

## A REVIEW OF MICROCORYPHIA FAUNA FROM VIETNAM, WITH NEW SUBGENUS, NEW SPECIES OF *MACHILONTUS SILVESTRI* (MACHILOIDEA: MEINERTELLIDAE), AND NEW DATA FOR SEXUAL DIMORPHISM IN THE ORDER

**Zhi-Shun Song**

Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing, 100101, China  
Email: songzs@ioz.ac.cn (Corresponding author)

**Luis F. Mendes**

Instituto de Investigação Científica Tropical, JBT, Zoologia, Rua da Junqueira, 14, P-1300-343 Lisboa, Portugal  
Email: luis.mendes@iict.pt

**Fu-Sheng Huang**

Key Laboratory of Zoological Systematics and Evolution, Institute of Zoology, Chinese Academy of Sciences, Beijing, 100101, China

**ABSTRACT.** — The Microcoryphia fauna of Vietnam remains inadequately studied. Only three species were described before the present study: *Pedetontus (Verhoeffilis) bouvieri* (Silvestri, 1906), *P. (V.) meridionalis* Mendes, 1981 (Machilidae), and *Machilellus heteropalpus* Mendes, 1981 (Meinertellidae). Two new species *Machilontus* (s. str.) *phami*, new species, and *M. (Protumidolontus) lii*, new species, are described and illustrated from northern Vietnam, with the latter representing a new subgenus of *Machilontus*. The material was collected from the canopy layer of tropical rainforests in northern Vietnam with the canopy fogging technique. *Protumidolontus*, new subgenus, provides new data on sexual dimorphism in the order. A key to the genera (including subgenera) of Microcoryphia from Vietnam is provided.

**KEY WORDS.** — Microcoryphia, *Machilontus*, new subgenus, new species, sexual dimorphism, Vietnam

---

### INTRODUCTION

Vietnam is located on the eastern margin of the Indo-China Peninsula, neighbouring China, Laos, and Cambodia. The S-shaped country has a north-to-south distance of 1650 km and is about 50 km wide at its narrowest. Its size, location and historical interaction of the complex topographic, climatic and ecological factors, makes Vietnam possess high levels of species diversity and endemism (Liu et al., 2010).

As most developing countries, however, the Microcoryphia fauna of Vietnam remains inadequately studied. Only three species were described from Vietnam: *Pedetontus (Verhoeffilis) bouvieri* (Silvestri, 1906), *Pedetontus (Verhoeffilis) meridionalis* Mendes, 1981 (Machilidae), and *Machilellus heteropalpus* Mendes, 1981 (Meinertellidae). Mendes et al. (2000) redescribed *Machilis bouvieri* and transferred it to *Pedetontus (Verhoeffilis)* Paclt, 1972 in the subfamily Petrobiinae Kaplin, 1985. The number of described species undoubtedly represents only a small fraction of the actual diversity of the entire Vietnamese Microcoryphia fauna.

The genus *Machilontus* Silvestri, 1912 is widely recorded from Lesser Sunda Islands, Java, Sulawesi, Sumatra, Kalimantan, Thailand, Burma, Assam, Nepal, and southwestern China in Austro-Oriental regions (Sturm & Bach, 1988; Mendes, 1989; Sturm & Machida, 2001; Song et al., 2011). Its northernmost record is located in Medog, Tibet, southwestern China, at about 30°N, 95°E (Song et al., 2011). Sturm & Bach (1988) degraded *Megalopsobius* Silvestri, 1912 as a subgenus of *Machilontus*. Up to the present, the genus includes two subgenera and 14 known species (Song et al., 2011). A distribution map and a key to the species of *Machilontus* were provided by Song et al. (2011).

In 2008, an extensive faunal survey of the invertebrates (mainly spiders) from three national parks (the Cuc Phuong National Park, the Cat Ba National Park and the Tam Dao National Park) in northern Vietnam was carried out by the Chinese Academy of Sciences and the Vietnamese Academy of Science and Technology. While sorting and identifying the apterygote material from the collection, we found two new *Machilontus* species *M. (s. str.) phami*, new species, and *M. (Protumidolontus) lii*, new species, representing the first

record of the genus *Machilontus* from Vietnam. *Machilontus* (*Protumidolontus*), new subgenus, presents new data on sexual dimorphism in the order Microcoryphia.

## MATERIAL AND METHODS

Study area information can be found in ‘Material and Methods’ in Liu et al. (2010). The type material was collected from the canopy layer of tropical rainforests in northern Vietnam with the canopy fogging technique (Paarmann & Stork, 1987; Fig. 1).

The specimens are deposited in the following institutions or personal collection whose names are abbreviated in the text as follows: **L.M.**, the collection of Luis F. Mendes; **MNHN**, the Museum National d’Histoire Naturelle, Paris, France; **IZCAS**, the Insect Collection of the Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Morphological terminology follows that of Sturm & Bach (1988), Mendes (1989), and Sturm & Machida (2001).

## TAXONOMY

### Key to the genera and subgenera of Microcoryphia from Vietnam

1. Abdominal sternites II–VII well developed; article II of maxillary palps in males without a dorsal distal hook-like process; penis longer than half of length of coxites IX; parameres present at least on abdominal segment IX ..... 2 (*Machilidae*)
- Abdominal sternites II–VII small; article II of maxillary palps in males usually with a dorsal distal hook-like process; penis usually no longer than half of length of coxites IX; parameres absent ..... 3 (*Meinertellidae*)
2. Flagellum of antennae without scales, but present on scapus and pedicel; lateral ocelli shoe-shaped, subinferior to eyes, more or less close each other; mandible with four distinct teeth in incisor portion; parameres annulated, restricted to abdominal segment IX; male genitalia covered by coxites IX; ovipositor tertiary type; two pairs of eversible vesicles on abdominal segments II–VI ..... *Pedetontus* (s. str.) Silvestri
- ... External morphology mostly similar to *Pedetontus* (s. str.), but two pairs of eversible vesicles on abdominal segments II–V ..... *Pedetontus* (*Verhoeffilis*) Paclt
3. Coxal stylet absent on legs; tarsi with three articles; thorax somewhat humpbacked, especially mesothorax very developed ..... *Machilellus* Silvestri
- Coxal stylet present on hind legs; tarsi with two articles; thorax normal ..... 4
4. Eyes longer than wide, with ratio of length to width over 1.2; dorsal process of article II of male maxillary palps with a well separated cylindrical base ..... *Machilontus* (*Megalopsobius*) Silvestri
- Eyes wider than long; dorsal process of article II of male maxillary palps without a cylindrical base ..... 5
5. Sexual dimorphism of non-genital portions relatively scarce; male frons slightly convex, antennal scapus typical and smooth; article III of maxillary palps normal, nearly as long as article II; article II of labial palps normal, without process on apex ..... *Machilontus* (s. str.) Silvestri

- Sexual dimorphism of non-genital portions very distinct, particularly frons, scapus, maxillary palps and labial palps; male frons with a large process; scapus modified; article III of maxillary palps distinctly elongate, nearly 1.7–2.5 times longer than article II; article II of labial palps distinctly elongate, with a conspicuous process on apex ..... *Machilontus* (*Protumidolontus*), new subgenus

## MACHILIDAE Grassi, 1888

### PETROBIINAE Kaplin, 1985

#### *Pedetontus* Silvestri, 1911

#### *Pedetontus* (*Verhoeffilis*) *bouvieri* Silvestri, 1906

*Machilis bouvieri* Silvestri, 1906: 328

*Pedetontus* (*Verhoeffilis*) *bouvieri* Silvestri: Mendes et al., 2000: 269

**Type material examined.** — *Holotype*. female, [Vietnam]: (1) Museum Paris, Tonkin, Lichtenfelder, 100–97, *Machilis bouvieri* Silv., Type female –“Redia” vol. III fasc. 2°– 1905-p. 328; (2) Tonkin, Lichtenfelder, 100–97; (3) *Machilis bouvieri* Silv., female Typus (MNHN).

**Remarks.** — Mendes (1990: 63) noted that “*Machilis bouvieri*, described (Silvestri, 1906) from the Vietnam (Tonkin), needs to be changed to any other (described or undescribed) genus (*Machilinae* or *Petrobiinae*?)”. Mendes et al. (2000) later redescribed and transferred it to *Pedetontus* (*Verhoeffilis*) Paclt, 1972 based on examination of type material from MNHN.

**Distribution.** — Northern Vietnam

#### *Pedetontus* (*Verhoeffilis*) *meridionalis* Mendes, 1981

*Pedetontus meridionalis* Mendes, 1981: 23

*Pedetontus* (*Verhoeffilis*) *meridionalis* Mendes: Mendes, 1990: 78



Fig. 1. Microhabitat of *Machilontus* (s. str.) *phami*, new species, collected with canopy fogging technique, photographed by Dr Guo Zheng at the Cuc Phuong National Park, Vietnam in 21 July, 2008.

**Type material examined.** — *Holotype*. male, Vietnam: Indochina, Kontum, coll. Dawidoff, 1933 (L.M.). *Allotype*. female, same data as holotype (L.M.). *Paratypes*. 1 male, 1 female, same data as holotype; 2 males, 3 females, Vietnam: Caûda, Sud-Annam, coll. Dawidoff, Oct–Jan.; 1 male, 1 female (junior), Vietnam: Chütt, coll. Dawidoff, 11 Oct.[19]33, (L.M.).

