



NEW SPECIES AND RECORDS OF ASIAN PELTOPERLIDAE (INSECTA: PLECOPTERA)

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ABSTRACT

Nine new peltoperlid species are described from Southeast Asia including five *Cryptoperla* Needham and four *Peltoperlopsis* Illies, and provisional keys for males of both genera are presented. The female, larva and egg are described for *C. fraterna* (Banks), the female and egg for *C. ishigakiensis* (Kawai), and unassociated females of *Cryptoperla* and *Peltoperlopsis* are also described with informal designations. New records are given for *C. karen* Stark, *P. concolor* Banks and *P. malickyi* Stark & Sivec, *Peltoperla nigrifulva* Wu is transferred to *Peltoperlopsis*, *Peltoperla sinensis* Wu & Claassen is transferred to *Cryptoperla*, and a checklist of Asian Peltoperlidae is presented.

Keywords: Plecoptera, Peltoperlidae, Southeast Asia, new species, *Cryptoperla*, *Peltoperlopsis*

INTRODUCTION

Stark (1989) placed Asian peltoperline stoneflies in five genera but only *Cryptoperla* Needham (1909) and *Peltoperlopsis* Illies (1966) display significant diversity in Southeast Asia. *Cryptoperla*, as presently defined, includes some 23 species and *Peltoperlopsis* now includes 4 species (Uchida & Isobe 1988; Stark 1989; Sivec 1995, 2005; Maruyama 2002; Stark & Sivec 1999, 2007). Both genera are thought to be "broadly defined" and the lack of associated larvae and females with eggs continues to be a barrier to any resolution of the current system.

The present study includes material of five new species which we place in *Cryptoperla* and four which we place in *Peltoperlopsis*, and additional species of *Peltoperlopsis* from the Philippine Islands and of *Cryptoperla* from China are described under informal designations. Specimens are placed in the following collections as indicated in the text. Royal Ontario

Museum, Toronto (ROM); Museum für Naturkunde, Berlin (MNB); Institute of Ecology and Biological Resources, Hanoi (IEBR); Prirodoslovni Muzej Slovenije, Ljubljana (PMSL); Museum Zoologi Bogor, Indonesia (MZB); United States National Museum, Washington (USNM); Zwick/Illies/LFS collection, Schlitz; Bill P. Stark Collection, Mississippi College, Clinton (BPS). This research was partially funded by National Science Foundation (Biotic Surveys and Inventories) Grant DEB-0103144, awarded to G. Courtney, Iowa State University. We also thank the National Research Council of Thailand (NRCT) and Royal Forestry Department (RFD) for permission to conduct research and use facilities in the national parks of Thailand.

Following is a systematic checklist of 41 peltoperlid species recognized in Asia.

Family Peltoperlidae Claassen

Subfamily Microperlinae Uchida & Isobe

- Microperla brevicauda* Kawai, 1958
M. geei Chu, 1928

Subfamily Peltoperlinae Claassen

- Cryptoperla aculeata* Wu, 1973
C. akha Stark, 1989
C. bisaeta (Kawai, 1968a)
C. chiangi (Banks, 1940)
C. curvata sp. nov.
C. dui Sivec, 2005
C. formosana (Okamoto, 1912)
C. fraterna (Banks, 1938)
C. fujianica Sivec, 1995
C. hubleyi sp. nov.
C. ishigakiensis (Kawai, 1968b)
C. japonica (Okamoto, 1912)
C. kali Stark, 1989
C. karen Stark, 1989
C. kawasawai Maruyama, 2002
C. kosai sp. nov.
C. kumari Stark, 1989
C. meo Stark, 1989
C. meyi sp. nov.
C. naga Stark, 1989
C. obtusa (Wu, 1973)
C. pentagonalis Zwick & Sivec, 1980
C. simplex sp. nov.
C. sinensis (Wu & Claassen) comb. nov.
C. stilifera Sivec, 1995
C. torva Needham, 1909
Peltoperlopsis anomala sp. nov.
P. cebuano sp. nov.
P. concolor (Banks, 1931)
P. malickyi Stark & Sivec, 1999
P. mindanensis (Banks, 1924)
P. nigrifulva (Wu, 1962) comb. nov.
P. spinosa sp. nov.
P. swanni sp. nov.
Peltopteryx zwicki Stark, 1989
Yoraperla altaica Devyatkov, 2004
Yoraperla han Stark & Nelson, 1994
Y. uchidai Stark & Nelson, 1994
Y. uenoi (Kohno, 1946)

RESULTS AND DISCUSSION

Cryptoperla curvata sp. nov.
(Figs. 1-7)

Material examined. Holotype ♂ and 3 ♂, 4 ♀ paratypes (1 ♂ damaged) from Vietnam, Gia Lai, An Khe District, Tram Lap, Azun River, UV light, 2 km NW on trail from forestry building, 14° 27' N, 108° 33' E, 17 June 1996, D.C. Currie, J. Swann, ROM 961056 (ROM). Additional paratypes, all from Vietnam: Gia Lai, An Khe District, Tram Lap, Azun River, 3 km NE forestry building, 21 June 1996, UV light, D.C. Currie, J. Swann, ROM 961076, 2 ♂, 3 ♀ (ROM). Gia Lai, An Khe District, 6 km wide tributary of Azun River, NE of Tram Lap, 20 June 1996, B. Hubley, D.C. Currie, 961073, 1 ♂ (IEBR).

Adult habitus. Biocellate. Head yellow with slightly darker yellow brown area extending from ocelli over central frons to anterior callosities and beyond as a tongue shaped extension (Fig. 1). Pronotum pale with obscure darker areas scattered on disc. Wings transparent, veins pale amber. Legs yellow brown but apical tarsi slightly darker.

Male. Forewing length 8.5 mm. Posterior margin of tergum 10 parabolic; center offset from apex by a pair of low, elevated lateral knobs (Fig. 2). Basal cercal segment ca. 4.5X long as basal width and with sparse to dense inner marginal setal fringe near apex (Fig. 4); apex of basal segment curved dorsad and armed with a multidentate spur which bears ca. 10 subapical teeth. Vesicle about 1.3X wide as long (Fig. 3). Aedeagus membranous, armed at bases of apical lobes with a pair of sparse patches of thick setae; additional armature on ventral surface consists of very fine, short setae and microtrichia (Fig. 5).

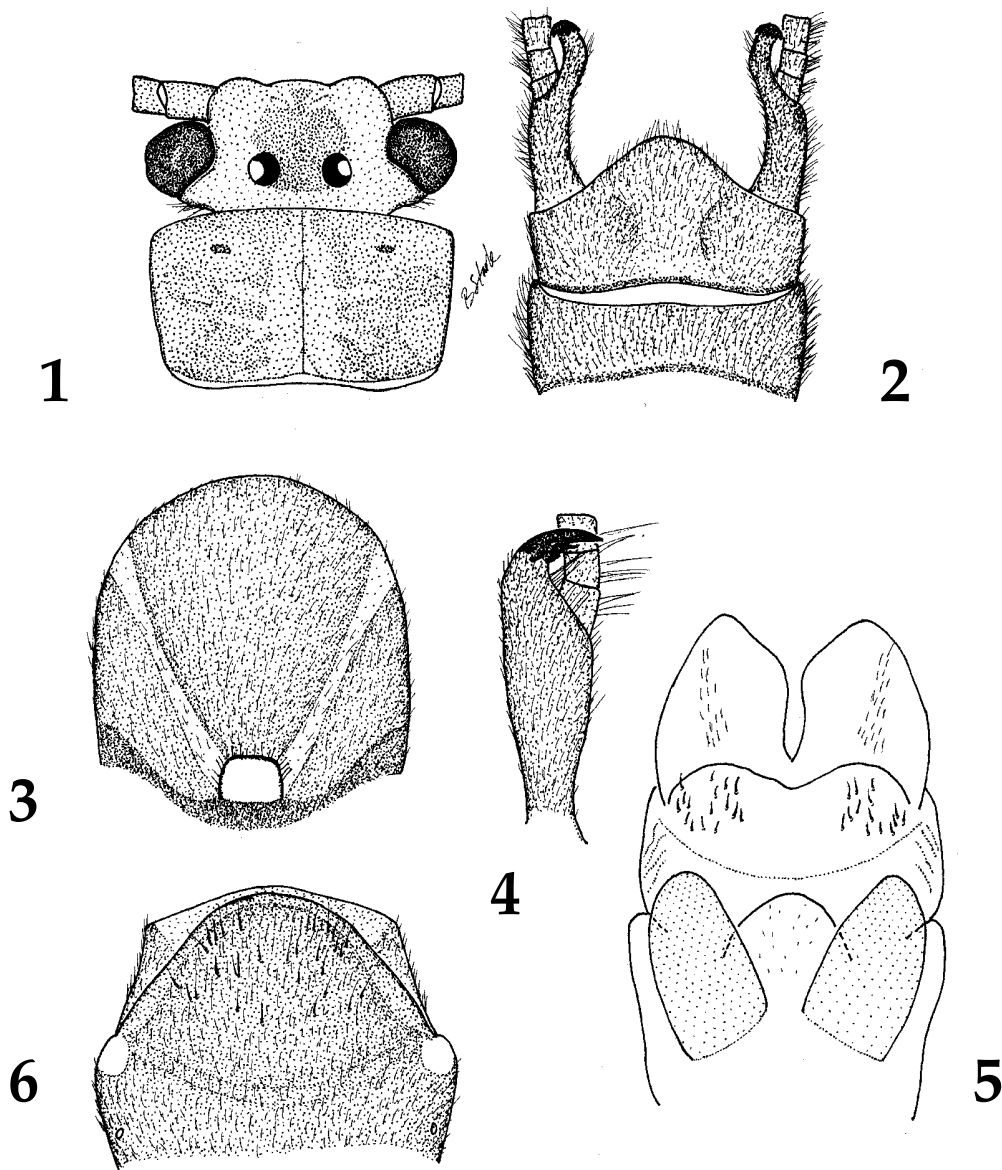
Female. Forewing length 9.5 mm. Subgenital plate parabolic and reaching near posterior margin of sternum 9 (Fig. 6); plate with a narrow bare marginal band and an internal transverse band of microtrichia near gonopore. Sternum 9 bare except on lateral margins; posterior margin slightly produced over base of segment 10.

Egg. Total length about 0.296 mm, width about 0.158 mm. Collar short, length about 0.01 mm, width about 0.052 mm. Chorion coarsely punctate throughout; each pit surrounded by an obscure follicle cell impression (FCI); ca. 17 longitudinal rows of pits and ca. 11 horizontal rows visible in lateral aspect (Fig. 7). Micropyles set on FCI walls between pits.

Larva. Unknown.

Etymology. The species name is based on the upturned spur of the basal cercal segment.

