

**Cixiidae of Taiwan, Part (I) Pentastirini**

**臺灣菱飛虱科昆蟲：(一)五胸脊飛虱族**

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### 摘 要

曹順成·許洞慶·Jan Van Stalle 臺灣菱飛蝨科昆蟲：(-)五胸脊飛蝨族 臺灣  
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本文將臺灣過去已記錄之五胸脊飛蝨族昆蟲九種 (即 *Oliarus formosanus* Matsumura, *O. hopponis* Matsumura, *O. horishanus* Matsumura, *O. mori* Matsumura, *O. oryzae* Matsumura, *O. velox* Matsumura, *O. speciosus* Matsumura, *O. tappanus* Matsumura, 與 *Pentastiridius pachycephs* (Matsumura), 其中 *Pentastiridius pachycephs* (Matsumura) 為 *Oliarus pachycephs* 之新組合), 以其雄蟲外性器重新描述, 以補過去記述之不足; 並繪圖、敘述最近研究中發現之新種四種 (即 *Oliarus bifidus*, *O. chiangi*, *O. elevatus*, 與 *O. scalenus*)。此外, 重新描述之各種也於文中指定其後模式標本, 並就目前已知分布於臺灣之本族種類附以檢索表, 及概述 *P. pachycephs* 種類之二至五齡若蟲之形態特徵。

**關鍵詞：**菱飛蝨科, 五胸脊飛蝨族, 臺灣。

### Abstract

A revision is given of the Pentastirini of Taiwan. A key to the species is provided. *Pentastiridius pachycephs* (Matsumura) is proposed as a new combination for *Oliarus pachycephs*. The following species are redescribed by means of the male genitalia: *Oliarus formosanus* Matsumura, *O. hopponis* Matsumura, *O. tappanus* Matsumura, *O. mori* Matsumura, *O. oryzae* Matsumura, *O. speciosus* Matsumura, *O. horishanus* Matsumura, *O. velox* Matsumura and *Pentastiridius pachycephs* (Matsumura). The following species are described as new to science: *O. bifidus*, *O. chiangi*, *O. elevatus*, and *O. scalenus*. A lectotype is selected for *Oliarus formosanus*, *O. horishanus*, *O. mori*, *O. oryzae*, *O. speciosus*, *O. tappanus*, *O. velox*, and *Pentastiridius pachycephs*. The nymphs of *Pentastiridius pachycephs* are described.

**Key words:** Cixiidae, Pentastirini, Taiwan.

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## Introduction

The family Cixiidae has a worldwide distribution and is one of the largest families of Fulgoroidea, with 124 genera and 1918 species presently described, arranged in two sub-families: the Cixiinae and the Bothriocerinae; the former comprises four tribes, viz. Cixiini, Bennini, Pentaliini and Pentastirini. The family is most closely related to the Delphacidae, which can be distinguished by the presence of a mobile spur on the hind tibiae. The fauna of the Palearctic and the Nearctic regions are fairly well known by the recent work of Dr. F. W. Mead (U.S.A.), Dr. J. P. Kramer (U.S.A.), Dr. H. Hoch (B.R.D.), Dr. J. Dlabola (Czechoslovakia), Dr. A. F. Emeljanov (U.S.S.R.) and Dr. V. N. Logvinenko (U.S.S.R.) and the African fauna is currently being revised by the third author. On the contrary, the fauna of the Neotropical and Oriental regions have hardly been explored and any comprehensive revisionary work is lacking.

This paper is the first of a series dealing with a revision of the cixiid fauna of Taiwan. We hope to publish a complete revision of this fauna within four years. This first part deals with the Taiwanese species of Pentastirini, which is represented here by the genera *Oliarus* and *Pentastiridius*. In total 9 species were recorded in the past. In this paper these species are redescribed and 4 further species are newly described. The genus *Pentastiridius* is recognized here for the first time in the Oriental region. This genus which has many Palearctic representatives was firstly recognized in the Tropics by Van Stalle (1986) who reported 16 species.

## Historical review

The first cixiid from Taiwan was described by Melichar (1903) as *Kirbyana pagana*. Matsumura (1911, 1914 & 1940) described in total 33 species belonging to 9 genera, but unfortunately he did not provide any illustrations of the male genitalia which are indispensable for the recognition of cixiid species. Nast (1950) added *Brixia formosana*. Fennah

(1956) described *Cixius scrupeus* and provided a key to the Chinese Cixiidae. Hori (1982) described 3 species of *Betacixius*, bringing the total number of cixiid species in Taiwan up to 39, placed in 11 genera.

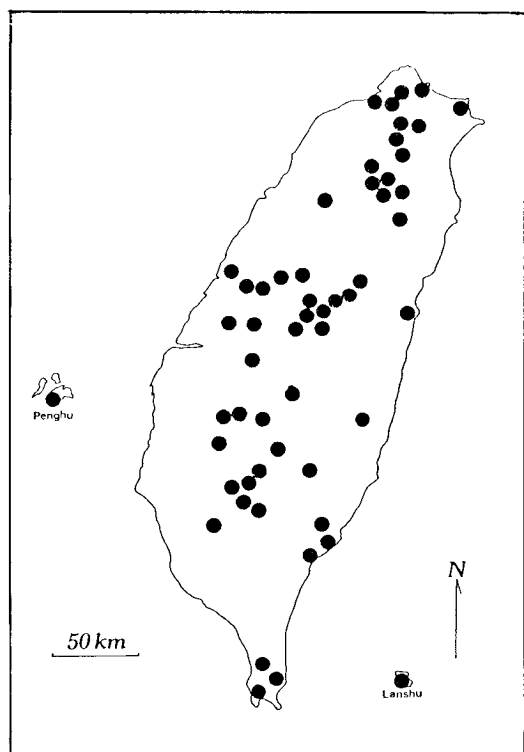
## Biology

The biology and nymphal stages of most Cixiidae represent a nearly unexplored field. The immature stages of cixiids live subterranean near the roots of plants. Hudson (1924), Hacker (1925) and Cumber (1952) described the nymphs of respectively *Oliarus oppositus* (Walker), *O. felis* Kirkaldy and *O. atkinsoni* Myers, and Myers (1929) treated the biology of *Mnemosyne cubana* Stål and *Bothriocera signoreti* Stål. Wilson and Tsai (1982) described the immatures of *Myndus crudus* Van Duzee. Wilson, Tsai and Thompson (1983) described the immature stages of *Oecleus borealis* Van Duzee. The immature stages of *Pentastiridius pachycephs* are described below.

## Materials and Methods

Most of the material studied here was collected by the first author during field trips in 1984 to 1987. They were collected mostly by sweeping sometimes light traps and Malaise traps also used. Additional material was kindly given on loan by Dr. R. F. Hou, Dr. K. C. Lo and Mr. L. Y. Chou. The Matsumura types were studied by the third author. For each species the male genitalia have been dissected and illustrated here; in the case where only females were available in the type series, these specimens were directly compared to other series from Taiwan. We have been able to find males for all species which are redescribed below. The nymphal stages of *Pentastiridius pachycephs* are described by the first author.

The dried specimen is soaked and boiled in 10% KOH for minutes till the specimen become clear, then dissecting. The dissected parts are treated on cavity slide glass containing a small amount of Glycerin and examined under the compound microscope, in case to keep the parts still a small amount of cotton



MAP 1: Distribution of collecting localities of Taiwanese Pentastirini.

added. Tegmina are mounted in micro slides with few drops of Hoyer's solution. Nymphal stages are also treated as above. Figures are made with camera lucida or drawing tube and inked. In order to preserve the dissected material, Glycerin is used. In making measurement, adults are from dried specimens and nymphs are made from macerated material. The insect is measured with a micrometer rule under a binocular microscope.

The terminology used here is explained in Fig. 1 and 2; for the description of the chaetotaxy of the first and second joint of the hind tarsi the following formula is adopted: the number of teeth on each tarsite is separated by a slash; when this number is given between parentheses it refers to a double row of spines consisted of a proximal row of small black teeth and a distal row of membraneous teeth; when the number is given without parentheses it refers to a single row of large black teeth.

The material studied below is deposited

in the following institutions and museums, which are listed in the text with their abbreviations as follows:

|      |   |
|------|---|
| NCHU | National Chung Hsing University (R.O.C., Taichung)                        |
| NTU  | National Taiwan University (R.O.C., Taipei)                               |
| TARI | Taiwan Agricultural Research Institute (R.O.C., Taichung)                 |
| KBIN | Koninklijk Belgisch Instituut voor Natuurwetenschappen (Belgium, Brussel) |
| HU   | Hokkaido University (Japan, Sapporo)                                      |
| BPBM | B. P. Bishop Museum (U.S.A., Honolulu)                                    |
| NCSU | North Carolina State University (U.S.A.)                                  |
| BMNH | British Museum (Natural History) (U.K.)                                   |

### Terminology

|     |                                    |
|-----|------------------------------------|
| ICP | = Intermediate carina of pronotum. |
| LV  | = Length of vertex.                |
| MCM | = Median carina of mesonotum.      |
| MCV | = Median carina of vertex.         |
| SCM | = Submedian carinae of mesonotum.  |
| TG  | = Tegula.                          |
| WM  | = Width of mesonotum.              |
| WV  | = Width of vertex.                 |
| LT  | = Length of tegmen.                |
| WT  | = Width of tegmen.                 |

### List of Taiwan species of Pentastirini

#### I. Genus *Oliarus*

1. *O. scalenus* Tsaur et Hsu n. sp.
2. *O. formosanaus* Matsumura, 1914
3. *O. hopponis* Matsumura, 1914
4. *O. horishanus* Matsumura, 1914
5. *O. mori* Matsumura, 1914
6. *O. oryzae* Matsumura, 1911
7. *O. speciosus* Matsumura, 1914
8. *O. tappanus* Matsumura, 1914
9. *O. velox* Matsumura, 1914
10. *O. bifidus* Tsaur et Hsu n. sp.
11. *O. elevatus* Tsaur et Hsu n. sp.

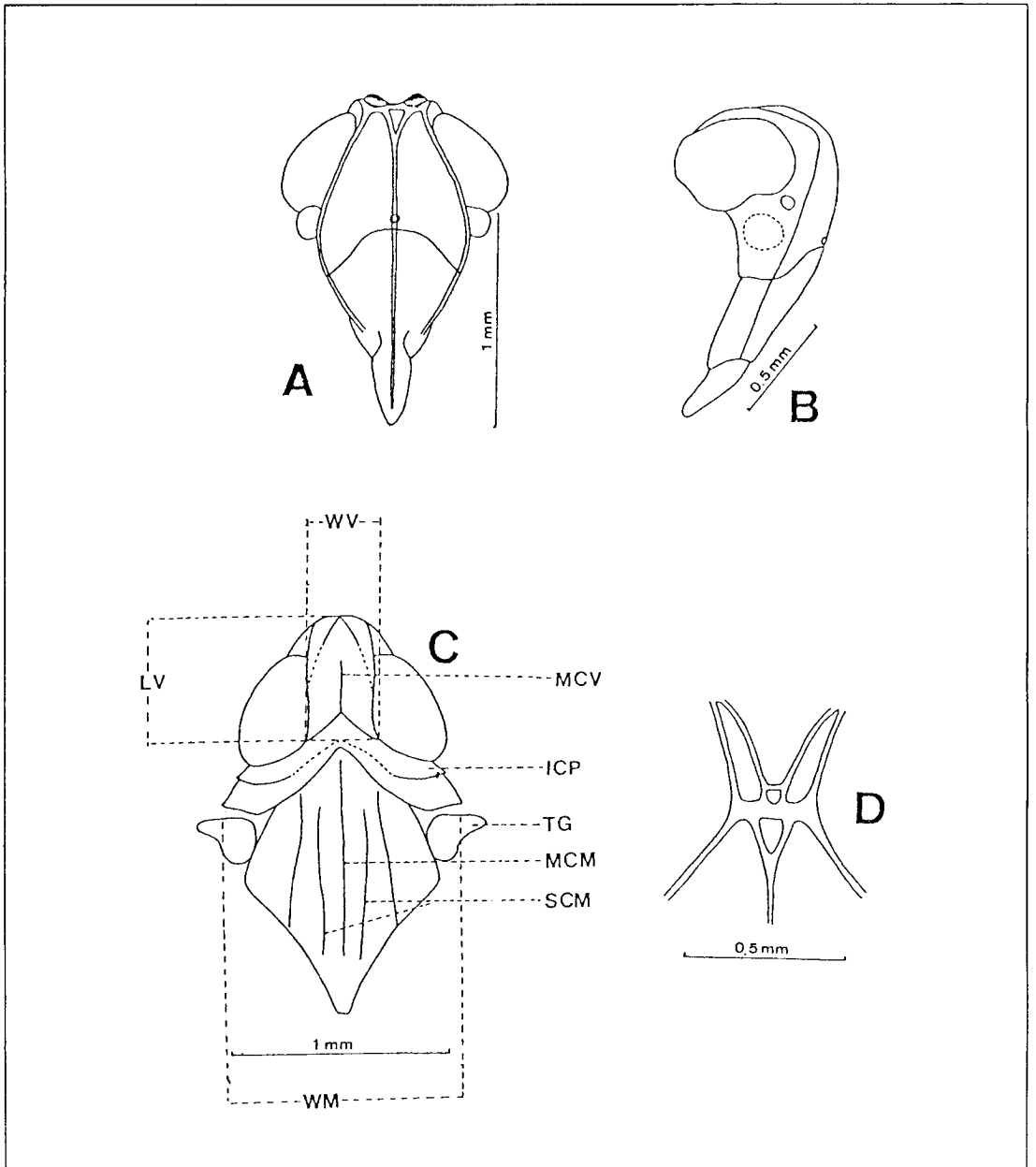


Fig. 1. A–B. Head. A. Ventral view; B. Lateral view; C. Head, pronotum and mesonotum, dorsal view; D. Anterior portion of vertex and upper portion of frons.

12. *O. chiangi* Tsaor et Hsu n. sp.
13. *O. sp1* incertae sedis
14. *O. sp2* incertae sedis

## II. Genus *Pentastiridius*

15. *P. Pachyceps* (Matsumura, 1914) n. comb.

## Family Cixiidae Spinola, 1839

Type genus: *Cixius* Latreille, 1804

*Cixioides* Spinola, 1839, Ann. Soc. Ent. France 8:204.

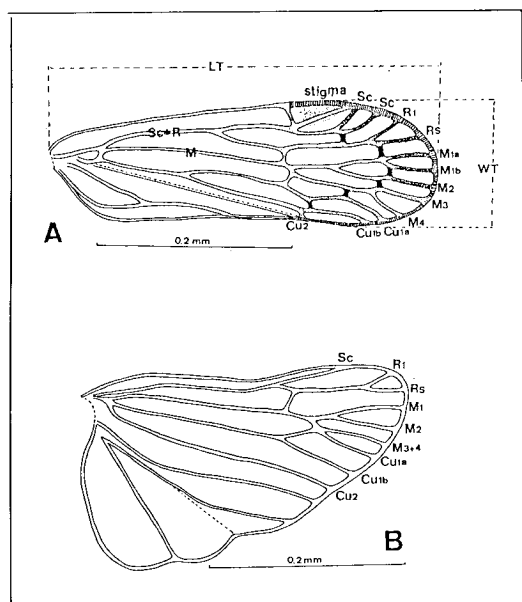


Fig. 2. A. Tegmen; B. Wing.

Cixiidae Muir, 1923, Proc. Hawaiian Ent. Soc. 5:222.

This is a family of usually small to large (4.05–19.00 mm) fulgorids, mostly dull or inconspicuously colored forms. Most of them with body depressed, others compressed. Head not elaborately developed as in most fulgorids; vertex usually longer than wide, with slightly or strongly elevated sides, midline usually partly carinate; frons in lateral view slightly convex, median ocellus usually present on median carina of frons except in *Microledrida*, slightly above frontoclypeal suture. Rostrum slender, 3-segmented, last segment longer than wide, often very long. Thorax large, with 3–5 longitudinal carinae on mesonotum; tegulae present and distinct. Species usually macrop-terous, with tegmina slightly to steeply tecti-form; 4–5 anteapical cells and 10–12 apical cells from stigmal area around apex to tip of clavus; claval suture ending in the commissural margin. Legs relatively simple, providing useful taxonomic characters at generic level; hind coxae each with a horn-shaped meracanthus extending backwardly, hind tibiae with 3–7 lateral spines and a cluster of spines apically,

first and second hind tarsal segments also with row of spines across their apices. Male genitalia: Anal segment, pygofer and genital styles bilaterally symmetrical or asymmetrical; pygofer usually longest on ventral margin, lateral margins angulately bent or rounded, medioventral process usually present on ventral margin of pygofer between genital styles; genital styles often capitate distally, anal segment usually elongated, with modified apical portion; aedeagus asymmetrical, consisting of basal shaft and variably developed apical flagellum; flagellum usually bearing sclerotized processes. Periandrium large, firmly articulate at two points on the dorsal bridge of the pygofer or with the anal segment, generally tubular, with great variety of shapes and processes; a strongly chitinous tube, the apodeme of the aedeagus, from base passing through the periandrium and attached to the apodeme which connected the genital styles by the connectivum, ejaculatory duct opening at the membranous area of flagellum. Female genitalia: pygofer oval in caudal view, wider than long, usually with rows of short setae medially or along margin and bearing wax secreting pores. Pregenital sternite with small convex process medially. Ovipositor with reduced or complete valvulae.

### Subfamily Cixiinae Tribe Pentastirini

The Pentastirini can be recognized from all other cixiids by the combination of the following characters: face flat, lateral keels not touching each other, vertex usually flat, lateral margins not highly elevated, no subantennal process, mesonotum with five longitudinal carinae, male genitalia with aedeagus connected to the pygofer and not articulating with the anal segment, female genitalia with reduced ovipositor, first and second pairs of valvulae thin.

