



FIVE NEW SPECIES OF *CHINOPERLA* ZWICK (PLECOPTERA: PERLIDAE) FROM VIETNAM AND THAILAND

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ABSTRACT

Five new species of *Chinoperla* Zwick are proposed from Vietnamese and Thai specimens. Descriptions are presented for *Chinoperla gorohovi* sp. n., *C. porntip* sp. n., *C. sila* n. sp., *C. spinata* sp. n. and *C. yi* sp. n., and holotype males are designated for each. Two unassociated females are also described under informal designations and the female is described for *C. unidentata* Sivec & Zwick. A provisional key for males is provided.

Keywords: *Chinoperla*, Plecoptera, Vietnam, Thailand, New species

INTRODUCTION

Genus *Chinoperla* (Zwick 1980) currently includes eight species of small, brownish stoneflies found in Southeast Asia from Hainan and Fujian Provinces in China to Borneo and Sumatra (DeWalt et al. 2009). Although the group is poorly represented in collections, and the species are known from single, or

very few specimens, most species are well illustrated and have been redescribed or described rather recently (Cao & Bae 2007; Sivec & Zwick 1989; Sivec et al. 1988; Zwick 1982; Zwick & Sivec 1980). The following list gives the distribution and numbers of known specimens for the currently known species of *Chinoperla*:

<i>C. borneensis</i> Sivec & Zwick, 1989	Borneo	1 ♀
<i>C. fascipennis</i> (Banks, 1931)	Thailand, Malaysia	1 ♂ 2 ♀
<i>C. nigriceps</i> (Banks, 1914)	India	6 ♂ 2 ♀
<i>C. nigrifrons</i> (Banks, 1939)	Hainan	3 ♂ 2 ♀
<i>C. nigroflavata</i> (Wu, 1948)	Fujian	1 ♂ (lost ?)
<i>C. reducta</i> (Geijskes, 1952)	Sumatra	1 ♂
<i>C. rhododendrona</i> Cao & Bae, 2007	Vietnam	3 ♂, 3 ♀
<i>C. unidentata</i> Sivec & Zwick, 1989	Thailand	1 ♂

We have acquired collections from the Royal Ontario Museum, H. Malicky (Lunz) and A.V. Gorohov (St. Petersburg) from Vietnam and from the Chiang Mai University Team in Thailand which

include specimens of five undescribed *Chinoperla* species. Because specimens of this genus are relatively rare and are often found at remote sites, we are providing descriptions for these few additional

representatives. We also take this opportunity to propose a key to the known males of the genus and provide descriptions for the female of *C. unidentata* Sivec & Zwick, and for two unassociated females under informal designations. Specimens are deposited in the Royal Ontario Museum, Toronto (ROM) and the Slovenian Museum of Natural History, Ljubljana (PMSL) as indicated in the text.

RESULTS AND DISCUSSION

Chinoperla gorohovi sp. n.

(Figs. 1-4)

Material examined. Holotype ♂ and 3♂ paratypes from Tam Dao, Vietnam, 600-900 m, 17-31 May 1995, A.V. Gorohov (PMSL).

Adult habitus. Biocellate. Ocelli relatively large, about two diameters apart and slightly closer to each other than to the compound eye margin. Head uniformly dark brown, antennae and palpi brown. Pronotum brown, wider than long and with dark rugosities. Wings and veins dark brown.

Femora pale in proximal half, distal half of femora, tibiae and tarsi uniformly dark brown. Cerci brown.

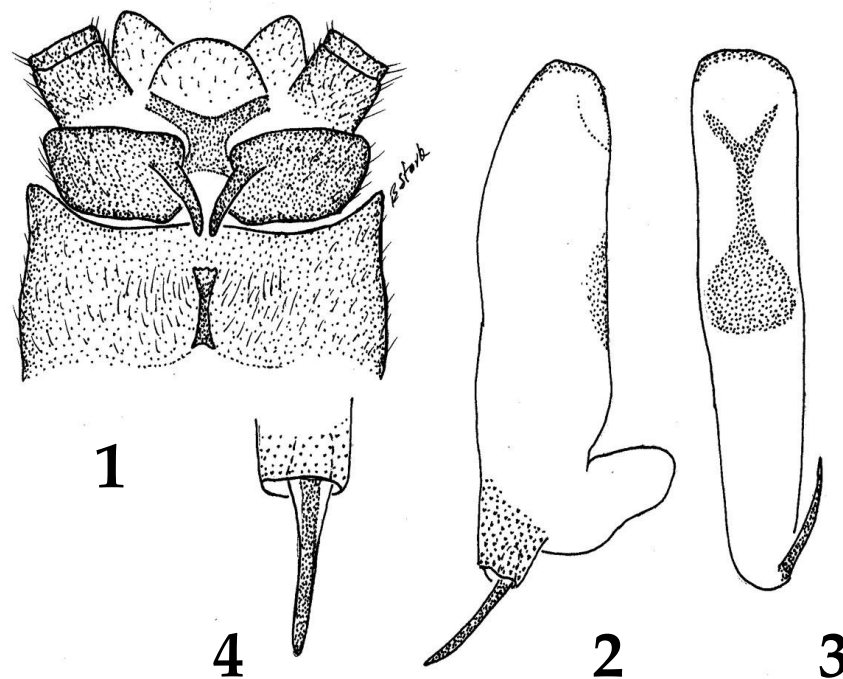
Male. Forewing length 9.5 mm. Dark median process of tergum 9 very slender, about 3 times long as wide and slightly enlarged on posterior margin (Fig. 1). Finger shaped hemitergal processes about 2.5 times long as basal width. Aedeagal tube poorly sclerotized; sac terminating in an upturned dorsal membranous lobe and a spinose lobe bearing a long slender spine (Figs. 2-4).

Female. Unknown.

