (236–239: ♀; 240–243: ♂; magnification is larger in ♂ than in ♀).



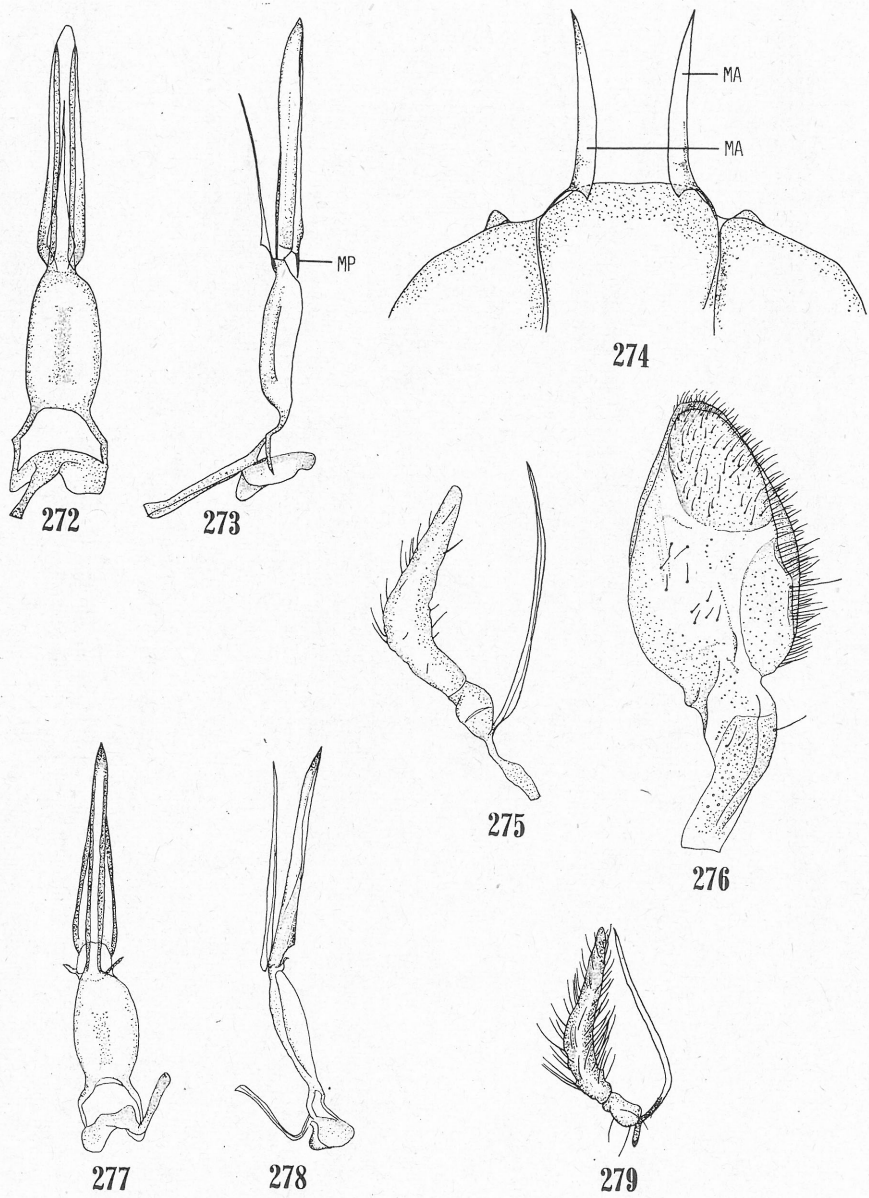
Figs. 244–247. *Arthroceras japonicum*, ♀. Figs. 248–251. *Chrysopilus tanakai*, ♀.



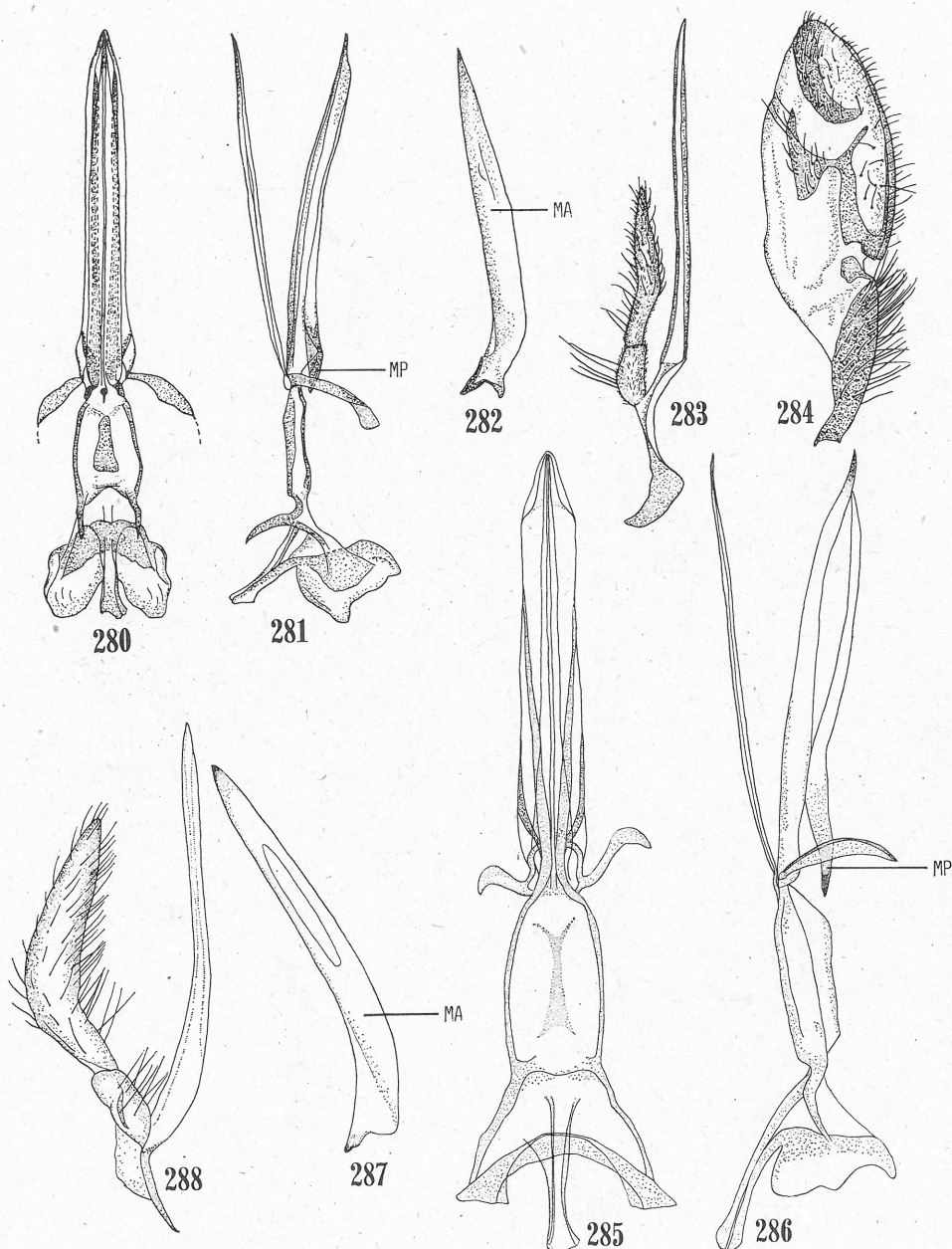
Figs. 252–259. *Atherix basilica* (252–255: ♀; 256–259: ♂). Figs. 260–264. *Atherix ibis*, ♀.



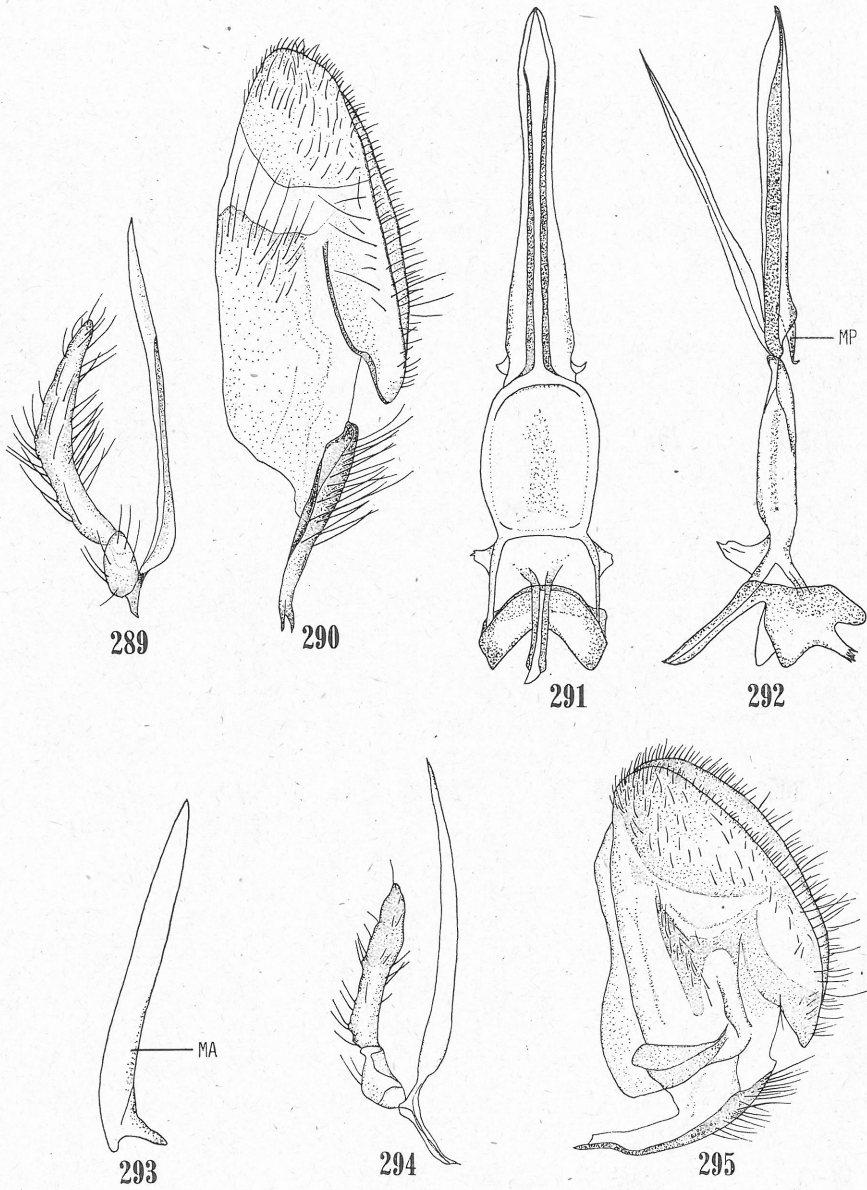
Figs. 265–266. *Atherix ibis*, ♂. Figs. 267–271. *Ibisia marginata*, ♀.