**Remarks.** — The species can be separated from *P. (V) bouvieri* by the much shorter ovipositor (extended beyond terminal spines of stylets IX by about 1.5 times in *bouvieri*); the distinct stylets/coxites ratios and a very different distribution of the spines along the coxites IX.

**Distribution.** — Central Vietnam (Kon Tum)

## MEINERTELLIDAE Verhoeff, 1910

### *Machilellus* Silvestri, 1911

#### *Machilellus heteropalpus* Mendes, 1981

*Machilellus heteropalpus* Mendes, 1981: 20

**Type material examined.** — *Holotype*. male, Vietnam: Indochina, Sud Annam, coll. Dawidoff, Oct–Jan.1933 (L.M.). *Allotype*. female, Vietnam: Kontum, coll. Dawidoff, Jun.1933 (L.M.). *Paratype*. 1 female (junior), Vietnam, coll. Dawidoff, no date (L.M.).

**Remarks.** — *Machilellus* was established by Silvestri in 1911 based on a single species, *M. orientalis* Silvestri, 1911 from Java. *M. heteropalpus* is the second species of the genus.

**Distribution.** — Central Vietnam (Kon Tum)

### *Machilontus* Silvestri, 1912

#### *Machilontus* (s. str.) *phami*, new species

(Figs. 2A–K, 3A–F, 4A–G, and 5A–J)

**Material examined.** — *Holotype*. male, Vietnam: Ninh Binh, Cuc Phuong National Park (20°20'56.6"N, 105°36'02.4"E), natural forest, 408 m, canopy fogging, coll. D. S. Pham, G. Zheng & S. Q. Li, 21 Jul.2008 (IZCAS). *Paratypes*. 2 females, same data as holotype; 2 females, Vietnam: Vinh Phuc, Tam Dao National Park (21°30'36.4"N, 105°33'48.9"E), shrub land, 440 m, canopy fogging, coll. D. S. Pham, G. Zheng & S. Q. Li, 27 Jul.2008; 1 male, 2 females, Vietnam: Hai Phong, Cat Ba National Park (20°48'25.8"N, 107°00'58.1"E), natural forest, 24 m, canopy fogging, coll. D. S. Pham, G. Zheng & S. Q. Li, 15 Jul.2008 (all in IZCAS).

**Diagnosis.** — Lateral ocelli with a small dark patch on inner edge. Frons without V-shaped stripes above median ocellus. Antennae very long, more than three times longer than body length; scapus with a long dark stripe on inner and outer surfaces. Maxillary palps as follows: article I with dorsal triangular process elongate, as long as the maximum diameter of article I; article II in males with dorsal hook-like process relatively short and small, incurved internally and ventrally; articles VI and VII respectively with 18–20 and 41–43 hyaline spines from base to apex along dorsal surface in males and

22–28 and 32–38 in females. Legs with pigmented stripes on femora and tibiae. Penis relatively big, nearly as long as half of coxites IX. Ovipositor tertiary type, slightly extended beyond terminal spines of stylets IX.

**Description of males.** — Body length (from apex of head to tip of abdomen) 9.4–9.7 mm; maximum antennae length 34.4 mm; cerci length 12.9 mm; caudal filament incomplete, not measured. Scale pattern unknown. General colour with dark brown dense scales. Head and appendages devoid of scales, with dark brown or violet-brown epidermic patches or stripes (Fig. 2A).

Compound eyes black, large and convex, with ratios of length to width 0.86–0.87 and line contact to length 0.50–0.57 (Fig. 2B, C). Lateral ocelli reddish, with a small dark pigmented patch on inner edge; ocelli long sole-shaped, more or less constricted in middle, the outer area slightly wider than the inner one, nearly 3.5 times as wide as its length (Fig. 2B). Frons with a small dark patch and several setae between lateral ocelli and a relatively large dark spot on inner base of antennae (Fig. 2C).

Antennae very long, the maximum length more than three times longer than body length (Fig. 2A); scapus about 2.5 times as long as its width, with a long dark stripe on inner and outer surfaces, respectively (Fig. 2C, E).

Mandible with four distinct teeth in incisor portion (Fig. 2D). Maxillary palps as follows (Fig. 2F, G): article I with dorsal triangular process elongate, as long as the maximum diameter of article I, two small inner processes above dorsal process and a small process on inner apex; article II with dorsal hook-like process relatively short and small, incurved internally and ventrally, with some black strong setae on dorsal base; article III with dense black strong setae on inner surface; article IV with distinct preformed breaking point at base; articles IV–VII slender than proximal articles; article V with dense black strong setae on ventral surface and with 1–3 hyaline spines near dorsal apex; articles VI and VII with 18–20 and 41–43 hyaline spines from base to apex along dorsal surface, respectively; distal article distinctly elongate, with ratio of length of articles VII: VI: V = 1: (0.71–0.77): (0.80–0.89). Distributions of pigmented patches of maxillary palps on inner surface as in Fig. 2F and on outer surface as in Fig. 2G.

Labium with some dark strong setae on base (Fig. 2H). Labial palps with distal article clavate and slightly expanded apically, with numerous sensory cones.

Legs with fore coxae, femora and tibiae slightly thicker than middle and hind ones; hind tibiae longer than fore and middle ones. Femora and middle and hind tibiae with long pigmented stripes. Fore tibiae with characteristic field of numerous brownish strong setae on ventral border, trochanters and femora with numerous translucent long setae on ventral surface, and middle and hind tibiae with numerous brownish strong setae and translucent long setae on ventral surface. Distributions of pigmented patches and chaetotaxy of legs as in Fig. 2I–K.

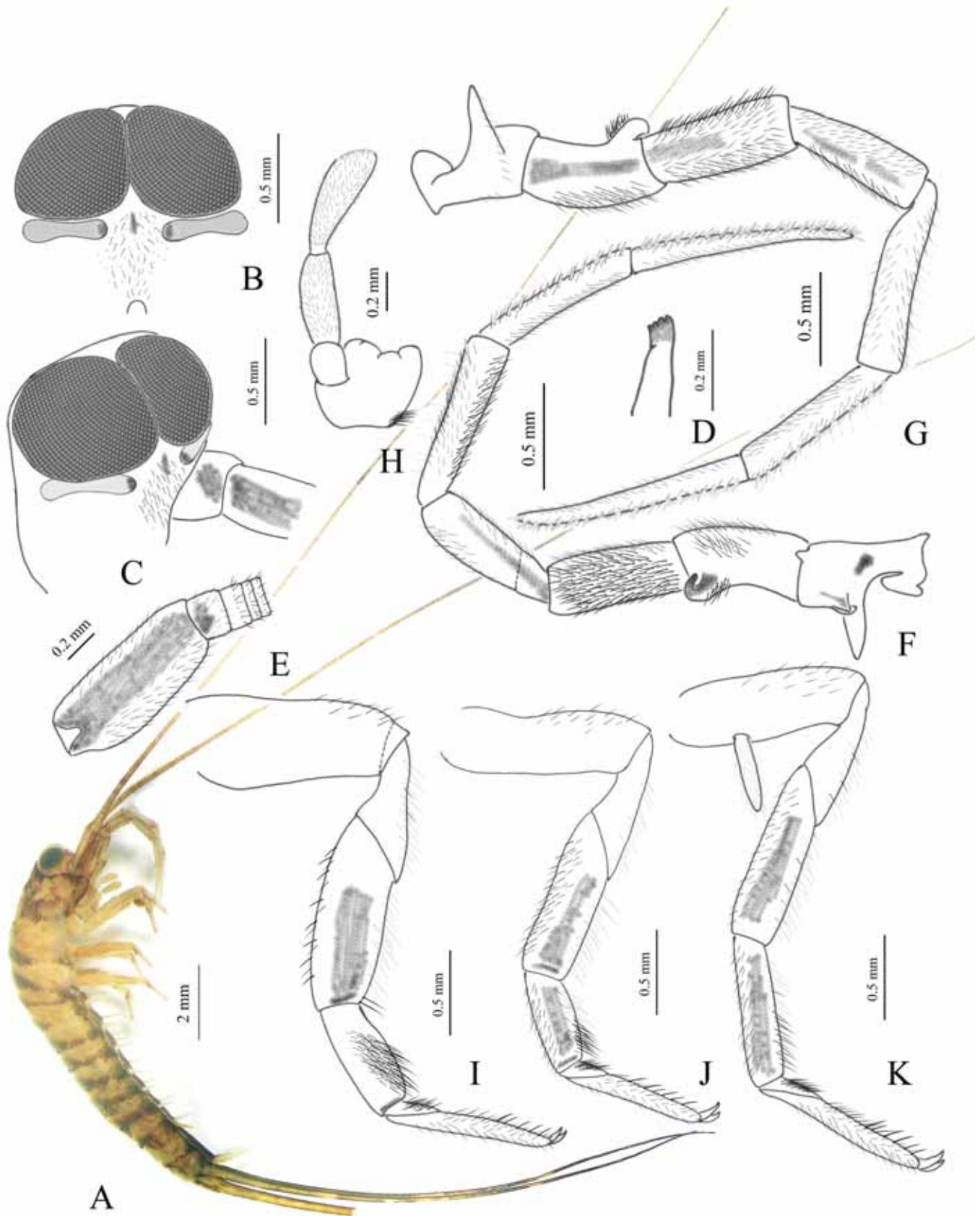


Fig. 2. *Machilontus* (s. str.) *phami*, new species, male, holotype. A. habitus, lateral view; B. eyes and ocelli, front view; C. same, right lateral-front view; D. distal area of mandible; E. base of antenna; F. maxillary palp, inner view; G. same, outer view; H. labium and labial palp; I. fore leg, outer view; J. middle leg, outer view; K. hind leg, outer view.