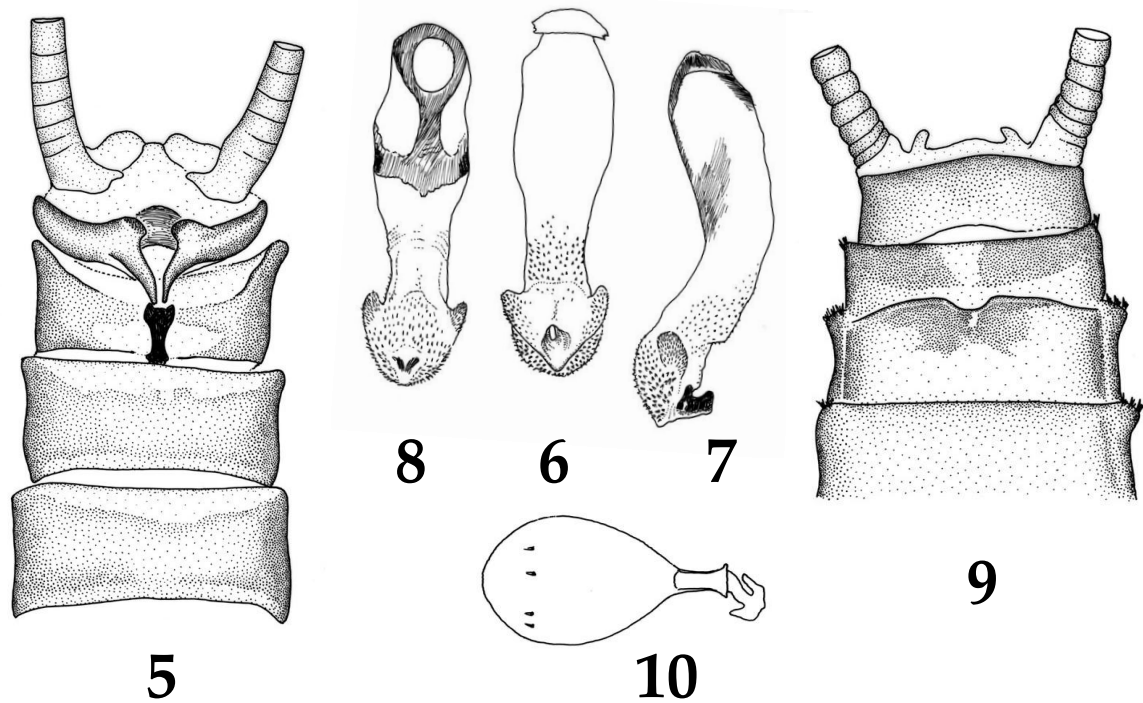
Larva. Unknown.

Etymology. The patronym honors Dr. A.V. Gorohov of St. Petersburg, collector of the type material.

Diagnosis. The aedeagus of this species is similar to that of *C. unidentata* Sivec & Zwick and to *C. sila* (described below) in having a single long slender spine. In this species the dorsal aedeagal lobe is significantly larger than in *C. unidentata* (Fig. 2) and the median process of tergum 9 is much longer in this species (Fig. 1) than for either of its related congeners (Sivec & Zwick 1989).



Figs. 1-4. *Chinoperla gorohovi*. 1. Male terminalia. 2. Aedeagus lateral. 3. Aedeagus dorsal. 4. Aedeagal spine.



Figs. 5-10. *Chinoperla porntip*. 5. Male terminalia. 6. Aedeagus ventral. 7. Aedeagus lateral. 8. Aedeagus dorsal. 9. Female terminalia. 10. Egg.

***Chinoperla porntip* sp. n.**

(Figs. 5-10)

Material examined. Holotype ♂ and paratype ♀ from Thailand, Chiang Mai Province, Doi Inthanon National Park, Namtok Siriphum waterfall, 1460 m, 98° 31' N, 18° 32' E, 7-8 June 2002, Chiang Mai University Team (PMSL). Additional paratypes: Thailand: Type locality, 19 May 2001, 28♂, 10♀ (PMSL). Chiang Mai Province, Doi Inthanon National Park, Namtok Siriphum, lower waterfall, 1380 m, 98° 31' N, 18° 32' E, 7-8 June 2002, 1♂, 2♀ (PMSL). Chiang Mai Province, Doi Inthanon National Park, Huai Sai Lueng, 1060 m, 98° 27' N, 18° 31' E, 9 May-8 June 2002, 8♂, 8♀ (PMSL). Same site, 4 April-3 May 2002, 4♀ (PMSL). Same site, 8 June-7 July 2002, 2♀ (PMSL).

Adult habitus. Biocellate. Head dark brown, nearly black; palpi brown, antennae pale at base and darker distally. Pronotum dark brown except at anterolateral angles; rugosities obscure. Wings and veins dark brown. Legs and cerci uniformly brown.

Male. Forewing length 9 mm. Dark median process of tergum 9 slightly expanded posteriorly and concave along lateral margins (Fig. 5). Finger shaped

hemitergal processes about 2.5 times long as basal width. Aedeagal tube sclerite forming an expanded bracelet-like distal ring; sac expanded at apex into a sagittate process covered with spines; apex of sac with a short, thick recurved hook (Figs. 6-8).

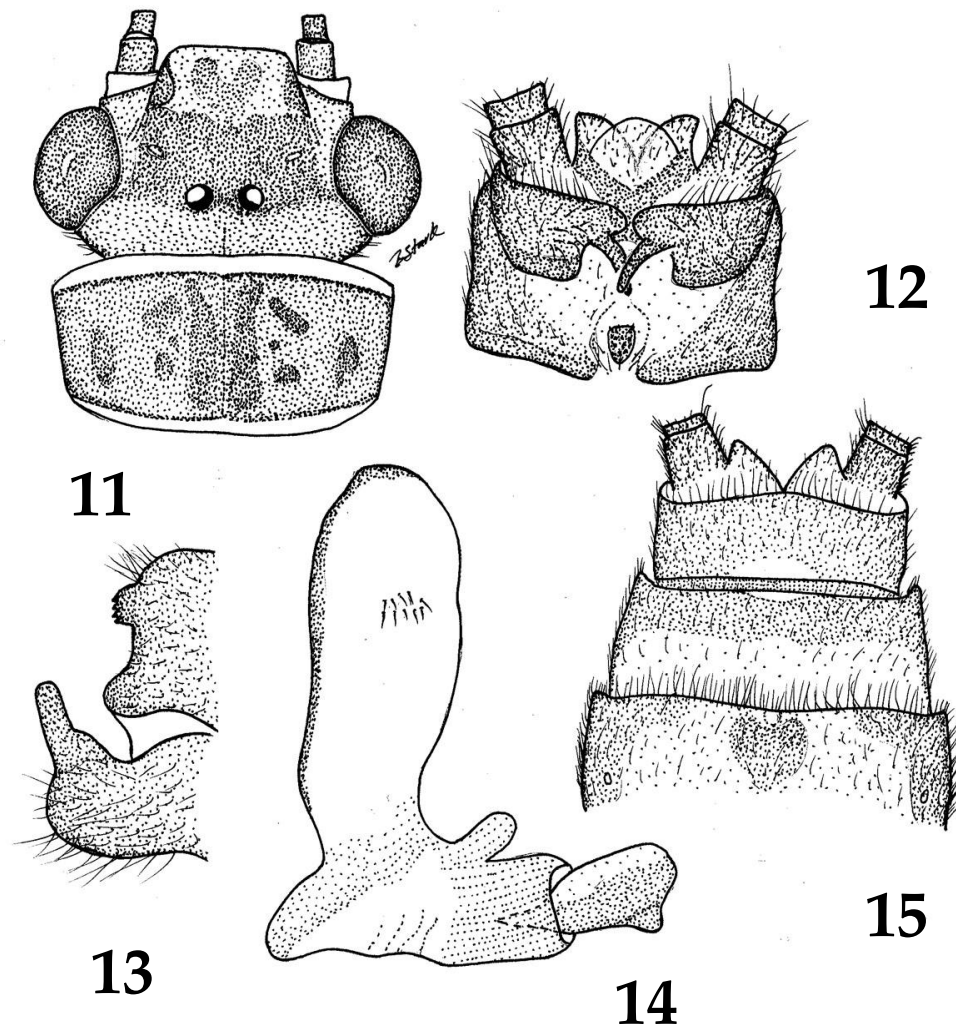
Female. Forewing length 12 mm. Subgenital plate slightly produced and bearing a shallow mesal notch (Fig. 9).

