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TAIWANESE SPECIES OF *CRYPTOPERLA* (PLECOPTERA: PELTOPERLIDAE)

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ABSTRACT
The Taiwanese species of *Cryptoperla* are reviewed and three species are given formal recognition. Records are given for *Cryptoperla formosana* (Okamoto), a previously recognized species and a new name, *C. klapaleki* is proposed for *C. formosana* (Klapálek). The latter species is redescribed from the holotype and from fresh material, and a new species *C. uchidai* is also proposed. Unassociated females for one species are described under an informal designation.

Keywords: *Cryptoperla*, Plecoptera, Taiwan, new species

INTRODUCTION

Recent studies of Oriental stoneflies have documented a modest regional diversity, but a surprising range of egg chorionic and male cercal morphology for the genus *Cryptoperla* (Stark 1989; Stark & Sivec 2007, Sivec 1995, 2005; Maruyama 2002). This structural diversity has rendered difficult the establishment of clear generic boundaries and this das lead to the recognition of *Cryptoperla* as a "broadly defined genus" (Stark 1989).

Only two species of peltoperlid stoneflies have previously been described from Taiwan, and both bear *formosana* as the species name. Okamoto (1912) proposed *Nogiperla formosana* from a male specimen collected in 1906 at "Matsumura, Giran [=Ilan], Formosa" (Uchida & Isobe 1988), and Klapálek (1913) proposed *Peltoperla formosana* from a single female specimen collected in 1911 at "Taihorin, Formosa". Because the two species are distinct, but both are now placed in genus *Cryptoperla*, the latter species proposed by Klapálek is a secondary homonym and must be renamed. In addition, material collected by one of us (IS) and a colleague, B. Horvat, or obtained from the Bernice P. Bishop Museum, Honolulu (BPBM), or from other colleagues, includes additional species new to science. Although we anticipate more discoveries of new species in remote and poorly accessible sites on the island, we take this opportunity to update the Taiwanese peltoperlid fauna in order to promote awareness and interest in these uncommon insects.

RESULTS AND DISCUSSION

Cryptoperla formosana (Okamoto, 1912)

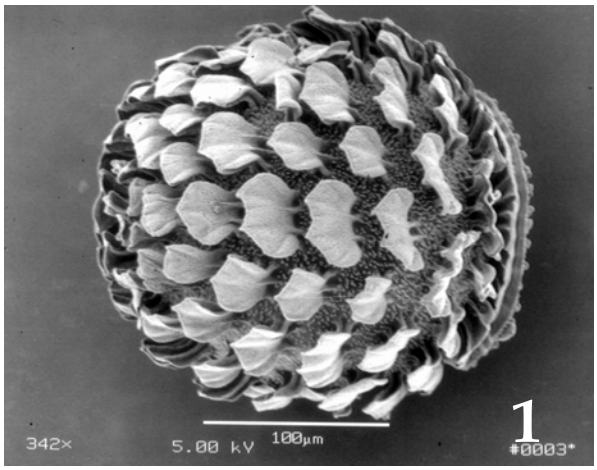
(Figs. 1-4)

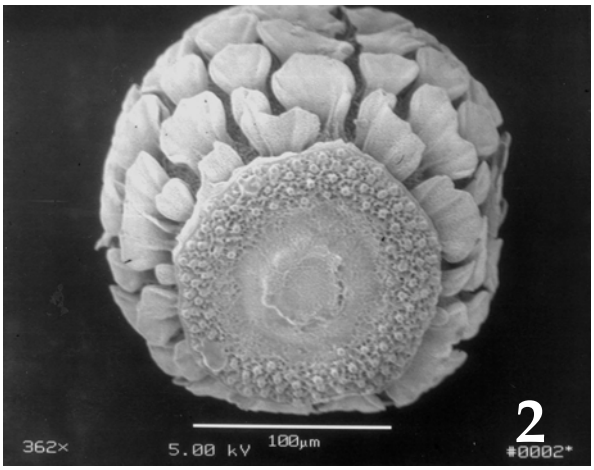
Nogiperla formosana Okamoto, 1912:136. Holotype ♂, Matsumura, Formosa.
Cryptoperla formosana: Uchida & Isobe, 1988:23. Redescription.

