

## Leptophlebiidae of Taiwan (Ephemeroptera)

Shih-Chang Kang & Chung-Tu Yang\*

Accepted January 20, 1994

### 摘要

康世昌·楊仲圖 臺灣的褐蜉科(蜉蝣目) 臺灣省立博物館半年刊 47(1):57–82

本文描述分布於臺灣的褐蜉科種類，共計5屬9種，分別為：*Choroterpes trifurcatus* Ueno, *C. taiwanensis* n.sp., *Choroterpides nigella* n.sp., *Thraululus fatuus* n.sp., *T. macilentus* n.sp., *T. umbrosus* n.sp., *Habrophlebiodes tenella* n.sp., *Paraleptophlebia spina* n.sp. 及 *P. erratica* n.sp.。種類的判別均根據稚蟲特徵。所有種類均自老熟雌稚蟲取得卵，並經用掃描式電子顯微鏡觀察與描述。文中附屬及種的檢索表。

**關鍵詞：**褐蜉科，*Choroterpes*, *Choroterpides*, *Thraululus*, *Habrophlebiodes*, *Paraleptophlebia*, 稚蟲，卵，臺灣。

### Abstract

Nine species of Leptophlebiidae including eight new species have been described from Taiwan. They are *Choroterpes trifurcatus* Ueno, *C. taiwanensis* n.sp., *Choroterpides nigella* n.sp., *Thraululus fatuus* n.sp., *T. macilentus* n.sp., *T. umbrosus* n.sp., *Habrophlebiodes tenella* n.sp., *Paraleptophlebia spina* n.sp. and *P. erratica* n.sp. All species were described based on nymphal and egg stage. All the egg materials were obtained from mature female nymphs and were observed using scanning electron microscopy. Key for the nymphs is provided for the genera and species.

**Key word:** Leptophlebiidae, *Choroterpes*, *Choroterpides*, *Thraululus*, *Habrophlebiodes*, *Paraleptophlebia*, nymph, egg, Taiwan.

### Introduction

The widespread family Leptophlebiidae was very poorly known in Taiwan. Since Ueno described a species—*Choroterpes trifurcatus* based on nymph in 1928, there has been no taxonomic work of Leptophlebiidae in Taiwan.

Comprehensive redefinition and addition of 19 Eastern Hemisphere genera by Peters and Edmunds (1970) has provided a basis for further leptophlebiid studies. In the present work, we followed their terminology and procedures.

The nine species collected from Taiwan,

are classified based on the nymphal stage and divided into five genera — *Choroterpes* Eaton, 1881, *Choroterpides* Ulmer, 1939, *Thraululus* Eaton, 1881, *Habrophlebiodes* Ulmer, 1919 and *Paraleptophlebia* Lestage, 1917. In addition, the chorionic structure of every species was examined using scanning electron microscopy.

All types and examined specimens in this work were nymphs. Egg materials were acquired from mature female nymphs (with black wing pads).

Abbreviations used in the collection localities, collectors and deposition of types

\*Department of Entomology, National Chung Hsing University, Taichung 402, Taiwan, Republic of China.

are: Taiwan (TW), Taipei Hsien (TPH), Ilan Hsien (ILH), Hualien Hsien (HLH), Taitung Hsien (TTH), Pingtung Hsien (PTH), Kaohsiung Hsien (KSH), Chiayi Hsien (CIH), Nantou Hsien (NTH), Taichung Hsien (TCH), Hsinchu Hsien (HCH), Shih-Charig Kang (SCK), Hsien-Cheng Chang (HCC), Wen-Bin Yeh (WBY), Department of Entomology, National Chung-Hsing University, Taichung, Taiwan (NCHU) and National Museum of Natural Science, Taichung, Taiwan (NMNS).

**Key to the Genera and Species of  
Leptophlebiidae of Taiwan  
(for nymph only)**

1. Gills II–VII each with 2 lamellae; lingue of hypopharynx with well developed lateral processes (Fig. 2-B). . . . . 2
  - Gills II–VII with only 1 lamella; lingue of hypopharynx with well developed lateral processes (Figs. 7-L, 8-B, 9-B). . . . . 7
2. Lamellae of gills II–VII each with 3 processes at apex (Figs. 1-B, 2-B, 3-B). . . . . 3
  - Lamellae of gills II–VII each with long, fine fringe (Figs. 4-J, 5-J, 6-J) (*Thraululus*). . . . . 5
3. Maxillary and labial palpi greatly elongated and extending beyond sides of head (Fig. 3-M); gill I absent; lamellae of gills II–VII each with 3 small, short, acute processes at apex (Figs. 3-I-J) (*Choroterpides*). . . . .
  - . . . . . *Choroterpides nigella* n.sp.
  - Maxillary and labial palpi not same as above; gills I present, slender (Figs. 1-I, 2-I); lamellae of gills II–VII each with 3 long, blunt processes (Figs. 1-J, 2-J) (*Choroterpes*). . . . . 4
4. Maxilla with a distinct, tooth-like process at mesal apical corner and over 10 comb-shaped setae on crown (Fig. 1-D); inner edges of posterolateral spines on abdominal segments VIII–IX each with secondary spines (Fig. 1-M). . . . .
  - . . . . . *Choroterpes trifurcatus* Uéno
  - Maxilla with a blunt, short process at mesal apical corner and 6–7 comb-shaped setae near anterior margin (Fig. 2-D); inner edges of posterolateral spines on abdominal segments VIII–IX without secondary spines (Fig. 2-M). . . . .
    - . . . . . *Choroterpes taiwanensis* n.sp.
5. Dorsum of middle and hind femora with black, broad markings on distal half; anterior margin undulate (Fig. 4-B); denticles of claw gradually enlarge apically. (Fig. 4-H). . . . . *Thraululus fatuus* n.sp.
  - Middle and hind femora pale; anterior margin concave smoothly (Figs. 5-B, 6-B); median denticles of claw larger than apical (Figs. 5-H, 6-H). . . . . 6
6. Labrum with dense setae near antero-medial margin (Fig. 5-B); galea-lacinia of maxilla with 19–20 comb-shaped setae near anterior margin (Fig. 5-D). . . . .
  - . . . . . *Thraululus macilentus* n.sp.
  - Labrum with sparse setae near antero-medial margin (Fig. 6-B); galea-lacinia of maxilla with 24–26 comb-shaped setae near anterior margin (Fig. 6-D). . . . .
    - . . . . . *Thraululus umbrosus* n.sp.
7. Anteromedian margin of lingua of hypopharynx with a cleft, each part with a tuft of dense, fine setae near anterior margin (Fig. 7-L); anteromedian margin of labrum with a deep emargination (Fig. 7-L); anteromedian margin of labrum with a deep emargination (Fig. 7-A); claw slender, denticles at apical 1/3 to base (Fig. 7-H) (*Habrophlebiodes*). . . . .
  - . . . . . *Habrophlebiodes tenella* n.sp.
  - Anteromedian margin of lingua of hypopharynx without cleft, (Figs. 8-B, 9-B); anteromedian margin of labrum with a shallow emargination (Figs. 8-A, 9-A); denticles of claw at apical 1/4 to base (Figs. 8-H, 9-H) (*Paraleptophlebia*). . . . . 8
8. Base of gills with several acute setae; tracheal branches distinct (Figs. 8-I-J); anterior margin of lingua of hypopharynx slight ridgy (Fig. 8-B). . . . .
  - . . . . . *Paraleptophlebia spina* n.sp.
  - Base of gills without acute setae; tracheal branches indistinct (Figs. 9-I-J); anterior margin of lingua of hypopharynx slight concave (Fig. 9-B). . . . .
    - . . . . . *Paraleptophlebia erratica* n.sp.

*Choroterpes trifurcatus* Uéno

(Figs. 1, 10)

*Choroterpes trifurcatus* Uéno, 1928. Mem. Coll. Sci. Kyoto Univ., B. 4(1): 19–63.

*Cryptogenella facialis* Gillies, 1951. Proc. R. Entomol. Soc. London (Ser. B) 20: 121–130.

**Mature nymphs:** (Fig. 1)

Body length: female 5.02–6.02 mm, male 4.10–5.20 mm. General coloration: dorsum yellow to brown, venter pale.

**Head:** antenna pale, pedicel with a wide dark band medially. Lateral margins of clypeus nearly parallel, slightly divergent apically. **Labrum:** 0.48–0.50 × width of head, subequal or narrower than clypeus; anteromedian emargination with 5 broad-based denticles, the lateral ones larger than median one; 2 transverse rows of setae on dorsal surface, divergent laterally, branched setae near anterior margin, long fine setae on median area. **Mandibles:** incisors forked at apex; in left mandible, outer incisor smaller than inner one; in right mandible, outer incisor larger than inner one. **Maxillae:** a large tooth-like process and a large, thick, comb-shaped seta on mesal corner; galea-lacinia with 15–17 fine comb-shaped setae near anterior margin; segment III of maxillary palpus triangular, with numerous long fine setae, lateral margin truncate obliquely at apical half, 0.58–0.67 × length of segment I, 0.61–0.71 × length of segment II. **Labium:** segment III of labial palpus with 5–7 stout, dorsal acute setae medially, 0.56–0.65 × length of segment I and 0.69–0.85 × length of segment II; glossa reniform, venter with clavate setae, scattered triangular; paraglossa subquadrate, 0.59–0.65 × width of head, venter with a transverse row of closely set setae near anterior margin, dorsal setae scattered on anterior area.

**Thorax:** pronotum with shallow antero-medial emargination; anterolateral margins round curved and with 7–10 acute setae. **Fore legs:** trochanter with long pinnate setae; femur pale, with 3 brown markings, posterior margin with long acute and long fine setae,

median area with blunt setae, anterior margin with long pinnate and blunt setae; tibia 0.99–1.16 × length of femur, with closely set pinnate acute setae on mesal margin; tarsus 0.39–0.45 × length of femur; claw with 13–14 denticles, separate into 2 parts and denticles gradually enlarge apically; the apical part with 9–10 denticles and basal with 3–4. **Middle legs:** tibia 0.93–1.03 × length of femur, mesal margin with sparse acute setae; tarsus 0.31–0.35 × length of femur. **Hind legs:** femur with broad transverse median and apical dark brown markings; tibia 0.87–1.11 × length of femur, mesal and lateral margins with short and long blunt setae; tarsus of female and male 0.26–0.31 × and 0.46–0.51 × length of femur.

**Abdomen:** dorsum brown, venter pale. Tergite I with a longitudinal pale band medially; tergites II–IX each with paired pale triangular markings near anterior margin; each posterior margin of tergites I–IX with irregular and tergite X with more regular serrate spines which enlarge medially; mesal edges of pasteur-lateral spines on abdominal segments VIII–IX curved and with secondary acute spines. **Gills:** gill I slender, with fine setae; gills II–XII alike, each includes 2 broad plate-like lamellae; lamella with distinct, arborescent, darkish tracheas; each lamella terminated in 3 processes, with median process longer than on lateral.

**Eggs:** (Fig. 10)

General shape ovoid; chorionic surface with asteroid or flower-like ridges, the ridges flat, thick near the center; in the center of asteroid costa, a rounded tubercle present; without polar cap; a visible micropyle on subequatorial area.

**Mature nymphal specimens examined:**

1♂, 1♀, Pinglin, TPH, 17-XI-1990, SCK & HCC; 1♀, Peipu, HCH, TW, 190 m, 19-XI-1990, SCK; 1♀, Taoyuan, KSH, 14-XII-1990, SCK; 3♀♀, Chinlu, Shityu, PTH, TW, 205 m, 17-XII-1990, SCK; 1♂, 5♀♀, Kungliao, TPH, TW, 30-V-1991, SCK & HCC; 2♂♂, 15♀♀, Kanchiao, Shuangchi, TPH, TW, 30-V-1991, SCK & HCC; 3♀♀, Shuangchi, TPH, TW, 31-V-1991, SCK &

HCC; 1♀, Shuangchi, TPH, TW, 31-V-1991, SCK & HCC; 2♀♀, Wusichso, Wufeng, TCH, TW, 16-XI-1991, SCK; 6♀♀, Gutuyulin, Kuohsing, NTH, TW, 16-XI-1991, SCK; 14♀♀, Guching, Kuohsing, NTH, TW, 13-XII-1991, SCK; 6♀♀, Kuohsing, NTH, TW, 13-XII-1991, SCK; 1♀, Pinghun, Pingchi, TPH, TW, 250 m, 28-III-1992, SCK; 2♂♂, 10♀♀, Kanchiao, Shuangchi, TPH, TW, 140 m, 28-III-1992, SCK; 1♂, 1♀, Hontung, Juifang, TPH, TW, 120 m, 29-III-1992, SCK; 3♀♀, Hwosauliao, Pingchi, TPH, TW, 365 m, 30-III-1992, SCK; 3♂♂, 6♀♀, Kuolain, Pinglin, TPH, TW, 315 m, 30-III-1992, SCK.

