



## NEW SPECIES OF *KAMIMURIA* Klapálek (PLECOPTERA: PERLIDAE) FROM THAILAND AND VIETNAM, WITH NOTES ON CHINESE SPECIES

Ignac Sivec<sup>1</sup> and Bill P. Stark<sup>2</sup>

<sup>1</sup> Slovenian Museum of Natural History, Prešernova 20, P.O. Box 290, SLO-1001 Ljubljana, Slovenia

E-mail: [isivec@pms-lj.si](mailto:isivec@pms-lj.si)

<sup>2</sup> Box 4045, Department of Biology, Mississippi College, Clinton, Mississippi, U.S.A. 39058

E-mail: [stark@mc.edu](mailto:stark@mc.edu)

### ABSTRACT

The *Kamimuria* from Thailand and Vietnam are reviewed and 12 species are given formal recognition. *Kamimuria similis* Klapálek and *Kamimuria anamensis* (Banks) n. comb. are redescribed from type material and 10 species new to science are proposed. New taxa from Vietnam include *K. atrocephala* sp. n., *K. azunensis* sp. n., *K. curriei* sp. n. and *K. zonata* sp. n.; new taxa from Thailand include *K. punctata* sp. n., *K. trang* sp. n. and *K. turbinata* sp. n., and three species, *K. atra* sp. n., *K. jaryiae* sp. n. and *K. obtusa* sp. n. are proposed based on samples from both countries. The eggs of two additional species known from unassociated females are described under informal designations, and *K. poilanina* Navas is referred to genus *Togoperla* based on the large subgenital plate of the holotype female. Three poorly known Chinese species, *K. klapaleki* (Wu & Claassen), *K. manchuriana* Wu and *K. tuberosa* Wu are redescribed and a neotype is designated for *K. manchuriana*. An updated checklist of *Kamimuria* species and a provisional key to regional males is provided.

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

### INTRODUCTION

*Kamimuria* was established by Klapálek (1907) as a subgenus of *Perla* and given generic rank by Klapálek (1912); *Perla tibialis* Pictet, a Japanese species, was later designated as type (Klapálek 1923). Illies (1966) placed the genus as a synonym of *Perla* where it remained until Zwick (1977) resurrected the group. Sivec et al. (1988) gave a generic diagnosis and provided a list of 25 species considered valid at that time, together with synonyms. Subsequently, Uchida & Isobe (1991) redescribed *K. tibialis* and brought *K. uenoi* Kohno from synonymy, Ra et al. (1994) described *K. coreana* from South Korea, Du et al. (2001) described *K. sparsula* from China, Teslenko (2006) described *K. lyubaretzi* from the Russian Far East, and Stark & Sivec (2008) added *K. zwicki* from South Korea. Du et al. (1999) included 28 *Kamimuria*

in their list of Chinese perlids and more than 50 have been proposed for the entire Oriental-eastern Palearctic region.

The genus remains one of the more challenging for species determinations within Plecoptera, in part because many species descriptions are inadequate and much type material is lost, of questionable status, or generally inaccessible to students of the group. As a result, Sivec et al. (1988) "excluded" many nominal species from their list of "valid species", but most of these should properly be designated as *nomina dubia*. The most challenging aspect of the group, however, is the difficulty of finding reliable characters from the male hemiterga and aedeagi of many species. In some areas species can be found with profoundly different color patterns and eggs, but with virtually identical male genital characters, whereas in other

species groups the eggs and female genitalia may lack variability.

We have examined all type material which could be located but this leaves as *nomina dubia*, 14 species proposed by Wu (1935, 1936, 1938, 1947-1948) for which no surviving holotype or apparently valid neotype exists. We do not believe Wu's (1962) blanket statement, "...the known species herein dealt with have been redescribed from the Neotypes", meets the full requirements of the code in establishing neotypes for *K. brevata* Wu and *K. magna* Wu. Furthermore, we are unsure if these apparently invalid "neotypes" are present in the Institute of Zoology, Academia Sinica, where they are said to be deposited. In the meantime, fresh material continues to accumulate in collections, and if we are to break the current impasse, these specimens must be comparatively studied and carefully described in order that others might make reliable determinations. Some risk exists that by doing so additional synonyms might be created but these risks are reduced somewhat because no Thai species of *Kamimuria* have been proposed, and only three of those proposed from Vietnam appear to be valid *Kamimuria*, and these appear distinct from all new taxa we are proposing.

The current study is based on fresh samples of *Kamimuria* collected in Thailand by the senior author, Prof. Dr. P. Chantaramongkol and the Chiang Mai University team, and in Vietnam by personnel of the Royal Ontario Museum, and by H. Malicky (Lunz) and A. Gorohov (St. Petersburg). This material was supplemented by older museum material from several sources listed below. We recognize 17 species of *Kamimuria* in these samples including 10 we consider new to science. We also give redescrptions for *K. similis* Klapálek, *K. anamensis* (Banks) *K. manchuriana* Wu and *K. klapaleki* (Wu & Claassen) from type material; subgenital plate shape for the female holotype of *K. poilanina* suggests it should be placed in genus *Togoperla*. Specimens are deposited in the Royal Ontario Museum, Toronto (ROM), the Institute of Ecology and Biological Resources, Hanoi (IEBR), the Zoologisches Museum der Humboldt Universität, Berlin (ZMH), the Museum National d'Histoire Naturelle, Paris (MNHN), the United States National Museum, Washington (USNM), the Museum of Comparative Zoology, Cambridge (MCZ) and the Slovenian Museum of Natural History, Ljubljana (PMSL) as indicated in the text.

## RESULTS AND DISCUSSION

### *Kamimuria anamensis* (Banks), n. comb. (Figs. 66-69)

*Perla anamensis* Banks, 1920:318. Holotype ♀ (MCZ, 10,830), Anam (=Vietnam)

**Material examined. Vietnam:** Unknown site, 1 ♀ (MCZ holotype 10830).

**Adult habitus.** Color pattern obscured due to specimen condition. Banks (1920) indicates a pale yellow habitus with black ocellar spot and brown thorax. Wings almost hyaline with yellow veins; legs pale with slender black apical marking on femora.

**Male.** Unknown.

**Female.** Forewing length about 25 mm. Subgenital plate more or less triangular with small median notch.

**Egg.** Outline oval with short wide collar, length ca. 0.32 mm, width ca. 0.28 mm. Chorion covered throughout with coarse pits (Figs. 66-69), ca. 11 pit rows visible in lateral aspect with about 11 pits above micropyles and 6 pits below micropyles in a typical full row; pits in median field wider than long, appearing more or less linear. Pits have smooth floors except at collar end of every other pit row, a hexagonal pit with punctate floor is located. Micropylar row subequatorial, pits with smooth orifices which lack distinctive sperm guides.

**Larva.** Unknown.

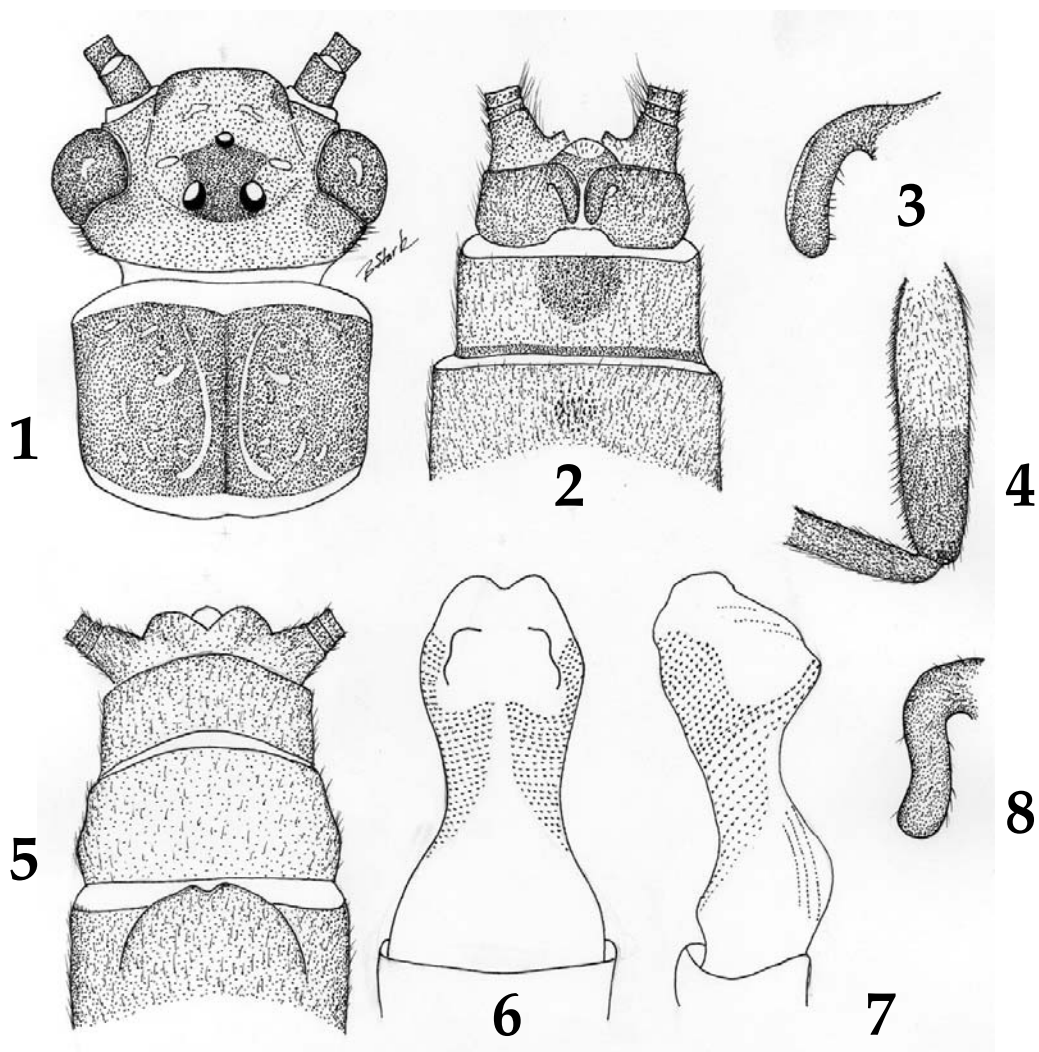
**Comments.** Illies (1966) included *Perla anamensis* in the "Unsichere Arten" section of his catalogue and Sivec et al. (1988) indicate the existing data do not permit placement of this species at the generic level. However, our SEM study of eggs dissected from the holotype confirm this is another *Kamimuria* species. The female terminalia and color pattern of *K. anamensis* are quite similar to several other regional species, and the egg is similar to that of *K. trang* and others with a coarsely punctate chorionic reticulation, but the presence of finely punctate FCI floors in cells surrounding the collar (Fig. 67) is otherwise unknown among *Kamimuria* species.

### *Kamimuria atra* sp. n. (Figs. 1-8, 70-71)

**Material examined.** Holotype ♂ and 1 ♀ paratype from Thailand, Chiang Mai Province, Doi Inthanon National Park, Huai Sai Leung, 98° 35' E, 19° 23' N,

1060 m, 7-8 May 2002, Chiang Mai University team (PMSL). Additional paratypes: **Thailand:** Type locality, 20 March 2002, 1 ♂, 1 ♀ (PMSL). Same site, 4 April-3 May 2003, 5 ♂ (PMSL). Same site, 4 April 2002, 5 ♂, 5 ♀ (PMSL). Same site, 8 June-7 July 2002, 1 ♂ (PMSL). Same site, 6-7 July 2002, 1 ♀ (PMSL). Same site but Bang Khun Klang, 98° 32' E, 18° 32' N, 1200 m, 29 May-5 June 1989, 1 ♂, 4 ♀ (PMSL). Same site, 3-10 July 1989, 1 ♂ (PMSL). Same site, 8-15 May 1989, 5 ♂, 1 ♀ (PMSL). Same site, 19-26 June 1990, 4 ♂, 7 ♀ (PMSL). Same site, 22-29 May 1989, 2 ♀ (PMSL). Same site but Nam Mae Klang, Ban Sop Aep, 98° 36' E, 18° 31' N, 630 m, 1 ♀ (PMSL). Same site, 7-8 June 2002, 1 ♂ (PMSL). Same site but Namtok

Siripum, 98° 31' E, 18° 32' N, 1460 m, 8-9 May 2002, 1 ♂ (PMSL). Same site, 7-8 June 2002, 1 ♂, 1 ♀ (PMSL). Same site, 2 March 2002, 2 ♂, 1 ♀ (PMSL). Same site, 2-3 April 2002, 2 ♂, 2 ♀ (PMSL). Same site but lower, 1380 m, 10-11 August 2002, 1 ♂ (PMSL). Same site, 13-14 March 2003, 2 ♂ (PMSL). Same site, 2-3 April 2003, 9 ♂, 9 ♀ (PMSL). Chiang Mai Province, Doi Inthanon National Park headquarters 18 May 2001, 4 ♀. Chiang Mai Province, Doi Suthep-Pui National Park, Namtok Monthatarn, 98° 55' E, 18° 49' N, 600 m, 6-7 June 2002, 10 ♀ (PMSL). Same site but Huai Kaew, Namtok Sai Yoi, 98° 55' E, 18° 48' N, 1000 m, 5-6 April 2002, 1 ♂, 1 ♀ (PMSL). Same site, 6-7 June Same site, 7 May 2002, 3 ♂ (PMSL). Chiang Mai



Figs. 1-8. *Kamimuria atra* adult structures. 1. Head and pronotum, 2. Male terminalia, 3. Male hemitergal lobe, dorsal, 4. Femur, 5. Female terminalia, 6. Aedeagus, dorsal, 7. Aedeagus, lateral, 8. Male hemitergal lobe, lateral.

Province, Chiang Dao Wildlife Research Center, 98° 55' E, 19° 21' N, 520 m, 3-26 May 2002, 1 ♂ (PMSL). Same site, 11 June 2003, 1 ♀ (PMSL). Same site, 9 June 2003, 1 ♀ (PMSL). Same site 8-26 June 2003, 1 ♂, 5 ♀ (PMSL). Same site, 1 July 2003, 1 ♂ (PMSL). Same site Phayao Province, Doi Luang National Park, Namtok Champatong, 99° 44' E, 19° 13' N, 620 m, 25 May 2002, 5 ♂ (PMSL). Same site, 23-24 June 2002, 1 ♂ (PMSL). Same site, 25 April 2003, 1 ♂ (PMSL). Phrae Province, Wieng Ko Sai National Park, Namtok Maekueng Lueang, tier 1, 99° 35' E, 17° 58' N, 350 m, 1 ♂ (PMSL). Phitsanulok Province, Phu Hin Rongkla National Park, Namtok Romglao, 101° 00' E, 16° 59' N, 1190 m, 20-21 July 2002, 1 ♂ (PMSL). Same site, 22-23 August 2002, 3 ♂ (PMSL). **Vietnam:** Lao Cai, ca. 12 km on road from Sapa to Lai Chau, 103° 46' 15.7" E, 22° 20' 58.3" N, 1950 m, 30 April-12 May 1999, ROM 992006, B. Hubley, 1 ♂ pinned (ROM). Vinh Phu, Tam Dao Hill Station, lower waterfall of stream flowing through town, 11 May 1996, B. Hubley, D. C. Darling, ROM 961030, 6 ♂ pinned (ROM). Tam Dao, 600-900 m, 17-31 May 1995, A. Gorohov, 1 ♂, 1 ♀ (PMSL).

**Adult habitus.** General color dark brown to black. Head almost entirely dusky to black but darker on lappets and between ocelli, especially in recently emerged specimens (Fig. 1); tentoria and M-line pale. Wing membrane dark brown, veins darker. Femora bicolored with pale basal and dark apical half (Fig. 4); tibiae and tarsi dark brown.

**Male.** Forewing length 16-18 mm. Hemiterga slender, fingerlike, and bearing a partially hidden concave excavation along inner margins (Figs. 2, 8); sensilla basiconica absent or rare on tips. Tergum 9 with a mesal patch of sensilla basiconica; tergum 8 with a smaller patch. Setal brushes present on sterna 4-6. Aedeagal sac membranous with apex expanded in lateral aspect and mesally constricted in ventral aspect (Figs. 6-7). Armature consists of patch of fine to small spines covering most of sac venter, but apex and base bare.

**Female.** Forewing length 20-21 mm. Subgenital plate wide, but scarcely projecting over basal third of sternum 9 (Fig. 5).

**Egg.** Outline oval with short medium width collar. Collar rim flanged and irregularly scalloped. Chorion covered throughout with obscure, shallow pits (Figs. 70-71).

**Larva.** Unknown.

**Etymology.** The species name refers to the dark adult habitus.

**Diagnosis.** Among Thai and Vietnamese *Kamimuria*, this species is distinctive by virtue of its dark habitus. The excavated inner margins of male hemiterga (Figs. 2, 8) are also distinctive and the egg (Fig. 70) will allow separation from known species.