Egg. Tear drop shaped with long slender collar and stalked anchor (Fig. 10).

Larva. Unknown.

Etymology. The species name, used as a noun in apposition, honors Professor Dr. Porntip Chantaramongkol for her assistance and leadership in the study of Thai aquatic insects.

Diagnosis. The aedeagus of this species is generally similar to those of *C. spinata* and *C. yi* (both described below) in having a single, thick, curved hook on the aedeagal apex (Fig. 6), and a somewhat Y-shaped median sclerite on tergum 9 (Fig. 5). It differs from both species in having the aedeagal apex sagittate (Figs. 7-8) and in having the aedeagal tube sclerite encircle much of the tube apex as a slender band (Fig. 8).



Figs. 11-15. *Chinoperla rhododendrona*. 11. Head and pronotum. 12. Male terminalia, dorsal. 13. Male terminalia, lateral. 14. Aedeagus lateral. 15. Female terminalia.

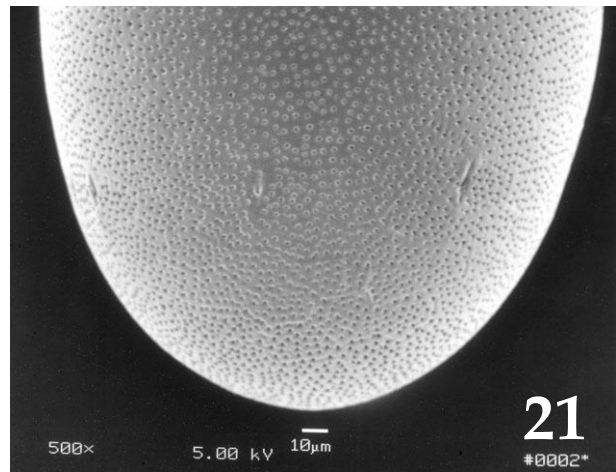
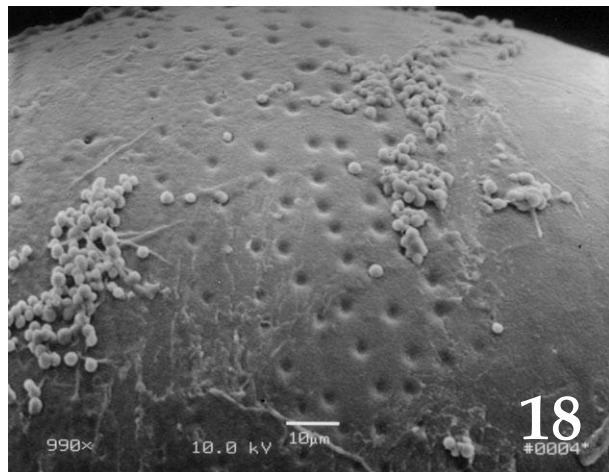
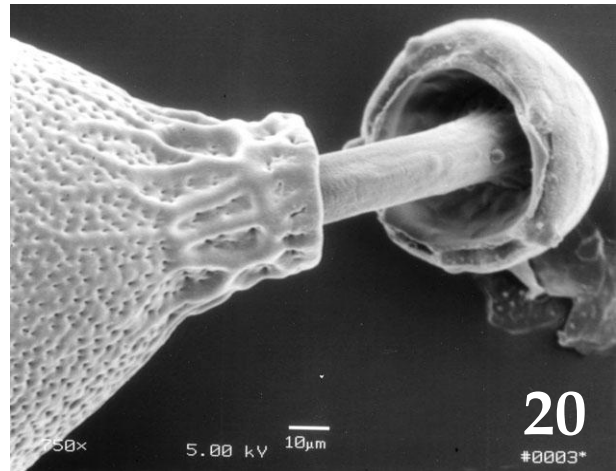
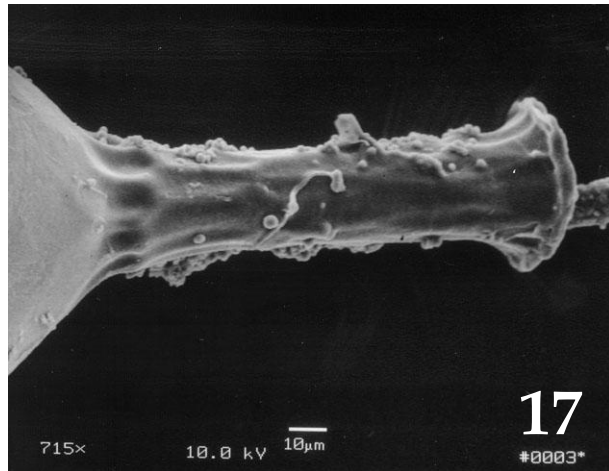
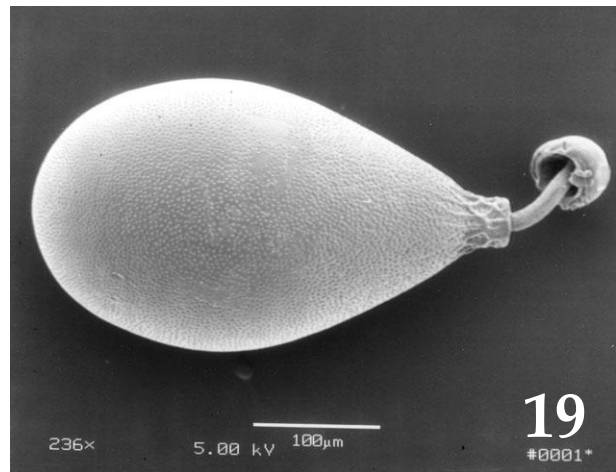
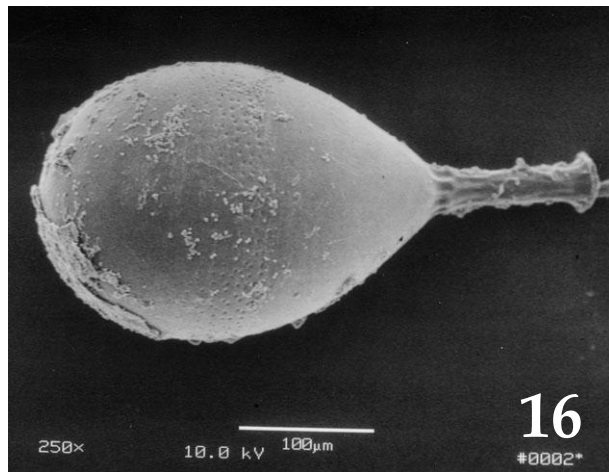
***Chinoperla rhododendrona* Cao & Bae**
(Figs. 11-18)

Chinoperla rhododendrona Cao & Bae, 2007:125. Holotype ♂ (Aquatic Insect Collection, Seoul Women's University), Do Quyen stream, Bach Ma National Park, Thua Thien-Hue Province, Vietnam

Material examined. Vietnam: Thua Thien-Hue, Vietnam, Bach Ma National Park, small stream ca. 200 m along Five Lakes Trail, 1200 m, 16° 11' 37.4" N, 107° 51' 19.5" E, 4-16 June 2000, ROM 2000505, B. Hubley, 1 ♂ (ROM). Same site, 7-16 June 2000, ROM

2000515, B. Hubley, 1 pinned ♀ (ROM).