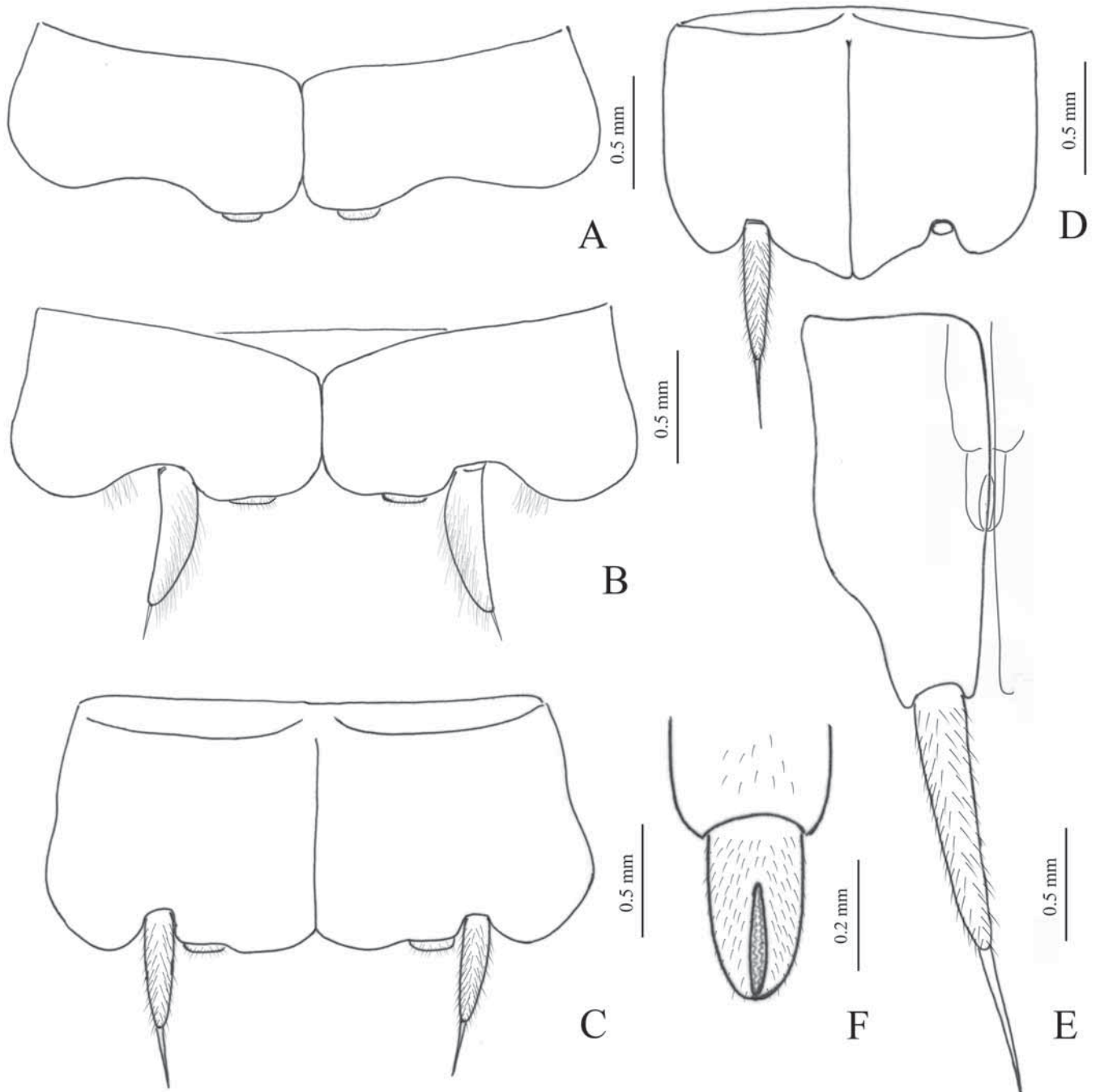


Fig. 3. *Machilontus (s. str.) phami*, new species, male, holotype. A. coxites I; B. coxites II; C. coxites V; D. coxites VIII; E. coxites IX; F. penis.

Abdominal coxites I–VII with 1+1 eversible vesicles, coxites II–IX with stylets. Coxites I distinctly shorter than coxites II, without urosternite (Fig. 3A). Coxites II rounded and expanded laterally, with relatively large urosternite with some long hyaline setae on inner subapex; stylets II long and robust, with numerous long hyaline setae (Fig. 3B). Coxites III–IX glabrous, stylets III–IX with numerous short setae (Fig. 3C–E). Ratios of stylets (without terminal spine) to corresponding coxites as follows: 0.73–0.79 for coxites II, 0.50–0.55 for coxites V, 0.51–0.60 for coxites VIII, and 0.67–0.76 for coxites IX. Ratios of terminal spines to corresponding stylets as follows: 0.14–0.25 for coxites II, 0.50–0.52 for coxites V, 0.42–0.53 for coxites VIII, and 0.49–0.55 for coxites IX.

Parameres absent. Penis relatively big, nearly as long as half of coxites IX (Fig. 3E), aperture reddish, pointed oval (Fig. 3F).

**Description of females.** — Body generally larger and longer than males, body length (from apex of head to tip of abdomen) 9.3–10.2 mm; maximum antennae length 24.0 mm; cerci and caudal filament incomplete, not measured (Fig. 4A).

Compound eyes with ratios of length to width 0.87–0.90 and line contact to length 0.56–0.60 (Fig. 4B, C). Lateral ocelli and frons similar to males. The maximum length of antennae more than twice longer than body length (Fig. 4A), scapus nearly 2.5 times as long as its width, with a long dark stripe on inner and outer surfaces (Fig. 4C, D).

Maxillary palps similar to males (Fig. 4E, F), article II without hook-like process and characteristic strong setae; article V with 2–4 hyaline spines near dorsal apex; articles VI and VII with 22–28 and 32–38 hyaline spines on dorsal surface, respectively; distal article distinctly elongate, with ratio of length of articles VII: VI: V = 1: (0.71–0.78): (0.83–1.05). Distribution of pigmented patches of maxillary palps on inner surface as in Fig. 4E and on outer surface as in Fig. 4F. Labial palps similar to males (Fig. 4G).

Legs similar to males, distributions of pigmented patches and chaetotaxy of legs as in Fig. 5A–C.

Abdominal coxites I–VII similar to males (Fig. 5D–F). Ratios of stylets (without terminal spine) to corresponding coxites as follows: 0.74–0.79 for coxites II, 0.49–0.56 for coxites V,