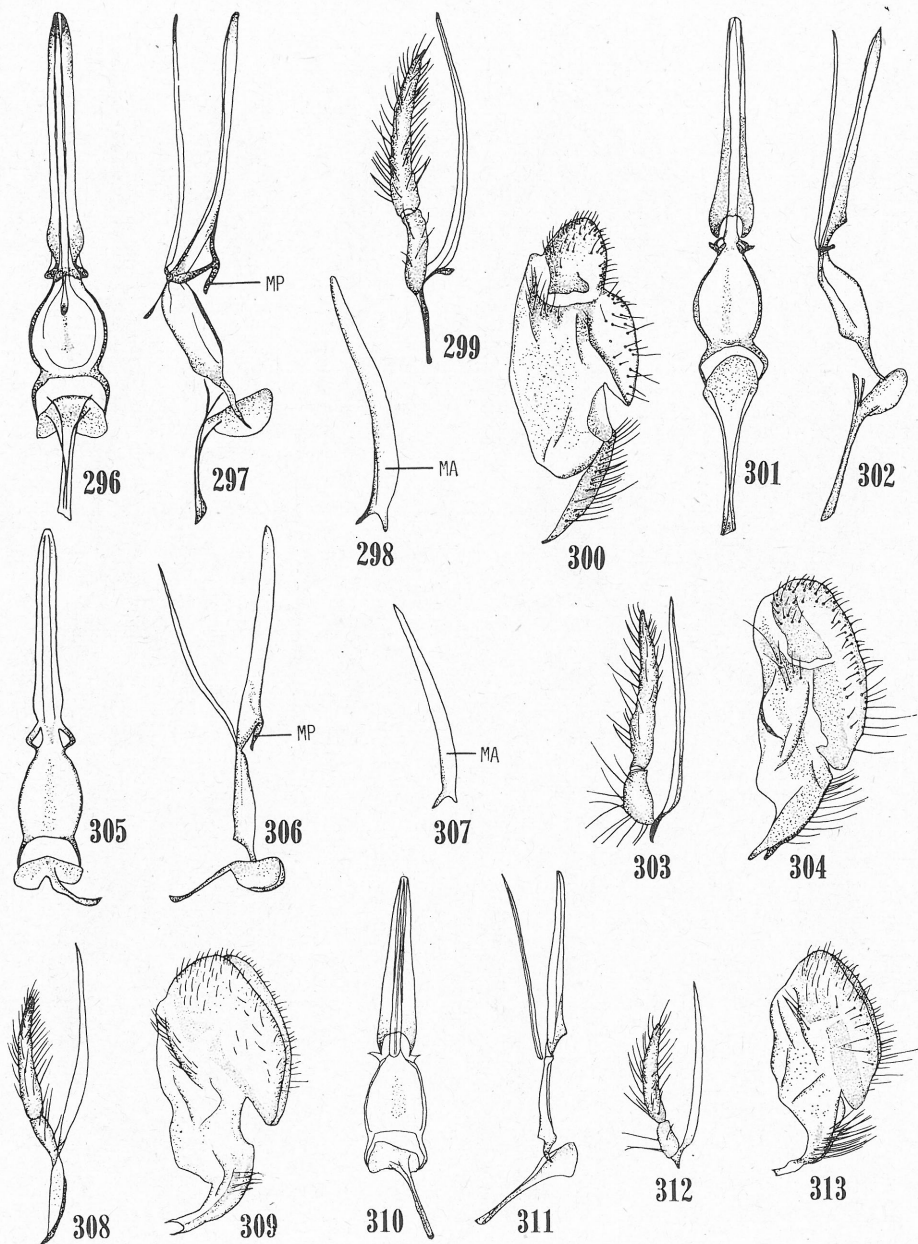
Figs. 272–279. *Suragina caerulea* (272–276: ♀; 277–279: ♂).



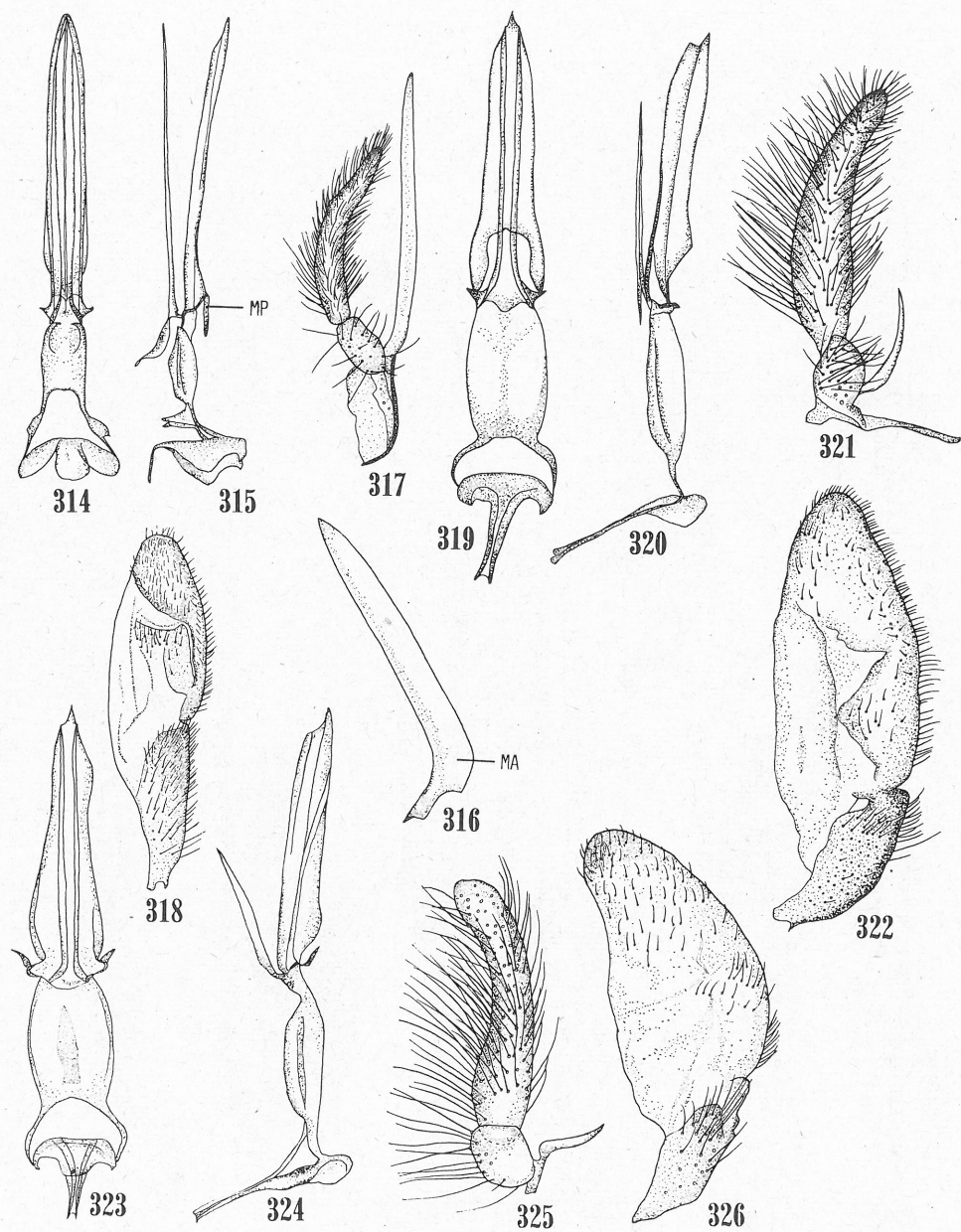
Figs. 280–284. *Suragina longipes*, ♀. Figs. 285–288. *Suragina satsumana*, ♀.



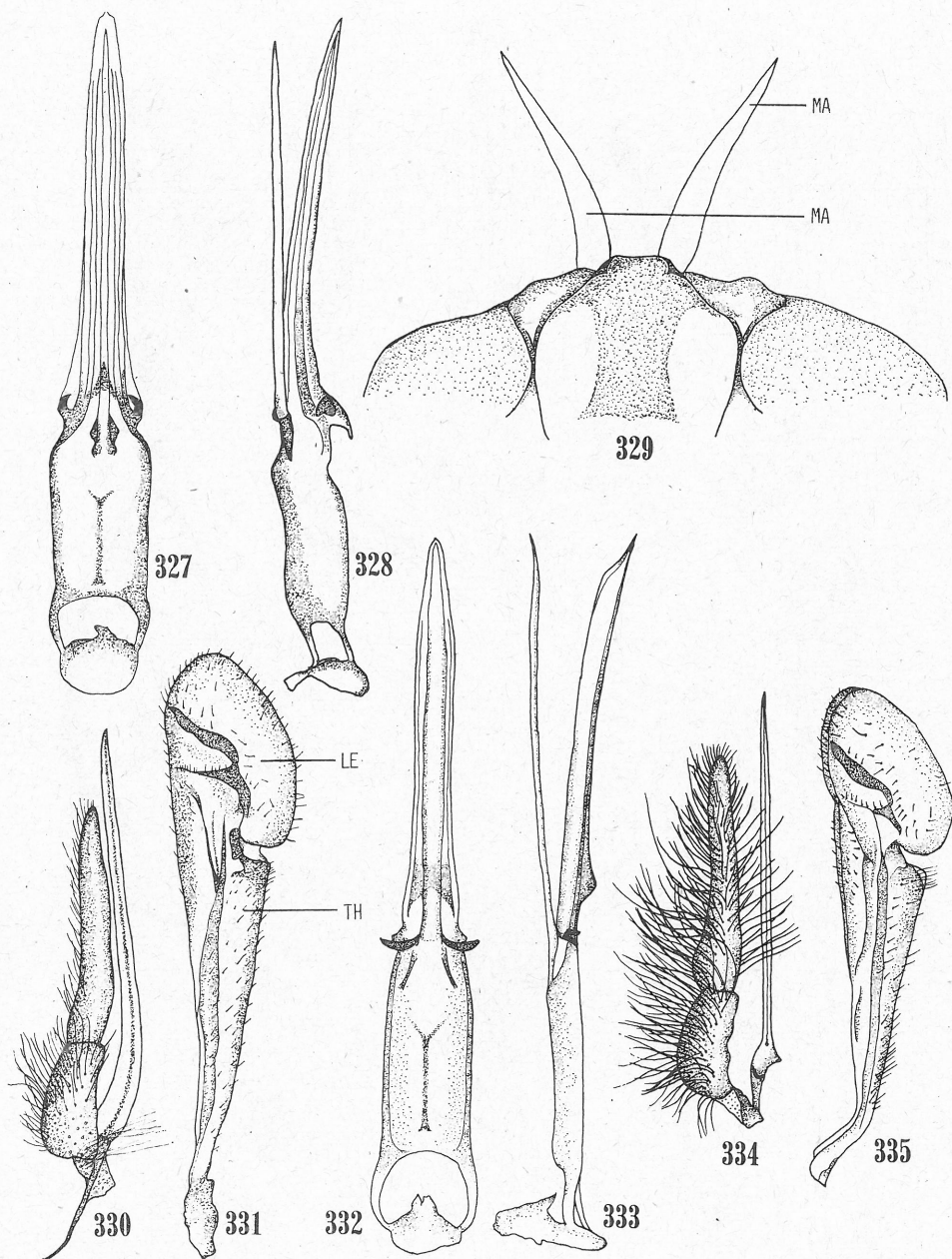
Figs. 289–290. *Suragina satsumana*, ♂. Figs. 291–295. *Suragina yaeyamana*, ♀.



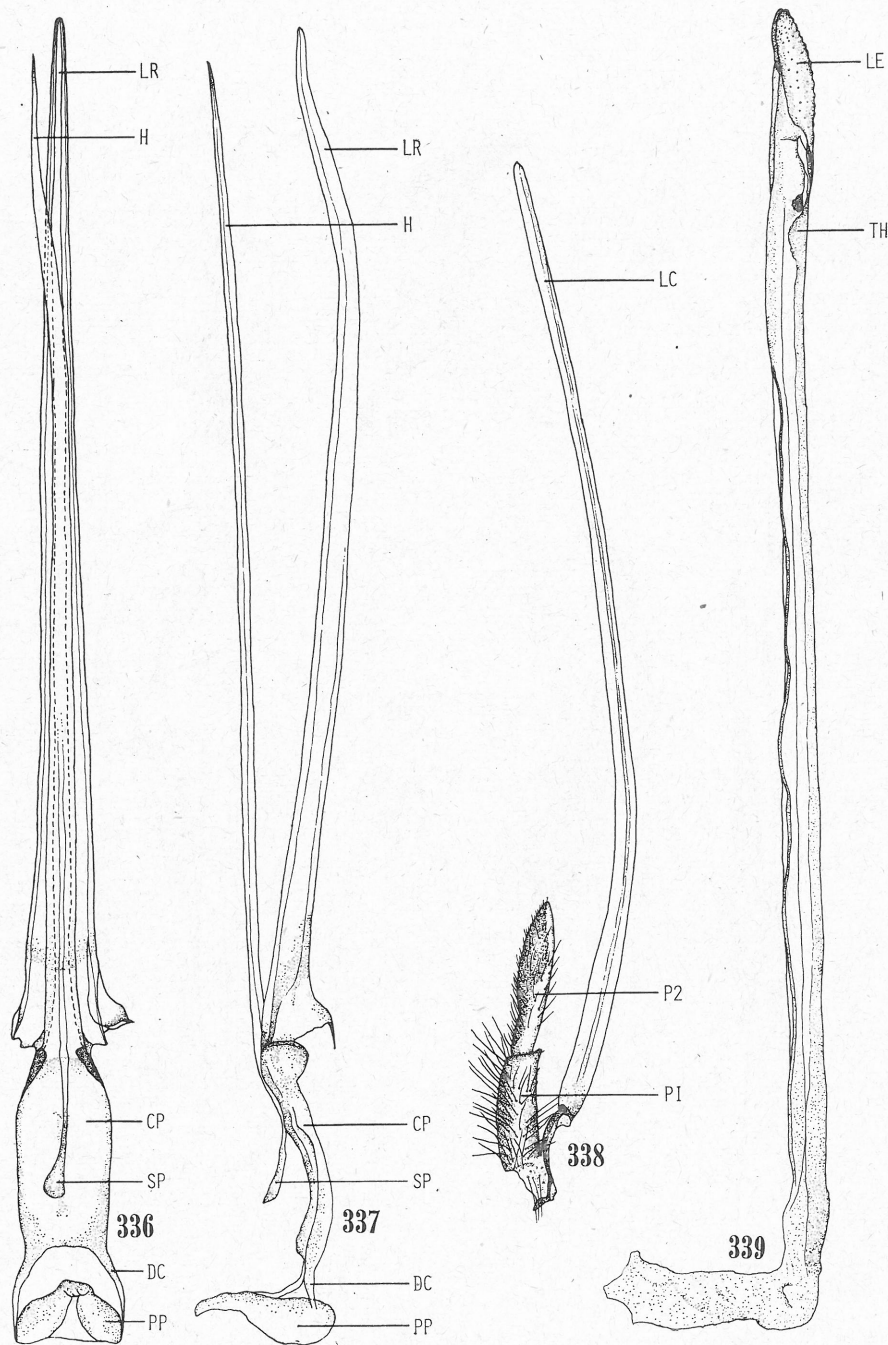
Figs. 296–304. *Atrichops fontinalis* (296–300: ♀; 301–304: ♂). Figs. 305–313. *Atrichops morimotoi* (305–309: ♀; 310–313: ♂).