### Key to genera of Pentastirini in Taiwan

1. Chaetotaxy of hind tarsi (9–12)/(7–10); tegmina with apical third dull in male,

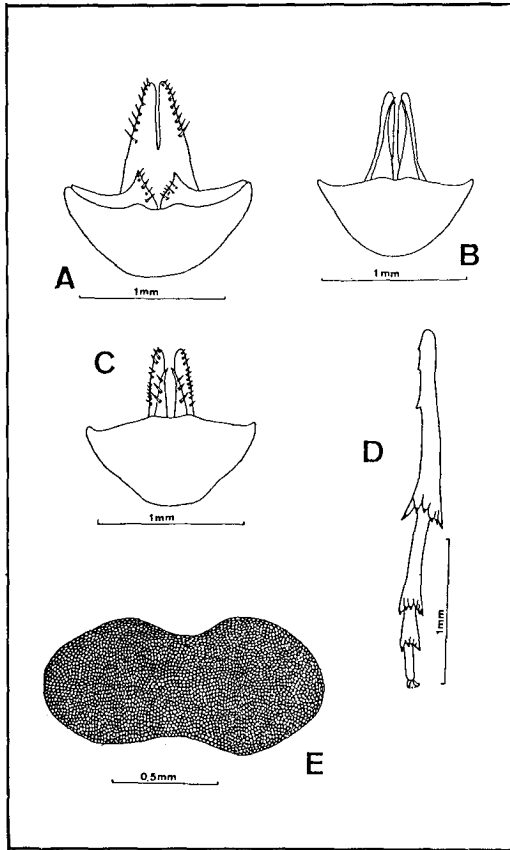


Fig. 3. A-C. Pregenital sternites and valvulae. A. *Oliarus mori*; B. *O. horishanus*; C. *O. scalenus*; D. Hind leg; E. Pygofer of female, caudal view.

- without dark stigma; costal margin not regularly granulated between base and stigma . . . . . *Pentastiridius*
- . Chaetotaxy of hind tarsi 7-8/5-6; tegmina hyaline, with dark stigma, costal margin sometimes regularly granulated between base and stigma . . . . . *Oliarus*

### Genus *Oliarus* Stål

*Oliarus* Stål, 1862, Berliner Ent. Zeit. 6:306.

- . Edwards, 1894, Hemip.-Homop. British Islands Pt. 1:23.
- . Dozier, 1928, Tech. Bull. Agric. Exp. Stn. Miss. 14:57.
- . Mead & Kramer, 1982, Trans. Amer. Ent. Soc. 107:391-393.

-. Van Stalle, 1987, Zoologische Wissenschaften Ann. 252:7.

Type species: *Cixius Walkeri* Stål (subsequent designation by Distant)

This is the largest Genus of Cixiidae comprising 492 recorded taxa described from all over the world. Only 9 species have been recorded from Taiwan by Matsumura in 1911 and 1914.

Total length of Taiwan forms varying from 5.00-11.50 mm. Head not as wide as pronotum, triangularly excavated at base, vertex concave medially, base slightly wider than apex. longer than width between eyes, except as long as broad in *tappanus*, *horishanus* and *chiangi*. lateral carinae diverging posteriorly, with a median carina extending forward from base only obscure in sp1; separated from frons by arcuate transverse carina near apex and a frontal carina at apex, these joined by two longitudinal carinae, the four carinae thus forming two lateral foveae and a small mediar compartment. Face narrowing basally, gradually widening to beyond middle then narrowing towards vertex; apex wider than base; fronto-clypeal suture arched dorsally; median carina distinct, percurrent on frons and clypeus. Rostrum varying in length from just attaining hind coxae to exceeding base of femora. Pronotum short, chevron, each side with prominent intermediate carina. Mesonotum usually quinquecarinate, tegmina longer than abdomen while resting. Hind tibia usually with 3 lateral and 6 apical spines. Chaetotaxy of the hind tarsi usually 7/5. Pygofer depressed dorsoventrally, medioventral process greatly variable in shape and size: awl-shaped in *scalenus*, *formosanus* and *velox*; absent in *tappanus*; flame-shaped in *horishanus*, small triangular in *mori*, *bifidus* and *chiangi*. Anal segment large, shape varying from narrow and flap-like to broad boot-like. Anal style slender finger-shaped. Genital styles often asymmetrical, loosely connected with each other, capable of independent movement. Female genital with pygofer narrowed dorsoventrally, ova wider than long, bearing wax secreting pores which usually beset with short setae. Ov

positor with reduced first and second valvulae and well developed third valvulae generally curving dorsad. Anal segment fairly small, shaped triangular or rectangular.

#### Key to the species of *Oliarus* in Taiwan

1. Aedeagus with 4 spinose processes . . . . 2
  - Aedeagus with more or less spinose processes than above . . . . . 7
2. Vertex twice as long as broad or more . . . 3
  - Vertex 1.5 times as long as broad or less . . . . . 4
3. Genital styles penetrate through pygofer (Fig. 11B); apical margin of aedeagus with a spiral, awl-shaped process (Fig. 11C); anal segment of male complete . . . . . *velox* Matsumura
  - Genital styles laying above ventral margin of pygofer; apical margin of aedeagus without process; anal segment of male in caudal view with a longitudinal slit medially (Fig. 16B) . . . . . *hopponis* Matsumura
4. Aedeagus with process on right side . . . . 5
  - Aedeagus without any process on right side . . . . . 6
5. Genital style with a outer lobe subapically (Fig. 8A); flagellum directed right side (Fig. 8C) . . . . . *chiangi* n. sp.
  - Genital style without any lobe; flagellum curving left then right (Fig. 15E) . . . . . *speciosus* Matsumura
6. Anal segment of male symmetrical, of female ovate; aedeagal process 3 directed laterad, 1 cephalad (Fig. 5C–D) . . . . . *formosanus* Matsumura
  - Anal segment of male asymmetrical, of female triangular; aedeagal process 1 directed laterad 3 cephalad (Fig. 4C–D) . . . . . *scalenus* n. sp.
7. Aedeagus tubular . . . . . 9
  - Aedeagus irregular . . . . . 8
8. Body length (includ. teg.) of male more than 9 mm; medioventral process flame-shaped; genital style with smooth margin (Fig. 12A) . . . . . *horishanus* Matsumura
  - Body length (includ. teg.) of male less than 7 mm; medioventral process reduced; genital style with sinuate margin (Fig. 6E) . . . . . *tappanus* Matsumura
9. Vertex twice as long as broad; out side of genital style with production subapically . . . . . 10
  - Vertex 1.6 times as long as broad or less; genital style without any production . . . . . *oryzae* Matsumura
10. Aedeagus with 5 spinose processes . . . . 11
  - Aedeagus with 3 spinose processes . . . . . *bifidus* n. sp.
11. Aedeagal process directed cephalad (Fig. 10F); male anal segment crooked (Fig. 10I) . . . . . *elevatus* n. sp.
  - Aedeagal process only one directed cephalad (Fig. 7C); male anal segment asymmetrically ovate (Fig. 7E) . . . . . *mori* Matsumura

#### *Oliarus scalenus*\* n. sp. (Fig. 4)

General color black. Body somewhat covered with powdery wax. Face and vertex with yellow keels. Pronotum fumated with black. Ocelli, antennae, mesonotal carinae and median carina of frons usually yellowish brown, sometimes brownish. Mesonotum each side with a brown, longitudinal stripe between submedian carina and outer carina. Tarsi and first segment of rostrum yellow. Tegmina hyaline, stigma fuscous, veins yellow, covered with small concolor granules; costal margin yellow, without granules; *Sc+R* forked distad of *Cu*.

Vertex 1.5 times as long as broad, median carina distinct on basal half, lateroapical areolets extending backwards to basal third, contiguous at apex. Frons shorter in middle line than wide at widest portion, median carina forked at basal fourth. Rostrum just attaining hind coxae. Tegmen with 11 apical cells and 5 anteapical cells, 3.2 times as long as broad.

\* *L. scalenus* – unequal, indicated the asymmetrical anal segment of male.



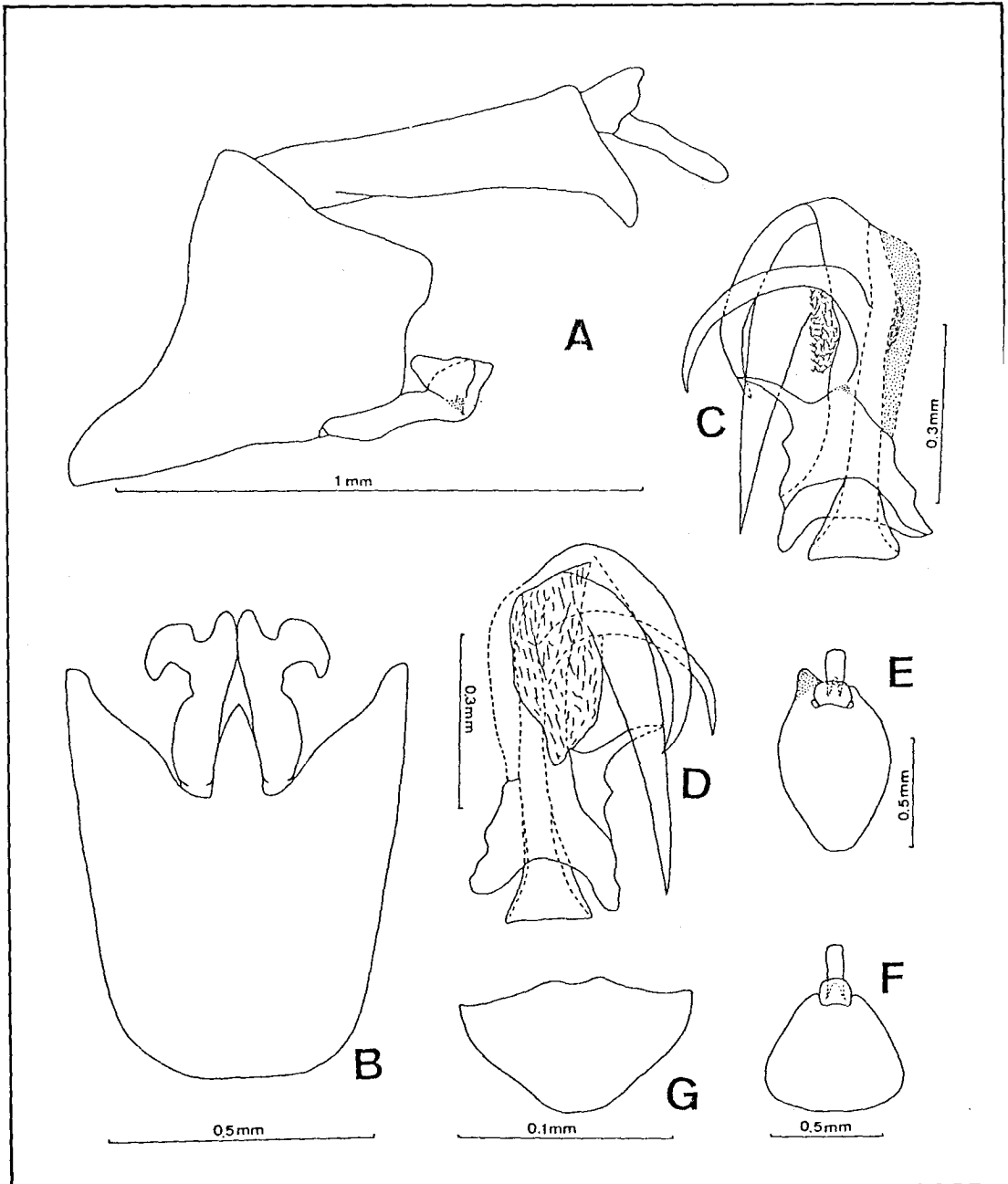


Fig. 4. *O. scalenus* n. sp. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. deagus. C. Ventral view; D. Dorsal view; E–F. Anal segment, dorsal view. E. Male; F. Female; G. I genital sternite of female.

#### Male genitalia:

Pygofer asymmetrical, dorsolateral angle produced into a rounded lobe, medioventral

process widest at base and tapering distally longer than broad (1.8:1), reaching to full length of genital style. Anal segment in dorsal view longer than broad, asymmetrically ov-

right caudolateral angle with a triangular projection; in lateral view slender and produced lateroapically into a ventral process. Anal style slender. Genital styles in ventral view symmetrical; in lateral view slightly narrowing medially and obscure medioventral process, apex bilobed, outer lobe covering most portion of inner one. Aedeagus in total with four long spinose processes, all visible in ventral orientation: one acuminate spine implanted on left side on sclerified periandrium and curved downward, one falcate process near middle, coiled 180 degrees and directed upward and two further spines implanted on apex and running cephalically, parallel to membranous flagellum. Flagellum with many scale-shaped sculptures on surface.

#### Female genitalia:

Anal segment in dorsal view small, subtriangular. Pygofer with rows of short setae medially. Wax secreting pores larger in central area, smaller in other parts. Pregenital sternite with two very small convex processes submedially. Ovipositor with reduced awl-shaped second valvulae, each with three long setae. Third pair of valvulae blade-shaped, slightly shorter than anal segment.

Length of body (includ. teg.): Male: 5.14–5.28mm; Female: 5.95–6.35mm.

Length of tegmen: Male: 4.05–4.46mm; Female: 4.86–5.14mm.

Width of mesonotum: Male: 1.35–1.42 mm; Female: 1.49mm.

#### Holotype:

Male. Karenko (=Hualien), Hualien Hsien 23–IV–1932 L. Gressit, NCSU.

#### Paratypes:

4♂ 3♀♀ M. Kato, BMNH; 2♀♀ HENCHUN, Pintung Hsien 25–IV–1918 J. Sonan; 1♀ LANSHU, Taitung Hsien 3–IV–1932 S. Hirayama; 1♂ CHUKOU, Chiayi Hsien 29–I–1985 C. T. Yang; 1♀ NANJENSHAN, Pintung Hsien 11–II–1985 S. C. Tsaur; 1♂ 12–II–1985 S. C. Tsaur; 1♀ 14–II–1985 S. C. Tsaur; 1♀ LANSHU, Taitung Hsien 4–VII–1985 S. C.

Tsaur; 1♂ 8–VII–1985 S. C. Tsaur; 3♂♂ 3♀♀ 12–VII–1985 C. T. Yang; 1♂ 2♀♀ 14–VII–1985 J. T. Yang; 1♂ 1♀ M. M. Yang; 4♂♂ 3♀♀ 29–IX–1985 S. C. Tsaur; 1♂ 5♀♀ 30–IX–1985 S. C. Tsaur; 1♂ 1♀ 1–X–1985 S. C. Tsaur; 1♂ SHIHMEN, Pintung Hsien 22–I–1987 S. C. Tsaur; 1♀ C. C. CHIANG; 3♂♂ 2♀♀ 23–I–1987 S. C. Tsaur; 1♂ 1♀ CHIHNANKUNG, Taipei 28–IV–1987 C. C. CHIANG.

#### Host plant:

Unknown (Sweeping from *Casuarina equisetifolia* Forst.).

#### Distribution:

Taiwan.

#### Notes:

Closely related to *O. insetosus* and *O. formosanus*. From these species it can be distinguished by the different form of the right margin of the pygofer, the larger excavation of the apex of the anal segment, and the place of implantation of the spines on the aedeagus. This is the most distinctive South Taiwanese species.

#### *Oliarus formosanus* Matsumura, 1914

(Fig. 5)

*Oliarus formosanus* Matsumura, 1914:427.

Body somewhat covered with powdery wax. Ocelli, antennae, mesonotal carinae and median carina of frons yellowish brown to brownish. Pronotum with deep yellowish margins. Tegmina hyaline, stigma fuscous.

Vertex 1.3 times as long as broad, median carina distinct on basal half, lateroapical areolets extending backwards to basal third, contiguous at apex. Frons shorter in middle line than wide at widest portion, median carina forked at basal fourth. Rostrum just attaining hind coxae. Tegmen with 11 apical cells and 5 anteapical cells, 3.1 times as long as broad.

#### Male genitalia:

Pygofer in ventral view asymmetrical, with acuminate left angle slightly longer than rounded right angle. Anal segment in dorsal

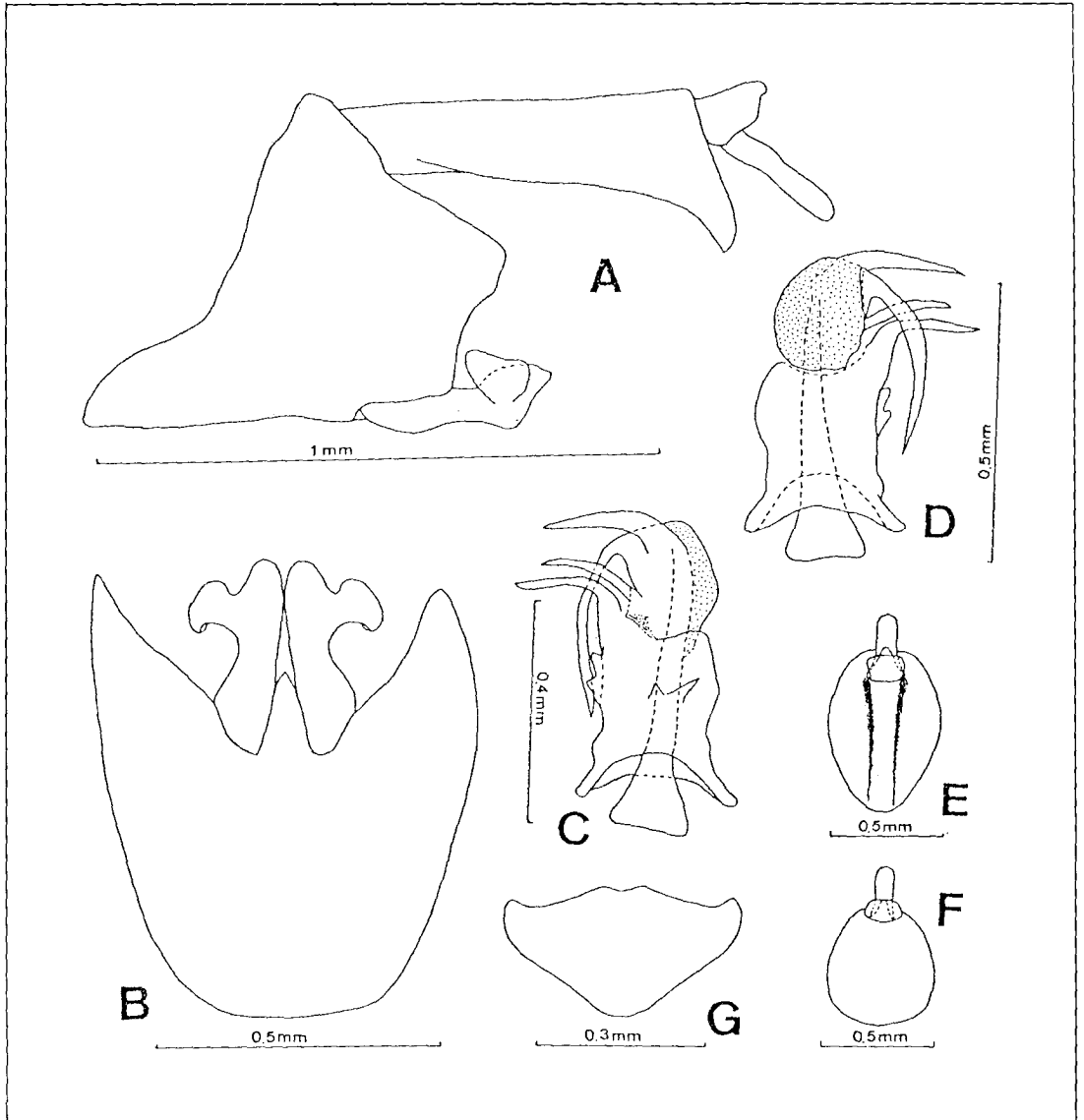


Fig. 5. *O. formosanus* Matsumura. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C-D. Aedeagus. C. Ventral view; D. Dorsal view; E-F. Anal segment, dorsal view. E. Male; F. Female; G. Pregenital sternite of female.

view longer than broad, symmetrically ovate, central portion convex longitudinally from base to anal opening; in lateral view slender and produced into a ventral process lateroapically. Anal style slender. Medioventral process widest at base and tapering distally, longer than broad (1.7:1), reaching to half length of genital style. Genital styles in ventral view symmetrical, slightly narrowing medially; in lateral view

obscure medioventral process; apex bilobed, outer lobe covering most portion of inner one. Aedeagus in total with four long spinose processes, all visible in ventral orientation: one slender process implanted on left side of sclerotized perianthium and turned left, one nearly straight and slender, slightly above the former, one acuminate, implanted on apex also turned left, one compressed, coiled 180 degrees;

directed cephalically, parallel to membranous flagellum. Sclerified periandrium in ventral view convex lateroapically and with four small, acuminate processes, two on left side, directed caudad, two on median basoventral area, divergent, directed ventrocaudad.

