



NEW SPECIES OF *TYLOPERLA* (PLECOPTERA: PERLIDAE) FROM VIETNAM AND THAILAND

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ABSTRACT

Two new species of *Tyloperla* Sivec & Stark are proposed from Vietnam and one from Thailand. The new taxa, *T. courtneyi*, sp. n., *T. illiesi*, sp. n. and *T. khang*, sp. n. are described from adult specimens and are compared to others in the genus. A provisional key for males of the genus is presented.

Keywords: Plecoptera, Vietnam, Thailand, *Tyloperla*, new species

INTRODUCTION

Tyloperla Sivec & Stark is a small genus of perlid stoneflies presently known from Assam, Taiwan and mainland China (Sivec et al. 1988; Stark & Sivec 1991; Yang & Yang 1993). The genus was proposed for *T. attenuata* (Wu & Claassen) and a related species formerly placed in *Tylopyge* Klapálek after the type of that genus was found by Zwick (1988) to be a species of *Paragnetina* Klapálek; the genus also nominally includes *T. sauteri* (Navas), a species known from the holotype female and originally described in *Kamimuria* Klapálek (Sivec et al. 1988). Subsequently Stark & Sivec (1991) and Yang & Yang (1993) have each proposed an additional species for the group.

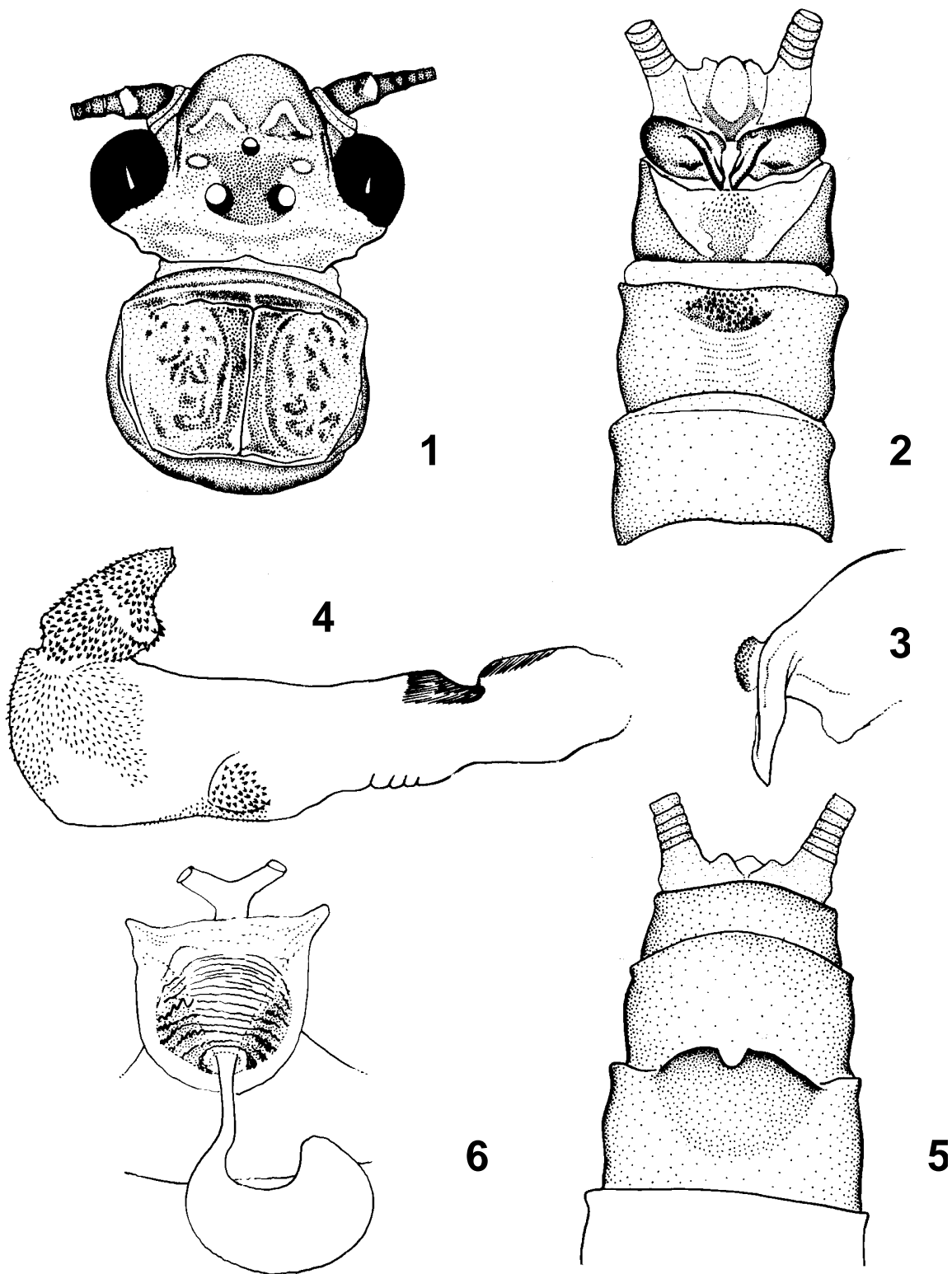
This study is based on a small sample of *Tyloperla* specimens collected in Vietnam by personnel of the Royal Ontario Museum and by A. Gorohov (St. Petersburg), and in Thailand by Prof. Dr. Porntip Chantaramongkol and her students (Chiang Mai University team). Our study of this material indicates three additional *Tyloperla* species should be recognized. Specimens are deposited in the Royal Ontario Museum, Toronto (ROM), the Institute of Ecology and Biological Resources, Hanoi (IEBR), the Slovenian Museum of Natural History (PMSL) and the Stark Collection, Clinton (BPS) as indicated in the text.