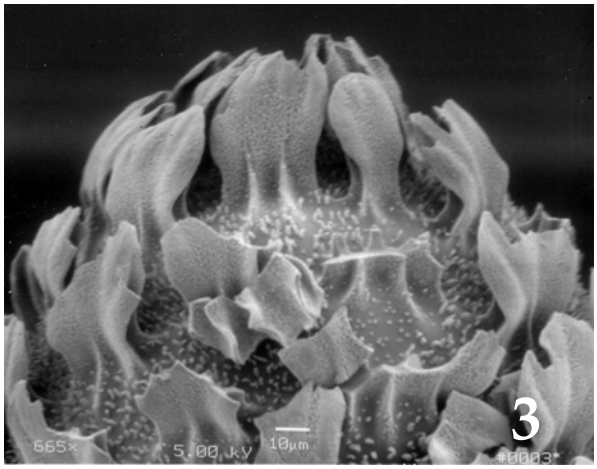
Material examined. Material. Taiwan: Hsin Chu Co., S. Chingchuan, 830 m, 16 October 1996, I. Sivec, 1 ♀ (PMSL). Hua Lien Co., Hongyehshi, 6 July 1988, Wong, 11 ♂, 7 ♀ (PMSL). Ilan Co., Chilan, 25 October 1995, Hsu, 2 ♂, 1 ♀ (PMSL). Ilan, Fushan, 22 March 1995, Chun-Lin Li, 2 ♀ (PMSL).Ilan Co., Rian Jer

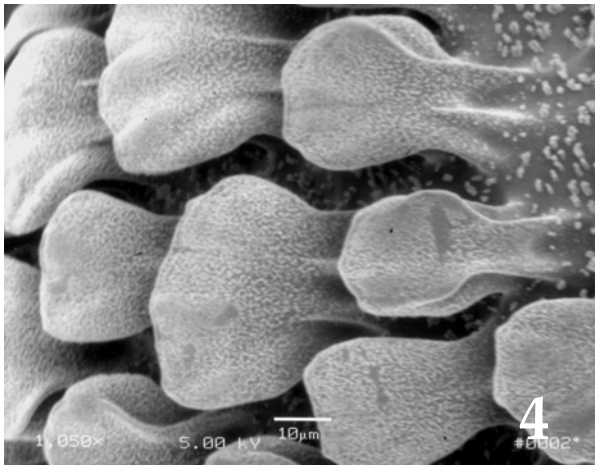
Spring, 570 m, 12 October 1996, I. Sivec, 4 ♂, 3 ♀ (PMSL). Nanton Co., Shihtzuton, 760 m, 25 October 1996, I. Sivec, 3 ♀ (PMSL). Nanton Co., W. Tatung, 880 m, 25 October 1996, I. Sivec, 1 ♂ (PMSL). Taipei Co., Yangminshan, 500 m, 13 October 1996, I. Sivec, 2 ♀ (PMSL). Taipei Co., Fushan, 23 October 1995, Hsu, 9 ♂, 6 ♀ (PMSL). Same site, 430 m, 15 October 1996, I. Sivec, 2 ♂, 1 ♀ (PMSL). Same site, 23-25 August 1990, Jeng, 2 ♂ (PMSL).

Remarks. Uchida & Isobe (1988) redescribed this small brown species in all life stages. Males have an acute, straight or slightly curved, usually pigmented spur on the basal cercal segment and the inner margin of this segment bears a fringe of setae along the apical half of the segment. The female forewing length is generally less than 11 mm and the egg has a distinctive "pine cone" appearance (Figs. 1-4).









Figs. 1-4. *Cryptoperla formosana* eggs. 1. Lateral aspect, 2. Oblique aspect anchor pole, 3. Anterior pole, 4. Chorionic plate detail.