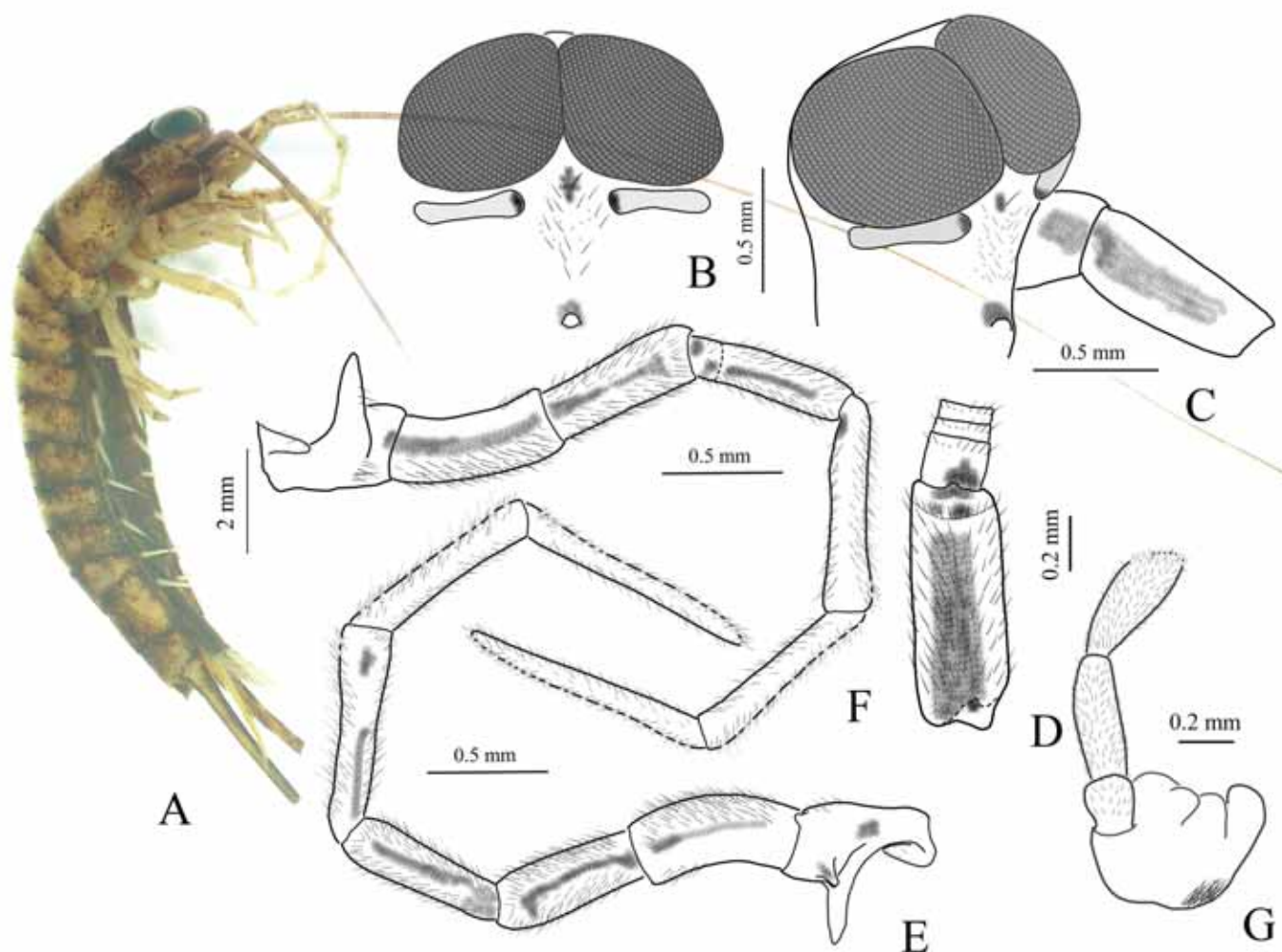


Fig. 4. *Machilontus* (s. str.) *phami*, new species, female, paratype. A. habitus, lateral view; B. eyes and ocelli, front view; C. same, right lateral-front view; D. base of antenna; E. maxillary palp, inner view; F. same, outer view; G. labium and labial palp.

0.57–0.61 for coxites VIII (Fig. 5G), and 0.65–0.69 for coxites IX (Fig. 5I). Ratios of terminal spines to corresponding stylets as follows: 0.10–0.23 for coxites II, 0.42–0.47 for coxites V, 0.30–0.37 for coxites VIII, and 0.45–0.60 for coxites IX.

Ovipositor tertiary type, slightly extended beyond terminal spines of stylets IX. Gonapophyses VIII with nearly 75 divisions, most them with setae: basal 1/3 divisions with 5–6 short setae, remainders with 4 long setae, apical division with a long setae (Fig. 5H). Gonapophyses IX slender, with nearly 65 divisions, basal 2/3 divisions glabrous, the remaining with 1–3 short setae, apical division with a long seta (Fig. 5J).

**Etymology.** — The new species is named after Dr. Dinh-Sac Pham, one of three collectors and an excellent arachnologist from Vietnam.

**Biology.** — The new species *M. (s. str.) phami* and *M. (Protumidolontus) lii* both maybe live in the canopy layer of tropical rainforests in northern Vietnam

**Remarks.** — The new species is similar to *M. (s. str.) yoshii* Mendes, 1989 from northern Kalimantan, but can be separated from the latter by its scapus with a long dark stripe on inner and outer surfaces (with a light patch in the basal

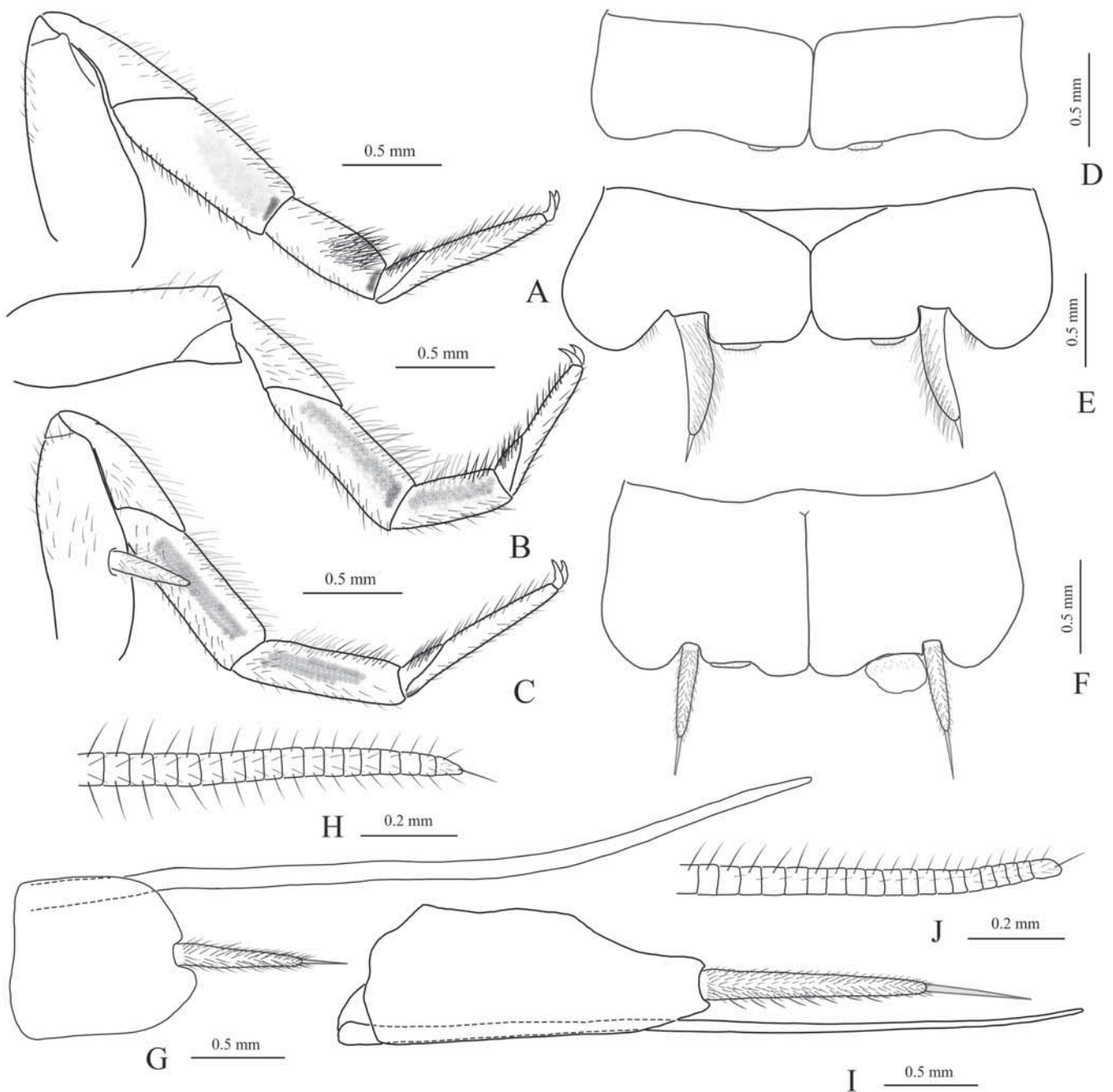


Fig. 5. *Machilontus (s. str.) phami*, new species, female, paratype. A. fore leg, outer view; B. middle leg, outer view; C. hind leg, outer view. D. coxites I; E. coxites II; F. coxites V; G. coxites VIII; H. terminal divisions of gonapophyses VIII; I. coxites IX; J. terminal divisions of gonapophyses IX.

ventral region and a dark ante-apical ring in *yoshii*); article II of maxillary palps in males with dorsal hook-like process relatively short and small, incurved internally and ventrally (long and large, pointed dorsally and internally, not incurved, with numerous minute denticulations at apex in *yoshii*); and the differences of pigmented stripes on legs.

**Distribution.** — Northern Vietnam (Ninh Binh, Vinh Phuc, Hai Phong).

***Machilontus (Protumidolontus)*, new subgenus**

**Type species.** — *Machilontus (Protumidolontus) lii*, new species

**Diagnosis.** — Compound eyes large, distinctly convex, and wider than its length. Lateral ocelli sole-shaped, sublateral to eyes. Frons sexually dimorphic, strongly produced in a large robust process between lateral ocelli in males and slightly protruded in females. Antennae sexually dimorphic, scapus with two bumps providing with dense long dark setae in males, but bump and long dark setae absent in females. Maxillary palps with article III distinctly elongate, nearly 2.5 times in males and 1.7 times in females longer than article II. Labial palps with article II distinctly elongate, with a conspicuous process on apex (process larger and longer in males than in females). Hind coxae with coxal stylet. Tarsi with two articles. Coxites I–VII each with a pair of eversible vesicles and coxites II–IX with stylets. Penis relatively big, nearly as long as half of coxites IX. Ovipositor tertiary type.

**Etymology.** — The new subgenus name is from the Latin “*Protumidus*”, which means the prominent frons in males. The termination “*lontus*” is after the suffix of *Machilontus* Silvestri, 1912. The gender is masculine.