*Kamimuria atrocephala* sp. n.  
(Figs. 9-12)

**Material examined.** Holotype ♂ and 2 ♀ paratypes from Vietnam, Vinh Phu, Tam Dao, 800-1100 m, 21° 28' N, 105° 38' E, 19 May-13 June 1995, H. Malicky (PMSL).

**Adult habitus.** General color brown patterned with dark brown. Head dark brown over most of surface but pale laterally in front of eyes and along anterior margin; ocellar triangle somewhat darker (Fig. 9). Pronotum mostly brown but with scattered pale rugosities and a longitudinal pale spot along lateral margins; downturned lateral edges very dark.

**Male.** Forewing length 18 mm. Hemitergal lobes slender, finger-like and bluntly rounded at apex (Fig. 10). Tergum 9 with a wide mesal patch of sensilla basiconica and tergum 8 with a smaller patch of ca. 25 sensilla. Aedeagal sac membranous, slender mesally and expanded apically into a head-like structure with a pair of bare, dorsal, ear-like lobes (Fig. 12). Sac armature covers most of ventral surface to near apex but basodorsal area, ear lobes and apex of dorsum bare; largest spines occur in a narrow zone below the bare ear lobe region.

**Female.** Forewing length 22 mm. Subgenital plate a small triangular projection with mesal notch which reaches over about the basal third of sternum 9 (Fig. 11).

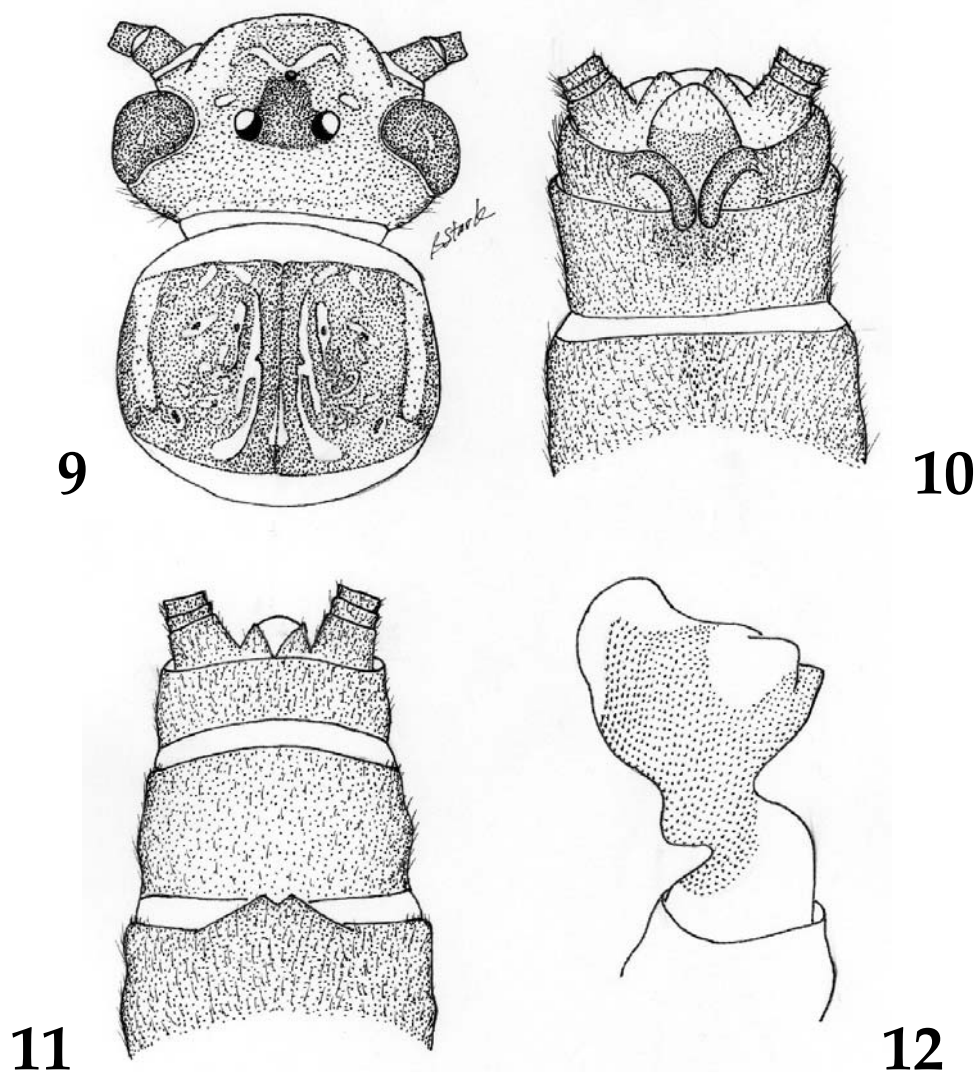
**Egg.** Unknown.

**Larva.** Unknown.

**Etymology.** The species name refers to the dark head of this species.

**Diagnosis.** The internal male genitalia of this species is generally similar to that of *K. azunensis* but in that species the "ear lobes" of the aedeagal sac are covered with fine spines (compare Figs. 12 and 18). Hemiterga also differ for these species with those of *K. azunensis* narrowed apically and swollen at the base (Figs. 15, 20). In addition, the area of dark pigment on the head is restricted to the ocellar region





Figs. 9-12. *Kamimuria atrocephala* adult structures. 9. Head and pronotum, 10. Male terminalia, 11. Female terminalia, 12. Aedeagus, lateral.

in that species (Fig. 13), but covers most of the surface in *K. atrocephala* (Fig. 9).

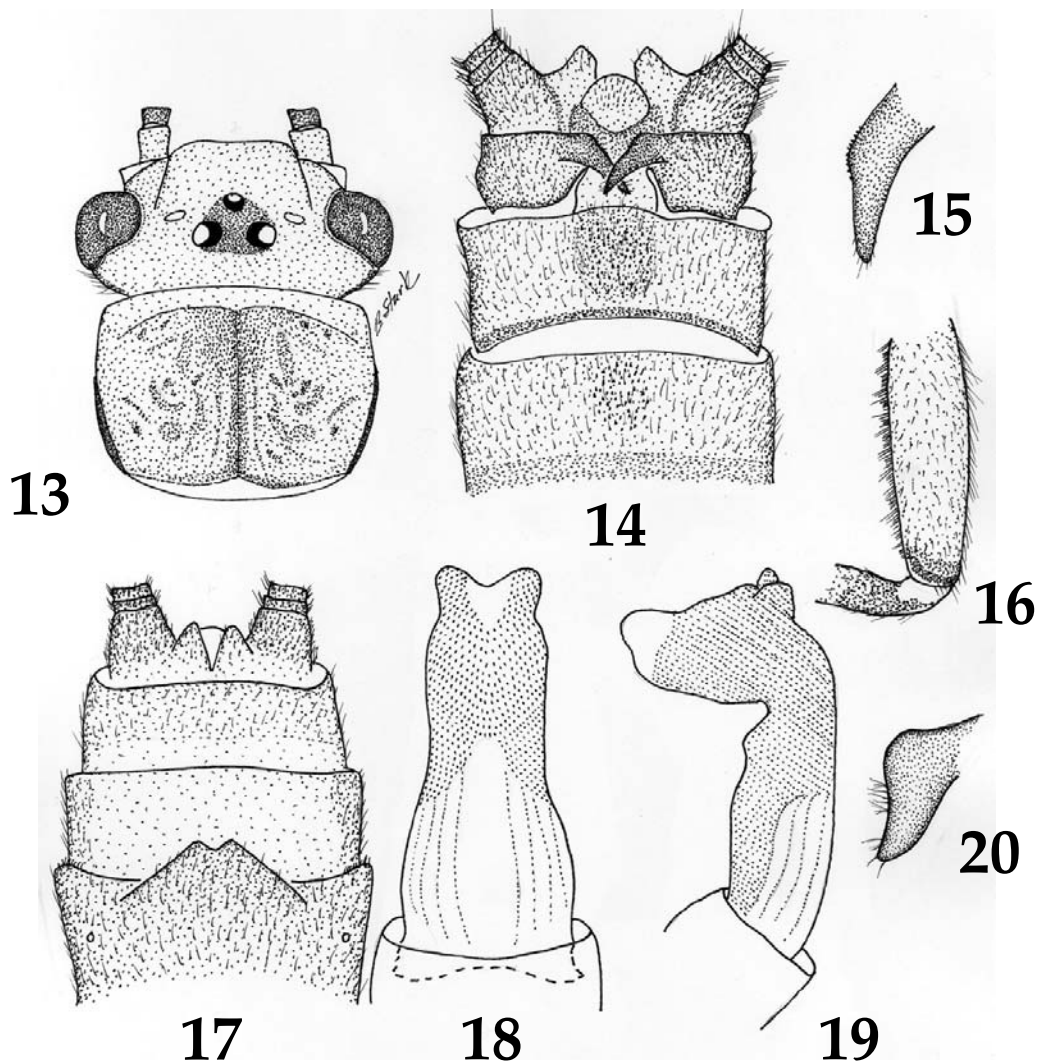
***Kamimuria azunensis* sp. n.**  
(Figs. 13-20, 72-73)

**Material examined.** Holotype ♂ and 1 ♀ paratype from Vietnam, Gia Lai, An Khe District, Tram Lap, Azun River, 3 km NE forestry building, 21 June 1996, ROM 961076, D. Currie, J. Swann (ROM).

**Adult habitus.** General color pale brown patterned with dark brown. Head pale except for dark brown ocellar triangle (Fig. 13). Basal antennal segment pale,

segments 2 through about 10 dark, segments 11 through about 20 alternating dark and light, rest of segments pale. Pronotum pale brown but downturned lateral edges very dark; disc with scattered slightly darker rugosities. Wing membrane pale, veins pale brown. Femora pale except for narrow apical band (Fig. 16); tibiae mostly pale but with narrow basal band and small area of dark pigment at apex; tarsi pale.

**Male.** Forewing length 22 mm. Hemiterga relatively broad basally and narrowed to tip; inner margins with irregular row of fine spines near base (Figs. 14-15, 20). Tergum 9 with small median lobe and patch



Figs. 13-20. *Kamimuria azonensis* adult structures. 13. Head and pronotum, 14. Male terminalia, 15. Male hemitergal lobe, dorsal, 16. Femur, 17. Female terminalia, 18. Aedeagus, dorsal, 19. Aedeagus, lateral, 20. Male hemitergal lobe, lateral.

of sensilla basiconica; tergum 8 with sensilla basiconica patch extending over most of tergum length; tergum 7 with a few sensilla basiconica in a sparse mesal patch. Hair brushes on sterna 4-7. Aedeagal sac membranous, shaped somewhat like an animal's head in lateral aspect (Fig. 19); sac armature consists of minute to small spines covering most of ventral surface but reduced on dorsal surface (Fig. 18); small apical area without spines and area between ear-like lobes bare in dorsal aspect.

**Female.** Forewing length 26 mm. Subgenital plate broadly triangular with median notch; plate extends over ca. basal third of segment 9 (Fig. 17).

**Egg.** Inversely conical with short wide collar; sides of collar with irregularly spaced ridges; base of collar smooth. Chorion covered throughout with large pits grading into small, regularly sized pits below micropylar line; ca. 11 rows of pits above micropylar line with ca. 8 pits per row (Figs. 72-73).

**Larva.** Unknown.

**Etymology.** The species name is based on the type locality.

**Diagnosis.** The distinctive black edges to the pronotum help in recognizing this species but the male aedeagus shape in lateral aspect and egg characters are also diagnostic. The egg is similar in

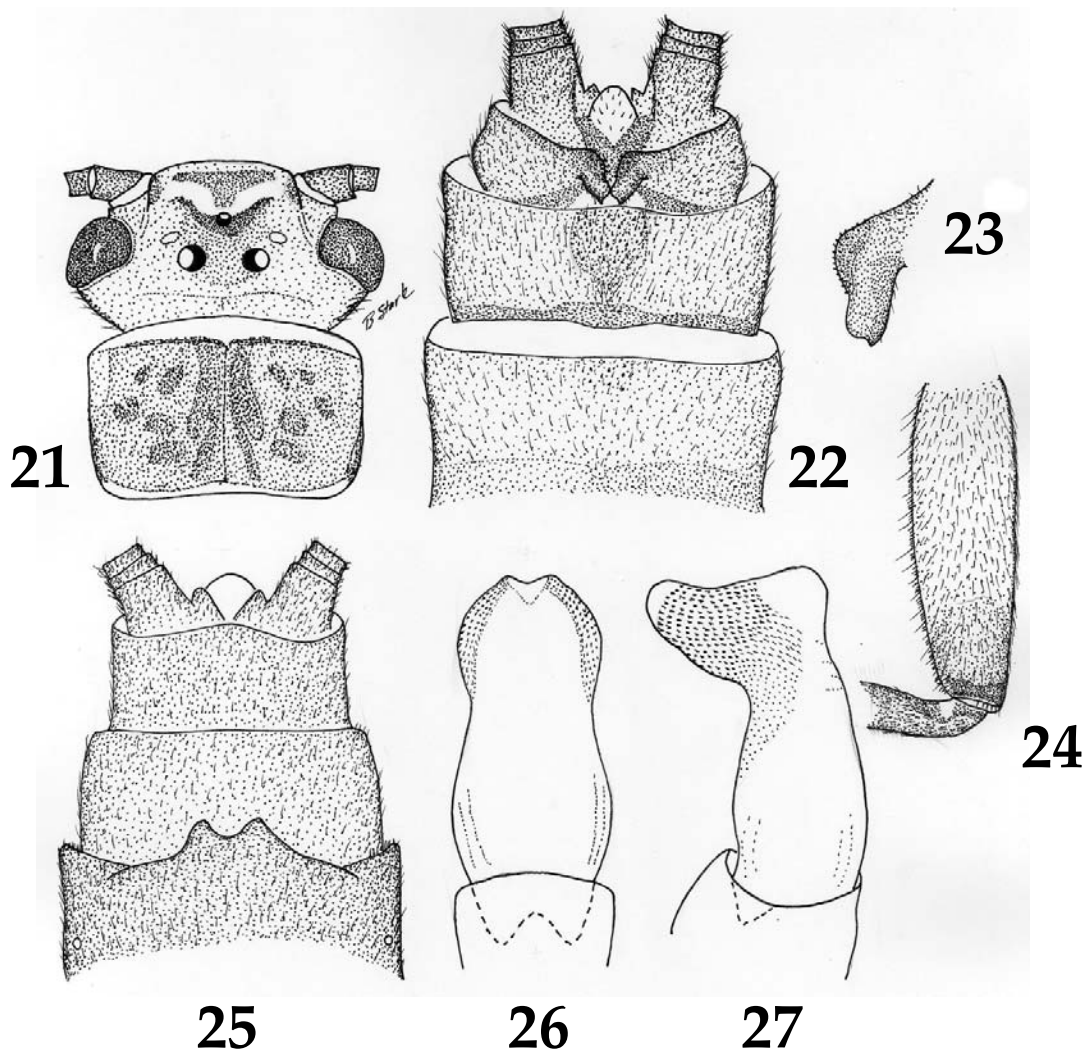
general shape to that of *K. turbinata* but the chorionic pits are relatively smaller in that species (compare Figs. 72 and 86).

***Kamimuria curriei* sp. n.**  
(Figs. 21-27, 74-75)

**Material examined.** Holotype ♂ and 1 ♂, 2 ♀ paratypes from Vietnam, Lao Cai, Sapa, large waterfall on road from Sapa to Lai Chau, 8 May 1995, ROM 956022, D. Currie, B. Hubley, J. Swann (ROM). Additional paratype: **Vietnam:** Lao Cai, Sapa, Muong Hoa Ho River, 5-12 May 1995, ROM 956007,

D. Currie, B. Hubley, J. Swann, 1 ♀ (IEBR).

**Adult habitus.** General color brown patterned with dark brown. Head dusky brown with darker areas between ocelli and forward of M-line (Fig. 21); M-line and anterior margin of head pale; antennal base brown, second segment darker, flagellum brown. Pronotum brown with darker rugosities on disk; median suture, anterior and posterior margins of disk and lateral downturned edges dark brown. Wing membrane pale brown, veins brown. Femora pale basally, becoming dusky near apex (Fig. 24); narrow apical band black; ventral base of tibiae with an oblique dark band, most of tibiae brown; tarsi brown.



Figs. 21-27. *Kamimuria curriei* adult structures. 21. Head and pronotum, 22. Male terminalia, 23. Male hemitergal lobe, lateral, 24. Femur, 25. Female terminalia, 26. Aedeagus, dorsal, 27. Aedeagus, lateral.



**Male.** Forewing length 21-22 mm. Hemitergal lobes short, wide at apex and bearing a basal callus covered with sensilla basiconica (Figs. 22-23); outer tips of hemiterga with 1 or 2 sensilla giving an acute spine-like appearance to apices. Tergum 9 with a median low knob covered with sensilla basiconica; tergum 8 with only 4-5 small sensilla basiconica in a sparse mesal patch. Aedeagal sac membranous except for ventral base; apex of sac directed ventrally giving a foot shaped structure covered along apical half of ventral surface and mid-laterally with fine to moderate sized spines (Figs. 26-27); largest spines occur laterally and ventrally near apex and these transition into finer, long spines below the small membranous lobes located on sac dorsum. Dorsal and ventral third of sac without armature.