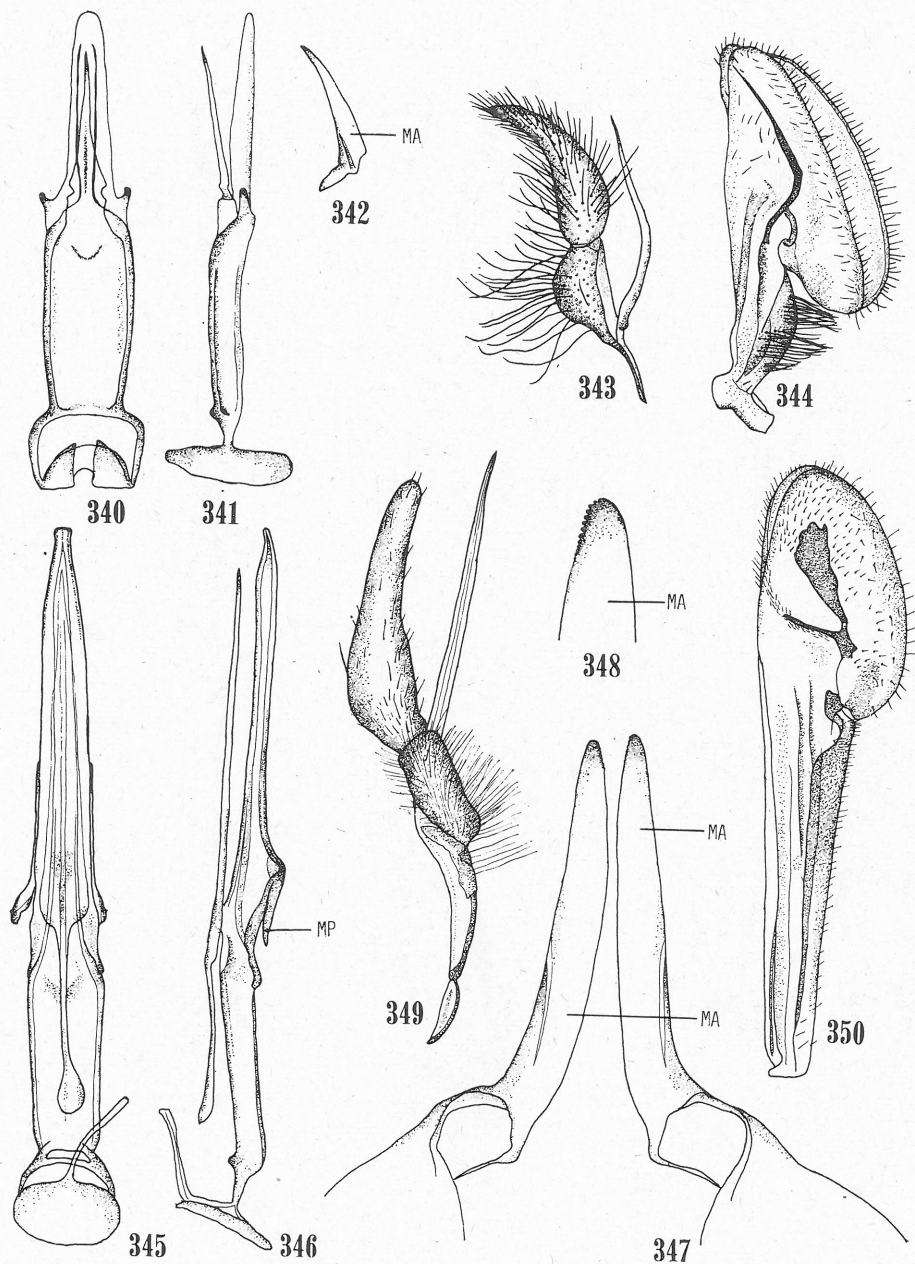
Figs. 314–318. *Dasyomma caeruleum*, ♀. Figs. 319–326. *Dasyomma maculipennis* (319–322: ♀; 323–326: ♂).



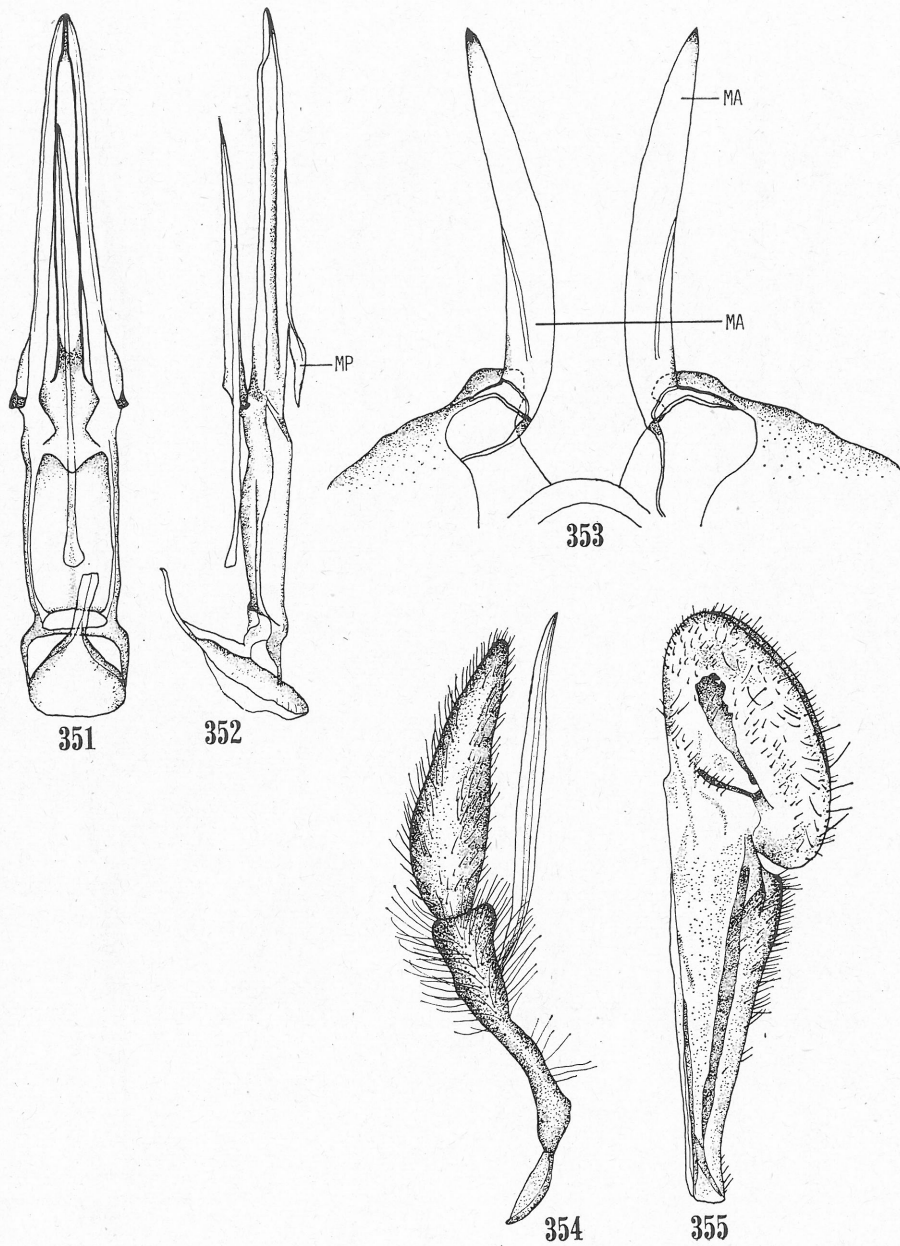
Figs. 327–335. *Stonemyia yezoensis* (327–331: ♀; 332–335: ♂).



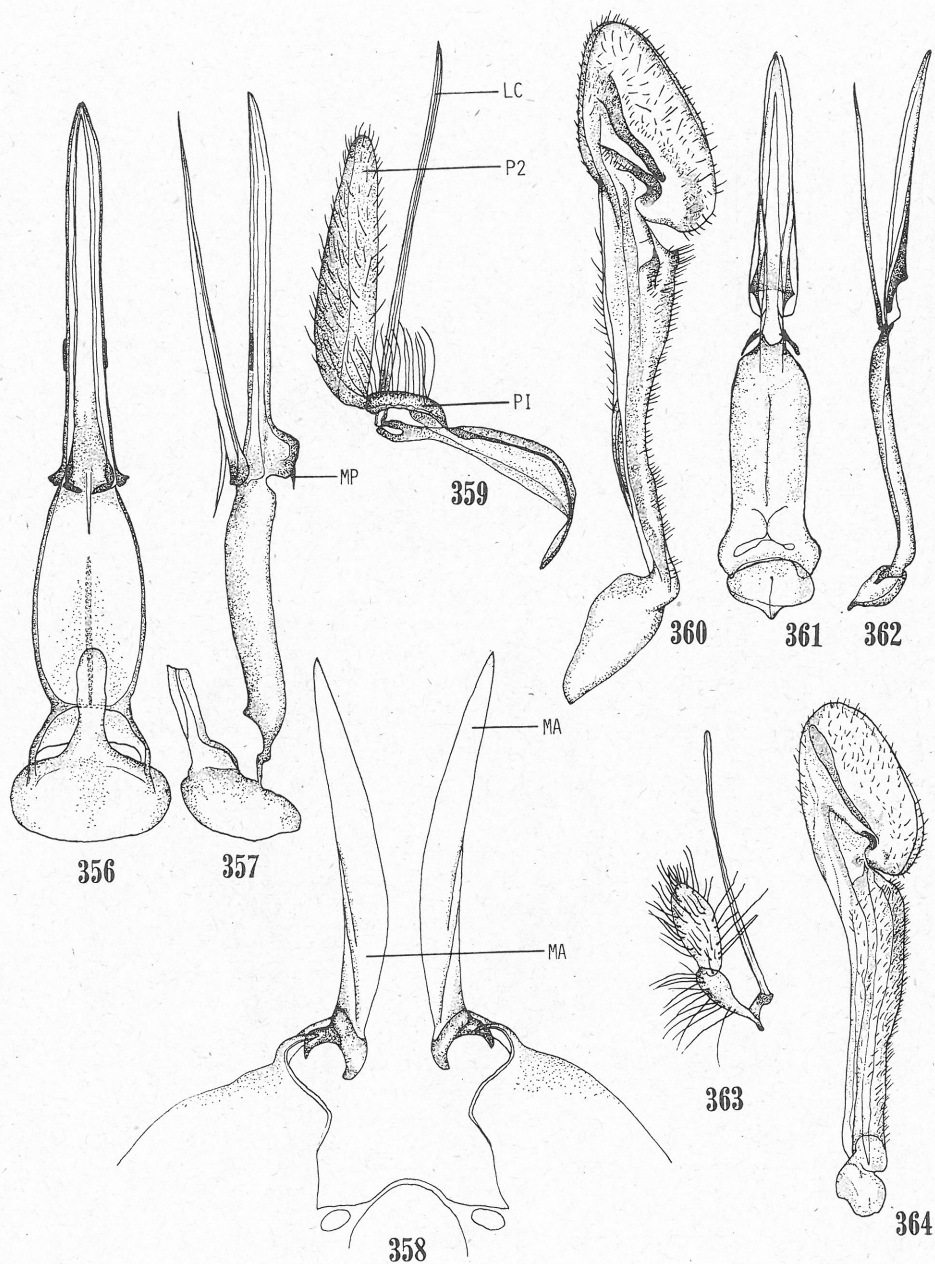
Figs. 336–339. *Pangonius funebris*, ♂.



