



THE GENUS *TOGOPERLA* Klapálek (PLECOPTERA: PERLIDAE)

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ABSTRACT

The genus *Togoperla* Klapálek is reviewed and 11 eastern Palearctic and Oriental species are considered valid. Most known species are redescribed from type material, several new synonymies are proposed, and keys are provided for the identification of male and female specimens. *Togoperla clavata* sp. n., from Vietnam is described and *Kamimuria poilanina* Navas is transferred to *Togoperla*.

Keywords: *Togoperla*, Plecoptera, Southeast Asia, New species

INTRODUCTION

Togoperla was proposed by Klapálek (1907) as a subgenus of *Perla* with *Perla limbata* Pictet designated as type (Klapálek 1923). Although the genus was considered valid throughout the last century, its history is intertwined with that of *Paragnetina* Klapálek, and the two are considered sister genera in the phylogeny proposed by Sivec et al. (1988).

The confusion surrounding these genera was addressed by Ricker (1949) for five American species which he transferred to *Paragnetina*. Needham & Claassen (1925) and Frison (1935, 1937) had included some of these species in *Togoperla*, treated first as a subgenus of *Perla*, and later as a valid genus. Following Ricker's (1949) study, *Togoperla* has been restricted to a few poorly known Asian species (Illies 1966; Zwick 1973a; Sivec et al. 1988). In the latter study 17 potential *Togoperla* names were reduced to four through synonymy, transferral to other genera and exclusion due to poor condition of type material. Because it was beyond the scope of the Sivec et al. (1988) review of Perlinae genera to include descriptions of individual species we have combined these data with descriptions from subsequent studies (Stark & Sivec 1991; Uchida 1990; Du & Chou 1999)

to provide a species level treatment which can serve as a basis for further study of the genus.

Specimens were borrowed from, or are deposited with, the following museums and individuals as indicated in the text: British Museum of Natural History, London (BMNH); California Academy of Sciences, San Francisco (CAS); C.P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins (CSU); Institute of Ecology and Biological Resources, Hanoi (IEBR); Museum of Comparative Zoology, Harvard University, Cambridge (MCZ); Museum National d'Histoire Naturelle, Paris (MNHN); National Museum of Natural History, Prague (NMP); Slovenian Museum of Natural History, Ljubljana (PMSL); Royal Ontario Museum, Toronto (ROM); S. Uchida, Toyota, Japan (SU); United States National Museum, Washington (USNM); Zoological Institute, Polish Academy of Sciences, Warsaw (ZIP); Zoologische Staatssammlung, Munich (ZSM); Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMB); Zoological Institute, Academia Sinica, Beijing (ZIAS); Zoologisches Museum der Humboldt-Universität, Berlin (ZMB); B.P. Stark, Clinton (BPS).

RESULTS AND DISCUSSION

Genus *Togoperla* Klapálek, 1907

Type species.- *Perla limbata* Pictet, 1841.

Distribution.- Eastern Palearctic and Oriental regions.

Known from China, Japan, Thailand and Vietnam.

Diagnosis. Adult *Togoperla* are large, typically dark, and fully winged. Males of all known species have a well developed, truncate, emarginate or slightly notched lobe on the 5th abdominal tergum and large mesal membranous areas on terga 6-9 which often bear setal clusters but seldom have sensilla basiconica patches. Male hemiterga have a basal callus and a relatively short (in comparison to *Agnestina*) anterior process. The aedeagal tube of all species has a basodorsal lobe and most also have a pair of lateral lobes on the tube; the membranous apical sac is coarsely armed with small triangular spines. Females have a large parabolic subgenital plate, frequently with a median sclerite in the dorsal membrane of the plate. The subgenital plate in several species is emarginate or shallowly notched but no examples of narrow deep notches are known for the group. Egg collars are absent for most species, but two species have a sessile collar without a flanged rim and another has a small thickened polar disc. Larvae are associated for only one species, *T. limbata* (Pictet) (Sivec et al. 1988), which lacks anal gills, has few (usually 1-2) slender intercalary setae on abdominal terga, and lacks a median dorsal fringe of long silky setae. Provisional keys for adult *Togoperla* are presented below the species accounts.

Current species. 1) *canilimbata* (Enderlein, 1909); 2) *clavata* sp. n.; 3) *fortunati* Navas, 1926; 4) *limbata* (Pictet, 1841); 5) *noncoloris* Du & Chou, 1999; 6) *perpicta* Klapálek, 1921; 7) *poilanina* (Navas, 1934); 8) *shan* Stark & Sivec, 1991; 9) *totanigra* Du & Chou, 1999; 10) *triangulata* Du & Chou, 1999; 11) *tricolor* Klapálek, 1921.

Togoperla canilimbata (Enderlein)

(Figs. 1-6, 57-58)

Perla canilimbata Enderlein, 1909:347. Lectotype ♀ (ZIP), Manson-Gebirge, Vietnam. Designation Zwick, 1973b
Paragnetina tonkinensis Navas, 1919:187. Holotype ♀

(MNHN, damaged), Vietnam. nov. syn.

Togoperla sinensis Banks, 1939:442. Holotype ♂ (MCZ), Yim Na San, Kwangtung [Guangdong], China, nov. syn.

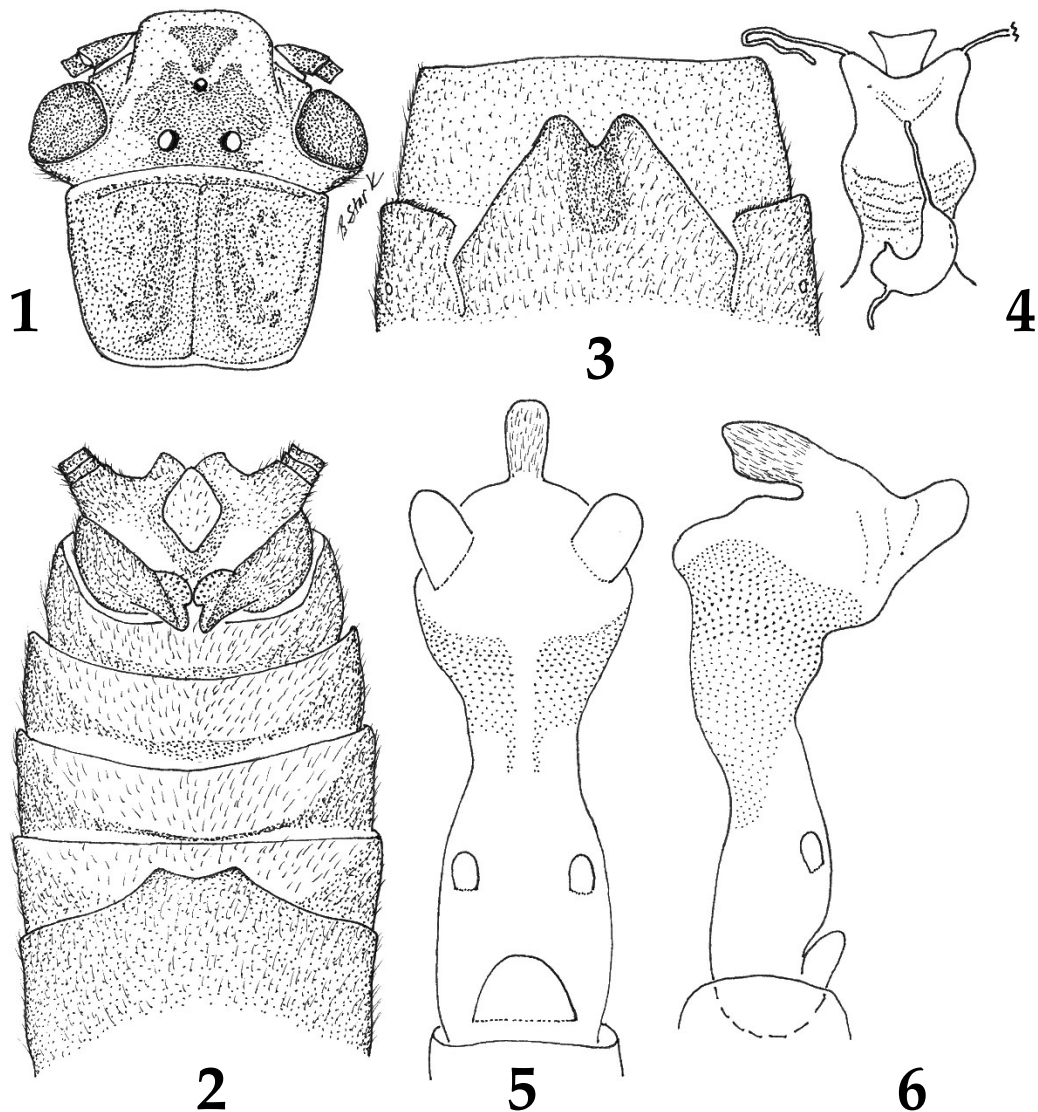
Togoperla klapaleki Banks, 1939:443. Holotype ♀ (MCZ), Yim Na San, Kwangtung [Guangdong], China, nov. syn.

Material examined. China: Guangdong, Yim Na San, 11-16 June 1936, L. Gressitt, 3 ♀ (MCZ, *T. klapaleki* holotype and paratypes). Same location, 11-16 June 1936, L. Gressitt, 1 ♂, 1 ♀ (MCZ, *T. sinensis* holotype and paratype). Vietnam: Manson-Gebirge, 2-3000', April-May, H. Fruhstorfer, 2 ♀ (ZIP, *T. canilimbata* lectotype and paralectotype). Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, UV light, 8 May 1995, ROM 956022, D. Currie, B. Hubley, J. Swann, 16 ♂, 1 ♀ (ROM, IEBR, BPS). Lao Cai, Sapa, Fan Si Pang Mountain, 22-29 April 1995, 1600 m, 2 ♂ (ZMB).

Adult habitus. General color dark brown, patterned with yellow. Head dark brown over ocelli, extending laterally over calluses and forward to M-line; a broad triangular dark patch is located forward of M-line (Fig. 1); head pale laterally and behind eyes on occiput. Pronotum brown with scattered paler rugosities. Wings dark brown except costal area pale to cord. Legs banded; both femora and tibiae with pale mesal band and dark basal and apical bands.

Male. Forewing length 24-26 mm. T5 produced as an emarginate lobe; T6-T9 typical with anterior margin and lateral areas sclerotized and mid section membranous; membrane of T6-T9 and lobes of T5 somewhat hairy (Fig. 2). Dorsal aspect of hemiterga relatively short, length from basal callus to hemitergal tip about equal to length of basal callus. Membranous aedeagal sac terminating in a pair of slender, bare lateral lobes and a slender median lobe armed with fine brown setal spines; subapical area of aedeagus armed with a coarse band of triangular spines and microtrichia (Figs. 5-6); spine band narrowly interrupted mid-dorsally but forming a complete band to beyond mid-length on venter. Dorsobasal area of aedeagus bearing a pair of small, bare lateral lobes.