Tyloperla courtneyi, sp. n. (Figs. 1-6, 21-23)

Material. Holotype ♂ and 1 ♀ paratype from Thailand, Chiang Mai, Doi Inthanon National Park, Siriphum waterfall, 8-9 May 2002, Chiang Mai University Team (PMSL).

Adult habitus. Triocellate. Head yellowish with dark brown spot between ocelli expanded along anterior margin near callosities; anterior region of frons dusky brown forward of M-line; pronotum brown with darker rugosities (Fig. 1). Palpi, antennae and cerci brown. Legs brown with distal end of femora and proximal end of tibiae slightly darker. Wing membrane and veins brown.

Male. Forewing length 17 mm. Hairbrushes reduced on abdominal sternum 5 but well developed on sternum 6-7 and on thoracic metasternum. Tergum 8 and 9 without distinct lobes but each with a mesal low mound covered with sensilla basiconica (Fig. 2). Basal cushion of hemitergal process about 1/3 of inner length of process; process rounded dorsally, grooved along inner surface and pointed dorsoapically (Fig. 3). Aedeagal sac apically recurved and bearing a pair of small basolateral, spiny lobes (Fig. 4); sac apex offset by a distinct subapical constriction; armature well developed as a broad patch of small spines over apex and extending beyond subapical constriction over lateral and ventral surfaces to near midlength of sac. Cercal segments with a single enlarged ventral bristle.



Figs. 1-6. *Tyloperla courtneyi*. 1. Head and pronotum. 2. Male terminalia. 3. Hemitergal process, dorsolateral. 4. Aedeagus, lateral. 5. Female terminalia. 6. Vagina and spermatheca.