#### Distribution:

Taiwan, Hong Kong.

#### *Choroterpes taiwanensis* Kang & Yang n.sp.

(Figs. 2, 11)

#### Mature nymphs: (Fig. 2)

Body length: female, 4.19–5.16 mm, male 3.80–5.10 mm. General coloration: dorsum yellow to brown, venter darkish yellow.

**Head:** antenna pale, pedicel with a wide dark band medially. Lateral margins of clypeus nearly parallel, slightly divergent apically. **Labrum:** 0.45–0.46 × width of head, subequal or wider than clypeus; anteromedian emargination deeply cleft, with 5 broad-based denticles, 2 transverse rows of setae on dorsal surface, nearly parallel, branched setae near anterior margin, long fine setae on submedian area. **Mandibles:** incisors forked at apex; in left mandible, outer incisor smaller than inner one; in right mandible, outer one larger than inner one. **Maxillae:** apical mesal corner with a short, blunt, tooth-like process and a large cristae process, teeth of cristae process reduced toward base and apex; 6–7 comb-shaped setae near mesal anterior margin; segment III of maxillary palpus with numerous long fine setae, 0.67–0.71 × length of segment I, 0.52–0.63 × length of segment II; mesal margins of segments II and III with long acute setae. **Labium:** segment III of labial palpus 0.54–0.65 × length of segment I, 0.53–0.59 × length of segment II, lateral margin truncate obliquely at apical

half, with 4–6 stout acute setae on median area of dorsal surface; glossa turbinate, venter with clavate setae; paraglossa semicircular, 0.54–0.58 × width of head.

**Thorax:** pronotum with shallow emargination anteromedially. **Fore legs:** trochanter with long pinnate setae; femur yellow, with faint brown markings, posterior margin with long acute and long fine setae on distal half, central area with blunt or acute setae, anterior margin with long pinnate on basal half and blunt setae on distal half; tibia 0.99–1.03 × length of femur, with pinnate acute setae on mesal margin and long fine setae on mesal and lateral margins; claw with 11–13 denticles, separate into 2 parts, basal part with 3–4 denticles, gradually larger to apex; **Middle legs:** femur with 2 distinct markings at medial and distal areas; mesal margin with acute setae sparsely; tibia 0.87–0.90 × length of femur; tarsus 0.34–0.35 × length of femur. **Hing legs:** tibia 0.81–0.87 × length of femur; tarsus 0.33–0.34 × length of femur; mesal and lateral margins of tibia with short and long acute or long fine setae.

**Abdomen:** dorsum brown, venter darkish yellow. Each posterior margin of tergites I–IX with subequal serrate spines, serrate spines enlarge medially; mesal edges of posterolateral spines on abdominal segments VIII–IX curved smoothly, without secondary acute spines. **Gills:** gill I slenger, with fine setae; gills II–XII alike, each includes 2 narrow plate-like lamellae; lamellae with arborescent darkish tracheas; each lamella terminated in 3 processes, subequal in length.

#### Eggs: (Fig. 11)

General shape ovoid; chorionic surface with asteroid or flower-like ridges, the ridges clear and thick uniformly; in the center of asteroid costa, a small rounded tubercle present; without polar cap.

**Holotype:** mature female nymph, Kanchiao, Shuangchi, TPH, TW, 140 m, 28-III-1992, SCK. In NCHU.

**Paratypes:** 11♂♂, 10♀♀, same data as for holotype. 8♂♂, 8♀♀, in NCHU, 3♂♂, 2♀♀ in NMNS.



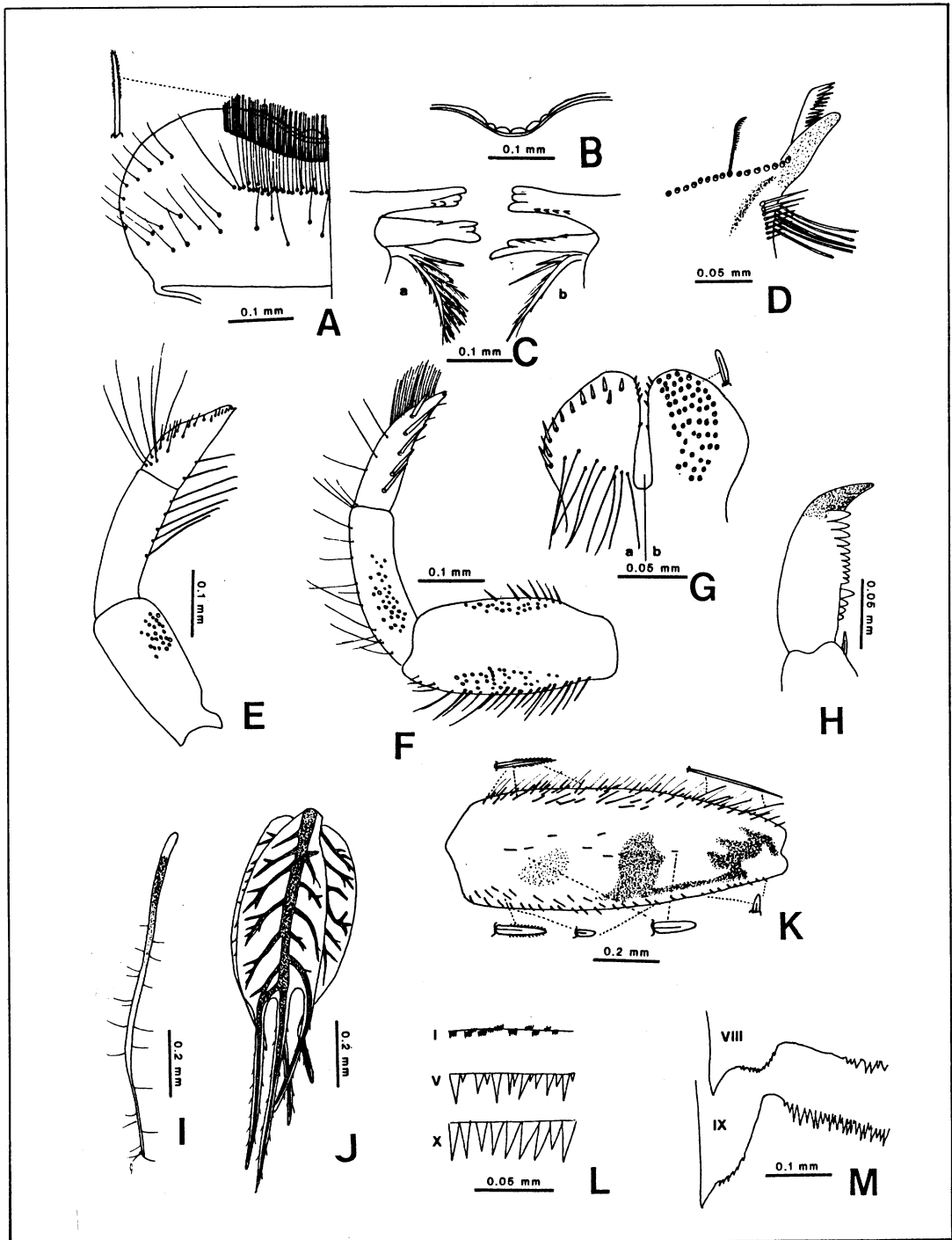


Fig. 1. Nymph of *Choroterpes trifurcatus* Uéno. A. labrum, dorsal; B. anteromedian margin of labrum; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. posterolateral spines of abdominal segments VIII and IX.

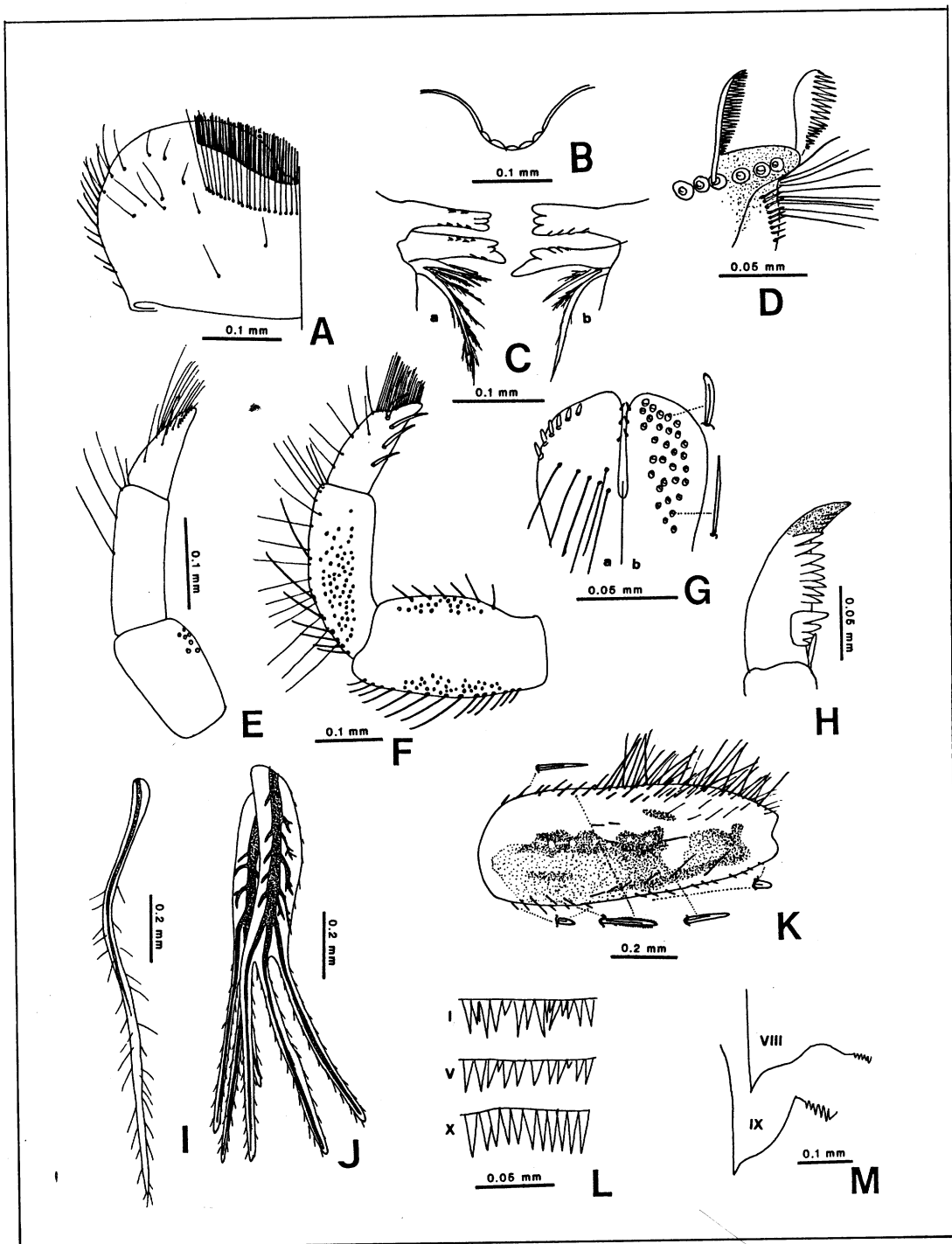


Fig. 2. Nymph of *Choroterpes taiwanensis* n.sp. A. labrum, dorsal; B. anteromedian margin of labrum; C. incisors and prosthæcae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. posterolateral spines of abdominal segments VIII and IX.

**Other mature nymphal specimens examined:**

2♂♂, 4♀♀, Hanchanchiao, Hsincheng, HLH, TW, 1-IV-1990, SCK; 2♂♂, Nanao, ILH, TW, 2-IV-1990, SCK; 1♂, 1♀, Peinan, TTH, 1-IV-1991, HCC; 2♀♀, Laochichaun, Shoufeng, HLH, TW, 85 m, 3-IV-1991, SCK; 1♂, Sanchan, Hsincheng, HLH, TW, 65 m, 3-IV-1991, SCK; 3♂♂, Kanchiao, Shuangchi, TPH, 30-V-1991, SCK & HCC; 1♂, Shuangchi, TPH, TW, 31-V-1991, SCK & HCC; 1♂, Pingsin, Shuangchi, TPH, 31-V-1991, SCK & HCC; 1♀, Wufeng, HCH, TW, 304 m, 24-X-1991, SCK & HCC; 1♂, Kuohsing, NTH, TW, 235 m, 22-XI-1991, SCK; 9♂♂, 9♀♀, Changyuan, Shuangchi, TPH, TW, 145 m, 29-III-1992, SCK; 7♂♂, 11♀♀, Pinglin, TPH, TW, 365 m, 30-III-1992, SCK; 10♂♂, 2♀♀, Chachiao, Sanhsia, TPH, TW, 225 m, 31-III-1992, SCK.