Female. Forewing length 28-30 mm. Subgenital plate parabolic, usually with a median notch or emargination; plate extends over much of S9 (Fig. 3); dorsal sclerite of plate not reaching to lateral margins



Figs. 1-6. *Togoperla canilimbata*. 1. Head and pronotum, 2. Male terminalia, 3. Female terminalia, 4. Vagina, 5. Aedeagus, dorsal aspect, 6. Aedeagus, lateral aspect.

of sternum 8. Vagina with small bulge at midlength (Fig. 4); vaginal accessory glands subequal to vagina in length.

Egg. Length 0.42-0.44 mm, width 0.30-0.32 mm. Collar absent, general shape oval (Fig. 57). Micropylar row set near equator. Chorion smooth (Fig. 58).

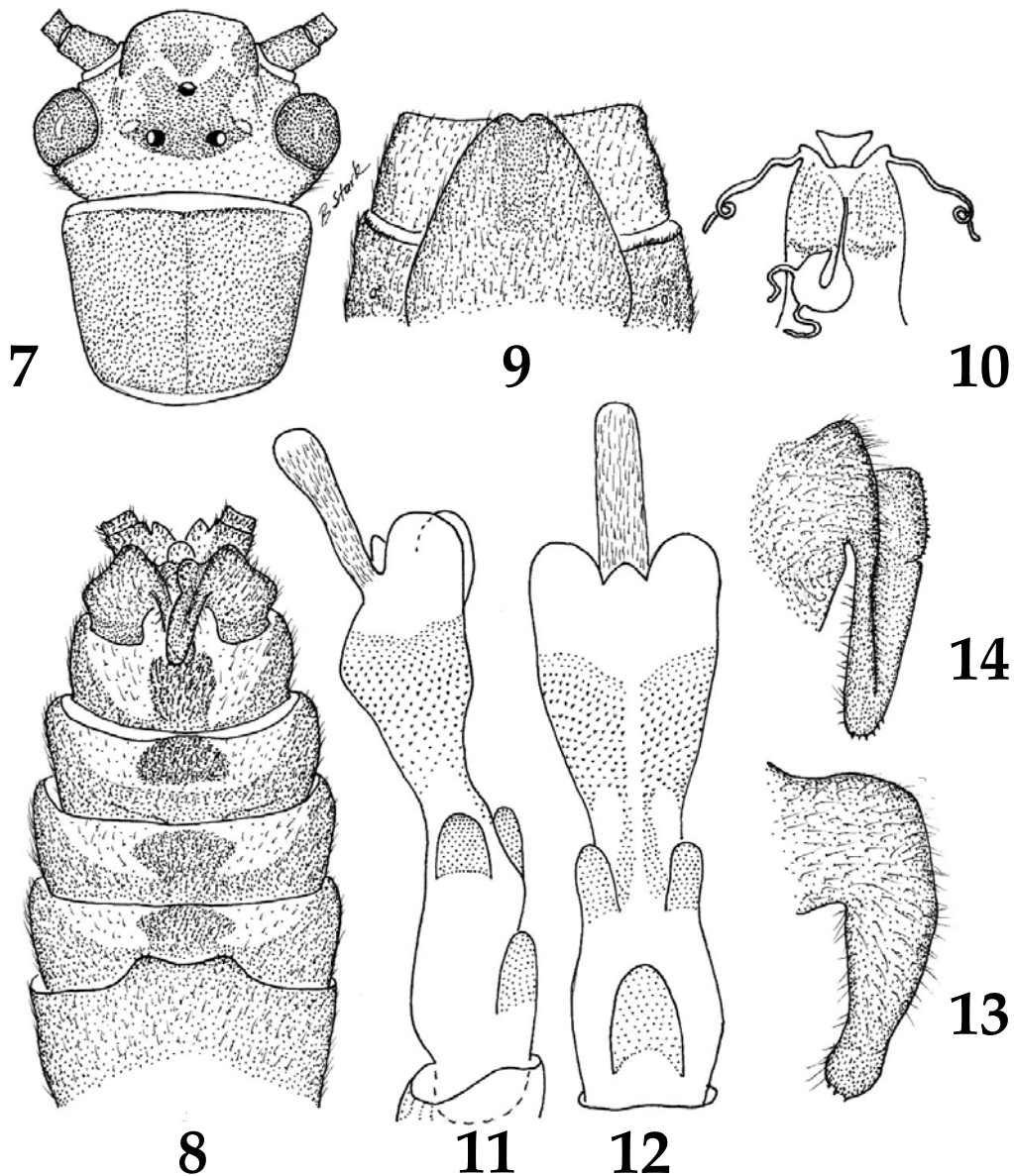
Distribution. Known from southeastern China and northern Vietnam.

Remarks. Sivec et al. (1988) considered *T. canilimbata*, *T. fortunati* and *T. grahami* as synonyms and this was

repeated by Du & Chou (1999). Zwick (1973b) found syntype females of *T. canilimbata* and illustrated the lectotype subgenital plate and vagina; although the subgenital plate is shown without emargination, this is present on the paralectotype and the two specimens agree in coloration and in vaginal shape. Evidently the subgenital plate margin shows some variation in the expression of a notch or emargination. One of us (IS) examined the lectotype and paralectotype and noted both femora and tibiae have wide yellow median bands which are larger on

the hind legs. This color pattern is in agreement with the leg pattern of *T. klapaleki* and *T. sinensis* described by Banks (1939) as "...black band at base and tip of femora and tibiae as in *perpicta*." Types of *T. fortunati* and *T. grahami*, however, lack pale tibial bands and also lack a dark basal band on the femora, consequently these species are removed from synonymy with *T. canilimbata*. A consequence of these changes in synonymy is the male of this species is now based on *T. sinensis* and the recent material from Vietnam with short hemitergal lobes, rather

than *T. fortunati* and *T. grahami* with long hemitergal lobes. *Togoperla tonkinensis* had been reported only from the holotype, supposedly a male, but with the abdomen missing. The damaged specimen from Vietnam, in the Museum National d'Histoire Naturelle has the head, thorax, wings and some legs intact. The legs show the characteristic banding pattern associated with *T. canilimbata* and allows the placement of *T. tonkinensis* as a synonym of that species.



Figs. 7-14. *Togoperla clavata*. 7. Head and pronotum, 8. Male terminalia, 9. Female terminalia, 10. Vagina, 11. Aedeagus, lateral aspect, 12. Aedeagus, dorsal aspect, 13. Male hemitergum, lateral, 14. Male hemitergum, dorsal.

Togoperla clavata sp. n.
(Figs. 7-14)

Material examined. Holotype ♂ (alcohol) and 7♂, 1 ♀ (pinned) from Vietnam, Vinh Phu, Tam Dao Hill Station, stream 5 km along trail at west edge of town, UV light, 11 May 1996, B. Hubley, M. Hanson, ROM 961013 (ROM). Additional paratypes: Vietnam: Vinh Phu, Tam Dao, lower waterfall of stream flowing through town, UV light, 11 May 1996, B. Hubley, D.C. Darling, ROM 961030, 4 ♂ (ROM, IEBR). Vinh Phu, Tam Dao Hill Station, 2 km along trail at west edge of town, 4-31 May 1996, ROM 961005, B. Hubley, 1 ♀ (pinned, ROM). Thua Thien-Hue, Bach Ma National Park, Campsite trail, edge of small stream, 1200 m, 2 June 2000, ROM 2000502, B. Hubley, 1 ♀ (pinned, ROM).

Adult habitus. General color dark brown. Head mostly brown except for pale M-line and sublateral areas between lappets and dark area along anterior frons (Fig. 7); area between eyes almost entirely dark brown. Pronotum dark brown with darker rugosities and slightly paler area along median suture. Wings dark brown, veins darker except for pale band on costa from base to cord. Femora banded with basal yellow band and dark brown apical band; tibiae and tarsi dark brown.

Male. Forewing length 21-23 mm. Hairbrushes well developed on metathoracic basisternum and abdominal sterna 6-7, weakly developed on sterna 5 and 8. Abdominal tergum 5 produced into a truncate or emarginate lobe partially covering T6; T6-9 with mesal sclerite set in large membranous posteromesal field bearing long setae (Fig. 8). Hemitergal finger process longer than basal callus, area forward of callus ca. 1.8X longer than callus; process deeply grooved between lateral margin and callus in dorsal aspect, and somewhat club shaped in lateral aspect (Figs. 13-14). Basolateral lobes of aedeagal tube well developed and covered with fine spines; aedeagal sac armature consists of coarse triangular spines and smaller spicules covering most of sac in lateral and dorsal aspects (Figs. 11-12); patch terminates at level of lateral lobes and is constricted on dorsal surface forward of lobes; patch is very narrowly divided along median field. Sac bears a pair of apical dorsolateral lobes and a smaller mesal one above a terminal ventroapical polyp shaped lobe; the latter lobe bears a sparse coat of fine, long setal-like spines.

Female. Forewing length 26-29 mm. Subgenital plate parabolic with small apical emargination (Fig. 9); dorsal sclerite present on plate; intersegmental membrane between sterna 9 and 10 covered with microtrichia. Vagina slightly swollen posterior to midlength (Fig. 10) and lined with pale brown spinules.

Egg. Outline oval, collar absent, chorion smooth, similar to *T. canilimbata*.

Larva. Unknown.

Etymology. The species name refers to the club shaped lateral aspect of the male hemitergal lobes.