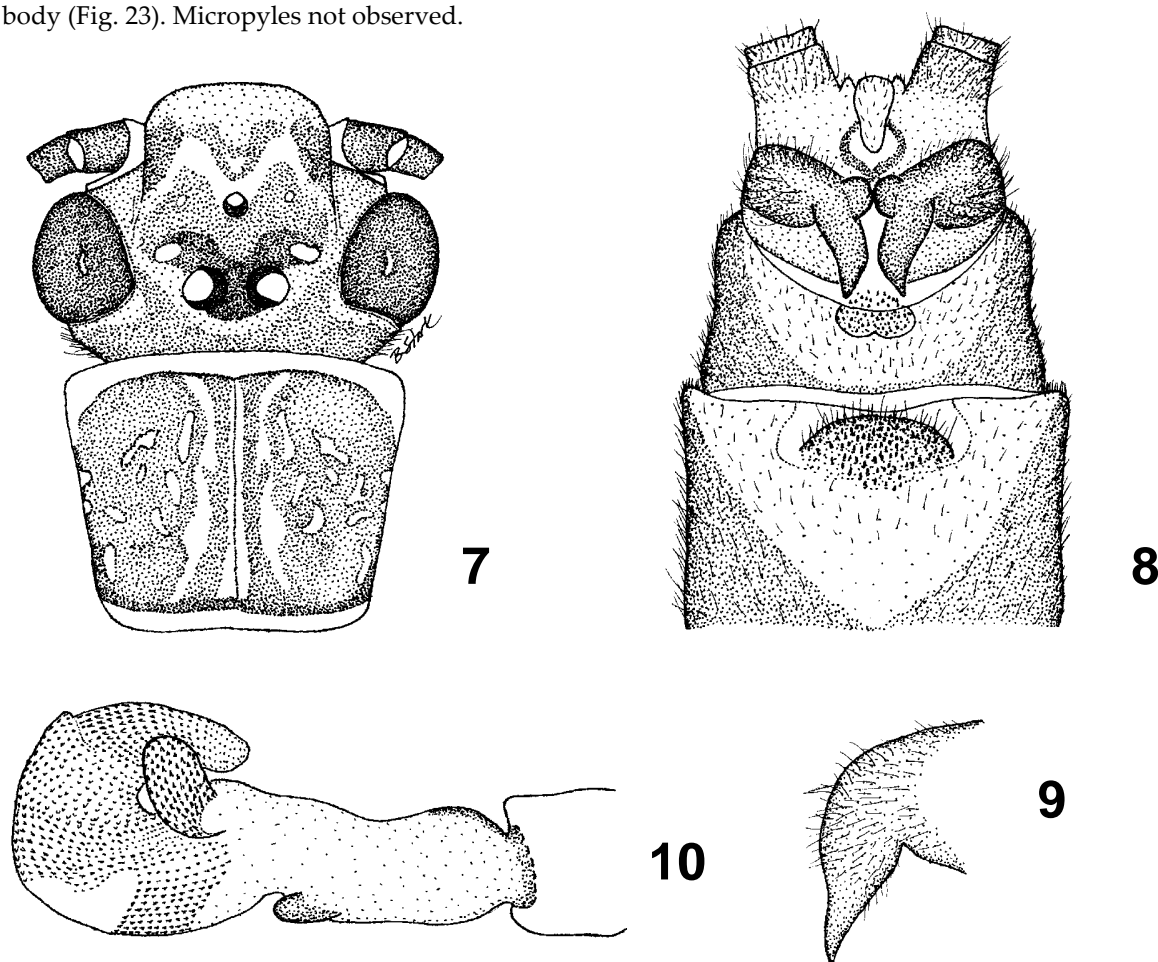
Female. Forewing length 24 mm. Subgenital plate arcuate with a median U-shaped notch extending deeply into plate; plate produced over ca. $\frac{1}{4}$ or less of sternum 9 (Fig. 5). Vagina about as wide as long with major anterior chamber weakly lined along lateral wrinkles with brown setae. Spermatheca hook shaped (Fig. 6).

Egg. Length ca. 0.42 mm, width ca. 0.38 mm. Collar short, ca. 0.03 mm in length, and wide, ca. 0.20 mm in diameter (Fig. 22); collar rim smooth and slightly flanged, sides with a series of obscure vertical ridges (Fig. 21). Chorion covered with irregularly shaped large pits with ornately punctate floors. Opercular ring distinct as a narrow groove separating lid from egg body (Fig. 23). Micropyles not observed.

Larva. Unknown.

Diagnosis. Males of this species are similar to those of *T. formosana* (Okamoto) and *T. khang* (described below) in external genitalic features. It differs from the former in having shorter, more rounded hemitergal calluses and in lacking small subapical lobes on the aedeagal sac. *Tyloperla khang* lacks lateral lobes on the aedeagal sac but a pair of these are present basolaterally in *T. courtneyi*.

Etymology. The patronym honors G. Courtney for his leadership in the study of Thai aquatic insects.



Figs. 7-10. *Tyloperla illiesi*. 7. Head and pronotum. 8. Male terminalia. 9. Hemitergal process, lateral. 10. Aedeagus, lateral.