**Distribution:**

Taiwan.

**Note:**

This new species resembles *Choroterpes trifurcatus* Uéno but can be differentiated in nymphs by the following characters: (1) the venter of body is darkish yellow but pale in *trifurcatus*; (2) anterior margin of labrum with a emargination cleft deeply; (3) mesapical corner of maxilla has a short, blunt, tooth-like process; (4) anterior margin of maxilla has only 6–7 comb-shaped setae; (5) mesal margins of maxillary palpi have no long setae; (6) segments II–VII of abdomen have narrow plate-like gills; (7) posterior margin of tergite I has distinct serrate spines; (8) edges of posterolateral spines of abdominal segments VIII–IX smoothly curved. The chorionic structure resembles that of *trifurcatus* but the ridges are sharp and clear, instead of flat.

***Choroterpides nigella* Kang & Yang n.sp.**

(Figs. 3, 12)

**Mature nymphs:** (Fig. 3)

Body length: female 6.78–7.74 mm. General coloration: dark brown.

**Head:** dark brown, with light brown markings between eyes. Maxillary and labial palpi greatly elongated and extended beyond sides of head. Lateral margins of clypeus slightly divergent apically. **Labrum:** 0.69–0.72 × width of head, 1.31–1.36 × width of clypeus, dorsum surface shagreened, decline toward anterior suddenly, with a transversal, curved row of extremely long setae medially, lateral margins and areas with long setae; anterior margin with broad emargination. **Mandibles:** lateral margins of left and right mandible convex strongly and with closely set long setae medially. **Maxillae:** mesapical corner with a large, acute, tooth-like process, the process with 3 comb-shaped setae at base; segment III of maxillary palpus with numerous extremely long setae, 1.36–1.68 × length of segment I, 1.30–1.43 × length of segment II; mesal margins of segment II with extremely long setae apically. **Labium:** labial palpus extremely elongate, segment III of labial palpus 1.05–1.15 × length of segment I, 0.90–0.91 × length of segment II, segments II and III with extremely long setae; glossa oblong, ventro-apical half and anterodorsal margin with clavate setae; dorsum with acute setae on basal half and extremely long setae at base; paraglossa oval, 0.87–0.91 × width of head, with closely set setae on venter and apical half of dorsum.

**Thorax:** pronotum with shallow emargination anteromedially. **Fore legs:** femur with pinnate acute setae on central area and near basal half of posterior margin; tibia 1.04–1.07 × length of femur, with closely set pinnate acute setae on mesal margin; tarsus 0.36–0.39 × length of femur; claw with 15–16 denticles, separate into 2 parts, apical part with 9–11 denticles, basal with 4–5; denticles become large toward apex. **Middle legs:** the whole of leg with long blunt setae; tibia 0.91–0.92 × length of femur; tarsus 0.29–0.30 × length of femur; claw with 13–14 denticles. **Hind legs:** tibia 0.90–0.93 × length of femur; tarsus 0.24–0.25 × length of femur; claw with 15 denticles; mesal and lateral margins of tibia with long blunt setae.

**Abdomen:** dorsum dark brown, venter

darkish yellow. Posteromedian margins of tergites I–IX each with serrate spines, become large to distal segments; posterior margin of sternum IX with broad v-shaped emargination. Gills: gills present on abdominal segments II–VII alike; each gill with broad, black, plate-like lamellae, one of lamellae with 2 deep clefts, another with 3 processes at apex, median process longer than on laterals; 3 each lamellae without visible arborescent tracheas.

#### Eggs: (Fig. 12)

General shape ovoid; chorionic surface with asteroid or flower-like ridges, the ridges clear and gradually thicken toward the center of asteroid; in the center of asteroid costa, a small rounded tubercle present; 1–2 visible micropyles on equatorial area, without polar cap.

**Holotype:** mature female nymph, Kuolai, Pinglin, TPH, TW, 315 m, 30-III-1992, SCK. In NCHU.

**Paratypes:** 23♀♀, same data as for holotype. 18♀♀ in NCHU, 5♀♀ in NMNS.

#### Other mature nymphal specimens examined:

155♀♀ same data as for holotype; 37♀♀, same locality and collector, 10-IX-1993; 29♀♀ Chukun, Yuanshan, IL, TW, 180 m, SCK.

#### Distribution:

Taiwan.

#### Note:

This new species is the third species of *Choroterpides* Ulmer, the other 2 species are *C. exiqua* (Eaton) and *C. major* Ulmer. We examined over 200 specimens from three locales, but found no male nymph. Both male and female specimens of the other two species of this genus were examined. This new species resembles *C. major* but can be differentiated in the nymphs by the following characters: (1) labrum has a transversal, curved row of extremely long setae on dorsum medially; (2) mesapical corner of maxilla with a large, acute tooth-like process and 3 comb-shaped setae at base of process. This species is very similar in the chorionic structure of the asteroid

or flower-like ridge to *Choroterpes* spp. Although *Choroterpes* and *Choroterpides* differ significantly in nymphal characters, they appear closely related in terms of chorionic morphology.

#### *Thraululus fatuus* Kang & Yang n.sp.

(Figs. 4, 13)

#### Mature nymphs: (Fig. 4)

Body length: female 6.88–7.20 mm; male 6.50–6.82 mm. General coloration: dark brown.

**Head:** dark brown, darkish between ocelli, frontal and mesal side of eyes with light brown markings; eyes of male divided into 2 portions, upper light orange, lower black; lateral margins of clypeus slightly convex, base with a shallow emargination. **Labrum:** 0.44–0.45 x width of head, 0.94 x width of clypeus; anterior margin undulate and with 6 splits medially; dorsum with a straight, transversal, closely set row of setae near anterior margin; at apical 1/3 of labrum with a loosely set row of long setae; venter with a loosely set row of blunt setae near anterior margin. **Maxillae:** mesapical corner with a large cristae process; galea-lacinia with 18–21 comb-shaped setae near anterior margin; segment I of maxillary palpus darkish, segments II and III pale and with long acute setae on mesal margin; segment III of maxillary palpus with numerous long setae, 0.62–0.70 x length of segment I, 0.70–0.74 x length of segment II; mesal margins of segment II with long setae apically. **Labium:** segment III of labial palpus 0.62–0.72 x length of segment I, 0.67–0.78 x length of segment II, segments I darkish, segments II and III pale, with acute setae on mesal margin and long setae on lateral margin; glossa oblong, venter with closely set setae, dorsum with loosely set of setae near anterior margin; paraglossa subsquare, 0.54–0.58 x width of head, apical half of dorsum and venter with closely set setae.

**Thorax:** posterior margin of mesonotum, between fore wing pads with 2 lobes. Fore legs: femur darkish and with a transversal pale band medially, anterior margin with blunt setae,

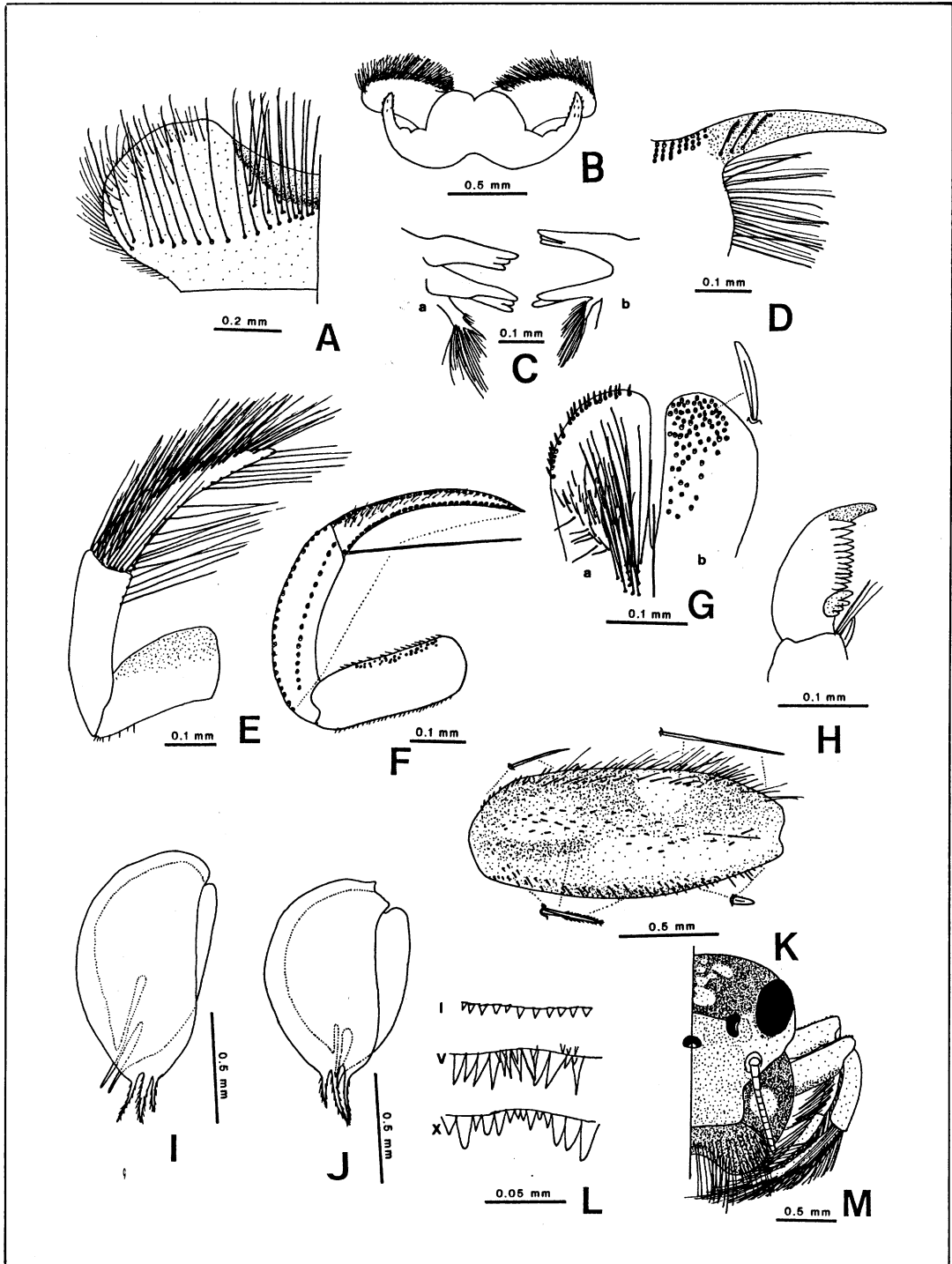


Fig. 3. Nymph of *Choroterpides nigella* n.sp. A. labrum, dorsal; B. hypopharynx, dorsal; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. head, dorsal.

