



NEW SPECIES AND NEW RECORDS OF PLECOPTERA FROM KOREA AND THE RUSSIAN FAR EAST

Peter Zwick

Schwarzer Stock 9, D-36110 Schlitz, Germany.

E-mail: pleco-p.zwick@t-online.de

ABSTRACT

Plecoptera collected with Malaise traps in South Korea were studied. The material comprised 25 identified species, including seven new species, and six new records for Korea. The genus *Despaxia* (Leuctridae) is recorded from Asia for the first time. The following new species are named: *Amphinemura denstigris*, *Nemoura rugosa*, *Nemoura tripotini*, *Despaxia asiatica*, *Paraleuctra malaisei*, *Megarcys teslenkonis*, and *Sweltsa zhiltzovae*. Descriptions of several known species are supplemented. *Nemoura sahlbergi problematica* Zwick, 1973 is considered a *nomen dubium*. The total number of Plecoptera species known from Korea now equals 57. In addition, *Nemoura lazoensis*, a new species from the Russian Far East, Primorjski Territory, is described.

Keywords: Republic of Korea, Russian Far East, new records, new species, redescrptions, Nemouridae, Leuctridae, Capniidae, Perlodidae, Chloroperlidae

INTRODUCTION

Since the overview of the literature dealing with Korean stoneflies (Kim et al. 1998) several studies of Korean Plecoptera were added (Ham 2008, 2009, Stark 2010). However, the stonefly fauna of the Korean peninsula is still incompletely known. From collections made with Malaise traps several new records and new species are herein reported. The number of formally named stonefly species known from Korea (Ham 2009, Stark 2010) now equals 56.

Korea is inhabited by species that are regarded as Korean endemics, and a number of species shared with the adjacent Asian mainland and/or Japan. The Scopuridae, a monogeneric family of wingless species, are known only from Korea and Japan, and provide clear evidence of past connections between the presently separate lands.

MATERIAL AND METHODS

The present paper deals with Plecoptera collected

in South Korea with Malaise traps by P. Tripotin, Mont St. Aignan, France. The material is deposited in the Entomology Department, United States National Museum, Smithsonian Institution, Washington, D.C. which houses also the holotypes and most paratypes of the new species. Some duplicates are also in my collection. A new *Nemoura* species collected by hand by the author in the Russian Far East is included.

Specimens are preserved in alcohol. Many lack one or several legs or antennae, however, the genitalia are always in excellent condition.

Standard methods using a Wild M5 dissecting microscope (magnifications up to 50x), and a Leica DMLS compound microscope (magnifications up to 600x) were employed. Both instruments were equipped with drawing tubes. Microscope preparations made of genital parts or eggs of some specimens were mounted in Euparal.

Female genital sclerites of *Amphinemura* spp. were cleared in KOH and mounted on slides. The soft

tergal cuticle was torn and folded sideways, to permit a clear view of vaginal structures from the dorsal side.

RESULTS AND DISCUSSION

Nemouridae

Genus *Amphinemura*

Amphinemura males present an amazing diversity of bizarre secondary genital characters and species distinction is not normally a problem, even among close relatives. However, females are often externally rather similar. It is therefore suggested to illustrate the internal female genital sclerites whenever possible. Their examination will not be practical in routine identifications but may provide important help in critical distinctions, for example when new regional records are to be based on only females. The present study provides sketches of sclerotized vaginal structures for diagnostic purposes only. The attachment of the two hyaline seminal receptacles typical of the family lies on top and is easily seen while the unpaired oviduct lies ventrally and is rarely noticed under the folded and partly sclerotized copulatory pouch (Zwick 1973c). A full understanding of structural details and how particular folds interconnect would require special study and was not attempted.

Amphinemura coreana Zwick, 1973

(Fig. 1)

Material examined. REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, many ♂ and ♀; same locality, 27.VII.-16.VIII.2004, 2♀. Chungnam, Keumsan, Gunbuk-Myeon, Sanan-2-li, 7.-20.IV. 2005, 2 Malaise traps on small stream, 6♂, 6♀; same locality, 20.IV.-8.V. 2005, 5♂, 9♀. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, ca 160 ♂, ♀; same data, but 500 m, 21♂, 22♀.

Notes. This very large species was first described

from Korea (Zwick 1973a) but occurs also in the Russian Far East (Zhiltzova 2003).

Female. The male genitalia are very different from other Korean *Amphinemura*, and so are the female genital sclerites. In dorsal view of a cleared specimen (Fig. 1) one notices a large, strongly sclerotized pouch about as long as wide, with parabolic front margin and an acute, rearward pointing muscle attachment on the side. The dorsal face is anteriorly covered by a large collar-like shield with crenulate margin. The shield includes a heart-shaped anterior membranous area with delicate funnel-shaped folds to which the bases of the two receptacles are attached. In the centre of the rear half appear two strong sclerotized folds which converge and form a Y-shaped pattern.