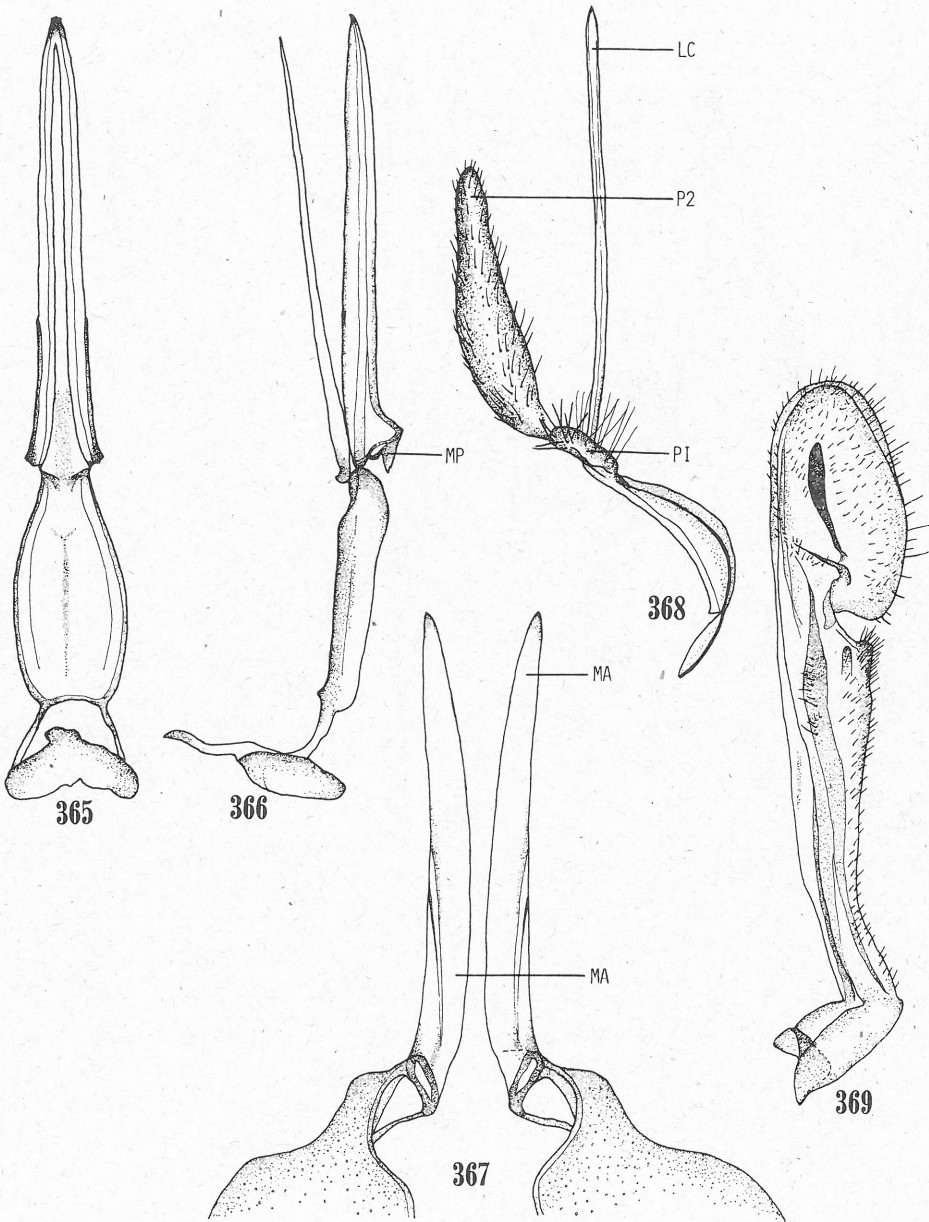
Figs. 340–344. *Nagatomyia melanica*, ♀. Figs. 345–350. *Silvius shirakii*, ♀ (348: enlarged apical portion of mandible).



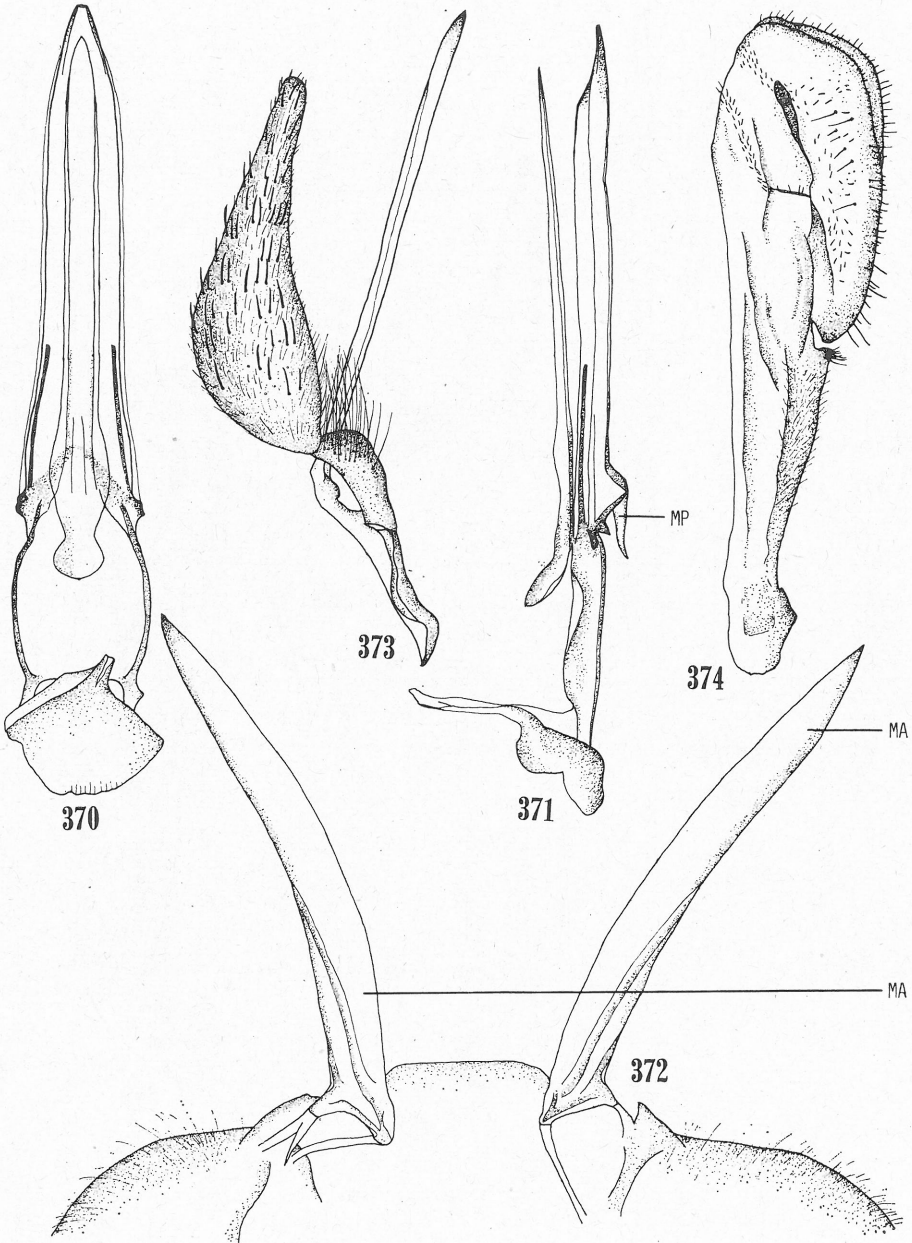
Figs. 351–355. *Silvius oshimaensis*, ♀.



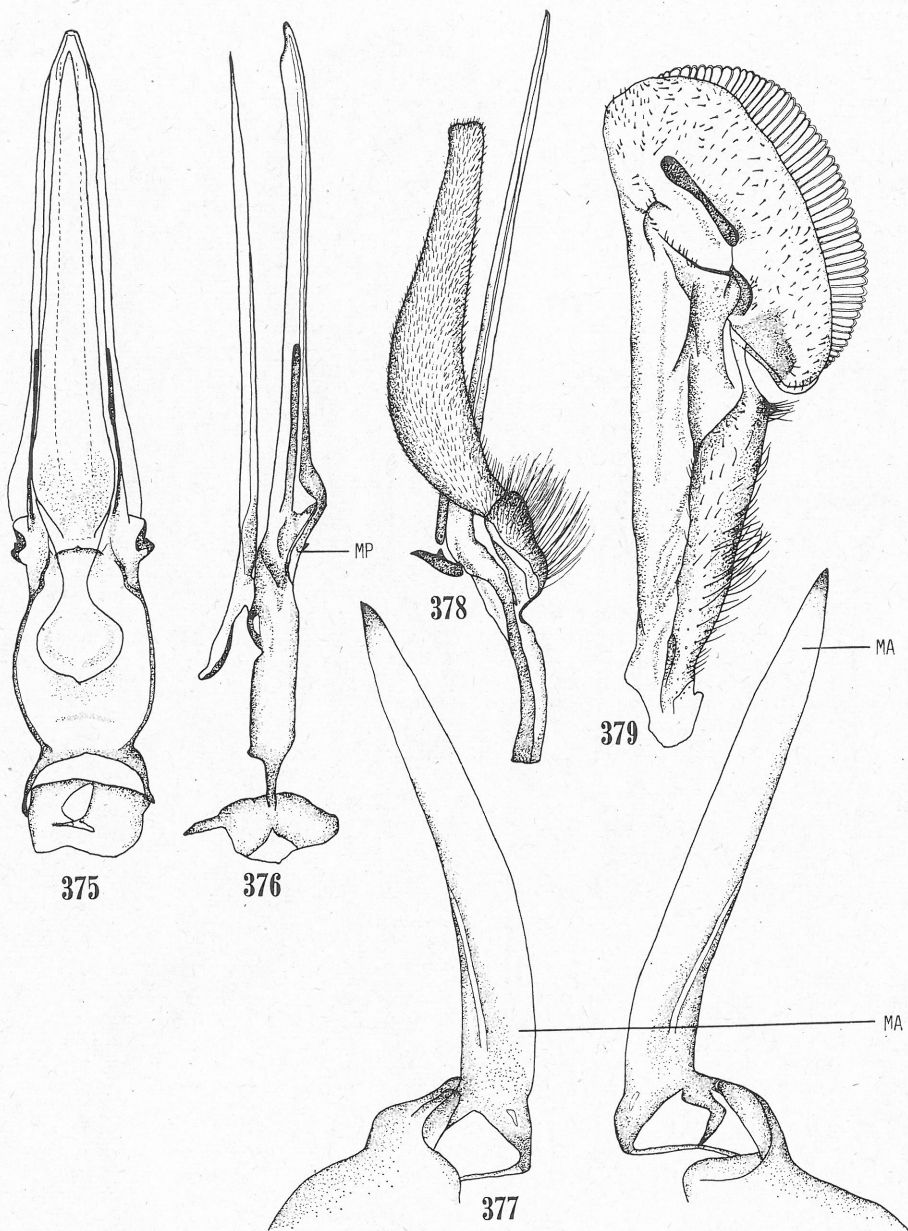
Figs. 356–364. *Chrysops japonicus* (356–360: ♀; 361–364: ♂).