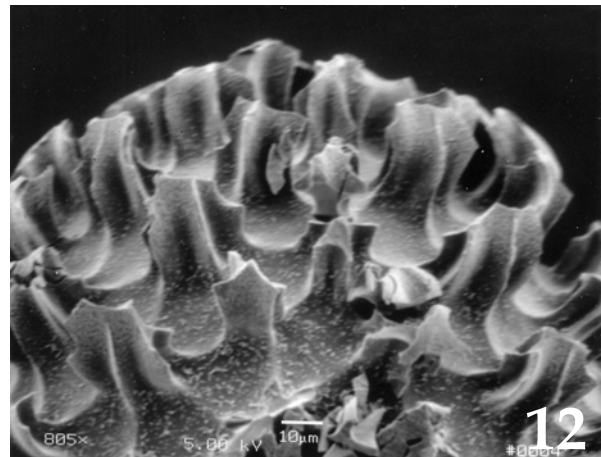
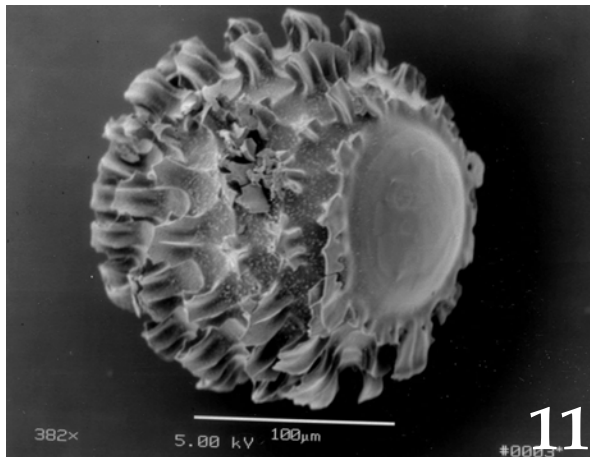
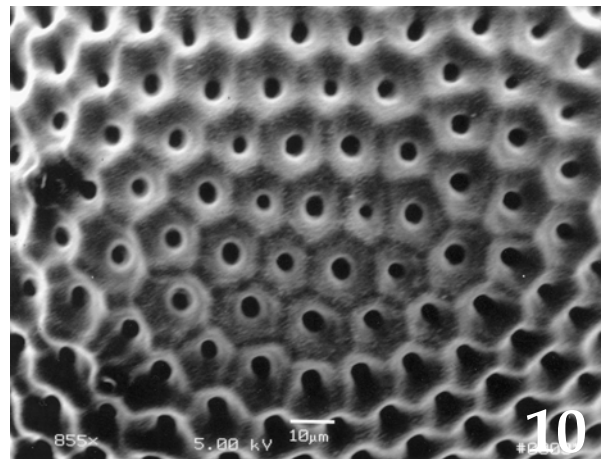
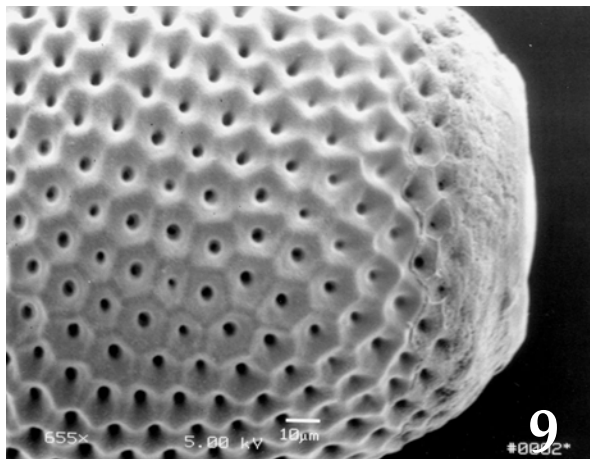
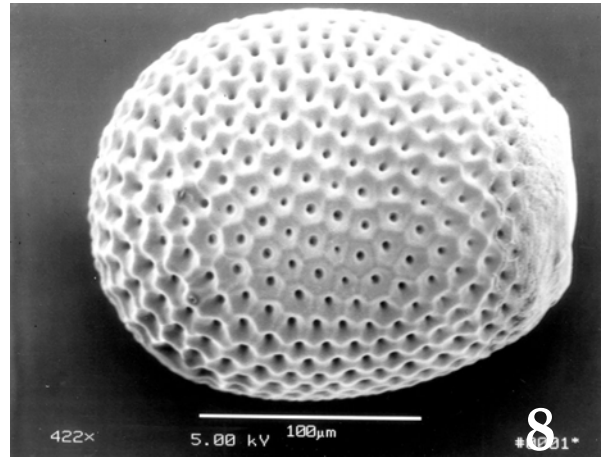
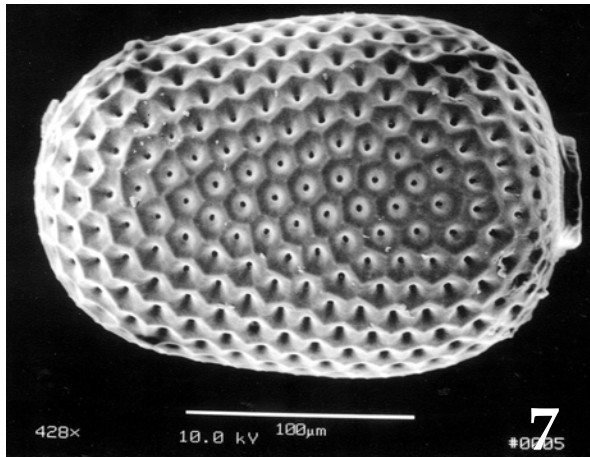
Diagnosis. Males of this species will key to *C. karen*



Figs. 1-6. *Cryptoperla curvata*. 1. Adult head and pronotum, 2. Male terminalia, dorsal, 3. Male sternum 9, 4. Male basal cercal segment, lateral, 5. Male aedeagus, ventral, 6. Female terminalia.

in Stark (1989) and the female and egg are also similar to that species, suggesting a sister group relationship. Males are distinguished by the upturned cercal spurs having ca. 10 spines instead of the 1-3 long spines found in *C. karen*. Females share the bare marginal band on the subgenital plate with *C. karen* but the presence of an internal transverse

microtrichia band near the gonopore in *C. curvata* will distinguish the two. Eggs of the two species are virtually identical but in the small sample presently available, those of *C. curvata* are narrower at the micropylar line than below the collar, whereas those of *C. karen* have almost parallel sides (Stark 1989; Stark & Sivec 1999).



Figs. 7-12. *Cryptoperla* micrographs of eggs. 7. *C. curvata* entire egg, 8-10. *C. fraterna*, 11-12. *C. ishigakiensis*.

***Cryptoperla fraterna* (Banks)**
(Figs. 8-10, 13-14)

Nogiperla fraterna Banks, 1938:223. Lectotype ♂, Pahang, Malaysia (Museum of Comparative Zoology),

designation Stark, 1989:514
Neopeltoperla fraterna: Hitchcock, 1962:83
Cryptoperla fraterna: Uchida & Isobe, 1988:20
Cryptoperla fraterna: Stark, 1989:514

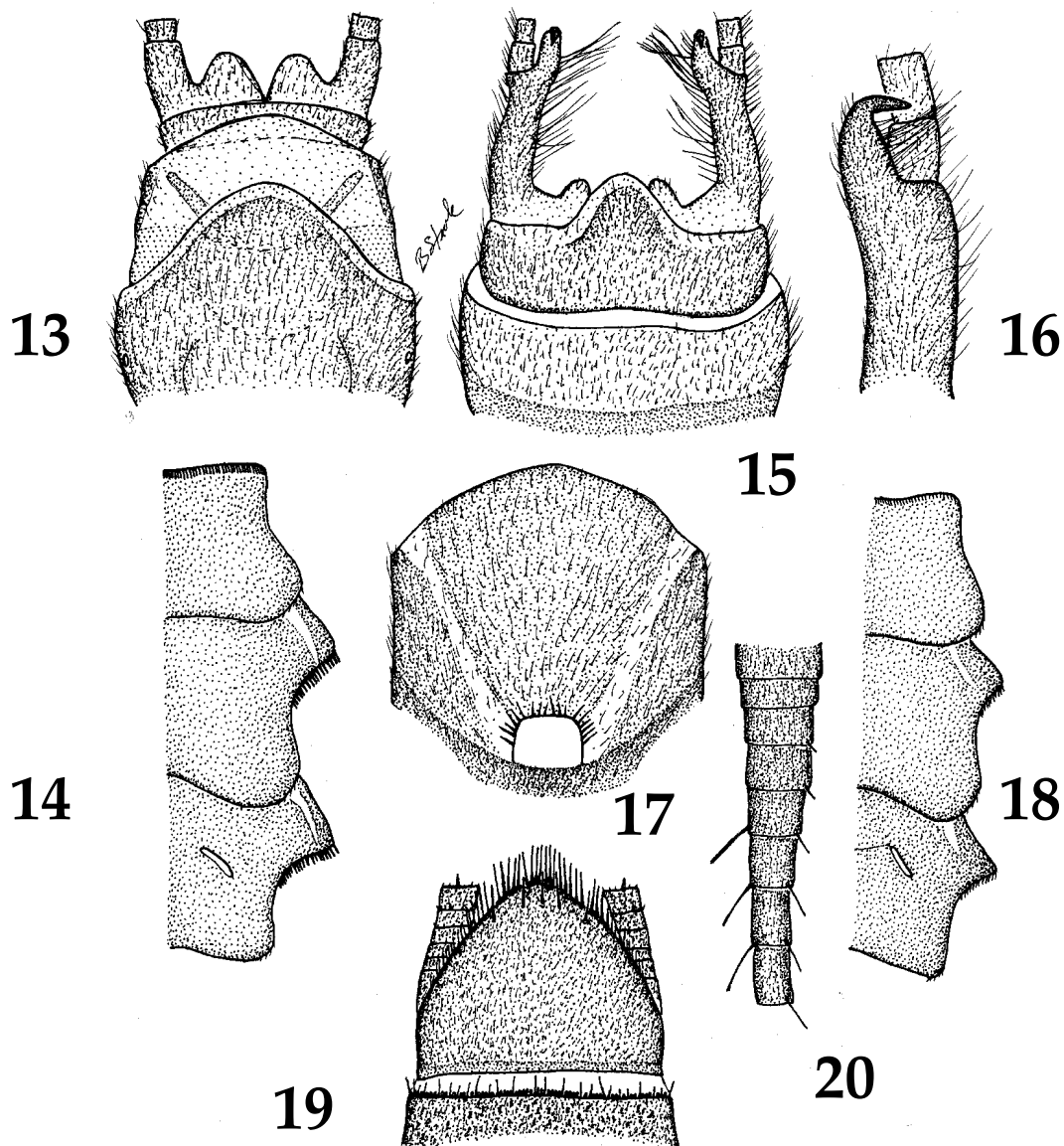
Material examined. Malaysia: Hulu Perak, Belum Expedition Base Camp, 1-3 April 1994, I. Sivec, 2 ♂, 1 ♀, 5 larvae, 1 exuvium (PMSL). Same site, 8-10 April 1994, I. Sivec, 2 ♀, 9 larvae (PMSL).

Remarks. Stark (1989) figured variations in the male basal cercal segment for various populations of this species but the female, egg and larva have not previously been described.

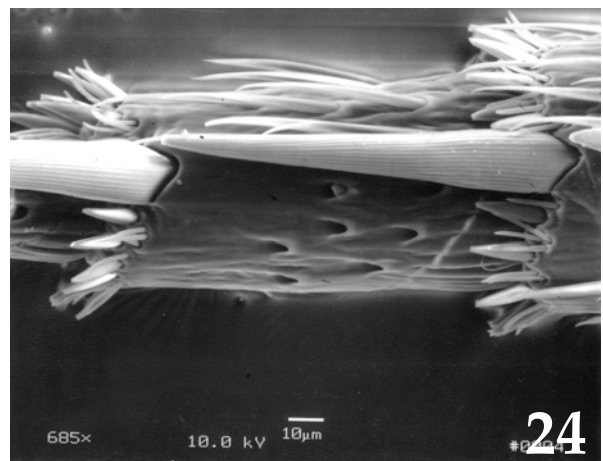
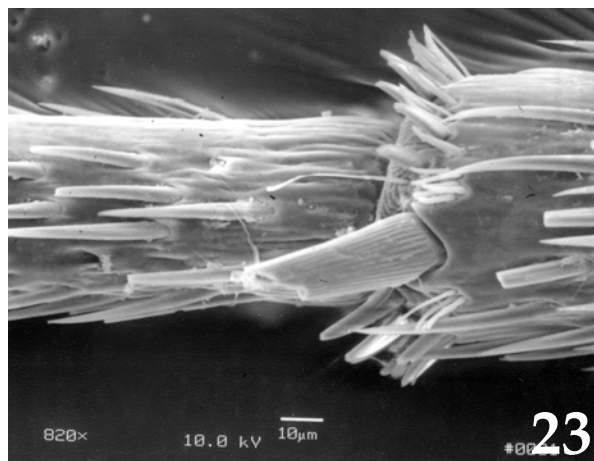
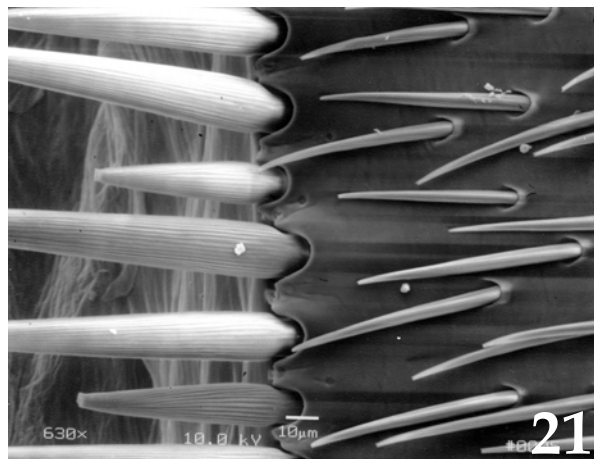
Female. Forewing length 10 mm. Subgenital plate parabolic, covering ca. half of sternum 9; margin of plate with a narrow, transparent, hairless zone

(Fig.13). Sternum 9 produced mesally, overlapping base of sternum 10; base of sternum 9 with microtrichial band extending under subgenital plate; lateral bars present.

Egg. Bulb shaped with low, wide collar surrounded by smooth rim. Chorion punctate with each pit surrounded by hexagonal FCIs (Figs. 8-10); FCIs larger at anterior pole opposite collar; ca. 16 longitudinal and ca. 16 horizontal rows of pits visible in lateral aspect. Micropyles subequatorial nearest anterior pole.