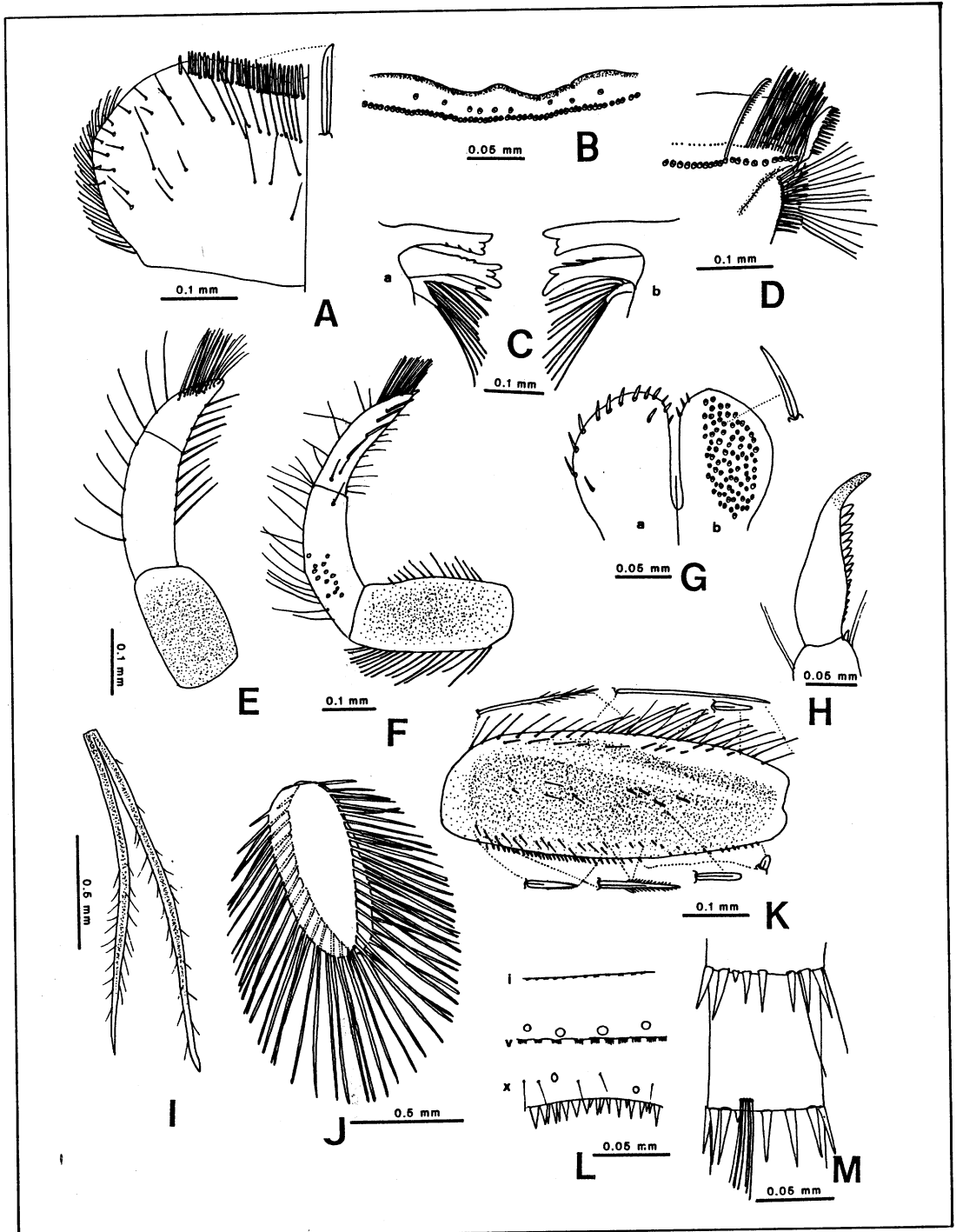


Fig. 4. Nymph of *Thraulius fatuus* n.sp. A. labrum, dorsal; B. anteromedian margin of labrum, dorsal; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. segments of cerci, about at basal 1/5, dorsal.

posterior margin with long fine setae and long pinnate acute setae; tibia  $0.98-1.03 \times$  length of femur, with closely set various setae on mesal margin, include short or long, branched or pinnate setae; tarsus  $0.43-0.45 \times$  length of femur; claw with 12–14 denticles, gradually enlarge apically. **Middle legs:** femur pale, with black broad marking on distal half; a transversal pale band splits the marking; tibia  $0.90-0.96 \times$  length of femur; tarsus  $0.34-0.38 \times$  length of femur; claw with 14–16 denticles. **Hing legs:** basal half of femur pale, distal half black and with a transversal pale band; tibia  $0.97-1.00 \times$  length of femur; tarsus  $0.31-0.33 \times$  length of femur; claw with 12–15 denticles.

**Abdomen:** dorsum dark brown, venter darkish yellow; each tergite with a pair of faint, triangular, light brown markings on anterior margin; posterior margins of tergites I–X each with fine serrate spines, in tergites VIII–X more distinct than in I–VII; tergites I–VIII each with pores near or on posterior margin; posterior margin of sternum IX truncated. **Gills:** gills present on abdominal segments I–VII, black; each gill with 2 similar portions; gill I slender, lanceolate, with fine setae; gills II–VII oval, with long fringed margins, width about  $2/5$  of length. **Caudal filaments:** pale, basal part with whorls of long acute and fine setae on each articulation; distal part with long fine setae on every other articulation.

#### Egg: (Fig. 13)

General shape olivary, the poles somewhat truncate or blunt; the chorionic surface with crochet-like ridges; both poles with radiation ridges and 8 pairs of hooks, length of hooks about  $1/3$  of egg; no visible micropyle on chorionic surface.

**Holotype:** mature female nymph, Taiping, TCH, TW, 330 m, 8-X-1990, SCK & HCC. In NCHU.

**Paratypes:** 3♂♂, 3♀♀, same data as for holotype; 2♀♀, Wufeng, TCH, TW, 27-IX-1990, W. C. Chuang & C. W. Chen. 2♂♂, 4♀♀ in NCHU, 1♂, 1♀ in NMNS.

#### Other mature nymphal specimens examined:

1♂, Shinlu, Shityu, PTH, TW, 205 m, 17-XII-1990, SCK; 1♀, between Hsitou to Shanlinhsi, Luku, NTH, TW, 1,010 m, 30-VIII-1991, SCK & HCC.

#### Distribution:

Taiwan.

#### Note:

This new species resembles *Thraululus bishopi* Peters & Tsui 1972, but can be differentiated in the nymphs by the following characters: (1) in the anterior margin of labrum undulate and with 6 splits medially; (2) in the marking patterns of legs; (3) in the denticles of claw gradually enlarge apically.

#### *Thraululus macilentus* Kang & Yang n.sp.

(Figs. 5, 14)

#### Mature nymphs: (Fig. 5)

Body length: female 6.10–6.32 mm, male 5.10–5.49 mm. General coloration: dorsum brown, venter pale.

**Head:** pale, darkish between ocelli; eyes of male divided into 2 portions, upper light yellow, lower black; lateral margins of clypeus slightly convex, base with a shallow emargination. **Labrum:**  $0.50-0.52 \times$  width of head,  $1.00-1.02 \times$  width of clypeus; anterior margin slightly concave and with 6 splits medially; dorsum with a transversal, closely set row of setae near anterior margin and numerous same kind of setae scattered ahead; at apical  $1/3$  of labrum with a loosely set row of long setae; venter with a loosely set row of short acute setae near anterior margin. **Mandibles:** outer incisor of left mandible with 2 acute processes near apex, inner incisor with a acute processes medially. **Maxillae:** mesapical corner with a large cristae process; galealacinia with 19–20 comb-shaped setae near anterior margin; segment III of maxillary palpus with numerous long setae,  $0.65-0.80 \times$  length of segment I,  $0.73-0.80 \times$  length of segment II; mesal margins of segment II with

long setae apically. **Labium:** segment III of labial palpus  $0.76-0.78 \times$  length of segment I,  $0.82-0.90 \times$  length of segment II, segments I darkish, segments II and III pale, with acute setae on mesal margin and long setae on lateral margin; glossa semicircular, venter with closely set spoon-shaped setae, basal setae longer than apical; dorsum of glossa with loosely set of setae along anterior margin; paraglossa subsquare,  $0.57-0.59 \times$  width of head; apical  $1/3$  of dorsum with closely set setae; venter with closely set setae cross the median area.

**Thorax:** nota of thorax pale, anterolateral corners of mesonotum blackish; posterior margin of mesonotum, between fore wing pads with 2 lobes. **Fore legs:** pale, distal half of tibia light darkish; anterior margin and median area of femur with blunt pinnate setae, posterior margin with long pinnate; tibia  $0.98-1.01 \times$  length of femur, with closely set pinnate acute and acute setae on mesal margin; tarsus of female and male  $0.47-0.48 \times$  and  $0.56-0.61 \times$  length of femur; claw with 10 denticles, median and basal denticles larger than at apex. **Middle legs:** femur pale; with acute setae on anterior margin, with long acute setae on posterior margin, with a row of long pinnate acute setae near posterior margin and blunt pinnate setae on basal half near anterior margin and on median area; tibia  $0.96-0.99 \times$  length of femur; tarsus  $0.36-0.41 \times$  length of femur; claw with 9 denticles. **Hind legs:** tibia  $0.95-0.97 \times$  length of femur, mesal margin with closely set of branched and acute setae, lateral areas with acute setae; tarsus  $0.29-0.33 \times$  length of femur; claw with 10 denticles.

**Abdomen:** dorsum blackish, venter pale; each tergite with a pair of triangular, pale markings on anterior margin; each posterior margin of tergites I–VIII with very fine or no visible serrate spines, in tergites IX–X each with distinct than in I–VII; tergites I–VIII with pores near or on posterior margin; posterior margin of sternum IX truncated. **Gills:** blackish, gills present on abdominal segments I–VII, black; each gill with 2 portions; gill I slender, lancet, with fine setae; gills II–VII with 2 oval but differ in width of portions,

each portion with long fringed margins. **Caudal filaments:** pale, basal part with whorls of sparse, blunt or acute spines on each articulation; distal part with long fine setae on every other articulations.

**Egg:** (Fig. 14)

General shape long olivary, the poles somewhat acute; the chorionic surface with longitudinal stripe ridges; both poles with 4 pairs of hooks, length of hooks about  $1/2$  of egg; no visible micropyle on chorionic surface.

**Holotype:** mature female nymph, Dungs-hygher, Pingshi, TPH, TW, 280 m, 31-V-1991, SCK & HCC. In NCHU.

**Paratypes:** 2♂♂, 2♀♀, same data as for holotype; 1♂, 1♀, Gaupaur, Fuhsing, TYH, TW, 400 m, 9-IX-1993, SCK; 1♀, Kuolai, Pinglin, TPH, TW, 315 m, 10-IX-1993, SCK. 2♂♂, 3♀♀ in NCHU, 1♂, 1♀ in NMNS.

**Distribution:**

Taiwan.

**Note:**

This species resembles *Thraulius fatuus* n.sp. but can be differentiated in the nymphs by the following characters: (1) labrum with closely set row of setae near anterior margin and numerous same kind of setae scattered ahead; (2) anteromedian margin of labrum concave smoothly; (3) venter of glossa with spoon-shaped setae; (4) all femora of legs pale; (5) median and basal denticles of fore claw larger than at apex and (6) basal part of caudal filaments with whorls of sparse, blunt or acute spines on each articulation. These two new species are very different in chorionic structure, in *macilentus* with only 4 pairs hook on each poles, and the length of hook and ridges of chorionic surface are very different.

*Thraulius umbrosus* Kang & Yang n.sp.  
(Figs. 6, 15, 16)

**Mature nymphs:** (Fig. 6)

Body length: female 5.05–6.04 mm, male



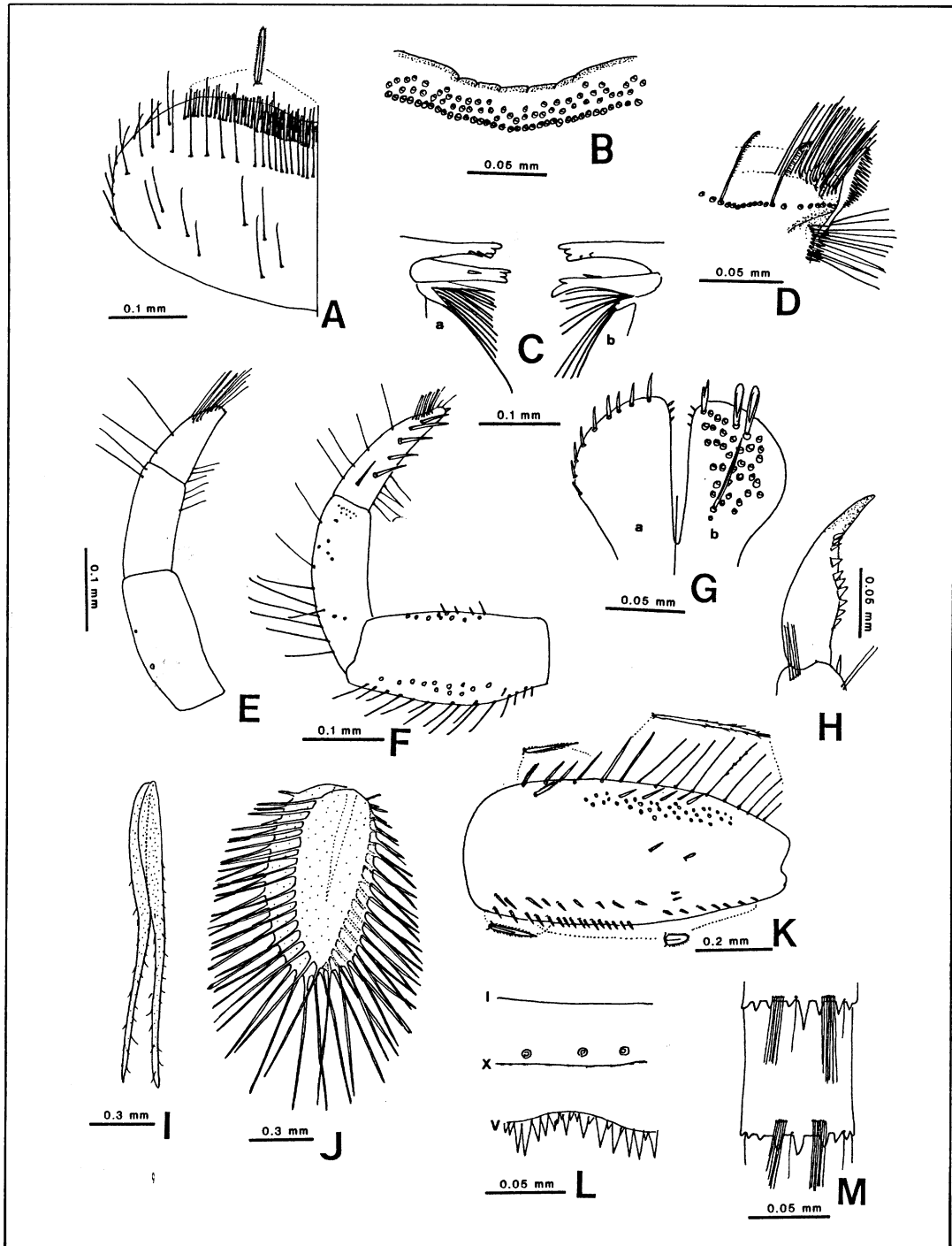


Fig. 5. Nymph of *Thraulius macilentus* n.sp. A. labrum, dorsal; B. anteromedian margin of labrum, dorsal; C. incisors and prothecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. segments of cerci, about at basal 1/5, dorsal.