**Female.** Forewing length 26-28 mm. Subgenital plate a short triangular projection with shallow, wide notch; apex of plate extends over basal third of sternum 9 (Fig. 25).

**Egg.** Outline oval to spherical with short, narrow, stalked collar; rim of collar flanged and irregularly incised. Chorion covered throughout, except for area surrounding collar, with fine pits of rather uniform size (Figs. 74-75).

**Larva.** Unknown.

**Etymology.** The patronym honors Dr. Douglas Currie, one of the collectors of the type series of this species and other material used in this study.

**Diagnosis.** Males of this species have similar hemiterga to *K. obtusa* and *K. klapaleki* but differ significantly from both in aedeagal features (compare Figs. 27, 37 and 97). The female subgenital plates for *K. curriei* and *K. obtusa* (Figs. 25, 36) are also distinct.

*Kamimuria jariyae* sp. n.  
(Figs. 28-32, 76-77)

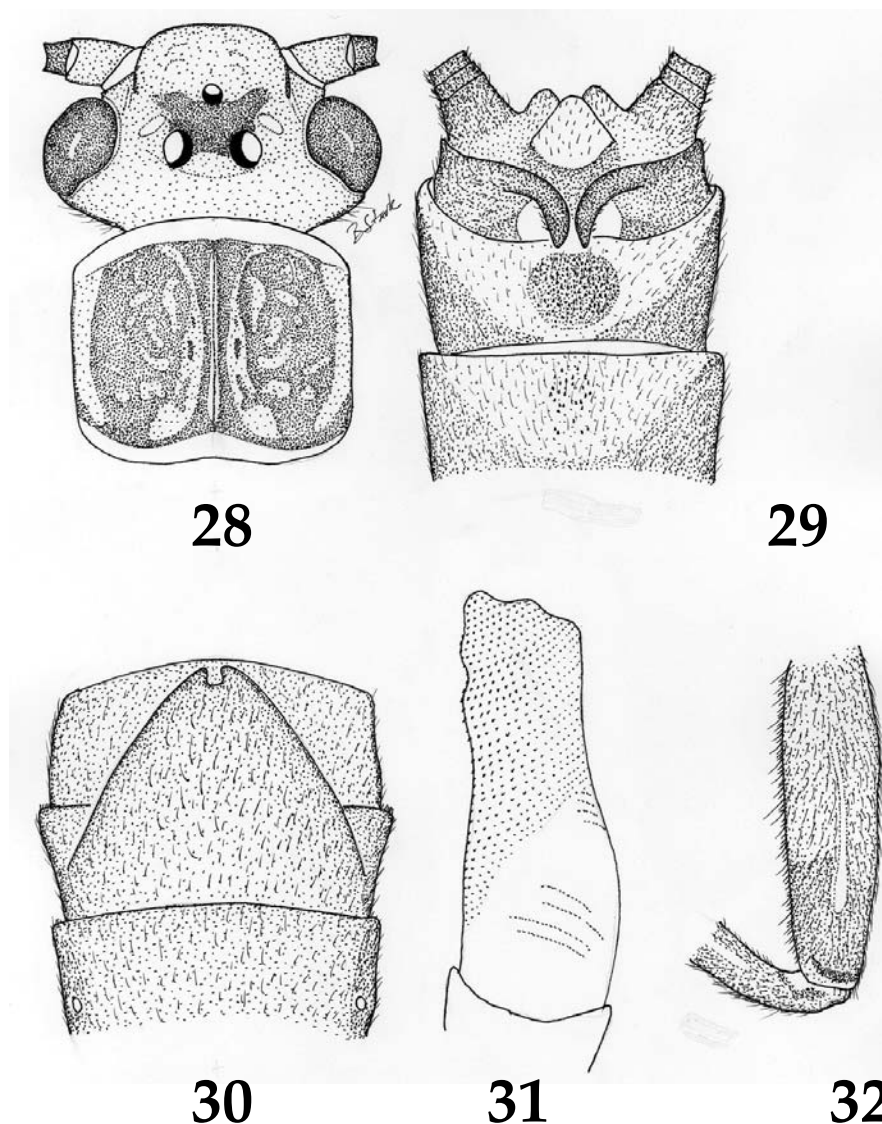
**Material examined.** Holotype ♂ and 1 ♀ paratype from Thailand, Khao Yai National Park, Pa Tabac, 28 October 2000, I. Sivec (PMSL). Additional paratypes: **Thailand:** Khao Yai National Park, 3.2 km, 16 October 2000, I. Sivec (PMSL). Chiang Mai Province, Doi Inthanon National Park, Huai Sai Leung, 98° 27' E, 18° 31' N, 1060 m, 1 ♀ (PMSL). Same site, 14-15 November 2002, 1 ♀ (PMSL). Same site, 16 November- 7 December 2002, 1 ♀ (PMSL). Same site but Bang Khun Klang, 98° 32' E, 18° 32' N, 1200 m, 7-14 November 1989, 1 ♀ (PMSL). Same site but Nam Mae Klang, Ban Sop Aep, 98° 36' E, 18° 31' N, 630 m,

29-30 September 2002, 2 ♂ (PMSL). Same site but Huai Mae Pan Noi, 98° 25' E, 18° 31' N, 750 m, 6-7 October 2002, 1 ♂ (PMSL). Same site, 15 November 2002, 1 ♀ (PMSL). Same site, 7-8 December 2002, 1 ♂ (PMSL). Phitsanulok Province, Phu Hin Rongkla National Park, Namtok Romglaio, 101° 00' E, 16° 59' N, 1190 m, 27-28 September 2002, 1 ♂ (PMSL). Same site but Waterwheel Falls, 101° 00' E, 16° 59' N, 1280 m, 20-21 October 2002, 1 ♂ (PMSL). Phrae Province, Wien Ko Sai National Park, upper Nam Panjaen, 99° 34' E, 17° 57' N, 285 m, 26 October 2002, I. Sivec, 1 ♀ (PMSL). Same site, 22-23 November 2002, 1 ♂ (PMSL). Same site, 19-20 December 2002, 1 ♂ (PMSL). Same site, 18-19 January 2003, 1 ♂ (PMSL). Same site but lower Nam Panjaen, 99° 34' E, 17° 56' N, 270 m, 25-26 October 2002, 3 ♂ (PMSL). Same site, 29-30 September 2002, 6 ♂, 3 ♀ (PMSL). Same site, 22-23 November 2002, 2 ♂ (PMSL). Same site, 19-20 December 2002, 1 ♀ (PMSL). Same site, 21-22 March 2003, 1 ♀ (PMSL). Unknown Province, Panombenja National Park, 15-16 November 2000, 1 ♂ (PMSL). Unknown Province, Ton Nga Chang Waterfall, 100° 14' E, 06° 57' N, 100 m, 24 April 1993, S. Thailand, 4 ♂ (PMSL). Same site, 17 March 1994, S. Thailand, 2 ♂, 1 ♀ (PMSL). Unknown Province, Boripat Waterfall, 100° 09' E, 06° 59' N, 200 m, 27-28 April 1993, S. Thailand, 4 ♂ (PMSL). Unknown Province, Kao Soi Dao National Park, 102° 10' E, 13° 06' N, 400 m, 2 ♂ (PMSL). **Vietnam:** Gia Lai, Buoenloy, May 1995, A. Gorohov, 1 ♂ (PMSL). Lao Cai, Sapa, Fan Si Pang Mountain, 1600 m, 22-29 April 1995, LF, 1 ♂ (PMSL). Additional material: **Thailand:** Khao Yai National Park, larvae (PMSL).

**Adult habitus.** General color brown. Head with dark brown quadrangular spot covering ocellar triangle; paler laterally, anterior to M-line and on occiput (Fig. 28). Basal antennal segment pale brown, second and subsequent segments dark brown. Pronotum dark brown with scattered obscure pale rugosities. Legs brown to pale brown with narrow dark marking on apex of femora (Fig. 32). Cerci pale.

**Male.** Forewing length 18 mm. Hemiterga simple, slender, finger shaped and armed on inner margins and on apex with a few sensilla basiconica (Fig. 29). Abdominal tergum 9 with a median patch of sensilla basiconica; tergum 8 with a few sensilla basiconica in mesal field. Aedeagus simple, tubular, entirely membranous and armed on the apical half of sac with a fairly continuous field of minute to small triangular spines (Fig. 31).





Figs. 28-32. *Kamimuria jaryiae* adult structures. 28. Head and pronotum, 29. Male terminalia, 30. Female terminalia, 31. Aedeagus, lateral, 32. Femur.

**Female.** Forewing length 23 mm. Subgenital plate wide, triangular and long, extending over most of sternum 9; apex of plate with a small notch (Fig. 30). Vagina membranous, spermatheca a large, inflated, sac-like structure.

**Egg.** Outline oval with wide, short collar. Chorionic surface covered throughout with coarse pits, each pit centered in a follicle cell impression; ca. 11 pit rows visible in lateral aspect and ca. 6 pits in each row between collar and micropylar line. Pits below micropylar line similar to those above line; area around collar with an irregular surface, including

ridges on sides of collar, but pits absent in collar zone (Figs. 76-77).

**Larva.** General color brown patterned with pale areas on head and thorax. Head pattern mostly brown but with narrow, pale M-line, pale tentoria and pale midlateral spots on occiput. Occipital row complete; pronotum completely fringed laterally with short, stout bristles. Abdominal terga with short, stout intercalary bristles, dark clothing bristles and well developed posterior bristle row. Occiput, posterior margin of pronotum and median longitudinal area of abdomen fringed with long silky setae. Cercal

swimming fringe well developed, anal gills absent.

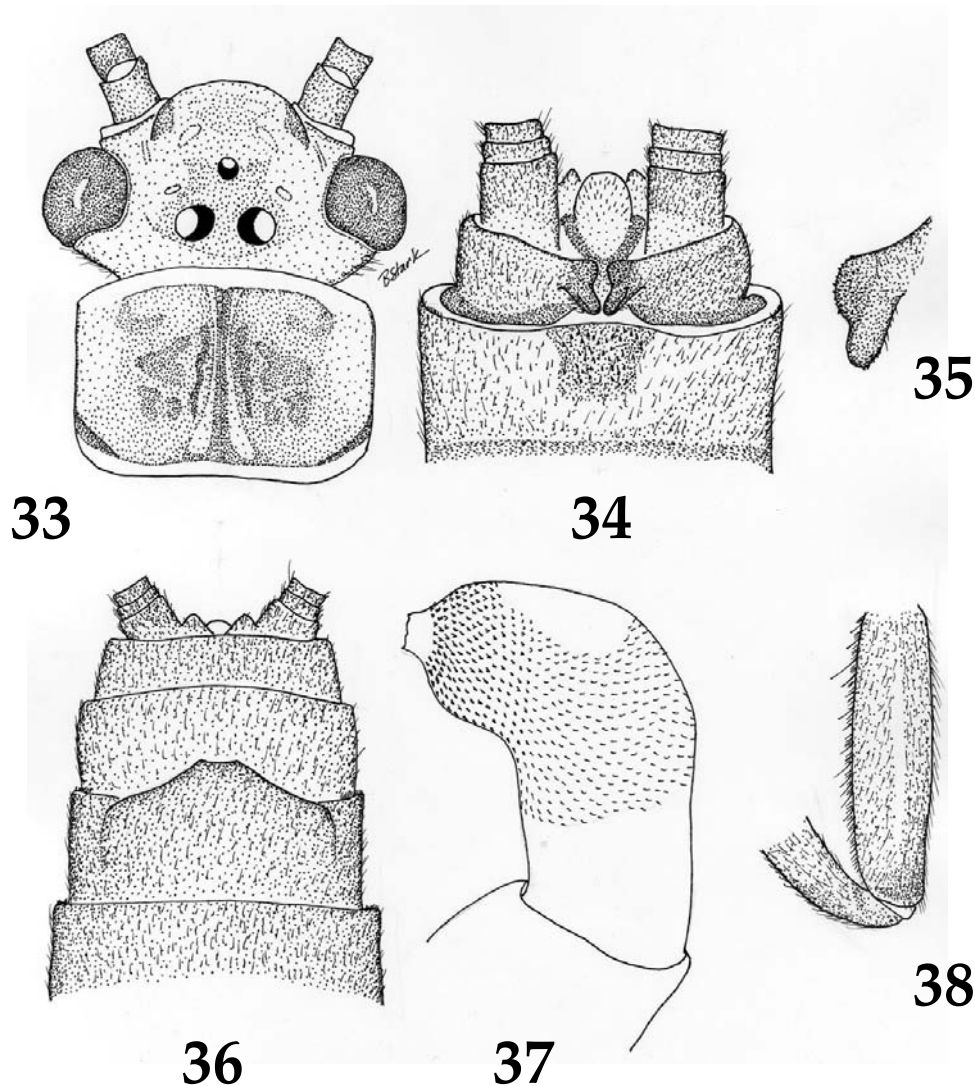
**Etymology.** The matronym honors Professor Dr. Jariya Chanpaisaeng of Kasetsart University, Bangkok for her assistance in this project.

**Diagnosis.** Among Thai and Vietnamese *Kamimuria* this species is most easily distinguished by the coarsely and rather uniformly punctate egg. Males have moderately long, slender hemitergal lobes, similar to those of *K. atra* and *K. atrocephala* but they are more attenuated near the tips in this species (Fig. 29) and the aedeagus is also distinct (compare Figs. 7, 12 and 31).

***Kamimuria obtusa* sp. n.**

(Figs. 33-42, 78-79)

**Material examined.** Holotype ♂ from Thailand, Doi Inthanon National Park, Huai Sai Leung, 98° 35' E, 19° 23' N, 1060 m, 7-8 May 2002, Chiang Mai University team (PMSL). Additional paratypes: **Thailand:** type locality, 20 March 2002, I. Sivec, 5 ♂, 1 ♀ (PMSL). Same site, 4 April-3 May 2003, 2 ♂ (PMSL). Same site, 25-26 February 2003, 1 ♂ (PMSL). Same site, 14-15 March, 2 ♂ (PMSL). Same site, 3-4 April 2003, 2 ♂ (PMSL). Same site, 4 April 2002, 3 ♂,



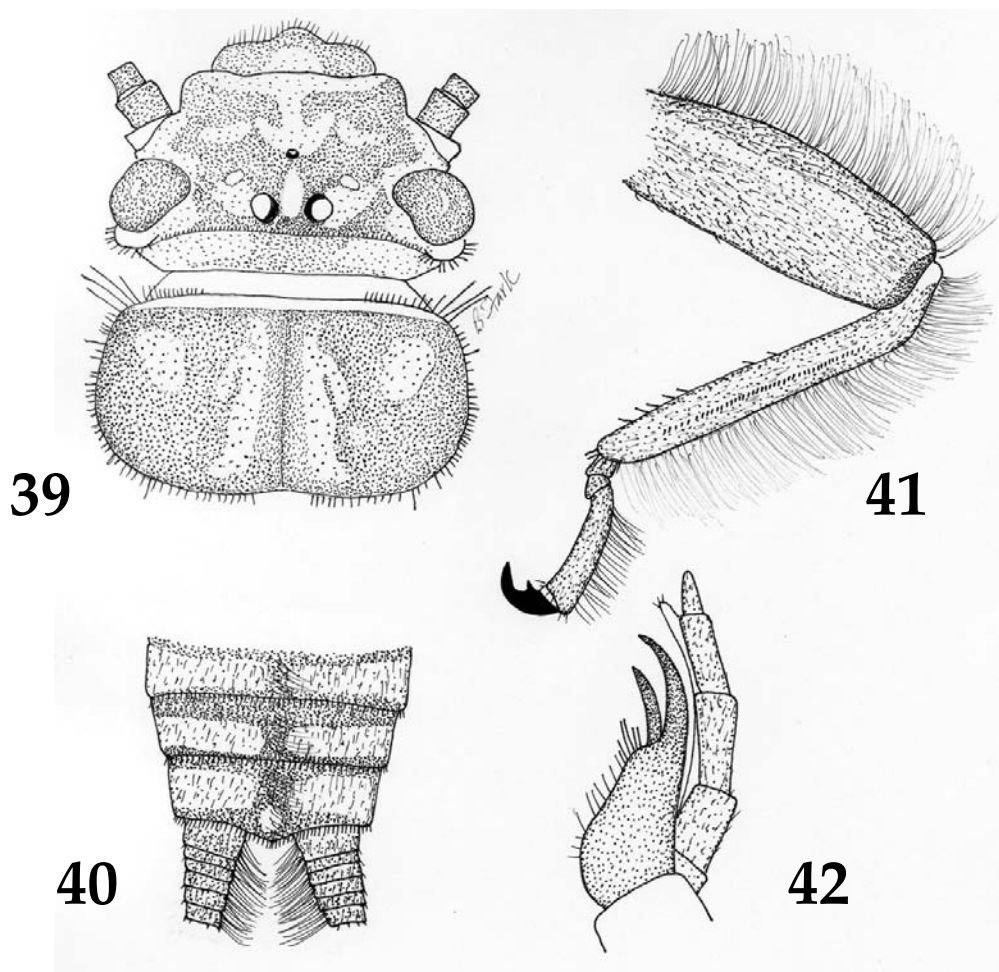
Figs. 33-38. *Kamimuria obtusa* adult structures. 33. Head and pronotum, 34. Male terminalia, 35. Male hemitergal lobe, lateral, 36. Female terminalia, 37. Aedeagus, lateral, 38. Femur.