Figs. 13-20. *Cryptoperla* structures. 13-14. *C. fraterna*. 13. Female terminalia, 14. Larval thoracic sternum, 15-20. *C. hubleyi*. 15. Male terminalia, dorsal, 16. Male basal cercal segments, lateral, 17. Male sternum 9, 18. Larval thoracic sternum, 19. Larval abdominal terga, 20. Larval cercal segments 5-12, lateral.



Figs. 21-24. *Cryptoperla hubleyi* micrographs of larval structures. 21. Abdominal sternum 8, posterior fringe and clothing hairs, 22. Abdominal tergum 8, posterior fringe with clavate setae, 23. Dorsal aspect cercal segments 9-10, 24. Ventral aspect subapical cercal segments.

Larva. Pre-emergent body length 6-7.5 mm. Dorsal body color rather uniformly reddish brown, sometimes paler on basal abdominal terga. Prothorax and thoracic sterna without gills, mesothorax and metathorax each with a supracoxal gill projecting under the wingpad; paraprocts each with a slender, delicate dorsal gill filament, median gill reduced and obscure on membranous ventral margin of tergum 10. Lacinia tridentate, mesal tooth slightly larger than laterals; galea brush expanded, much wider than apex of lacinia. Thoracic sterna without posterior or subapical setal fringes; fringes confined to anterior margin of prosternum and lateral margins of mesosternum and metasternum around coxae; posterior margin of metasternum concave (Fig. 14). Abdominal sterna 1-4 without posterior setal fringe;

fringe on sternum 5 interrupted mesally but complete on sterna 6-9. Cerci short and without ventral blade-like setae in apical whorls.

Cryptoperla hubleyi sp. nov.
(Figs. 15-24)

Material examined. Holotype ♂ from Vietnam, Thua Thien-Hue, Bach Ma National Park, small stream ca. 100 m past Five Lakes Trail, 1200 m, 16° 11' 37" N, 107° 51' 19" E, Mercury vapor light, 9 June 2000, B. Hubley, ROM 2000518 (ROM). Additional material: Vietnam, Thua Thien-Hue, Bach Ma National Park, small stream along Five Lakes Trail, 1200 m, 16° 11' 20" N, 107° 51' 08" E, 10 June 2000, B. Hubley, ROM 2000519, 4 larvae (ROM).

Adult habitus. Biocellate. Head yellow with slightly darker yellow brown area over ocelli and central frons. Pronotum mostly yellow brown with scattered pale rugosities and a conspicuous mesal pale spot on median suture. Femora yellow, tibiae and tarsi darker. Wings transparent, veins pale amber.

Male. Forewing length 10 mm. Posterior margin of tergum 10 parabolic (Fig. 15). Basal cercal segment ca. 4X long as basal width and with relatively dense inner marginal setal fringe (Fig. 16); apex of basal segment curved sharply dorsad and armed with a single prominent spur attached to segment at an approximate right angle in lateral aspect. Vesicle ca. 1.5X long as basal width (Fig. 17).

Female. Unknown.

Larva (putative). Pre-emergent body length 7.5-9.0 mm. General color brown to reddish brown. Pronotum with a pair of small circular pale spots located midway between median suture and lateral margins. Thoracic sterna without setal fringes except on anterior margin of prosternum and laterally around coxal bases of mesosternum and metasternum (Fig. 18); posterior notal margins with dense rows of short blunt setae, angles of metathorax with longer pointed setae. Abdominal terga 4-9 uniformly red brown; anterior terga paler and tergum 10 yellow brown. Abdominal terga without conspicuous bristles except 2-4 subapical ones on tergum 10; terga clothed with dark clothing hairs and minute spicules over entire surface; posterior fringe primary bristles widely spaced and short with shorter clavate setae interspersed (Figs. 19, 22); posterior sternal fringe bristles longer and without clavate setae (Fig. 21). Cerci with less than 15 segments, apical 4-5 with a single thick, moderately long dorsal and ventral bristle in segmental whorl (Figs. 20, 23-24). Paraproct gills short, not projecting beyond tip of paraprocts and difficult to observe; ventromedian area of tergum 10 apex apparently without gills; mesothorax and metathorax with supracoxal gills beneath wingpads; prothorax and thoracic sterna without gills.

Etymology. The patronym honors B. Hubley, collector of the holotype and larval specimens.

Diagnosis. This species is closely related to *C. karen* and *C. curvata*. Males are distinguished from both by the unidentate cercal spur, and by the sharp angle at which the spur joins the basal segment.

Cryptoperla ishigakiensis (Kawai)
(Figs. 11-12, 25)

Neopeltoperla ishigakiensis Kawai, 1968b:231. Holotype ♂, Karayama, Ishigaki Island, Japan (Bernise Bishop Museum)

Cryptoperla ishigakiensis: Uchida & Isobe, 1988

Material examined. Japan, Ryukyu Islands, Ishigaki Island, Omoto-sawa, August 1974, K. Tanida, 1 ♂, 1 ♀ (BPS).

Remarks. This material, provided by S. Uchida, represents the second known collection of this species. Kawai (1968b) described the species from a single male; we now add descriptions for the female and egg.

Female. Forewing length 9 mm. General color yellow brown without distinctive pattern. Subgenital plate parabolic, covering most of sternum 9 (Fig. 25). Lateral bars obscure on sternum 9.

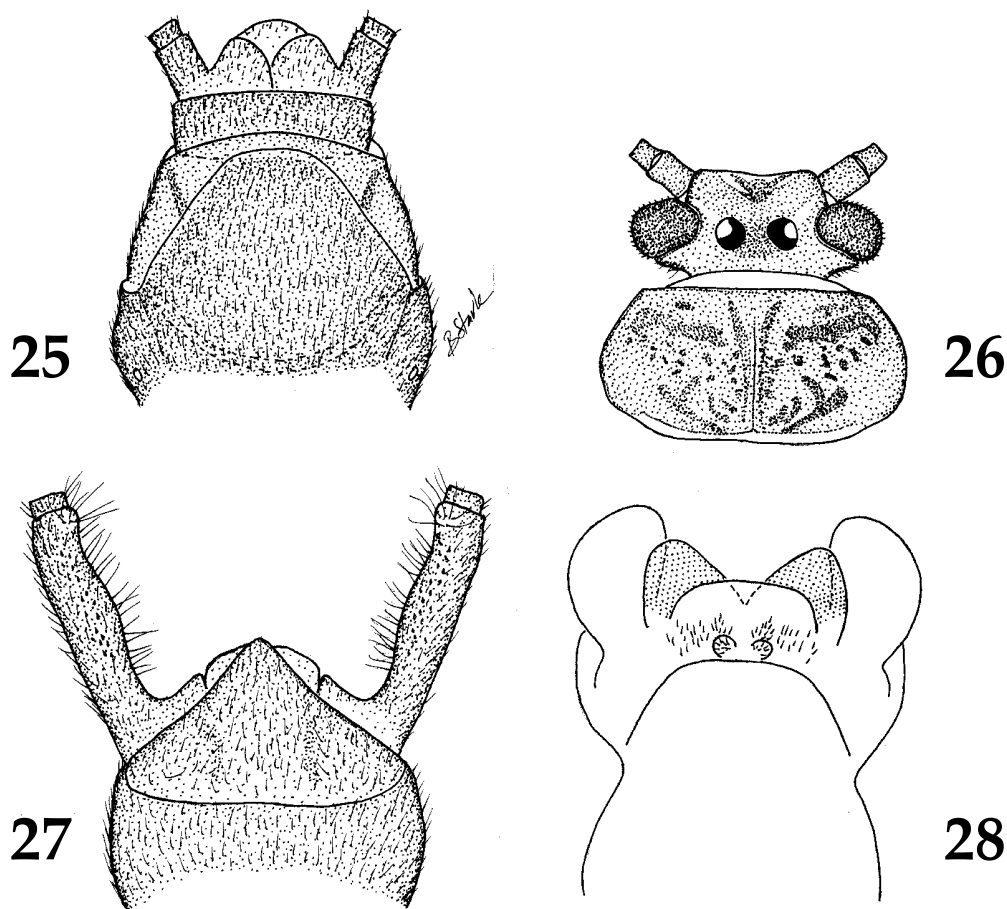
Egg. Chorion covered with elaborate scales but with broadly rounded sessile collar (Fig. 11). Scales (mostly broken in Figs. 11-12) only slightly wider at apex than at base; apical scales near anterior pole with a single prominent keel extending from base to near apex; some scales located near collar with two prominent keels. Micropyles located on scales adjacent to collar. Chorion between scales covered with fine processes.

Diagnosis. The female and egg of this species are similar to *C. formosana* from the nearby island of Taiwan (Stark & Sivec 2007), and to the Japanese species, *C. japonica* (Uchida & Isobe 1988), but the subgenital plate is longer than in either of these species, and is less rounded than *C. formosana* and less triangular in outline than *C. japonica*. The egg differs slightly from both in having one or two prominent keels on the chorionic scales which approach the scale apex; in *C. japonica* the scale keels are poorly developed (Uchida & Isobe 1988) and in *C. formosana* they are well developed only at the scale bases (Stark & Sivec 2007).

Cryptoperla karen Stark

Cryptoperla karen Stark, 1989:504. Holotype ♂, Chiang Mai, amp. Fang, tambon Kew Kor Mah, Thailand (United States National Museum)

Cryptoperla karen: Stark & Sivec 1999:238. Vietnam record



Figs. 25-28. *Cryptoperla* structures. 25. *C. ishigakiensis* female terminalia, 26-28. *Cryptoperla kosai*. 26. Head and pronotum, 27. Male terminalia, dorsal, 28. Aedeagus, ventral.

Material examined. Vietnam: Vinh Phu, Tam Dao, lower waterfall of stream flowing through town, UV light, 11 May 1996, B. Hubley, D.C. Darling, ROM 961030, 1 ♂ (ROM). Same site, 11 May 1996, B. Hubley, D.C. Darling, ROM 961029, 1 larva (ROM). Tam Dao, 800-1100 m, 19 May-13 June 1995, H. Malicky, 1 ♂ (PMSL).

Remarks. Stark & Sivec (1999) previously recorded this species from two Vietnamese sites and compared the eggs of Thai and Vietnamese specimens.

Cryptoperla kosai sp. nov.
 (Figs. 26-28)

Material examined. Holotype ♂ from Thailand, Upper Panjane and Wieng Ko Sai National Park, 25-

26 October 2002, I. Sivec (PMSL). Paratypes: Thailand: Chiang Mai Province, Doi Inthanon National Park, Bang Khun Klang, 1200 m, 98° 32' N, 18° 32' E, 29 August-5 September 1989, H. Malicky, P. Chantaramongkol, 2 ♂ (PMSL).

Adult habitus. Biocellate. General color yellow brown. Head with brown patch covering ocelli and extending forward over most of anterior frons (Fig. 26). Pronotum yellow brown with scattered darker and lighter rugosities on disc.