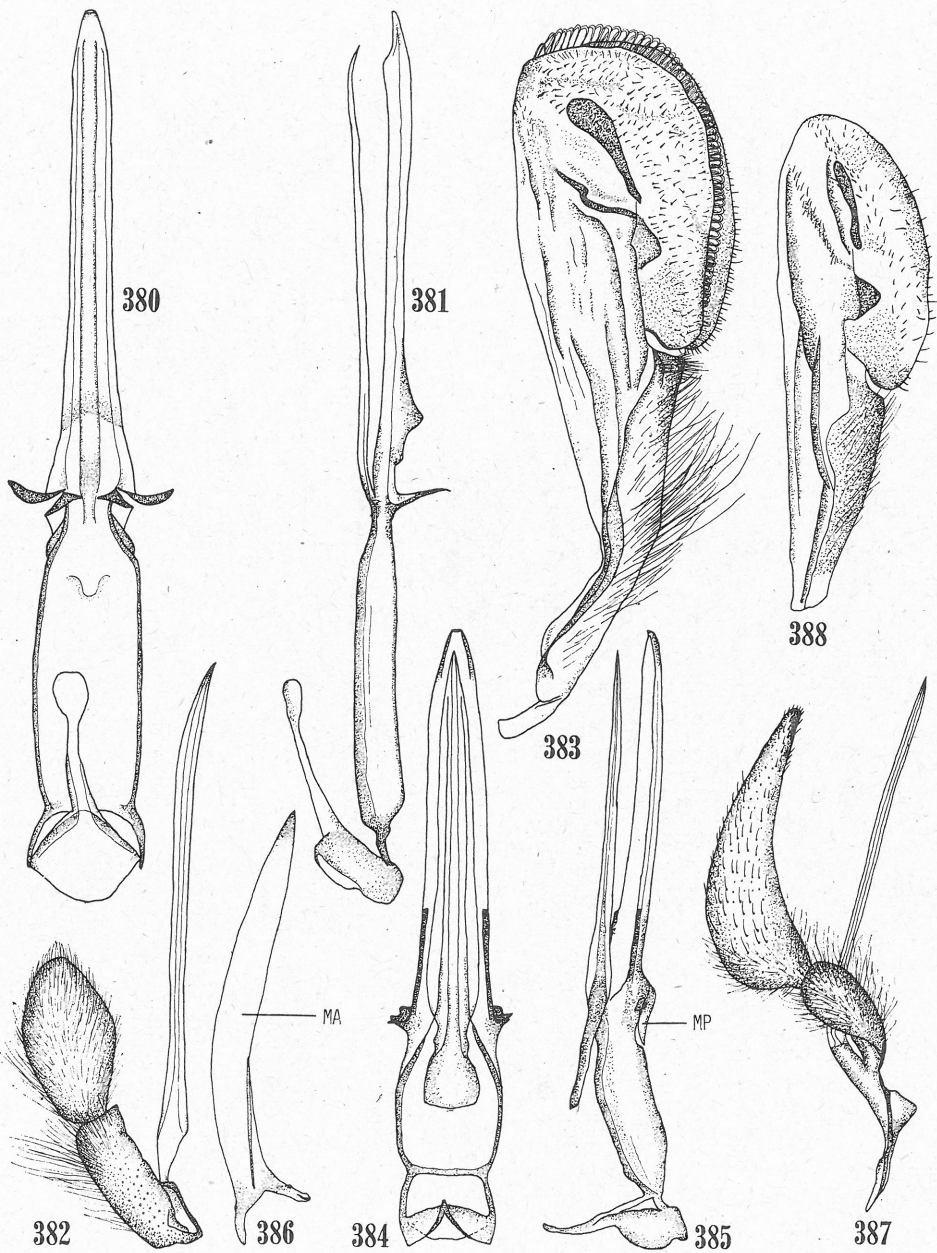
Figs. 365–369. *Chrysops suavis*, ♀.



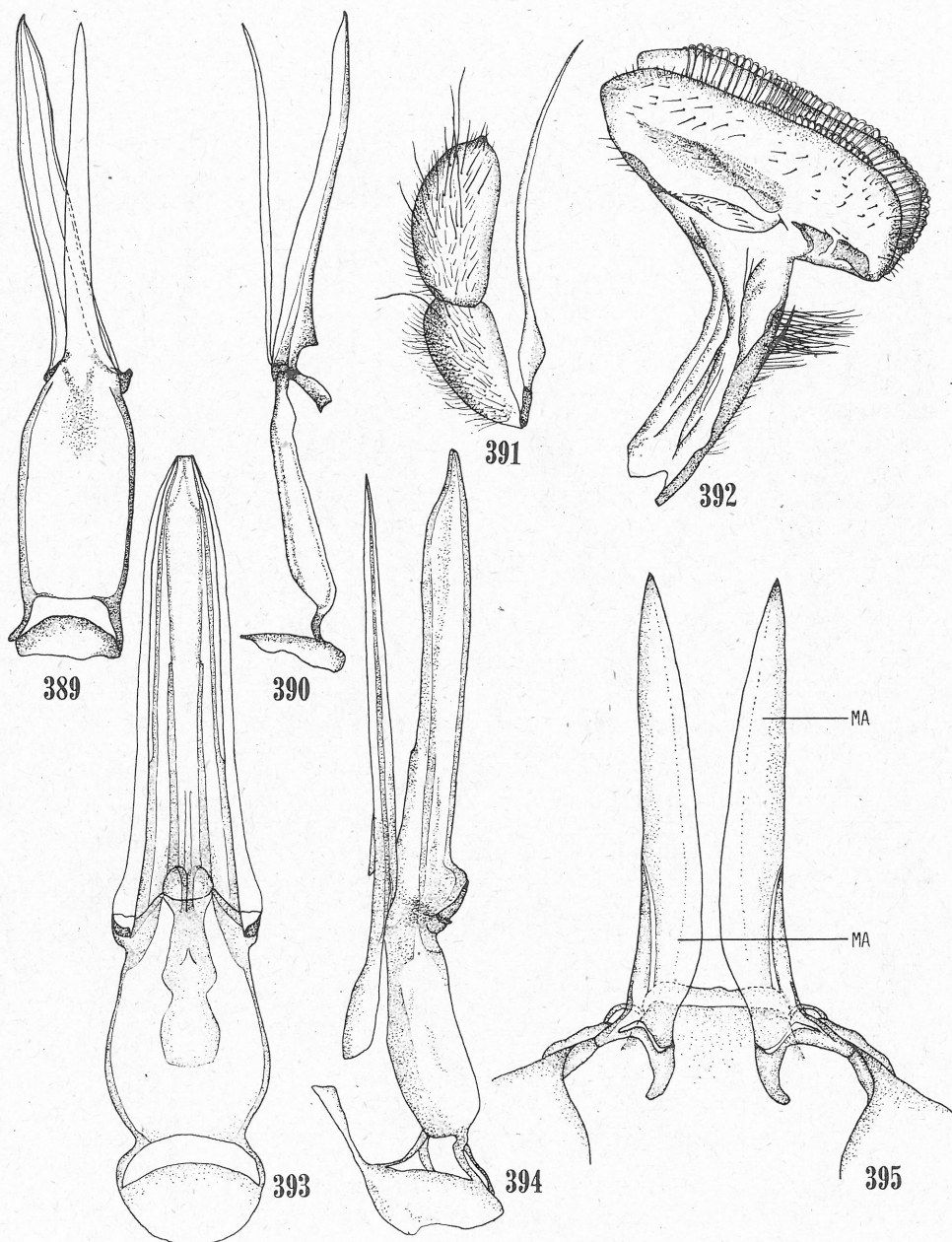
Figs. 370–374. *Atylotus horvathi*, ♀.



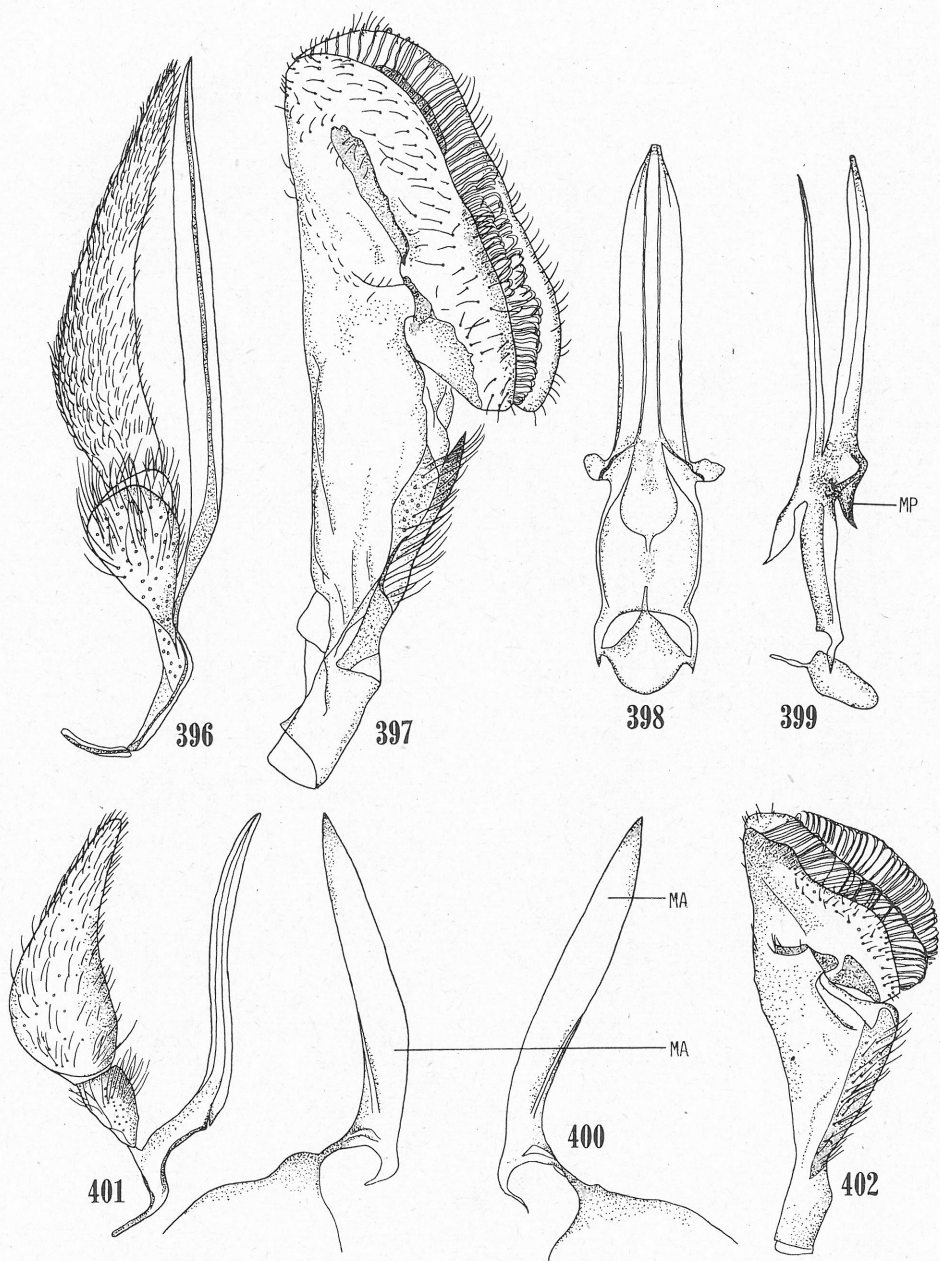
Figs. 375 – 379. *Tabanus chrysurus*, ♀.