#### Female genitalia:

Anal segment in dorsal view small, ovate. Pygofer with rows of short setae medially. Wax secreting pores nearly same size throughout. Pregenital sternite with two small convex processes submedially. Ovipositor with reduced awl-shaped second valvulae, each with three long setae. Third pairs of valvulae blade-shaped, slightly shorter than anal segment.

Length of body (includ. teg.): Male: 5.00–5.30mm; Female: 5.76–6.49mm.

Length of tegmen: Male: 3.92–4.32mm; Female: 4.59–5.26mm.

Width of mesonotum: Male: 1.35mm; Female: 1.49–1.62mm.

#### Lectotype:

Male (here designated), Hokudo (=Peitou), Taipei 31–VII–1906, HU (examined).

#### Paralectotypes:

4♀♀ Koshun (=Henchun), Pingtung Hsien 7–7–?, HU (examined); 8♂♂ 12♀♀ same data, HU (examined).

#### Additional specimens examined:

1♀ Santiaoling, Taipei Hsien 19–XI–1957, BMNH; 8♂♂ 19♀♀ Wulai, Taipei Hsien 23–IX–1957, BMNH; 1♂ Liukuei, Kaohsiung Hsien III–IV–1964, T. C. Maa, BMNH; 1♂ 2♀♀ Kwanzeling, Tainan Hsien 6–7–IV–1965; 1♂ Shonoryo (=Channaoliao), Chiayi Hsien 11–VI–1932, NCSU; 3♂♂ Wushe, Nantou Hsien 18–V–1919 T. Okuni; 1♂ Lichi, Taitung Hsien 19–III–1924 N. Takeda; 2♂♂ 3♀♀ Nantou Hsien 16–III–? T. Shiraki; 1♂ Wushe, Nantou Hsien 16–VII–1971 C. T. Yang; 1♀ Wufeng, Taichung Hsien 2–XI–1982 C. H. Chen; 1♀ Tadushan, Taichung 30–VIII–1983 C. T. Yang; 1♀ Jihyuetan, Nantou Hsien 8–XII–1983 C. T. Yang; 1♂ Songho, Taichung Hsien

21–XII–1983 C. T. Yang; 2♂♂ 1♀ Hsenping, Kaohsiung Hsien 14–VII–1984 C. T. Yang; 1♀ 15–VII–1984 H. M. Way; 1♀ Toubienkeng, Taichung 25–VIII–1984 J. T. Yang; 1♂ puli, Nantou Hsien 14–XI–1984 C. T. Yang; 1♀ Peipu, Hsinchu Hsien 30–XII–1984 C. T. Yang; 5♂♂ 1♀ Takeng, Taichung 20–IV–1985 M. M. Yang; 1♀ Wufeng, Taichung Hsien 24–VI–1985 S. C. Tsaur; 1♀ Puli, Nantou Hsien 26–X–1985 S. C. Tsaur 5♂♂ 4♀♀ Baolai, Kaohsiung Hsien 21–VII–1985 S. C. Tsaur; 3♂♂ 3♀♀ Kaochung, Kaohsiung Hsien 22–VII–1985 S. C. Tsaur; 1♂ Fuhshing, Taoyuan Hsien 31–VIII–1985 S. C. Tsaur; 1♀ Peitou, Taipei 6–IX–1985 S. C. Tsaur; 6♂♂ 5♀♀ Kuanyinshan, Taipei Hsien 6–IX–1985 S. C. Tsaur; 2♀♀ Nanshanchi, Nantou Hsien 7–IX–1985 S. J. Fang; 1♂ 2♀♀ Wulai, Taipei Hsien 9–IX–1985 S. C. Tsaur; 1♂ 1♀ Chushan, Nantou Hsien 26–X–1985 C. T. Yang; 1♂ 1♀ Chingmei, Taipei 15–VI–1986 T. C. Hsu; 1♂ Palin, Taoyuan Hsien 8–VII–1986 L. Y. Huang; 1♀ Fonkang, Pingtung Hsien 22–VII–1986 C. T. Yang; 1♀ Wanli, Taipei Hsien 11–VIII–1986 C. T. Yang; 1♂ Outei, Taipei Hsien 12–VIII–1986 C. T. Yang; 1♂ 1♀ Chishan, Kaohsiung Hsien 12–VIII–1986 S. C. Tsaur; 1♀ Chiasien, Kaohsiung Hsien 14–VIII–1986 S. C. Tsaur; 1♂ Tayuling, Nantou Hsien 5–IX–1986 S. C. Tsaur; 6♂♂ 8♀♀ Yuanlin, Changhua Hsien 3–III–1987 C. T. Yang; 1♀ Taichung 23–III–1987 C. T. Yang; 1♀ Baolai, Kaohsiung Hsien 29–III–1987 C. T. Yang; 2♂♂ 30–III–1987 C. T. Yang; 2♂♂ 2♀♀ Henchun, Pingtung Hsien 18–IV–1987 C. T. Yang; 3♂♂ Chiabaotai, Taichung Hsien 11–VII–1987 C. T. Yang; 1♀ Kuantaochi, Nantou Hsien 20–VII–1987 C. T. Yang; 1♀ Kukuan, Taichung Hsien 30–VII–1987 C. T. Yang; 1♀ Chingmei, Taipei 17–VIII–1987 I. C. Hsu; 1♀ Wanfang, Taipei 18–VIII–1987 W. J. Wu; 3♀♀ Tachigiao, Taipei Hsien 20–VIII–1987 I. C. Hsu; 1♀ Chihhankung, Taipei 22–VIII–1987 I. C. Hsu; 1♂ Fuyuan, Hualien Hsien 26–VIII–1987 C. C. Chiang; 2♂♂ 4♀♀ Hueisun, Nantou Hsien 7–IX–1987 S. C. Tsaur.

#### Host plant:

Unknown.

**Distribution:**

Taiwan.

**Notes:**

*O. formosanus* similar to *O. scalenus* in appearance, but differs from latter in having symmetrical male anal segment and pygofer. Female could also be separated by shape of anal segment; triangular in *scalenus*, oval in *formosanus*. This is the most commonly collected *Oliarus* in Taiwan. *O. formosanus* also closely resembles *O. insetosus* which is known from Southern China and from some specimens from Taiwan. The observed differences are constant in all examined specimens and is therefore considered as valid species.

***Oliarus tappanus* Matsumura, 1914**

(Fig. 6)

*Oliarus tappanus* Matsumura, 1914:424.

General color black. Body somewhat covered with powdery wax. Pro- and mesonotum bordered yellow on margins. Antennae brown. Legs and median carina of mesonotum brownish black. Tegmina hyaline, veins yellowish, transverse veins fumated with brown; costal margin yellow, covered with concolorous granules, with black spots. Abdomen brown, genital segments yellowish.

Vertex as long as broad, median carina distinct on basal half, lateroapical areolets extending backwards to apical sixth, contiguous at apex, lateral keels slightly converging at apical third. Frons slightly shorter in middle line than wide at widest portion, median carina forked at basal third. Rostrum just attaining hind coxae. Mesonotum with submedian carinae curved outwardly. Tegmen with 9 apical cells and 4 anteapical cells; 3.1 times as long as broad.

**Male genitalia:**

Pygofer asymmetrical, in ventral view smooth, right side convex, inner margin each with a production medially, medioventral process absent, replaced by two small productions; in lateral view dorsolateral angle

quadrate, with sinuate margin beset with many setae. Anal segment in dorsal view longer than broad, asymmetrical, slender, slightly curving to right, convex medially, apices each side with a sharp process directed downward, right one slightly longer than left one; in lateral view very slender, swelling at basal half, narrowing before apical half, posterior margin curving downward near apex then produce a sharp process directed caudad. Anal style short. Genital styles in ventral view surpassing level of angles of pygofer; in lateral view thumb-shaped, apical margin rounded, with many setae along margin. Aedeagus screw-shaped, extending caudad for a long distance, basal half sclerotized, irregular, apical half membranous, with a long tongue-shaped process basoventrad, reaching as long as aedeagus. Flagellum in lateral view covered by aedeagus basally then curving 180 degrees covering anterior margin of aedeagus, basal third protruding a club-shaped process, recurving caudad at apical half forming a circle and a acuminate process directed left, another pointed process originating from recurving portion, directed ventrad. Central portion of circle membranous, with a cylindrical process directed left.

**Female genitalia:**

Pygofer with many short, equal length setae arranging tightly at middle not touching anterior and posterior margins, some loose ones arranging along lateral margins. Wax secreting pores uniformly small. Anal segment in dorsal view small, suboval, with many slender setae throughout. Pregenital sternite with convex, rounded process medially. Ovipositor with second valvulae stout for most portion and reduced into needle-like processes subapically. Third pair of valvulae cylindrical, slightly shorter than anal segment. Two pairs of valvulae all beset with setae.

Length of body (includ. teg.): Male: 5.38–5.90mm; Female: 5.94–6.22mm.

Length of tegmen: Male: 4.25–4.72mm; Female: 5.00–5.14mm.

Width of pronotum: Male: 1.41–1.51mm; Female: 1.48–1.51mm.

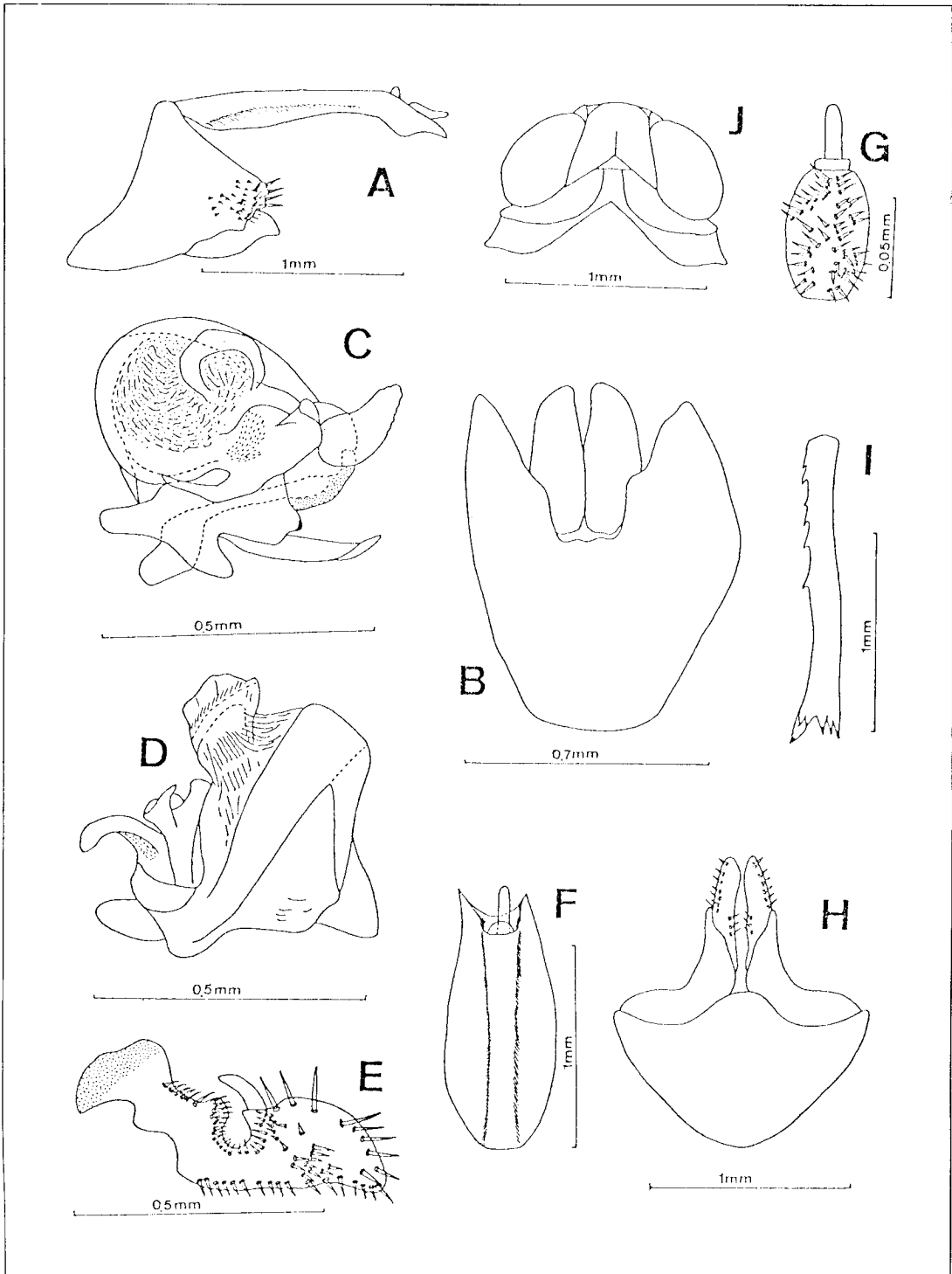


Fig. 6. *O. tappanus* Matsumura. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Lateral view; D. Caudal view; E. Left genital style, Lateral view; F–G. Anal segment, dorsal view. F. Male; G. Female; H. Pregenital sternite and valvulae, ventral view; I. Hind tibia; J. Vertex and pronotum, dorsal view.

**Lectotype:**

Male (here designated), "Formosa, Matsumura, Tappan, 24-VI-1907", originally in same *Sambucus* as paratype, now replaced on a separate needle, HU (examined).

**Paralectotypes:**

1♀ same data as lectotype, HU.

**Additional specimens examined:**

1♂ Tungpu, Nantou Hsien 8-XII-1963 T. C. Maa, BPBM; 2♀♀ Taitung, Taitung Hsien 25-II-1919 J. Sonan; 1♀ Meishan, Kaohsiung Hsien 25-X-1981 C. T. Yang; 1♂ Kukuan, Taichung Hsien 3-V-1983 J. J. Perng; 1♂ Shihtyutou, Nantou Hsien 31-X-1985 S. C. Tsaur; 1♂ Tachigiao, Taipei Hsien 5-XI-1985 C. C. Chiang; 1♂ Ssuling, Taoyuan Hsien 21-VI-1986 C. C. Chiang; 1♀ Litao, Taitung Hsien 12-VIII-1987 M. L. Chan; 1♀ Shiao-wulai, Taoyuan Hsien 13-XI-1987 S. C. Tsaur.

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

The most diagnostic characters of *O. tappanus* are the highly variable aedeagal complex, related to *O. kurseongensis* in the structure of the vertex and general structure of the genitalia.

***Oliarus mori* Matsumura, 1914**

(Fig. 7)

*Oliarus mori* Matsumura, 1914:426.

General color black. Female darker than male. Body not covered with powdery wax. Head and pronotum black with yellow keels and borders. Ocelli, antennae and median carina of frons yellowish brown. Lateral keels of vertex yellow in basal half. Tegmina hyaline in male, grayish black in female; veins and stigma yellowish. *Sc+R* forked at same level

as *Cu*. Legs yellow, femora fuscous. Abdomen brown, genital styles and part of pygofer yellowish.

Vertex moderately narrow, 1.6 times as long as broad, without median carina, lateroapical areolets extending backwards to basal half, contiguous at apex, lateral keel strongly elevated at basal half. Frons as long in middle line as wide at widest portion, median carina forked at basal fourth. Rostrum attaining hind coxae. Tegmen with 10-11 apical cells and 5 anteapical cells, 3.1 times as long as broad. Hind tibia sometimes with more than 3 (5-6) lateral spines.

**Male genitalia:**

Pygofer asymmetrical, in dorsal view deeply incised medially; in lateral view dorso-lateral angle produced a triangular lobe with several long setae along margin; in ventral view narrowing medially, each inner side with a rounded production medially, medioventral process widest at base and tapering distally, small, longer than broad (1.5:1). Anal segment in dorsal view asymmetrically ovate, longer in middle line than wide at widest portion; in lateral view dilating apically; in caudoventral view each lateroapical angle with a rounded production, right one larger than left one. Genital styles symmetrical, in lateral view straight for most portion and curving mesad apically, projecting a pointed process anteriorly, a stout production posteriorly, another small thumb-shaped production set before it, anterior margin with a convex lobe medially. Aedeagus in total with five spinose processes, all visible in dorsal orientation: in lateral view banana-shaped, a distinct process originating from anterior fourth, directed to right, right side of flagellum with a stout production originating basally; in dorsal view slightly shorter than aedeagus (twice as large in one specimen labelled: Formosa, M. Kato"), an awl-shaped process at midway of left lateral side, another awl-shaped process at right apical angle, directed cephalad, a rounded production on opposite position, a bifurcated process originating apically then curving to right, upper one shorter than lower one.