**Remarks.** — The new subgenus can be distinguished from other *Machilontus* subgenera by the much longer article III of maxillary palps; the much longer article II of labial palps with a distinct process on apex; and several particular sexual dimorphism of non-genital portions (e.g., frons strongly produced in a large process between lateral ocelli, antennal scapus with two bumps providing with long dark setae and special chaetotaxy on frons, scapus and maxillary palps in males). In comparison to *M.* (s. str.) and *M. (Megalopsobius)*, these distinct characters seem to be autapomorphic within *Machilontus*, but they can not be considered significant enough to establish different taxa beyond the subgeneric level.

A similar case also occurs in the family Machilidae. *Corethromachilis gibba* Carpenter, 1916 from Seychelles was considered later by Paclt (1969) as the type species of his genus *Dromadimachilis* because of the frons protruding in a conspicuous process and the hump-shaped metanotum. Sturm (2001) reevaluated the characters and recognised *Dromadimachilis* as a subgenus of *Corethromachilis*. *Graphitarsus (Hybographitarsus) riedeli* Sturm, 2001 from Halmahera in Indonesia is a similar case as well.

***Machilontus (Protumidolontus) lii*, new species**

(Figs. 6A–D, 7A–K, 8A–F, 9A–H, and 10A–I)

**Material examined.** — *Holotype*: male, Vietnam: Vinh Phuc, Tam Dao National Park (21°28'336.7"N, 105°38'09.4"E), disturbed forest, 1007 m, canopy fogging, coll. S. Q. Li, D. S. Pham & G. Zheng, 26 Jul.2008 (IZCAS). *Paratypes*. 1 male, 2 females, same data as holotype; 2 female, Vietnam: Vinh Phuc, Tam Dao National Park (21°31'50.1"N, 105°33'43.4"E), natural forest, 1060 m, canopy fogging, coll. S. Q. Li, D. S. Pham & G. Zheng, 26 Jul.2008 (IZCAS).

**Description of males.** — Body length (from apex of head to tip of abdomen) 9.7–10.1 mm; maximum antennae length 11.3 mm; cerci and caudal filament incomplete, not measured. Scale pattern unknown. General colour dark brown in scaled areas. Head and appendages devoid of scales, with a few dark brown epidermic patches or stripes (Fig. 6B–D).

Compound eyes with ratios of length to width 0.83–0.87 and line contact to length 0.62–0.64 (Fig. 7A–C). Lateral ocelli surrounded by a pale narrow margin in freshly collected specimens (Fig. 6C), and a small black pigmented patch on inner edge; ocelli long sole-shaped, nearly 3.5 times as wide as its length (Fig. 7C).

Frons produced in a large robust process above median ocellus between lateral ocelli; the process elongate, obtuse apically and directed anteriorly, with a pair of lateral dark patches from inner margin of lateral ocelli to subapex and a pair of dorsal pale patches; numerous long dark setae intercrossed at apex (Fig. 7B, C).

Antennae with scapus distinctly elongate, nearly three times as long as its width, with two bumps on base and apex of inner side; numerous long dark setae surrounding on the bumps (Fig. 7D).

Maxillary palps as follows (Fig. 7E–G): article I with dorsal triangular process well developed, much longer than inner basal process, slightly shorter than the maximum diameter of article I, two small inner processes above dorsal process and an additional small process on inner apex; article II with dorsal hook-like process large and elongate, incurved internally and ventrally, numerous black strong spines extending from base to beneath process on inner dorsal surface; article III distinctly elongate, nearly 2.5 times longer than article II, with dense slender long setae on ventral surface and denser long dark setae on dorsal surface, especially on basal half; articles IV–VII slender than proximal articles, with numerous dark setae; article V with 1–3 hyaline spines near dorsal apex; articles VI and VII with 21–22 and 35–37 hyaline spines from base to apex along dorsal surface, respectively. Ratio of length of articles VII: VI: V = 1: (0.91–0.94): (1.16–1.21). Distribution of pigmented patches of maxillary palps on inner surface as in Fig. 7E and on outer surface as in Fig. 7G.

Labial palps as in Fig. 7H, without distinct patches; article II distinctly elongate, with a long large process on apex; distal article clavate, slightly expanded apically.



Legs rarely pigmented, only fore and middle femora with small transverse spot on apex, and fore and middle tarsi II with small spot on base. Fore tibiae with characteristic field of numerous brownish strong setae on ventral border, middle and hind femora with numerous translucent long setae on ventral surface, and middle and hind tibiae with numerous brownish strong setae and translucent long setae on ventral surface. Distributions of pigmented patches and chaetotaxy of legs as in Fig. 7I–K.

Coxites I distinctly shorter than coxites II, without sternite (Fig. 8A). Coxites II rounded and expanded laterally, with relatively large sternite; stylets II long and robust, with long hyaline setae on inner surface (Fig. 8B). Coxites III–IX glabrous, stylets III–IX with numerous short setae (Fig. 8C–E). Ratios of stylets (without terminal spine) to corresponding coxites as follows: 0.75–0.82 for coxites II, 0.45–0.53 for coxites V, 0.49–0.63 for coxites VIII, and 0.68–0.80 for coxites IX. Ratios of terminal spines to corresponding stylets

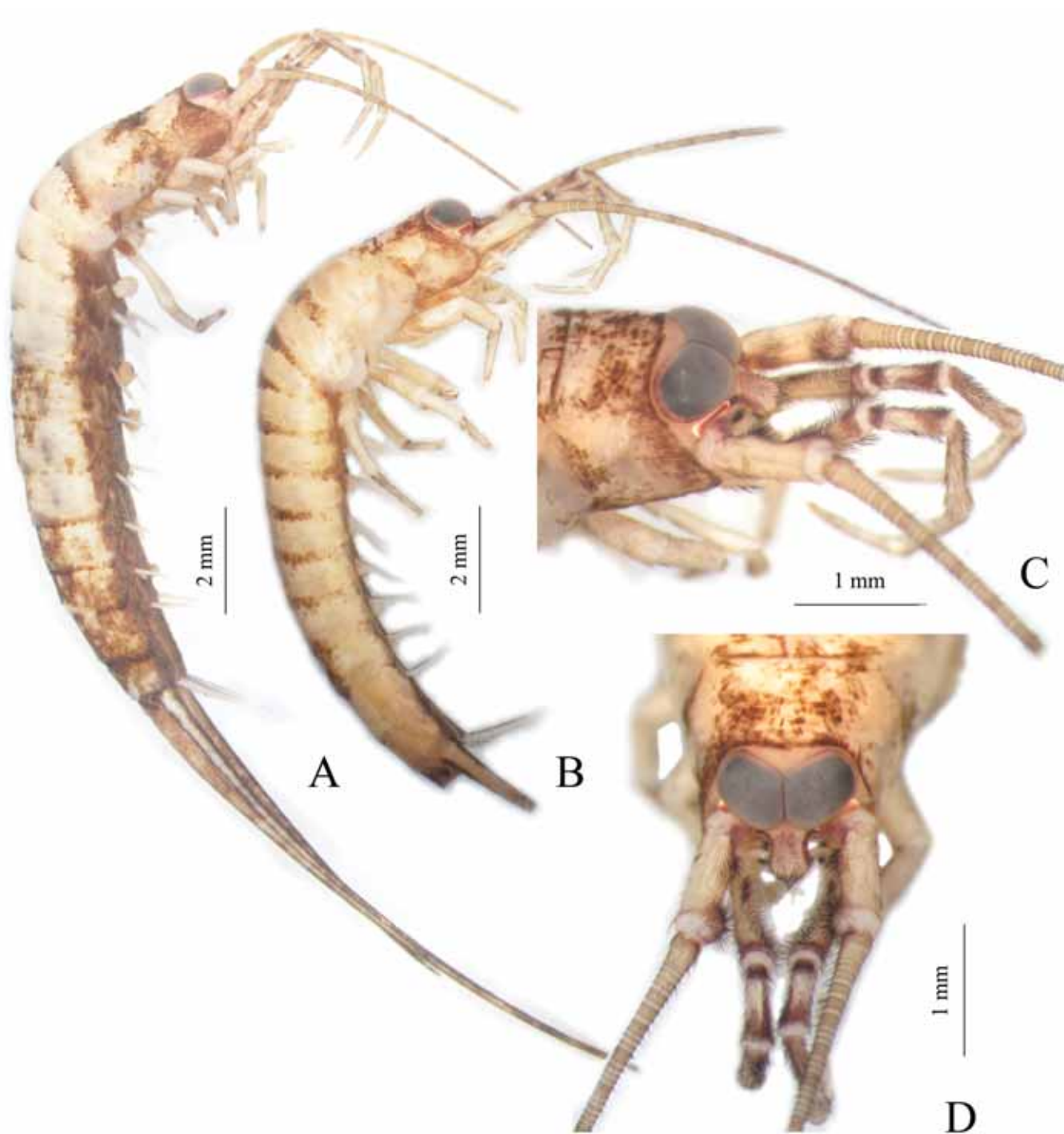


Fig. 6. *Machilontus (Protumidolontus) lii*, new subgenus, new species. A. habitus of female, paratype, lateral view; B. habitus of male, holotype, lateral view; C. head, holotype, lateral view; D. same, front view.