Male. Forewing length 8.5 mm. Tergum 10 triangular at apex. Basal cercal segment ca. 5X long as basal width, sparsely fringed along inner margin with fine long setae and slightly swollen around midlength; spur absent (Fig. 27). Ventroapical aedeagal margin 4-lobed; inner lobes smaller and covered with fine,

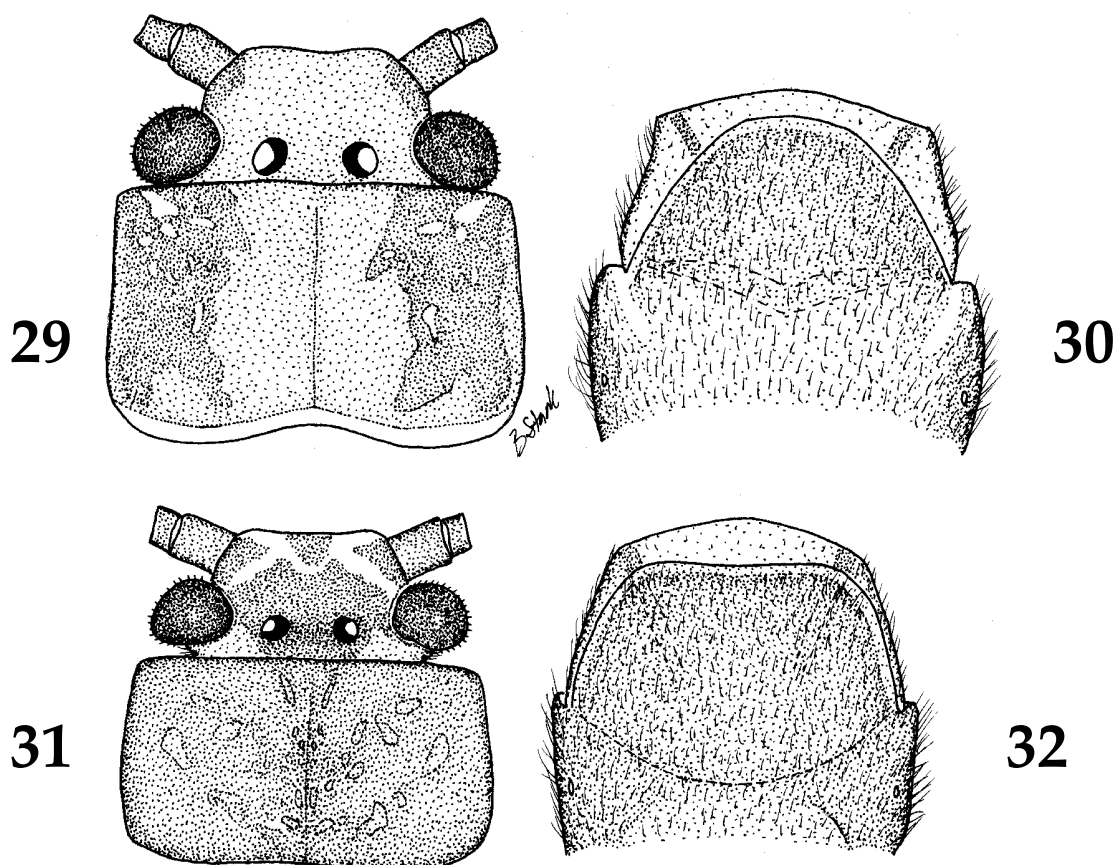
brownish microtrichia. Mesobasal field bearing a pair of small membranous knobs and a sparse area of pale brown setae (Fig. 28).

Female. Unknown.

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, is based on the type locality in Wieng Ko Sai National Park.

Diagnosis. This species is similar, externally to *C. simplex* (described below) but the two are distinct in aedeagal armature pattern. This species has the setae separated into a pair of sparse patches populated by mostly short, pale setae, whereas in *C. simplex* the setae are grouped into a single patch of dark brown, long setae. The two paratypes listed above have longer setae than the holotype and may represent a closely related sister species.



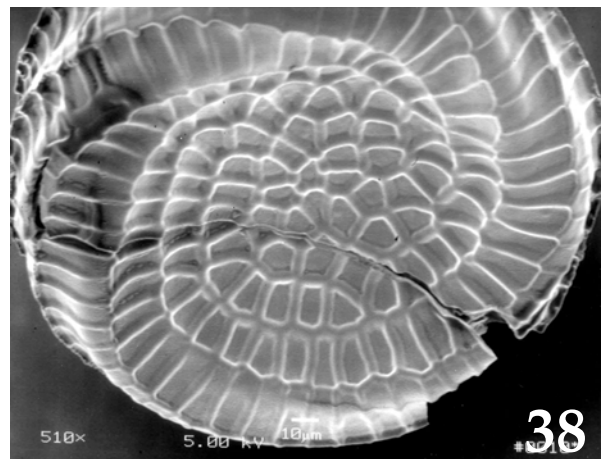
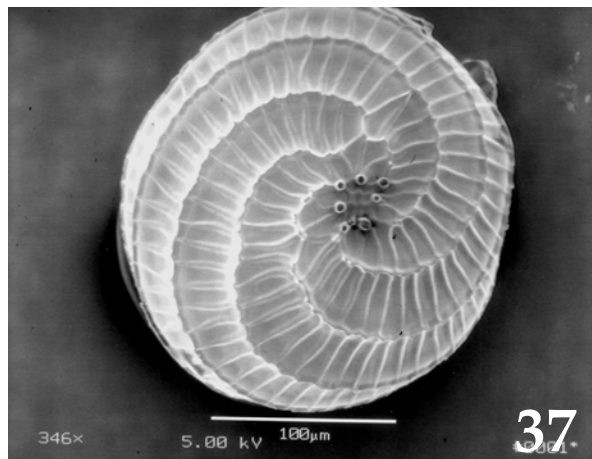
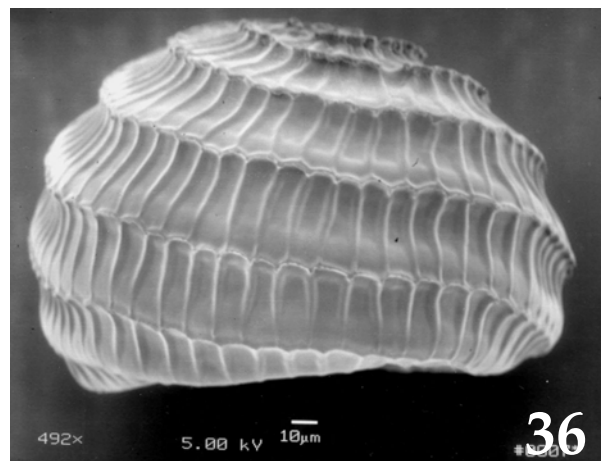
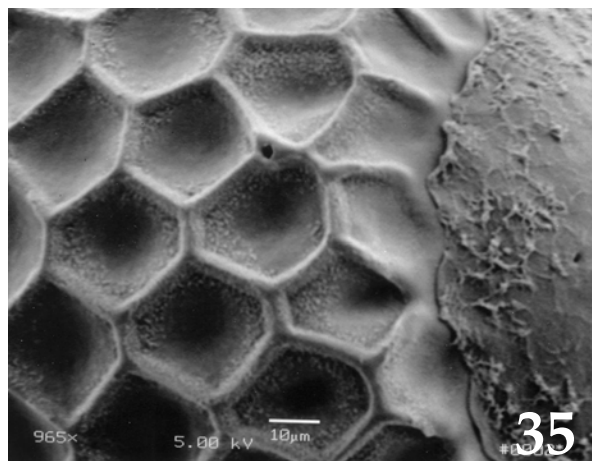
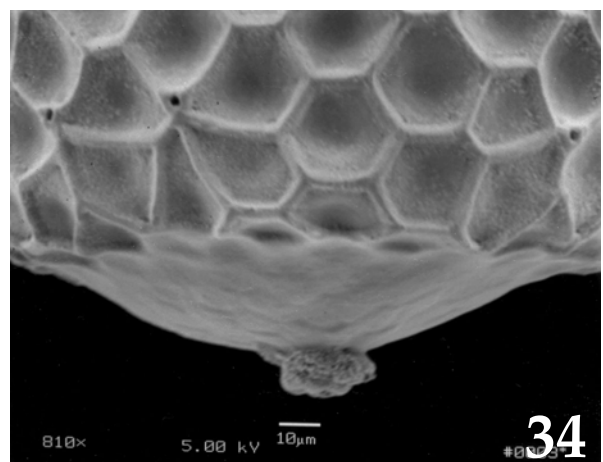
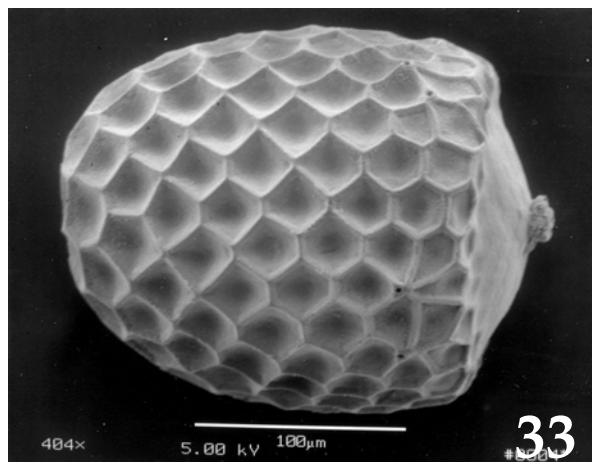
Figs. 29-32. *Cryptoperla* structures. 29-30. *C. meyi*. 29. Head and pronotum, 30. Female terminalia. 31-32 *C. sp.* Ch A. 31. Head and pronotum, 32. Female terminalia.

Cryptoperla meyi sp. nov.

(Figs. 29-30, 33-35)

Material examined. Holotype ♂ from Vietnam, Sa Pa, Fan Si Pang Mts., 25-30 March 1995, W. Mey (MNB). Paratypes all from Vietnam: Mt. Fan Si Pan, 22° 17' N, 103° 45' E, 1-5 March, 1 ♀ (MNB). Sa Pa, Okui-ho 1100 m, 24-25 March 1995, W. Mey, 1 ♀ (MNB).

Adult habitus. Biocellate. General body color yellow-brown. Head pale except for darker lappets. Pronotum with pale median band and darker midlateral band extending almost to margin; small pale rugosities scattered in dark band (Fig. 29). Wings transparent, veins pale amber except costa, subcosta and radius which are pale in apical half. Femora pale except at tip; tibiae brown but slightly darker in basal third.



Figs. 33-38. *Cryptoperla* micrographs of eggs. 33-35. *C. meyi*. 36-38. *C. sp.* Ch A.

Male. Unknown.

Female. Forewing length 16-17 mm. Subgenital plate large, parabolic, covering most of sternum 9 (Fig.30). Sternum 9 with prominent lateral bars; median field

essentially hairless. Base of vagina visible through subgenital plate due to microtrichia patches.

Egg. Outline thimble shaped with low button collar surrounded by wide smooth zone (Figs. 33-35). Body

of egg covered with prominent 4-6 sided FCIs; ca. 7 longitudinal and 10 horizontal rows of FCIs in lateral aspect. FCI floors form conical pits, rims smooth and narrow (Fig. 35). Micropyles located near collar on FCI rims.

Larva. Unknown.

Etymology. The patronym honors W. Mey, collector of the holotype.

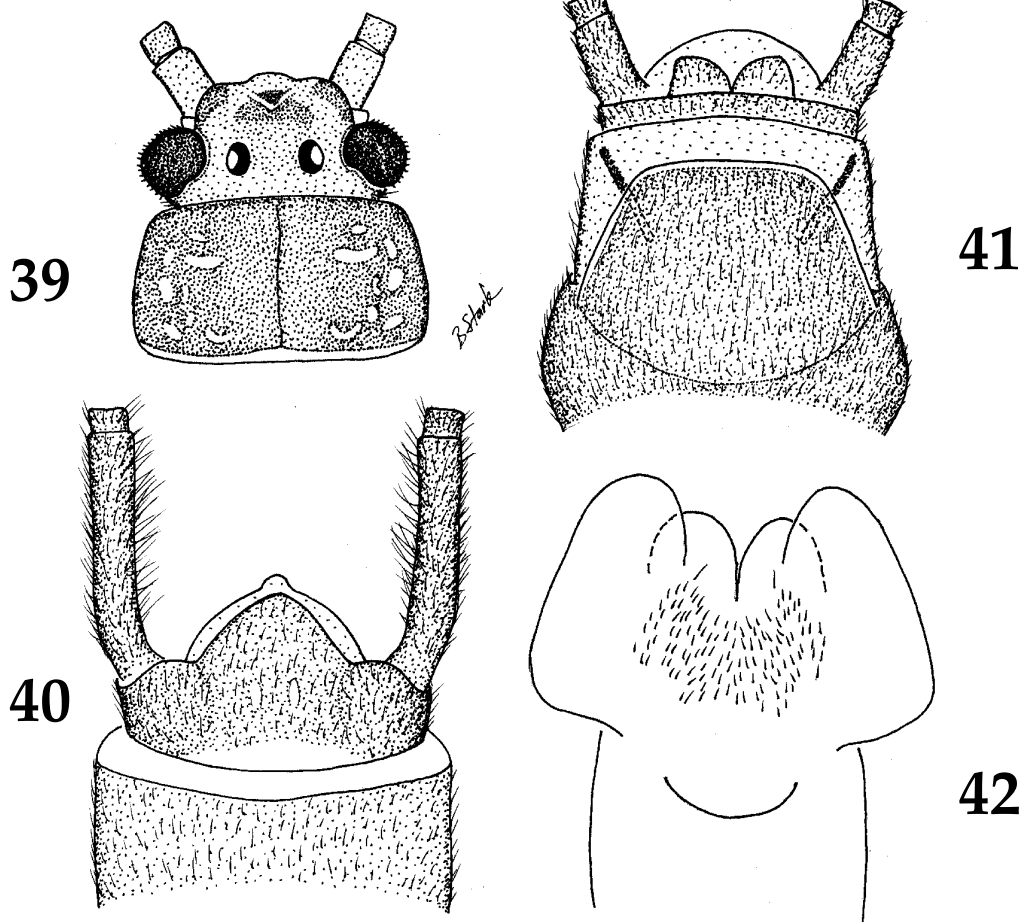
Diagnosis. The subgenital plate for this species is generally similar to that of several other species, but *C. meyi* is larger than known *Cryptoperla* except *C. kumari* (Stark 1989) and two Chinese species, *C. obtusa* (Wu 1973) and *C. sinensis* (Wu & Claassen 1934). Wu (1973) reports male *C. obtusa* to have a body length of 18 mm and Wu & Claassen (1934) list the female body length for *C. sinensis* to be 17 mm. If these sizes are accurate, both these species should have longer wing lengths than *C. meyi*. The female for the former species is unknown, but the redescription of the latter

species (Stark 1989) indicates its subgenital plate is shorter and more broadly rounded than that of *C. meyi*. The newspecies differs from *C. kumari* females in having a slightly less parabolic subgenital plate, more prominent lateral bars, and microtrichial bands in the vaginal base. In addition, the pale pronotal band and almost entirely pale head are distinctive for *C. meyi*. Unfortunately the eggs are not known for *C. obtusa*, *C. kumari*, or *C. sinensis*.