1 ♀ (PMSL). Same site but Namtok Siripum, 98° 31' E, 18° 32' N, 1460 m, 2-3 April 2002, 1 ♂ (PMSL). Same site, 7-8 June 2002, 5 ♂ (PMSL). Same site, 2 March 2002, 1 ♀ (PMSL). Same site but Bang Khun Klang, 98° 32' E, 18° 32' N, 1200 m, 19-26 June 1990, 2 ♂, 1 ♀ (PMSL). Same site, 10 April 1989, 4 ♂ (PMSL). Same site, 5-12 July 1989, 1 ♂ (PMSL). Same site but 34.5 km, 98° 31' E, 18° 31' N, 1600 m, 4 ♂, 3 ♀ (PMSL). Unknown Province, Tung Yaw, 18 km NW Ba Pa Pael, 98° 39' E, 19° 08' N, 1200 m, 17 April 1989, 1 ♂, 1 ♀ (PMSL). **Vietnam:** Lao Cai, tributary Muong Hoa Ho River, 15 km E Sapa, 926 m, 10 May 1995, ROM 956033, D. Currie, B. Hubley, J. Swann, 2 ♂ (ROM). Same site, 6 May 1995, ROM 956013, D. Currie, B. Hubley, J. Swann, 1 ♂ (IEBR). Additional material: Lao Cai, tributary Muong Hoa Ho River, 15 km E Sapa, 926 m, 11 May 1995, ROM 956034, D.

Currie, B. Hubley, J. Swann, 7 nymphs (ROM).

**Adult habitus.** General color pale brown. Head mostly yellow brown with darker areas around antennal bases and forward of median ocellus (Fig. 33). Femora pale but darker apically (Fig. 38), tibiae brown but slightly darker at base and apex.

**Male.** Forewing length 22 mm. Hemitergal lobes short, wide, rounded apically and bearing a small basal callus armed with sensilla basiconica (Figs. 34-35); a short carina extends along dorsal edge of hemiterga. Tergum 9 with a median patch of sensilla basiconica but sensilla basiconica absent from tergum 8. Aedeagus membranous, cylindrical but strongly narrowed at apex. Armature consists of small to moderate size spines in ventral patch in apical half of sac; patch strongly narrowed on dorsum to an apical or subapical band (Fig. 37).



Figs. 39-42. *Kamimuria obtusa* nymphal structures. 39. Head and pronotum, 40. Abdominal terga 8-10, 41. Foreleg, 42. Maxilla.



**Female.** Forewing length 29 mm. Subgenital plate broadly triangular with an apical emargination or small truncate apex (Fig. 36).

**Egg.** Outline almost spherical to slightly oval with short, narrow collar; rim of collar scalloped with irregular lumpy projections. Chorion finely punctate throughout; punctations vary slightly in diameter over most of surface but smaller ones occur generally below micropylar line. In equatorial third of egg punctations outline follicle cell impressions with ca. 3-4 pits per cell side; cells enclose simple floors with highly variable numbers of pits, usually clustered near cell centers (Figs. 78-79).

**Larva.** Anal gills absent. Head and body distinctively patterned in yellow and dark brown pigment. Head dark with pale areas lateral to and between ocelli, along M-line and across anterior margin of frons (Fig. 39); pronotum dark with scattered pale areas. On the abdominal terga, dark apical, basal and mesal bands connect to outline a pair of linear pale areas on each side of terga (Fig. 40). Intercalary bristles absent from abdominal terga. Pronotum with setal fringe complete, but somewhat sparse laterally; setae at anterior corners conspicuously longer. Long silky setae occur along median line of body, across occiput and dorsally on cerci. Femora, tibiae and tarsi also bear outer fringe of long silky setae; femora armed above bare median band with prominent bristles, and below band with shorter thick bristles (Fig. 41); tarsal claws with basal tooth. Inner lacinial margin with row of close-set, thick bristles which extend from base of subapical tooth for most of length of lacinia (Fig. 42).

**Etymology.** The species name refers to the broadly rounded hemitergal tips.

**Diagnosis.** *Kamimuria obtusa* shares the short, broad hemitergal lobes and aedeagal armature pattern with *K. klapaleki* but can be distinguished by careful comparison of details in aedeagal armature. In *K. obtusa* the armature extends essentially to the aedeagal apex and the patch is continuous on the dorsum forward of the subapical bare spot (Fig. 37), whereas in *K. klapaleki* the apical armature ends well before the tip and the dorsoapical patch is not continuous forward of the subapical bare spot (Fig. 97). Chorionic features including the mesal field of obscure follicle cell impressions composed of rows of pits (Fig. 78) permit recognition of gravid females and larvae were associated through dissection of the aedeagus and eggs from pharate specimens.

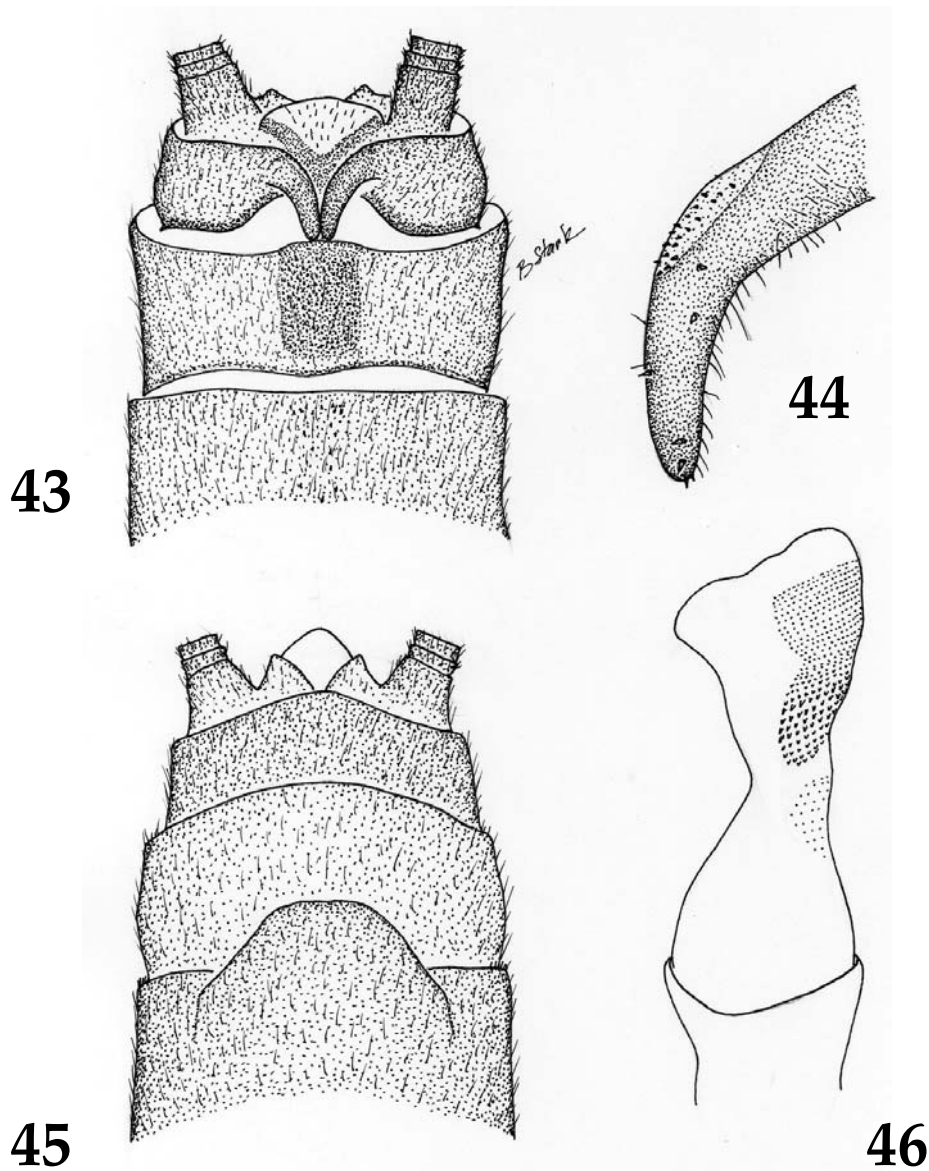
Although few larvae are known in this genus, and color pattern may not ultimately prove to be a reliable method for species recognition, this species is distinct in head color pattern from *K. tibialis* (Sivec et al. 1988).

*Kamimuria punctata* sp. n.  
(Figs. 43-46, 80-81)

**Material examined.** Holotype ♂ and 1 ♀ paratype from Thailand, Chiang Mai Province, Doi Suthep-Pui National Park, Namtok Monthatarn, 98° 55' E, 18° 49' N, 600 m, 12-13 April 2002, Chiang Mai University team (PMSL). Paratypes: **Thailand:** Type locality, 22-23 April 2003, 1 ♀ (PMSL). Chiang Mai Province, Doi Suthep-Pui National Park, Huai Kaew, Namtok Sai Yoi, 98° 55' E, 18° 48' N, 1000 m, 7 May 2002, 2 ♀ (PMSL). Chiang Mai Province, Doi Inthanon National Park, Bang Khun Klang, 98° 32' E, 18° 32' N, 1200 m, 1 ♂ (PMSL). Same site but Nam Mae Klang, Ban Sop Aep, 98° 36' E, 18° 31' N, 630 m, 1-2 April 2003, 1 ♂ (PMSL). Chiang Mai Province, Doi Inthanon National Park, 950 m, 3 April 1993, 1 ♂ (PMSL). Chiang Mai Province, Chiang Dao Wildlife Experimental Center, 99° 55' E, 19° 21' N, 520 m, 22 March 2003, 1 ♂, 1 ♀ (PMSL). Same site, 27 February 2003, 1 ♀ (PMSL). Loei Province, Na Heaw National Park, Namtok Tat Huang, 100° 59' E, 17° 33' N, 500 m, 9-10 March 2002, I. Sivec, 1 ♂ (PMSL). Phayao Province, Doi Luang National Park, Namtok Champatong, 99° 44' E, 19° 13' N, 620 m, 25 April 2003, 2 ♀ (PMSL). Phrae Province, Wieng Ko Sai National Park, Namtok Maekueng Luang, tier 1, 99° 35' E, 17° 58' N, 400 m, 19-20 February 2003, 2 ♂, 1 ♀ (PMSL). Same site, 19-20 December 2002, 1 ♂ (PMSL). Same site, 22-23 March 2003, 1 ♂, 1 ♀ (PMSL). Same site, 22-23 April 2003, 1 ♀ (PMSL). Same site but Namtok Maekueng Luang, tier 7, 99° 35' E, 17° 58' N, 430 m, 22-23 April 2003, 1 ♀ (PMSL). Same site but Lower Nam Panjaen, 99° 34' E, 17° 56' N, 270 m, 25-26 January 2003, 2 ♂ (PMSL). Same site, 19-21 February 2003, 3 ♂ (PMSL). Same site, 21-22 March 2003, 1 ♀ (PMSL). Unknown Province, Ban Yang Bong, 98° 54' E, 19° 21' N, 500 m, 19 March 1992, 6 ♂, 1 ♀ (PMSL).

**Adult habitus.** General color pale brown but details are obscured by the teneral specimen condition.

**Male.** Forewing length 25 mm. Hemitergal lobes slender, finger-like with few scattered sensilla basiconica on inner margins near base and at apex



Figs. 43-46. *Kamimuria punctata* adult structures. 43. Male terminalia, 44. Male hemitergal lobe, dorsal, 45. Female terminalia, 46. Aedeagus, lateral.

(Figs. 43-44). Tergum 9 slightly produced mesally and bearing a mesal patch of more than 50 sensilla basiconica. Hair brushes present on sterna 4-7. Aedeagus membranous, more or less cylindrical but expanded in distal third; armature consists of a dorsal patch of minute to small triangular spines located on apical half of sac (Fig. 46); largest spines located basally except for an additional grouping of fine spines narrowly separated from main patch. Venter of sac without armature.

**Female.** Forewing length 31 mm. Subgenital plate a moderate size, broadly triangular process projecting over basal third to half of sternum 9 (Fig. 45).

**Egg.** Outline oval, collar short, wide and surrounded basally by an irregular series of pores extending under rim of collar. Chorion rather uniformly and coarsely punctate throughout; ca. 18 rows of pits visible in lateral aspect with ca. 10-11 pits per row above micropylar line and ca. 9 pits per row below line (Figs. 80-81).

**Larva.** Unknown.

**Etymology.** The species name refers to the rather uniformly pitted egg chorion.

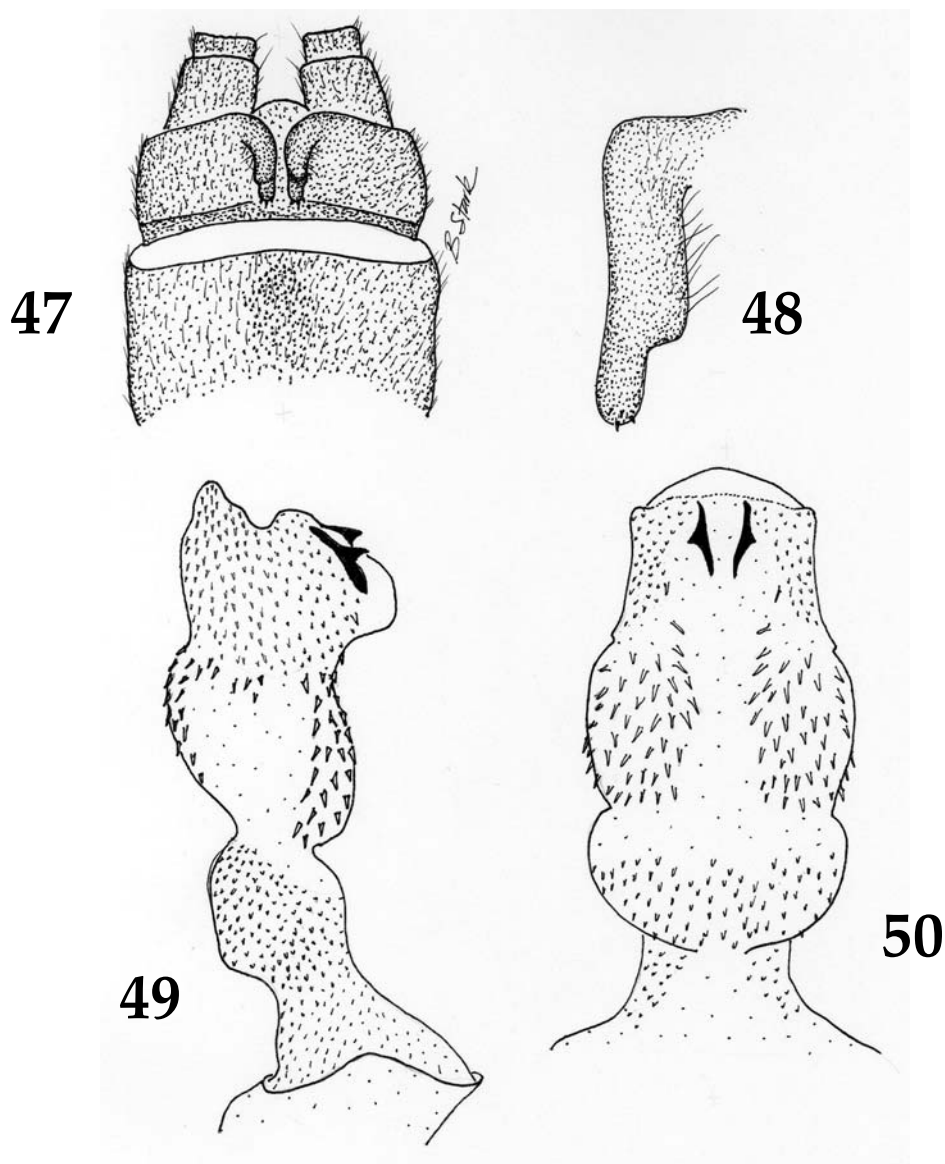
**Diagnosis.** This species is most easily distinguished from Thai and Vietnamese congeners by the uniformly pitted egg chorion. Among species with longer, more slender hemiterga, the males are distinctive by virtue of the absence of ventral armature on the aedeagal sac (Fig. 46).

*Kamimuria similis* Klapálek  
(Figs. 47-50)

*Kamimuria similis* Klapálek, 1912:100. Holotype ♂ (MNHN), Lao Cai/Ho-Kheou region, Tonkin [=Vietnam]

**Material examined. Vietnam:** Lao Cai/Ho-Kheou region, 1 ♂ (holotype, MNHN).

**Adult habitus** (translated from Klapálek 1912). General color yellow-brown to brown. Head yellow brown but with a black interocellar area. Pronotum brown, legs mostly brown but tips of femora darker and base of tibia pale brown. Wings brown except costal field pale. Hind ocelli much larger than anterior ocellus and nearer eyes than each other.