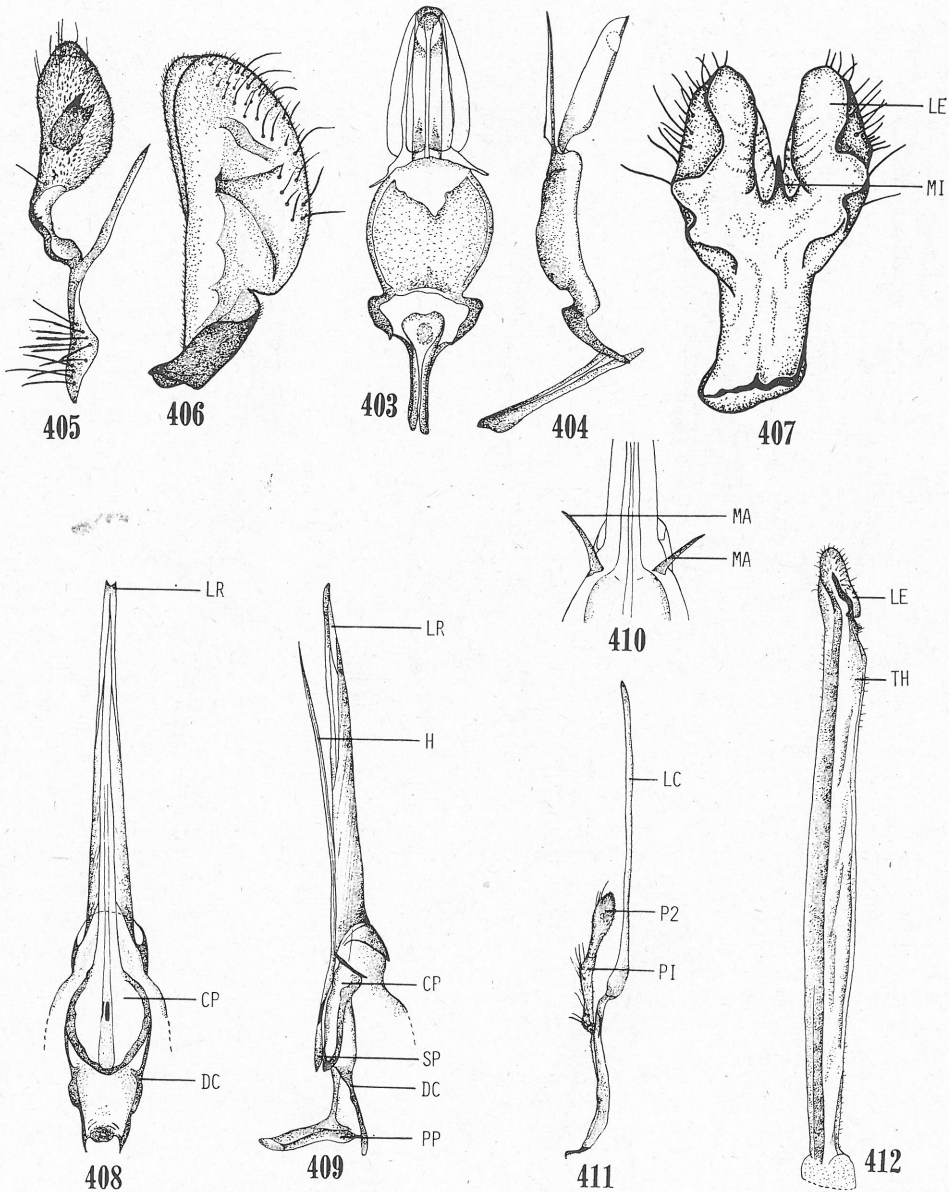
Figs. 380–383. *Tabanus chrysurus*, ♂. Figs. 384–388. *Tabanus iyoensis*, ♀.



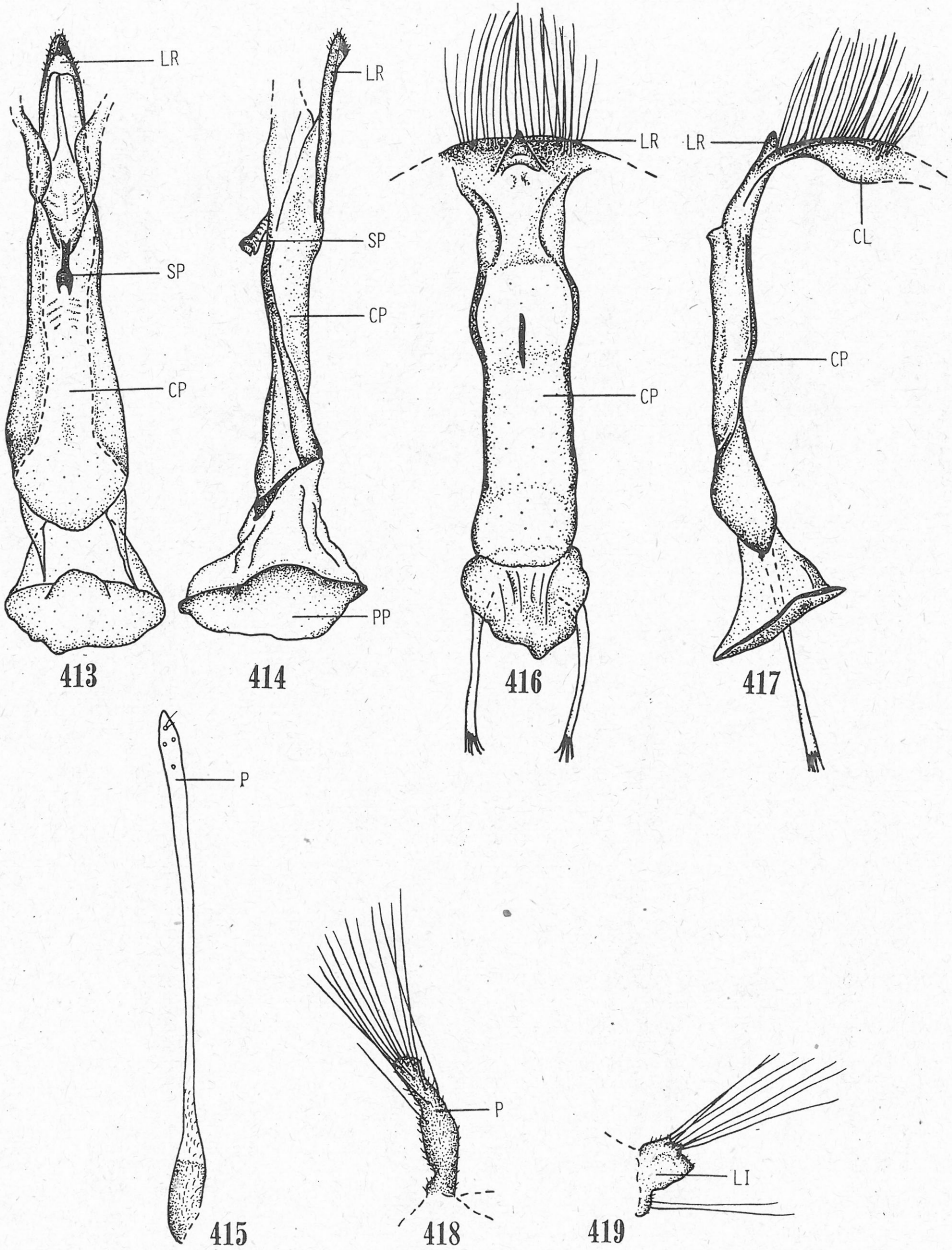
Figs. 389–392. *Tabanus iyoensis*, ♂. Figs. 393–395. *Isshikia yajimai*, ♀.



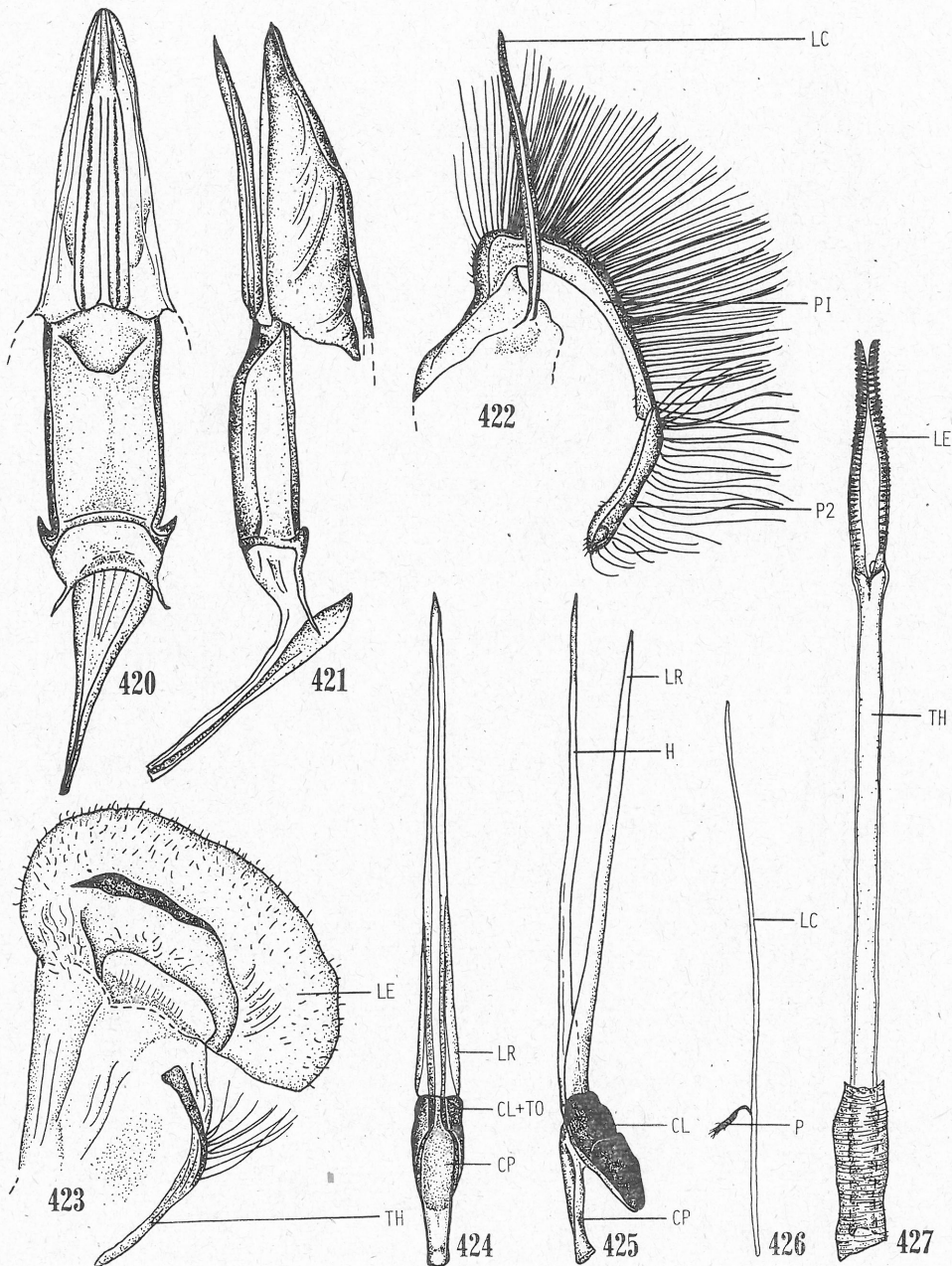
Figs. 396–397. *Isshikia yajimai*, ♀. Figs. 398–402. *Haematopota tristis*, ♀.