Cryptoperla simplex sp. nov.

(Figs. 39-43)

Material examined. Holotype ♂ and 3 ♂, 9 ♀ paratypes from Thailand, Phitsanulok Province, Phu Hin Rongkla National Park, Waterwheel Falls, 1280 m, 101° 00' N, 16° 59' E, 20-21 October 2002, I. Sivec (PMSL). Additional paratypes: Thailand: Khao Yai,



Figs. 39-42. *Cryptoperla simplex*. 39. Head and pronotum, 40. Male terminalia, dorsal, 41. Female terminalia, 42. Aedeagus, ventral.

Khao Kheo, 16-17 October 2000, I. Sivec, 1 ♂, 1 ♀ (PMSL). Chiang Mai Province, Chiang Dao, Chiang Dao W. Res. Center, 520 m, 98° 55' N, 19° 21' E, 9-14 October 2002, I. Sivec, 2 ♀ (PMSL). Additional material: Thailand: Khao Yai, Khao Kheo, 16 September 2000, I. Sivec, 1 larva (PMSL)

Adult habitus. Biocellate. General color pale brown with dusky markings on frons and darker rugosities on pronotal disc (Fig. 39). Legs pale brown. Wings transparent, veins pale brown.

Male. Forewing length 9-9.5 mm. Tergum 10 outline triangular. Basal cercal segment ca. 5.5 X long as basal width; spur absent but inner margin with sparse fringe of long setae (Fig. 40). Aedeagal apex with four lobes; venter of inner lobes bear a large median patch of brown setae (Fig. 42); base of aedeagus with a brownish tint, perhaps due to fine microtrichia. Vesicle typical of genus.

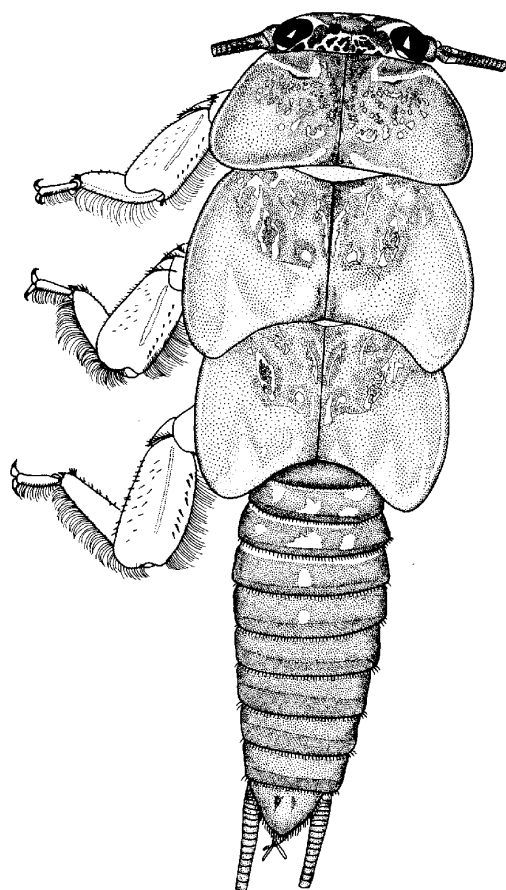


Fig. 43. *Cryptoperla simplex* larval habitus.

Female. Forewing length 10-10.5 mm. Subgenital plate covers most of sternum 9; posterior margin

truncate (Fig. 41). Lateral bars distinct on sternum 9; mesal field with few setae.

Egg. Unknown.

Larva. Pre-emergent body length 7 mm. Body brown with dorsal maculations on thorax and abdomen (Fig. 43). Thorax with supracoxal gill on mesothorax and metathorax under wingpads; gills absent from prothorax and all thoracic sterna; each paraprot with a single dorsal, slender gill filament; ventral apex of tergum 10 with a similar median gill filament. Metasternum truncate and completely fringed with erect clavate setae, lateral margins partially fringed around coxal bases and continuing onto sternal plate near furcal pits. Mesosternum with subapical and midlateral short bristle rows; prosternum with complete anterior and short subapical bristle rows. Abdominal sterna with complete posterior fringes of similar erect, clavate setae. Cerci with ca. 40 segments; ventral segmental whorls armed with 4-5 large, erect, blade-like setae on most segments.

Etymology. The species name refers to the unmodified apical area of the male basal cercal segment.

Diagnosis. Males of this species key to *C. kumari* in Stark (1989) but the abdominal apex is more rounded in that species and the female has a parabolic rather than truncate subgenital plate. In addition, the aedeagal armature of *C. kumari* is separated into two distinct ventral patches whereas in *C. simplex* the setation is clustered in a single large ventral patch. *C. kumari* is also somewhat larger with forewing length of 13-15 mm among male specimens.

Cryptoperla spec. Ch A
(Figs. 31-32, 36-38)

Material examined. China: Sichuan, Jiulong Valley, 200 km W Chengdu, 900-1200 m, 21-22 May 1991, I. Sivec, 1 ♀ (PMSL).

Adult habitus. General color brown to dark brown. Head mostly dark brown but with pale areas forward of M-line and on occiput (Fig. 31); pronotum dark brown with pale brown rugosities; antennae and legs brown. Wings brown, veins darker.

Male. unknown

Female. Forewing length 12.5 mm. Subgenital plate large, almost quadrate but with rounded posterolateral angles, and covering most of sternum

9; plate margined with a narrow, transparent, hairless band (Fig. 32). Sternum 9 produced over base of sternum 10; sternum 9 mostly transparent and hairless over most of mesal field.; lateral bars present; microtrichia band present in vaginal base.

Egg. Diameter ca. 0.207 mm, height ca. 0.144 mm, width ca. 0.213 mm. Shape somewhat nautiloid with a prominent spiral ridge forming a series of tiers which are cross-connected by vertical bars forming rows of more or less rectangular cells (Fig. 36). Chorionic surface within cells smooth. Micropyles clustered on apex of spire (Fig. 37); opposite pole concave, depression filled with hexagonal FCIs (Fig. 38).

Larva. Unknown.

Diagnosis. The subgenital plate shape for this species is similar to that of *C. sinensis* but this specimen is significantly smaller than that species as discussed above for *C. meyi*. The extraordinary egg shape should help in associating future material and perhaps in establishing the correct generic placement.

Provisional key to *Cryptoperla* males

(*C. meyi*, *C. sinensis* and *C. torva* unknown)

- 1 Basal cercal segment with apical spur or projecting lobe or lobes on inner margin (Fig. 2) 2
- 1' Basal cercal segment without projecting apical spur or lobes 17
- 2 Cercal spur curved dorsad (Fig. 2) 3
- 2' Cercal spur or lobes straight or directed mesad or ventrad 5
- 3 Cercal spur simple, upturned abruptly at an approximate right angle (Fig. 16) *hubleji*
- 3' Cercal spur multidentate (Fig. 2); curvature gradual 4
- 4 Cercal spur with 1-3 long teeth *karen*
- 4' Cercal spur with ca. 10 short teeth (Fig. 2) *curvata*
- 5 Cercal spur at least partially sclerotized, usually spine-like, acute but sometimes multidentate ... 6
- 5' Cercal spur or lobe unsclerotized, usually blunt, rounded or truncate and often bearing an apical tuft of setae 13
- 6 Cercal process a single, often acute spur 7
- 6' Cercal process multidentate 12

- 7 Cercal spur broad to midlength, abruptly narrowed to acute tip; spur parallels cerci and slightly exceeds subsequent five segments in length *stilifera*
- 7' Cercal spur tapered throughout length; spur divergent from cerci and not exceeding next three segments in length 8
- 8 Known from mainland Asia 9
- 8' Known from Asian islands 10
- 9 Cercal process bicolored, transparent apically; known from Thailand *akha*
- 9' Cercal process uniformly pigmented; known from Yunnan and Sichuan, China *aculeata*
- 10 Known from Ryukyu Islands *ishigakiensis*
- 10' Known from Taiwan 11
- 11 Cercal spur unpigmented, transparent, usually blunt and thumb shaped; ventrolateral aedeagal lobes more than twice as large as mesal lobes and moderately divergent from midline *uchidai*
- 11' Cercal spur usually pigmented and acute; ventrolateral aedeagal lobes slightly larger than mesal lobes and strongly divergent from mesal lobes *formosana*
- 12 Cercal spur spatulate with serrate apex ... *chiangi*
- 12' Cercal process with a major spur and 3-10 smaller dorsal spines *fraterna*
- 13 Process of basal cercal segment consists of 4-5 short, truncate lobes with apical hair tufts *dui*
- 13' Process of basal cercal segment a single, simple structure with or without apical hair tufts 14
- 14 Apex of process about as wide as base; known from Fujian Province, China *fujianica*
- 14' Apex of process narrowed apically; known from Japan, Assam or Thailand 15
- 15 Cercal process with 1-4 terminal setae; known from Assam or Thailand 16
- 15' Cercal process very hairy at apex; known from Shikoku, Japan *kawasawai*
- 16 Cercal process about 3X long as wide; apex with 2-3 long setae; cercal segment 2 with a short dorsal process; known from Thailand *bisaeta*
- 16' Cercal process slightly longer than wide; apex with 1-2 short setae; cercal segment 2 without dorsal process; known from Assam *kali*
- 17 Apex of basal cercal segment slightly swollen, producing a rounded process sometimes overlapping base of 2nd segment *naga*
- 17' Apex of basal cercal segment unmodified 18
- 18 Known from Japan or Taiwan 19

- 18' Known from mainland Asia 20
- 19 Aedeagal apex with a pair of lateral lobes and a wide truncate mesal lobe; known from Japan *japonica*
- 19' Aedeagal apex with a large rounded lobe and two subapical pairs of lateral lobes; known from Taiwan *klapaleki*
- 20 Body length ca.18 mm; tergum7 with a triangular mesal lobe overlapping most of tergum 8; known from China *obtusa*
- 20' Body length ca. 15 mm or less; tergum 7 without mesal lobe; known from India, Nepal, Assam or Thailand 21
- 21 Basal cercal segment less than 3.5X long as wide; cercal setal fringe sparse on inner margins *meo*
- 21' Basal cercal segment at least 4X long as wide; cercal setal fringe often well developed on inner margins 22
- 22 Basal cercal segment about 4.5X long as wide; aedeagal armature without dense, paired setal patches *pentagonalis*
- 22' Basal cercal segment about 5-6X long as wide (Fig. 40); aedeagus armed with one or more mesal setal patches near base of ventroapical lobes (Fig. 42) 23
- 23 Aedeagus with a pair of dense mesal setal patches near base of ventroapical lobes; known from Assam *kumari*
- 23' Aedeagus with a single, broad setal patch near base of ventroapical lobes (Fig. 42), or a pair of sparse widely separated patches (Fig. 28); known from Thailand 24
- 24 Ventral aedeagal setae grouped in a single, wide patch (Fig. 42); apical aedeagal section much wider than base; basal cercal segment about the same width throughout (Fig. 40) *simplex*
- 24' Ventral aedeagal setae grouped in a pair of widely separated, sparse patches (Fig. 28); apical aedeagal section not conspicuously wider than base; basal cercal segment slightly swollen near midlength (Fig. 27) *kosai*

Peltoperlopsis anomala sp. nov.
(Figs. 44-49)

Material examined. Holotype ♂ (pinned) from Indonesia, East Kalimantan, Kec. Pujangan, Kayan-Mentarang Nature Reserve, 500 m, 2° 52' N, 115° 49' E, October 1994, Malaise trap, D.C. Darling, Rosichon