***Tyloperla illiesi*, sp. n.** (Figs. 7-10)

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

Adult habitus. Triocellate. Head with dark brown ocellar patch expanded around front of ocelli and inner margins of callosities and extending to M-line (Fig. 7); lappets brown, occiput dusky brown. Pronotum brown with extensive matrix of rugosities. Wings pale brown, veins brown. Femora with narrow brown apical band; tibiae yellow brown but slightly darker at knee and at apex.

Male. Forewing length 16-17 mm. Hair brushes on abdominal sterna 5-7 and on thoracic mesosternum. Abdominal tergum 7 with a small patch of sensilla basiconica. Tergum 8 with a small rounded and raised lobe covered with sensilla basiconica. Membranous field of tergum 9 with a mesal patch of sensilla basiconica set on a low mound (Fig. 8). Hemitergal processes acute, rather wide at base and curved outward at tip; basal cushion about a third as long as inner length of process; process in lateral aspect hooked slightly downward at tip (Fig. 9). Aedeagal sac trilobed; mesal lobe long, sharply curved and armed from bases of lateral lobes with small triangular spines; apical third of mesal lobe offset by an indistinct groove; lateral lobes small and covered almost entirely with spines (Fig. 10). Tube with a pair of small dorsoapical lobes.

Female. Unknown.

Larva. Unknown.

Diagnosis. This species is closely related to *T. schmidi* Stark & Sivec from Assam, but differs in the shape of the hemitergal processes (Stark & Sivec 1991). In that species the processes are less acute apically and not as wide at the base. In addition, the aedeagal sac armature is partitioned into two patches in *T. schmidi* and that species lacks a subapical groove on the aedeagal sac.

Etymology. We are pleased to propose this species in honor of the late Professor Joachim Illies in the initial volume of *Illiesia*.

***Tyloperla khang*, sp. n.** (Figs. 11-20)

Material. Holotype ♂ from Vietnam, Gia Lai, An Khe District, Tram Lap, Azun River, 3 km NE forestry

building, 21 June 1996, D. Currie, J. Swann, ROM 961076 (ROM). Paratypes: Vietnam: Gia Lai, Buoenloy, May 1995, A. Gorohov, 1 ♂ (PMSL). Thua Thien-Hue, Bach Ma National Park, junction Rhododendron and Five Lakes trails, 16 June 2000, 1200 m, B. Hubley, D.C. Darling, ROM 2000531, 1 ♀ (IEBR).

Adult habitus. Triocellate. Head with dark spot over ocelli distinctly narrowed anteriorly (Fig. 11). Wing membrane pale brown, veins darker. Legs banded, femora dark brown apically, tibiae with apical and basal dark bands.