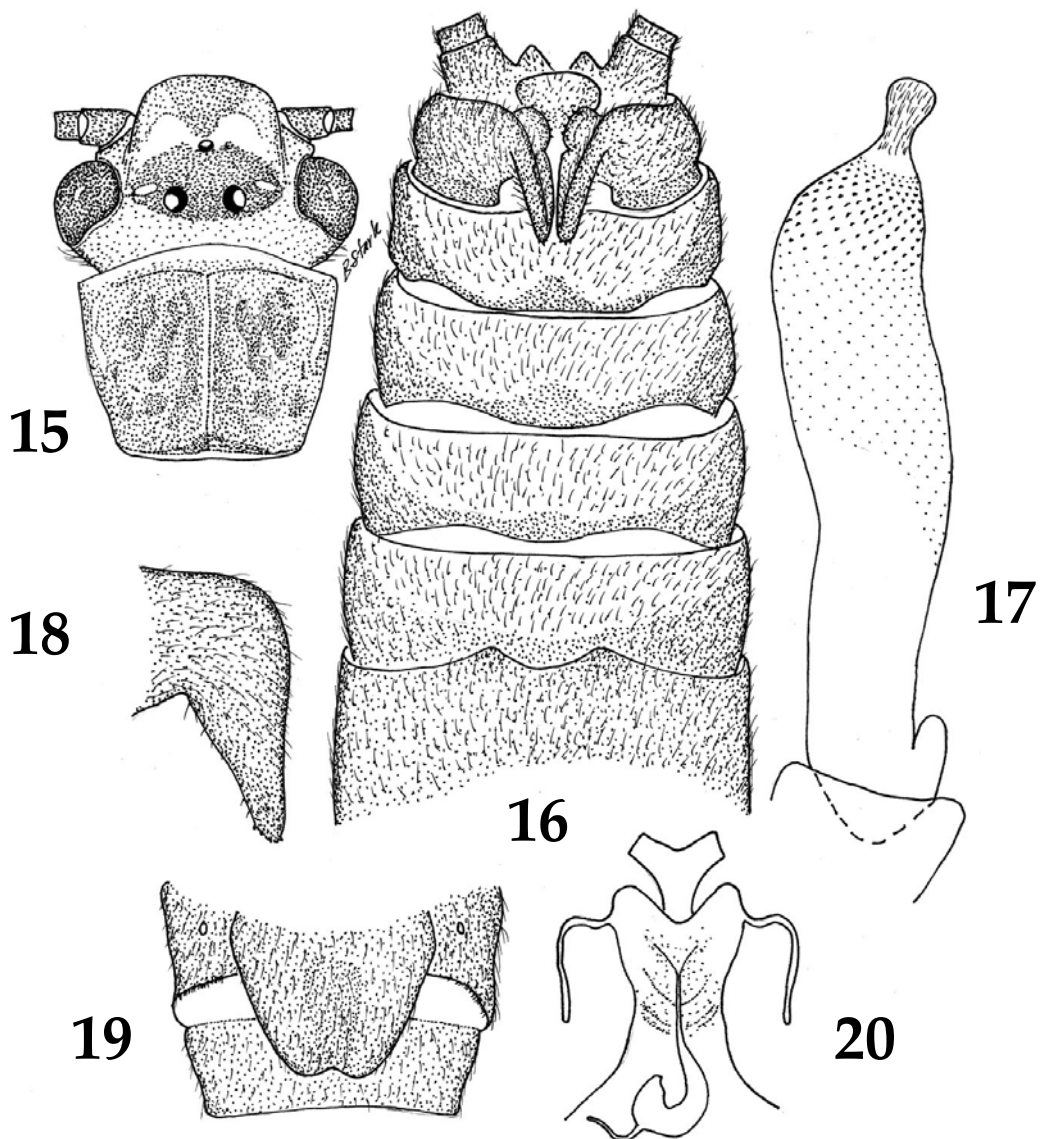
Diagnosis. The long hemitergal lobes and banded femora are similar to those of *T. poilanina* (see below) and *T. fortunati*. It differs from males of the latter in shape of the hemitergal lobes in lateral aspect and in aedeagal armature and shape. The aedeagus for *T. fortunati* is more cylindrical, lacks the basolateral lobes and also differs in armature patterns. Externally the presence of brown sclerites on terga 6-9 is typical of *T. clavata* but not *T. fortunati*. Two of the Chinese species described by Du & Chou (1999) also share these tergal sclerites, but neither have the same pattern of aedeagal armature and one of them (*T. noncoloris*) also differs in pigment pattern and in hemitergal lobe shape. The subgenital plate form will not distinguish females of this species from other *Togoperla*, but the barrel shape of the vagina and the color pattern will help in recognition.

Togoperla fortunati (Navas)
(Figs. 15-20)

Paragnetina fortunati Navas, 1926:106. Holotype ♂ (MNHN), Kweiyang [Guiyang], Guizhou Province, China

Togoperla grahami Banks:1940:176. Holotype ♂ (USNM), Lin Ngai Si, near Kuanshien [Guanxian], Sichuan Province, China

Material examined. China: Kweiyang, Kouy-Tcheou, Fujian Province, 1906, P.P. Cavalerie and Fortunat, 1 ♂ (MNHM, *T. fortunati* holotype). Sichuan Province, Lin Ngai Si, near Kuanshien, 3500', 20 September 1930, D.C. Graham, 1 ♂ (USNM, *T. grahami* holotype). Sichuan Province, Emei Shan, 710 m, 20 June 1979, 1 ♂, 1 ♀ (ZIAS). Sichuan Province, Won Chuan, August 1938, D.C. Graham, 1 ♀ (USNM). Sichuan Province, Kuanshien, 3-13 July 1937, 1 ♂, 3 ♀ (MCZ).



Figs. 15-20. *Togoperla fortunati*. 15. Head and pronotum, 16. Male terminalia, 17. Aedeagus, lateral aspect, 18. Male hemitergum, lateral, 19. Female terminalia, 20. Vagina.

Adult habitus. General color brown to dark brown. Ocellar area covered by dark brown quadrangular spot and area forward of M-line with smaller triangular dark area (Fig. 15); occiput pale brown. Pronotum dark brown with scattered rugosities. Wings brown with pale costal area. Femora banded, pale basally and dark apically; tibiae dark brown.

Male. Forewing length 20-22 mm. T5 produced into an emarginate lobe; T6-9 with large mesal, membranous field covered with fine setae (Fig. 16).

Projecting portion of hemitergum about twice as long as basal callus in dorsal aspect, gradually tapered to rounded tip in lateral aspect (Fig. 18). Aedeagus cylindrical, relatively straight and armed with microtrichia and small triangular spines over most of apical half (Fig. 17); apex terminating in a slender cylindrical lobe armed with fine brown setal spines; basolateral lobes absent.

Female. Forewing length 24-26 mm. Subgenital plate covers most of sternum 9 and is slightly emarginate

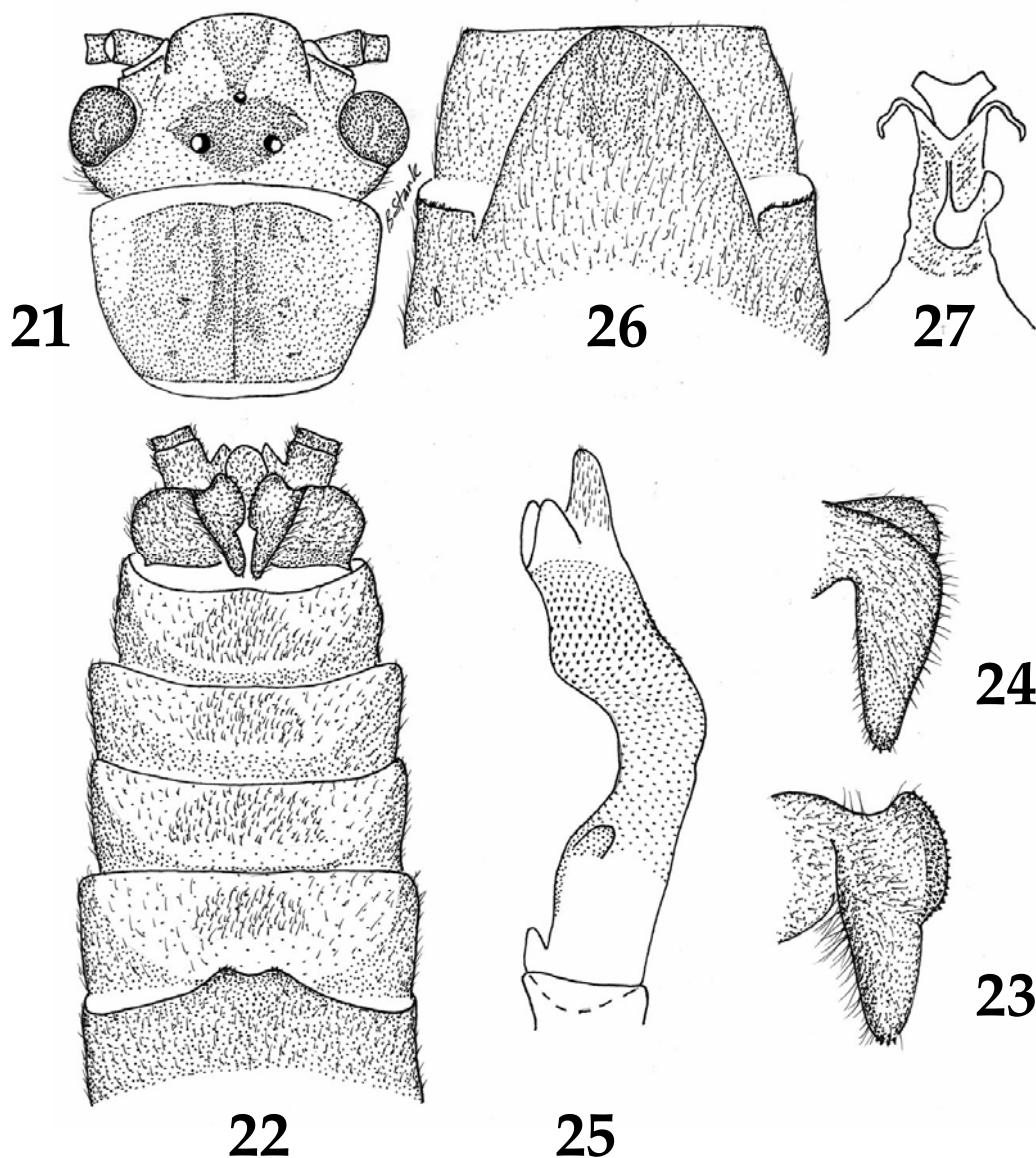
or entire on posterior margin (Fig. 19). Vagina constricted near midlength; accessory glands less than half as long as vagina (Fig. 20).

Egg. Outline oval. Collar absent. Chorion smooth, similar to *T. canilimbata*.

Larva. Unknown.

Remarks. This species is known from southwest China, primarily from the *T. fortunati* and *T. grahami*

type series. Sivec et al. (1988) listed it as valid, but erroneously placed *T. canilimbata* as a synonym; had *T. canilimbata* and *T. fortunati* remained synonyms, the former species would have priority. As discussed above under *T. canilimbata*, these species are now regarded as distinct, primarily due to differences in leg banding patterns and distribution.



Figs. 21-27. *Togoperla limbata*. 21. Head and pronotum, 22. Male terminalia, 23. Male hemitergum, dorsal, 24. Male hemitergum, lateral, 25. Aedeagus, lateral aspect, 26. Female terminalia, 27. Vagina.