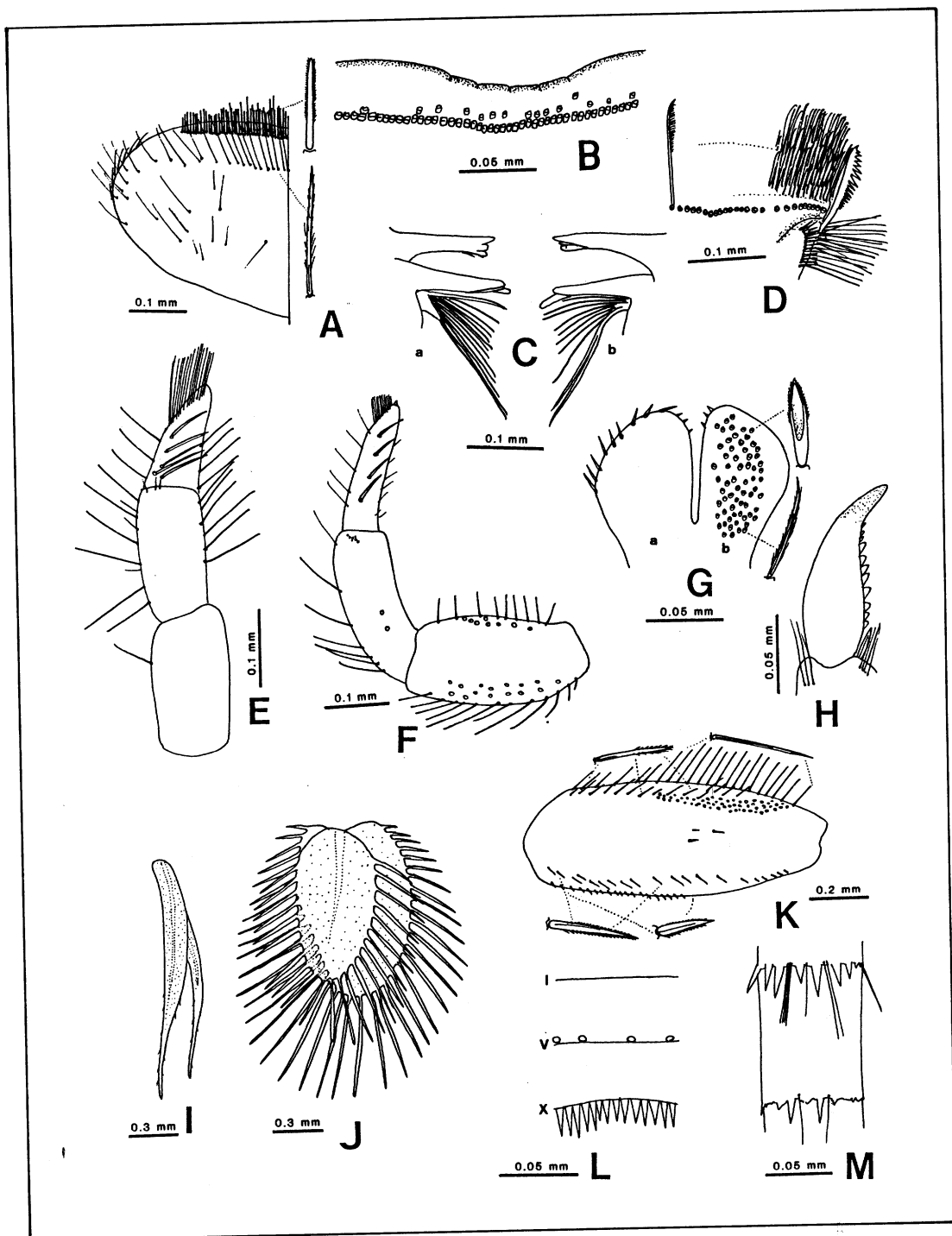


Fig. 6. Nymph of *Thraulius umbrosus* n.sp. A. labrum, dorsal; B. anteromedian margin of labrum, dorsal; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. posteromedian margins of tergites I, V and X; M. segments of cerci, about at basal 1/5, dorsal.

5.04–5.31 mm. General coloration: dorsum blackish, venter light yellow.

**Head:** lateral margins of clypeus slightly convex, base with a shallow emargination; eyes of male divided into 2 portions, upper light yellow, lower black. **Labrum:**  $1/2$  width of head, equal to width of clypeus; anterior margin slightly concave and with 5 splits medially; posterior margin convex; dorsum with a transversal, closely set row of pinnate setae near anterior margin and a few same kind of setae scattered ahead; at apical  $1/4$  of labrum with a loosely set row of long pinnate setae; venter with a loosely set row of acute setae near anterior margin. **Maxillae:** mesapical corner with a large cristae process; galea-lacinia with 24–26 comb-shaped setae near anterior margin; segment III of maxillary palpus  $0.75-0.89 \times$  length of segment I,  $0.71-0.89 \times$  length of segment II; mesal margins of segments II and III with long setae apically. **Labium:** segment III of labial palpus with 5–7 stout setae medially,  $0.76-0.81 \times$  length of segment I,  $0.72-0.84 \times$  length of segment II, segments I darkish, segments II and III pale, with acute setae on mesal margin and long setae on lateral margin; glossa semi-circular, venter with closely set spoon-shaped, pinnate setae, basal setae longer than at apex; dorsum of glossa with loosely set of acute setae along anterior margin; paraglossa sub-semicircular,  $0.58-0.61 \times$  width of head; apical  $1/4$  of dorsum with closely set setae; venter with closely set setae cross the median area, and along anterior margin.

**Thorax: Fore legs:** pale, Femur with pinnate acute setae near or on anterior margin, with long pinnate acute near posterior margin and long setae on posterior margin; tibia equal to length of femur, with closely set pinnate acute and acute setae on mesal margin; tarsus of female and male  $0.44-0.46 \times$  and  $0.58-0.60 \times$  length of femur; claw with 7–9 denticles, median denticles larger than apical and basal. **Middle legs:** femur with pinnate acute setae on anterior margin, with long acute setae on posterior margin, with a row of long pinnate acute setae near posterior margin; tibia slightly shorter than length of femur; tarsus  $0.36-0.41$

$\times$  length of femur; claw with 7–9 denticles. **Hind legs:** tibia equal or slightly longer than femur, mesal margin with closely set of branched and acute setae, lateral areas with acute setae; tarsus  $0.30-0.35 \times$  length of femur; claw with 6–9 denticles.

**Abdomen:** dorsum blackish, venter light yellow; posterior margins of tergites I–VIII each with very fine or no visible serrate spines, tergites IX–X distinct that in I–VII; tergites I–VIII each with pores near or on posterior margin; posterior margin of sternum IX with a emargination. **Gills:** blackish, gills present on abdominal segments I–VII, black; each gill with 2 portions; gill I narrow, lancetot, with a few fine setae; gills II–VII with a oval and 1 subcordate portion, each portion with long fringed margins. **Caudal filaments:** pale, basal part with whorls of sparse, blunt or acute spines on each articulation; distal part with long fine setae on every other articulations.

#### Eggs: (Figs. 15, 16)

General long oval, cucumber-like; the chorionic surface with longitudinal ridges, in which with 2 patterns of ridge alternately, one stripe, the others sinuate and with vertical branch; without visible hook.

**Holotype:** mature male nymph, Dona Spring, Maulin, KSH, TW, 335 m, 20-XII-1991, SCK. In NCHU.

**Paratypes:** 2♂♂, 2♀♀, same data as for holotype. 1♂, 2♀♀, in NCHU; 1♂ in NMNS.

#### Distribution:

Taiwan.

#### Note:

This species resembles *Thraulius macilentus* n.sp. but can be differentiated in the nymphs by the following characters: (1) labrum with closely set row of setae near anterior margin and a few same kind of setae scattered ahead; (2) anteromedian margin of labrum with 5 splits; (3) galea-lacinia with 24–26 comb-shaped setae near anterior margin, the number of setae more than in *macilentus*; (4) gills II – VII with 2 different shaped portions.

The corionic structure of this species differs from that of *fatuus* and *macilentus* is absent of hook-like structure.

***Habrophlebiodes tenella* Kang & Yang n.sp.**

(Figs. 7, 17)

**Mature nymphs:** (Fig. 7)

Body length: female 6.20–9.52 mm; male 4.50–5.38 mm. General coloration: darkish yellow.

**Head:** antenna pale, pedicel blackish; lateral margins of clypeus slightly convex; eyes of male divided into 2 portions, lower portion black, upper light yellow. **Labrum:** 0.38–0.40 × width of head, 0.89–1.00 × width of clypeus; anteromedian margin with a shallow emargination; a row of blunt setae along anterior margin except anteromedian emargination; many closely set of fine branched setae scattered near anterior margin. **Hypopharynx:** anteromedian margin of lingua with a cleft, each lobe with a tuft of dense setae near anterior margin. **Mandibles:** outer and inner incisors of left and right mandible short and stout; stem of prosthema of right mandible sinuated. **Maxillae:** mesapical corner with some acute processes; galea-lacinia with 4–7 comb-shaped setae near anterior margin; segment III of maxillary palpus with numerous long fine setae, mesal margin somewhat concave, 0.86–1.00 × length of segment I, 0.86–1.17 × length of segment II; lateral margin of segment I with several stout acute. **Labium:** segment III of labial palpus with 4 rows of dorsal, stout, acute setae on mesal half, 0.50–0.68 × length of segment I, 0.82–0.88 × length of segment II; segments I with a row of stout setae along posterior margin; glossa semi-circular, dorsum with closely set long acute setae; venter of glossae with a row of long acute seta along lateral margin, with short acute setae centrally; paraglossa semicircular, mesapical corner expansive, 0.36–0.39 × width of head; apical 1/3 of dorsum and venter with closely set setae about.

**Thorax:** nota of thorax pale, anterolateral corners of mesonotum blackish; posterior

margin of mesonotum, between fore wing pads with 2 lobes. **Fore legs:** femur darkish, with pinnate acute setae near anterior and posterior margins and on median, with several acute setae on posterior margin; tibia with closely set acute setae on mesal margin and long fine setae on lateral margin, 0.93–0.97 × length of femur; tarsus of female and male 0.52–0.55 × and 0.58–0.62 × length of femur; claw slender, with 17–22 denticles from apical 1/3 to base, gradually enlarge apically. **Middle legs:** femur pale, setae same as in fore leg; tibia 0.88–0.92 × length of femur; tarsus 0.37–0.41 × length of femur; claw with 13–19 denticles. **Hind legs:** femur pale, tibia with acute setae on mesal and lateral margins, 0.91–1.00 × length of femur; tarsus 0.37–0.42 × length of femur; claw with 13–22 denticles.

**Abdomen:** dorsum blackish, venter yellow; tergite X pale, dark on posterior margin; posterior margins of tergites I–VI each with very fine serrate spines; abdominal segments VIII and IX with posterolateral spines; tergites VII–X each with serrate spines distinctly. **Gills:** present on abdominal segments I–VII alike, gills deeply biforked; gills II–VII with tracheae branched distinctly. **Caudal filaments:** pale, basal part with whorls of sparse, blunt or acute spines and long fine setae groups at articulation; distal part with long fine setae on every articulation.