Remarks. The aedeagus of this species is shaped somewhat like that of *C. sila* and it is also similar in having the dorsal surface of the median process of tergum 9 covered with tooth-like projections (present in our specimen but not mentioned by Cao & Bae, 2007). The two species differ markedly in the shape of the apical process on the dorsal aedeagal lobe, and this species appears to lack the pale wing margin found in *C. sila*. The everted sac of the aedeagus is short, has a basal membranous lobe and is armed over much of its surface with small triangular spines, not shown by Cao & Bae (2007). The female, collected



Figs. 16-21. *Chinoperla* eggs. *C. rhododendrona* (16-18) 16. Egg. 17. Egg collar. 18. Micropyle and equatorial chorionic detail. *Chinoperla sila* (19-21). 19. Egg. 20. Egg collar and anchor. 21. Micropyles and polar chorionic detail.

at the same site as our male is slightly darker but shares the same weakly banded hind leg pattern, and unlike the female of *C. rhododendrona* described by Cao & Bae (2007), it lacks a mesal notch on the subgenital plate. The egg, however, is similar to that described by Cao & Bae (2007). We include Figs. (11-18) to assist in recognition of this species.

***Chinoperla sila* sp. n.**
(Figs. 19-25)

Material examined. Holotype ♂, 15♂ and 6♀ paratypes from Tam Dao, Vietnam, 800-1100 m, 19 May-13 June 1995, H. Malicky (PMSL).

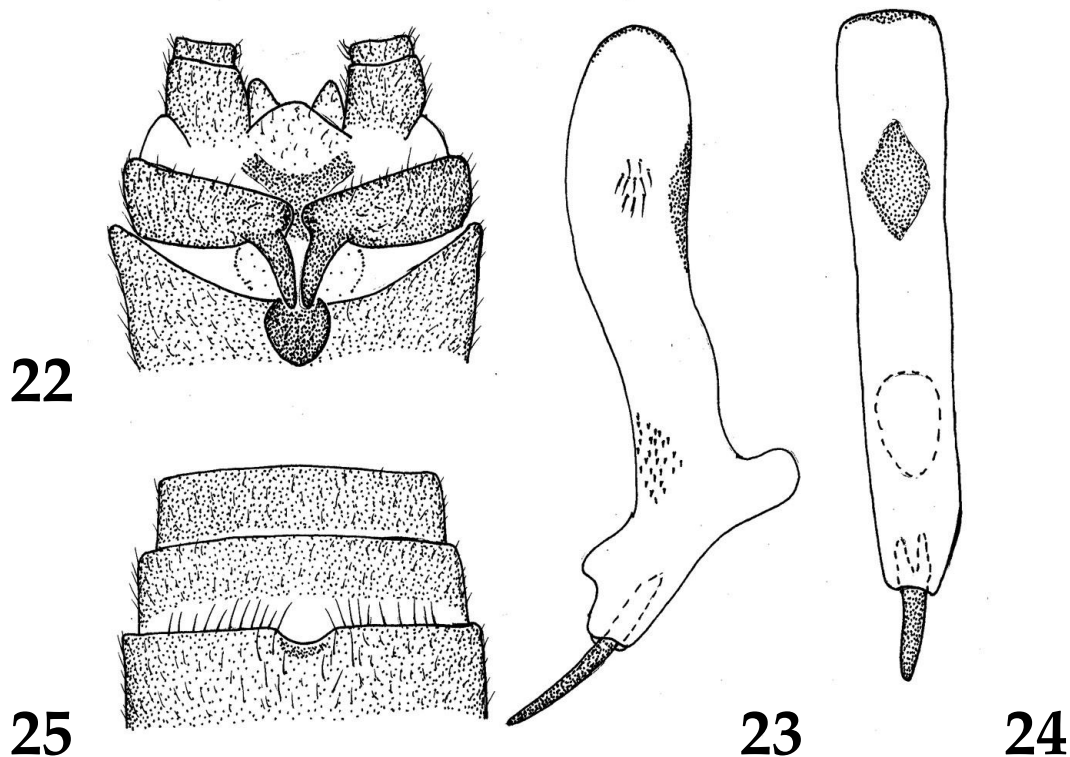
Adult habitus. Biocellate. Head with dark brown pigment over most of dorsum but interrupted by pale M-line and clypeus. Pronotum pale brown with darker rugosities clustered near midline and center of disk. Wings tinted brown except for narrow pale costal and apical band. Legs banded with narrow brown band on apex of femur and base of tibiae.

Male. Forewing length 9 mm. Median process of tergum 9 more or less circular and distinctly rugose. Finger like hemitergal processes short, ca. twice as long as basal width (Fig. 22). Aedeagal tube poorly sclerotized and bearing a pair of sparse setal patches basolaterally (Figs. 23-24); sac with a dorsal and smaller ventral membranous lobe and bearing a long slender terminal spine; basoventral margin of sac armed with sparse patch of small spines.

Female. Forewing length 10 mm. Subgenital plate unproduced but posterior margin of sternum 8 bearing a shallow, median U-shaped notch (Fig. 25).

Egg. Length ca. 0.39 mm, width ca. 0.22 mm. Tear drop shaped with short narrow collar and stalked anchor (Fig. 19). Chorionic surface finely punctate throughout; collar surface and adjacent egg body with an irregular pattern of meshwork formed by anastomosing low ridges (Fig. 20). Micropylar orifices slender, surrounded by small area of smooth chorion (Fig. 21).

Larva. Unknown.



Figs. 22-25. *Chinoperla sila*. 22. Male terminalia. 23. Aedeagus lateral. 24. Aedeagus dorsal. 25. Female terminalia.

Etymology. The species name, used as a noun in apposition, honors the Si La people of northern Vietnam.

Diagnosis. This is another species whose aedeagus is similar to that of *C. unidentata* in having a single, long, slender apical spine (Fig. 23). It can be distinguished from *C. gorohovi* and *C. unidentata* by the somewhat circular and rugose process of tergum 9 (Fig. 22), and by the narrow pale margin of the wing tips.

Chinoperla spinata sp. n.
(Figs. 26-34)

Material examined. Holotype ♂ from Thailand, Phrae Province, Wieng Ko Sai, Upper Nam Panjanae, 295 m, 99° 34' N, 17° 57' E, 21-22 April 2003, Chiang Mai University Team (PMSL). Paratypes: Thailand: Phrae Province, Wieng Ko Sai, Lower Nam Panjanae, 270 m, 99° 34' N, 17° 56' E, 20-21 February 2003, 1♀ (PMSL). Huey Nam Ru, 1400 m, 18 April 1989, H. Malicky, 1♀ (PMSL).