***Togoperla limbata* (Pictet)**
(Figs. 21-27)

Perla limbata Pictet, 1841:219. Lectotype ♂ (ZMB), Japan, desig. Zwick, 1972
Perla (Togoperla) kawamurae Okamoto, 1912:123. Holotype ♀ (Hokkaido University, Sapporo, lost), Japan, syn. Sivec et al., 1988.
Perla (Togoperla) matsumurae Okamoto, 1912. Lectotype ♀, (Hokkaido University, Sapporo), Haki, Japan, design. Uchida, 1990, syn. Sivec et al., 1988.

Material examined. Japan: Unknown locality, 4 July 1981, S. Uchida, 1 ♂ (PMSL). Hozuyama, Kuwada Gori, Tamba, June 1897, 3 ♀ (??). Honshu, Obama, May 1926, 1 ♂ (CSU).

Adult habitus. General color brown. Head with dark brown pigment over ocelli and forward of M-line; occiput dusky brown. Pronotum brown but usually with pale anterolateral areas on disc (Fig. 21). Wings brown except costal area pale. Legs entirely brown, without distinctive banding.

Male. Forewing length 19-22 mm. T5 produced into a notched or emarginate lobe; T6-T9 typical; membrane of T6-T9 bearing patches of mixed setae and scattered sensilla basiconica. Dorsal aspect of hemiterga moderately long and attenuated from basal callus to tip; length from basal callus to hemitergal tip about 1.3-1.5 times as long as basal callus (Fig. 22); lateral aspect of hemiterga slender across basal curve and gradually narrowed to form a slender triangular structure (Fig. 23); sensilla basiconica clustered on basal callus and sparse on hemitergal tip. Membranous aedeagal sac armed with a coarse band of variably sized spines from subapical lobes to about midlength of tube (Fig. 25); largest spines occur in a band somewhat proximal to margin of spinous zone; apex of sac extends as a nose like lobe below a pair of membranous, unarmed dorsal lobes; apical lobe armed at tip with a zone of slender, long spines; tube with a pair of midlateral spiny lobes.

Female. Forewing length 24-29 mm. Subgenital plate parabolic without apical emargination or notch. Dorsal membrane of plate with a short sclerotized mesal band reaching less than halfway to base of plate (Fig. 26). Vagina with essentially parallel sides, or sides slightly constricted at back of chamber (Fig. 27); accessory glands about half as long as vagina.

Egg. Length 0.38-0.42 mm, width 0.31-0.34 mm.

Collar expressed as a small dark brown disc. Micropyles oriented almost perpendicular to long axis of egg; micropylar row set almost halfway between equator and pole.

Distribution. Known only from Japan.

Remarks. Sivec et al. (1988) proposed the synonymy of *T. kawamurae* and *T. matsumurae* with *T. limbata* but omitted supporting data. Uchida (1990) supported these synonymies in his thesis, but this has remained unpublished. We accept and validate the lectotype for *T. matsumurae*, previously selected by Uchida (1990) in his thesis, which bears label data of, Haki, 8/10, *Perla matsumurae* Okam., Sesuji-kawagera, & Lectotype, *Perla matsumurae* Okamoto, S. Uchida det. 1984, HU, and is in the Hokkaido University collection, Sapporo. Uchida (1990) also described a second Japanese *Togoperla* species, generally similar to *T. limbata*, but differing in details of aedeagal armature, however this description has not been published and we have seen no material. Male hemiterga of this species are generally similar to those of *T. fortunati*, *T. poilanina* and others, however it is easily distinguished by virtue of geography and by the pattern of armature on the aedeagus.

***Togoperla noncoloris* Du & Chou**

Togoperla noncoloris Du & Chou, 1999:3. Holotype ♂ (Zhejiang University), Jinxiu, Guangxi, China

Remarks. We have seen no material of this species, but it appears distinctive by virtue of its pale wing pigmentation. The hemitergal lobes are short, the basolateral lobes of the aedeagal tube are small and bare, and the dorsoapical spine patch is fused mesally (Du & Chou 1999).

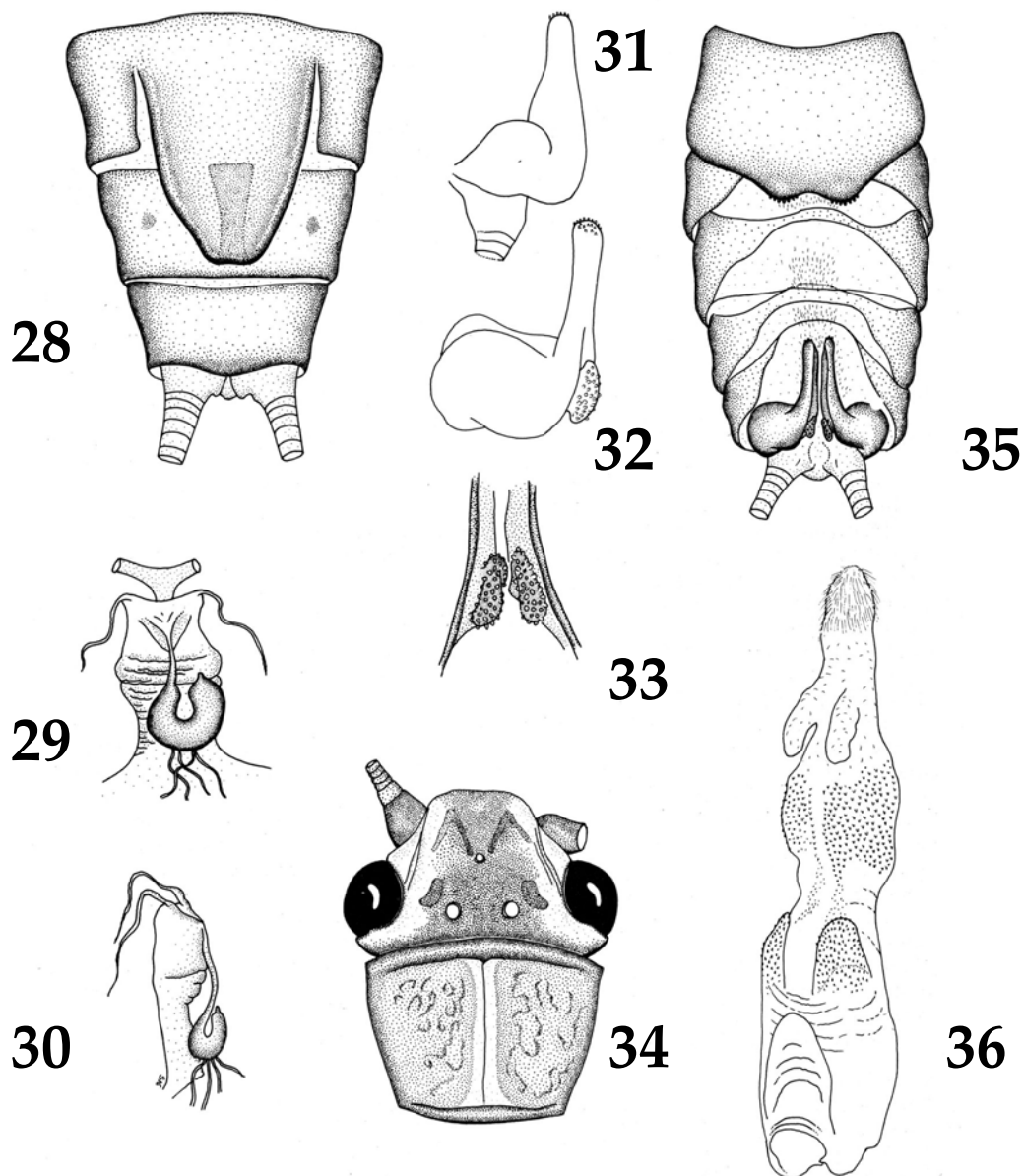
***Togoperla perpicta* Klapálek**
(Figs. 28-36)

Togoperla perpicta Klapálek, 1921. Lectotype ♂ (BMNH), Hong Kong, China, desig. Kimmins, 1970

Togoperla bifoveolata Klapálek, 1921. Syntype ♂ (ZMB, lost), Montes Mauson, Vietnam, syn. Sivec et al., 1988

Togoperla pichoni Navas, 1933. Holotype ♀ (MNHN, badly damaged), Hangchow [Hangzhou], Zhejiang Province, China, syn. Sivec et al., 1988

Paragnetina elongata Wu & Claassen, 1934. Holotype ♂ (Yenching University, lost), Foochow [Fuzhou], Fujian Province, China, syn. Sivec et al., 1988



Figs. 28-36. *Togoperla perpicta* (after Sivec et al. 1988). 28. Female terminalia, 29. Vagina, dorsal, 30. Vagina, lateral, 31. Male hemitergum, lateral, 32. Male hemitergum, dorsal, 33. Hemitergal basal callus, 34. Head and pronotum, 35. Male terminalia, 36. Aedeagus, dorsolateral aspect.

Material examined. China: Hong Kong, February-May, 1 ♂ (BMNH, *T. perpicta* lectotype). Fujian, Fuzhou (Foochow), 1935-1936, M.S. Yang, 1 ♂ (BMNH). Same site, 9 May 1936, M.S. Yang, 1 ♂ (BMNH). Fujian, Fuzhou, San Chiang, 1927, C.H. Pope, 1 ♂. Fujian Province, Tachulan, 4500', foot of Kuatun Mountain, 21-26 April 1948, J. Fu, 2 ♂, 1 ♀

(USNM). Same site, 21-25 May 1948, J. Fu, 1 ♂, 1 ♀ (USNM). Same site, 16-19 June 1948, J. Fu, 1 ♂ (USNM). Zhejiang (Chekiang), Hangzhou (Hangtcheou), 1925, A. Pichon 1 ♀ (MNHN, *T. pichoni* holotype).

Adult habitus. General color brown. Head with dark pigment over ocellar region, occiput and forward of

M-line; pale around eyes and on lateral margins (Fig. 34). Pronotum brown, wings brown except costal field. Legs banded, proximal and distal parts of femora and tibiae brown, mesal area yellow.

Male. Forewing length 18-21 mm. T5 produced into a truncate to emarginate lobe; T6-T9 typical with membrane bearing patches of long setae; T5 lobe with apical cluster of sensilla basiconica (Fig. 35). Dorsal aspect of hemiterga moderately long and only slightly narrowed from basal curve to tip; length from basal callus to hemitergal tip about 2.3-2.8 times as long as basal callus; lateral aspect of hemiterga gradually narrowed from basal curve to midlength but scarcely narrowed beyond midlength to rounded tip (Figs. 31-33). Membranous aedeagal sac coarsely armed with a broad basal spine band, interrupted on median dorsal surface; sac beyond spine band bearing a pair of dorsal unarmed or sparsely armed lobes and terminating with a long cylindrical lobe armed with fine long setal spines in apical half (Fig. 36); tube membranous and bearing a pair of spiny dorsolateral lobes near sac base.