**Eggs:** (Fig. 17)

General shape ovoid; chorionic surface with closely set, large, hunch-like tubercles; each tubercle with a round area medially, in which with several small pores; all the tubercles subequal in size and 8–12 tubercles close together.

**Holotype:** Mature female nymphs, Dungs-hygher, Pinghsi, TPH, TW, 280 m, 31-V-1991, SCK & HCC. In NCHU.

**Paratypes:** 4♂♂, 4♀♀, same data as for holotype; 4♂♂, 4♀♀, Kanchiao, Shuangchi, TPH, TW, 140 m, 13-XI-1993, SCK. 5♂♂, 5♀♀ in NCHU, 3♂♂, 3♀♀ in NMNS.

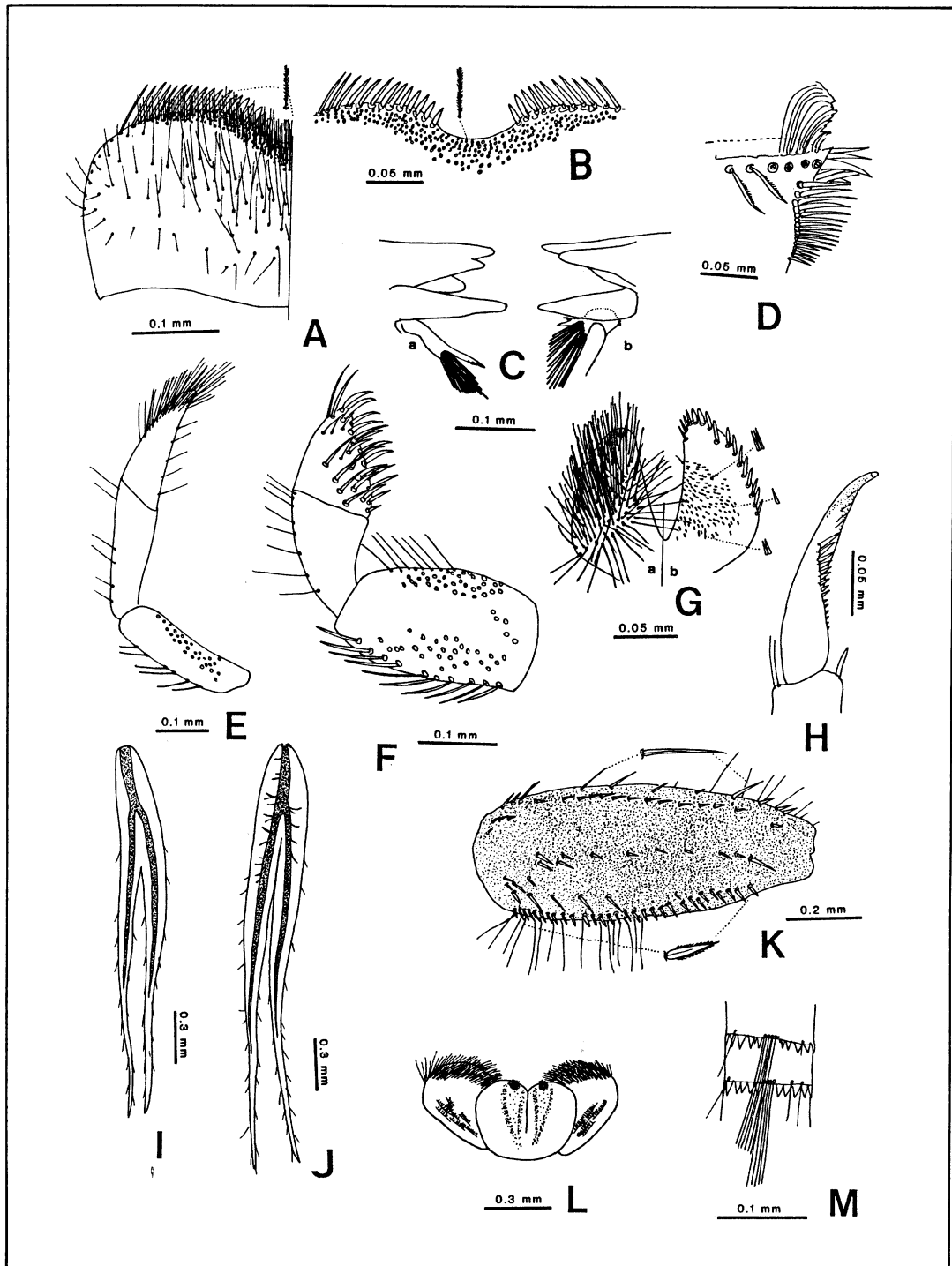


Fig. 7. Nymph of *Habrophlebiodes tenella* n.sp. A. labrum, dorsal; B. anteromedian margin of labrum; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. ventral; b. dorsal); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. hypopharynx, dorsal; M. segments of cerci, about at basal 1/5, dorsal.

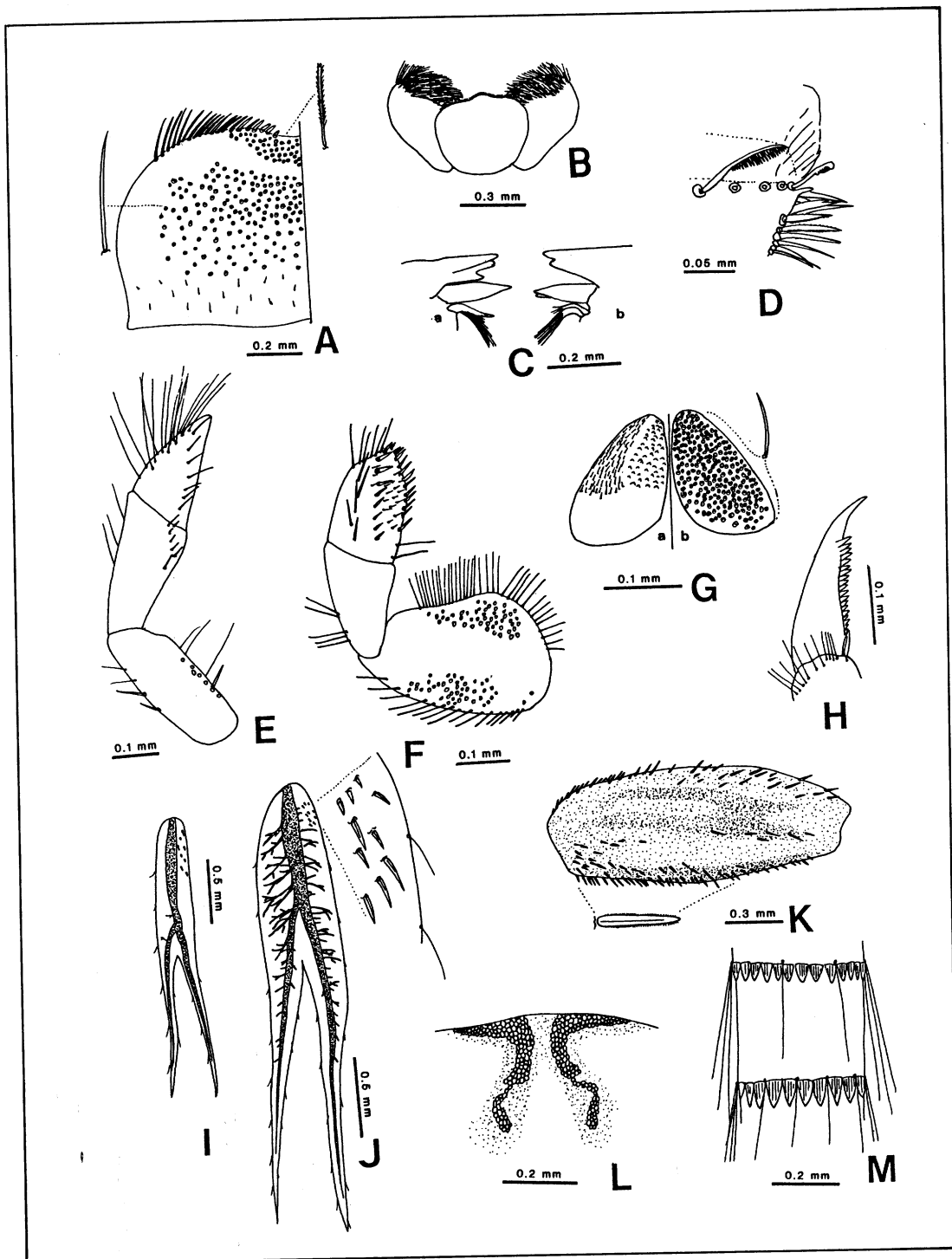


Fig. 8. Nymph of *Paraleptophlebia spina* n.sp. A. labrum, dorsal; B. hypopharynx, dorsal; C. incisors and prosthetae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. anteromedian area of tergite V; M. segments of cerci, about at basal 1/5, dorsal.

**Other mature nymphal specimens examined:**

2♀♀, Kuanhsi, HCH, TW, 460 m, 19-XI-1990, SCK; 1♀, Chihpen, Peiman, TTH, TW, 180 m, 15-XII-1990, SCK; 1♂, 4♀♀, Shinlu, Shityu, PTH, TW, 205 m, 17-XII-1990, SCK; 1♀, Hwesunlinchun, Lenai, NTH, TW, 750 m, 19-VIII-1991, HCC; 2♂♂, 1♀♀, Hwesunlinchun, Lenai, NTH, TW, 750 m, 20-VIII-1991, HCC; 2♂♂, 1♀, Shanlinsi, Luku, NTH, 22-VIII-1991, SCK & HCC; 1♂, between Luku to Hsitou, NTH, TW, 1,040 m, 30-VIII-1991, SCK & HCC; 1♂, between Hsitou to Shanlinhsi, NTH, TW, 1,010 m, 30-VIII-1991, SCK & HCC; 1♂, Meishan, CIH, TW, 815 m, 19-XI-1991, SCK; 1♀, Shanping, Liukuei, KSH, TW, 635 m, 19-XII-1991, SCK; 3♂♂, 1♀, Changyuan, Shuangchi, TPH, TW, 145 m, 29-III-1992, SCK; 1♂, 1♀, Kanchi, Pinglin, TPH, TW, 365 m, 30-III-1992, SCK; 1♂, Shuicheliao, Sanhsia, TPH, TW, 420 m, 31-III-1992, SCK.

**Distribution:**

Taiwan.

**Note:**

This species resembles *Habrophlebiodes gilliesi* Peters but can be differentiated in the nymphs by the following characters: (1) no dark brown band between ocelli in female nymph; (2) pronotum have no transverse band; (3) tergites X pale, dark only on posterior margin; (4) dorsum of fore leg is uniformly brown.

***Paraleptophlebia spina* Kang & Yang n.sp.**

(Figs. 8, 19)

**Mature nymphs: (Fig. 8)**

Body length: female 8.10–11.29 mm, male 7.10–8.67. General coloration: dark brown.

**Head:** dark brown, pale and striped between eyes; clypeus short, lateral margins convex; eyes of male divided into 2 portions, upper portion darkish yellow, lower black. **Labrum:** 0.41–0.43 × width of head, 0.93–0.99 × width of clypeus; anteromedian margin with a shallow emargination; a row of stout

setae along anterior margin except antero-median emargination; dorsum with closely set fine pinnate setae near anterior margin and closely set acute setae medially. **Hypopharynx:** lingua turbinate, anteromedian margin slightly ridgy; superlinguae oval, apical 1/3 with closely set acute setae. **Maxillae:** mesapical corner with acute spines; galea-lacinia with 5–7 comb-shaped setae near anterior margin; dorsum of segments II and III with a row of acute setae near mesal margins; segment III of maxillary palpus with numerous long setae, 0.77–0.91 × length of segment I, 0.77–0.91 × length of segment II. **Labium:** segment III of labial palpus 0.67–0.82 × length of segment I, 1.04–1.16 × length of segment II; segment I darkish, segments II and III pale, with acute setae on mesal margin and long setae on lateral margin; glossa triangular, venter with closely set setae, dorsum with closely set of fine acute setae on lateral half, mesal half with numerous small ridges; paraglossa semicircular, 0.44–0.50 × width of head, apical half of venter with closely set setae, apical half of dorsal setae scattered triangularly.

**Thorax: Fore legs:** femur darkish, 3 rows of acute or pinate setae near anterior, posterior margin and median; tibia 0.90–9.96 × length of femur, with closely set acute on mesal margin; tarsus of female and male 0.52–0.58 × and 0.58–0.63 × length of femur; claw with 14–19 denticles, gradually enlarge apically. **Middle legs:** tibia 0.85–0.89 × length of femur; tarsus 0.40–0.47 × length of femur; claw with 14–17 denticles. **Hind legs:** tibia 0.94–1.03 × length of femur, with acute setae on mesal and lateral margins; tarsus 0.39–0.45 × length of femur; claw with 15–19 denticles.