Figs. 47-50. *Kamimuria similis* adult structures. 47. Male terminalia. 48. Male hemitergal lobe, lateral. 49. Aedeagus, lateral. 50. Aedeagus, dorsal.



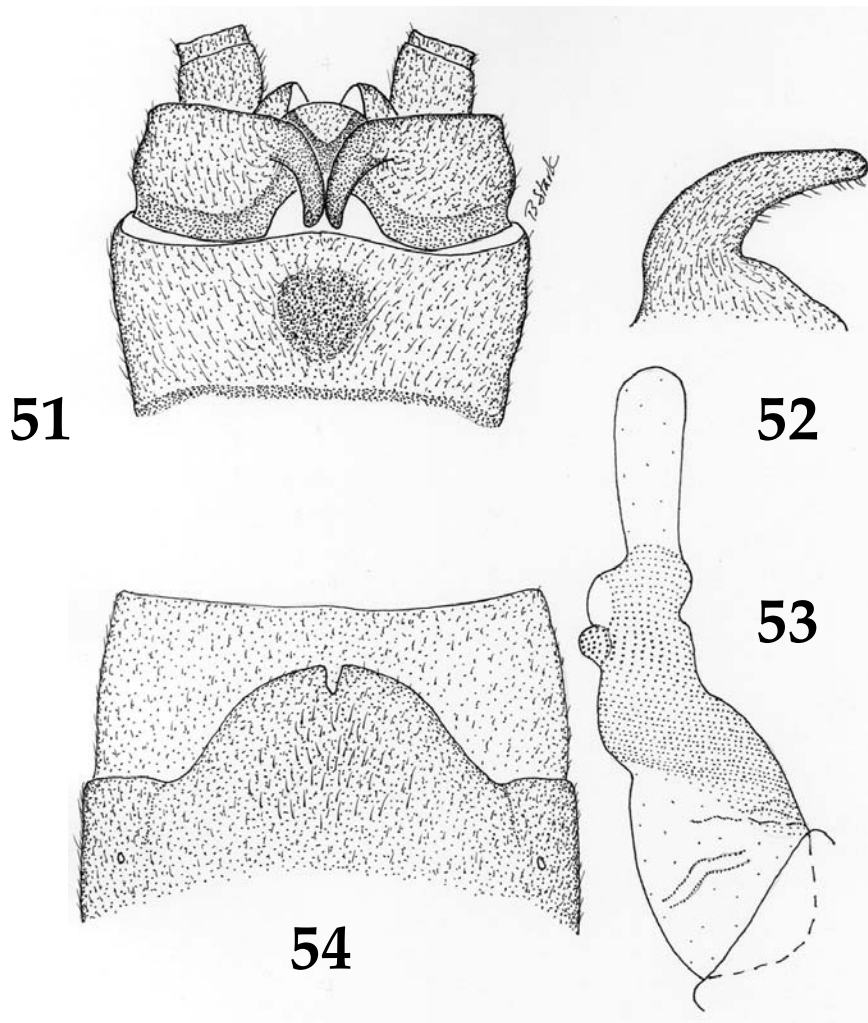
**Male.** Forewing length ca. 17 mm. Hemiterga long, slender and wide in lateral aspect beyond midlength and abruptly narrowed to tip (Figs. 47-48); tips with sensilla basiconica. Tergum 9 with a large mesal field of sensilla basiconica; tergum 8 sensilla basiconica patch much smaller. Aedeagus membranous but armed with prominent patches of spines; basal lobe armed throughout with small spines on venter and dorsum (Figs. 49-50); apical lobe armed dorsally with subapical lateral patches and an apical pair of large

spine-like sclerites; venter with a median subapical spine patch.

**Female.** Unknown.

**Larva.** Unknown.

**Comments.** The genitalic segments of the holotype were made available for our study through the courtesy of P. Zwick. Among known species the males are distinctive by virtue of the hemitergal lobe shape (Fig. 48) and in the presence of a pair of large spine-like sclerites on the dorsal aedeagal tip (Figs. 49-50).



Figs. 51-54. *Kamimuria trang* adult structures. 51. Male terminalia, 52. Male hemitergal lobe, lateral, 53. Aedeagus, lateral, 54. Female terminalia.

*Kamimuria trang* sp. n.  
(Figs. 51-54, 82-85)

**Material examined.** Holotype ♂ and 1 ♀ paratype

from Thailand, Trang, January-February, 1899, W.L. Abbott (USNM). Actual label location is "Trong lr Siam". Additional Paratypes: **Thailand**, Trang, W.L. Abbott, 2 ♂, 1 ♀ (USNM).

**Adult habitus.** General color appears to be pale yellow brown with pale wings, but the color pattern is obscured by specimen condition.

**Male.** Forewing length 20 mm. Hemiterga slender at tip and slightly expanded at base in dorsal aspect; tips with a small cluster of sensilla basiconica (Figs. 51-52). Tergum 9 with median sensilla basiconica patch anterior to hind margin. Aedeagus membranous, armed with small triangular spines and microtrichia in broad central band (Fig. 53); dorsum bearing a pair of small tubercles set posteriorly to a small dorsolateral bare spot.

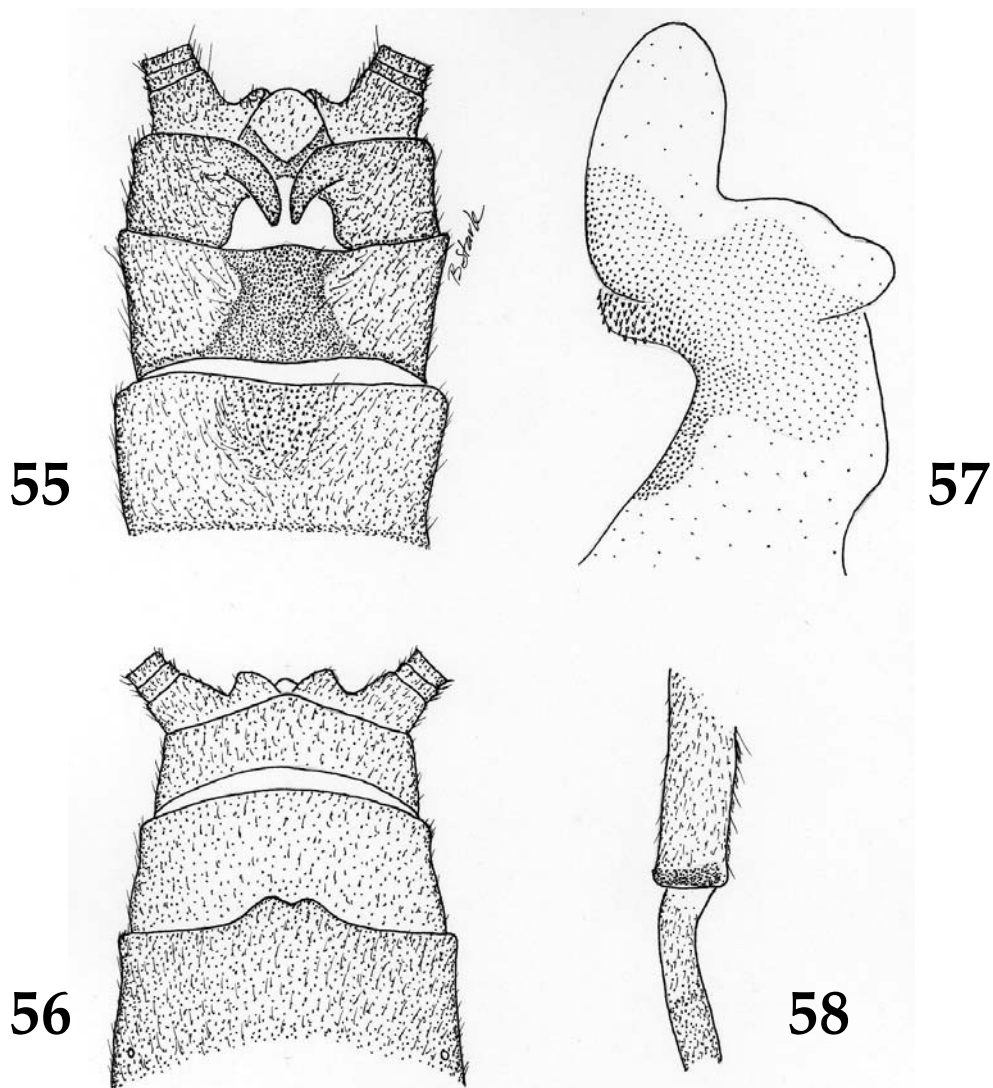
**Female.** Forewing length 24 mm. Subgenital plate sub-parabolic with narrow median notch (Fig. 54).

Sternum 8 with sparse patch of bristles in center of plate but rest of sterna 8 and 9 bearing only fine scattered setae.

**Egg.** Outline oval, length ca. 0.30 mm, width ca. 0.26 mm (Fig. 82). Collar short, ca. 0.11 mm wide and bearing a series of evenly spaced vertical struts which extend to rim (Fig. 83). Chorionic surface covered throughout with coarse pits centered in follicle cell impressions; inner walls of FCIs irregularly punctate (Fig. 84). Micropylar row subequatorial (Figs. 82, 84).

**Larva.** Unknown.

**Etymology.** The species name, used as a noun in apposition, is based on the type locality.



Figs. 55-58. *Kamimuria turbinata* adult structures. 55. Male terminalia, 56. Female terminalia, 57. Aedeagus, lateral, 58. Apex of femur and base of tibia.

**Diagnosis.** The hemiterga of this species generally resemble those of *K. jaryiae* and *K. atra* (described above), and *K. zonata* (described below), and the aedeagal armature is of the same general type for the four, however shape and lobing of the aedeagus differs, and only *K. trang* has the cylindrical, membranous apical lobe (Fig. 53). The five damaged specimens comprising the type series were previously determined by S.G. Jewett, Jr. as *K. kelantonica* Klapálek, a species known from “Kelanton, Ost Malakka” (Klapálek 1912); we assume this site to be on the island of Borneo.

***Kamimuria turbinata* sp. n.**  
(Figs. 55-58, 86-87)

**Material examined.** Holotype ♂ and 4 ♀ paratypes from Thailand, Chiang Mai Province, Doi Inthanon National Park, Huai Sai Lueng, 98° 35' E, 19° 23' N, 1060 m, 20 March 2002, I. Sivec (PMSL). Additional paratypes: **Thailand:** Chiang Mai Province, Doi Inthanon National Park, Huai Mae Pan Noi, 98° 25' E, 18° 31' N, 750 m, 3-4 April 2003, I. Sivec, 2 ♂, 1 ♀ (PMSL). Unknown Province, Huey Nam Ru, 98° 35' E, 19° 23' N, 1400 m, 18 April 1989, 2 ♀ (PMSL). Unknown Province, Ban Yang Bong, 19 March 1992, H. Malicky, 1 ♀ (PMSL).

**Adult habitus.** General body color pale yellow-brown; head coloration uniform without distinctive pattern, except for dark rings around ocelli. Palpi pale, first antennal segment pale, 2<sup>nd</sup> dark brown and rest of flagellum dark brown in basal half becoming pale beyond mid-point. Pronotum uniformly pale brown with slight relief from obscure rugosities. Femora pale except for narrow dark apical band; tibiae pale brown, tip of last tarsal segment dark brown (Fig. 58).

**Male.** Forewing length 17 mm. Hemitergal lobes slender, curved slightly and finger-like (Fig. 55); hemiterga with a few sensilla basiconica clustered at tip and additional ones scattered along dorsal margin. Tergum 9 with a large median patch of sensilla basiconica clustered from posterior margin to mid-point of tergum; median field of tergum 9 darker than lateral areas. Tergum 8 with a smaller median field of sensilla basiconica set near posterior margin. Aedeagus membranous, apex trilobed; triangular spines cover much of aedeagal surface particularly along ventroapical margin (Fig. 57).

**Female.** Forewing length 32 mm. Subgenital plate a

small mesal projection with slight median emargination or shallow notch. Plate covers less than a third of sternum 9 (Fig. 56).

**Egg.** Inversely conical in shape with wide, short collar and pointed lid. Chorion coarsely pitted throughout; pits becoming slightly smaller below micropylar line; ca. 13 rows of pits in lateral aspect, ca. 6-7 pits per row above micropylar line, and ca. 6-7 pits per row below line. Collar with narrow rim, surrounded by small, pit-free zone (Figs. 86-87).

**Etymology.** The species name refers to the inversely conical shape of the egg.

**Diagnosis.** This species is most easily distinguished by the inversely conical egg with chorionic punctations becoming somewhat smaller below the micropylar line. In hemitergal lobe features this species most closely resembles *K. jaryiae* but these species differ in aedeagal shape (Figs. 31, 57) and in other characters (e.g. subgenital plate shape).

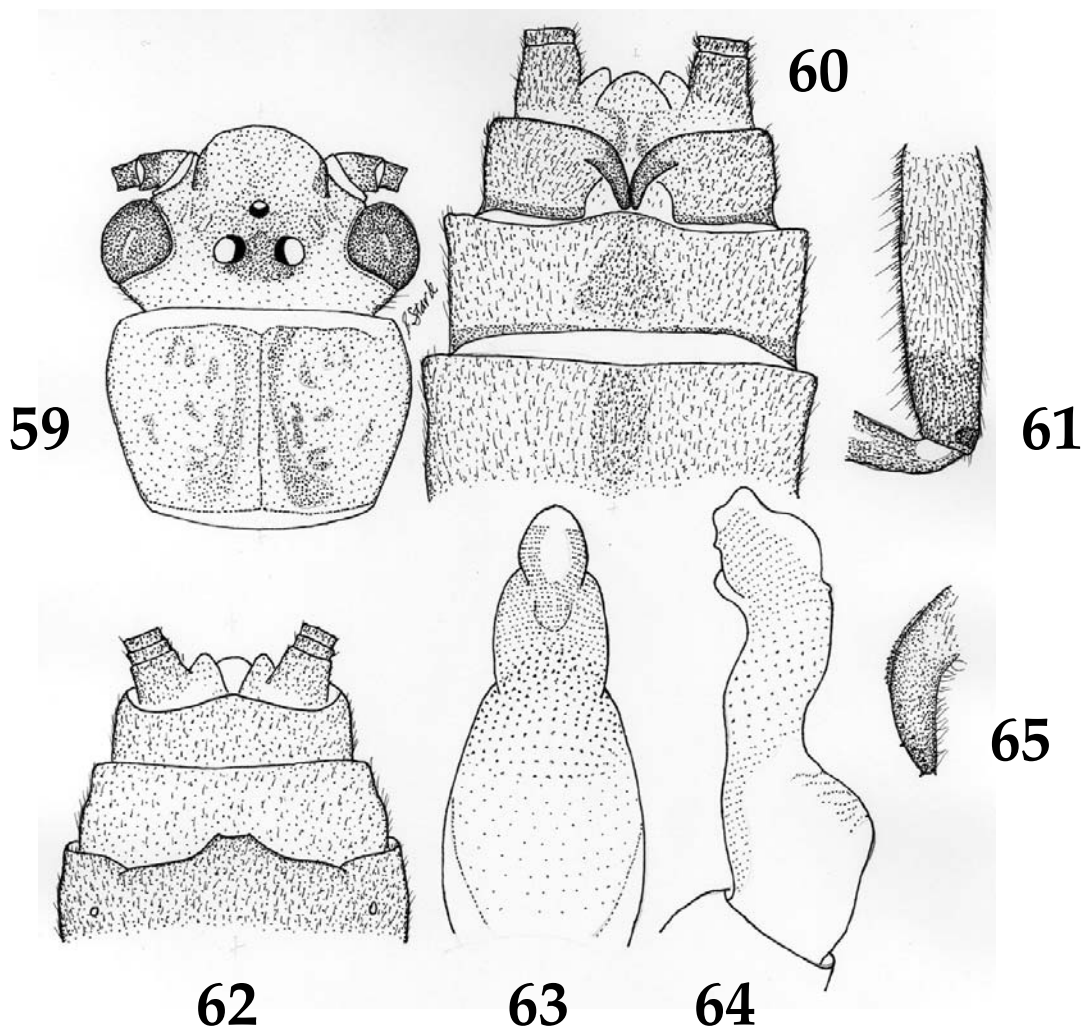
***Kamimuria zonata* sp. n.**  
(Figs. 55-58, 86-87)

**Material examined.** Holotype ♂ and 3 ♂ paratypes from Vietnam, Lao Cai, Sapa, Muong Hoa Ho River, 6 May 1995, ROM 956013, D. Currie, B. Hubley, J. Swann (ROM). Additional paratypes: **Vietnam:** Lao Cai, Sapa, vicinity Sapa Post guest house, 1600 m, 5-12 May 1995, ROM 956003, D. Currie, B. Hubley, J. Swann, 1 ♀ (ROM). Lao Cai, tributary Muong Hoa Ho River, 15 km E Sapa, 926 m, 10 May 1995, ROM 956033, D. Currie, B. Hubley, J. Swann, 1 ♀ (IEBR).