Cryptoperla klapaleki, nom. n.
(Figs. 5-12)

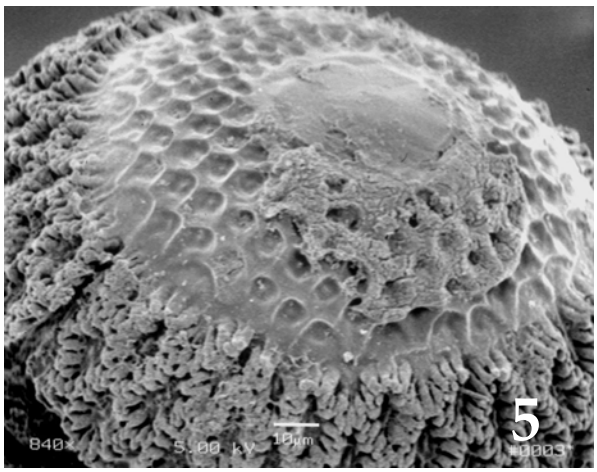
Peltoperla formosana Klapálek, 1913:123. Holotype ♀, Taihorin, Formosa (not *formosana* Okamoto, 1912:136). *Peltoperlopsis formosana*: Illies, 1966:24.

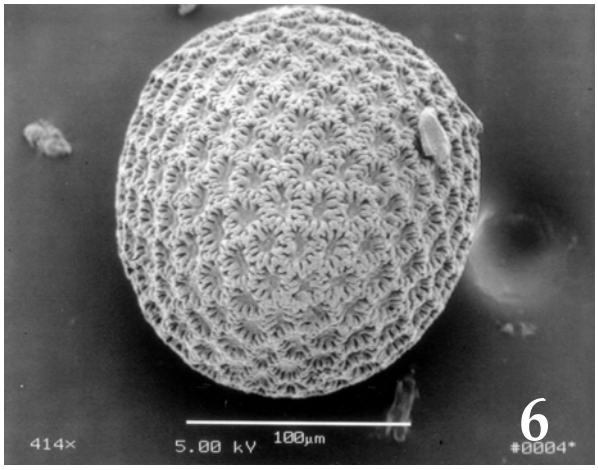
Material examined. Holotype ♀ from Taiwan, Taihorin, 7 May 1911, H. Sauter. Additional material: Taiwan: Hsin Chu Co., W Kuaishan, 1350 m, 17 October 96, I. Sivec, 1 ♂ (PMSL). Same site except 1140 m, 16 October 1996, I. Sivec, 1 ♂, 4 ♀, 1 exuvium (PMSL). Hua Lien Co., Tayuling, 2400 m, 26 October 1996, I. Sivec, 1 ♂ (PMSL). Hua Lien Co., Tzuen,

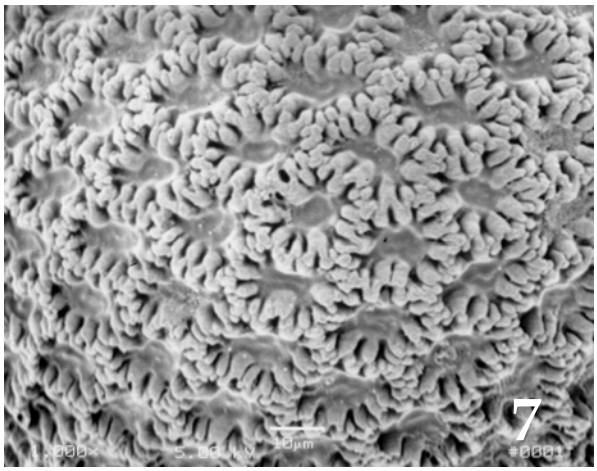
Taroko Natural Park, 1890 m, 13 April 1996, I. Sivec, B. Horvat, 1 ♂ (reared) (PMSL). Hua Lien Co., Anonymous Point, 1450 m, 5 April 1996, I. Sivec, B. Horvat, 5 ♂, 1 ♀ (PMSL). Ilan Co., E. Chihtuan, 1300 m, 19 March 1996, I. Sivec, B. Horvat, 1 ♀ (PMSL). Ilan Co., Chihtuan, 1110 m, 19 March 1996, I. Sivec, B. Horvat, 3 ♂ (PMSL). Kaoh Siung Co., E. Tientzu, 2400 m, 23 October 1996, I. Sivec, 1 ♂ (PMSL). Nanton Co., W. Puli, 880 m, 26 March 96, I. Sivec, B. Horvat, 1 ♀ (PMSL). Tai Chung Co., Wulin, 1950 m, Sheipa Natural Park, 29 October 1996, I. Sivec, 2 ♀ (PMSL). Tai Chung Co., Szchian-Lin, 550 m, 19 October 1996, I. Sivec, 2 ♂ (PMSL). Taipei Co., N. Shihpei, 350 m, 7 April 1996, I. Sivec, B. Horvat, 1 ♂ (PMSL). Taipei Co., N. Shihpei, 435 m, 7 April 1996, I. Sivec, B. Horvat, 1 ♂ (PMSL).Taipei Co., Gong Liao, 22 April 1995, P.L. Chang, Wang, 2 ♂ (PMSL)