Female. Forewing length 24-27 mm. Subgenital plate parabolic with a truncate apex (Fig. 28). Dorsal membrane of plate with a sclerotized mesal band extending about halfway from margin to base. Vagina expanded slightly at midlength (Fig. 29); accessory glands about two thirds vaginal length.

Egg. Length about 0.53 mm, width about 0.39 mm. Collar absent, outline oval with broadly rounded poles. Micropylar canals strongly slanted; micropylar row set near equator. Chorion smooth.

Distribution. Known from mainland China, Hong Kong and Vietnam.

Remarks. Sivec et al. (1988) illustrated this species and established the synonymy given above. Because types for the synonyms are either lost or badly damaged we have relied on illustrations by Klapálek (1923) and Wu & Claassen (1934) for *T. bifoveolata* and *T. elongata*, respectively. The *T. pichoni* type female in Paris is in very poor condition but the subgenital plate, vagina and leg pattern are consistent with those of *T. perpicta*.

***Togoperla poilanina* (Navas), comb. n.**
(Figs. 37-43, 63-68)

Kamimuria poilanina Navas, 1934:9. Holotype ♀ (MNHN), Quang Tri, Annam [Vietnam]

Material examined. Vietnam: Quang Tri [Annam], 1925, Poilane, 1 ♀ (MNHN, holotype). Vinh Phu Province, Tam Dao, 800-1100 m, 21° 28' N, 105° 38' E, 19 May-13 June, 1995, H. Malicky, 1 ♂, 1 ♀ (PMSL).

Adult habitus. General color dark brown. Head with dark brown area covering ocelli and forward to M-line. Pronotum brown with scattered rugosities and dark lateral margins (Fig. 37). Wings dark brown except for pale costal margin to cord. Femora pale on basal third to half and dark apically; tibiae entirely dark brown.

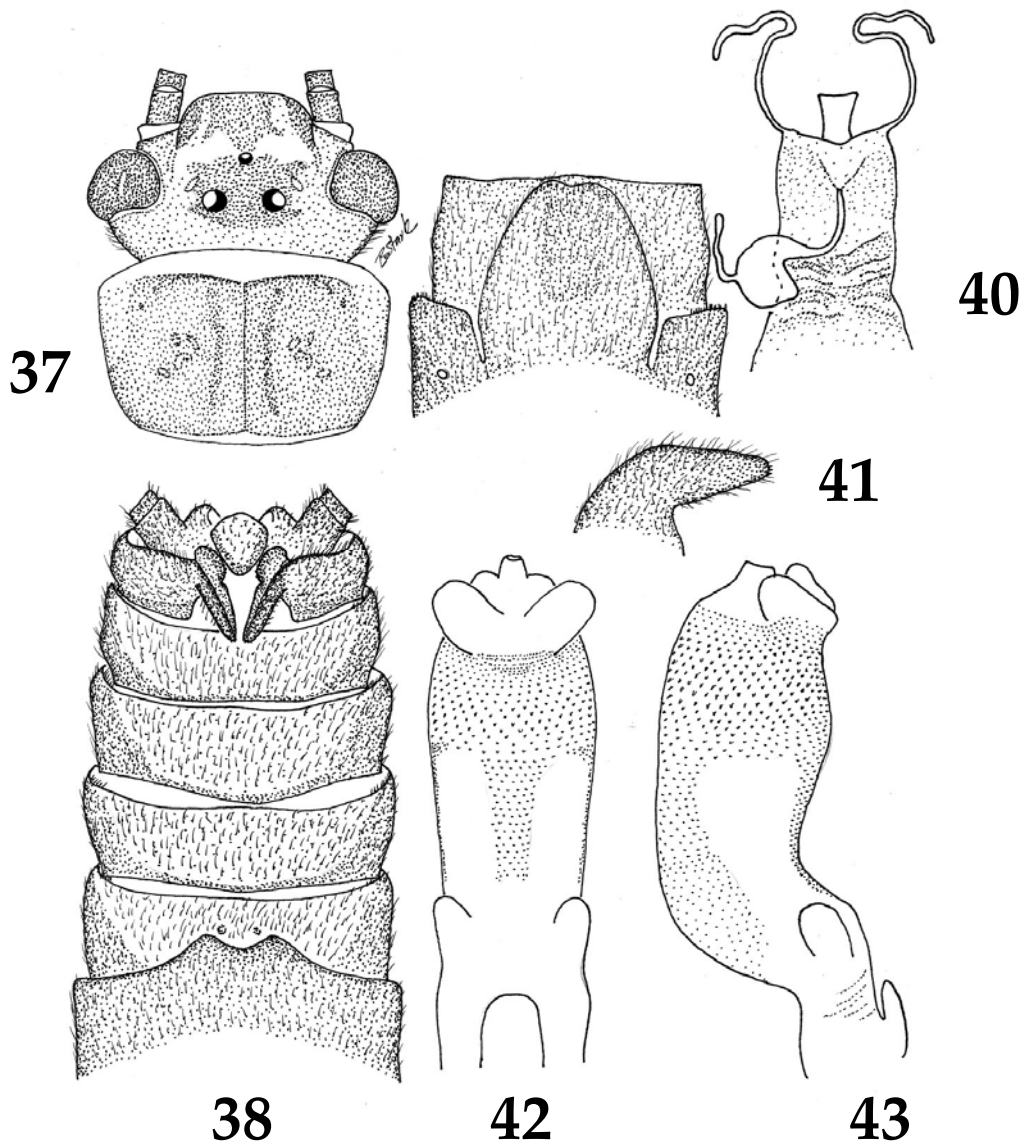
Male. Forewing length about 19 mm. Hemitergal lobes about twice as long as basal callus (Fig. 41); lobes gradually tapered from base to apex in lateral aspect (Fig. 38). T 6-9 with large mesal membranous area surrounded laterally and along anterior margin by sclerotized area; entire membranous area covered by setae. Tergum 5 produced as an emarginate lobe. Aedeagus sinuate in lateral aspect and swollen apically; apex with a dorsolateral pair of ear-like lobes and a terminal cylindrical lobe; armature ending subterminally and barely extending onto bases of lateral lobes; armature absent from basolateral lobes and from a large lateral area but covering most of venter; dorsal armature patch strongly narrowed to a small strip that approaches, but does not reach, basolateral lobes (Figs. 42-43).

Female. Forewing length 27-29 mm. Subgenital plate parabolic and slightly emarginate or shallowly notched. Dorsal sclerite on plate slender, extending to level of lateral margins of sternum 8 (Fig. 39). Lateral margins of vagina parallel for most of length (Fig. 40).

Egg. Outline barrel shaped; length ca. 0.37 mm, width ca. 0.30 mm. Collar sessile but wide and surrounded by a smooth rim with irregular lobing (Figs. 63-66). Chorion coarsely punctate except on rim (Figs. 67). Micropylar orifices surrounded by five or six chorionic punctations (Fig. 68).

Larva. Unknown.

Remarks. The association of the *K. poilanina* holotype with fresh material from Tam Dao was confirmed through comparison of SEM micrographs of eggs from the holotype and from the new locality. The two samples were found to be very similar and to be atypical for *Togoperla*, However the associated male from Tam Dao and the presence of a large subgenital plate with dorsal sclerite indicate this species is a true member of *Togoperla*.



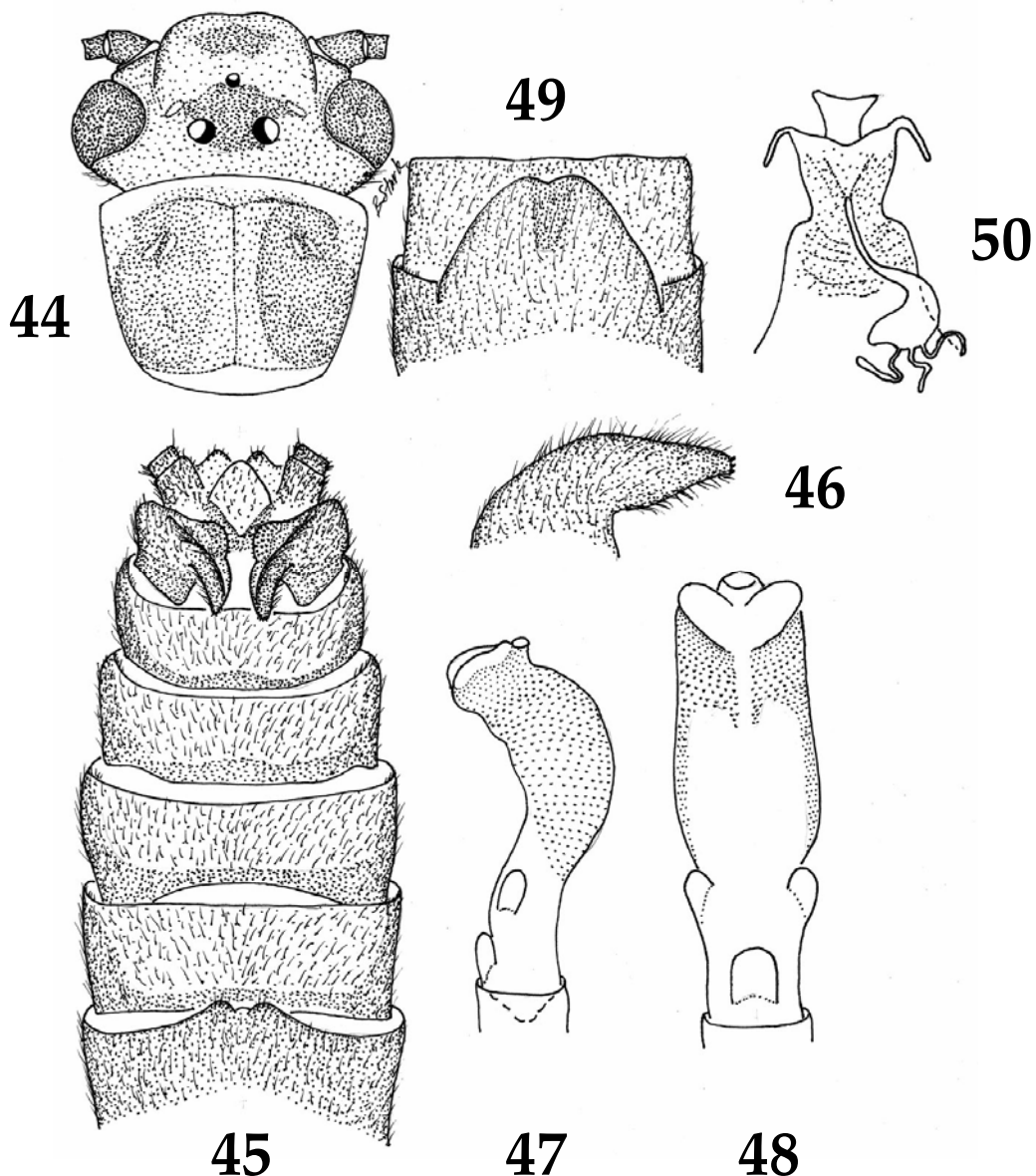
Figs. 37-43. *Togoperla poilanina*. 37. Head and pronotum, 38. Male terminalia, 39. Female terminalia, 40. Vagina, 41. Male hemitergum, lateral, 42. Aedeagus, dorsal aspect, 43. Aedeagus, lateral aspect.