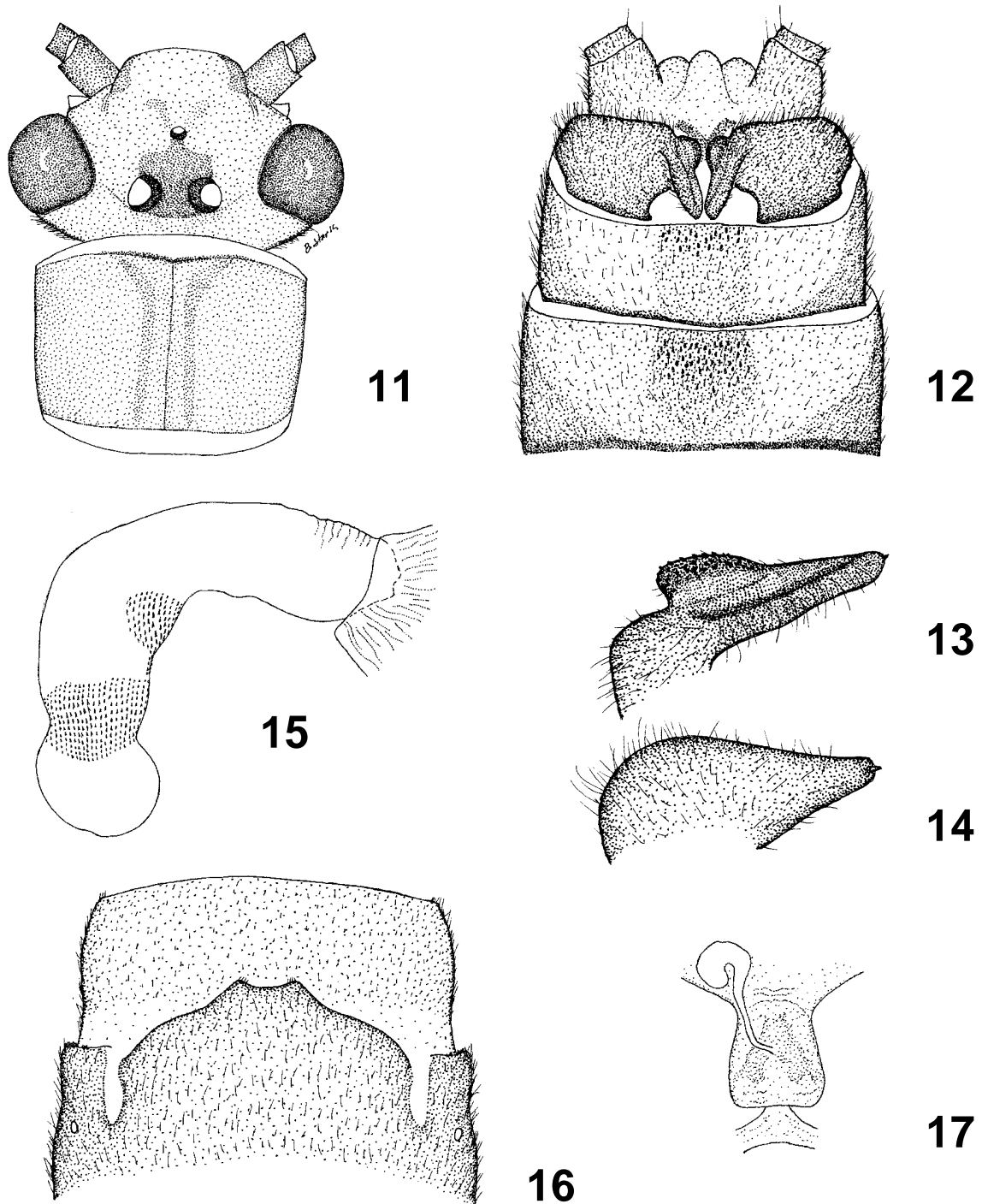
Male. Forewing length 12-13 mm. Hair brushes on abdominal sterna 5-7 and thoracic metasternum. Tergum 7 with a low posterior mound and a few sensilla basiconica in mesal patch. Tergum 8 with a mesal patch of sensilla basiconica on a slightly raised sclerite. Tergum 9 with a small mesal patch of sensilla basiconica (Fig. 12). Hemitergal processes rounded dorsolaterally (Fig. 14) and grooved along inner margin; basal cushion almost half as long as entire inner length of hemitergal process (Fig. 13). Everted aedeagal sac tubular, curved ventrad and without additional lobes (Fig. 15); armature consists of a subapical band of spines narrowly interrupted on dorsum, and a smaller mesal patch, narrowly connected to subapical band but broadly interrupted dorsolaterally.

Female (putative). Forewing length 15 mm. Subgenital plate generally triangular in outline, produced over about half of sternum 9 and slightly excavated on apical margin (Fig. 16). Vagina longer than wide, sparsely armed with small triangular spines around periphery but with several denser clusters near base of spermathecal stalk (Fig. 17). Spermatheca hook shaped but apex rounded.