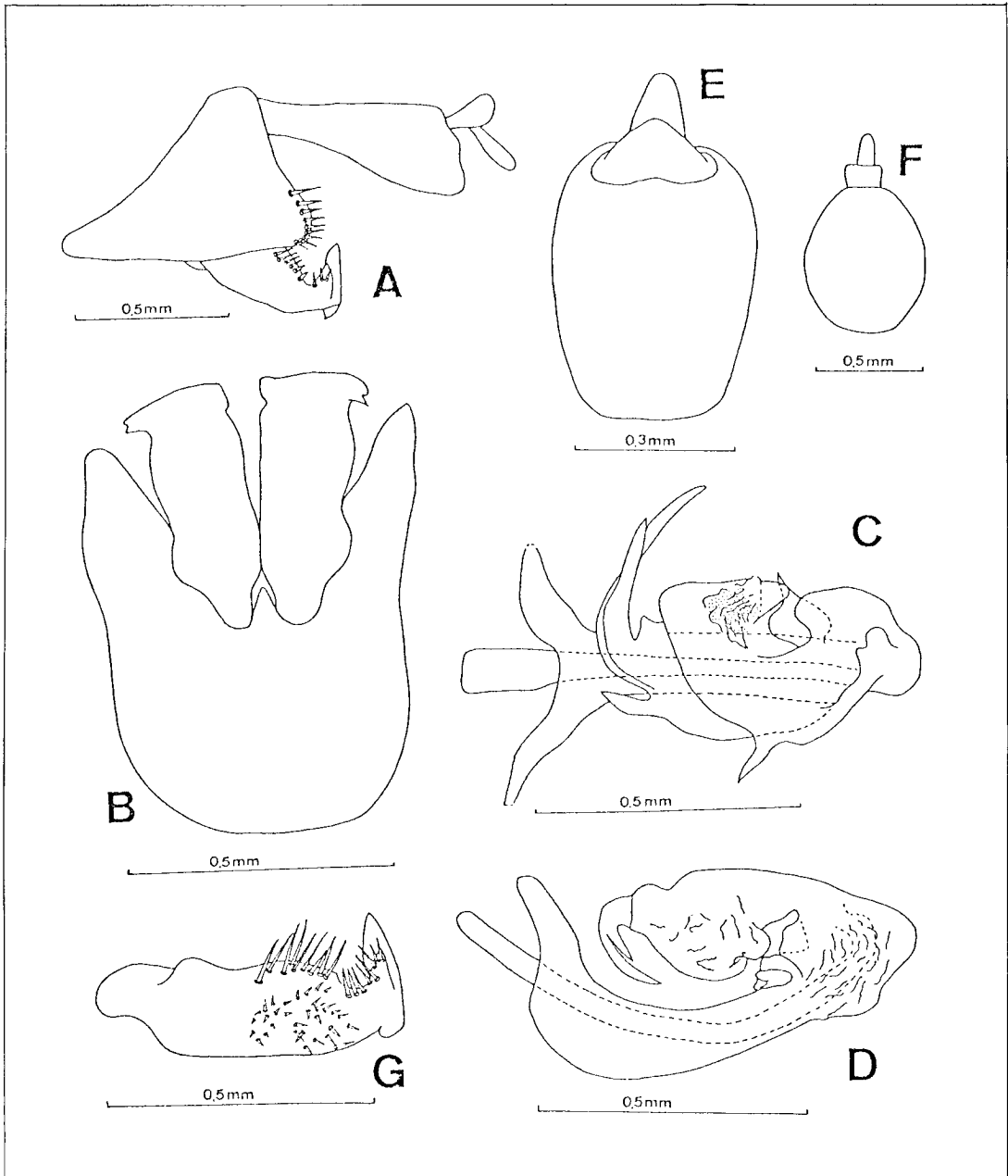


Fig. 7. *O. mori* Matsumura. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Dorsal view; D. Lateral view; E–F. Anal segment, dorsal view. E. Male; F. Female; G. Left genital style, lateral view.

#### Female genitalia:

Pygofer with rows of short setae medially, arranging subtriangularly, a row of setae along anterior to lateral margin, lower portion with

scattered setae arranging in a hollow semicircle which curving upward. Wax secretieng pores all equal size. Anal segment gently rounded, slightly broader apically, with thumb-shaped anal style above lower apical margin. Pregenital



sternite with two very small convex processes submedially. Ovipositor with reduced rounded second valvulae which each protruding backwards an awl-shaped process. Third pair of valvulae bifurcated, finger-shaped, longer than anal style.

Length of body (includ. teg.): Male: 5.14–5.68mm; Female: 6.35–6.76mm.

Length of tegmen: Male: 4.05–4.59mm; Female: 5.14–5.41mm.

Width of mesonotum: Male: 1.35–1.49mm; Female: 1.49–1.62mm.

**Lectotype:**

Male (here designated). "Formosa, Takao (=Kaohsiung), 4-IV-1907", HU (examined).

**Paralectotypes:**

2♂♂ 2♀♀ (examined), same data as lectotype, HU.

**Additional specimens examined:**

1♂ Pulj, Nantou Hsien 10-V-1913 M. Maki; 1♂ Uraj (=Wulaj), Taipei Hsien 1-IV-1932, NCSU; 2♂♂ Musha (=Wushe), Nantou Hsien 20-V-1932 L. Gressitt, NCSU; 1♂ Wulaj, Taipei Hsien 17-IV-1965, C. M. Yoshimoto, BPBM; 1♂ M. Kato, BMNH; 1♀ Kukuan, Taichung Hsien 27-VIII-1971 C. T. Yang; 4♂♂ 7♀♀ Wufeng, Hsinchu Hsien 6-IV-1981 T. C. Hsu; 2♀♀ Chubing, Nantou Hsien 25-VII-1984 C. T. Yang; 3♀♀ 26-VII-1984 S. C. Tsaur; 1♀ Kuantaoshan, Nantou Hsien 5-V-1985 S. C. Tsaur; 1♀ Fuhsing, Taoyuan Hsien 12-V-1985 S. C. Tsaur; 1♂ 1♀ 7-VII-1986 S. C. Tsaur; 1♂ Tsuifeng, Nantou Hsien 26-VII-1986 T. C. Hsu.

**Host plant:**

*Morus alba* L. (Moraceae).

**Distribution:**

Taiwan.

**Notes:**

This species resembles *bifidus*, *elevatus* by

having the same type of genital styles and pygofer but can be easily recognized by the shape of anal segment, ovate in *mori*, oblique decline to right in *bifidus*, oblique decline to left in *elevatus*.

*Oliarus chiangi*\* n. sp.  
(Fig. 8)

General color black. Body very slightly covered with powdery wax. Borders of vertex, face and ocelli yellow. Median carina of face brown. Tegmina milky hyaline, each with three black markings on forks of claval vein, *Cu* and *Sc+R* respectively.

Vertex moderately convex at middle portion, 1.5 times as long as broad, median carina distinct on basal half, lateroapical areolets extending backwards to basal half, contiguous at apex. Frons slightly shorter in middle line than wide at widest portion, median carina forked at basal fourth. Rostrum slender, reaching hind coxae. Tegmen with 11 apical cells and 5 anteapical cells, 3.1 times as long as broad, veins without any tiny seta. Hind tibia with 4–5 lateral spines.

**Male genitalia:**

Pygofer symmetrical, in ventral view slightly narrowed across level of basal margin, dorsolateral angles stout, only narrowing to ends at apical fourth; in lateral view dorsolateral angle with a rounded production, central portion beset with many short setae. Anal segment in lateral view dilating to apex, ventrolateral margin produced; in dorsal view oblique oval. Anal style in profile short, slightly sclerotized, membranous and hyaline for most portion. Medioventral process small, equilateral triangular. Genital styles in ventral view symmetrical, parallel-sided, only curving outward apically, forming a beak-shaped process dorsolaterally; in lateral view margins smooth, curving upward at apical half, forming a acuminate, reflexed process, directed outward, with a flap-shaped process subapically. Aedeagus sclerotized for most portion, mem-

\* Named after the collector Mr. C. C. Chiang.

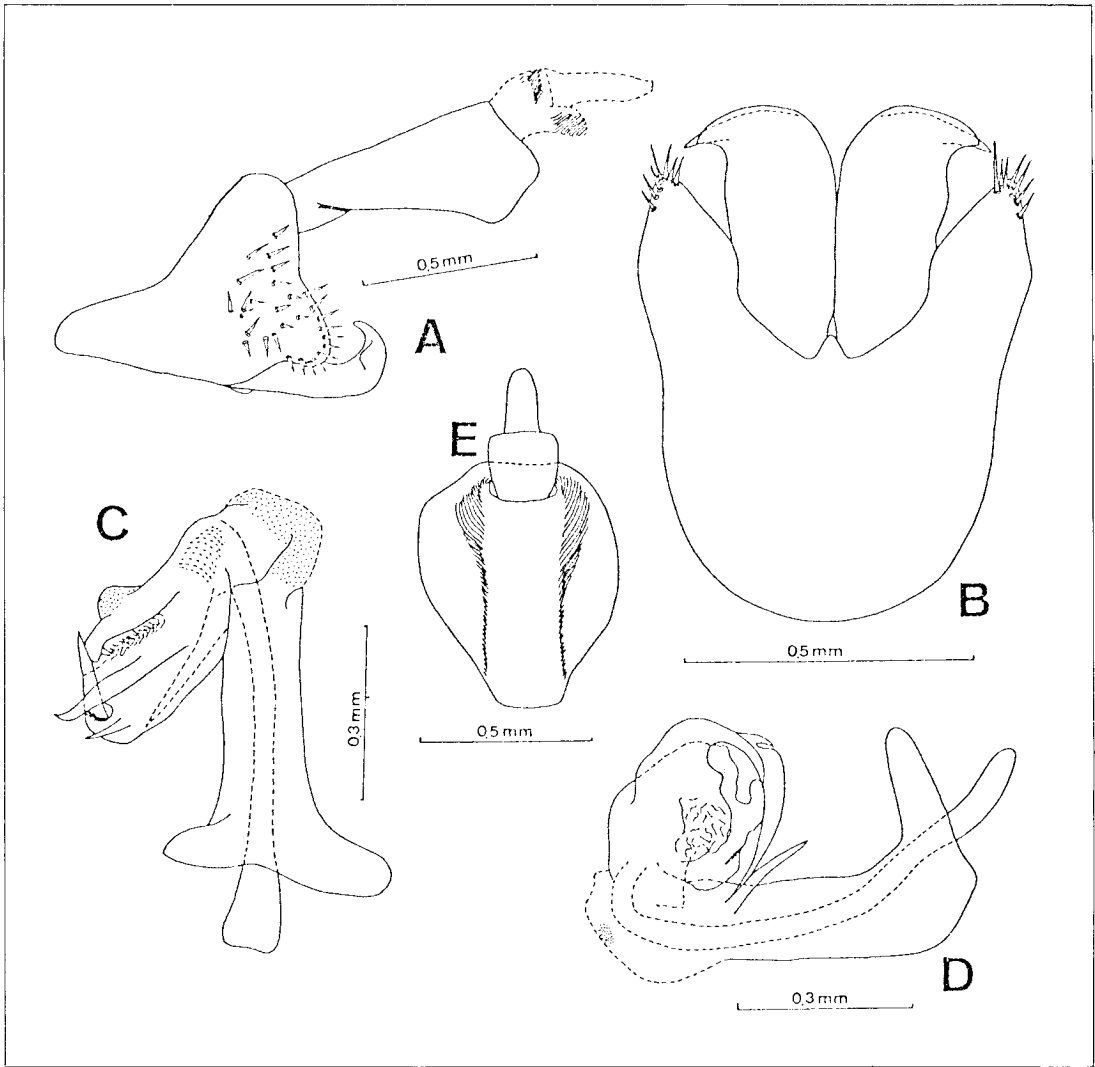


Fig. 8. *O. chiangi* n. sp. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Acedeagus. C. Dorsal view; D. Lateral view; E. Anal segment of male, dorsal view.

braneous and translucent at apical fourth, in total with four spinose processes, all visible in right-side orientation: one moderately long, implanted on right, dorsal margin, straightly directed dorsocephalad, flagellum strongly sclerotized, in dorsal view spiral-shaped, with three sinistral processes; in lateral view the largest one arising from apical margin then curving along flagellum, directed ventrocaudad, the smallest one originating dorsad, above the former, directed right side, the moderate one swollen basally, evenly reduced distally,

originating centrodorsad, smoothly curving downward, parallel with the formers.

Female unknown.

Length of body (includ. teg.): Male: 5.54–5.74mm.

Length of tegmen: Male: 4.73–4.80mm.

Width of mesonotum: Male: 1.47–1.49mm.

**Holotype:**

Male, Palin, Taoyuan Hsien 18–IV–1986

C. C. Chiang. (dissected, deposited in NTU)

**Paratype:**

Male, Tungpu, Nantou Hsien 16-20-IV-1984 K. C. Chou & C. H. Yung. (dissected, deposited in TARI)

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

*Oliarus bifidus*\* n. sp.  
(Fig. 9)

Body not covered with powdery wax. Ocelli light yellow. Posterior margin of pronotum, basal half of lateral keels of vertex yellow. Frons bordered with yellowish brown on margins. Tegmina hyaline, with a black stripe above fork of claval vein, gloomy at basal fourth.

Vertex 1.6 times as long as broad, median carina distinct on basal third, lateroapical areolets extending backwards to basal half, contiguous at apex. Frons slightly longer in middle line than wide at widest portion, median carina forked at basal third. Rostrum reaching hind coxae. Tegmen with 11 apical cells and 5 antepical cells, 3.2 times as long as broad. Hind tibia sometimes with more than 3 (7-8) lateral spines.

**Male genitalia:**

Pygofer asymmetrical, dorsolateral angle produced into a rounded lobe, in dorsal view deeply incised medially; in ventral view narrowing medially, each inner side with a small, rounded production medially, medioventral process small, widest at base and tapering distally, longer than broad (1.6:1). Anal segment in dorsal view longer than broad, asymmetrical ovate, base with concave right side; in lateral view dorsolateral angles produced downward in both sides, ventrolateral

angle with a rounded production, directed ventrad. Anal style enclosed by ends of anal segment. Genital styles in ventral view asymmetrical, right one stouter than left; in lateral view posterior margin nearly straight, only curving apically forming a hook-shaped process, directed outward, with a small, triangular concavity subapically, anterior margin with a rounded production medially, a small production at three-fourths, a thumb-shaped process subapically. Aedeagus in total with three spinose processes, all visible in dorsal orientation: right one implanted subapically, directed inwardly, curving upward to mid-length, downward to apex; left side of flagellum with two, slender one implanted on lateroapically, curving dorsad (apical half broken in paratype), flagellum terminating in a spine on left near apex, forked at apical third, directed cephalad. Ventroapical margin of aedeagus bearing a small, sclerotized spines (absent in paratype).

Female unknown.

Length of body (includ. teg.): Male: 6.89 mm.

Length of tegmen: Male: 5.54mm.

Width of mesonotum: Male: 1.89mm.

**Holotype:**

Male, Litao, Taitung Hsien 13-VIII-1987 S. C. Tsaur. (dissected, deposited in NTU)

**Paratype:**

Male, Shanpalin, Taoyuan Hsien 15-V-1985 C. J. Yu. (dissected, deposited in NCHU)

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

This species closely related to *O. cucullatus* but differs from latter in having a right, ventrolateral process on aedeagus.

\* *L. bifidus* - bifurcated, indicated the long dorsal process which forked apically.

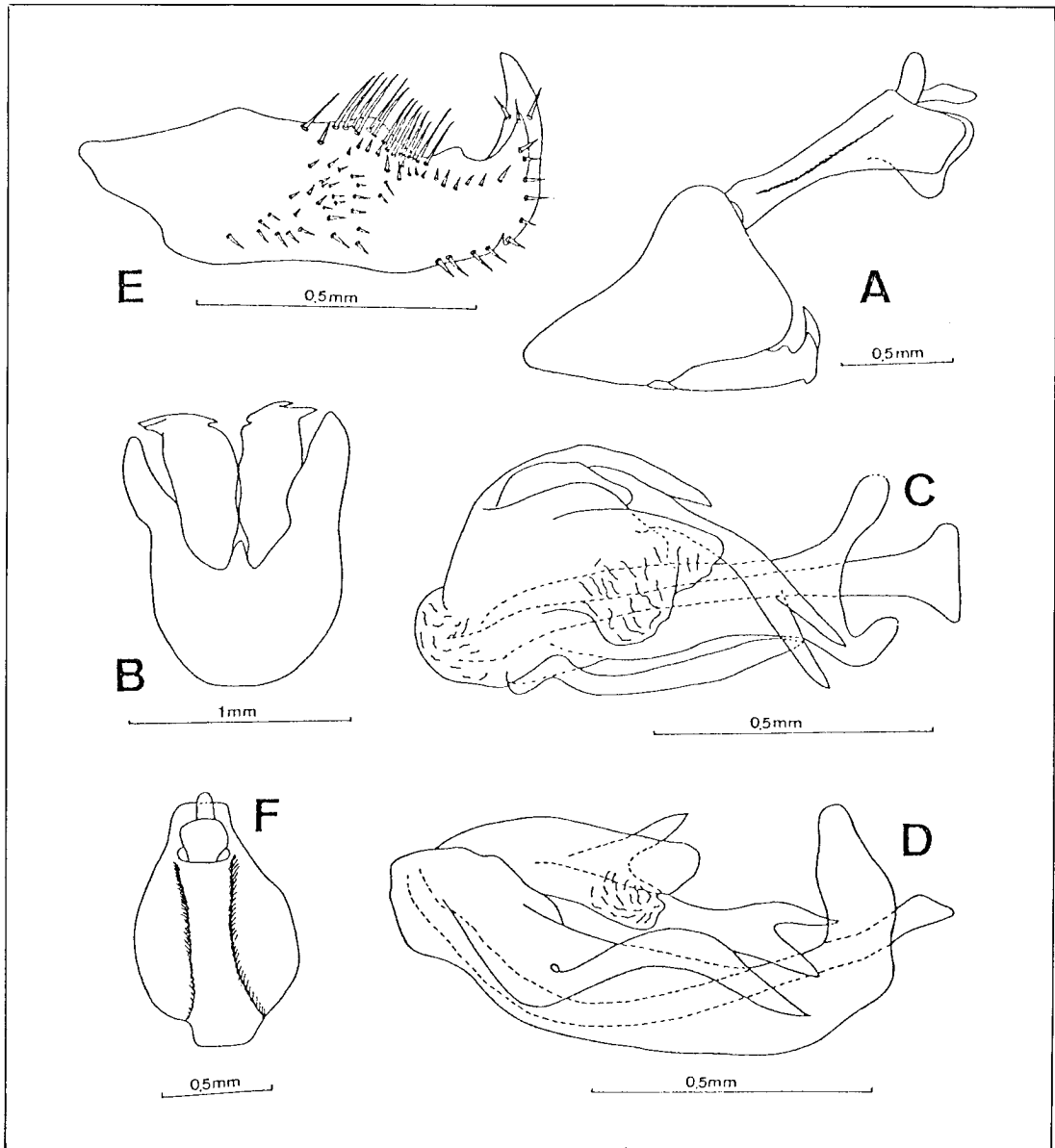


Fig. 9. *O. bifidus* n. sp. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Dorsal view; D. Lateral view; E. Left genital style, lateral view; F. Anal segment of male, dorsal view; G. Male anal segment, dorsal view.