**Adult habitus.** General color yellow brown patterned with dark brown. Head with dark pigment restricted to area between ocelli (Fig. 59). Basal antennal segment dark apically and pale in basal third, subsequent segments dark. Pronotum pale with obscure pattern from pale brown reticulations. Wings pale amber with slightly darker veins. Femora pale in basal half, dark distally (Fig. 61); tibiae and tarsi dark.

**Male.** Forewing length 27-28 mm. Hemiterga slender, finger-like; inner margins armed with irregular row of minute spines (Figs. 60, 65); dorsum and apex with a few (ca. 5-7) larger sensilla basiconica. Terga 7-9 with mesal patches of sensilla basiconica; patch on 9 extends from base of small median lobe to anterior margin of tergum; patch on 8 narrower than on 9 but extending across tergum; patch on 7 consists of a few scattered sensilla. Hair brushes present on sterna 4





Figs. 59-65. *Kamimuria zonata* adult structures. 59. Head and pronotum, 60. Male terminalia, 61. Femur, 62. Female terminalia, 63. Aedeagus, ventral, 64. Aedeagus, lateral, 65. Male hemitergal lobe, dorsal.

or 5-7. Aedeagal sac membranous and irregularly tubular; apical third bearing a small ventral lobe; armature consists of minute to small spines covering most of venter and a smaller dorsal area; ventral patch interrupted forward of small lobe leaving a narrow bare corridor which extends almost to apex (Figs. 63-64).

**Female.** Forewing length 31-33 mm. Subgenital plate strongly narrowed to a truncate posterior margin (Fig. 62).

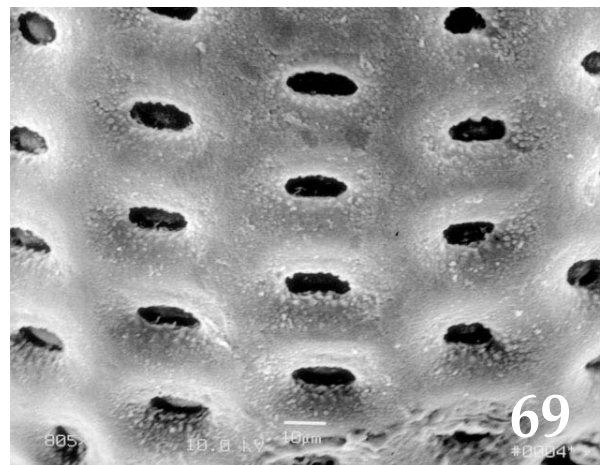
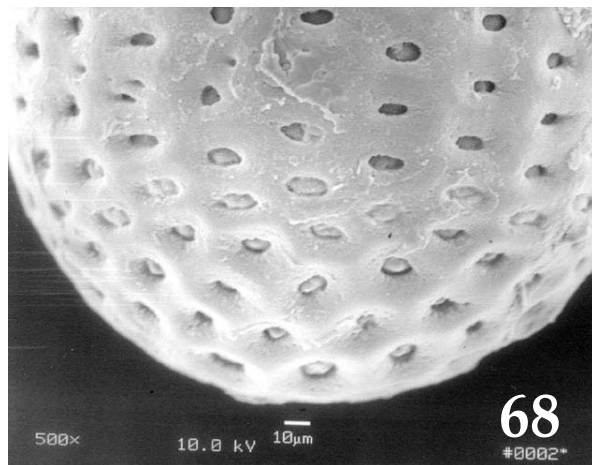
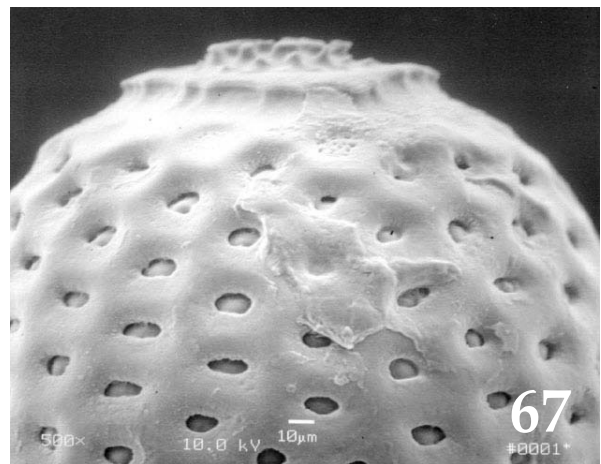
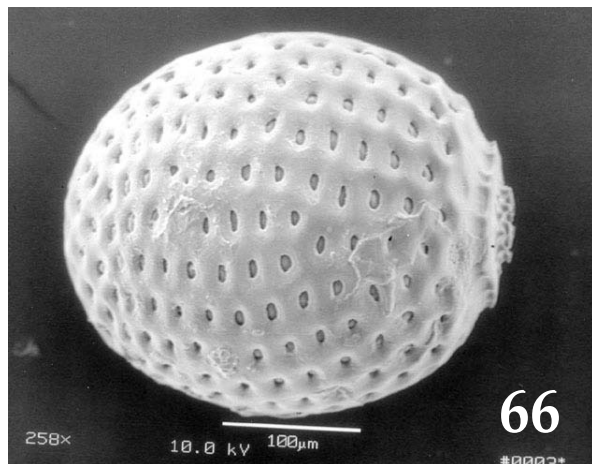
**Egg.** Outline oval with short stalked collar; collar moderately wide, rim flanged and margined with irregular tubercles. Chorion covered almost throughout with relatively uniform, coarse, shallow

pits; micropylar area with pits more or less interrupted; ca. 18 rows of pits visible in lateral aspect and ca. 9 pits per row above micropylar line (Figs. 88-89).

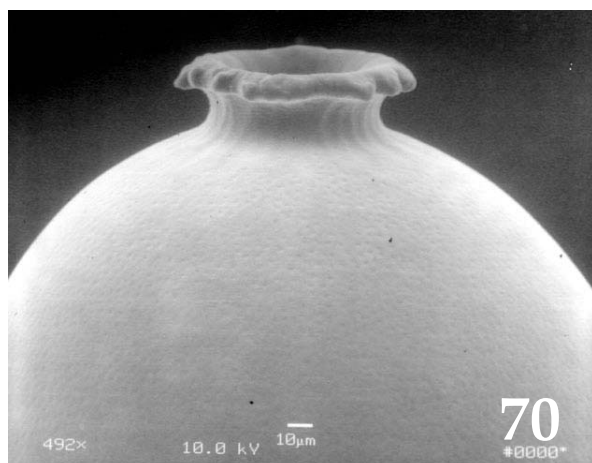
**Nymph.** Unknown.

**Etymology.** The species name refers to the distinctively banded legs.

**Diagnosis.** This species is most easily recognized by its color pattern, large size and egg chorionic features. The uniform, relatively small pits together with the wide, stalked collar are distinctive among Thai and Vietnamese *Kamimuria*. The aedeagal shape (Figs. 63-64) will distinguish males from related species with similar hemitergal lobes and femoral banding.

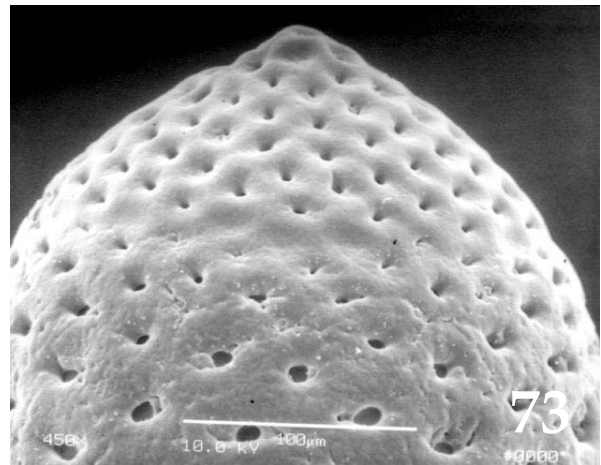
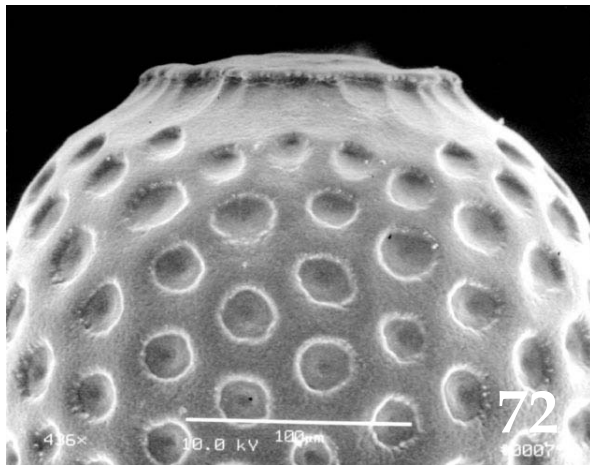


Figs. 66-69. SEM micrographs of eggs from holotype of *K. anamensis*. 66. Entire egg, 67. Collar and chorionic detail, 68. Anterior pole, 69. Chorionic detail.

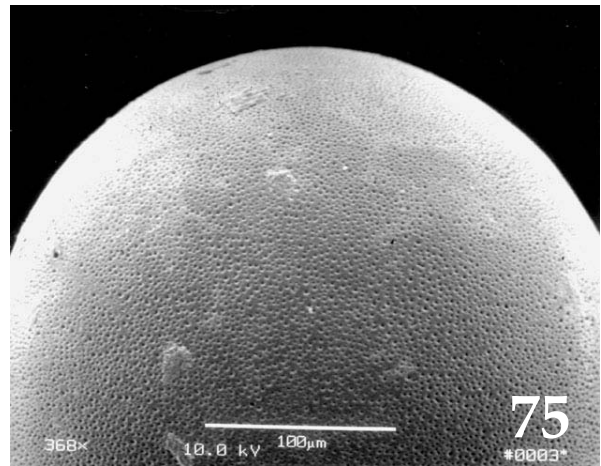
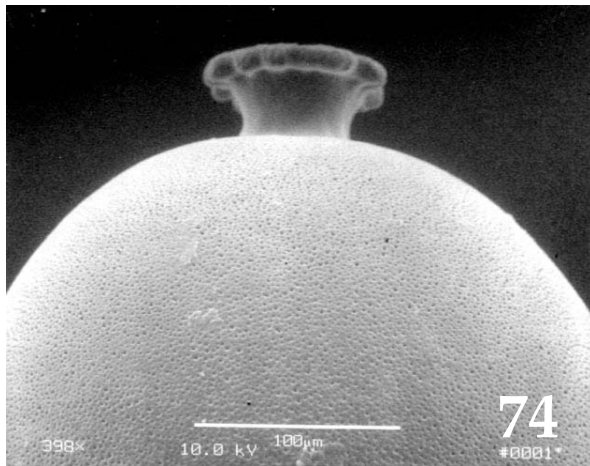


Figs. 70-71. SEM micrographs of eggs of *K. atra*. 70. Collar and chorionic detail, 71. Anterior pole.

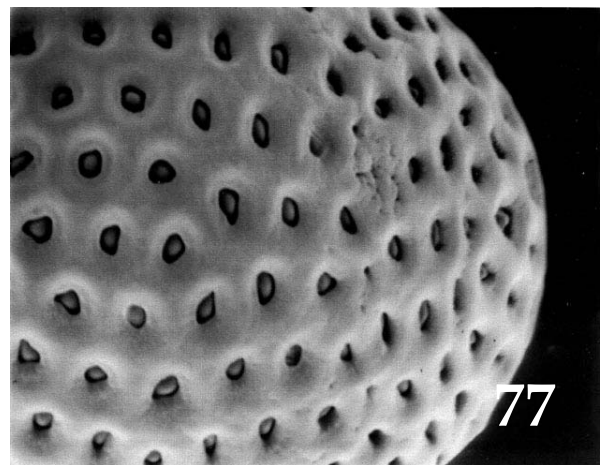
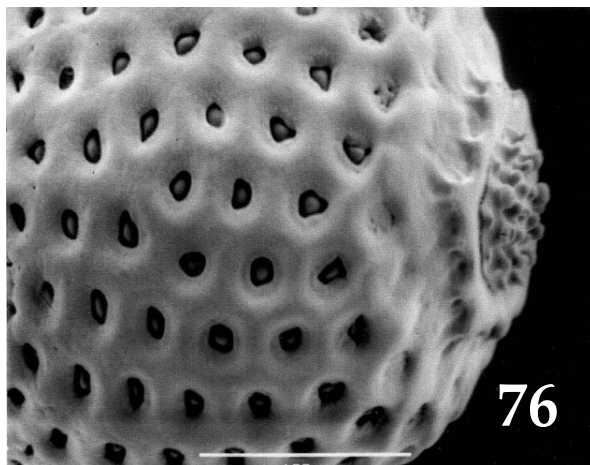




Figs. 72-73. SEM micrographs of eggs of *K. azunensis*. 72. Collar and chorionic detail, 73. Anterior pole.

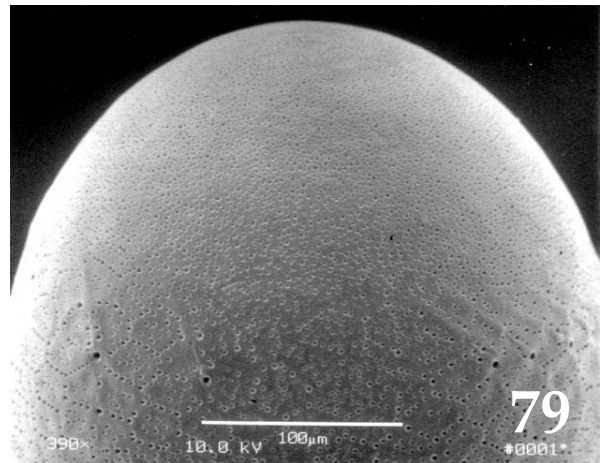
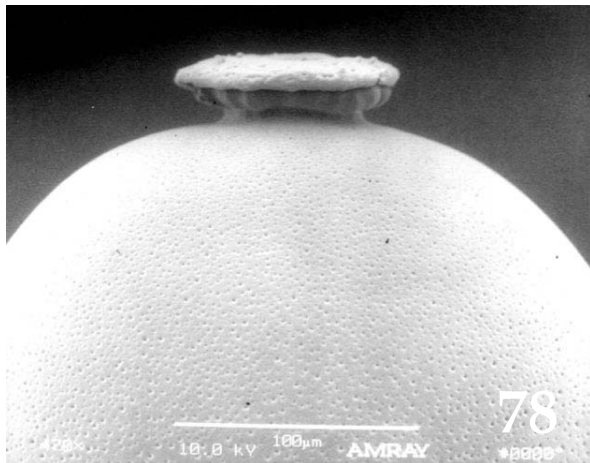


Figs. 74-75. SEM micrographs of eggs of *K. curriei*. 74. Collar and chorionic detail, 75. Anterior pole.

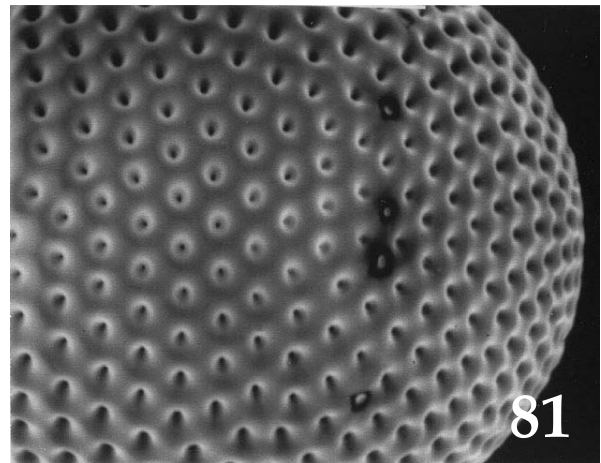
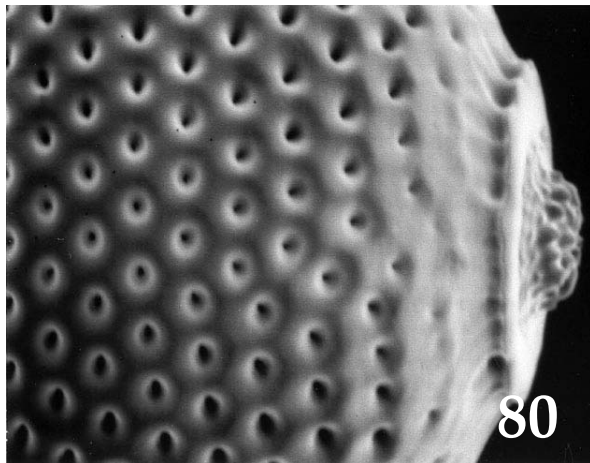


Figs. 76-77. SEM micrographs of eggs of *K. jariyae*. 76. Collar and chorionic detail, 77. Anterior pole.