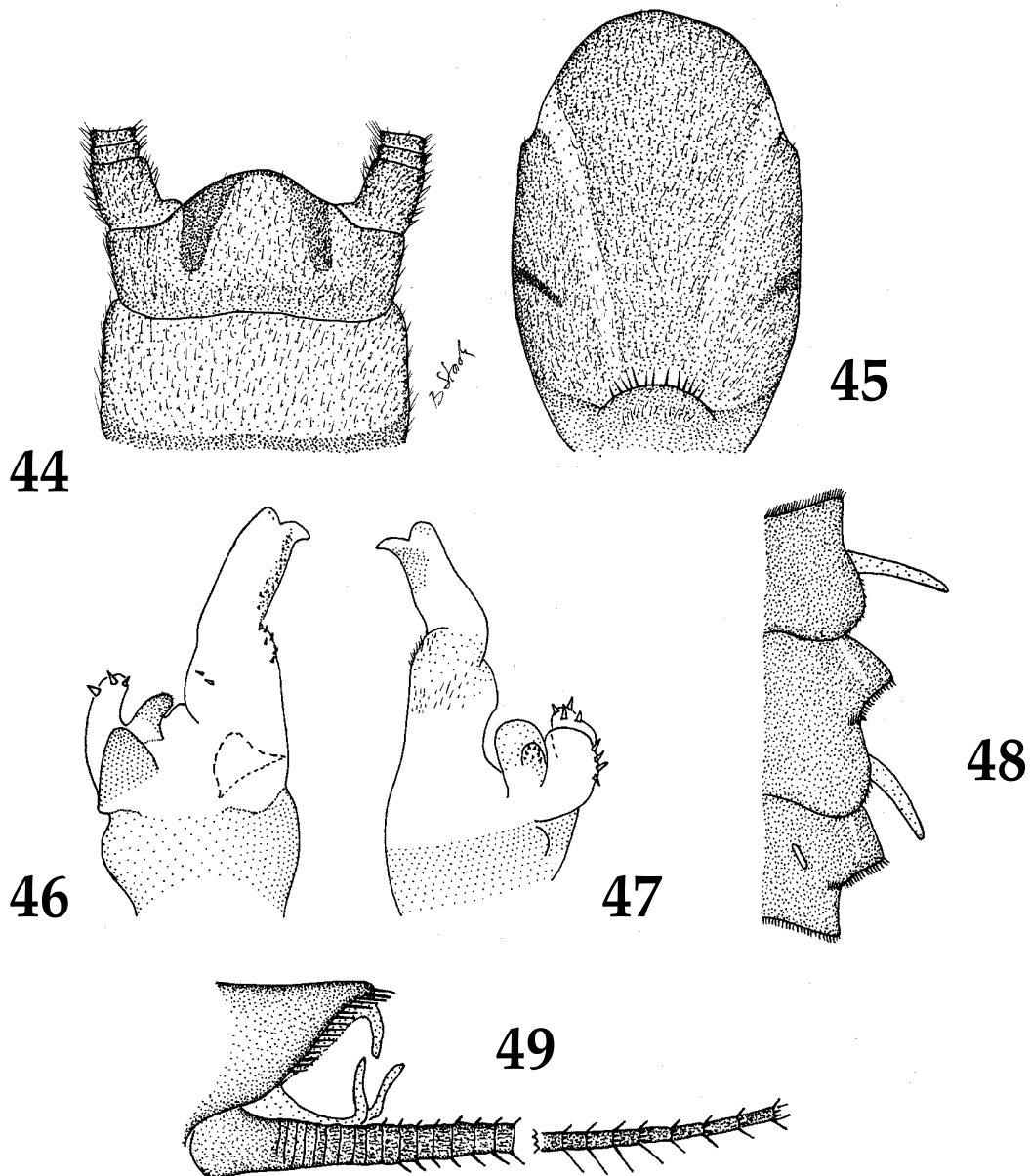
U., IIS 940606 (MZB). Additional material: Indonesia: East Kalimantan: Kayan-Mentarang Nature Reserve, Nggeng River, 2° 51' N, 115° 49' E, 378 m, 30 March 1994, B. Hubley, D.C. Darling, IIS 940510, 8 larvae (ROM). Bulungan, Kayan-Mentarang Nature Reserve, Lalut Birai Res. Sta., 2° 51' N, 115° 48' E, 355 m, 20 February-4 March 1993, D.C. Darling, IIS 930003, 2 larvae (MZB).

Adult habitus. Biocellate. General color brown. Head with dark brown over most of occiput; pale areas encircle anteromedian margins of ocelli but dark brown continues from interocellar area to M-line and forward as a small brown triangle; lappets and pronotum brown. Wings brown with slightly darker veins. Femora and tibiae brown but somewhat paler along ventral margins.

Male. Forewing length 9 mm. Tergum 10 with U-shaped mesal sclerite. Basal cercal segment ca. 1.25X long as basal width (Fig. 44). Segments clothed laterally with short fringe setae. Vesicle a poorly defined arc about 4X wide as long (Fig. 45). Aedeagus membranous, asymmetrical and armed with variably sized spines; basal third armed with dense microtrichia patch completely ringing structure; sinistral lobe bifurcate at tip with lateral lobe somewhat thumb shaped (Figs. 46-47); apical half of sinistral lobe armed with minute spines along ventrolateral margin and basal half with a small lateral patch of 5-6 large triangular spines and a dorsomesal patch of 2 large triangular spines; dextral lobe much shorter than sinistral lobe, consisting of three small, more or less rounded lobes; outer dextral lobe armed with a few (< 10) large spines and inner dextral lobes armed with finer and more numerous spines.

Female. Unknown.

Larva. Pre-emergent body length 7-8 mm. General color brown to red brown without conspicuous pattern. Long slender gills project from beneath prosternal and mesosternal plates (Fig. 48) and similar supracoxal gills occur on mesothorax and metathorax under wingpads; gills on paraprocts long, slender and sharply upturned (Fig. 49), median gill on ventroapical margin of tergum 10 delicate. Metasternum concave on posterior margin and completely fringed with small bristles; lateral margins with longer fringe bristles around coxal bases which continue onto plate as a short row of about five mesal bristles (Fig. 48). Mesosternum with



Figs. 44-49. *Peltoperlopsis anomala*. 44. Male terminalia, dorsal, 45. Male sternum 9, 46. Aedeagus, dorsal, 47. Aedeagus, ventral, 48. Larval thoracic sterna, 49. Larval abdominal apex and cerci.

only a few small posterolateral, bristles, lateral bristles around coxal bases and about 4 mesal bristles from continuation of lateral row onto plate. Prosternum with complete anterior row of erect bistles, mesolateral bristles absent. Cerci without enlarged blade setae, but segments 11-28 each with a single long seta in ventral whorls; long whorl setae generally less than half as long as next segment.

Etymology. The species name refers to the

asymmetry of the internal male genitalic structure.

Diagnosis. This species is similar to *P. concolor* (Banks 1931; Stark 1989) but is slightly darker, has shorter cercal fringe setae and the vesicle is arcuate rather than tab shaped. The aedeagus of *P. concolor* has a similar asymmetry (based on a specimen from Kinabalu National Park in the USNM collection) but the detailed lobe pattern and armature distribution are different. Specifically, the sinistral lobe of *P.*

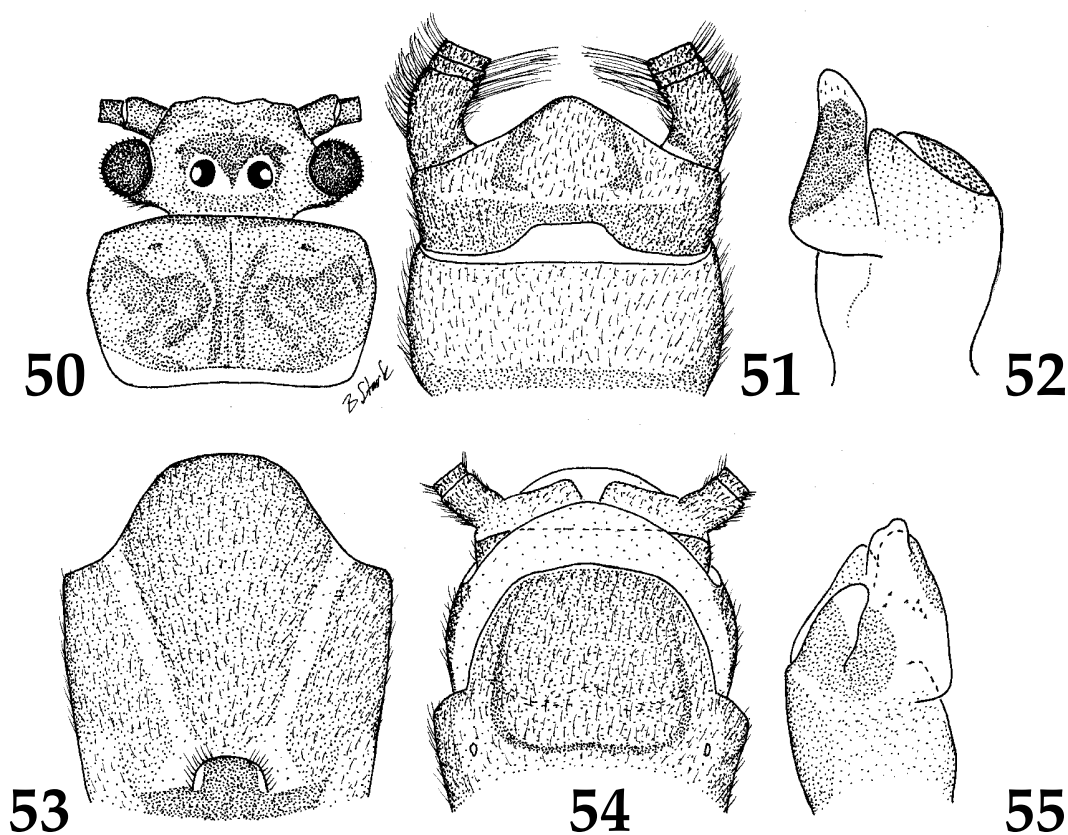
concolor is apically trifurcate and bears no large spines along the outer margin; however a small spherical lobe on the inner margin base has a few moderate sized spines. Other differences are apparent when the dextral lobes are compared. Unfortunately, eversion of the aedeagus for *Peltoperlopsis* males is difficult to achieve in fixed specimens, consequently collectors may need to routinely squeeze male specimens in the field to facilitate their study. Larvae can be distinguished from those of *P. concolor* on the basis of

the absence of flattened blade setae on the mesal cercal segments and perhaps by the presence of a delicate median ventroapical gill on abdominal tergum 10.

Peltoperlopsis cebuano sp. nov.

(Figs. 50-57)

Material examined. Holotype ♂, and 3 ♀ paratypes from the Philippines, Mindanao, Mt. Agtunganon, 1050 m, 28 May-7 June 1996, W. Mey (MNB).



Figs. 50-55. *Peltoperlopsis cebuano*. 50. Head and pronotum, 51. Male terminalia, dorsal, 52. Aedeagus, ventral, 53. Male sternum 9, 54. Female terminalia, 55. Aedeagus, dorsal.

Adult habitus. Biocellate. General color brown. Head with a distinctive mask over ocelli, but with pale halo surrounding ocellar pair and paler areas around eyes and at anteromedian margin (Fig. 50). Pronotum pale but with large irregular darker rugosities. Wing membrane brown, veins darker but costal area pale. Femora pale brown at base, darker toward apex;

tibiae dark brown.