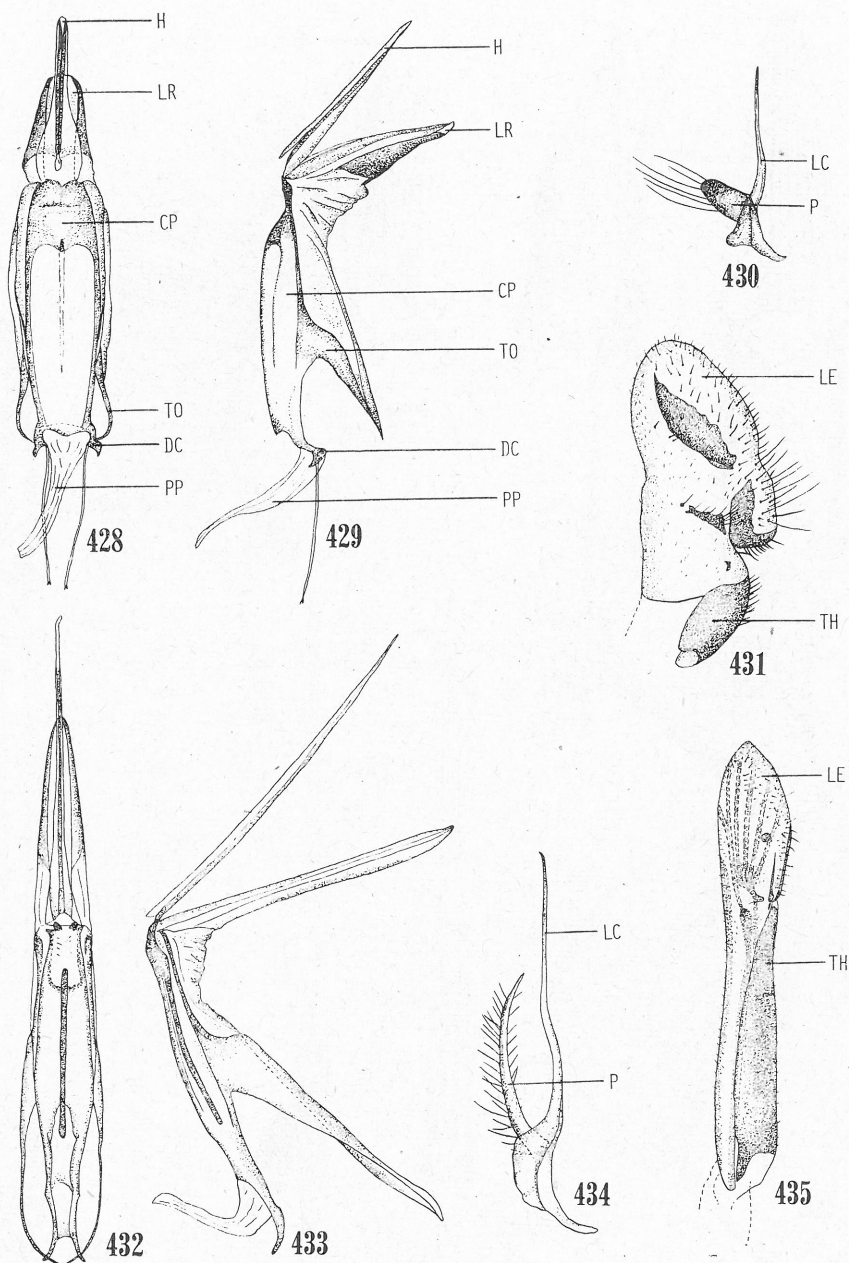
Figs. 403–407. *Vermileo comstocki*, ♀ (407: dorsal view). Figs. 408–412. *Lampromyia intermedia*, ♀.



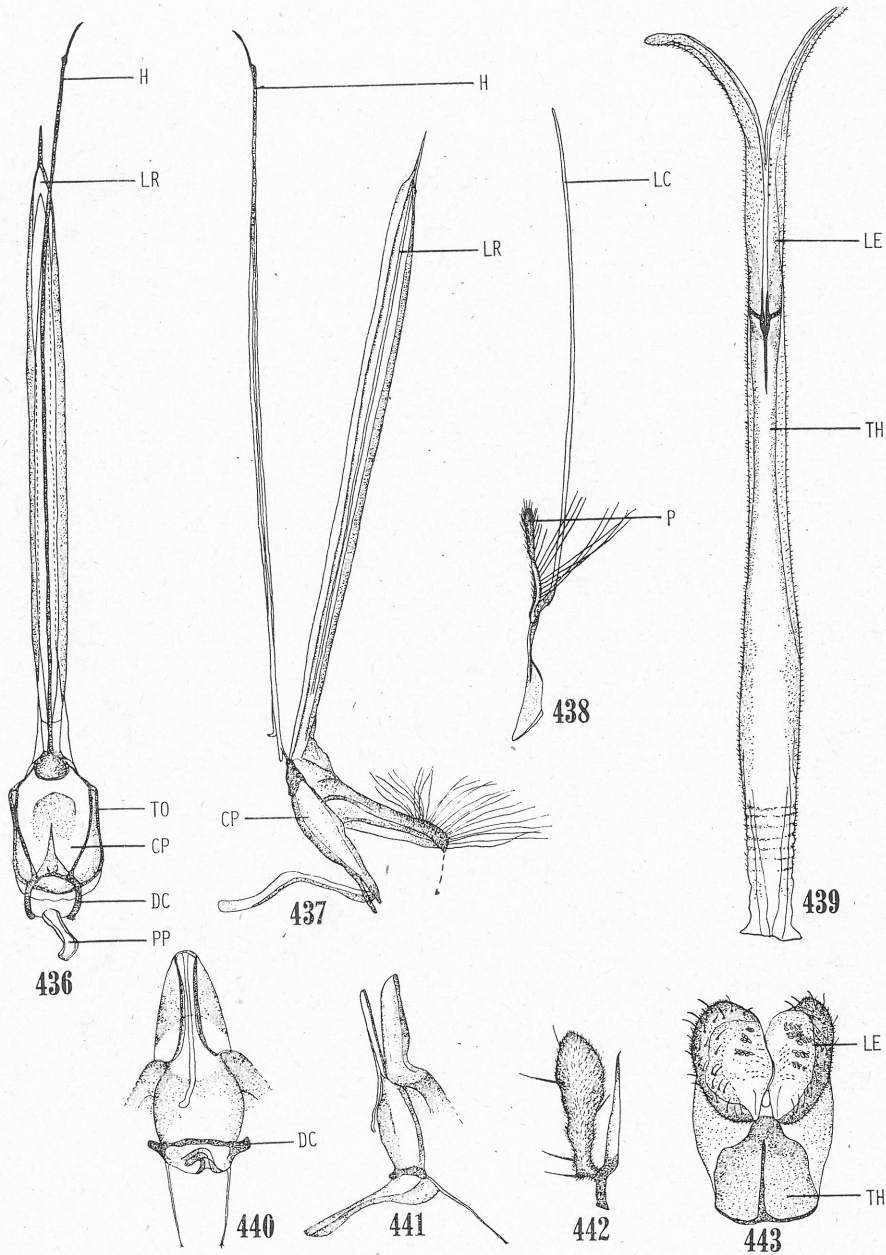
Figs. 413–415. *Atriadops javana*, ♂. Figs. 416–419. *Nycterimyia fenestro-inornata*, ♂.



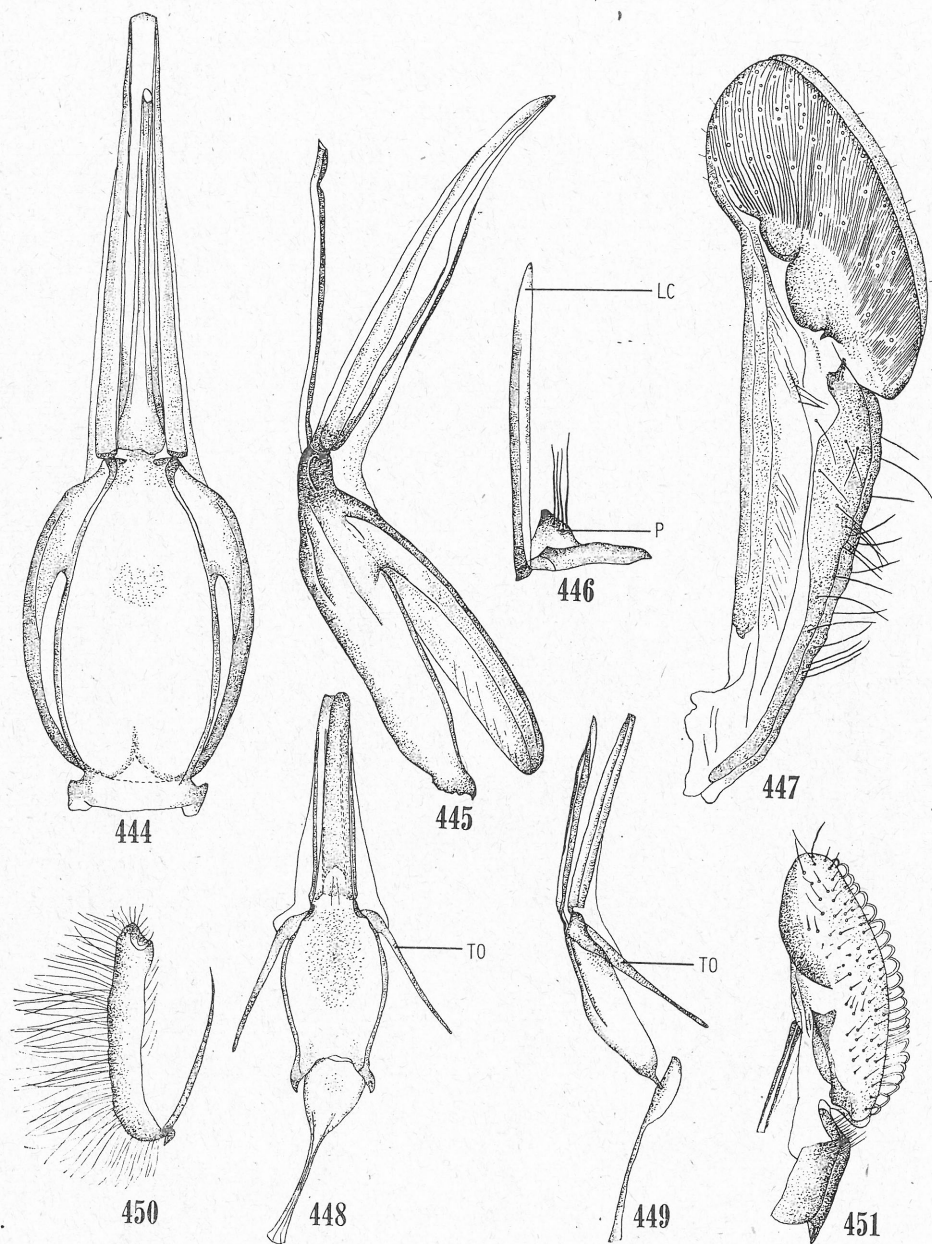
Figs. 420–423. *Hirmoeura* sp., ♂. Figs. 424–427. *Oligoneura hasegawai*, ♀ (427: ventral view).



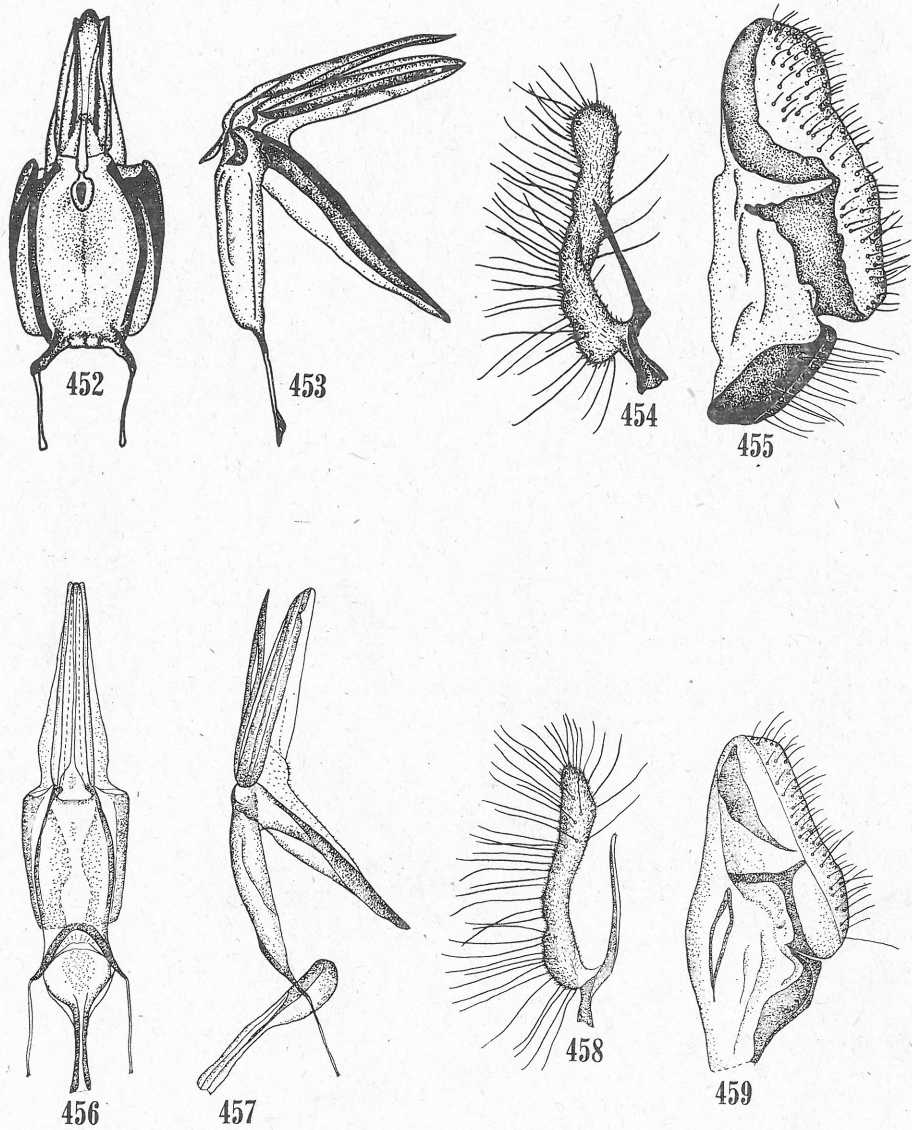
Figs. 428–431. *Anthrax* sp., ♀. Figs. 432–435. *Ligyra tantalus*, ♀.