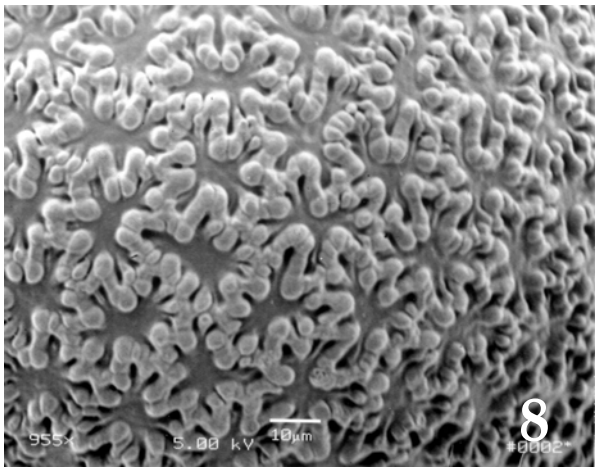
Adult habitus. Biocellate. General body color pale brown. Head pattern with a dark brown oval region anterior to ocelli connected to a narrow dark band between ocelli, or entire ocellar area dark; dark area behind ocelli somewhat paler (Fig. 9). Pronotum pale brown with paler rugosities. Wing membrane transparent or slightly tinted with pale brown; veins pale brown but R vein darker. Legs pale brown.

Male. Forewing length 10.5-12 mm. Posterior margin of tergum 10 parabolic (Fig. 10). Basal cercal segment ca. 3.5-4.5 X long as wide and bearing along inner margins, a dense but short setal fringe; cercal spur absent. Vesicle ca. 0.6-0.8 X long as wide. Aedeagal apex (possibly damaged) with three apparent major lobes (Fig. 11); mesal lobe broad and armed ventrally with a dense patch of dark brown microsetae and scattered fine, transparent setae; lateral lobes narrow, finger-like and armed along venter with ca. 30 pale brown, longer setal spines.