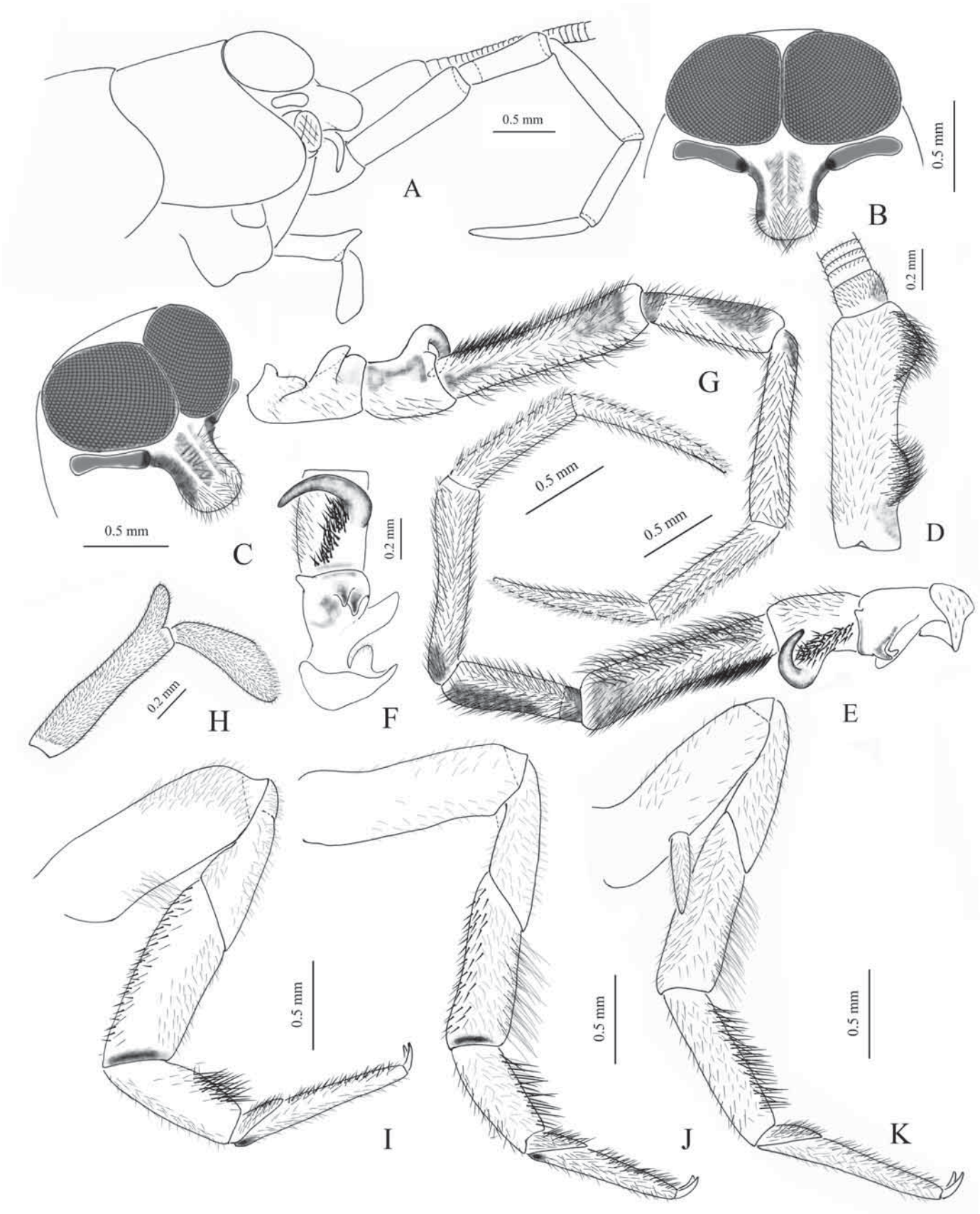


Fig. 7. *Machilontus (Protumidolontus) lii*, new subgenus, new species, male, holotype. A. anterior portion of body, lateral view; B. eyes and ocelli, front view; C. same, right lateral-front view; D. base of antenna; E. maxillary palp, inner view; F. base of maxillary palp; G. maxillary palp, outer view; H. labial palp; I. fore leg, outer view; J. middle leg, outer view; K. hind leg, outer view.

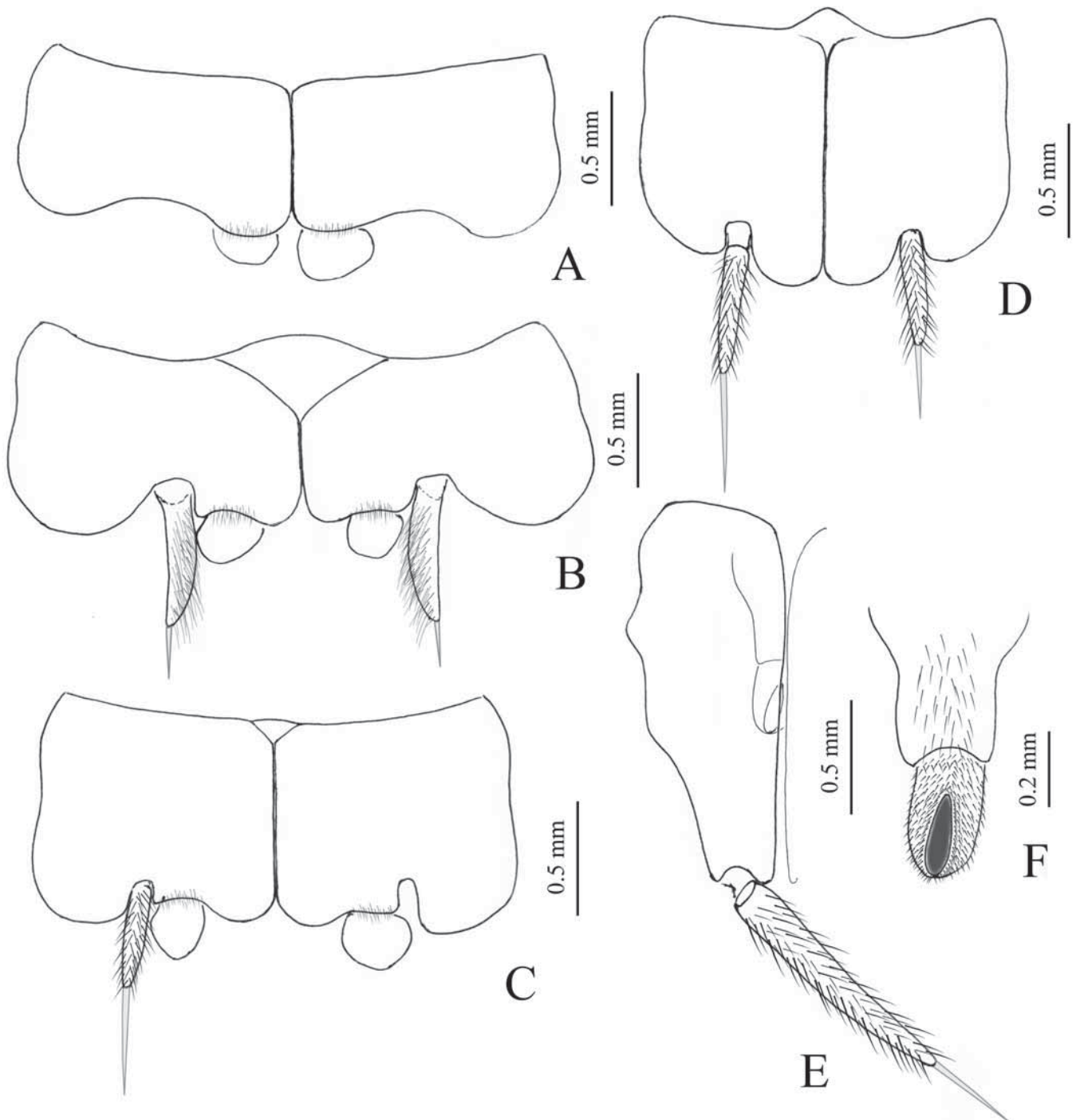


Fig. 8. *Machilontus (Protumidolontus) lii*, new subgenus, new species, male, holotype. A. coxites I; B. coxites II; C. coxites V; D. coxites VIII; E. coxites IX; F. penis.