*Oliarus elevatus*\* n. sp.  
(Fig. 10)

Body not covered with powdery wax.  
Ocelli light yellow. Lateral keels of vertex light

yellow basally, a yellow marking outside lateral keel before eye. Tegmina translucent, fulvous on basal half. Borders of frons and pronotum yellowish brown.

Vertex narrowly protruding forwardly, 1.1

\* *L. elevatus* – raised, indicated the strongly elevated lateral keels of vertex.

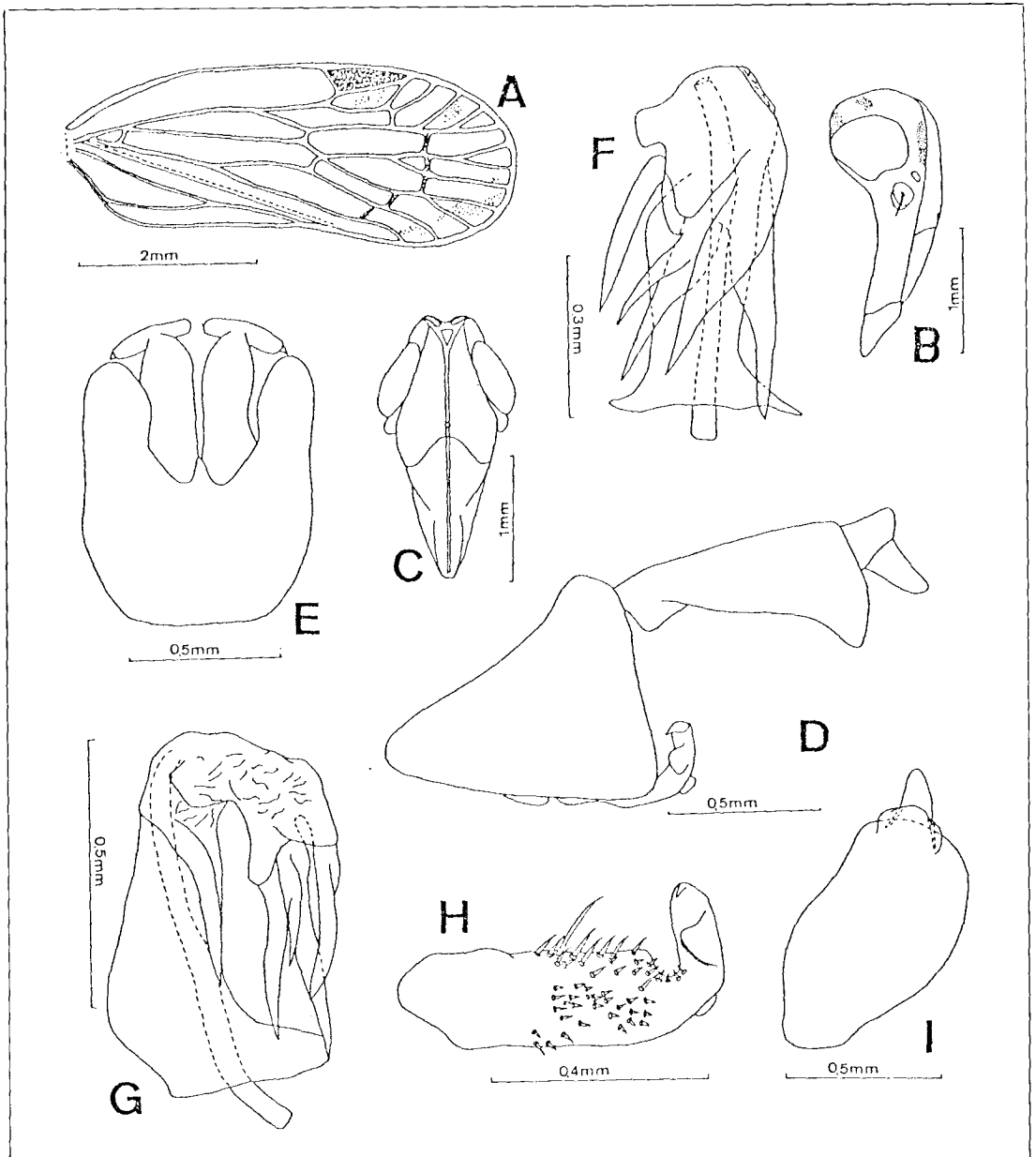


Fig. 10. *O. elevatus* n. sp. A. Tegmen; B–C. Head. B. Lateral view; C. Ventral view; D. Male genitalia, lateral view; E. Pygofer and genital styles, ventral view; F–G. Aedeagus. F. Dorsal view; G. Lateral view; H. Left genital style, lateral view; I. Anal segment of male, dorsal view.

times as long as broad, lateral keels strongly elevated medially thus forming a deeply incised concavity, median carina feeble on basal fourth, lateroapical areolets extending backwards to basal fourth contiguous at apex. Frons longer

median carina forked at basal fourth. Rostrum attaining hind coxae. Submedial carinae of mesonotum feeble. Tegmen with 12 apical cells and 5 anteapical cells, 2.1 times as long as broad. Hind legs with 3 lateral spines in

**Male genitalia:**

Pygofer asymmetrical, in lateral view slightly triangular, medioventral process in ventral view short and stout, widest at base and tapering distally, as long as broad. Anal segment in dorsal view oblique, obviously decline to left, longer than broad, with sub-triangular anal style; in lateral view lateroapical angle produced, inside dilating. Genital styles in ventral view T-shaped, nearly same width for most portion only narrowing subapically; in lateral view stout and same width before apical third, dorsal margin deeply concave in apical third then curving upward, forming a finger-shaped process which with a fin-like production at left side and a small triangular process apically, directed outside. Aedeagus in total with five long spinose processes, all visible in dorsal orientation, directed cephalad, slender: one implanted on right side of sclerified perandrium at apical third; another four originating from recurving portion, right one the longest, with basal half stout, apical half 1/2 width as basal, upper one acuminate to end, left one bifurcated, the lower longer than the upper one.

**Female genitalia:**

Pygofer with many short, equal length setae arranging tightly at middle not touching anterior and posterior margins, some loose ones arranging along lateral margins. Wax secreting pores uniformly small. Anal segment quadrate, longer than wide. Pregenital sternite with two convex processes submedially. Ovipositor with reduced, rounded second valvulae, each with a pointed process. Third of valvulae finger-shaped.

Length of body (include. teg.): Male: 6.17 mm; Female: 7.43mm.

Length of tegmen: Male: 5.45mm; Female: 6.22mm.

Width of mesonotum: Male: 1.35mm; Female: 2.57mm.

**Holotype:**

Male, Wanfeng Hill, Taichung Hsien, ?—

VIII—1984 K. S. Lin & K. C. Chou (dissected, deposited in TARI).

**Paratypes:**

1♂ without collecting label (dissected, deposited in NTU); 1♀ Ibuki (in Japanese), Honshu, Japan 22—VIII—? (in NTU).

**Host plant:**

Unknown.

**Distribution:**

Taiwan, Japan.

**Notes:**

Female genitalia and male anal segment similar to *O. velox* but can be easily recognized by the lateral keels of vertex strongly elevated.

***Oliarus velox* Matsumura, 1914  
(Fig. 11)**

*Oliarus velox* Matsumura, 1914:425.

Body not covered with powdery wax in male, very slightly in female. Head ochreous to brown, with paler keels. Ocelli light yellow. Pronotum pale ochreous. Mesonotum brown, on each side with two paler longitudinal streaks between the two outer keels. Tegmina milky hyaline, veins yellowish with concolorous granules; stigma and transverse veins fumated with brown; costal margin yellow, without granules; *Sc+R* forked at same level as *Cu*. Legs yellow.

Vertex 2.1 times as long as broad, surface deeply excavated and hereby forming prominent lateral keels; subapical keels strongly convex, meeting anterior border and thereby divided into two equal parts, median carina distinct on basal fourth, lateroapical areolets extending backwards to basal third, contiguous at apex, lateral carina strongly elevated distally. Frons narrowed basally about 1/4 as widest portion, shorter in middle line than wide at widest portion, median carina forked at basal third. Rostrum just attaining hind coxae. Tegmen with 11 apical cells and 5 anteapical cells, 3.2 times as long as broad.

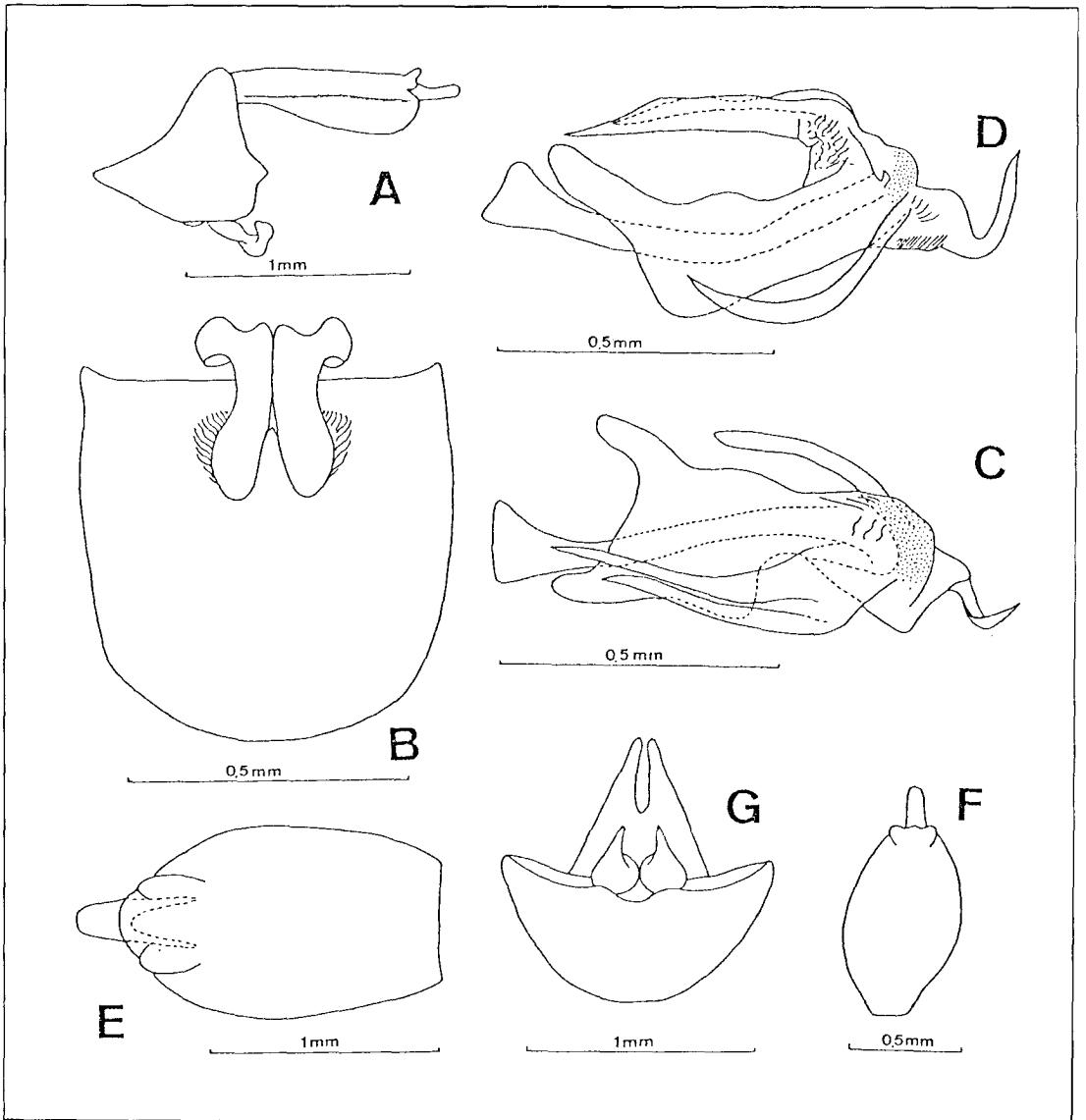


Fig. 11. *O. velox* Matsumura. A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Dorsal view; D. Lateral view; E–F. Anal segment, dorsal view. E. Female; F. Male; G. Pregenital sternite of female.

#### Male genitalia:

Pygofer symmetrical, dorsolateral angle produced into a small, triangular process, medioventral process widest at basal and tapering distally, longer than broad (1.9:1). Anal segment in dorsal view longer than broad, asymmetrically ovate, inclined to left side at apical half; in lateral view dilating apically;

in caudoventral view with apical margin curving mesad, in caudal view with a longitudinal slit medially. Anal style short and quadrate. Genital styles in ventral view like a pair of boot which hang upside down, penetrate through pygofer at apical third; in lateral view narrowing medially, dorsolateral margin with a stout production directed dorsad, inner side with a pointed small process also directed dorsad.

Aedeagus in total with four spinose processes, all visible in dorsal orientation: a slender, hook-shaped spine implanted on ventroapical side of sclerified perianthrium, curving ventrad then dorsad, two slender processes originating from recurving portion of flagellum, directed cephalad, one spiral process initially curving to left, terminate curving to right and directed dorsad.

#### Female genitalia:

Pygofer with rows of short setae medially, one single row of setae from mediolateral margins to anterior margin. Wax secreting pores larger in central area, smaller in other portion. Anal segment in dorsal view small, quadrate. Pregenital sternite with two very small, convex processes submedially. Ovipositor with reduced, rounded second valvulae, each with a pointed process. Third pair of valvulae finger-shaped.

Length of body (includ. teg.): Male: 5.41–5.68mm; Female: 6.49–7.28mm.

Length of tegmen: Male: 4.46mm; Female: 5.14–6.08mm.

Width of mesonotum: Male: 1.35–1.49 mm; Female: 1.49–1.62mm.

#### Lectotype:

Male (here designated), "Formosa, Matsumura, Koshun (=Henchun), 5–VII–1906, HU (examined).

#### Paralectotype:

Female, same data as lectotype (examined).

#### Additional specimens examined:

1♀ Puli, Nantou Hsien 10–V–1913 M. Maki; 1♀ Taitung, Taitung Hsien 25–II–1927 S. Inamura; 1♀ Taipingshan, Ilan Hsien 19–VII–1940 S. Miyamoto; 3♀ Wushe, Nantou Hsien 17–VII–1971 C. T. Yang; 1♂ Chubing, Nantou Hsien 26–VII–1984 S. C. Tsaur; 1♂ Chiabaotai, Taichung Hsien 11–VIII–1987 C. T. Yang.

#### Host plant:

Unknown.

#### Distribution:

Taiwan.

#### Notes:

*O. velox* somewhat resembles *O. hopponis* and *O. boninensis* in the structure of the vertex, the nervation of the tegmina and the general pattern of the male genitalia; *O. velox* is brown instead of black. The main differences are found in the structure of the male genitalia: in *O. velox* the aedeagus bears a hook-shaped spine while such a spine lacks in *O. hopponis* and *O. boninensis*. *O. velox* also superficially resembles the species of the *O. petasatus* group from which it can be distinguished by the totally different structure of the male genitalia. This species can also be easily recognized from the position of genital styles which penetrate pygofer but growing from apical margin of pygofer in other Taiwanese *Oliarus*.

#### *Oliarus horishanus* Matsumura, 1914 (Fig. 12)

*Oliarus horishanus* Matsumura, 1914:418.

–: Esaki, 1932:1777.

General color black dorsally, yellowish brown ventrally. Body covered with powdery wax. Ocelli light yellow. Face two-colored, frons brown, postclypeus pale ochreous, keels pale; a whitish, roundish macula on each side of frontoclypeal suture, in pale specimens connected to each other. Pro- and mesonotum bordered yellow on margins. Mesonotal carinae brownish black. Tegmina milky hyaline, female with a tapering oblique band extending from stigma along the nodal line of cross veins; *Sc+R* forked at same level as *Cu*, costal margin with some granules between base and stigma.