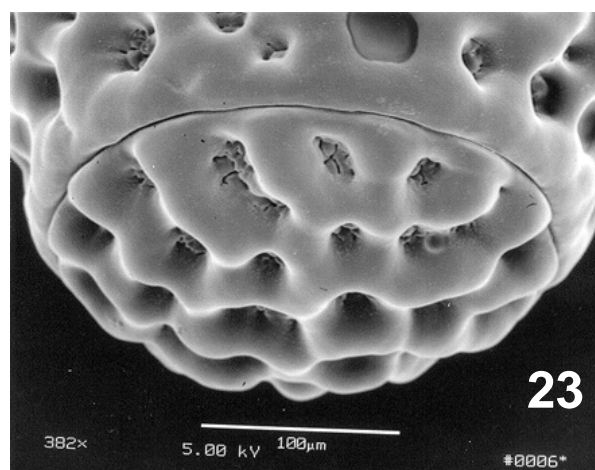
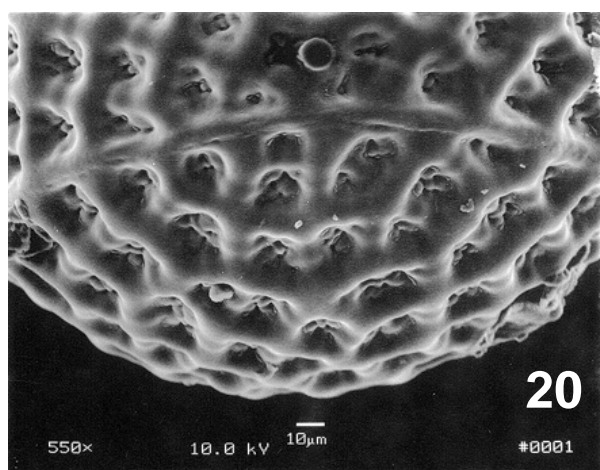
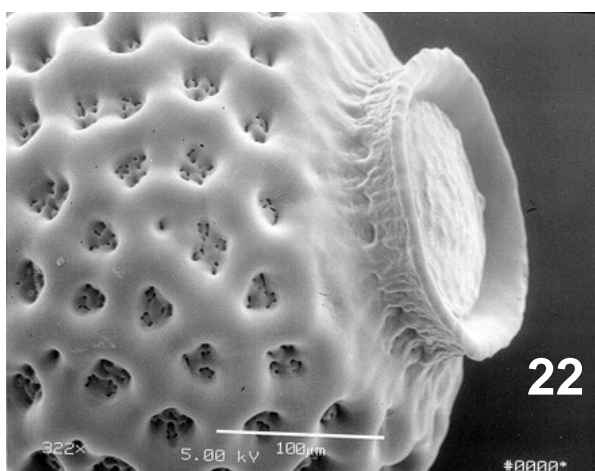
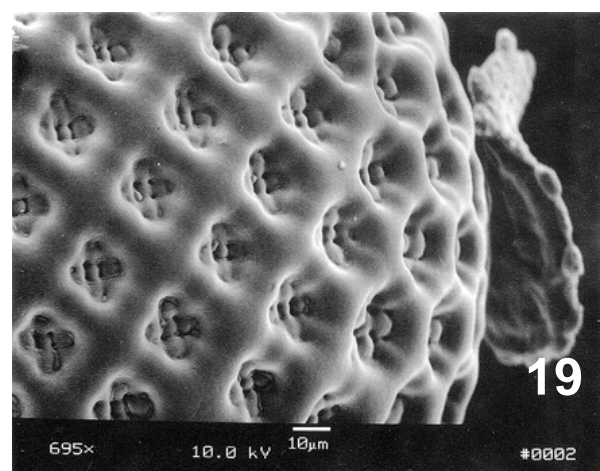
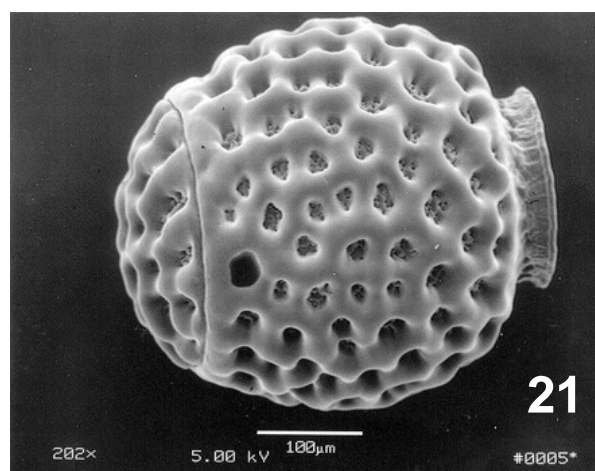
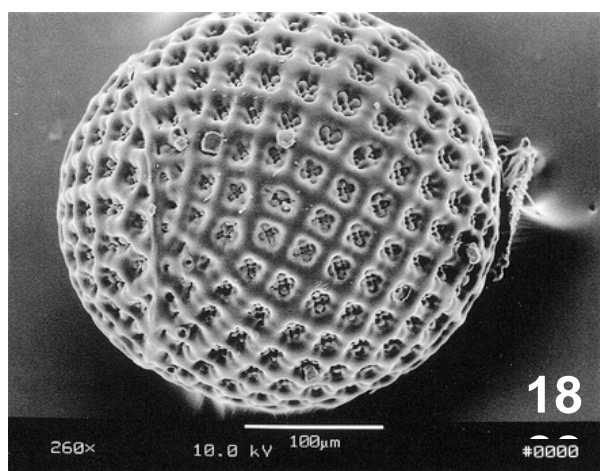
Egg. Outline more or less spherical (Fig. 18), collar reduced to a small button-like bump. Chorion covered throughout with large square pits with punctate floors (Fig. 19). Opercular ring distinct as a narrow ridge separating lid from egg body (Fig. 20). Micropyles with large funnel-like orifices located above opercular ring.