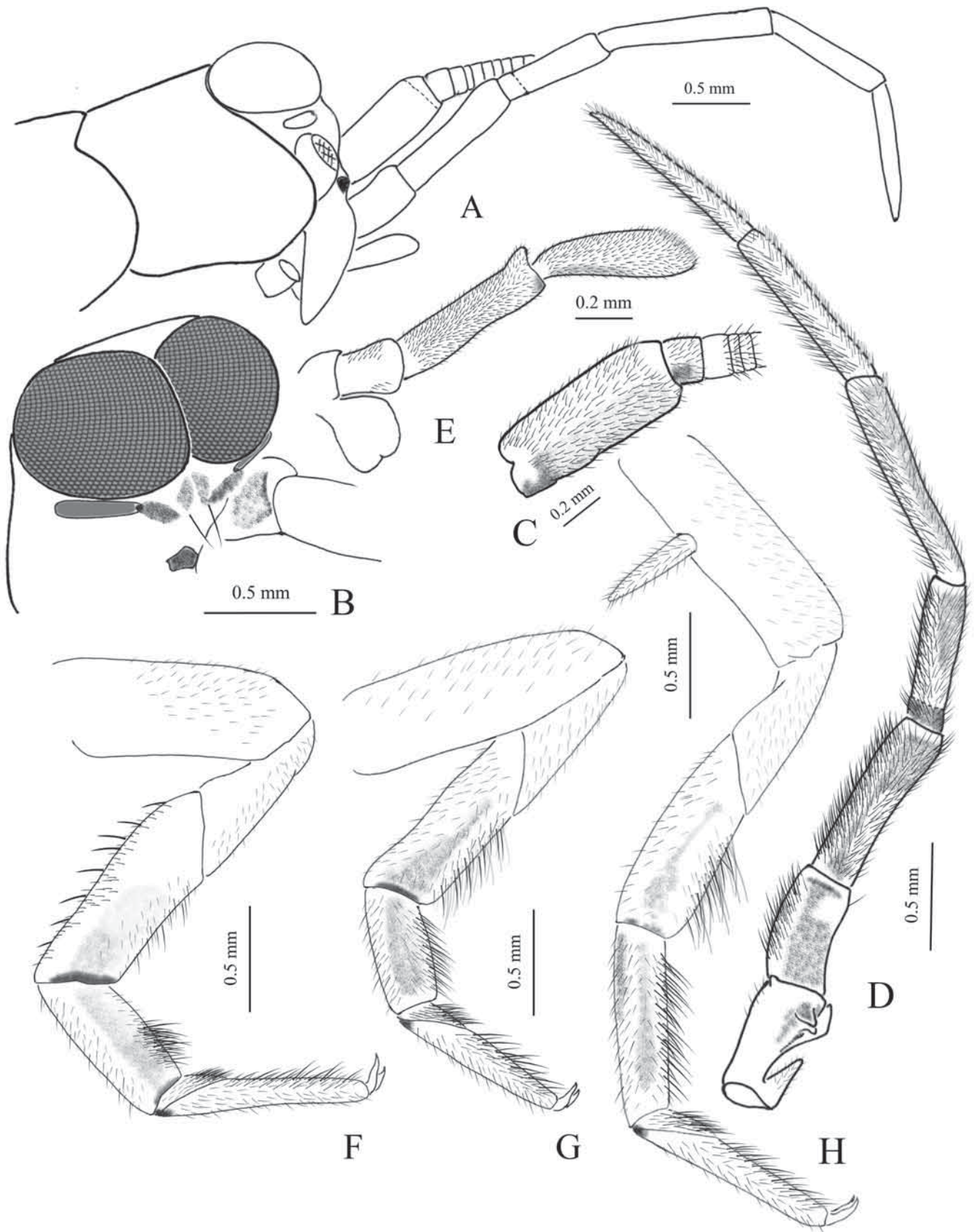


Fig. 9. *Machilontus (Protumidolontus) lii*, new subgenus, new species, female, paratype. A. anterior portion of body, lateral view; B. eyes and ocelli, right lateral-front view; C. base of antenna; D. maxillary palp, inner view; E. labial palp; F. fore leg, outer view; G. middle leg, outer view; H. hind leg, outer view.

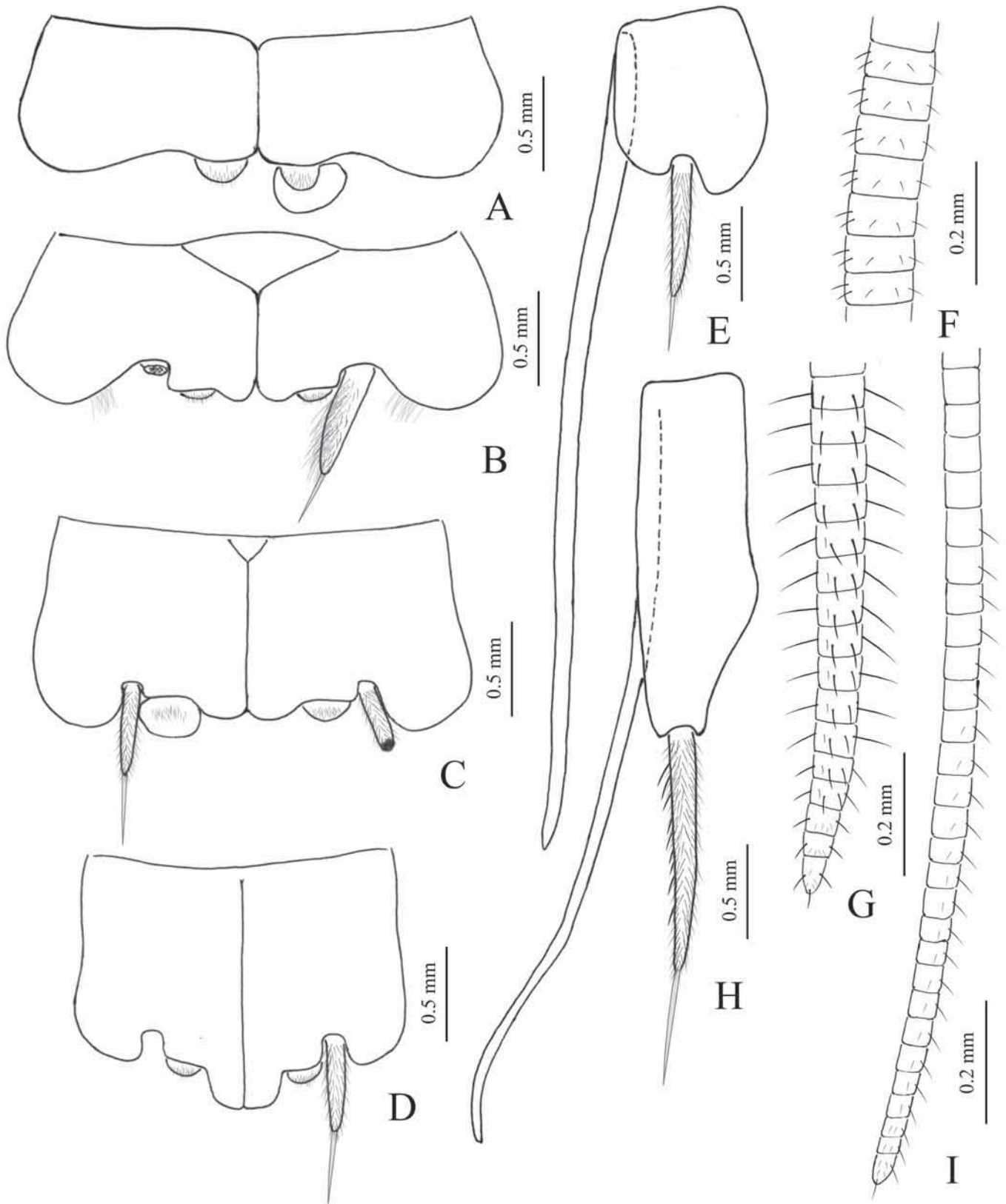


Fig. 10. *Machilontus (Protumidolontus) lii*, new subgenus, new species, female, paratype. A. coxites I; B. coxites II; C. coxites V; D. coxites VII; E. coxites VIII; F. fore divisions of gonapophyses VIII; G. terminal divisions of gonapophyses VIII; H. coxites IX; I. terminal divisions of gonapophyses IX.

## DISCUSSION

as follows: 0.33–0.55 for coxites II, 0.99–1.0 for coxites V, 0.64–0.92 for coxites VIII, and 0.38–0.45 for coxites IX.

Parameres absent. Penis relatively large, nearly as long as half of coxites IX (Fig. 8E), aperture reddish, pointed oval, surrounded by 2 rows of setae rising on small characteristic bumps (Fig. 8F).

**Description of females.** — Body generally larger and longer than males, body length (tip of head to tip of abdomen) 10.3–11.2 mm; maximum antennae length 12.6 mm; maximum cerci length 6.6 mm; maximum caudal filament length 10.4 mm (Fig. 6A).

Compound eyes with ratios of length to width 0.83–0.85 and line contact to length 0.60–0.65. Lateral ocelli similar to males, nearly four times as wide as long (Fig. 9B). Frons more or less convex between lateral ocelli, a pair of patches near inner margin of lateral ocelli dark and another pair of patches in middle paler, with two long dark setae in middle. Antennae with scapus relatively short, nearly 2.5 times as long as wide, only slightly convex near base of inner side, without long dark setae (Fig. 9C).

Maxillary palps similar to males, though neither with hook-like process on article II nor with specialised setae. Article V with 2–4 hyaline spines near dorsal apex, articles VI and VII with 22–23 and 32–38 hyaline spines from base to apex along dorsal surface, respectively. Ratio of length of articles VII: VI: V = 1: (0.92–0.96): (1.14–1.18). Distribution of pigmented patches on inner surface as in Fig. 9D. Labial palps as in Fig. 9E, article II distinctly elongate, with a small short process on apex.

Legs similar to males, but long pigmented stripes on femora and middle and hind tibiae distinct (Fig. 9F–H).

Abdominal coxites I–VII similar to males (Fig. 10A–D). Ratios of stylets (without terminal spine) to corresponding coxites as follows: 0.69–0.80 for coxites II, 0.46–0.50 for coxites V, 0.76–0.78 for coxites VIII (Fig. 10E), and 0.65–0.69 for coxites IX (Fig. 10H). Ratios of terminal spines to corresponding stylets as following: 0.25–0.47 for coxites II, 0.62–0.77 for coxites V, 0.40–0.79 for coxites VIII, and 0.48–0.62 for coxites IX.