Vertex concave deeply at middle portion, 1.8 times as long as broad, without median carina, lateroapical areolets extending backwards to basal fourth, contiguous at apex. Frons as long in middle line as wide at widest portion, narrowing basally about 1/4 length of widest portion, median carina forked at basal fifth. Rostrum slender, reaching base of hind femora. Tegmen with 12 apical cells and 5



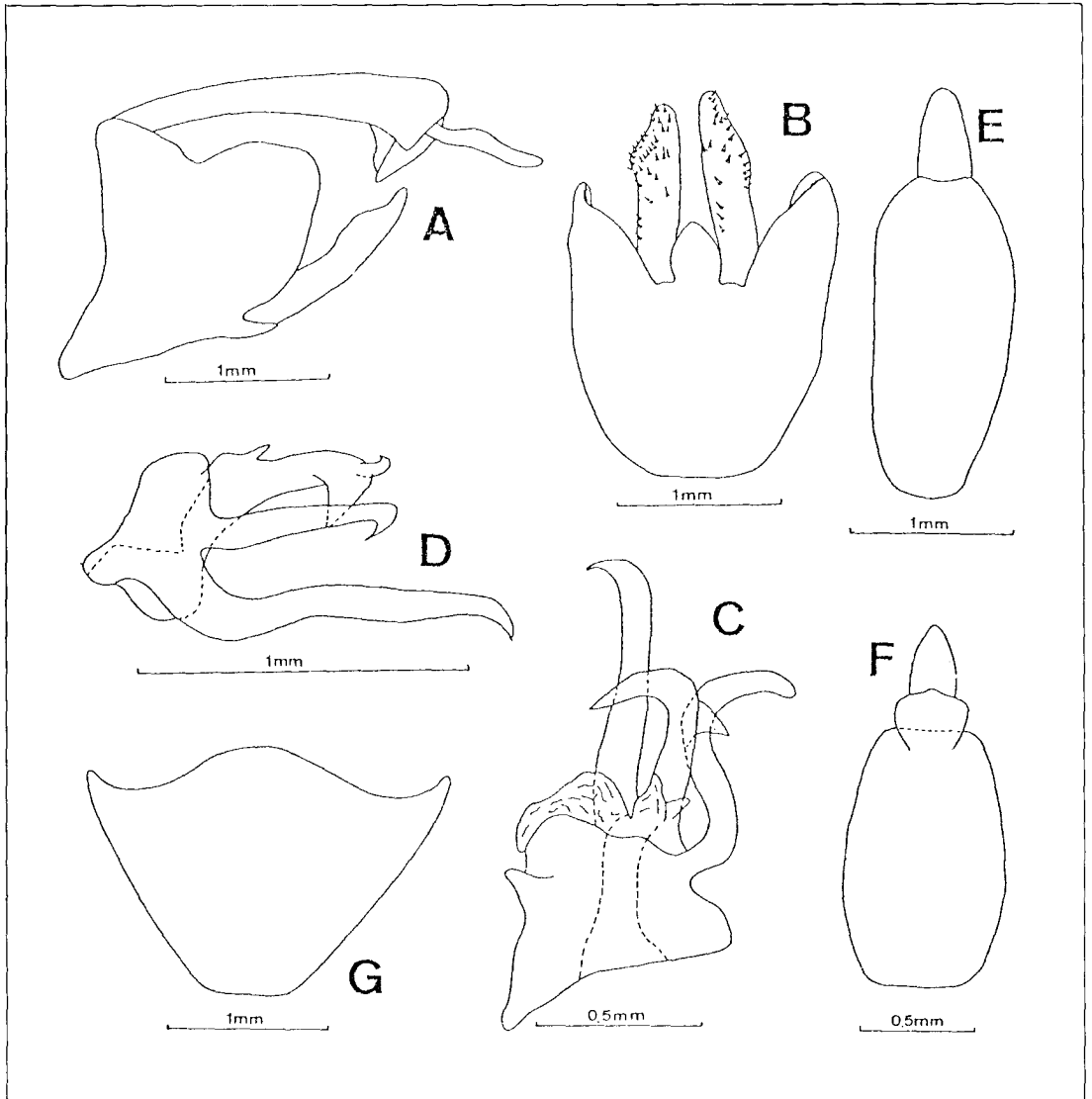


Fig. 12. *O. horishanus* Matsumura A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Dorsal view; D. Lateral view; E–F. Anal segment, dorsal view. E. Male; F. Female; G. Pregenital sternite of female.

anteapical cells. Veins without any tiny seta. Chaetotaxy of hind tarsi usually 7/7, sometimes 7–8/6. Tegmina 3.3 times as long as broad.

#### Male genitalia:

Genitalia variable and slightly asymmetrical. Lectotype: Anal segment long, with a small apical process on right side. Pygofer incised on right margin. Genital styles with right lobe somewhat longer than left lobe.

Aedeagus with three spinose processes inserted on base, the median process flat and forked at apex. In the male from "Hassenzan" (=Bahsien-shan) pygofer rounded on left and right side, not incised on right side; genital styles asymmetrical, apex longer than which of lectotype. Aedeagus with larger right spinose process than in the lectotype, both other spines show minor differences in shapes. In male form "Suisha" (=Shuishu) anal segment and pygofer shaped

like those of the lectotype; the genital styles less asymmetrical than in the preceding specimen; aedeagus with apical part of the spine inserted on left side, more curved ventrally than in the case in the lectotype.

#### Female genitalia:

Pygofer without any seta on surface. Wax secreting pores all uniformly small. Anal segment in dorsal view oblong, widest at basal third then narrowing to both ends, 1.6 times as long as broad in widest portion. Anal style subtriangular. Pregenital sternite produced in middle and excavated laterally, cephalic border rounded. Ovipositor with first pair of valvulae thickened basally. Anal segment oblong, 1.6 times as long as broad in widest part.

Length of body (includ. teg.): Male: 9.62–9.73mm; Female: 10.4–11.5mm.

Length of tegmen: Male: 7.58–8.09mm; Female: 8.65–9.32mm.

Width of mesonotum: Male: 2.43–2.57mm; Female: 2.57–2.73mm.

#### Lectotype:

Male (here designated), "Formosa, Matsumura, Gyochi (=Yuechih), 21–III–1904", HU (examined).

#### Paralectotypes:

1♂ (last segments of abdomen missing), 1♀ "Formosa, Matsumura, Arisan (=Alishan), 25–VI–1909", HU (examined); 1♂ "Formosa, Matsumura, Rinkihō (=Chushan), 23–IV–1907"; 1♀ "Formosa, Matsumura, Horisha (=Puli), 30–IV–1907", HU (examined).

#### Additional specimens examined:

1♂ Hassenzan (=Bahsienshan) 26–VI–1934, NCSU; 1♂ Suisha (=Shuishē) 1–VI–1934, NCSU; 1♂ 2♀♀ Hokki (=?) 14–17–V–1934, NCSU; 1♀ Henchun, Pintung Hsien 15–V–1918 J. Sonan; 1♀ (abdomen lost) Channaoliao, Chiayi Hsien 30–IV–1931 T. Shiraki; 1♀ Peito, Taipei ?–?–1934 T. Miwa; 1♀ Yangminshan, Taipei 3–VI–1934 S. Issiki; 1♂ Lalashan, Taoyuan Hsien 16–VII–1939 K. Endo; 1♀ Henchun, Pintung Hsien 4–IV–1940

R. Matsuda; 1♀ Kukuan, Taichung Hsien 14–VIII–1971 C. T. Yang; 1♂ 1♀ Wuchieh, Nantou Hsien 26–VII–1984 S. C. Tsaur; 1♀ Chingmei, Taipei 15–VI–1986 T. C. Hsu; 1♂ Shihtoushan, Hsinchu Hsien 17–V–1987 W. J. Wu; 3♂ 4♀♀ Hueisun, Nantou Hsien 5–IX–1987 S. C. Tsaur; 4♀♀ 8–IX–1987 Songfongshan, S. C. Tsaur.

#### Host plant:

Unknown.

#### Distribution:

Japan, Taiwan.

#### Notes:

*O. horishanus* can be easily separated from other *Oliarus* species by its gigantic body and the shape of the male genitalia. Sexual dimorphism appeared in this species: male is paler and smaller than female; female tegmen with a tapering oblique band extending from stigma along the nodal line of cross veins which is absent in male. *O. horishanus* is closely related to *O. nigronervatus* Fennah. With the material presently available it is impossible to decide whether both forms are synonyms or separate species. The examined specimens differ from *O. nigronervatus* only in details of the structure of the male genitalia: the left side of the pygofer is rounded while excavated on dorsal part in *O. nigronervatus*, and the left spines on the aedeagus is less curved than is the case in *O. nigronervatus*.

#### *Oliarus* sp1 incertae sedis (Fig. 13)

Body not covered with powdery wax. Ocelli yellow. Vertex with lateral keels light yellow at basal half. Pronotum dark brown. Tegmina translucent only black dorsoapically, with four distinct black spots, two at forks of claval vein and *Cu* respectively, one on *M* at basal four-fifths, one between ends of *Cu*<sub>2</sub> and claval suture. Wing black at dorsoapical angle.

Vertex 1.3 times as long as broad, median carina obscure, with many transverse stripes.

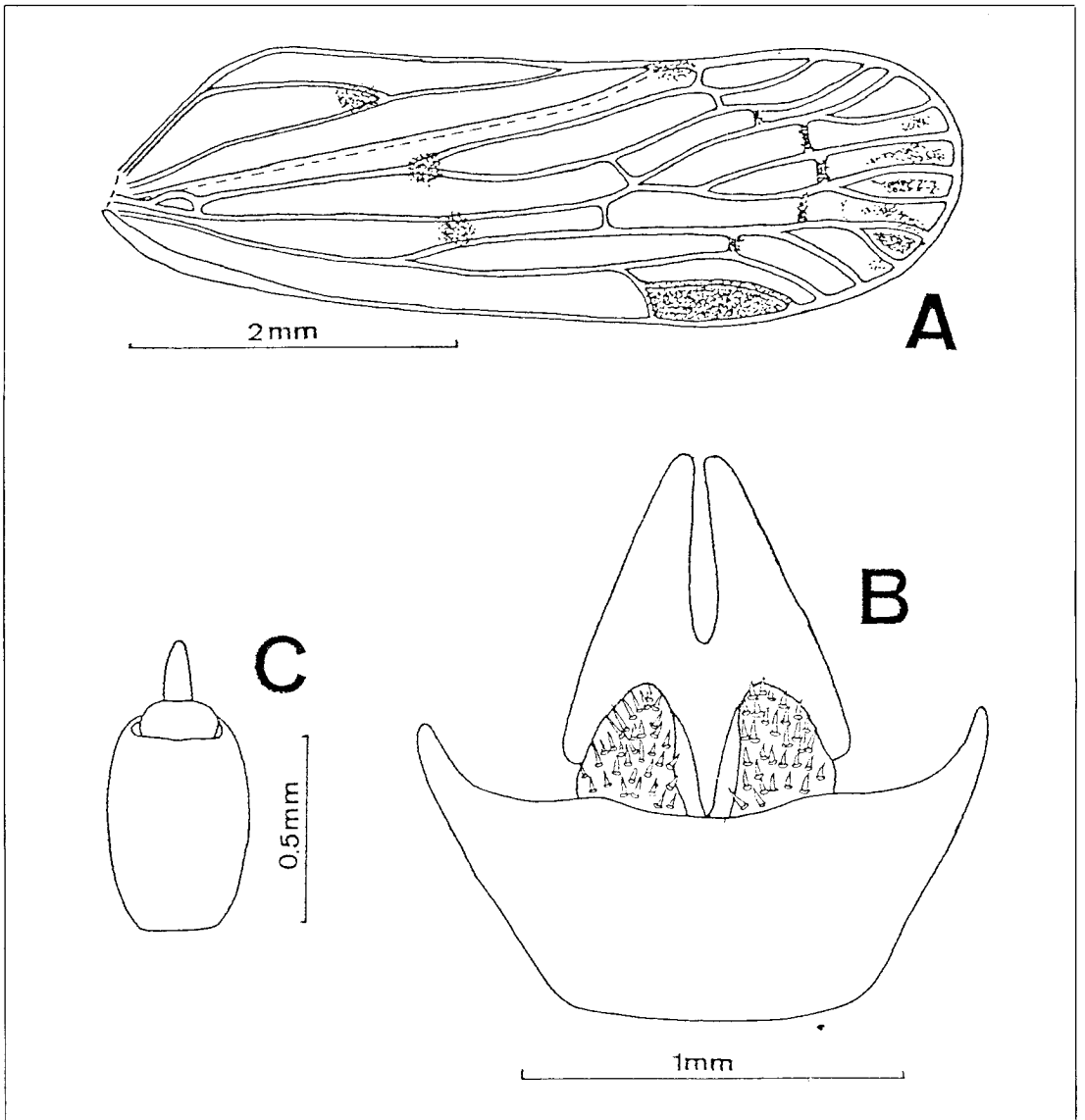


Fig. 13. *O. sp1* A. Tegmen; B. Pregenital sternite and valvulae, ventral view; C. Anal segment of female, dorsal view.

Frons slightly shorter in middle line than wide at widest portion, median carina forked at basal third. Rostrum just attaining hind coxae. Tegmen with 11 apical cells and 5 anteapical cells, 2.9 times as long as broad. Hind tibia with 6 lateral spines.

#### Female genitalia:

Pygofer with rows of short setae medially, upper margin with a row of setae, lower margin

with scattered setae arranging in a hollow semicircle which curving upward. Anal segment in dorsal view quadrate, widest medially. Pregenital sternite with two very small convex processes submedially. Ovipositor with reduced, thumb-shaped second valvulae protruding backward, densely covered with setae. Third pair of valvulae bifurcated, finger-shaped, longer than anal style.

Male unknown.

Length of body (includ. teg.): Female:  
7.57mm.

Length of tegmen: Female: 5.14mm.

Width of mesonotum: Female: 2.03mm.

wish to name it to avoid taxonomic problems  
in future.

*Oliarus* sp2 *incertae sedis*  
(Fig. 14)

**Specimen examined:**

Female, North Tungyaenshan, Nantou  
Hsien 23--VII--1985 S. J. Fang. (dissected,  
deposited in NCHU)

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

The black spots of tegmina resembles *O. tappanus*, differs from latter in having thumb-shaped second valvulae which stout for most portion and reduced into a needle-shaped process subapically in latter. This species was only represented by female and thus we don't

General color dark black. Ocelli, borders of face and basal half of lateral keels of vertex yellow. Median carina of face and submedian carinae of pronotum brown. Tegmina milky white, with black markings as figured. Wing black at dorsoapical angle.

Vertex 1.4 times as long as broad, median carina feeble on basal half. Frons as long in middle as wide at widest portion, median carina forked at basal fourth. Rostrum lost. Tegmen with 11 apical cells and 5 anteapical cells, 3.4 times as long as broad.

**Female genitalia:**

Pygofer with rows of short setae medially, arranging ovate, ventrolateral margin with scattered setae. Anal segment in lateral view

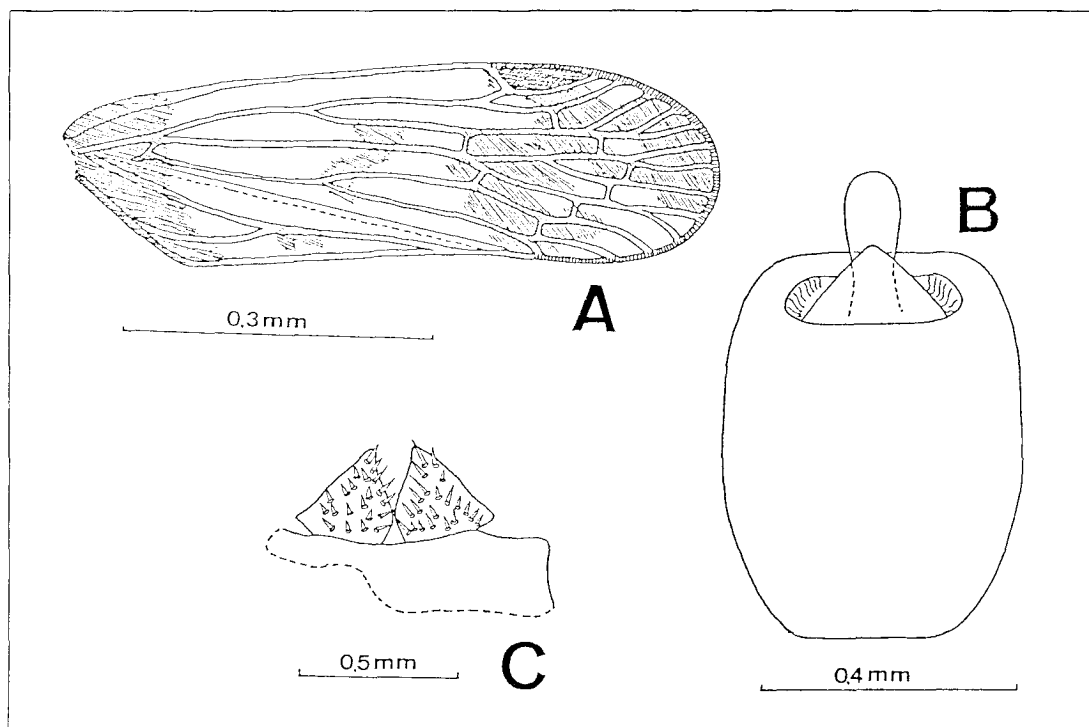


Fig. 14. *O. sp2* A. Tegmen; B. Anal segment of female, dorsal view; C. Pregenital sternite and valvulae, ventral view.

flattened, slight dilating to apex, in dorsal view cup-shaped. Pregenital sternite with two very small convex processes. Ovipositor with reduced, rounded second valvulae each bearing a short, pointed process apically. Third pair of valvulae lost.

Male unknown.

Length of body (includ. teg.): Female:  
7.70mm.

Length of tegmen: Female: 6.62mm.

Width of mesonotum: Female: 2.02mm.

**Specimen examined:**

Female, Kukuan, Taichung Hsien 26-IV-1987 W. H. Chen. (dissected, deposited in NCHU)

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

The specimen was kept in poor condition which rostrum, fore and midlegs, part of thorax and abdomen were lost or spoiled. Comparison with other females, this species is easily diagnosed by the markings of tegmina, shape of vertex and anal segment. This species was only represented by female and thus we don't wish to name it to avoid taxonomic problems in future.

***Oliarus speciosus* Matsumura, 1914  
(Fig. 15)**

*Oliarus speciosus* Matsumura, 1914:424.

General color ochreous to brown. Face yellowish, embrowned near vertex in male lectotype. Vertex brown, with keels paler. Pronotum and tegulae pale brown, mesonotum brown with keels paler. Tegmina with yellowish veins, covered with brown granules, transverse veins and stigma embrowned; costal margin yellowish, without granules. Legs yellowish brown. *Sc+R* forked distad of *Cu*.

Vertex 1.3 times as long as broad. Tegmina 3.5 times as long as broad. Chaetotaxy of hind tarsi 7/7.

**Male genitalia:**

Anal segment, pygofer and genital styles symmetrical or nearly so. Anal segment somewhat broader on left side. Aedeagus with four spines, two of which on ventral margin. The aedeagus from the specimen from "Siam" shows small differences with respect to the direction of the spines.

Length: 6-6.5mm.

**Lectotype:**

Male (here designated), "Formosa, Matsumura, Koshun (=Henchun), i.VII.1906", HU (examined).

**Paralectotype:**

1♀ same data as lectotype, HU (examined).

**Additional specimens examined:**

1♂ 1♀ "Siam, W.R.S. Ladell", BMNH.

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

The type series of *Oliarus speciosus* consists of four specimens collected in Koshun; we have examined two specimens from which the male was selected as lectotype.

***Oliarus hopponis* Matsumura, 1914  
(Fig. 16)**

*Oliarus hopponis* Matsumura, 1914:427.

General color black; head and pronotum with yellowish margins and keels. Tegmina slightly yellowish, veins yellowish to brown, covered with inconspicuous and concolorous granules; stigma and transverse veins fumated with brown; costal margin yellowish to brown, without granules. Legs yellowish.