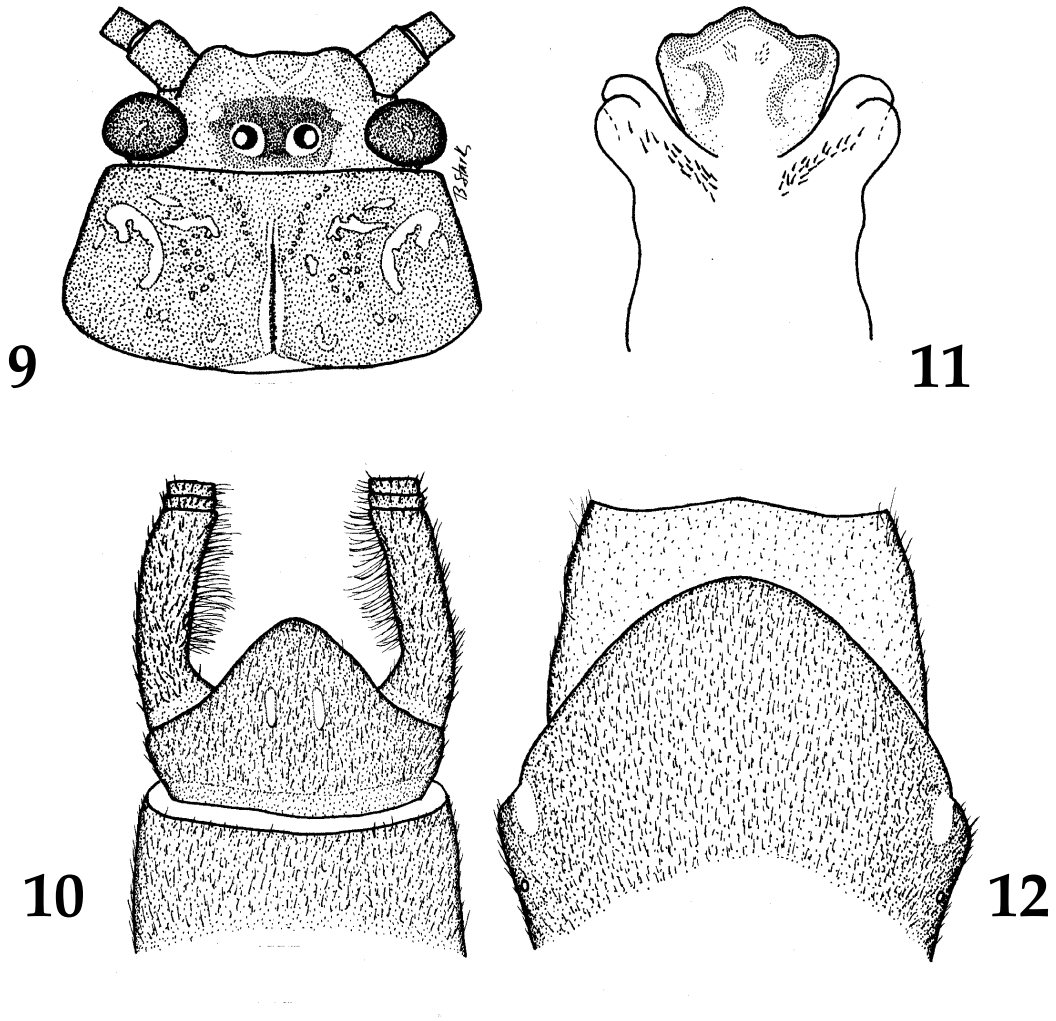








Figs. 5-8. *Cryptoperla klapaleki* eggs. 5. Oblique aspect anchor pole, holotype, 6. Oblique aspect anterior pole, holotype, 7. Chorionic detail, holotype, 8. Chorionic detail, specimen from E. Chihtuan, Ilan Co.



Figs. 9-12. *Cryptoperla klapaleki* structures. 9. Head and pronotum, 10. Male terminalia, 11. Aedeagus, ventral aspect, 12. Female sterna 8-9.