Ovipositor tertiary type, slightly extended beyond terminal spines of stylets IX. Gonapophyses VIII with nearly 70 divisions, most them with setae: basal 1/3 divisions with 5–6 short setae, remainders with 4 long setae, but apical division with 3 setae, penultimate and third with 2 setae (Fig. 10F, G). Gonapophyses IX slender, with nearly 60 divisions, basal 2/3 divisions glabrous, the remaining with 1–3 short setae (Fig. 10I).

**Etymology.** — The new species is named after Prof. Shu-Qiang Li, one of three collectors and an excellent arachnologist from China

**Distribution.** — Northern Vietnam (Vinh Phuc)

In the order Microcoryphia, most species exhibit sexual dimorphism of non-genital portions, such as the differences of the lengths of body, antennae and scapus, and lateral outline between males and females. Some particular dimorphic characters are often in the form of extreme structures in males only (Sturm & Machida, 2001). Sturm & Machida (2001) summarised the male sexually dimorphic organs in Archaeognatha (= Microcoryphia), but they neglected a rather important dimorphic organ, viz., the eversible vesicles on abdominal coxites.

Historically, the number of eversible vesicles on abdominal coxites was considered as an important diagnostic character at family level. Verhoeff (1910) divided two families: Teutoniidae with only a pair of eversible vesicles on each of several abdominal segments and Machilidae with two pairs of eversible vesicles on some abdominal segments. Remington (1954) firstly pointed out the character is unreliable as an indicator of monophyletic relationship in Machilidae (s. str.) and has no more than generic value. Actually the eversible vesicle is even a sexually dimorphic organ in some species. For example, *Allopsontus* (*Anisopsontus*) Mendes, 1990, one of six subgenera of *Allopsontus* Silvestri, 1911, possess a different number of eversible vesicles in both sexes: 1+1 vesicles on abdominal coxites I–VII in males, and 2+2 vesicles on coxites II–V and 1+1 vesicles on coxites I, VI and VII in females (Mendes, 1990; Huang et al., 2006). Thus this phenomenon implies that some related genera separated by the number of eversible vesicle need to be reevaluated.

In the family Meinertellidae, the commonest type of sexual dimorphism is a dorsal hook-like process on the article II of male maxillary palps. It almost occurs in all the meinertellids species. In the present study, several new sexually dimorphic characters are firstly found in the new subgenus *Protumidolontus*. In males of *M. (Protumidolontus) lii*, the frons produces in a large robust process above median ocellus between lateral ocelli; the scapus possesses two distinct bumps on inner surface surrounded with numerous long dark setae; and the article II of labial palps provides with a longer process on apex. Additionally, the special chaetotaxy on frons, scapus and maxillary palps in males is also different from females. The sexually dimorphic features in *M. (P.) lii* seem to be the most varied and diverse in Meinertellidae.

The functional study of sexual dimorphism in Microcoryphia is still scarce. Generally, most dimorphic traits in males are considered to be related to the foreplay with females (Sturm & Machida, 2001). Unfortunately there are no observations on the mating behavior for *M. (P.) lii*. The function of sexual dimorphism in *M. (P.) lii* is unknown. The present study only provides some potentially informative characters for taxonomic identification and phylogenetic studies. A more extensive survey including biology, behavior and ecology of *M. (Protumidolontus)* as well as other bristletail groups is needed.

## ACKNOWLEDGEMENTS

We are grateful to Dr Dinh-Sac Pham, Institute of Ecology and Biological Resources, Vietnamese Academy of Science and Technology, Hanoi, Vietnam, and Dr Shu-Qiang Li, Institute of Zoology, Chinese Academy of Sciences, Beijing, China, for presentation of the studied specimens. We thank Dr Guo Zheng, Shenyang Normal University, Liaoning, China, for providing the photographs of collecting microhabitat. We also wish to thank Dr Anh Duc Tran, Department of Invertebrate Zoology, Faculty of Biology, Hanoi University of Science, Hanoi, Vietnam, for his very kind editorial help with this paper. Two anonymous reviewers are greatly appreciated for their efforts in improving this paper.

The work on which this paper is based was supported by the following sources: Scientific Survey on the Middle- and Lower-reaches of Lancang (Mekong) River and Grand Shangri-La Area (No. 2008FY110300), National Natural Science Foundation of China (No. 31101657), National Science Fund for Fostering Talents in Basic Research (Special subjects in animal taxonomy, NSFC-J0630964/J0109) and a grant (No. O529YX5105) from Key Laboratory of Zoological Systematics and Evolution of Chinese Academy of Sciences.

## LITERATURE CITED

- Carpenter, G. H., 1916. The Apterygota of the Seychelles. *Proceedings of the Royal Irish Academy*, **33**(B): 1–70.
- Huang, F. S., Z. S. Song & A. P. Liang, 2006. A new bristletail species of the genus *Allopsontus* Silvestri (Microcoryphia: Machilidae) from Shaanxi, China. *Oriental Insects*, **40**: 231–236.
- Grassi, B., 1888. I progenitori dei Miriapodi e degli Insetti. VII. Anatomia comparata dei Tisanuri e considerazioni general sull'organizzazione degli Insetti. *Atti della Reale Accademia dei Lincei*, **4**: 543–606.
- Kaplin, V. G., 1985. On the classification and phylogeny of the Machilidae (Thysanura, Microcoryphia). *Entomological Review*, **64**: 117–131.
- Liu, J., S. Q. Li & D. S. Pham, 2010. The coelotine spiders from three national parks in Northern Vietnam (Araneae: Amaurobiidae). *Zootaxa*, **2377**: 1–93.
- Mendes, L. F., 1981. Sur quelques Microcoryphia de l'Asie Orientale: notes et descriptions (Insecta; Apterygota). *Nouvelle Revue d'Entomologie*, **11**: 15–28.
- Mendes, L. F., 1989. New data on the Microcoryphia and Zygentoma (Insecta) from the Malaysian Borneo and Philippines. *Garcia de Orta, Serie de Zoologia, Lisboa*, **15**: 105–112.
- Mendes, L. F., 1990. An annotated list of generic and specific names of Machilidae (Microcoryphia, Insecta) with identification keys for the genus and geographical notes. *Estudos Ensaios E Documentos*, **155**: 1–127.
- Mendes, L. F., M. Gaju-Ricart, C. Bach De Roca & R. Molero-Baltanás, 2000. On some Silvestri species of Machilidae (Microcoryphia: Insecta) which types are in the Museum National d'Histoire Naturelle, Paris. *Pedobiologia*, **44**: 268–284.
- Paarmann, W. & N. E. Stork, 1987. Canopy fogging, a method of collecting living insects for investigations of life history strategies. *Journal of Natural History*, **21**: 563–566.
- Paclt, J., 1969. Neue Beiträge zur Kenntnis der Apterygoten-Sammlung des Zoologischen Staatsinstitut und Zoologischen Museums Hamburg. III. Meinertellidae und Machilidae (Thysanura). *Entomologische Mitteilungen aus dem Zoologischen Staatsinstitut u. Zoologischen Museum Hamburg*, **3**(63): 269–292.
- Remington, C. L., 1954. The suprageneric classification of the order Thysanura (Insecta). *Annals of Entomological Society of America*, **47**: 277–286.
- Silvestri, F., 1906. Notes sui Machilidae. III. Descrizione di un nuovo genere di sei nuove specie. *Redia, Firenze*, **3**: 325–335.
- Silvestri, F., 1911. Materiali per lo studio dei Tisanuri. XIII. Nuove specie di Machilidae della regione indo-malese. *Bolletino del Laboratorio di Zoologia generale e agraria di Portici*, **5**: 88–95.
- Silvestri, F., 1912. Machilidarum (Thysanura) species nonnullae novae ex regione indo-malayana. *Zoologischer Anzeiger*, **40**: 1–8.
- Song, Z. S., F. S. Huang & A. P. Liang, 2011. *Machilontus* (s. str.) *medogensis* Song & Huang sp. nov. from Tibet, the northernmost record of the genus *Machilontus* Silvestri, 1912 and the first record of the family Meinertellidae (Insecta: Microcoryphia: Machiloidea) in China. *Zootaxa*, **2822**: 61–68.
- Sturm, H. & C. Bach de Roca, 1988. Archaeognatha (Insecta) from the Krakatau Islands and the Sunda Strait area, Indonesia. *Memoirs Museum of Victoria*, **49**: 367–383.
- Sturm, H. & R. Machida, 2001. *Archaeognatha. Handbook of Zoology, Volume 4, Arthropoda: Insecta, Part 37*. Walter de Gruyter, Berlin. 213 pp.
- Sturm, H., 2001. Zur Taxonomie der Buckelformen *Graphitarsus* (*Hybographitarsus*) stat. nov. und *Corethromachilis* (*Dromadimachilis*) stat. nov. bei Felsenspringern (Machilinae, Machilidae, Archaeognatha, Insecta) und Beschreibung einer neuen *Graphitarsus* (*Hybographitarsus*) Art. *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg*, **13**(163): 235–246.
- Verhoeff, K. W., 1910. Über Felsenspringer, Machiloidea, 4. Aufsatz: Systematik und Orthomorphose. *Zoologischer Anzeiger, Leipzig*, **36**: 425–438.