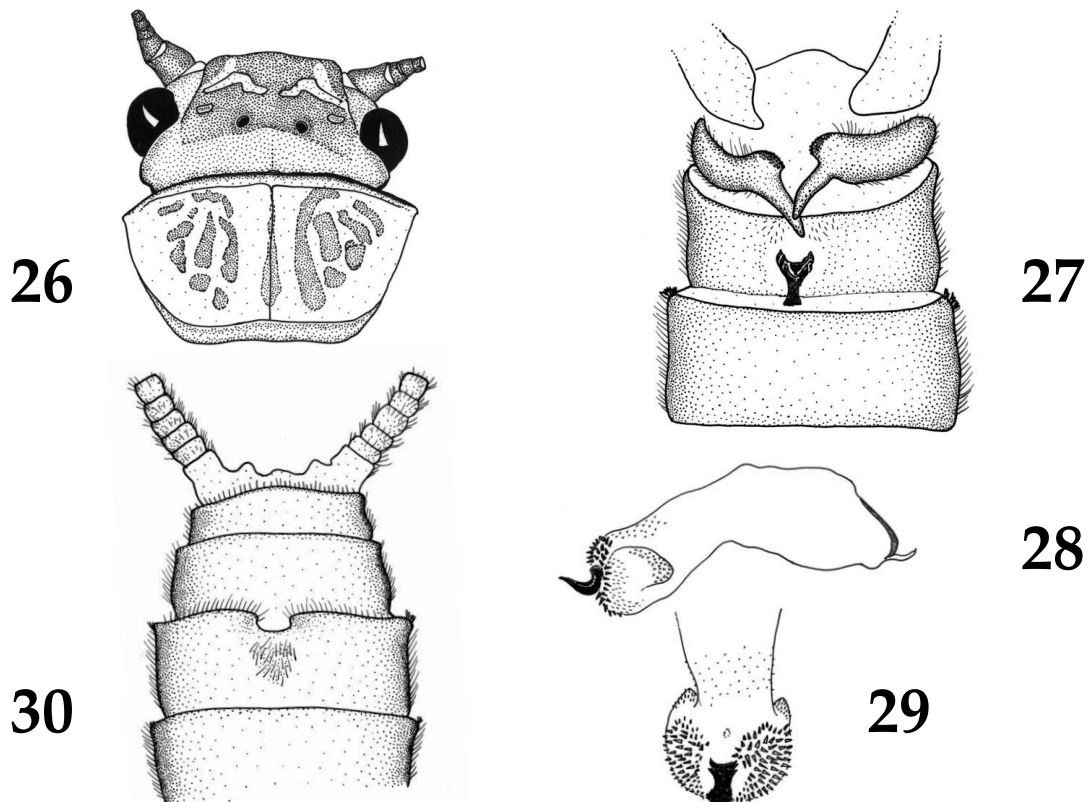
Adult habitus. Biocellate. Head dusky brown on occiput, dark brown over most of frons; M-line and callosities pale; antennae and palpi uniformly brown (Fig. 26). Pronotum pale brown with darker rugosities. Legs brown, distal part of femora and proximal part of tibiae darker.

Male. Forewing length 5 mm. Dark median process of tergum 9 shaped like a goblet (Fig. 27). Finger shaped hemitergal processes about 2.5 times long as basal width. Aedeagal tube poorly sclerotized; sac plump, apex bearing a dense patch of larger spines and a median, large, recurved hook (Figs. 28-29); a pair of spiny lateral lobes located subapically on sac.

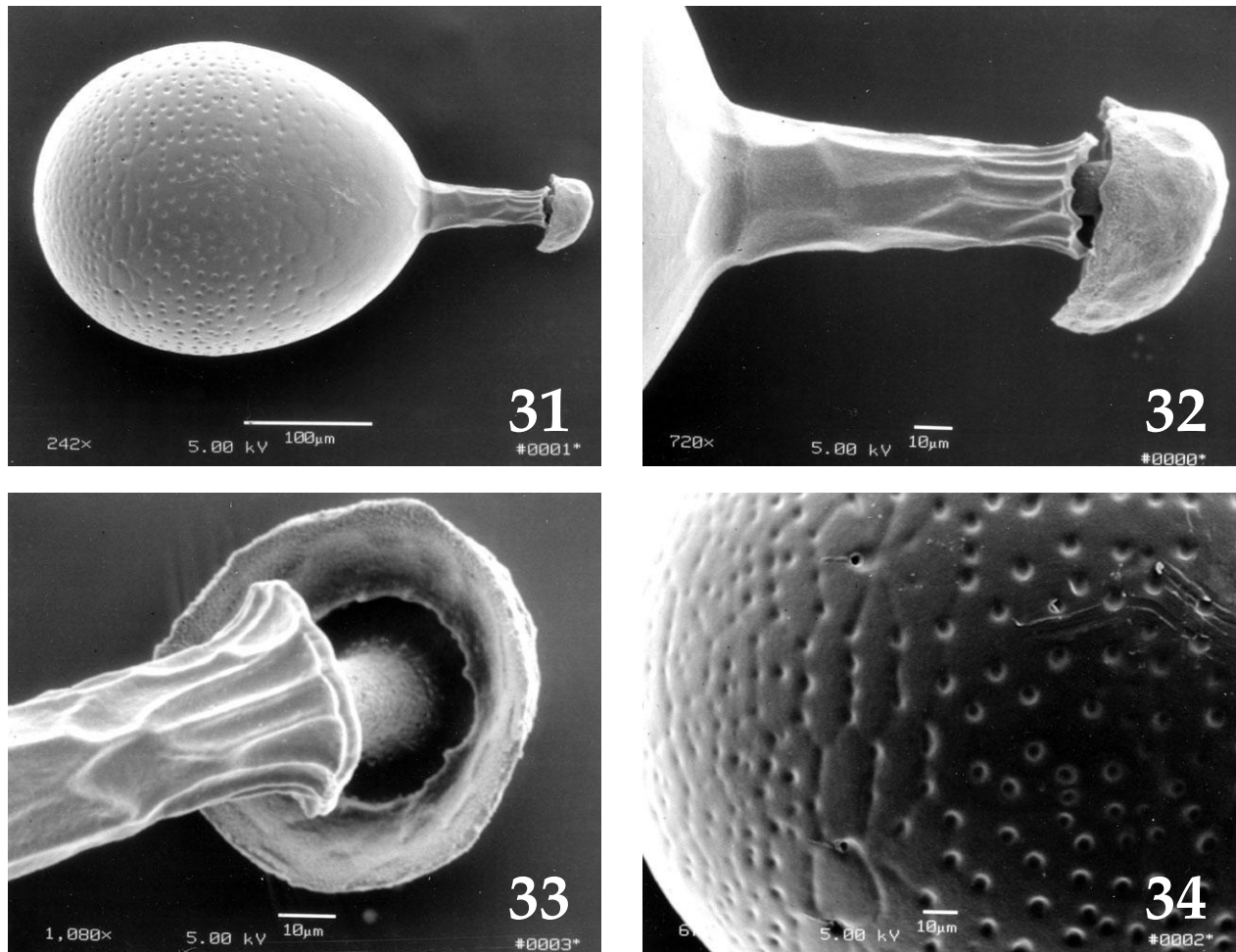
Female. Forewing length 11 mm. Subgenital plate scarcely produced but a prominent median notch occurs on posterior margin of sternum 8, and a brush of enlarged setae is positioned anterior to notch (Fig. 30).