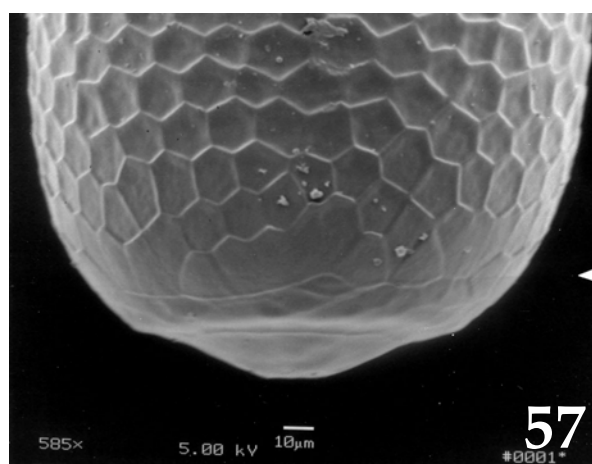
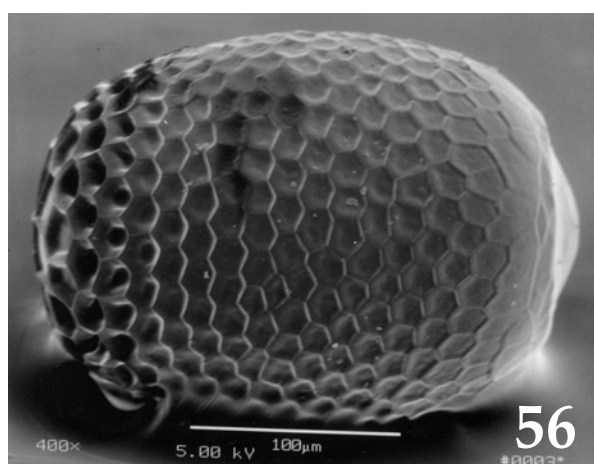
Male. Forewing length 10 mm. Tergum 10 with posterior U-shaped brown mark and dark transverse anterior band constricted in median field (Fig. 51). Basal cercal segment curved and about 2X long as wide; inner setal fringe well developed at least on middle segments. Vesicle about as long as wide and

with sclerotized base extending beyond lateral margins of structure (Fig. 53). Aedeagus asymmetrical and armed with variably sized spination; sinistral lobe apically rounded, membranous at tip and base, lightly sclerotized in mesal section, and armed ventrally with sparse patch of small spines and microtrichia (Fig. 52); dextral lobe with a major dorsal and ventral lobe; ventral lobe with sparse microtrichia. In dorsobasal aspect, much of surface covered with fine irregular ridges (Fig. 55). **Female.** Forewing length 12-13 mm. Subgenital plate large and broadly rounded; U-shaped sclerite and

transverse band of microtrichia visible from internal vaginal structure (Fig. 54). Sternum 9 reaches beyond sternum 10 and covers bases of paraprocts; mesal field of sternum 9 bare and weakly sclerotized.

Egg. Outline barrel shaped with nipple-like collar surrounded by depressed ring. Chorion covered with FCIs (Fig. 56); those near collar obscure (Fig. 57), but becoming gradually more prominent near anterior pole. FCI floors depressed, rims thin near collar but thick near anterior pole. Micropyles not observed.

Larva. Unknown.



Figs. 56-57. *Peltoperlopsis cebuano* micrographs of eggs. 56. Egg, lateral, 57. Egg collar, lateral.

Etymology. The species name, used as a noun in apposition, honors the people of the Cebuano ethnolanguage group.

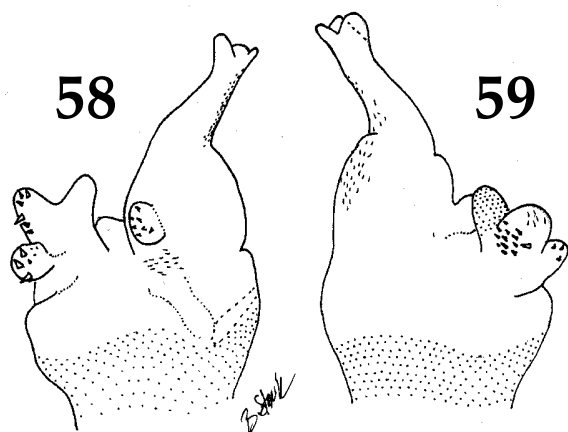
Diagnosis. This species is closely related to *P. mindanensis* but the two species clearly differ in egg morphology with the surface of *P. mindanensis* eggs covered with similar FCIs over most of the chorion (Stark 1989) and those of *P. cebuano* becoming progressively more distinct opposite the collar. They also appear to differ in aedeagal armature with *P. mindanensis* having a fairly large apical patch of spines on the dextral lobes and these being smaller and less abundant in *P. cebuano*. Banks (1924) also emphasizes the very dark blackish wings and dark brown head and pronotum of *P. mindanensis* whereas in the present sample, *P. cebuano* is a slightly larger and paler appearing species.

Peltoperlopsis concolor (Banks)
(Figs. 58-61)

Peltoperla concolor Banks, 1931:411. Lectotype ♂, Mt. Kinabalu, Sabah, East Malaysia (Museum of Comparative Zoology), designation Hitchcock, 1962:83
Peltoperlopsis concolor: Illies, 1966:24
Peltoperlopsis concolor: Stark, 1989:521

Material examined. Malaysia: Sabah: Kinabalu Park Headquarters, 1560 m, 6° 00' 22" N, 116° 32' 34" E, 9-18 April 1999, I. Sivec, 1 ♂, 1 ♀ (PMSL). Kinabalu National Park, Livagu River, 1410 m, 13 April 1999, I. Sivec, 1 ♀ (PMSL). Kinabalu National Park, Poring hot spring, 600 m, Sungai Kipungit, 23 April 1999, I. Sivec, 8 larvae (PMSL). Kundssang, Ranau, Negeri, 1800 m, 9 April 1994, S.C. Kang, 1 ♂, 1 ♀, 10 larvae (PMSL).

Remarks. Hitchcock (1962) redescribed the external genitalia of the male lectotype, and Stark (1989) provided figures of the female genitalia, eggs and armature of the ventrolateral aedeagal lobe. In order to enhance recognition of this species we are providing the following description of the male aedeagus and larva.

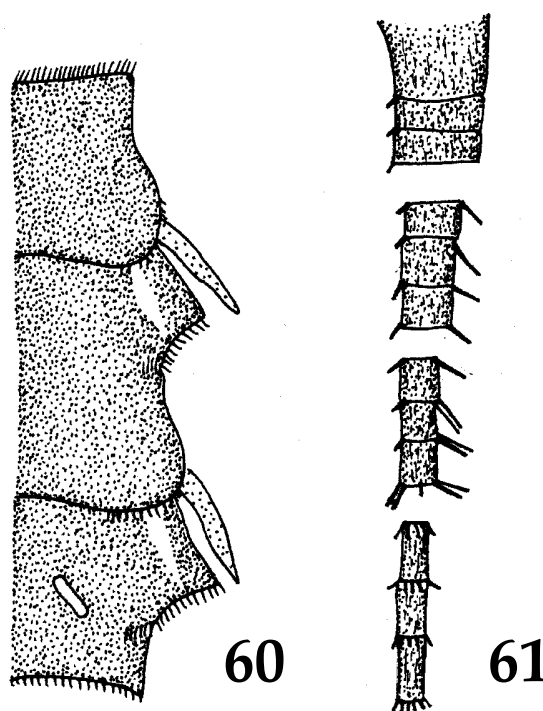


Figs. 58-59. *Peltoperlopsis concolor* structures. 58. Aedeagus, dorsal, 59. Aedeagus, ventral.

Male aedeagus. Asymmetrically lobed; sinistral lobe apically trifurcate and sparsely armed along ventroapical margin with short, setal-like spines; sinistral lobe trifurcate in ventral aspect; mesal part of lobe armed with large triangular and cultriform spines; microtrichia cover aedeagal base and apical part of sinistral lobe in ventral aspect (Figs. 58-59).

Larva. Pre-emergent body length 8.5-10 mm. General color pale brown to red brown without conspicuous pattern. Long, slender gills project from beneath prosternal and mesosternal plates and similar supracoxal gills occur on mesothorax and metathorax under wingpads; gills on paraprocts slender, delicate and upturned, median gill on ventroapical margin of tergum 10 apparently absent. Metasternum concave on posterior margin and completely fringed with small clavate setae (Fig. 60); lateral margins with slightly longer setae around base of coxae continuing onto sternal surface as a short row adjacent to lateral notch; mesosternum concave on posterior margin and fringed for a short distance with small clavate setae, but incomplete mesally; lateral margin fringe similar to metasternal fringe; prosternum with complete anterior fringe of close-set clavate setae but

only a few bristles occur on posterior margin near sternal angles. Abdominal terga without intercalary bristles; posterior fringe rows comprised of medium length, widely spaced acute bristles with ca. 4-6 short clavate setae interspersed between larger bristles. Cerci long and slender; venter of segments from about segment 10 through about segment 23 bears one or two large, flattened, acute blade setae; basal and apical segments without blade setae; longest ventral setae about as long as segment; dorsum of segments with only short bristles (Fig. 61). Galea with prominent apical brush, lacinia tridentate.



Figs. 60-61. *Peltoperlopsis concolor* structures. 60. Larval thoracic sterna, 61. Larval cerci, lateral.

Peltoperlopsis malickyi Stark & Sivec

Peltoperlopsis malickyi Stark & Sivec, 1999. Holotype ♂, Tam Dao, Vietnam (PMSL)

Material examined. Vietnam: Vinh Phu, Tam Dao, stream 5 km along forest trail at west end of town, UV light, 7 May 1996, B. Hubley, M. Hanson, ROM 961013, 1 ♀ (ROM).

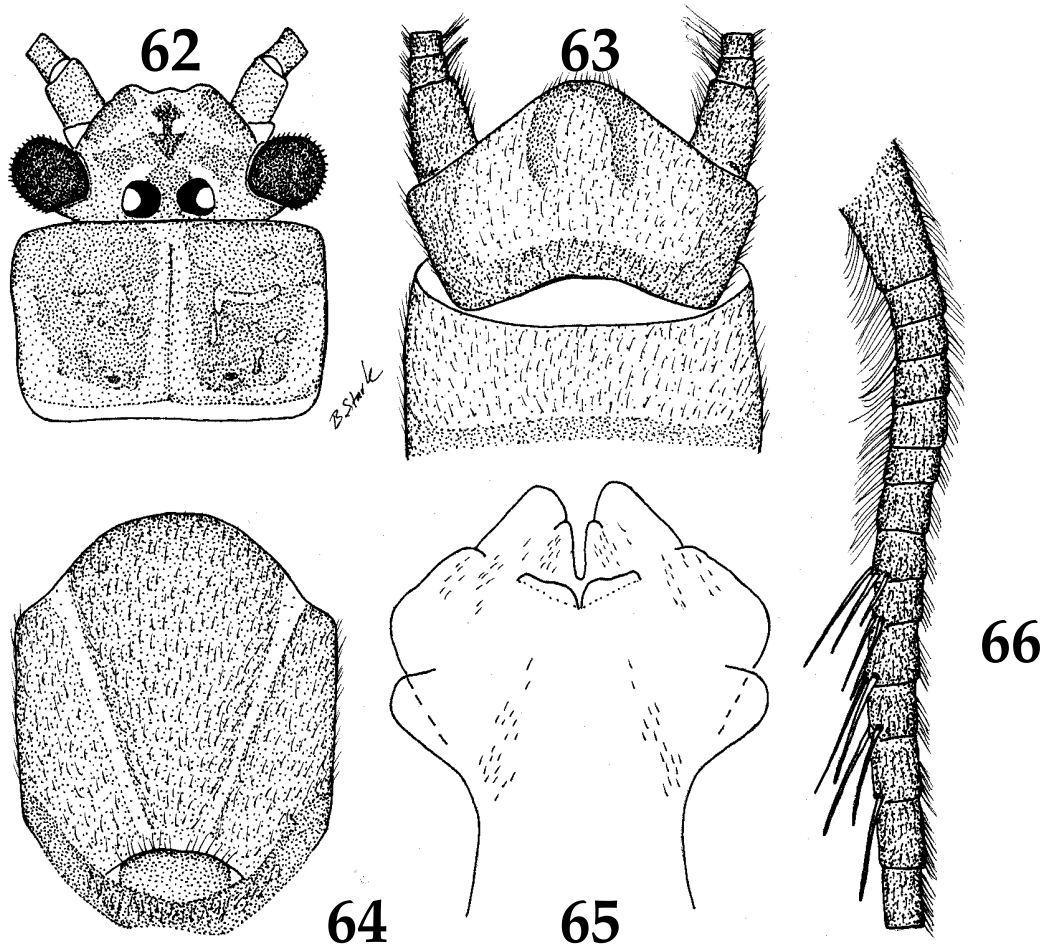
Remarks. This female represents the second collection of *P. malickyi* but all known specimens are from the Tam Dao area.

Peltoperlopsis spinosa sp. nov.
(Figs. 62-66)

Material examined. Holotype ♂ from Vietnam, Thua Thien-Hue, Bach Ma National Park near jct. Rhodendron and Five Lakes trails, 1200 m, 16° 11' 10" N, 107° 50' 55" E, 16 June 2000, B. Hubley, D.C.

Darling, ROM 2000531 (ROM).

Adult habitus. Biocellate. Head yellow brown with darker spots anterolateral to ocelli and on central frons distal to M-line. Pronotum yellow brown with scattered pale rugosities (Fig. 62). Wings transparent, veins yellow brown. Legs pale yellow brown.



Figs. 62-66. *Peltoperlopsis spinosa* structures. 62. Head and pronotum, 63. Male terminalia, dorsal, 64. Male sternum 9, 65. Aedeagus, ventral, 66. Male cerci, dorsal.