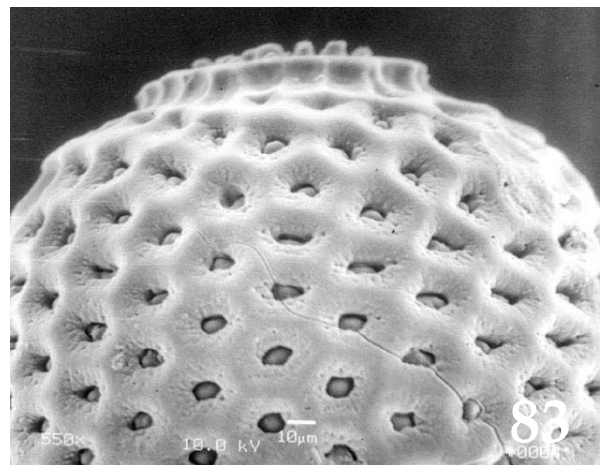
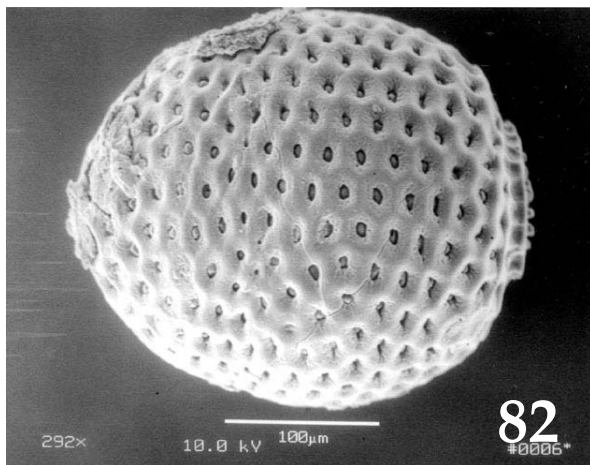




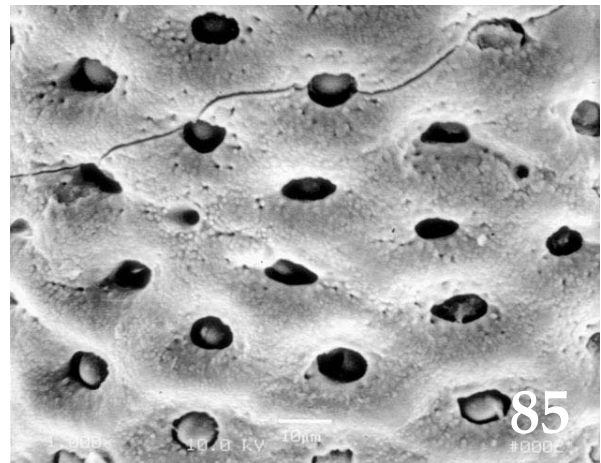
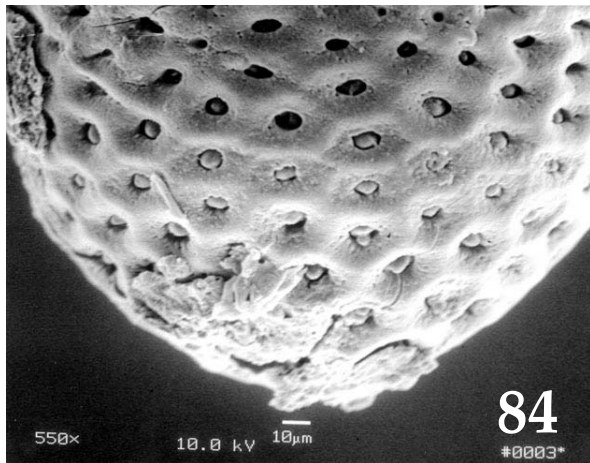
Figs. 78-79. SEM micrographs of eggs of *K. obtusa*. 78. Collar and chorionic detail, 79. Anterior pole.



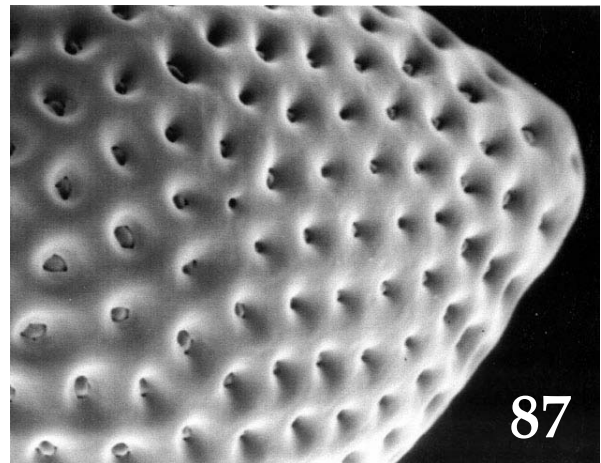
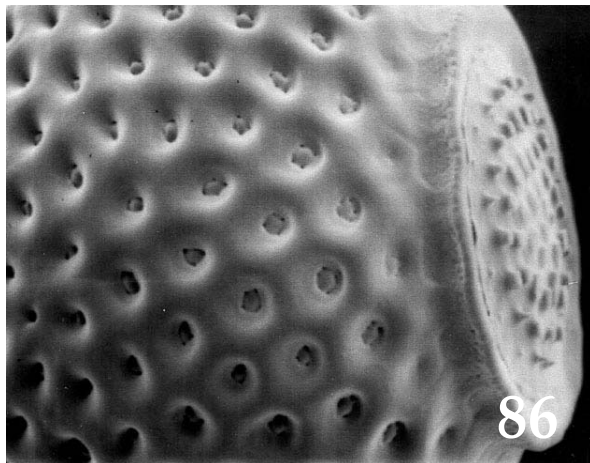
Figs. 80-81. SEM micrographs of eggs of *K. punctata*. 80. Collar and chorionic detail, 81. Anterior pole.



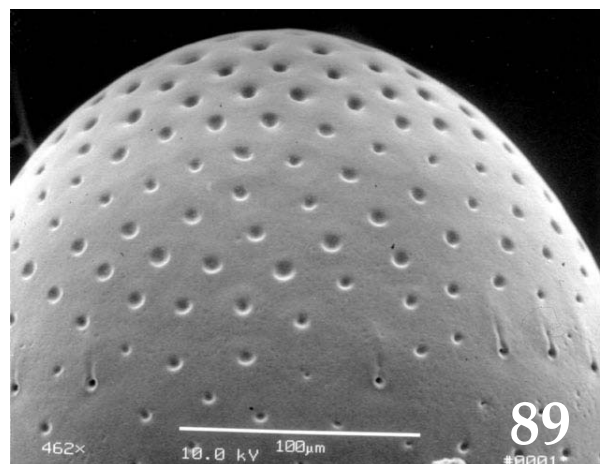
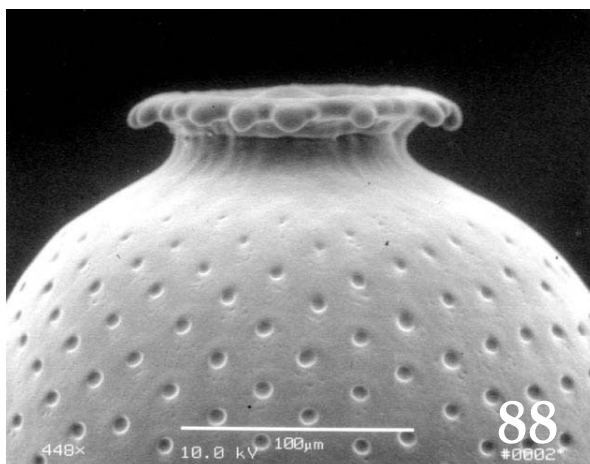
Figs. 82-83. SEM micrographs of eggs of *K. trang*. 82. Entire egg, 83. Collar.



Figs. 84-85. SEM micrographs of eggs of *K. trang*. 84. Anterior pole, 85. Chorionic detail.



Figs. 86-87. SEM micrographs of eggs of *K. turbinata*. 86. Collar and chorionic detail, 87. Anterior pole.



Figs. 88-89. SEM micrographs of eggs of *K. zonata*. Collar and chorionic detail, 89. Anterior pole.



## Unassociated Females

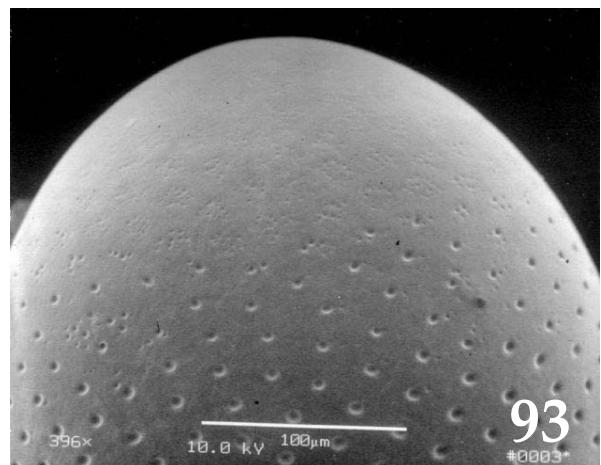
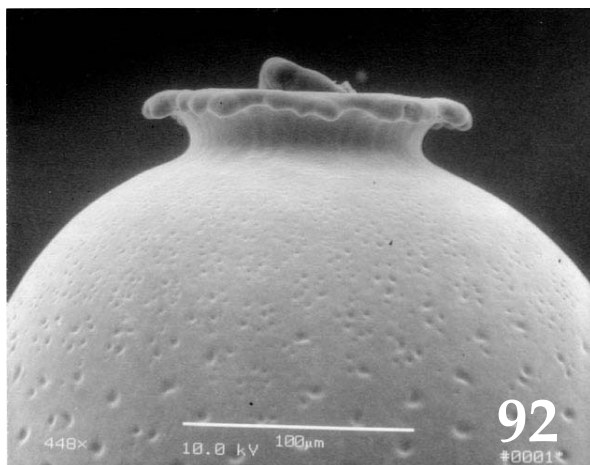
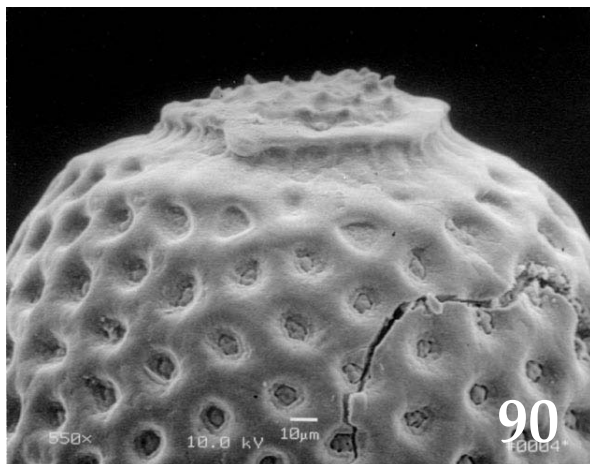
### *Kamimuria* Th-A (Figs. 90-91)

**Material examined.** Thailand, Unknown locality, 29 November 1985, 1 ♀ (PMSL).

**Egg.** Outline oval with short wide collar. Chorion covered throughout with coarse, more or less circular pits; ca. 13 rows of pits above micropylar line and ca.

10 pits per row below line; below line, surface between pits with irregular texture (Figs. 90-91).

**Diagnosis.** The eggs of this species are generally similar to those of *K. jaryiae* but in that species the egg lacks the irregular appearance of the chorionic surface below the micropylar line, and there are comparatively fewer pits per row above the line than in eggs of this specimen. The specimen is in poor condition and fresh material will be needed for proper evaluation.



Figs. 90-93. SEM micrographs of eggs of *K. Th-A* (90-91) and *K. Vn-A* (92-93). 90. Collar and chorionic detail, 91. Anterior pole, 92. Collar and chorionic detail, 93. Anterior pole.

### *Kamimuria* Vn-A (Figs. 92-93)

**Material examined.** Vietnam, Lao Cai, Sapa, Okui-Ho, 1100 m, 24-25 March 1995, W. Mey, 1 ♀ (ZMH).

**Egg.** Outline oval with short, stalked collar; collar rim

flanged and irregularly incised. Chorion covered throughout with pits or clusters of shallow pock marks; largest pits occur in a band covering middle third of egg, pits near collar and on lid are small, shallow and clustered in small groups of ca. 3-8 (Figs. 92-93).



**Diagnosis.** The egg of this specimen is distinct from the others known from Vietnam and Thailand but might represent *K. similis*, which was described from a male from this area.

**Provisional Key to Thai and Vietnamese Male  
*Kamimuria*  
(*K. anamensis* unknown)**

- 1 Projecting portion of hemitergal lobes not much longer than basal width (Fig. 22) ..... 2
- 1' Projecting portion of hemitergal lobes slender, finger-like and at least twice basal width (Fig. 60) ..... 3
- 2 Hemitergal lobes rounded apically (Figs. 34-35); everted aedeagus not distinctly foot shaped (Fig. 37) ..... *obtusa*
- 2' Hemitergal lobes with slight apical projection (Figs. 22-23); everted aedeagus foot shaped in lateral aspect (Fig. 27) ..... *curriei*
- 3 Femora banded, pale basally and dark in apical third (Fig. 4) ..... 4
- 3' Femora more uniformly pigmented except for narrow, dark apical band (Fig. 58) ..... 5
- 4 Hemitergal lobes conspicuously narrowed at apex (Fig. 65); most of aedeagal surface covered with microtrichia and small triangular spines in a broad continuous band (Fig. 63) ..... *zonata*
- 4' Hemitergal lobes rounded at apex and about as wide apically as at base (Fig. 3); aedeagal armature divided by narrow bare mid-dorsal band (Fig. 6) ..... *atra*
- 5 Hemitergal lobes abruptly narrowed in lateral aspect near tip (Fig. 48); aedeagus armed with bands of coarse triangular spines and a dorsoapical pair of larger spines (Fig. 50) ... *similis*
- 5' Hemitergal lobes gradually tapered; aedeagal armature without large spines (Figs. 18, 46) .... 6
- 6 Inner margins of hemitergal lobes with a small basal patch of sensilla basiconica (Fig. 15) ..... 7
- 6' Inner margins of hemitergal lobes without basal sensilla basiconica patch ..... 8
- 7 Hemitergal lobes almost acute in dorsal aspect (Fig. 15); everted aedeagus almost completely covered laterally with minute spines (Fig. 19) ..... *azunensis*
- 7' Hemitergal lobes narrowed but rounded at tips in dorsal aspect (Fig. 44); everted aedeagus with extensive lateral bare areas ..... *punctata*
- 8 Tergum 8 without median sensilla basiconica

- patch; everted aedeagus more or less cylindrical with long apical unarmed area (Fig. 53) ..... *trang*
- 8' Tergum 8 with well developed median sensilla basiconica patch (Fig. 55); aedeagus variable, but not as above ..... 9
- 9 Median sclerite and sensilla basiconica patch of tergum 9 extending across entire segment, or nearly so (Fig. 55); everted aedeagus S-shaped (Fig. 57) ..... *turbinata*
- 9' Median sclerite and sensilla basiconica patch of tergum 9 more circular in outline and not approaching margin (Fig. 10); everted aedeagus not S-shaped ..... 10
- 10 Hemitergal lobes scarcely narrowed at apex (Fig. 10); dark ocellar patch narrowed anteriorly (Fig. 10); everted aedeagus with animal head shape in lateral aspect (Fig. 12) ..... *atrocephala*
- 10' Hemitergal lobes narrowed apically (Fig. 29); everted aedeagus without animal head shape in lateral aspect (Fig. 31) ..... *jariyae*

**Chinese *Kamimuria***

More than 30 nominal species of *Kamimuria* have been proposed from Chinese material, primarily by Klapálek (1912, 1916, 1921) and Wu (1935, 1938, 1947, 1962, 1973). Type specimens for many of these species have been lost or destroyed, and the original descriptions do not usually include sufficient detail to allow associations of the name with fresh material. In some cases the identity can be inferred on a geographic basis, but this becomes improbable in Sichuan province where at least 10 species have been proposed. In this section we redescribe *K. klapaleki* (Wu & Claassen) from type material in the USNM, *K. manchuriana* Wu, from a newly designated neotype, and *K. tuberosa* Wu, based on a possible association. The type of the latter species is thought to be located in Beijing at the Zoological Institute, Academia Sinica, but we have had no opportunity to examine it for verification.

***Kamimuria klapaleki* (Wu & Claassen)  
(Figs. 94-97)**

*Tylopyge klapaleki* Wu & Claassen, 1934:119. Holotype ♂ (USNM), Yao-Gi, Szechuan (Sichuan), China  
*Kamimuria klapaleki*: Sivec et al., 1988:32

**Material examined. China:** Sichuan, Yao-Gi, 3 July

1929, D.C. Graham 1 ♂ (holotype, USNM). Paratypes (all from Sichuan Province): #63, 106, 107, 108, 116, 128, 141, 150, 153, 155 Accession number 107737, 10 ♂ (USNM). #13, Suifu, Accession number 107737, 2 ♂ (USNM). #97, foot of Washan, 4000-6000', 28 July 1925, 1 ♂ (USNM). # 114, 118, Songpan, 8000-9000', 11-16 July 1924, 2 ♂ (USNM).