This species occurs in the same area as *T. clavata* (described above), although not necessarily from the same stream, and the two species have similar male hemiterga, general coloration and leg patterns. Males of the two may be distinguished by the presence of brown sclerites in the membrane of terga 6-9 for *T. clavata* and by the club shaped hemiterga in lateral aspect for that species. In addition the aedeagal armature for *T. clavata* is narrowly divided along the mid-dorsum and the basolateral lobes are covered

with scale-like triangular spines. The color patterns also differ slightly on the head with *T. clavata* having a much more extensive area of black pigment between the compound eyes.

***Togoperla shan* Stark & Sivec**
 (Figs. 44-50, 59-60)

Togoperla shan Stark & Sivec, 1991:151. Holotype ♂ (USNM), Chiang Mai, amp. Fang, Tambon Pa Pah, Thailand



Figs. 44-50. *Togoperla shan*. 44. Head and pronotum, 45. Male terminalia, 46. Male hemitergum, lateral, 47. Aedeagus, lateral aspect, 48. Aedeagus, dorsal aspect, 49. Female terminalia, 50. Vagina.

Material examined. Thailand: Chiang Mai, amp. Fang, tambon Papah, 18-20 April 1975, A.E. Gordon, 14 ♂, 4 ♀ (USNM, BPS, PMSL).

Adult habitus. General color brown. Head with dark pigment over ocelli and forward of M-line. Pronotum brown with indistinct rugosities (Fig. 44). Legs brown without distinct banding.

Male. Forewing length 19-21 mm. T5 produced into a truncate or slightly emarginate lobe; T6-T9 typical; T5

lobe with marginal tufts of long setae (Fig. 45). Dorsal aspect of hemiterga moderately long with prominent sulcus and with tips curved slightly laterad; length from basal callus to hemitergal tip about 1.6-2.0 times as long as basal callus; lateral aspect triangular in shape but tip blunt (Fig. 46); sensilla basiconica clustered on basal callus and scattered on hemitergal tip. Membranous aedeagal sac coarsely armed with a broad band of short thick spines; band ends near sac

apex on dorsal surface but continues onto tube on venter (Figs. 47-48); sac apex trilobed; tube with a pair of unarmed lateral lobes.

Female. Forewing length 29-31 mm. Subgenital plate parabolic with emarginate apex (Fig. 49). Vagina constricted beyond midlength (Fig. 50); accessory glands short, much less than half vaginal length.

Egg. Length 0.45-0.47 mm, width 0.35-0.37 mm. Outline pear shaped with wide posterior pole and narrow collar; collar width 0.12-0.14 mm, length about 0.01-0.02 mm. Collar distinct but sessile, rim smooth but with a row of pits circling base (Fig. 59). Chorion relatively smooth but with faint follicle cell impressions (Fig. 60). Micropyles subequatorial with canals slanted.

Distribution. Known only from Thailand.

Remarks. Other than *T. poilanina*, this is the only *Togoperla* species known to have a distinct egg collar but in male and female genitalic features it is typical of the genus. The eggs of *T. poilanina* are coarsely punctate and those of *T. shan* lack punctations.

Togoperla totanigra Du & Chou

Togoperla totanigra Du & Chou, 1999:4. Holotype ♂ (Zhejiang University), Mt. Tianum, Zhejiang, China

Remarks. We have seen no material of this species, but it seems distinctive by virtue of a black mesal sclerite on T9, a character not otherwise reported among *Togoperla* species. The hemitergal lobes are short, the basolateral lobes of the aedeagal tube are small and bare, and the dorsoapical spine patch of the aedeagal sac is completely divided by a narrow, median line. The legs are presumed to be dark since Du & Chou (1999) indicate the species is "...similar to *Togoperla chekianensis*" [= *T. tricolor*].

Togoperla triangulata Du & Chou

Togoperla triangulata Du & Chou, 1999:5. Holotype ♂ (Zhejiang University), Huaping, Longsheng, Guangxi, China

Remarks. We have seen no material of this species which is said to be "...similar to *Togoperla perpicta*..." and presumably has banded femora and tibiae. The hemitergal lobes are long and "triangular" and the basolateral lobes of the aedeagal tube lack spines (Du

& Chou 1999).

Togoperla tricolor Klapálek

(Figs. 51-56, 61-62)

Togoperla tricolor Klapálek, 1921:64. Holotype ♀ (BMNH), Kiu Kiang [Jiujiang], Jiangxi Province China
Perla chekiangensis Chu, 1928:194. Holotype ♂ (Yenching University, lost), Lingyin Temple, Hangchow [Hangzhou], Zhejiang Province, China, syn. Sivec et al., 1988
Togoperla valvulata Wu, 1935:232. Holotype ♂ (Yenching University, lost), Hai Hui, Kiangsi [Jiangxi Province], China, syn. Sivec et al., 1988.

Material examined. China: Kiu Kiang, 1 ♀ (BMNH, *T. tricolor* holotype). Fujian Province, Tachulan, 4500', foot of Kuatun Mountain, 1-5 May 1948, J. Fu, 1 ♂ (USNM).

Adult habitus. General color dark brown. Head with dark brown area covering ocelli. Pronotum, femora and wings dark brown.

Male. Forewing length about 22 mm. T5 produced into a truncate or slightly emarginate lobe with lateral angles projecting (Fig. 51); T6-T9 typical, membranous areas bearing long setae. Dorsal aspect of hemiterga short, with a prominent sulcus and broadly rounded tip; length from basal callus to hemitergal tip slightly less than length of callus; sensilla basiconica clustered on basal callus and hemitergal tips (Fig. 56). Membranous aedeagal sac coarsely armed with short thick spines in a wide band encircling mesal section of sac (Figs. 52-53); distal margin of dorsal patch strongly notched and proximal margin of dorsal patch terminating in a pair of short pointed areas. dorsolateral surface with a pair of small unarmed lobes; apical lobe cylindrical and armed with an apical patch of long thin setae; dorsobasal lobes unarmed.

Female. Forewing length 25-32 mm. Subgenital plate parabolic, usually with a shallow apical notch or emargination. Dorsal membrane of plate with a sclerotized mesal band extending less than half the distance from margin to base (Fig. 54). Vagina swollen near midlength and strongly constricted near orifice (Fig. 55); accessory glands about half as long as vagina.

Egg. Length 0.44-0.47 mm, width 0.31-0.32 mm. Collar absent, outline oval with broadly rounded poles (Fig. 61). Micropylar canals strongly slanted

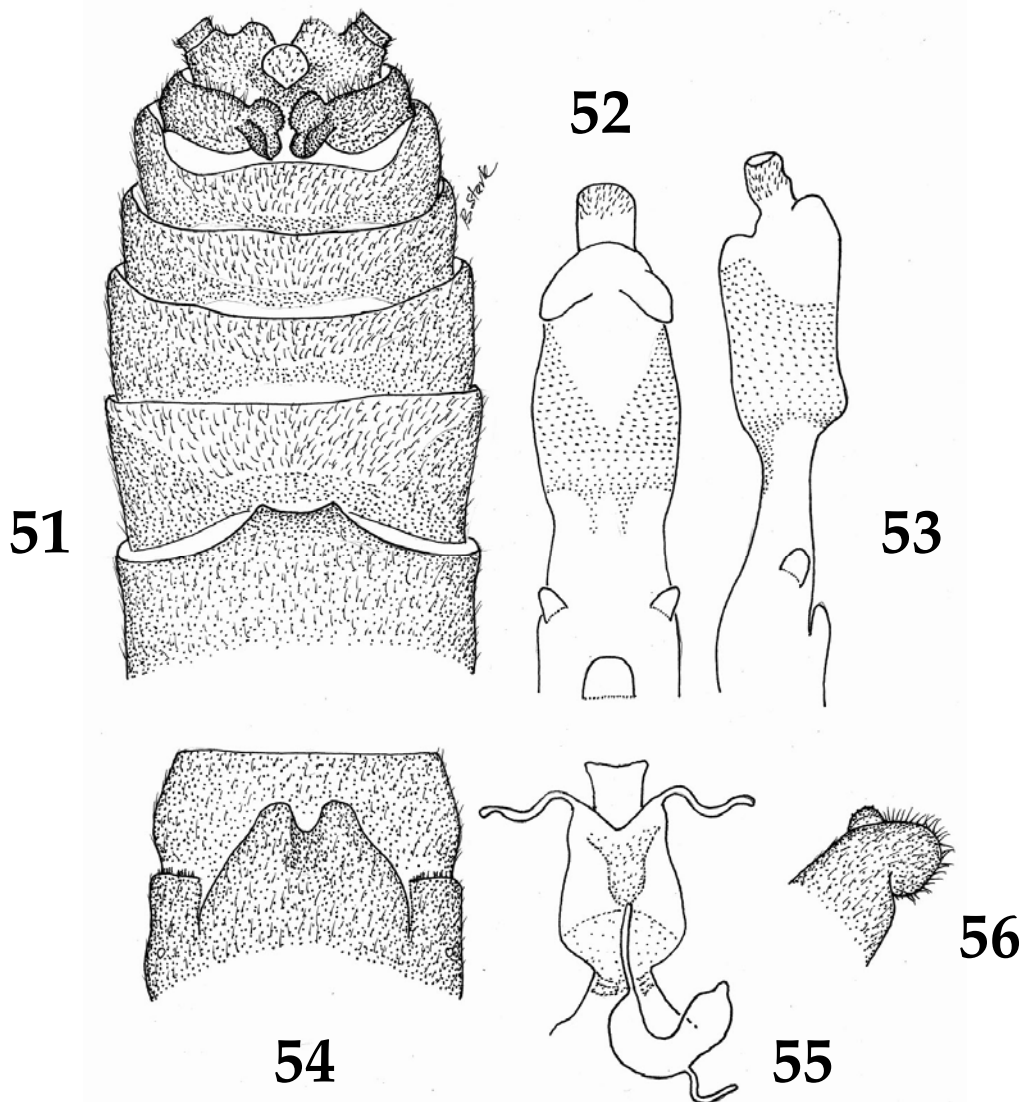
and subequatorial in position (Fig. 62).