Egg. Tear drop shaped with long, slender collar and stalked anchor. Chorion covered with fine punctations (Figs. 31-34).

Larva. Unknown.



Figs. 26-30. *Chinoperla spinata*. 26. Head and pronotum. 27. Male terminalia. 28. Aedeagus lateral. 29. Aedeagal apex. 30. Female terminalia.



Figs. 31-34. *Chinoperla spinata*. 31. Egg. 32. Egg collar and anchor, lateral. 33. Apex of egg collar and ventral aspect of anchor. 34. Micropyles and polar chorionic detail.

Etymology. The species name refers to the prominent aedeagal spine of this species.

Diagnosis. The aedeagus of this species is generally similar to those of *C. porntip* and *C. yi*. It differs from the former in lacking a distinct sagittate aedeagal apex (compare Figs. 6-8 and 28-29), and from the latter it differs in having smaller, and more posteriorly directed, lateral lobes of the aedeagal sac (compare Figs. 6 and 39).

***Chinoperla unidentata* Sivec & Zwick**
(Figs. 35-36)

Chinoperla unidentata Sivec & Zwick, 1989:11. Holotype

♂ (PMSL), 9 km W Chiang Dao, Thailand

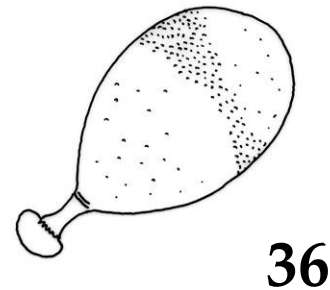
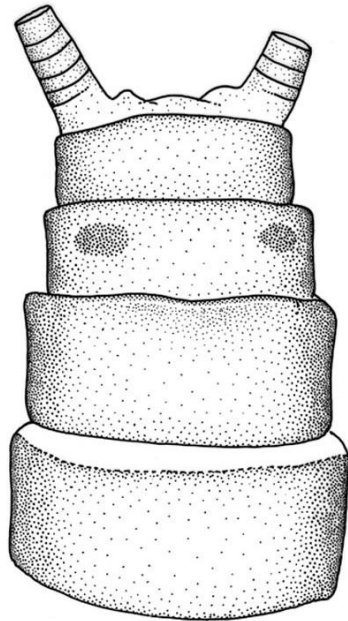
Material examined. Thailand: Chiang Mai Province, Doi Suthep-Pui National Park, Huai Phalat above road, 1200 m, 98° 54' N, 18° 48' E, 10 November 2001, 1♂ (PMSL). Khao Yai National Park, Khao Kheo, 11-25 November 2000, Korrakot Damrak, 1♂ (PMSL). Khao Yai National Park, Pa Tabak, 25 November- 9 December 2000, Korrakot Damrak, 1♀ (PMSL).

This species was previously reported from Thailand (Sivec & Zwick 1989) from a single male specimen. The aedeagus (as discussed above) is quite similar to those of *C. gorohovi* and *C. sila*. The previously unknown female is described below.

Female. Forewing length 10.5 mm. Subgenital plate not produced but hind margin of sternum 8 slightly emarginate mesally (Fig. 35). Bristles on posterior margin of sternum 8 long.

Egg. Tear drop shaped with moderately long collar and stalked anchor. Chorion punctate throughout but punctations finer and more densely packed in subequatorial ring (Fig. 36).

Comments. The female of this species is similar to that of *C. sila* but in that species the mesal emargination of the subgenital plate is much more conspicuous (Fig. 25) and the egg of that species has the collar about half as long as in *C. unidentata*; in addition the collar rim is not flanged and the chorion is uniformly punctate in the egg of *C. sila* (compare Figs. 19-21 and 36).



Figs. 35-36. *Chinoperla unidentata*. 35. Female terminalia. 36. Egg.

***Chinoperla yi* sp. n.**
(Figs. 37-39)

Material examined. Holotype ♂ from Lao Cai, Vietnam, large waterfall on road from Sapa to Lai Chau, 8 May 1995, D. Currie, B. Hubley, J. Swann, ROM 956022 (ROM). Paratype: Vietnam: Lao Cai, ca. 12 km on road from Sapa to Lai Chau, 1950 m, 1-12 May 1999, B. Hubley, ROM 992011, 1♂ (ROM).

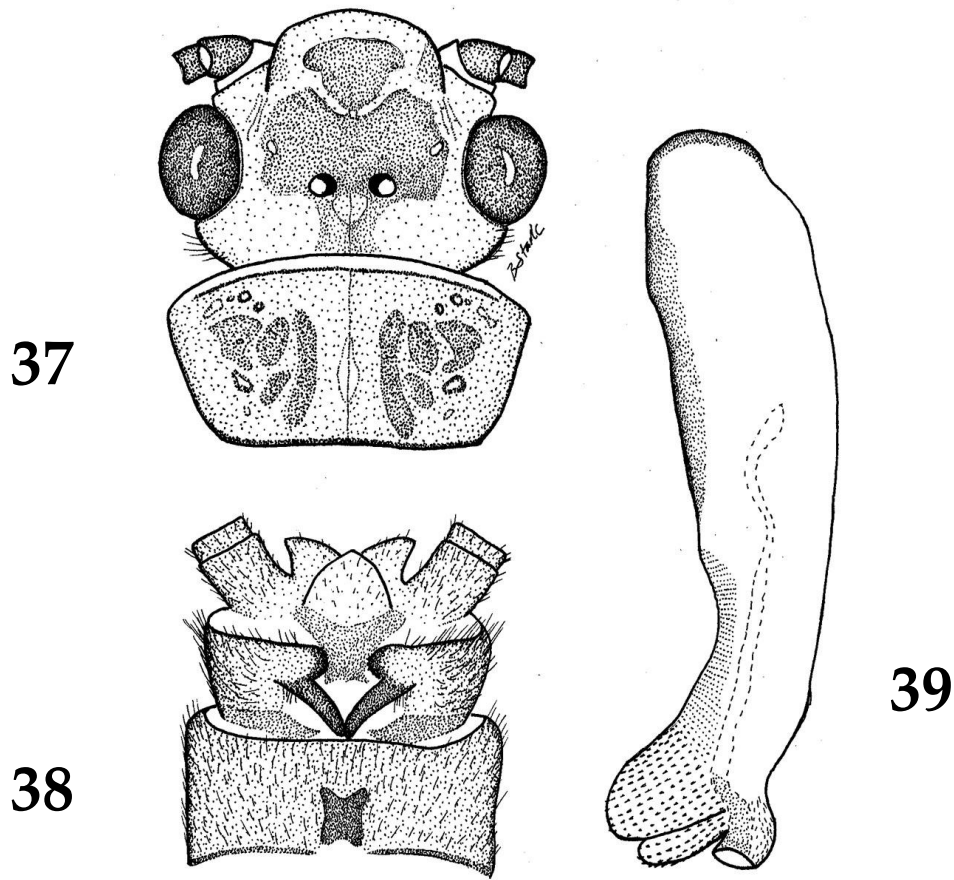
Adult habitus. Biocellate. Head with dark brown pigment over ocelli and central frons extending to pale M-line; forward of M-line, a bell shaped dark area covers central frons; lappets and mesal occiput dusky brown (Fig. 37). Pronotum pale brown with darker rugosities on disk; anterior and posterior margins with narrow dark brown band. Wings tinted with pale brown; veins dark brown except for pale