Larva. Unknown.

Diagnosis. Males of this species are similar to *T. formosana* (Okamoto) and *T. courtneyi* (described above) in the absence of a distinctly produced lobe on tergum 8. In the former species the basal cushions



Figs. 11-17. *Tyloperla khang*. 11. Head and pronotum. 12. Male terminalia. 13. Hemitergal process, dorsal. 14. Hemitergal process, lateral. 15. Aedeagus, lateral. 16. Female terminalia. 17. Vagina and spermateca.



Figs. 18-20. *Tyloperla khang* egg structures. 18. Entire egg, lateral. 19. Egg collar end with anchor. 20. Opercular ring and lid.

Figs. 21-23. *Tyloperla courtneyi* egg structures. 21. Entire egg, lateral. 22. Egg collar, polar aspect. 23. Opercular ring and lid.

of the hemitergal processes are long and less rounded and the aedeagal sac has a pair of small, subapical ear-like lobes. *Tyloperla courtneyi* can be distinguished on the basis of the paired basolateral lobes on the aedeagal sac which are absent in *T. khang*. Other species of *Tyloperla* differ in having a distinct mesal lobe on tergum 8. The putative female is associated on the basis of shared color pattern.

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

Key to *Tyloperla* Males

(*T. sauteri* and *T. sinensis* not included)

1. Aedeagal sac with a pair of basolateral lobes (Fig. 13).....2
 Aedeagal sac tubular, basolateral lobes absent (Fig. 18).....*T. khang*
2. Tergum 8 without a distinctly produced mesal lobe (Fig. 2).....3
 Tergum 8 with a distinctly produced mesal lobe (Fig. 11).....4
3. Basal cushion of hemitergal lobes more than half as long as inner length of process; aedeagal sac with largest spines forming a band distal to small ear shaped lobes; known from Taiwan.....*T. formosana*
 Basal cushion of hemitergal lobes about 1/3 as long as inner length of process (Fig. 2); aedeagal sac with largest spines forming a dense subapical patch (Fig. 4); known from Thailand*T. courtneyi*
4. Hemitergal processes slender throughout length and reaching well beyond hind margin of tergum 9.....*T. attenuata*
 Hemitergal processes broad at base and reaching, at most, hind margin of tergum 95
5. Aedeagal sac armature continuous laterally near base of lobes (Fig. 13); apical region of aedeagal sac offset by a subapical groove (Fig. 13); known from Vietnam.....*T. illiesi*
 Aedeagal sac armature divided laterally near base of lobes into two patches; apical region of aedeagal sac without subapical groove; known from Assam.....*T. schmidi*

ACKNOWLEDGMENTS

We thank B. Hubley and the Royal Ontario

Museum and A. Gorohov, for the loan of Vietnamese material used in this study. The material from Thailand was collected as part of a National Science Foundation (Biotic Surveys and Inventories) Grant DEB-0103144 awarded to Dr. G. Courtney of 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 northern Thailand.

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Received 20 November 2004, Accepted 20 December 2004,
 Published 25 January 2005

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Zeitschrift/Journal: [Illiesia](#)

Jahr/Year: 2005

Band/Volume: [01](#)

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Artikel/Article: [New species of Tyloperla \(Plecoptera: Perlidae\) from Vietnam and Thailand. 1-7](#)