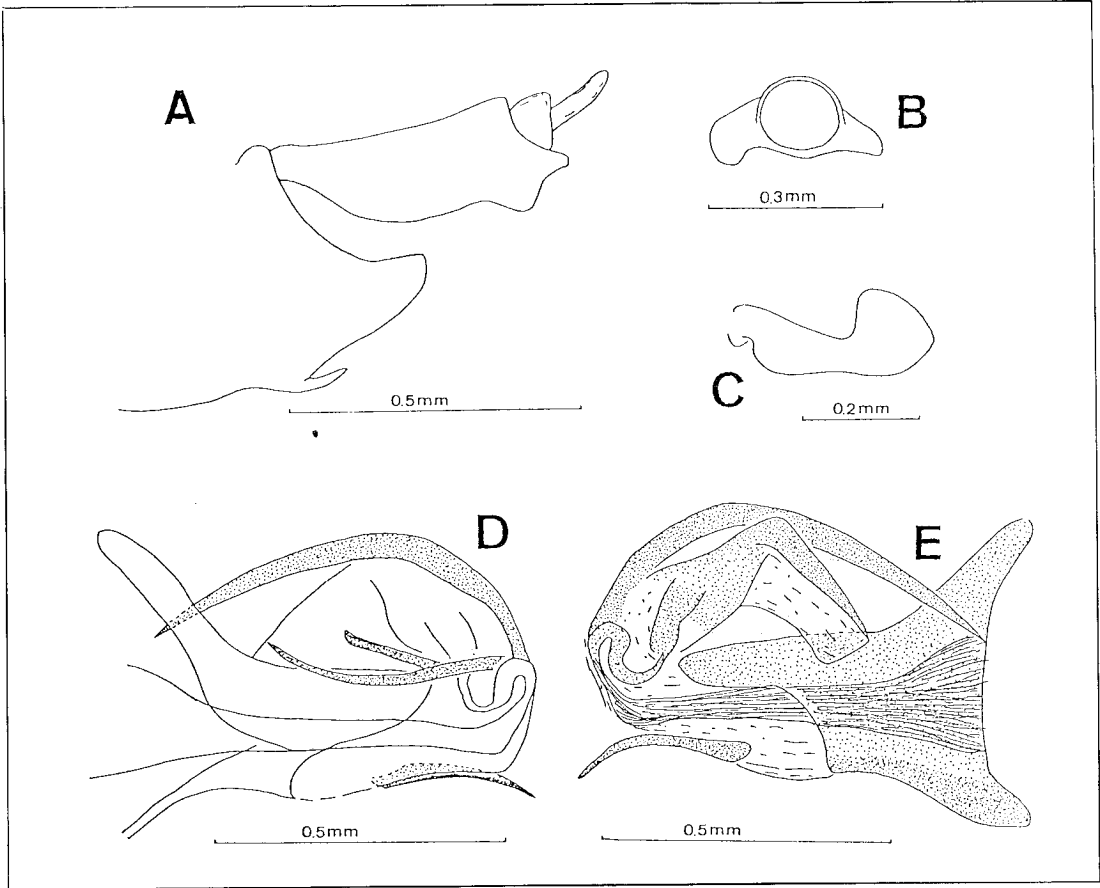


Fig. 15. *O. speciosus* Matsumura. A. Pygofer and anal segment, lateral view; B. Anal segment, caudal view; C. Left genital style, lateral view; D–E. Aedeagus. D. Lateral view; E. Dorsal view.

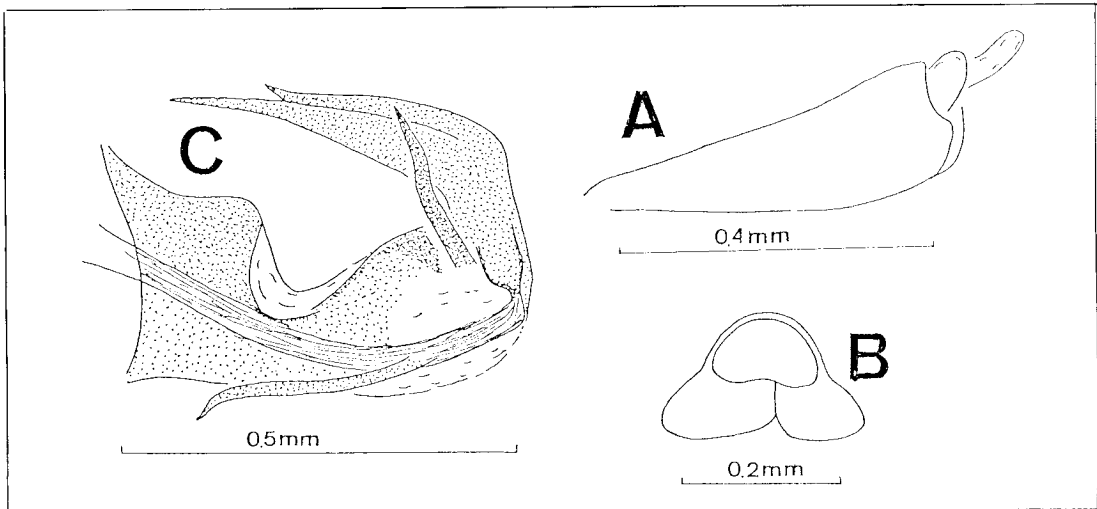


Fig. 16. *O. hopponis* Matsumura. A. Anal segment, lateral view; B. Anal segment, caudal view; C. Aedeagus, lateral view.

Vertex twice as long as broad. Tegmina 3 times as long as broad.

**Male genitalia:**

Pygofer and genital styles like those of *O. velox*. Anal segment in caudal view with a longitudinal slit medially, slightly differing in the structure of the apex in the specimens from Taitung Hsien, where the excavation is compressed, but distinctly excavated in other specimens, similar to *O. velox*. Aedeagus with four long spines, without a hook-shaped spine as is the case in *O. velox*.

Length: 6mm.

**Specimens examined:**

Female holotype, "Formosa, Matsumura, Hoppo (=Peipu), 7-VIII-1906", HU (examined); 1♂ Hokki (=?), 15-VI-1932 L. Gressitt, NCSU; 1♂ 1♀ Hassenzan (=Bahsien-shan), 21-VI-1932, NCSU; 1♂ Chipen, Taitung Hsien 31-III-1985 W. J. Wu, NCSU.

**Host plant:**

Unknown.

**Distribution:**

Taiwan.

**Notes:**

*O. hopponis* is closely related to *O. velox* and *O. boninensis*. It is distinguished from *O. velox* in the black color (generally brown in *O. velox*) and in the absence of a hook-shaped spine on the aedeagus. *O. hopponis* differs from *O. boninensis* in the absence on the aedeagus of a large lobe on left side of pygofer. It also superficially resembles *O. mori* and the other species of the *O. petasatus* group from which it can be distinguished by the general structure of the male genitalia.

***Oliarus oryzae* Matsumura, 1911**

(Fig. 17)

*Oliarus oryzae* Matsumura, 1911:134.

Head, pronotum and tegulae pale ochreous with yellowish keels. Mesonotum and abdomen

brown. Pygofer and genital styles partly yellow. Tegmina hyaline, part between base to level of *Cu*-fork, and a second area from level of stigma to apex pale brown; veins yellow, covered with very small, concolorous granules, *Sc+R* forked distad of *Cu*; costal margin not granulated. Legs yellowish.

Vertex twice as long as broad, subapical keel touching apex in middle, and median carina well-developed. Tegmina 3 times as long as broad.

**Male genitalia:**

Anal segment, pygofer and genital styles symmetrical. Aedeagus with five spines, three on ventral margin.

Length: 5mm.

**Lectotype:**

Male (here designated), HU.

**Paralectotypes:**

HU.

**Additional specimens examined:**

2♂♂ "Formosa, Matsumura, Koshun (=Henchun), 31-VII-1906", HU.

**Host plant:**

*Saccharum officinarum* L. (sugarcane).

**Distribution:**

Oriental region.

**Notes:**

Closely related to *O. cocosivora* and *O. annandalei*. *O. oryzae* differs from *O. cocosivora* in the different proportions of the aedeagal spines and in the absence of the same additional ventral spine which is illustrated in *O. cocosivora*.

**Genus *Pentastiridius* Kirschbaum, 1868**

Type species: *Flata pallens* Germar, 1821

*Pentastiridius* Kirschbaum, 1868, Cicad. Wiesbaden: 45.

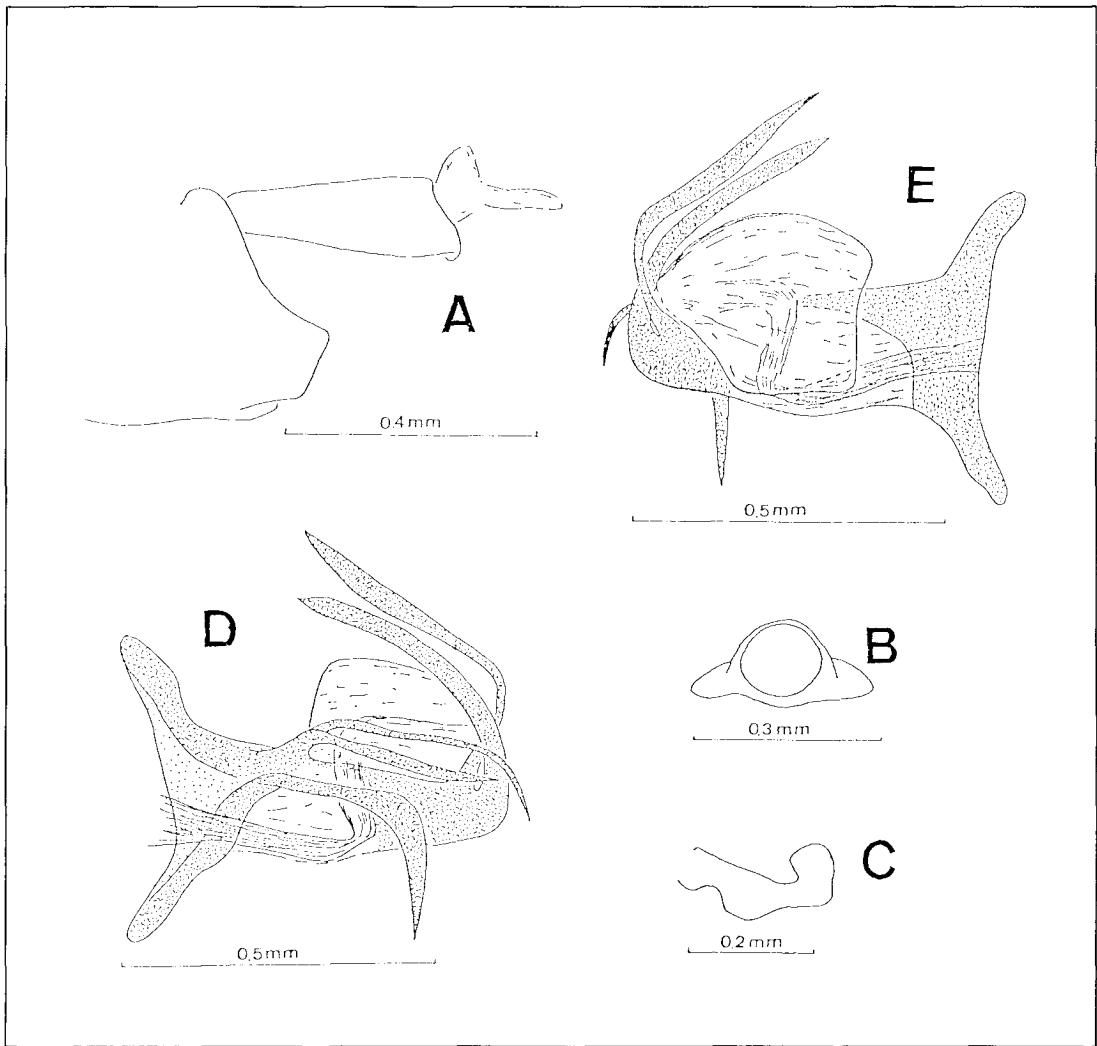


Fig. 17. *O. oryzae* Matsumura. A. Pygofer and anal segment, lateral view; B. Anal segment, caudal view; C. Left genital style, lateral view; D–E. Aedeagus. D. Ventral view; E. Dorsal view.

*Pentastiridius*: Van Stalle, 1986, Bull. Annl. Soc. r. belge. Ent. 122:82–83.

Body dark brown to black with yellowish carinae and borders. Vertex shallowly excavated, width at apex of emargination one or two times its length, with percurrent median carina. Median ocellus present. Rostrum surpassing hind coxae. Mesonotum with five distinct median carinae. Tegmina hyaline, sometimes dull in apical third in male. Costal margin not granulate. Hind tibia with three lateral spines, hind tarsus broad, providing with

a double row of spines with membranous scale teeth attached distally to all the spines except the lateral pairs, the first segment bearing more spines than the second, varying between 7 and 12. The number is variable within the species and even within a specimen from left to right. Male genitalia: pygofer and anal segment symmetrical, without distinct processes. Genital styles slightly asymmetrical. Aedeagus with one dextral process emerging from base of periandrium, two spines inserted apically near flagellum, one small spine near the two former and only visible in ventral view. Flagellum



without apical spine. Female genitalia: Pre-genital sternite small, valvulae of ovipositor as long as anal segment, first pair tapering distally, second pair hair-shaped, thin, third pair broad, sheath-shaped. Anal segment in dorsal view quadrate, longer than wide.

**Diagnosis:**

This genus can be easily recognized by the characteristic shape of the aedeagus, bearing a spoon-like dextral process and two large and

one small spinose processes. The chaetotaxy of the hind tarsus bearing a double row of black and membraneous teeth is also a useful generic character.

*Pentastiridius pachycephs*  
(Matsumura, 1914) comb. n.  
(Fig. 18)

*Oliarus pachycephs* Matsumura, 1914:420.

Female paler and larger than male. Body

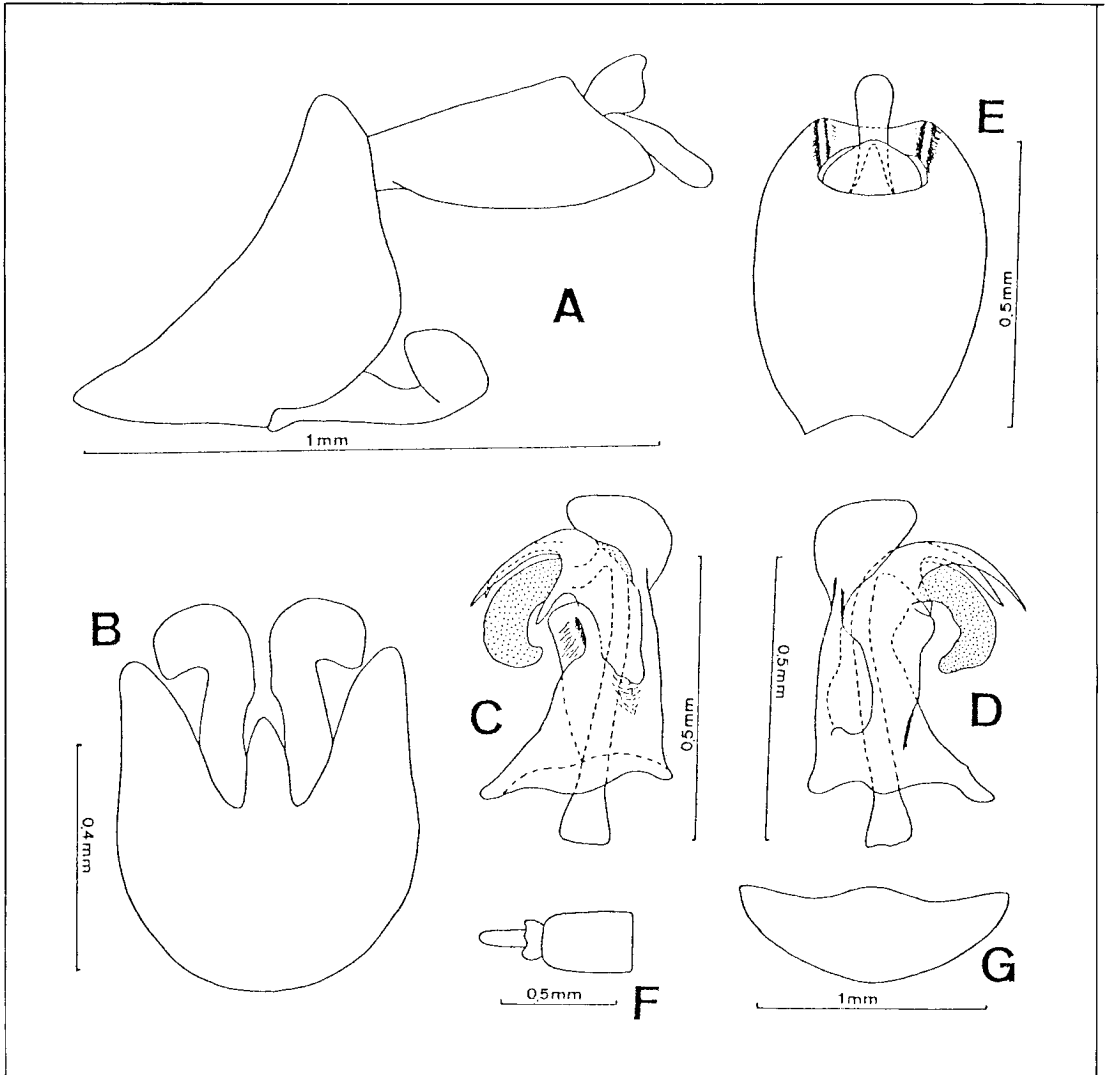


Fig. 18. *Pentastiridius pachycephs* (Matsumura) A. Male genitalia, lateral view; B. Pygofer and genital styles, ventral view; C–D. Aedeagus. C. Ventral view; D. Dorsal view; E–F. Anal segment, dorsal view. E. Male; F. Female; G. Pre-genital sternite of female

covered with powdery wax. Face in male black with broad yellow keels, brown to ochreous in female. Ocelli brownish yellow. Vertex with anterior compartment black, posterior compartment yellow in female, entirely black in male. Tegula, margins of pronotum yellowish brown. Frons bordered yellow on margins. Mesonotum brown to black, with concolorous keels, sometimes slightly marked with yellow. Tegmina hyaline, usually with apical third grayish black sometimes pale gray, veins yellow; apical transverse veins fumated with brown; costal margin not granulated; *Sc+R* forked distad of *Cu*. Legs yellowish, femora fumated with brown.

Vertex as long as broad or slightly broader, lateroapical areolets extending backwards to midlength, contiguous at apex. Frons shorter in middle line than wide at widest portion, median keel forked at basal fourth. Rostrum surpassing hind coxae, relative length of each segment 1.6:1.9:1. Tegmen with 10–12 apical cells and 4 anteapical cells, 3.2 times as long as broad. Chaetotaxy of hind tarsi: (9–16)/(7–12).