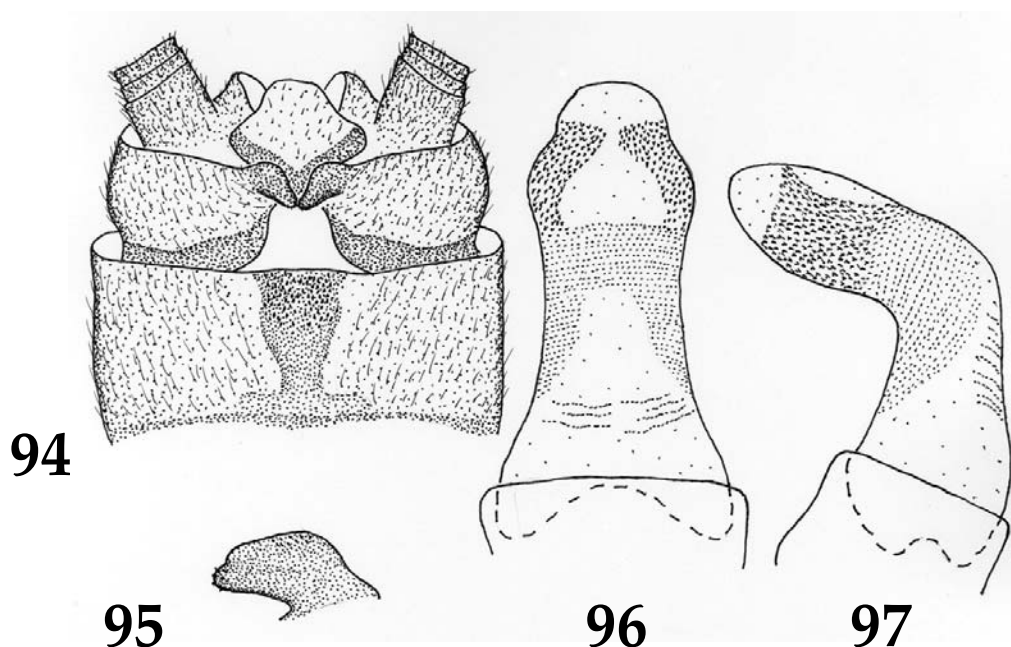
**Adult habitus.** (Adapted from Wu 1938). General color yellow brown. Head with a dark ocellar spot extending forward to M-line, antennae and palpi dark brown. Legs brown except for narrow distal dark line on femur.

**Male.** Forewing length 21-27 mm. Hemitergal lobes

short and somewhat swollen basally on inner margins; swollen base and apex with sensilla basiconica present (Figs. 95-96). Tergum 9 with a mesal patch of sensilla basiconica. Aedeagus membranous and curved ventrad from midlength; armature absent from apex, subapical dorsal section and dorsum from near midlength to base (Fig. 96); triangular spines located adjacent to bare apical zone and smaller microtrichia located near midlength and in more basal zones (Fig. 97).

**Female.** Described by Wu & Claassen (1934) and Wu (1938). No specimens were available for our study.

**Larva.** Unknown.



Figs. 94-97. *Kamimuria klapaleki* adult structures. 94. Male terminalia. 95. Male left hemitergal lobe, dorsal. 96. Aedeagus, dorsal. 97. Aedeagus, lateral.

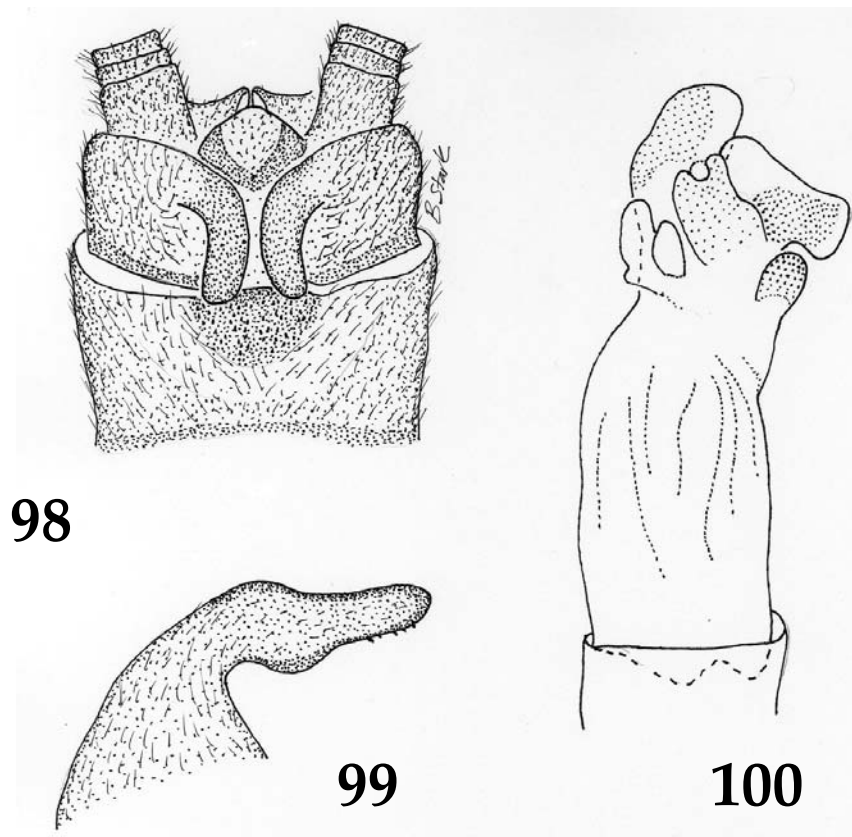
***Kamimuria manchuriana* Wu**  
(Figs. 98-100)

*Kamimuria manchuriana* Wu, 1938:199. Holotype ♂ [lost Wu, 1962] (Yenching University), Yalu River, 150-200 miles from mouth, Manchuria  
*Perla manchuriana*: Illies, 1966:291

**Material examined.** Neotype ♂ (pinned) from "Manchuria and Korea, Yalu River, 150-200 miles

from mouth", [border between Liaoning Province, China and North Korea], May, 1914, A.de C. Sowerbyi (USNM). Additional specimens, 1 pinned ♂ with same data (USNM).

**Adult habitus.** General color pale brown. Pattern obscured by specimen condition but according to Wu (1938) the holotype had a pale brown head and pronotum and a dark ocellar triangle. Antennae, palpi, cerci and legs were pale brown and the wings were pale with yellow veins.



Figs. 98-100. *Kamimuria manchuriana* adult structures. 98. Male terminalia, 99. Male right hemitergal lobe, lateral, 100. Aedeagus, lateral.

**Male.** Forewing length 14 mm. Hemitergal lobes relatively thick, curved and extending forward over tip of tergum 9 (Fig. 98); lobes swollen in basal third in lateral aspect (Fig. 99) and bearing a few sensilla basiconica on the ventroapical margin. Tergum 9 with a median patch of sensilla basiconica. Aedeagus multilobed and downturned near apex (Fig. 100); apex ending in a prominent median and pair of basolateral spiny lobes and additional subapical dorsal and ventral lobes; ventral subapical lobe small rounded and covered with microtrichia on apex, dorsal subapical lobe bare. Most of aedeagal surface unarmed.

**Female.** Unknown.

**Larva.** Unknown.

**Comments.** Wu (1962) indicates most of the type specimens in Chinese collections were destroyed during the war years and this has been confirmed by

one of us (IS) during previous visits to Beijing. Some specimens from Wu (1962, 1973) survived in poor condition but those from earlier studies, including collections in Yenching, Shanghai and various university museums were apparently destroyed. *Kamimuria manchuriana* was described by Wu (1938) from a single male from "...Manchuria, about 150-200 miles from the mouth of Yalu River; May 1914; A. de C. Sowerby collector" and the holotype male was placed in the "Yenching University collection". The two males from the USNM are part of the same series but apparently were unknown to Wu; these specimens are in close agreement with Wu's description, particularly in his reference to the presence of "fine spinules on the ventral surface of the [hemitergal] tip", and consequently we designate one of them with the aedeagus more fully everted as neotype, in order to clarify the identity of this species.



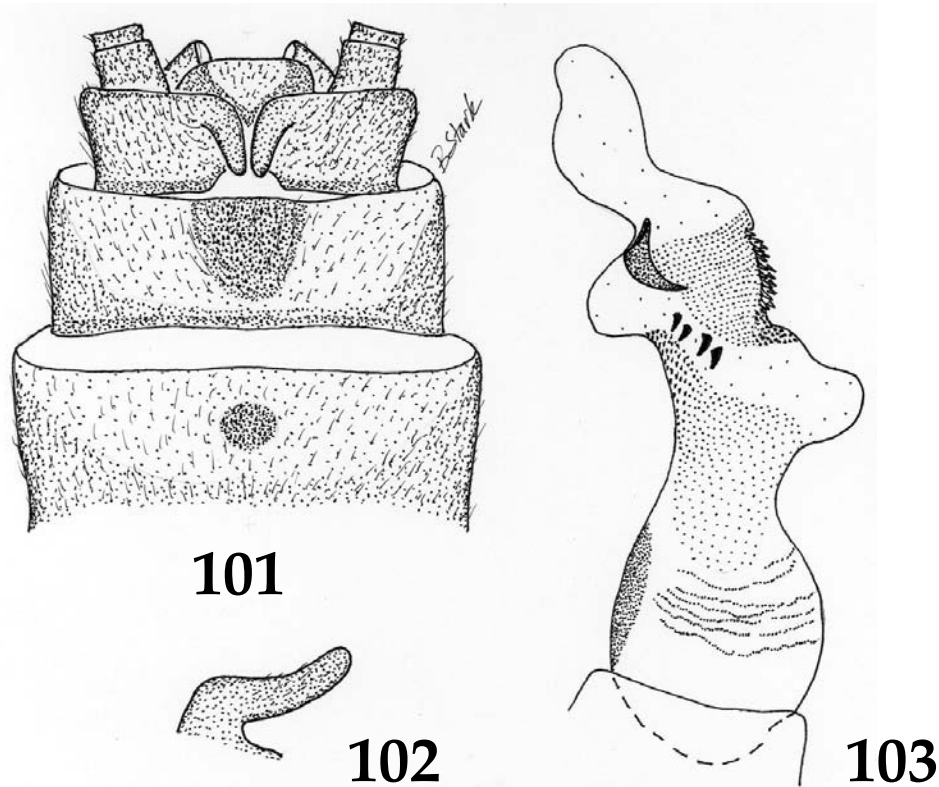
***Kamimuria tuberosa* Wu**  
(Figs. 101-103)

*Kamimuria tuberosa* Wu, 1973:117. Holotype ♂ (Academia Sinica, Institute of Zoology), Omei Shan, Szechuan (Sichuan), China

**Material examined.** China: Sichuan Province, Shin Kai Si, Mt. Omei, 4400', 18-20 August 1934, D.C. Graham, 1 ♂ (pinned USNM). Sichuan Province, Mt.

Omei, 11000', 21 July 1935, D.C. Graham, 1 ♂ (USNM). Sichuan Province, Kwanshien, 2900', 17 July 1938, D.C. Graham (1 ♂ pinned USNM). Sichuan Province, Kwanshien, 3000', 22 December 1934, D.C. Graham, 1 ♂ (USNM). Sichuan Province, Suifu, 1000', 5 November 1929, accession number 108446, 1 ♂ (USNM).

**Adult habitus.** Color pattern obscured by specimen condition. Wu (1973) indicates *K. tuberosa* in his sample were dark brown with dark wings.



Figs. 101-103. *Kamimuria tuberosa* adult structures. 101. Male terminalia, 102. Male right hemitergal lobe, lateral, 103. Aedeagus, lateral.

**Male.** Forewing length 16-18 mm. Hemitergal lobes very slender and slightly upturned in lateral aspect (Figs. 101-102). Tergum 9 with a median patch of sensilla basiconica and a much smaller patch sometimes present on tergum 8. Aedeagus with a small dorsobasal sclerite and a prominent pair of long curved spines located near the apical third; apex of aedeagus a slender, unarmed, membranous tube but subapical zone armed along ventral margin with multiple close-set rows of large triangular spines, and a second row of 4-5 lateral spines surrounding a field

of microtrichia and small triangular spines; an additional patch of spines and microtrichia is located laterally and extends from proximal to a dorsal and a ventral bare lobe to apex of dorsal sclerite (Fig. 103).

**Female.** Unknown.

**Larva.** Unknown.

**Comments.** Placement of these specimens as *K. tuberosa* is quite problematic since no less than five species with slender hemiterga have been named from Sichuan province and one of these, *K. orthogonia* Wu, was proposed from a population on Omei

[Emei] Shan, type locality for *K. tuberosa*. This provisional identification will need verification from study of the holotype specimen, presumed to be in the Zoological Institute, Academia Sinica, Beijing. The Suifu specimen was previously identified as “*Perla simplex*” and the Mt. Omei specimen from 11000’ and the Kwanshien specimen from 3000’ were previously identified by S.G. Jewett, Jr. as “*Kamimuria magna*”.

### Kamimuria Species Checklist

This checklist updates the one in Sivec et al. (1988) and includes *nomina dubia* marked in bold and with an asterisk. Synonyms in Sivec et al. (1988) are omitted from this list.

<i>K. acutispina</i> Wu, 1973	China
<i>K. amoena</i> Klapálek, 1912	China
<i>K. anamensis</i> (Banks, 1920)	Vietnam
<i>K. atra</i> sp. n.	Thailand
<i>K. atrocephala</i> sp. n.	Vietnam
<i>K. azunensis</i> sp. n.	Vietnam
<i>K. brunneicornis</i> (Klapálek, 1921)	China
<b><i>K. cheni</i> Wu, 1947*</b>	China
<b><i>K. chengtechensis</i> Wu, 1935*</b>	China
<b><i>K. chungnanshana</i> Wu, 1938*</b>	China
<i>K. coarctata</i> Klapálek, 1912	China
<i>K. coreana</i> Ra, Kim, Kang & Ham, 1994	South Korea
<b><i>K. crassispina</i> Wu, 1947*</b>	China
<i>K. crocea</i> Harper, 1976	Nepal
<i>K. curriei</i> sp. n.	Vietnam
<i>K. exilis</i> (McLachlan, 1875)	Russia
<i>K. fulvescens</i> Klapálek, 1912	China
<i>K. himalayana</i> Harper, 1976	Nepal
<i>K. infumata</i> (Navas, 1936)	China
<i>K. integra</i> (Navas, 1916)	China
<i>K. jaryiae</i> sp. n.	Thailand, Vietnam
<b><i>K. jeanneli</i> Wu, 1935*</b>	China
<i>K. kelantonica</i> Klapálek, 1912	East Malaysia
<b><i>K. kirinensis</i> Wu, 1938*</b>	China
<i>K. klapaleki</i> (Wu & Claassen, 1934)	China
<i>K. lepida</i> Klapálek, 1913	Taiwan
<b><i>K. liui</i> Wu, 1940*</b>	China
<b><i>K. longispina</i> Wu, 1947*</b>	China
<i>K. lutulenta</i> Zwick, 1977	Bhutan
<i>K. lyubaretzi</i> Teslenko, 2006	Russia
<b><i>K. magna</i> Wu, 1948*</b>	China

<i>K. manchuriana</i> Wu, 1938	China, North Korea
<b><i>K. melli</i> Wu, 1935*</b>	China
<b><i>K. nigriceps</i> Navas, 1919*</b>	Vietnam
<i>K. nigrita</i> Wu, 1962	China
<b><i>K. notalis</i> Navas, 1927*</b>	Russia
<i>K. obtusa</i> sp. n.	Thailand, Vietnam
<i>K. orthogonia</i> Wu, 1962	China
<i>K. punctata</i> sp. n.	Thailand
<i>K. quadrata</i> Klapálek, 1907	Japan
<b><i>K. ramosa</i> Navas, 1936*</b>	China
<b><i>K. robusta</i> Wu, 1947*</b>	China
<i>K. sahlbergi</i> Koponen, 1949	Russia
<i>K. senticosa</i> Harper, 1976	Nepal
<i>K. sikkimensis</i> (Enderlein, 1909)	India
<i>K. similis</i> Klapálek, 1912	Vietnam
<b><i>K. simplex</i> (Chu, 1929)*</b>	China
<i>K. sparsalu</i> Du, Sivec & Mingshui, 2001	China
<b><i>K. taoi</i> Wu, 1935*</b>	China
<b><i>K. tenuispina</i> Wu, 1947*</b>	China
<i>K. tibialis</i> (Pictet, 1841)	Japan
<b><i>K. tienmushanensis</i> Wu, 1938*</b>	China
<i>K. trang</i> sp. n.	Thailand
<i>K. trapezoidea</i> Wu, 1962	China
<i>K. tuberosa</i> Wu, 1973	China
<i>K. turbinata</i> sp. n.	Thailand
<i>K. uenoi</i> Kohno, 1947	Japan
<i>K. zonata</i> sp. n.	Vietnam
<i>K. zwicki</i> Stark & Sivec, 2008	South Korea

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