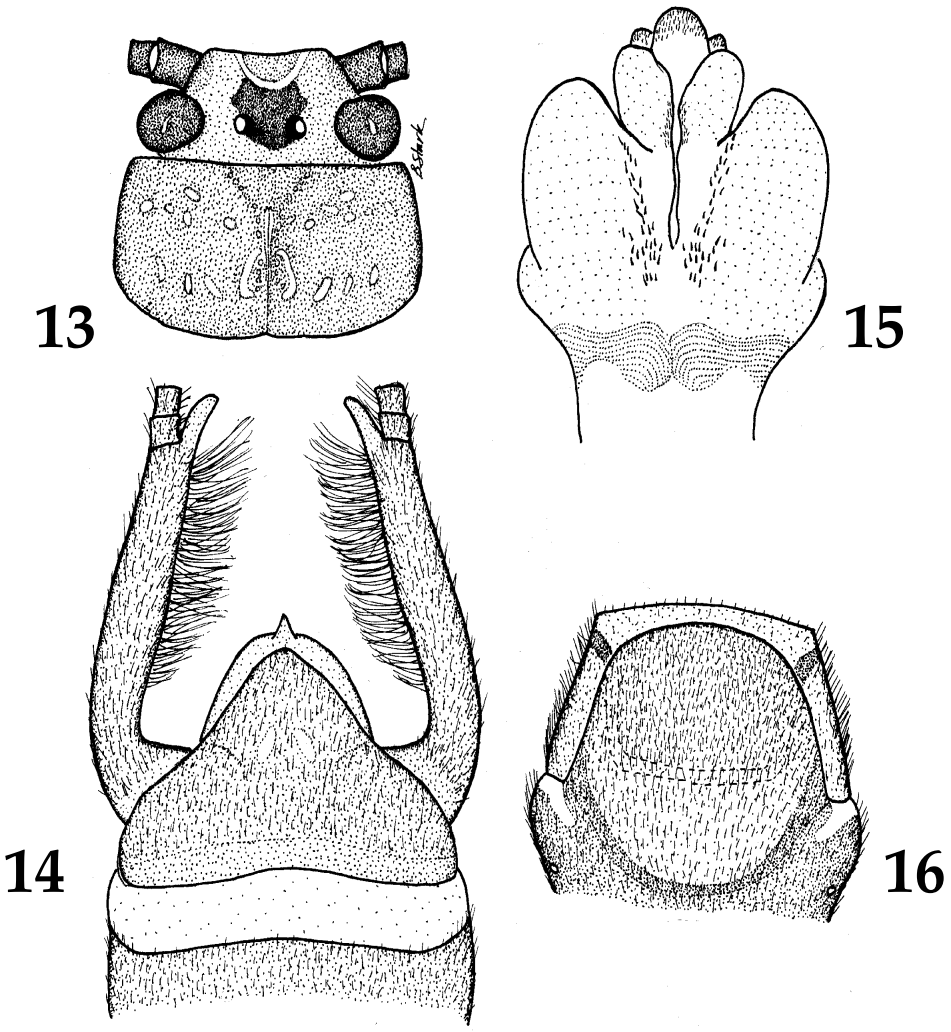
Female. Forewing length 12-15 mm. Subgenital plate parabolic and reaching beyond midlength of segment 9; segment 9 almost hairless except along lateral margins (Fig. 12).

Egg. Broadly oval, almost circular or bulb shaped in outline (Fig. 6), length ca. 0.21 mm, width ca. 0.20 mm. Collar sessile, button-like, but surrounded by zone of modified follicle cell impressions (Fig. 5). Chorion covered throughout by follicle cell impressions with elaborate, convoluted walls (Figs. 7-8). Micropyles not detected.

Larva. The larva appears to be indistinguishable from that of *C. uchidai*, described below.

Etymology. The patronym honors F. Klapálek for his original description of this and other Taiwanese stoneflies.

Diagnosis. Eggs from the holotype (Figs. 5-7) are quite similar to those from fresh material (Fig. 8), but some variation is obvious; when a larger sample of eggs are available it may be necessary to re-evaluate the status of these recent specimens. This is the only Taiwanese species we recognize, at present, which lacks a cercal spur; unfortunately for most of our specimens the aedeagus could not be properly examined because they had been damaged during squeezing. Consequently it would be highly desirable to have additional males for this comparative study.



Figs. 13-16. *Cryptoperla uchidai* structures. 13. Head and pronotum, 14. Male terminalia, 15. Aedeagus, ventral aspect, 16. Female sterna 8-9.

***Cryptoperla uchidai* sp. n.**
(Figs. 13-18)

Material examined. Holotype ♂ and ♀ paratype from Taiwan, Taipei Co., Wulai Shinoi, 350 m, 8 April 1996, I. Sivec (PMSL). Additional paratypes: Taipei-hsien, Wulai, 11 April 1982, S. Uchida, 3 ♀ (PMSL). Same site, 18 April 1982, 1 ♂, S. Uchida (reared, PMSL). Additional material: Type locality, 8 April 1996, I. Sivec, 1 nymph, 1 exuvium (PMSL). Taipei-hsien, Wulai, 2 April 1982, S. Uchida, nymphs (PMSL).

Adult habitus. Biocellate. General color yellow brown. Head with dark brown spot forward of ocelli, paler in interocellar area (Fig. 13). Pronotum pale brown with numerous small pale rugosities scattered over disc. Wing membrane and veins pale. Femora pale, tibiae brown.