#### Male genitalia:

Pygofer with dorsolateral angle smoothly rounded. Anal segment in dorsal view longer than broad, quadrate and gently rounded lateroapically; in lateral view dilating from basal half. Anal style short and stout. Genital styles in lateral view stout, narrowing medially and with apical half curving upward, beset with many long setae; in ventral view nearly same width, slightly divergent primarily, curving outward distally. Medioventral process in lateral view stout, slightly curving upward below posterior margin of genital style; in ventral view prominent between genital styles. Aedeagus in total with three long spinose processes all visible in ventral orientation: one acuminate, originating subapically directed cephalad, two slender, originating apically, directed cephalad. Sclerified periandrium in ventral view concave anteriorly, right side produced lateroapically, left side protruding forward forming a vertical plane basally then twist 90 degrees and turning left forming another horizontal plane apically. Flagellum

without any spines.

#### Female genitalia:

Pygofer ellipse in caudal view, broader than long, with rows of stout setae medially and some tiny hairs in other parts. Wax secreting pores slightly longer in central portion than in other portions. Anal segment in dorsal view small, quadrate, longer than broad. Anal style slender. Pregenital sternite with a small convex process medially. Ovipositor with reduced awl-shaped second valvulae. Third pair of valvulae sheath-shaped.

Length of body (includ. teg.); Male: 4.05–4.73mm; Female: 5.41–5.67mm.

Length of tegmen: Male: 3.18–3.78mm; Female: 4.32–4.59mm.

Width of mesonotum: Male: 1.35–1.49mm; Female: 1.76mm.

#### Lectotype:

Male (here designated), "Formosa, Matsumura, Koshun (=Henchun), 6–VII–1906", HU (examined).

#### Paralectotypes:

1♂ 1♀ "type, Koshun, 6–VII–1906", HU (examined).

#### Additional specimens examined:

2♂♂ 1♀ Ryukyu I., Iriomote I., Ohara 50 m, 1–XI–1963 G. A. Samuelson, BMNH; 1♀ Ryukyu I., Iriomote I., Shirahama, Sonai, 16–III–1965, BMNH; 6♂♂ 3♀♀ Shalu, Taichung Hsien 11–IX–1984 C. T. Yang; 8♀♀ 5–XII–1984 C. T. Yang; 1♀ Fushing, Taoyuan Hsien 11–V–1985 S. C. Tsaur; 1♀ 12–V–1985 S. C. Tsaur; 34♂♂ 1♀ Makung (the Martyrs Shrine), Penghu Hsien 7–VII–1986 C. T. Yang; 6♂♂ 3♀♀ C. L. Chen; 9♂♂ 2♀♀ 22–VII–1986 S. C. Tsaur.

#### Host plant:

*Cynodon dactylon* (L.) Pers.

#### Distribution:

Taiwan, Japan (Ryukyu, Honshu) (new record).

**Notes:**

This species has slightly sexual dimorphism: female are larger and paler in coloration.

**Second instar nymph (Fig. 19A)**

Body length 1.15mm, width 0.47mm.

General color light yellow. Body elongate, subcylindrical, slightly compressed dorsoventrally, widest across mesonotum.

**Head:**

Head with 27 pits on each side arranged in three irregular rows, devoid of lateral carinae. Vertex in dorsal view rounded anteriorly. Frons subquadrate, lateral margins slightly convex at level of antennae. Median ocellus absent. Labrum slightly dilating to midlength, narrowing distally then protruding a spinal process. Rostrum slender, 3-segmented, extending over hind coxae, second longer than third segment. Eyes reduced. Antennae 3-segmented, scape and pedicel cylindrical and subequal; flagellum bulbous basally, filamentous distally. Frontoclypeal suture strongly convex medially.

**Thorax:**

Pronotum with lateral margin slightly angulating towards side of body, without any carina, narrowing laterally. Each pronotal plate bearing 15 pits: 10 posteromedially from anteromedially, 5 arranging sinuately anterolaterally. Fore tarsus 2-segmented, division between segments very obscure.

Mesonotum quadrate, larger than pronotum, with very slightly developed fore wing pads not covering metanotum, each with 7 pits in the following arrangement: 3 extending anterolaterally from posteromedial angle and 4 near lateral margin. Mid-legs similar to fore legs except larger.

Metanotum quadrate, without developed hind wing pads, each plate bearing 4 pits: 2 posterolaterally, 2 posteromedially. Hind leg with a long knife-shaped meracanthus. Hind tibia without lateral spine. Hind tarsus 2-segmented. the second longer than the first

with two simple claws and a arolium. Spinal formula of hind leg 5-2-2.

**Abdomen:**

Abdomen 9-segmented, not extending to lateral margins, with segment I and II reduced, broadest across segment IV. Segments I-III without pit. The following number of pits on either side of midline of each segment: segment IV with 1 on tergite near middle, segment V with 4 on tergite, segment VI-VIII each with 2 on wax secreting area, segment IX surrounding anus, with 2 dorsally near middle, 2 on each lateral side, apices with many sharp processes directed mesad (Fig. 19E). Shape of wax secreting pores like 5-9-petalled flower. (Fig. 20)

**Third instar nymph (Fig. 19B)**

Body length 1.45-1.60mm, width 0.58-0.65mm.

Differs from the second instar nymph as follows:

**Head:**

Head with 24 pits on each side arranged in three irregular rows. Frons with a very weak median carina. Eyes not reduced. Each pronotal plate bearing 24 pits: 7 along midline to posteromedially, 17 crowded in lateral half. Each mesonotal plate bearing 14 pits: 1 near anteromedially, an oblique row of 4 pits extending anterolaterally from near posteromedial angle, 9 pits near lateral margin and extending onto wing pad, each wing pad slightly developed, covering metanotum anterolaterally. Each metanotal plate bearing 6-7 pits: 1 anteromedially (sometimes absent), an oblique row of 3 pits extending anterolaterally from near posteromedial angle and 3 pits posterolaterally. Hind wing pads not developed. Hind tibia with a lateral spine medially. Spinal formula of hind leg 6-3-2.

**Abdomen:**

Abdomen with each segment bearing the following number of pits on either side of midline: segment II with 1 on tergite near

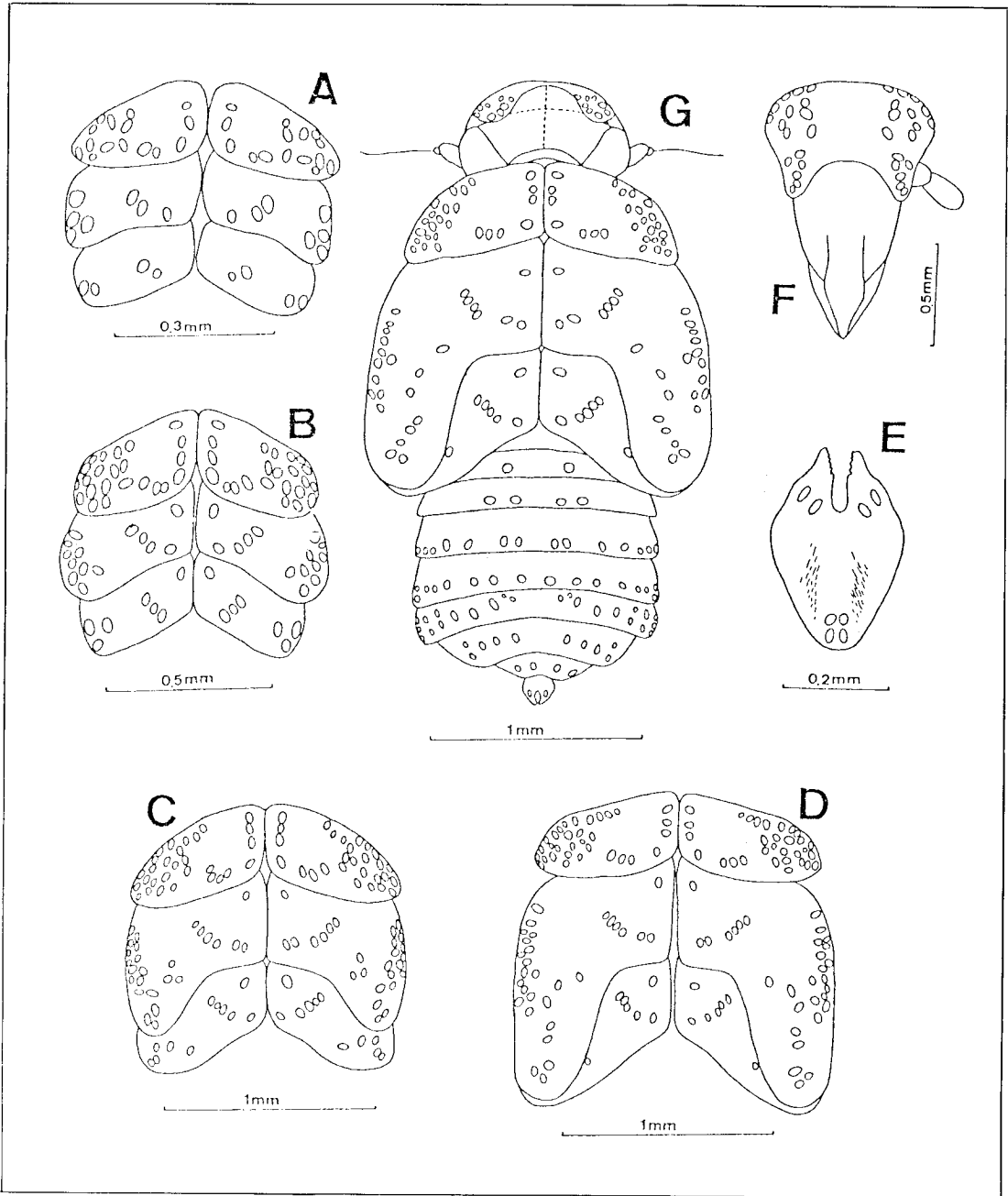


Fig. 19. Nymphs of *Pentastiridius pachycephs* (Matsumura) A–D. Thorax, flat surface. A. Second instar; B. Third instar; C. Fourth instar; D. Fifth instar; E. Genitalia, ventral view; F. Head, ventral view; G. Fifth instar, dorsal view.

middle, segment III with 2 on tergite, segment IV–V each with a transverse row of 7 extending from near midline to lateral margin, segment VI–VIII each with 3 within wax

secreting area, 2 laterally, segment IX with 1 dorsally, 2 laterally. Waxy exudate present from this to next two instars in living specimens.

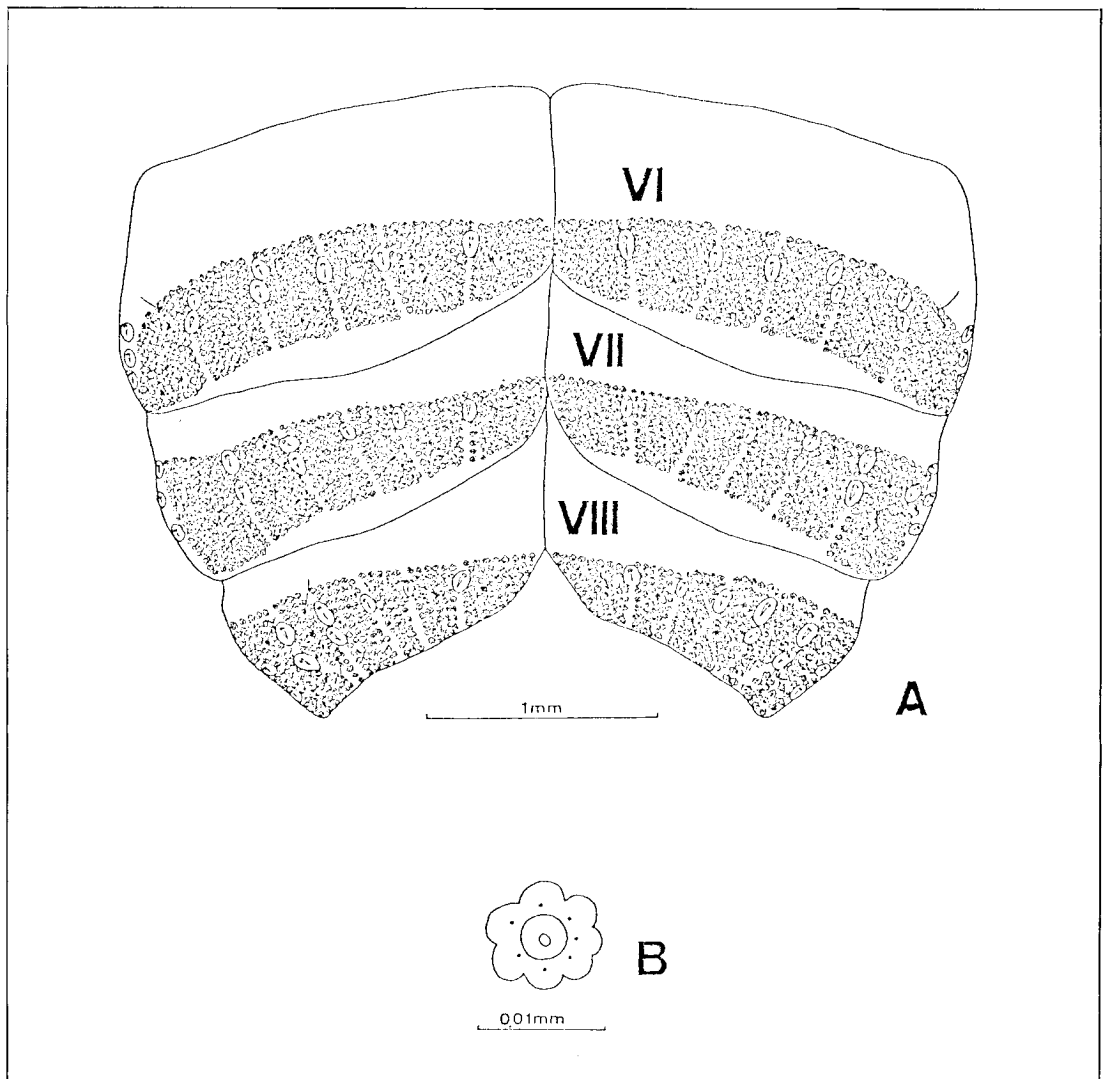


Fig. 20. Fifth instar nymph of *Pentastiridius pachycephs* (Matsumura) A. abdominal tergites VI–VIII; B. Wax secreting pore.

#### Fourth instar nymph (Fig. 19C)

Body length 2.10–2.52mm, width 0.89–1.00mm.

Differs from the third instar nymphs as follows:

#### Head:

Head with 27–28 pits on each side.

#### Thorax:

Each pronotal plate bearing 28 pits: 7(8)

along midline to posteromedially, 21(20) crowded in lateral half. Each mesonotal plate bearing 26 pits: 1 anteromedially, an oblique row of 6 pits extending anterolaterally from near posteromedial angle, 16 near lateral margin and extending onto wing pad, 3 slightly inside the former group, fore wing pad covering about one-fourth metanotum. Each metanotal plate bearing 11 pits: 1 anteromedially, an oblique row of 5 pits extending anterolaterally from near posteromedial angle, 1 posteromedially, 4 near posterolaterally. Hind tibia with 3

lateral spines. Hind tarsus 3-segmented. Spinal formula of hind leg 6–5–3.

#### Abdomen:

Abdomen with each segment bearing the following number of pits on either side of midline: segment II with 1 near middle, segment III with 2, segment IV–V each with a transverse row of 9 extending from near midline to lateral margin, segment VI–VIII each with 5 within wax secreting area and 2 laterally outside wax secretion area, segment IX bearing 1 dorsally, 2 laterally.

#### Fifth instar nymph (Fig. 19D–F)

Body length 2.80–4.32mm, width 1.35–1.73mm.

General color yellowish brown to dark brown. Lateral ocelli purplish red. Body elongate, subcylindrical, slightly compressed dorsoventrally, widest across wing pads.

#### Head:

Head with 24 pits on each side arranged in three irregular rows, and a weak median carina, devoid of lateral carina. Vertex in dorsal view rounded anteriorly. Frons subquadrate, lateral margin slightly convex at level of antennae, without median ocellus. Frontoclypeal suture convex medially. Labrum slightly dilating to midline, narrowing distally then protruding a spinal process. Rostrum 3-segmented, surpassing hind coxae, second longer than third segment. Eyes prominent. Antennae 3-segmented, with reduced scape and thinner and slender flagellum.

#### Thorax:

Pronotum with lateral margin slightly angulating towards side of body, without any carina. Each pronotal plate bearing 31–32 pits: 7 posteromedially from anteromedially, 24 crowded in lateral half.

Each mesonotal plate with 31 pits: 1 anteromedially, an oblique row of 6 extending anterolaterally from near posteromedial angle, 16 crowded in lateral margin and 8 in central portion of fore wing pad. Fore wing pad de-

veloped very well, covering about 1/2 of hind wing pad, attaining tergite II.

Each metanotal plate bearing 7 pits: 1 anteromedially, an oblique row of 5 extending anterolaterally from posteromedial angle and 1 on hind wing pad near inner side of fore wing pad. Hind leg with tibia bearing 4 lateral spines, tarsus 3-segmented and spinal formula 6–9–6.

#### Abdomen:

Abdomen with each segment bearing the following number of pits on either side of midline: segment II with 1 on tergite near middle, segment III with 2, segment IV–V with a transverse row of 12, 11 respectively, extending from near midline to lateral margin, segment VI–VIII each with 7, 8, 7 within wax secreting area and 3, 3, 2 laterally respectively, segment IX with 4–5 dorsally, 2 on each lateral side.

#### Nymphal specimens examined:

2nd instar nymph: 1  
3rd instar nymph: 5  
4th instar nymph: 20  
5th instar nymph: 13

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#### Notes:

Nymphs were living subterranean and feeding on rootlet of *Cynodon dactylon* (L.) Pers. They usually gather in large numbers under small rocks. Once interfered, they will walking quickly for a short distance or jumping away.

#### Key to nymphal stages of *Pentastiridius pachycephs*

1. Hind tarsus 2-segmented . . . . . 2
- . Hind tarsus 3-segmented . . . . . 3
2. Spinal formula of hind leg 5–2–2; each side of tergal pit configuration of thoracic segments 15–7–4 . . . . . Second instar nymph
- . Spinal formula of hind leg 6–3–2; each side of tergal pit configuration of thoracic

- segments 24–14–6(7) . . . . .  
 . . . . . Third instar nymph  
 3. Chaetotaxy of hind tarsi: 5/3; each side  
 of tergal pit configuration of thoracic  
 segments 28–26–11 . . . . .  
 . . . . . Fourth instar nymph  
 –. Chaetotaxy of hind tarsi: 9/6; each side  
 of tergal pit configuration of thoracic seg-  
 ments 32–31–7 . . . . Fifth instar nymph

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