**Abdomen:** dorsum brown, each tergite with a pair of shagreened area and dark near anterior margin; abdominal segments VIII and IX each with blunt posterolateral spines; posterior margins of tergites I–IX each with very fine serrate spines; lateral spines of tergite IX larger than in medial; tergite X with regular serrate spines distinctly; lateral areas of tergites I–IX with several acute setae. **Gills:** gills present on abdominal segments I–VII alike, single lamella, forked about at

basal 2/5; gills II–VII tracheae branched distinctly; each gill with several acute setae near base. **Caudal filaments:** basal part with whorls of triangular spines and long fine setae on each articulation, each spine with longitudinal strips; distal part with long fine setae on every articulation.

#### Eggs: (Fig. 19)

General shape long oval; chorionic surface scatter with small uniform tubercles, all the tubercles subequal in size; a lot of fine pores on the surface of chorion.

**Holotype:** mature female nymph, Tienchih, Lenai, NTH, TW, 2,855 m, 26-I-1991, SCK & HCC. In NCHU.

**Paratypes:** 10♀♀, 10♂♂, same data as for holotype. 6♂♂, 8♀♀ in NCHU, 4♂♂, 2♀♀ in NMNS.

#### Other mature nymphal specimens examined:

1♀, Chungyangchienshan, Hoping, TCH, 12-V-1990, WBY; 1♀, Hsini, NTH, 21-VI-1990, SCK; 2♂♂, 6♀♀, Alishan, CIH, 25-VII-1990, HCC; 1♀, Taipingshan, Nanao, ILH, 11-VIII-1990, SCK & HCC; 1♀, Jihsinkang, Lenai, NTH, TW, 2,565 m, 2-XII-1990, WBY; 1♀, Yuinhai, Lenai, NTH, TW, 2,360 m, 25-I-1991, SCK & HCC; 1♀, Alishan, CIH, TW, 2,195 m, 8-II-1991, HCC; 2♂♂, 6♀♀, Tienchih, Taoyuan, KSH, TW, 2,310 m, 2-IV-1991, SCK; 1♀, Sindayang, Hoping, TCH, TW, 1,860 m, 4-IV-1991, SCK; 2♀♀, Tatung, ILH, TW, 2,500 m, 7-VII-1991, HCC.

#### Distribution:

Taiwan.

#### Note:

This new species can be distinguished from all other described species of *Paraleptophlebia* by the combination of characters of nymphs: (1) in the lateral areas of tergites I–IX with several acute setae; (2) in the each gill with several acute setae near base; (3) in the each tergite with a pair of shagreened area and dark near anterior margin. This species lives on high mountain, above 1,500 m.

#### *Paraleptophlebia erratica* Kang & Yang n.sp. (Figs. 9, 20)

#### Mature nymphs: (Fig. 9)

Body length: female 5.05–5.59 mm; male 4.90–5.38 mm. General coloration: darkish yellow.

**Head:** darkish yellow, with a pair of black lunate markings between ocelli; eyes of male divided into 2 portions, upper darkish yellow, lower black. **Labrum:** 0.40–0.43 × width of head, 0.89–0.93 × width of clypeus; anteromedian margin with a shallow emargination; a row of blunt setae along anterior margin except anteromedian emargination; dorsum with closely set fine branched setae near anterior margin and closely set acute setae medially. **Hypopharynx:** lingua turbinate, anteromedian margin slightly concave; superlinguae oblong, apical 1/3 with closely set acute setae. **Maxillae:** mesapical corner with acute spines; galealacinia with 5 comb-shaped setae near anterior margin; segment III of maxillary palpus with numerous long setae, 0.83–1.00 × length of segment I, 0.83–0.95 × length of segment II; apex of segment I over apex of galea-lacinia; near mesal margins of segments II and III with long acute setae. **Labium:** segment III of labial palpus 0.74–0.80 × length of segment I, 1.07–1.31 × length of segment II, dorsum of segment III with 3 longitudinal rows of acute setae; glossa triangular, venter with closely set long acute setae, dorsum with a longitudinal row of acute setae medially, mesal half with numerous small acute ridges; paraglossa semicircular, 0.42–0.44 × width of head, apical half of dorsum with closely set setae, ventral setae concentrate in the middle.

**Thorax:** all legs pale. **Fore legs:** femur with pinnate setae on anterior margin and near posterior margin; tibia 0.95–0.99 × length of femur, with closely set acute on mesal margin; tarsus of female and male 0.50–0.52 × and 0.56–0.60 × length of femur; claw with 11–16 blunt denticles, gradually enlarge apically. **Middle legs:** tibia 0.89–0.94 × length of femur; tarsus 0.40–0.41 × length of femur; claw with 10–15 blunt denticles.



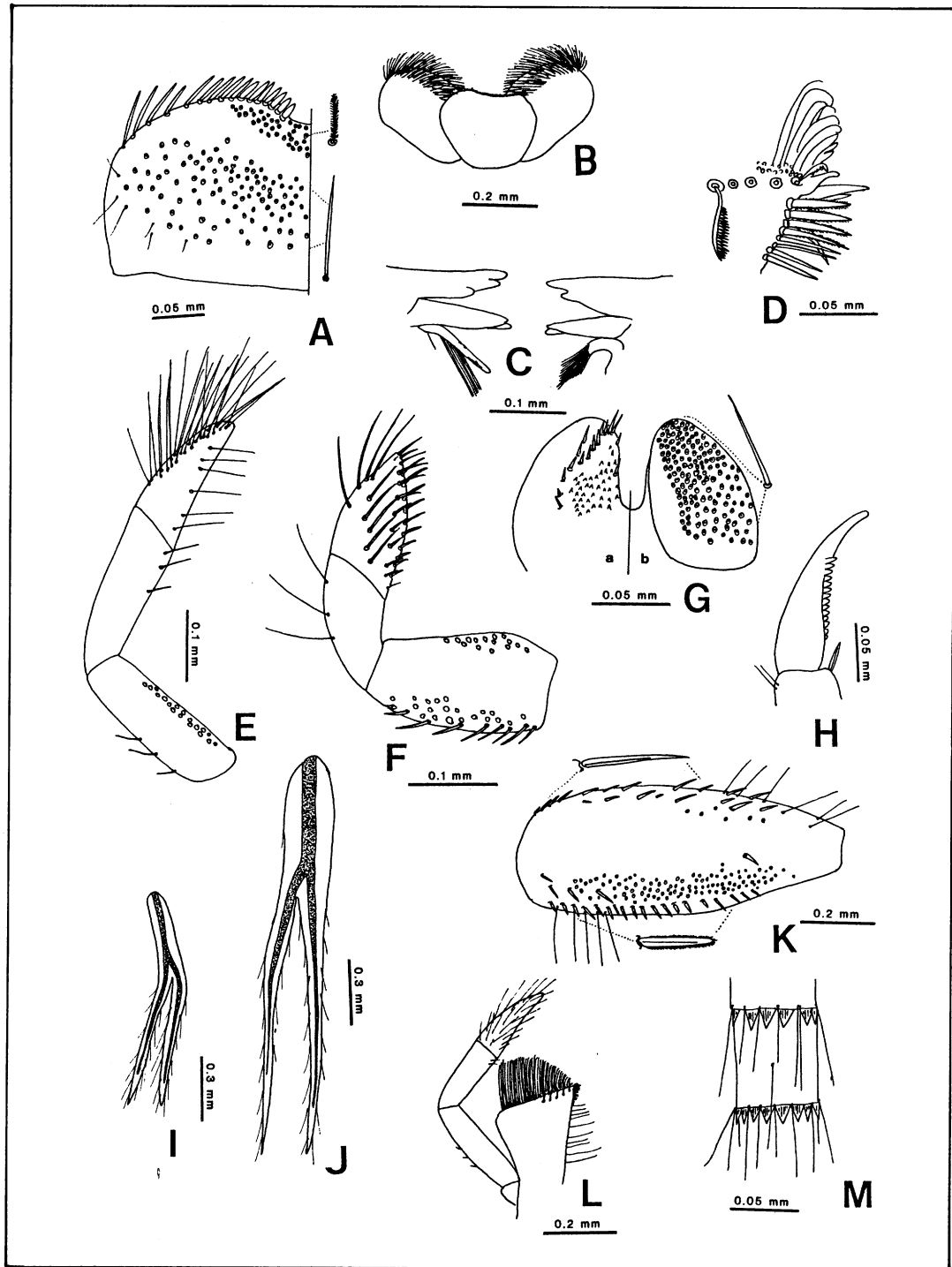
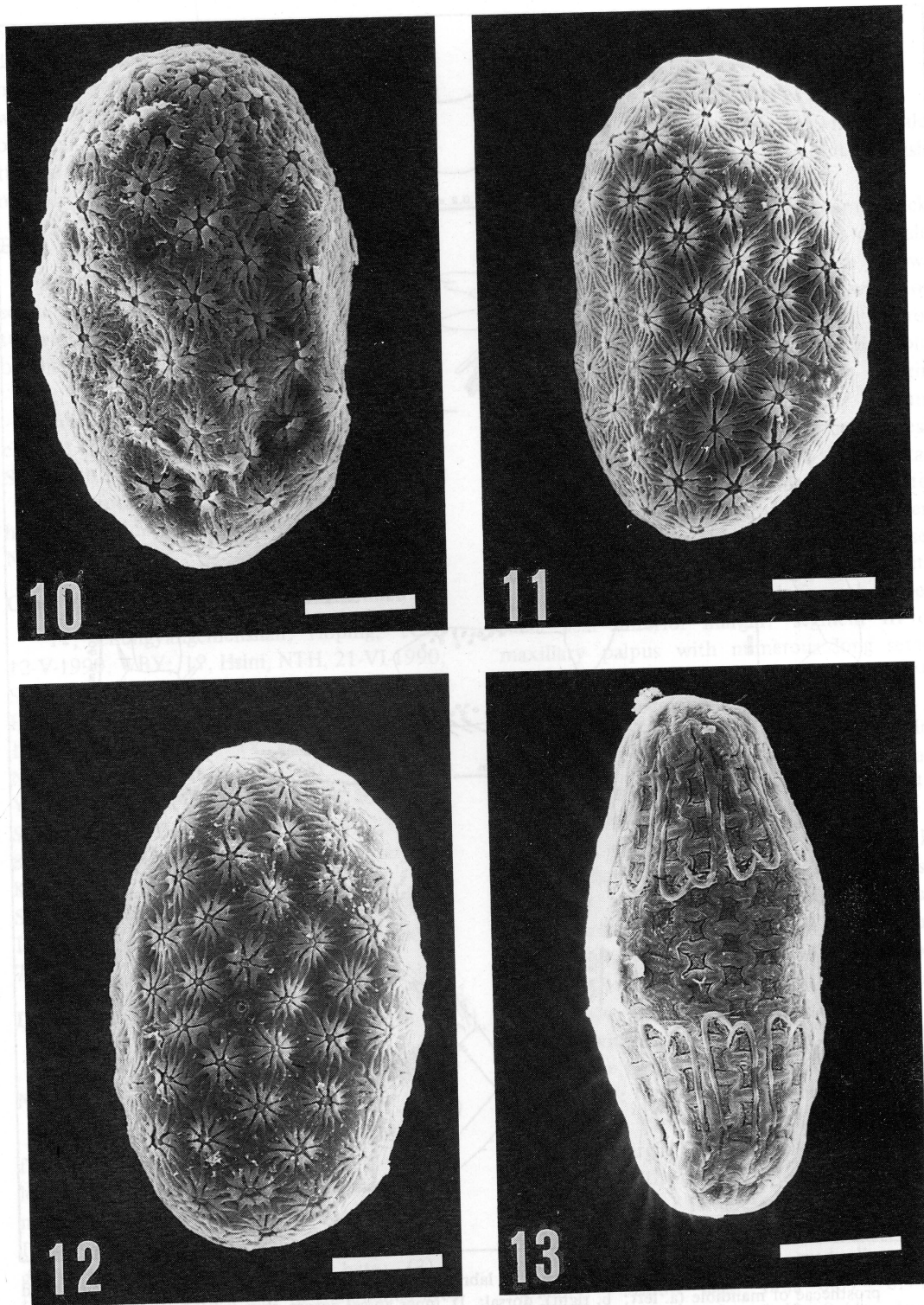
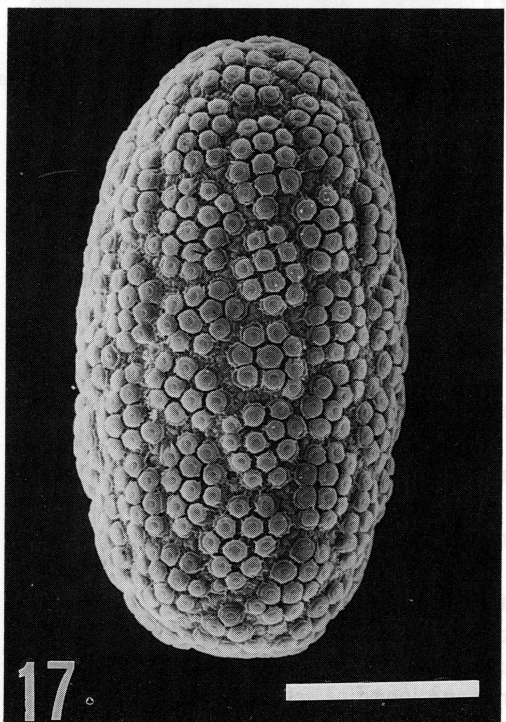
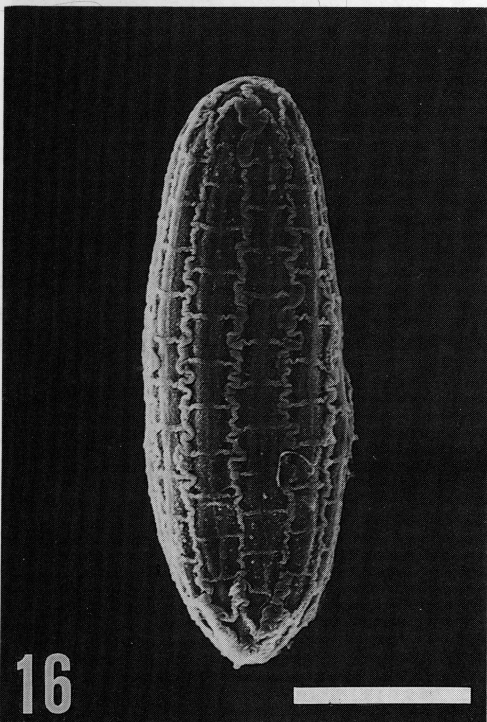
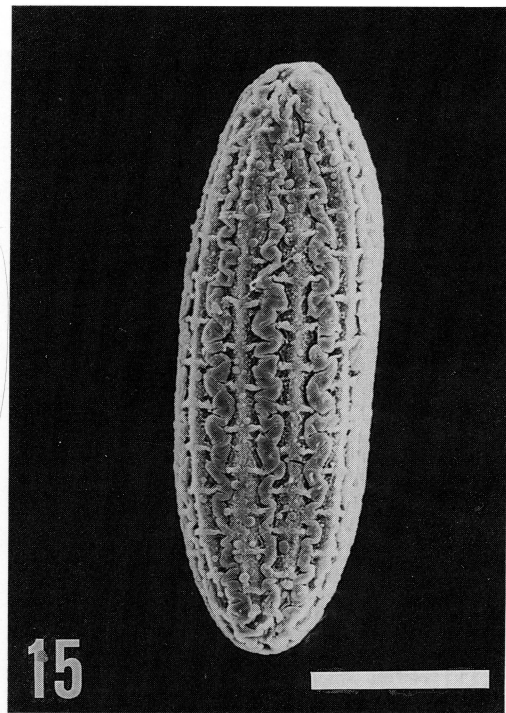
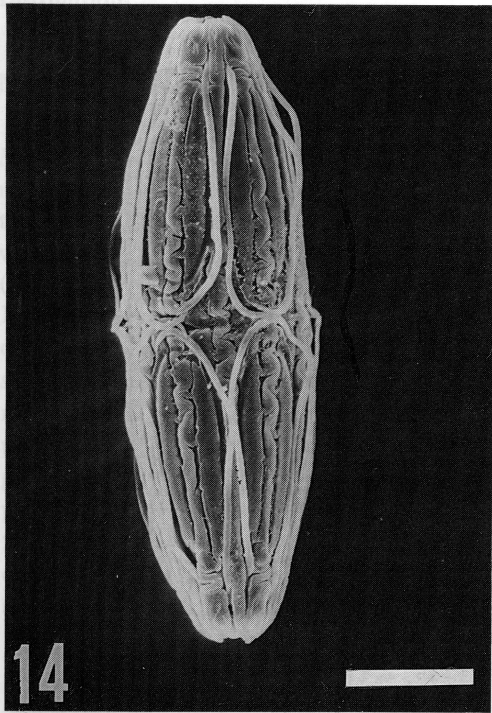