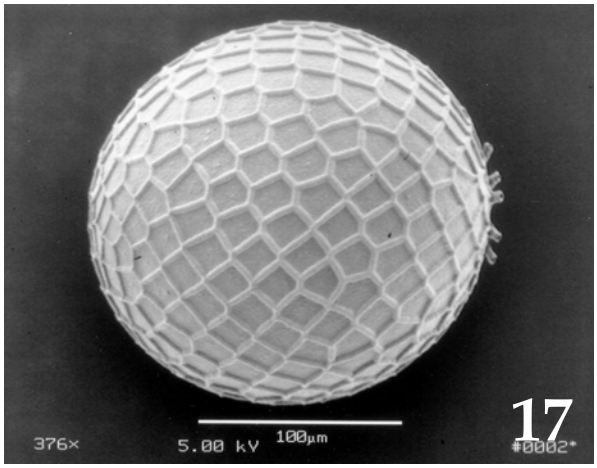
Male. Forewing length 12.5 mm. Posterior margin of tergum 10 parabolic; epiproct a membranous bulb with small recurved mesal projection (Fig. 14). Basal cercal segment ca. 6X long as basal width and with a dense inner marginal hair fringe; apex of basal segment armed with a transparent thumb shaped spur. Vesicle ca. 0.7X long as wide. Aedeagus complexly lobed; major ventral lobes armed along either side of mesal cleft with patches of ca. 25 long setae (Fig. 15); major apical lobe armed with dense

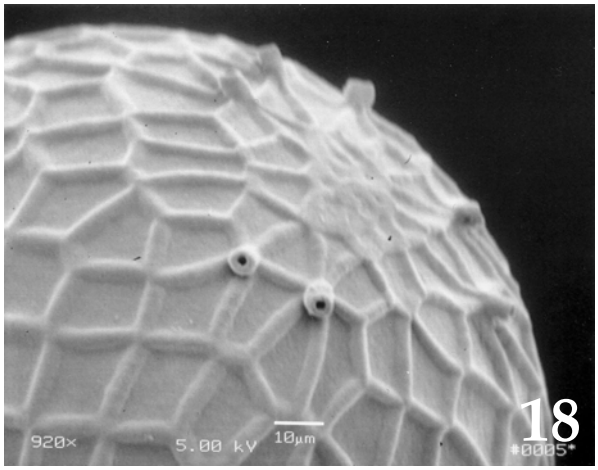
patch of short dark setae; microtrichia scattered over much of ventral surface form patches basolateral to major ventral lobes; dorsum of mesal aedeagal lobe armed with scattered fine ridges, microtrichia and microscales.

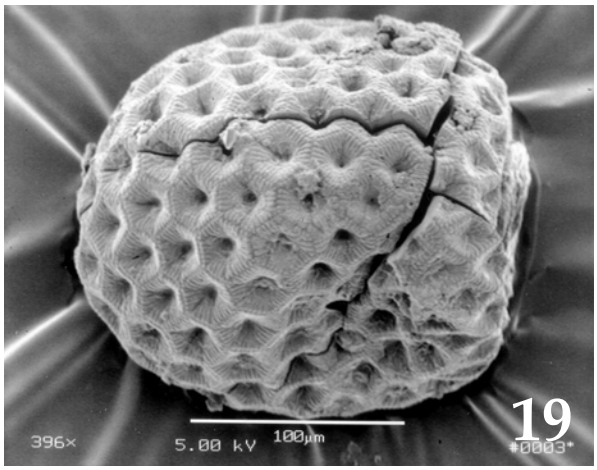
Female. Forewing length 14.0 mm. Subgenital plate parabolic and reaching near posterior margin of sternum 9 (Fig. 16). Sternum 9 bare except laterally and along posterior margin.