Male. Forewing length 10.5 mm. Tergum 10 bears a dark, posteromesal U-shaped mark (Fig. 63). Basal cercal segment ca. 1.4X long as basal width; segments 2-8 with inner marginal fringe of long thin setae; segments 9-13 bear 1-3 prominent, long, thick setae on dorsal and inner marginal surfaces (Fig. 66). Vesicle ca. 2X wide as long (Fig. 64). Aedeagus membranous, symmetrical and bearing sparse, thin

setal like spines in scattered ventral patches (Fig. 65).

Female. Unknown.

Larva. Unknown.

Etymology. The species name refers to the spiny appearance of the male cerci.

Diagnosis. This species is generally similar to *P. malickyi* but is distinguished on the basis of the enlarged setae present on cercal segments 9-13.

Peltoperlopsis swanni sp. nov.
(Figs. 67-70)

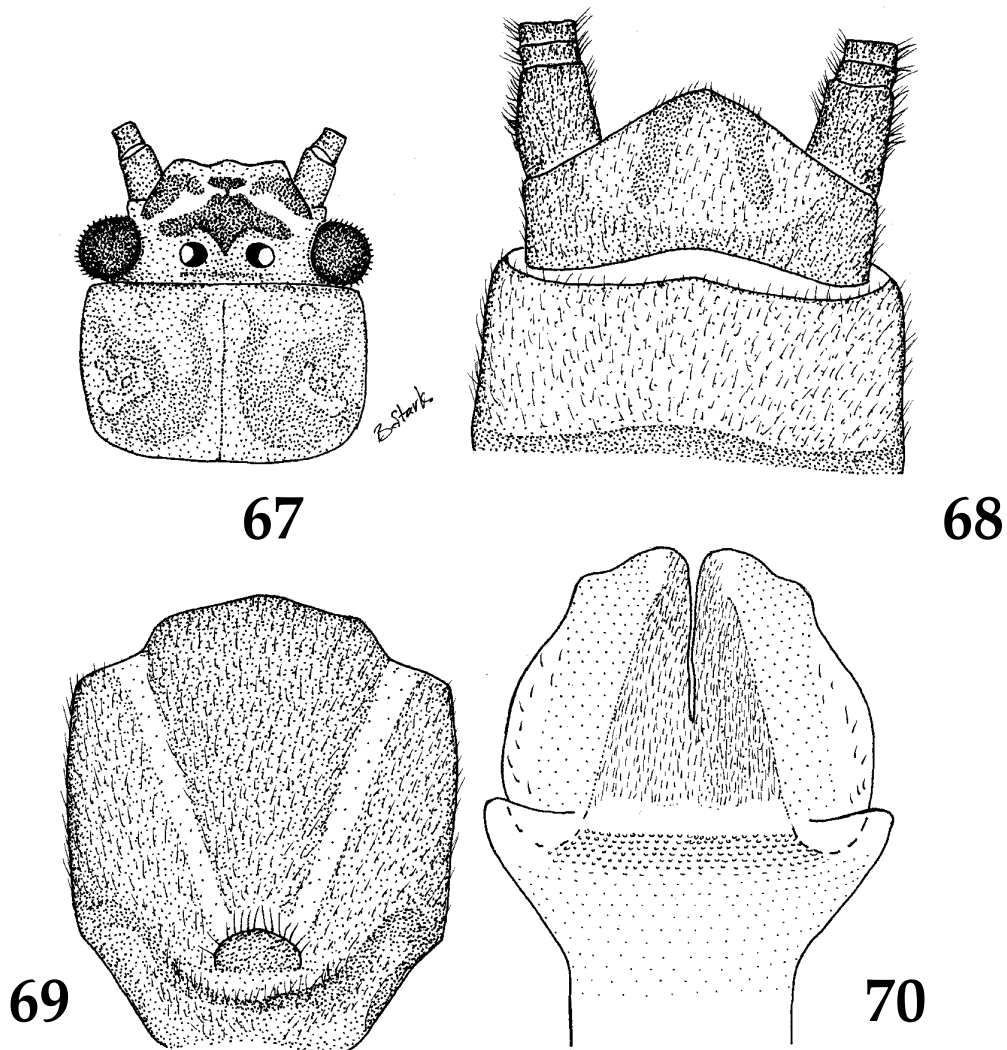
Material examined. Holotype ♂ from Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, UV light, 8 May 1995, D. Currie, B. Hubley, J. Swann, ROM 956022 (ROM).

Adult habitus. Biocellate. Head brown to yellow brown with pale M-line interrupted by narrow median brown band; area around ocelli pale brown (Fig. 67). Pronotum brown with scattered pale rugosities. Wing membrane pale brown, veins brown. Femora yellow brown, tibiae obscurely banded with broad pale mesal band between small, slightly darker apical bands.

Male. Forewing length 11 mm. Tergum 10 with U-shaped brown mark (Fig. 68). Basal cercal segment ca. 1.3X long as basal width; segments clothed laterally with short fringe setae. Vesicle about 2X wide as long (Fig. 69). Apical section of aedeagus deeply bilobed; lobes armed dorsally with tiny spike shaped microtrichia, a marginal patch of long thick setae, and an inner patch of fine brown hair-like spines (Fig. 70); the latter type of spines also occur ventrally in a large marginal patch. Ventral lobes with additional small lobe on each side armed with microtrichia and a patch of triangular spines.

Female. Unknown.

Larva. Unknown.



Figs. 67-70. *Peltoperlopsis swanni* structures. 67. Head and pronotum, 68. Male terminalia, dorsal, 69. Male sternum 9, 70. Aedeagus, dorsal.

Etymology. The patronym honors J. Swann, one of the collectors of the holotype.

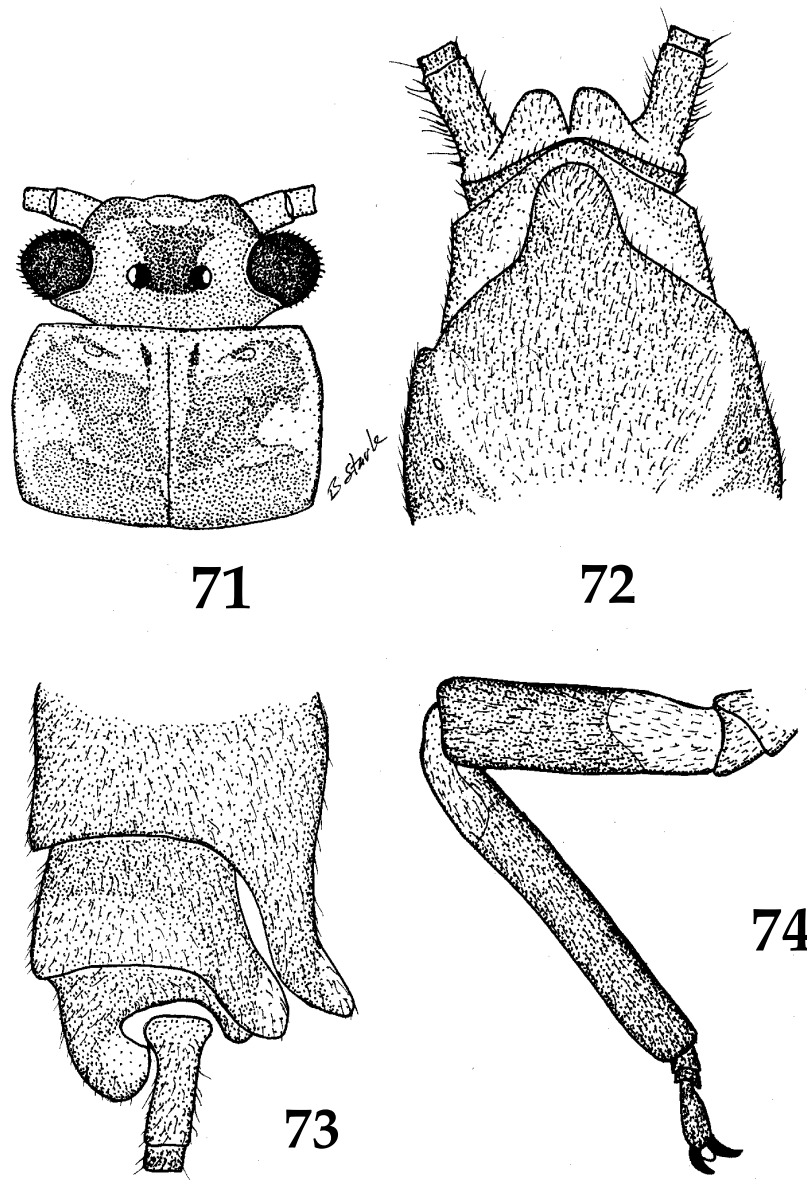
Diagnosis. This species shares the U-shaped tergum 10 feature with *P. malickyi* but differs from that species in having a smaller and better defined vesicle, shorter cercal fringe setae, and in details of aedeagal armature. Conspicuous among the aedeagal features is the absence of a pair of thin dorsal sclerites as shown by Stark & Sivec (1999) for *P. malickyi*. The species is also generally similar to *P. spinosa* but that

species has clusters of long bristles on several median cercal segments and long fringe setae on basal cercal segments.

Peltoperlopsis spec. Ph A

(Figs. 71-74)

Material examined. Philippines: Palawan: Port Barton waterfall, 13 March 1995, A. Zwick, 1 ♀ (Zwick/Illies/LFS collection).



Figs. 71-74. *Peltoperlopsis* spec. Ph A. 71. Head and pronotum, 72. Female terminalia, ventral, 73. Female terminalia, lateral, 74. Hind leg.

Adult habitus. Biocellate. General color brown. Head dark brown except for pale area around compound eyes from posterolateral occipital margin forward to near antennal bases. Pronotum mostly dark but with paler area near anterolateral margin, along median suture and midlaterally (Fig. 71). Wings and veins dark brown except bases of costa, subcosta and radius pale from wing base to first costal cross vein. Legs banded; femora pale basally, dark over apical half; tibiae dark brown but with pale base (Fig. 74).

Male. Unknown.

Female. Forewing length 8.5 mm. Subgenital plate covers most of sternum 9; apex of plate strongly constricted to a narrow, ventrally directed, tongue shaped structure (Figs. 72-73). Sternum 9 covers most of sternum 10 and is strongly keeled along meson, under subgenital plate.

Egg. Unknown.

Larva. Not definitely associated.

Diagnosis. The apically narrowed subgenital plate is similar to that of *P. malickyi*, but in that species the plate is not curved ventrad (Stark & Sivec 1999) and the two species may not be closely related. Four larvae taken with this female and three others taken at two other nearby sites (Salakat Falls, road to Napsan, upper waterfall; Pasadenia, waterfall Nagkalit-kalit) could not definitely be associated with this female even though one pharate female larva was dissected. The larvae have *Cryptoperla* type gills and the larval thoracic sterna have a short intercalary setal row on the pro and metasterna and a pair of intercalary rows on the mesosternum; the anterior prosternal row and posterior metasternal rows are complete. If larvae of this type can be associated with this female, the generic placement is very questionable.

Provisional key to *Peltoperlopsis* males

- 1 Mainland species; aedeagus symmetrical (Fig. 65) 2
- 1' Island species; aedeagus asymmetrical (Fig. 58) 5
- 2 General color dark brown 3
- 2' General color yellow or pale brown 4
- 3 Tergum 10 with U-shaped sclerite; vesicle broadly arcuate, shorter than wide; aedeagus with dorsolateral pair of narrow sclerites; known from Vietnam *malickyi*

- 3' Tergum 10 apparently without U-shaped sclerite; vesicle longer than wide; known from Yunnan, China *nigrifulva*
- 4 Cercal segments with enlarged dorsal bristles on mid segments (Fig. 66); vesicle broadly arcuate, shorter than wide (Fig. 64); ventroapical aedeagal lobes sparsely armed laterally with fine setal-like spines, apex bilobed (Fig. 65) *spinosa*
- 4' Cercal segments without conspicuously enlarged dorsal bristles; vesicle about as wide as long (Fig. 69); ventroapical aedeagal lobes armed laterally with dense patch of fine setal-like spines, apex indistinctly lobed (Fig. 70) *swanni*
- 5 Known from the Philippines 6
- 5' Known from Borneo 7
- 6 Sinistral aedeagal lobe weakly sclerotized along ventrolateral margin (Fig. 52); aedeagal lobes armed with small spines and microtrichia (Fig. 55) *cebuano*
- 6' Sinistral aedeagal lobe membranous; aedeagal lobes armed with apical patch of cultriform spines *mindanensis*
- 7 Sinistral aedeagal lobe bifurcate apically and armed with a few large spines at dorsolateral margin (Fig. 46) *anomala*
- 7' Sinistral aedeagal lobe trifurcate apically and armed dorsolaterally with small spicules; known from Mt. Kinabalu *concolor*

ACKNOWLEDGMENTS

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