costal area; Sc vein reduced, obscure except at base. Legs pale brown but darker at apex of femora and at base and apex of tibia.

Male. Forewing length 10 mm. Tergum 8 with a slightly produced, lightly sclerotized median lobe sparsely clothed with short setae. Dark median process of tergum 9 slightly longer than wide and broadly U-shaped on posterior margin (Fig. 38). Finger shaped hemitergal processes about twice as long as basal width. Aedeagal tube damaged and poorly sclerotized, bearing a lateral pair of setal patches near base (Fig. 39); sac not fully everted but with three spinous lobes; median lobe bearing a sclerotized terminal tooth shaped spine, dorsolateral lobes completely covered with small spines.

Female. Unknown.

Larva. Unknown.



Figs. 37-39. *Chinoperla yi*. 37. Head and pronotum. 38. Male terminalia. 39. Aedeagus lateral.

Etymology. The species name, used as a noun in apposition, honors the Yi people of the China-Vietnam border region near the type locality.

Diagnosis. Males of this species have a single tooth shaped aedeagal spine which is unlike the long slender spines found in *C. unidentata* and related species.

Chinoperla Vn-A
(Figs. 40-41, 43-45)

Material examined. Vietnam: Tam Dao, 800-1100 m, 19 May-13 June 1995, H. Malicky, 1♀ (PMSL).

Adult habitus. Biocellate. Head dark brown except for narrow pale M-line and clypeus. Pronotum brown with scattered darker rugosities on disk (Fig.

40). Wings uniformly brown. Legs brown.

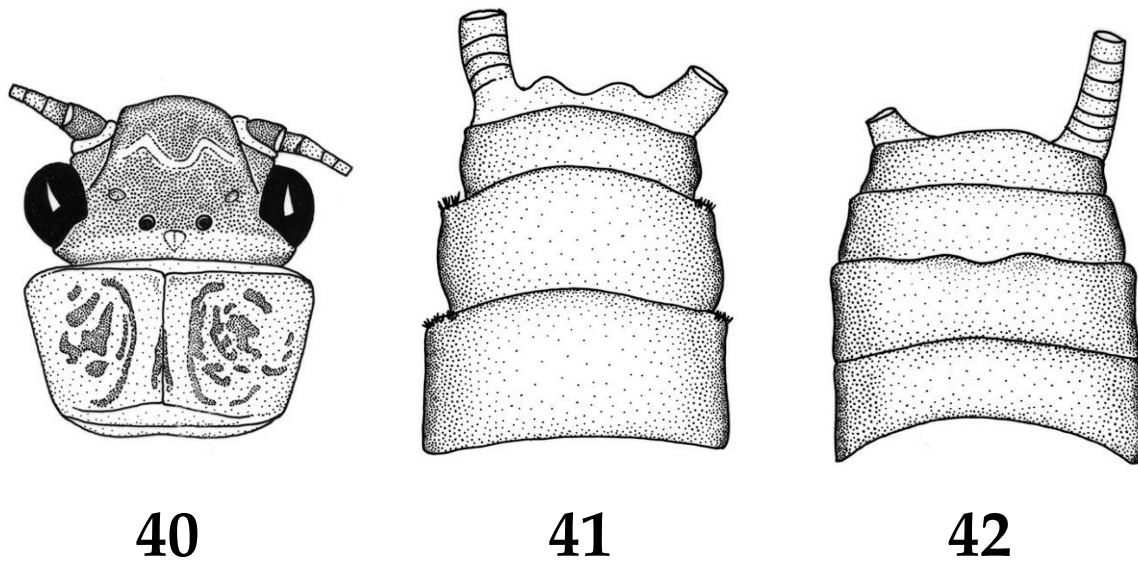
Male. Unknown.

Female. Forewing length 11 mm. Subgenital plate unproduced and without mesal notch (Fig. 41).

Egg. Egg length ca. 0.55 mm, egg width ca. 0.24 mm, collar length 0.17 mm. Tear drop shaped with long slender collar and petiolate anchor (Fig. 43). Chorionic surface finely pitted in obscure follicle cells near poles; more coarsely pitted in a narrow equatorial zone (Fig. 44). Collar with meshwork forming irregular long cells with smooth floors (Fig. 45); collar rim flanged.

Larva. Unknown.

Comments. The egg of this female is similar to that of *Phanoperla fuscipennis* (Navas) (Zwick 1983) and *C. serrata* (described above).



Figs. 40-42. *Chinoperla* Vn-A and Vn-B. 40. Head and pronotum, Vn-A. 41. Female terminalia, Vn-A. 42. Female terminalia, Vn-B.

***Chinoperla* Vn-B**
(Figs. 42, 46)

Material examined. Vietnam: Tam Dao, 29 May 1995, C.F. Lee, 1♀ (PMSL).

Adult habitus. Biocellate. General color brown to dark brown. Head dark brown except for pale narrow M-line and caluses. Pronotum pale brown with pale, yellowish lateral margins and darker, brown rugosities. Palpi pale, antennae uniformly brown. Fore and mid femora pale in basal third, rest of the femora dark brown; tibiae and tarsi of first and second leg uniformly brown. Hind femora pale in basal two thirds, dark brown over apical third of femora and proximal end of third tibia. Remainder of third tibiae pale, tarsal segments dark brown. Wings uniformly brown.

Male. Unknown.

Female. Forewing length 11 mm. Subgenital plate unproduced. Sternum 8 bearing an obscure median emargination (Fig. 42).