Fig. 9. Nymph of *Paraleptophlebia erratica* n.sp. A. labrum, dorsal; B. hypopharynx, dorsal; C. incisors and prosthecae of mandible (a. left; b. right), dorsal; D. inner apical corner of maxilla, ventral; E. maxillary palpus, dorsal; F. labial palpus, dorsal; G. glossae (a. dorsal; b. ventral); H. fore claw; I. gill I; J. gill IV; K. fore femur, dorsal; L. right maxilla, ventral; M. segments of cerci, about at basal 1/5, dorsal.

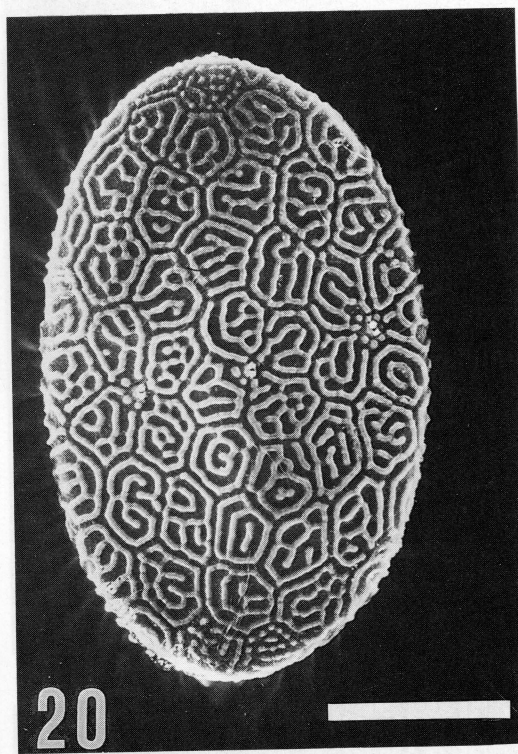
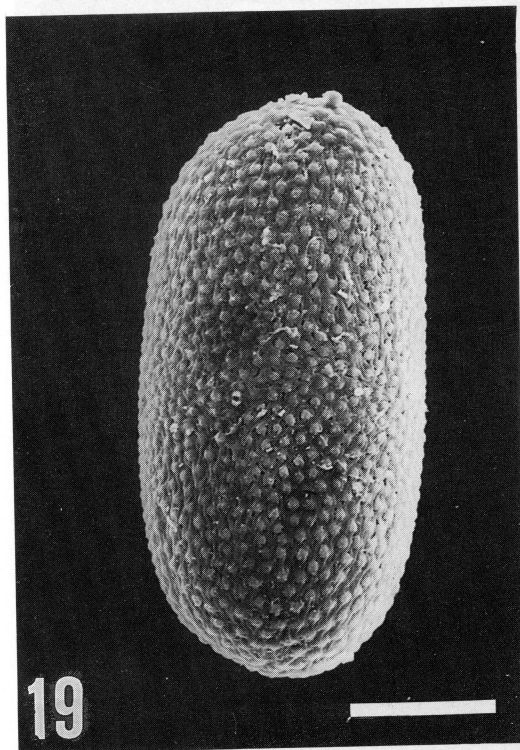


Figs. 10 – 13. SEM view of the whole egg. 10. *Choroterpes trifurcatus* Uéno; 11. *C. taiwanensis* n.sp.; 12. *Choroterpides nigella* n.sp.; 13. *Thraululus fatuus* n.sp. [each scale = 50  $\mu$ m].



Figs. 14 – 17. SEM view of the whole egg. 14. *Thraulius macilentus* n.sp.; 15–16. *T. umbrosus* n.sp.; 17. *Habrophlebiodes tenella* n.sp. [each scale = 50  $\mu$ m].





Figs. 18–19. SEM view of the whole egg. 18. *Paraleptophlebia spina* n. sp.; 19. *P. erratica* n. sp. [each scale = 50  $\mu$ m].

**Hind legs:** tibia  $0.90\text{--}0.91 \times$  length of femur, with sparse acute setae on mesal and lateral margins; tarsus  $0.38\text{--}0.39 \times$  length of femur; claw with 11–16 blunt denticles.

**Abdomen:** dorsum brown, each tergite pale medially; abdominal segments VIII and IX with blunt posterolateral spines; posterior margins of tergites I–IX each with very fine or no visible serrate spines, tergite X with serrate spines distinctly; **Gills:** gills present on abdominal segments I–VII alike, single lamella, forked about at basal  $2/5$ ; midrib of tracheae bold, no visible branches. **Caudal filaments:** basal part with whorls of triangular spines and long fine setae on each articulation, dorsal spines acute, ventral blunt; each spine with longitudinal strips; distal part with long fine setae on every articulations.

#### Eggs:

General shape oval, flat; chorionic surface with labyrinthine ridges, the polar ridges discontinue, dot-like; 3–4 small micropyles visible on equatorial area.

**Holotype:** mature female nymph, Shanping, Liukuei, KSH, TW, 635 m, 19-XII-1991, SCK. In NCHU.

**Paratypes:** 6♂♂, 8♀♀, same data as for holotype. 5♂♂, 6♀♀ in NCHU, 1♂, 2♀♀ in NMNS.

#### Other mature nymphal specimens examined:

2♂♂, 1♀, Taoyuan, KSH, TW, 570 m, 13-XII-1990, SCK; 1♀, Shanping, Maolin, KSH, 11-XII-1991, J. T. Yang; 1♀, Liukuei, KSH, TW, 280 m, 20-XII-1991, SCK.

**Distribution:**

Taiwan.

**Note:**

This new species resembles *Paraleptophlebia spina* n.sp. but can be differentiated in nymphs by the following characters: (1) in the galea-lacinia with 5 comb-shaped setae without clavate setae near anterior margin; (2) in the denticles of claw not over apical 1/4; (3) gills without distinct branches. Egg of this species is very different from that of *spina*. In fact, it's of different type and has no analogousness. Until recently, we knew poorly about the egg morphology of phyletic groups within *Paraleptophlebia*. The authors place these two new species in the same genus for nymphal characters but the generic status of *Paraleptophlebia*, as well as of other genera such as *Habrophlebiodes*, needs further study.

**Acknowledgements**

This research was financially supported by the National Science Council (NSC) under project NSC81-0409-B-005. Thanks are due to Prof. William L. Peters, Florida A. & M. University for providing the examined specimens of *Habrophlebiodes* and *Paraleptophlebia* and giving us some kind suggestions. Thanks are also extended to our colleagues Hsien-Chen Chang and Wen-Bin Yeh for their collections.

**References**

- Gillies, M. T. 1951. Further notes on Ephemeroptera from India and South East Asia. Proc. Roy. Ent. Soc. Lond. (ser. B) 20: 121–130.
- Grant, P. M., and W. L. Peters. 1993. Description of four new genera of *Thraulius* group mayflies from the eastern Hemisphere and redescription of *Simothraulius* and *Chiusanophlebia* (Ephemeroptera: Leptophlebiidae: Atalophlebiinae). Trans. Amer. Entomol. Soc. 119(2): 131–168.
- Peters, W. L., and G. F. Edmunds Jr. 1970. A revision of the generic classification of the Eastern Hemisphere Leptophlebiidae (Ephemeroptera). Pacific Insects 12(1): 157–240.
- Peters, W. L., and P. T. P. Tsui. 1972. New species of *Thraulius* from Asia (Leptophlebiidae: Ephemeroptera). Oriental Insects 6(1): 1–17.
- Tsui, P. T. P., and W. L. Peters. 1970. The nymph of *Habrophlebiodes gilliesi* Peters (Ephemeroptera: Leptophlebiidae). Roy. Entomol. Soc. London. Proc. Ser. A. Gen. Entomol. 45(7/9): 89–90.
- Uéno, M. 1928. Some Japanese mayfly nymphs. Mem. Coll. Sci. Kyoto Univ., B. 4(1): 19–63.
- Ulmer, G. 1939–1940. Eintagsfliegen (Ephemeropteren) von den Sunda-Inseln. Arch. Hydrobiol. (Supp.) 16: 443–692.