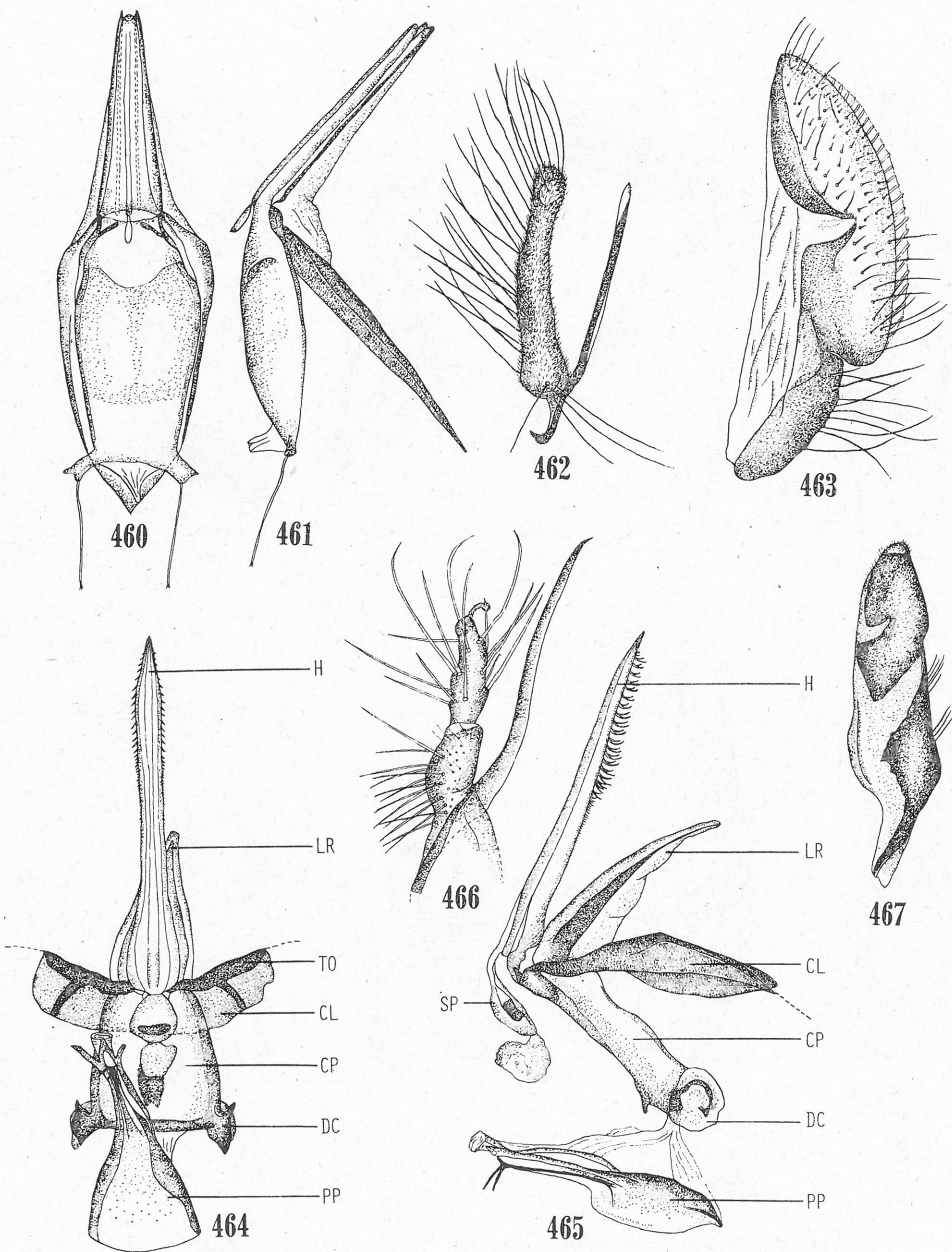
Figs. 436–439. *Bombylius major*, ♀ (439: ventral view). Figs. 440–443. *Hilarimorpha* sp., ♂ (443: ventral view).



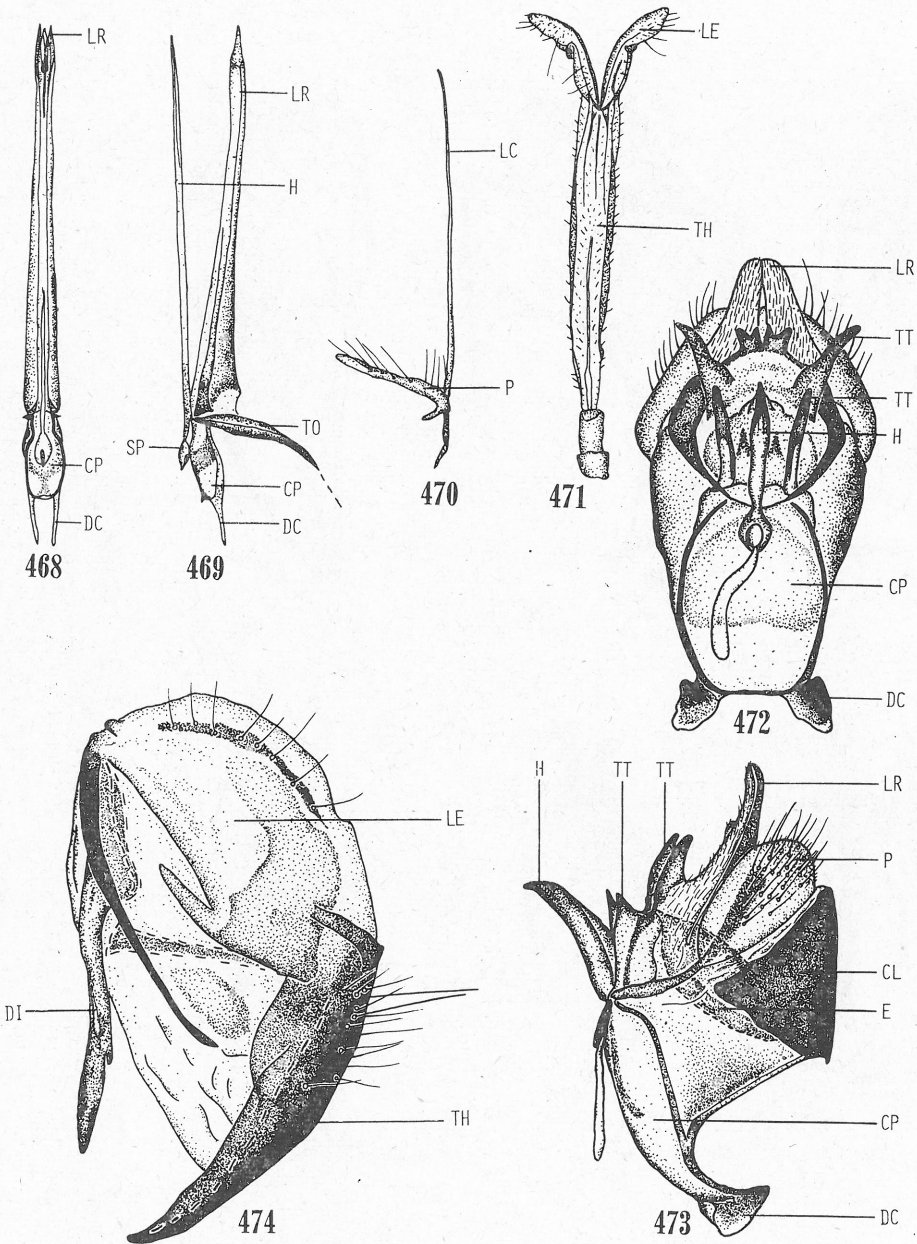
Figs. 444–447. *Nemomydas gruenbergi*, ♀. Figs. 448–451. *Dialineura albata*, ♀.



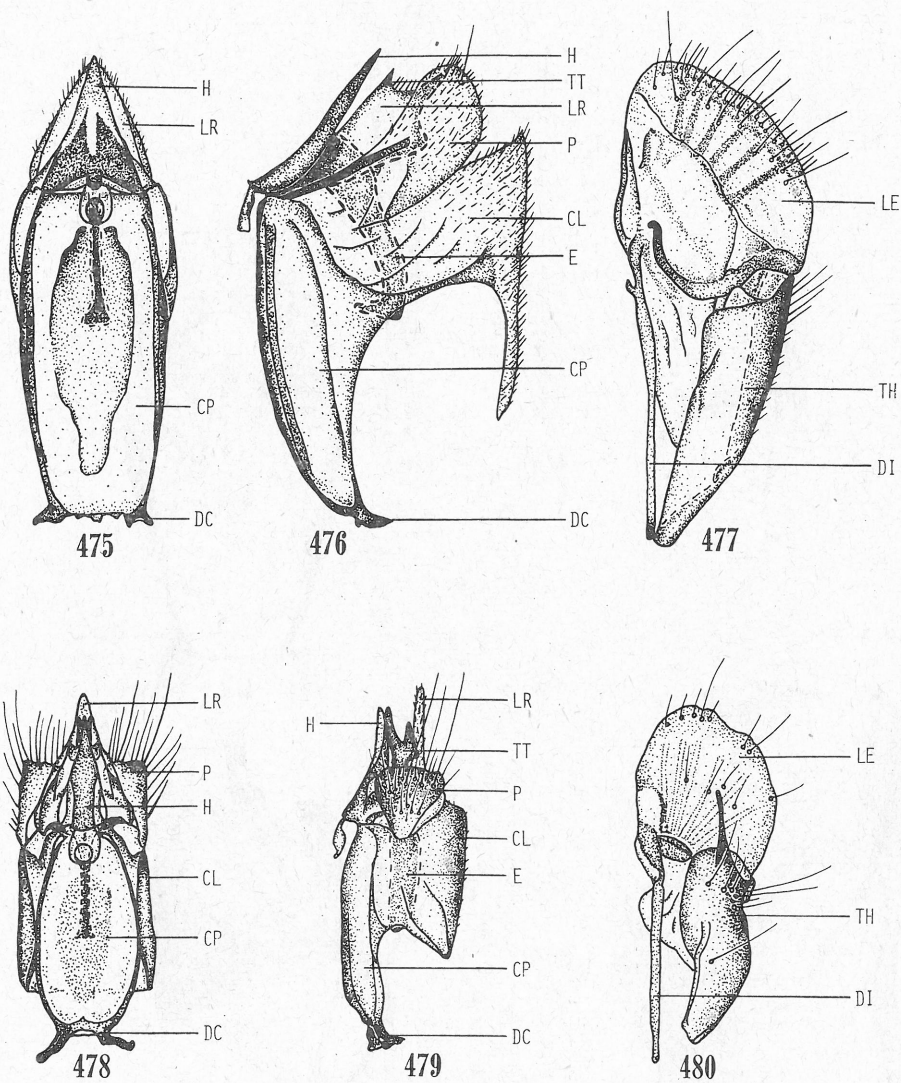
Figs. 452–455. *Dichoglena sapporensis*, ♀. Figs. 456–459. *Irwinella* sp., ♀.



Figs. 460-463. *Thereva major*, ♀. Figs. 464-467. *Scylaticus sayano*, ♀.



Figs. 468–471. *Empis seminitida*, ♂ (471: ventral view). Figs. 472–474. *Diostracus antennalis*, ♀.



Figs. 475–477. *Dolichopus plumipes*, ♂. Figs. 478–480. *Sciapus nebulosus*, ♀.