Distribution. Known from east China.

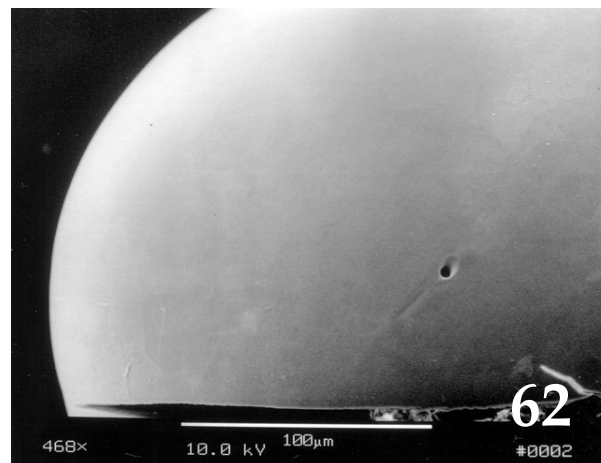
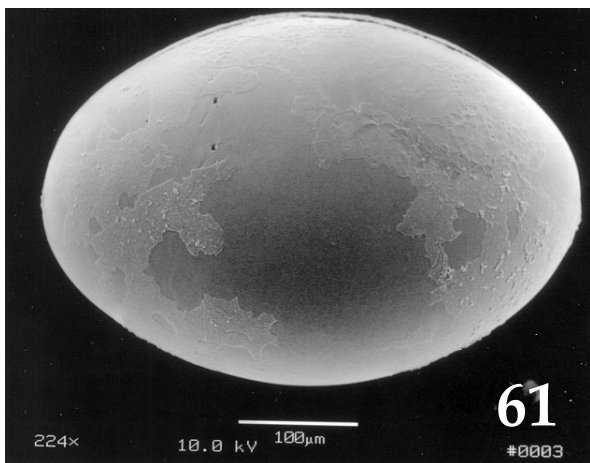
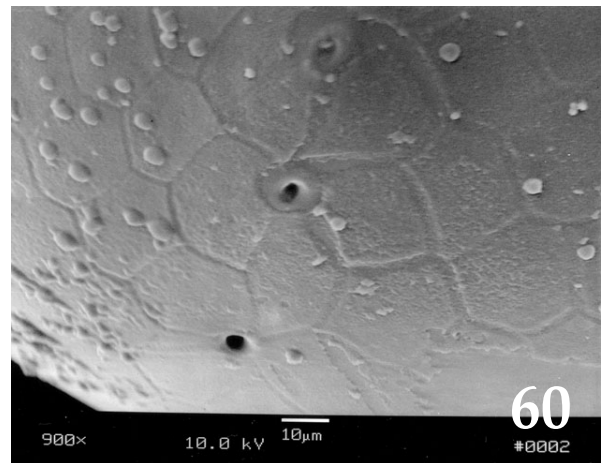
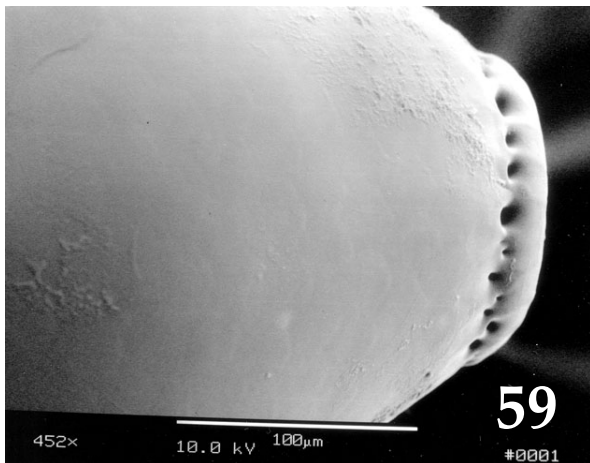
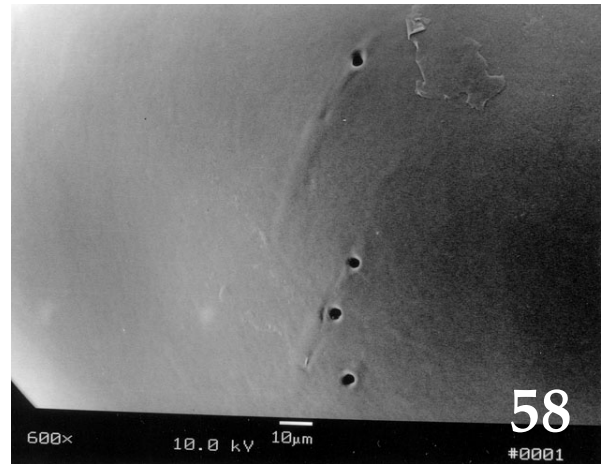
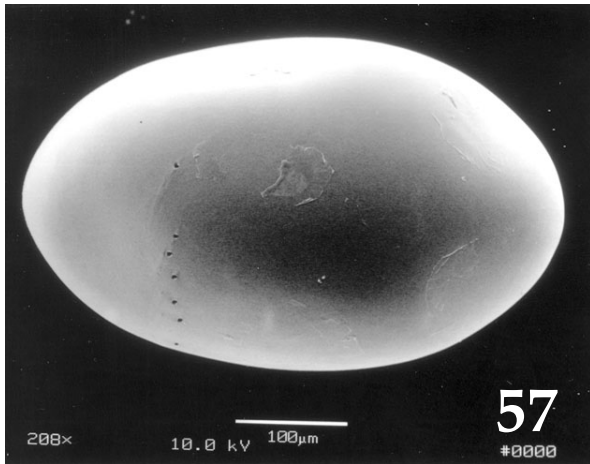
Remarks. Sivec et al. (1988) considered the three species listed above as synonymous (but incorrectly placed them in the synonymy of *T. sinensis*), whereas Du & Chou (1999) apparently overlooked *T. tricolor* and treated *T. chekiangensis* as the valid name with *T. sinensis*, *T. valvulata*, and *T. klapaleki* as synonyms. Types for *T. chekiangensis* and *T. valvulata* are lost but figures in Wu (1938) show males of these species to have the short wide hemiterga typical of *T. tricolor* and both are reported to have uniformly dark legs similar to those of *T. tricolor*, consequently we continue to

support the synonyms proposed by Sivec et al. (1988), except *T. tricolor* is recognized as the valid name.

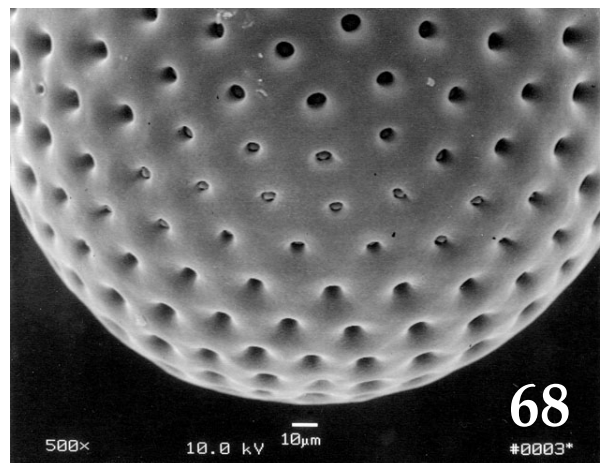
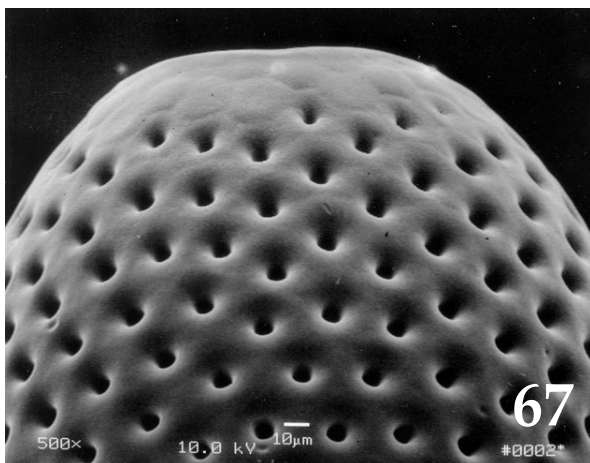
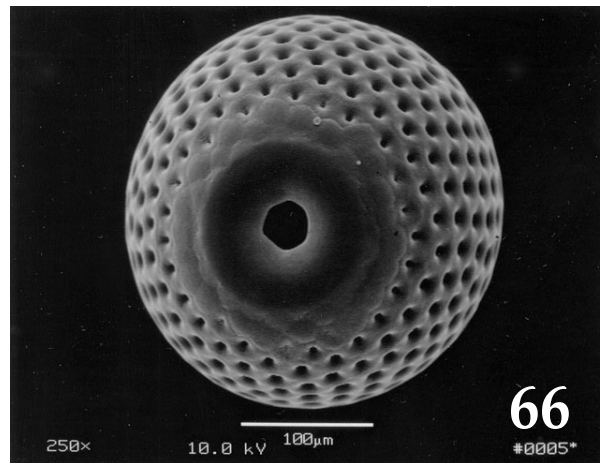
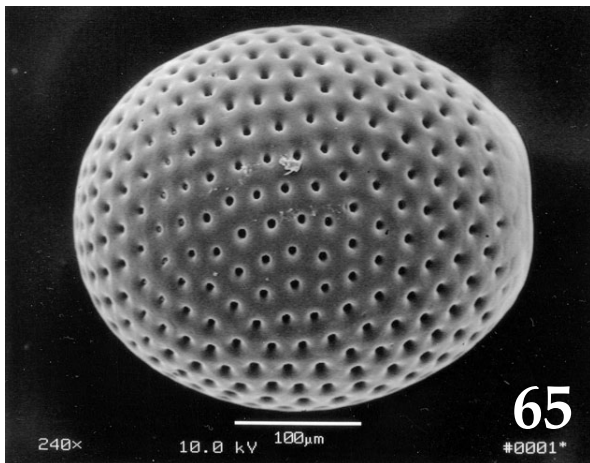
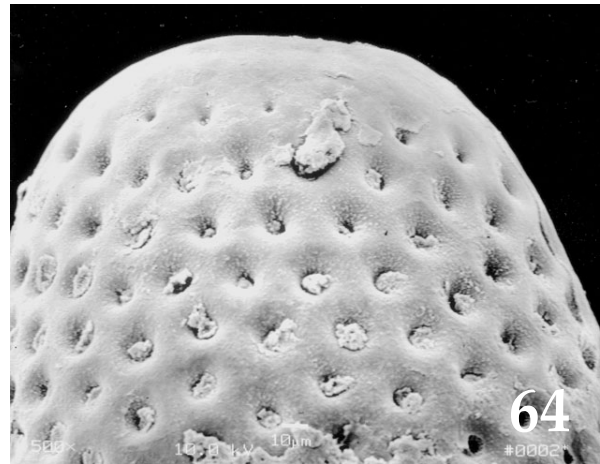
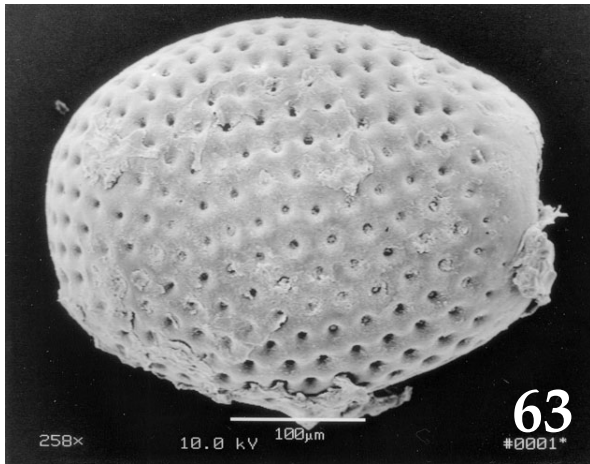
The dorsal armature pattern on the aedeagus of this species is similar to the pattern of *T. noncoloris* in having a distal V-shaped incursion of membrane, but that species has dark mesal sclerites on terga 6-9 which are not present in this species. In addition, Du & Chou (1999) do not show the proximal edge of the dorsal aedeagal armature to project in the same way as in this species, and the wing pigmentation patterns also differ.