Egg. Collar length ca. 0.03 mm, collar width ca. 0.04 mm. Tear drop shaped with short, narrow collar and petiolate anchor (Fig. 46). Collar slightly wider than long, rim not flanged. Chorionic surface finely punctate throughout; sides of collar and adjacent egg

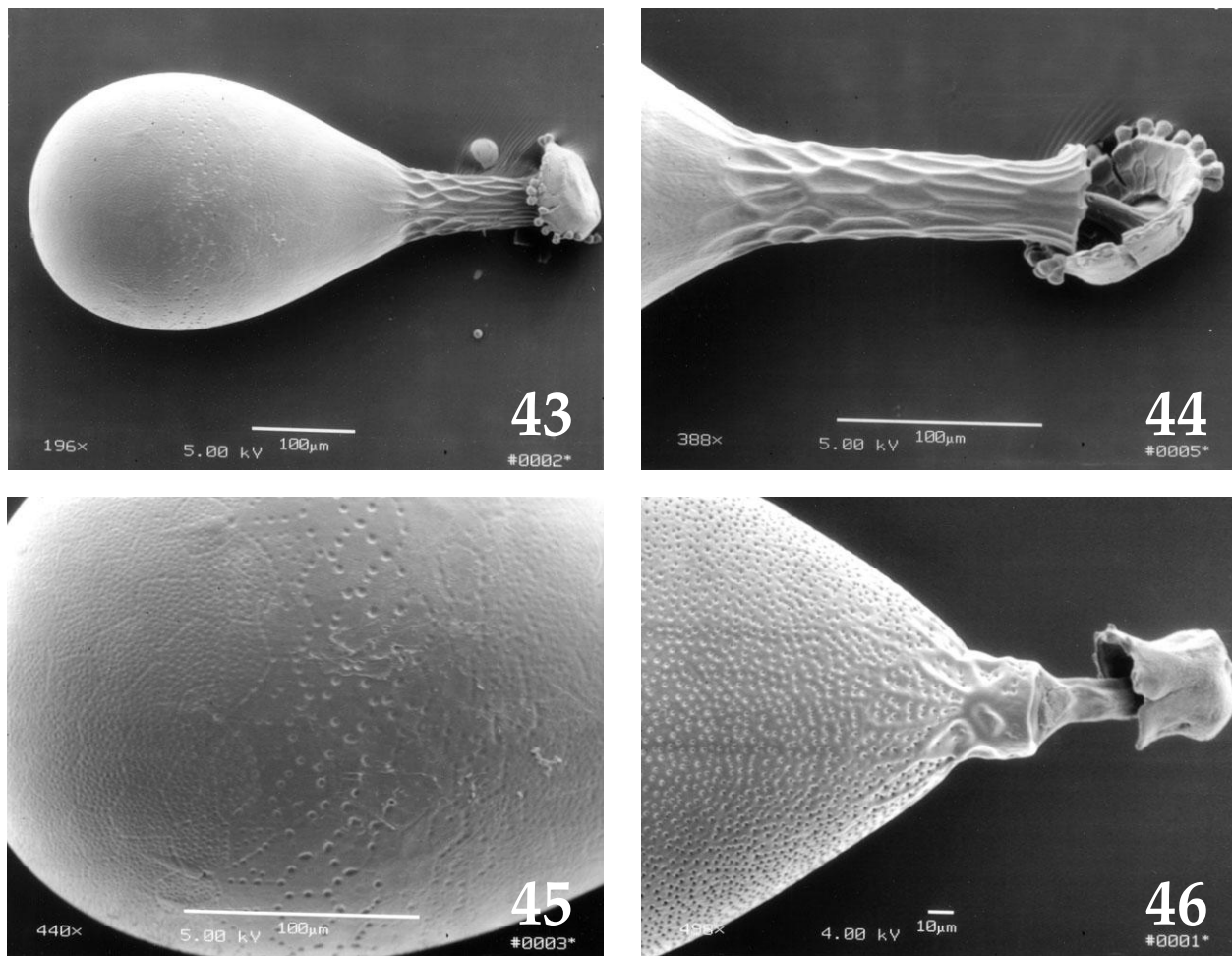
body with a meshwork formed from a few low, smooth ridges.

Larva. Unknown.

Comments. The egg of this species is quite similar to that of *C. sila* and may represent a simple variant, but the collar of this specimen is shorter and slightly less ornate than in specimens of that *C. sila*.

Provisional Key for Male *Chinoperla*
(*C. nigroflavata* not included)

- 1 Known from Borneo *borneensis*
- 1' Known from Sumatra, Hainan or mainland Asia 2
- 2 Aedeagal tip armed with a single long slender spine (Fig. 4) 3
- 2' Aedeagal tip variously armed with a broad sclerite, one or more short tooth or hook shaped spines, or with numerous small spines 5
- 3 Tergum 9 process somewhat circular or oval and covered with small knobs or teeth (Figs. 13-18) *sila*
- 3' Tergum 9 process linear and without knobs or teeth (Fig. 1) 4
- 4 Process of tergum 9 slender, more than twice as long as wide; upturned membranous aedeagal



Figs. 43-46. *Chinoperla* eggs. 43. Entire egg, Vn-A. 44. Egg collar and anchor, Vn-A. 45. Micropyles and polar chorionic detail, Vn-A. 46. Egg collar and anchor, Vn-B.

- | | |
|--|--------------------|
| lobe larger than spine-bearing lobe (Fig. 2); known from Vietnam | <i>gorohovi</i> |
| 4' Process of tergum 9 about as wide as long; upturned membranous aedeagal lobe smaller than spine-bearing lobe; known from Thailand | <i>unidentata</i> |
| 5 Wings with dark apical band; aedeagal apex armed with a group of three moderately large teeth and two ventral clusters of 6-8 smaller teeth; known from Sumatra | <i>reducta</i> |
| 5' Wing tips uniformly pigmented; aedeagal apex variously armed but not as above; known from Hainan or mainland Asia | 6 |
| 6 Wings with narrow pale apical band and pale median spot; dorsal process of tergum 9 expanded on posterior margin with a pair of small foot shaped extensions; known from Thailand and Malaysia | <i>fascipennis</i> |
| 6' Wings without pale apical band; dorsal process of tergum 9 not as above | 7 |
| 7 Hemitergal finger shaped processes at least 3 times long as basal width; aedeagal apex without large tooth like spines; known from India | <i>nigriceps</i> |
| 7' Finger shaped hemitergal processes about 2.5 times long as basal width; aedeagal apex with one or more teeth | 8 |
| 8 Aedeagal apex with one large spine (Fig. 7) | 9 |

- 8' Aedeagal apex with several large spines; known from Hainan *nigrifrons*
- 9 Aedeagal apex sagittate (Fig. 6); sclerite of aedeagal tube bracelet-like; known from Thailand *porntip*
- 9' Aedeagal apex shape not sagittate; aedeagal tube sclerite linear 10
- 10 Apical aedeagal armature, a broad sclerite bearing a small fin-like process near tip (Fig. 14); tergum 9 process bearing a few small knobs or teeth; known from Vietnam *rhododendrona*
- 10' Apical aedeagal armature without broad sclerite and fin-like process; tergum 9 process without knobs or teeth; known from Thailand or Vietnam 11
- 11 Lateral aedeagal lobes directed backward (Fig. 28); largest spines of armature patch surround apical tooth; known from Thailand *spinata*
- 11' Lateral aedeagal lobes directed ventrad (Fig. 39); largest spines of armature patch located on lateral lobes; known from Vietnam *yi*

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