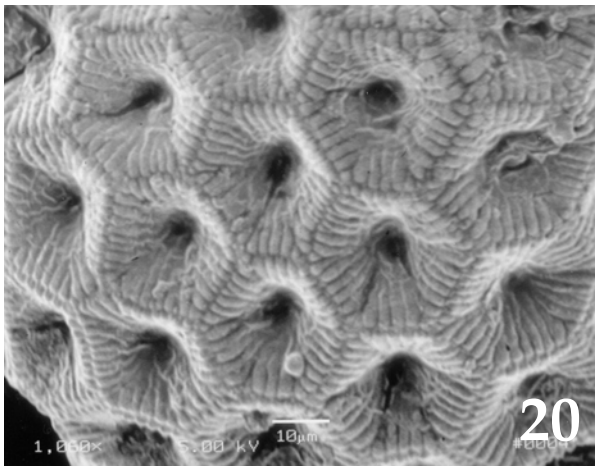
Egg. Outline broadly oval to almost circular in outline. Length ca. 0.21 mm, width ca. 0.20 mm. Collar sessile, but surrounded by triangular follicle cell impressions and an irregular ring of stalked micropyles (Figs. 17-18). Chorion covered throughout by square to hexagonal follicle cell impressions; walls narrow and raised above flat, impunctate floors.

Larva. Pre-emergent body length 9-10 mm. General color brown patterned with pale areas on dorsum of thorax and abdomen. A single supracoxal gill occurs laterally under mesonotal and metanotal wing pads, gills absent from prothorax; each paraproct with a single long slender dorsal gill and ventral apex of tergum 10 with a similar, ventrally directed gill. Posterior metasternal margin truncate and completely fringed by a row of close set, erect, clavate setae; lateral row of clavate setae around coxa continues onto sternal plate as a short row approaching furcal pit. Mesosternal plate with a short, subapical clavate setal row near posterolateral angles; lateral row around coxa continues onto sternal plate as a short row near midlength of plate. Prosternum with a complete anterior marginal row of clavate setae and a subapical row near posterolateral angles of plate. Abdominal sterna with









Figs. 17-20 *Cryptoperla uchidai* and *Cryptoperla* sp. Tw A. eggs. 17. *C. uchidai*, lateral aspect, 18. *C. uchidai* oblique anterior pole, 19. *C.* Tw A, lateral aspect, 20. *C.* Tw A chorionic detail.

posterior fringes of close set, erect clavate setae similar to thoracic sternal fringes. Cerci long with ca. 40 segments; ventral segmental bristle whorls include 4-5 large, erect, close set, blade shaped setae on most segments; apical segments also with a ventral fringe of fine long setae.

Etymology. We take great pleasure in naming this species for our colleague and friend, S. Uchida. Dr. Uchida generously shared his notes and an egg sample taken from the holotype of Klapálek's (1913) *P. formosana* specimen, and he also provided the first specimens of this species for our study.

Diagnosis. Among known Taiwanese *Cryptoperla*, males of this species are most similar to *C. formosana* in having a prominent cercal spur. In *C. formosana* the spur is straight to slightly curved, more acute, and amber in color and the forewing length is less than 10 mm. The distinctive eggs should permit identification for gravid specimens.

Cryptoperla sp. Tw A
(Figs. 19-20)

Peltoperla formosana Stark, 1989:521 (not *formosana* Klapálek).

Material examined. Taiwan: Chito Experimental Forest, 1150 m, 12-15 October 1957, T.C. Maa, 1 ♀ (BPBM, specimen lost). Chaochi near Yilan to Pinglin, Taipei, Hsien, 15-16 April 1965, C.M. Yoshimoto, 1 ♀ (BPBM, specimen lost).

Male. Unknown.

Female. Forewing length 11 mm. Subgenital plate parabolic, reaching near posterior margin of sternum 9 (Fig. 79 in Stark 1989).

Egg. Outline bulb shaped. Collar an obscure low button surrounded by a broad, smooth depression. Chorionic surface covered with hexagonal follicle cell impressions. FCI walls thick and slanted inward creating small, flat floors; floors with a single central pore; rims and walls covered with irregular parallel ridges which almost meet on the rim, but leave a narrow irregular line around each FCI. Micropyles near collar end set at junction of FCIs (Figs. 19-20).

Diagnosis. These females were described by Stark (1989) who speculated "they may represent this [*P. formosana* Klapálek] species". Our study of the eggs from the holotype of that species ends that speculation, and we are left with the possibility that these females represent a species distinct from any of the others known from Taiwan. Unfortunately, the specimens are missing from the Bishop Museum. Hopefully additional material of this species will become available in the near future.

ACKNOWLEDGMENTS

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