Figs. 51-56. *Togoperla tricolor*. 51. Male terminalia, 52. Aedeagus, dorsal aspect, 53. Aedeagus, lateral aspect, 54. Female terminalia, holotype, 55. Vagina, 56. Male hemitergum, lateral aspect.



Figs. 57-62. Scanning electron micrographs of eggs. 57. *T. canilimbata*, 58. *T. canilimbata* micropyles and chorionic detail, 59. *T. shan* collar, 60. *T. shan* micropyles and chorionic detail, 61. *T. tricolor*, from holotype, 62. *T. tricolor* micropyle and chorionic detail.



Figs. 63-68. Scanning electron micrographs of *T. poilanina* eggs, 63. Entire egg from holotype, 64. Collar and chorionic detail from holotype, 65. Entire egg from Tam Dao specimen, 66. Collar from apical aspect from Tam Dao specimen, 67. Collar and chorionic detail from Tam Dao specimen, 68. Lid from Tam Dao specimen.

Provisional Key to *Togoperla* Males

- 1 Hemitergal process forward of basal callus about as long as callus (Fig. 2) 2
- 1' Hemitergal process forward of basal callus distinctly longer than callus (Fig. 8) 5
- 2 Wings hyaline; terga 6-9 with brown mesal sclerite *noncoloris*
- 2' Wings mostly dark brown except for pale costal area 3
- 3 Tergum 9 with a black mesal sclerite, T 6-8 without sclerite *totanigra*
- 3' Tergum 9 without mesal sclerite 4
- 4 Legs uniformly pigmented except for narrow dark apical femoral band *tricolor*
- 4' Legs banded, femora and tibiae dark basally and at apex, but with mesal yellow band ... *canilimbata*
- 5 Femora without conspicuous banding 6
- 5' Femora with conspicuous banding 7
- 6 Basolateral lobes of aedeagal tube armed with spines (Fig. 25); known from Japan *limbata*
- 6' Basolateral lobes of aedeagal tube without spines (Fig. 48); known from Thailand *shan*
- 7 Tibiae and femora with conspicuous black and yellow bands 8
- 7' Tibiae without pigment bands 9
- 8 Basolateral lobes of aedeagal tube covered with fine spines (Fig. 36); head yellow brown around dark ocellar area *perpicta*
- 8' Basolateral lobes of aedeagal tube without spines; head brown around ocellar area *triangulata*
- 9 Hemitergal lobes slightly swollen at tips in lateral aspect (Fig. 14); terga 6-9 with mesal sclerite (Fig. 8); dorsal aedeagal armature extends to near basolateral lobes and covers surface of lobes (Fig. 12) *clavata*
- 9' Hemitergal lobes more nearly acute in lateral aspect (Fig. 18); terga 6-9 without mesal sclerite; dorsal aedeagal armature does not approach bare, basolateral lobes 10
- 10 Everted aedeagus a more or less straight cylinder in lateral aspect (Fig. 17); dorsolateral armature connected to ventral armature in a slanted line of spines; known from southwest China *fortunati*
- 10' Everted aedeagus sinuate in lateral aspect (Fig. 43); dorsolateral armature strongly excavated leaving a large lateral bare area (Fig. 42); known from Vietnam *poilanina*

Provisional Key to *Togoperla* Females

(*T. noncoloris*, *T. totanigra*, *T. triangulata* not included)

- 1 Femora distinctly banded in yellow and dark pigment 2
- 1' Femora essentially uniformly brown except for narrow dark apical band 5
- 2 Median part of femora yellow with dark apical and basal bands; tibiae banded *canilimbata*, *perpicta*
- 2' Basal part of femora yellow, apical half to two thirds dark brown; tibiae uniformly pigmented 3
- 3 Known from southwest China *fortunati*
- 3' Known from Vietnam 4
- 4 Dark pigment between eyes restricted to ocellar area; egg coarsely punctate and bearing a collar (Fig. 65) *poilanina*
- 4' Dark pigment between eyes covers ocelli and approaches inner margins of eyes; egg chorion smooth, collar absent *clavata*
- 5 Known from Japan *limbata*
- 5' Known from mainland Asia 6
- 6 Egg pear shaped with sessile collar (Fig. 59); vagina constricted near midlength; known from Thailand *shan*
- 6' Egg oval, without collar; vagina constricted near attachment to subgenital plate; known from east China *tricolor*

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REFERENCES

- Banks, N. 1939. New genera and species of neuropteroid insects. Bulletin of the Museum of Comparative Zoology, 85:439-504.
- Banks, N. 1940. Report on certain groups of

- neuropteroid insects from Szechwan, China. *Proceedings of the United States National Museum*, 88:173-220.
- Chu, Y.T. 1928. Descriptions of a new genus and three new species of stone-flies from Hangchow. *China Journal*, 9:194-198.
- Du, Y. & I. Chou. 1999. Notes on Chinese species of the genus *Togoperla* Klapalek (Plecoptera: Perlidae: Perlinae). *Entomotaxonomia*, 21:1-8.
- Enderlein, G. 1909. Plecopterologische Studien. II. *Stettiner Entomologische Zeitung, Stettin*, 70:324-352.
- Frison, T.H. 1935. The stoneflies, or Plecoptera, of Illinois. *Illinois Natural History Survey Bulletin*, 20:281-471.
- Frison, T.H. 1937. Studies of Nearctic aquatic insects: descriptions of Plecoptera. *Illinois Natural History Survey Bulletin*, 21:78-99.
- Illies, J. 1966. Katalog der rezenten Plecoptera. *Tierreich* 82. XXX + 632 pp.
- Klapálek, F. 1907. Japonské druhy rodu *Perla* Geoffr. *Rozpravy Česke Akademie cisare Frantiska Josefa*, 16:1-28.
- Klapálek, F. 1921. Plécoptères nouveaux. *Annales de la Societe Entomologique de Belgique*, 61:57-67, 146-150, 320, 327.
- Klapálek, F. 1923. Plécoptères II. Fam. Perlidae. *Collections Zoologiques du Baron Edm. de Selys Longchamps. Catalogue Systématique et descriptif*, 4:1-193.
- Navas, R.P.L. 1919. Plecoptera. Pp. 186-189. *In: Névroptères de l'Indo-Chine. Insecta*, Rennes 9.
- Navas, R.P.L. 1926. Plecópteros. Pp. 111-112. *In: Algunos insectos del Museo de Paris. Brotéria Série Zoológica*, 23.
- Navas, R.P.L. 1933. *Insecta Orientalia. Memorie della Pontificia Accademia Romana dei Nuovi Lincei*, 17:81-85.
- Navas, R.P.L. 1934. Plecoptera. Pp. 9-12. *In: Névroptères et insectes voisins. Chine et pays environnants. Notes d'Entomologie Chinoise, Musée Heude*, 2.
- Needham, J.G. & P.W. Claassen. 1925. A monograph of the Plecoptera or stoneflies of America North of Mexico. *Entomological Society of America, Thomas Say Foundation* 2. 397 pp.
- Okamoto, H. 1912. Erster Beitrag zur Kenntnis der Japanischen Plecopteren. *Transactions of the Sapporo Natural History Society*, 4:105-170.
- Pictet, F.J. 1841. *Histoire naturelle générale et particulière des insectes Névroptères. Famille des Perlides. 1. Partie*. 423 pp.
- Ricker, W.E. 1949. The North American species of *Paragnetina* (Plecoptera, Perlidae). *Annals of the Entomological Society of America*, 42:279-288.
- Sivec, I., B.P. Stark & S. Uchida. 1988. Synopsis of the world genera of Perlinae (Plecoptera: Perlidae). *Scopolia*, 16:1-66.
- Stark, B.P. & I. Sivec. 1991. Descriptions of Oriental Perlinae (Plecoptera: Perlidae). *Aquatic Insects*, 13:151-160.
- Uchida, S. 1990. A revision of the Japanese Perlidae (Insecta: Plecoptera), with special reference to their phylogeny. Unpublished PhD Dissertation, Tokyo Metropolitan University. 228 pp.
- Wu, C.F. 1935. New species of stoneflies from east and south China. *Peking Natural History Bulletin*, 9:227-243.
- Wu, C.F. 1938. *Plecopteroum Sinensium*, a monograph of the stoneflies of China (Order Plecoptera). Peking. 225 pp.
- Wu, C.F. & P.W. Claassen. 1934. Aquatic insects of China. Article XVIII. New species of Chinese stoneflies (Order Plecoptera). *Peking Natural History Bulletin*, 9:111-129.
- Zwick, P. 1972. Die Plecopteren Pictets und Burmeisters, mit Angaben über weitere Arten (Insecta). *Revue Suisse de Zoologie*, 78:1123-1194.
- Zwick, P. 1973a. *Insecta: Plecoptera Phylogenetisches System und Katalog. Das Tierreich* 94. 465 pp.
- Zwick, P. 1973b. Die Plecopteren-Arten Enderleins (Insecta): Revision der Typen. *Annales Zoologici*, 30:471-507.

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