Amphinemura verrucosa Zwick, 1973

(Fig. 2)

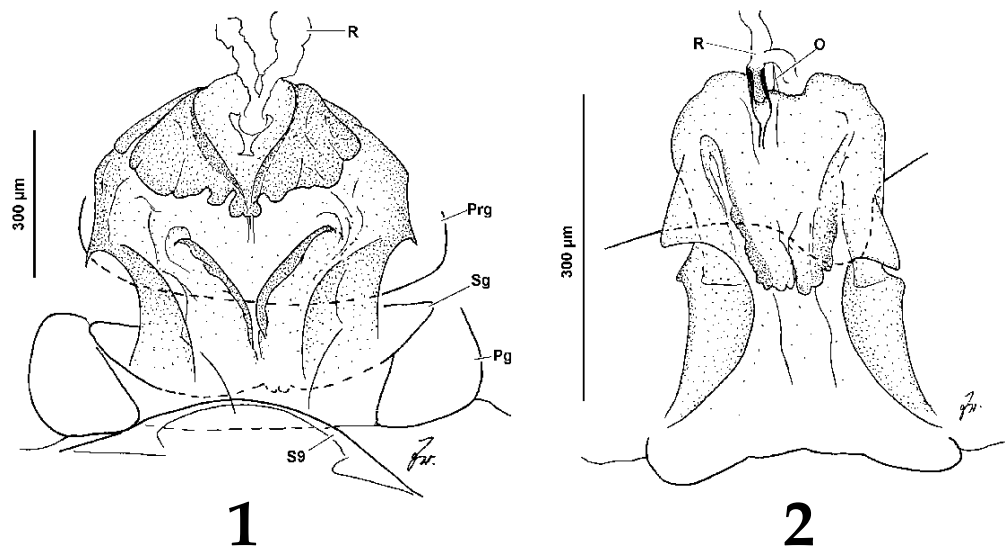
Amphinemura verrucosa Zwick, 1973a:161. Holotype ♂, PEOPLE'S REPUBLIC OF KOREA, Prov. Kanwon, Diamond Range, Hotel Go-song (Museum Budapest). *Amphinemura* sp. - Zwick, 1973a:161. (♀).

Material examined. REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24.74'N 127°43.82'E, 6.-27.VI. 2004, Malaise trap in forested area at sunlight, 2♂, 11♀. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 1♂.

Notes. Known from Korea (Zwick 1973a) and the South of the Russian Far East (Zhiltzova 2003). Both sexes are easily identified by their genitalia.

Female. The female was first illustrated as *Amphinemura* sp. (Zwick 1973a: fig. 16; repr. in Zhiltzova 2003: fig. 244) but Levanidova & Zhiltzova (1979) recognized it as the present species. Females are unmistakable because of a raised cone on the rear margin of S7.

The inner genital sclerites of a specimen from the Russian Far East, Khabarovsk kraj, tributary to River Khor (my collection) are elongate, with a small strongly sclerotized half-tube in front and two tongue-shaped dorsal sclerotized pockets on top, and triangular lateral extensions.



Figs. 1, 2. *Amphinemura* spp., cleared female genital sclerites in dorsal view. 1, *A. coreana*; 2, *A. verrucosa*. O, cuticular lining of oviduct; Pg, paragenital plate on S8; Prg, pregenital plate on S7; R, receptacle; S9, the scooped front margin of sternite 9; Sg, subgenital plate on S8. Broken lines show borders of underlying sternites.

***Amphinemura steinmanni* Zwick, 1973**

Amphinemura steinmanni Zwick, 1973a:161. Holotype ♂, PEOPLE'S REPUBLIC OF KOREA, Prov. Kanwon, Diamond Range, Hotel Go-song (Museum Budapest).

Material examined. REPUBLIC OF KOREA: Gangwondo, Pyeongchang, Yongpyeong-Myeon, Nodong-li, Nodong valley, Alt. 800 m, 5.-14.VI. 2006, 37°42.08'N 128°28.89'E, 3 Malaise traps in forest in shade, 1♂. Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24'74"N 127°43'82"E, 6.-27.VI. 2004 Pierre Tripotin coll. Malaise trap in forested area at sunlight, 4♀.

Notes. Another species originally described from Korea (Zwick 1973a) that extends into the South of the Russian Far East (Zhiltzova 2003).

The female genital region is generally similar to the next two species. Unfortunately, the Museum Budapest which houses the types no longer issues loans. The female syntypes could therefore not be examined for their inner genital sclerites. The present females are assigned to *A. steinmanni* for their obliquely truncate lobes of the subgenital plate and the rufus centre of head.

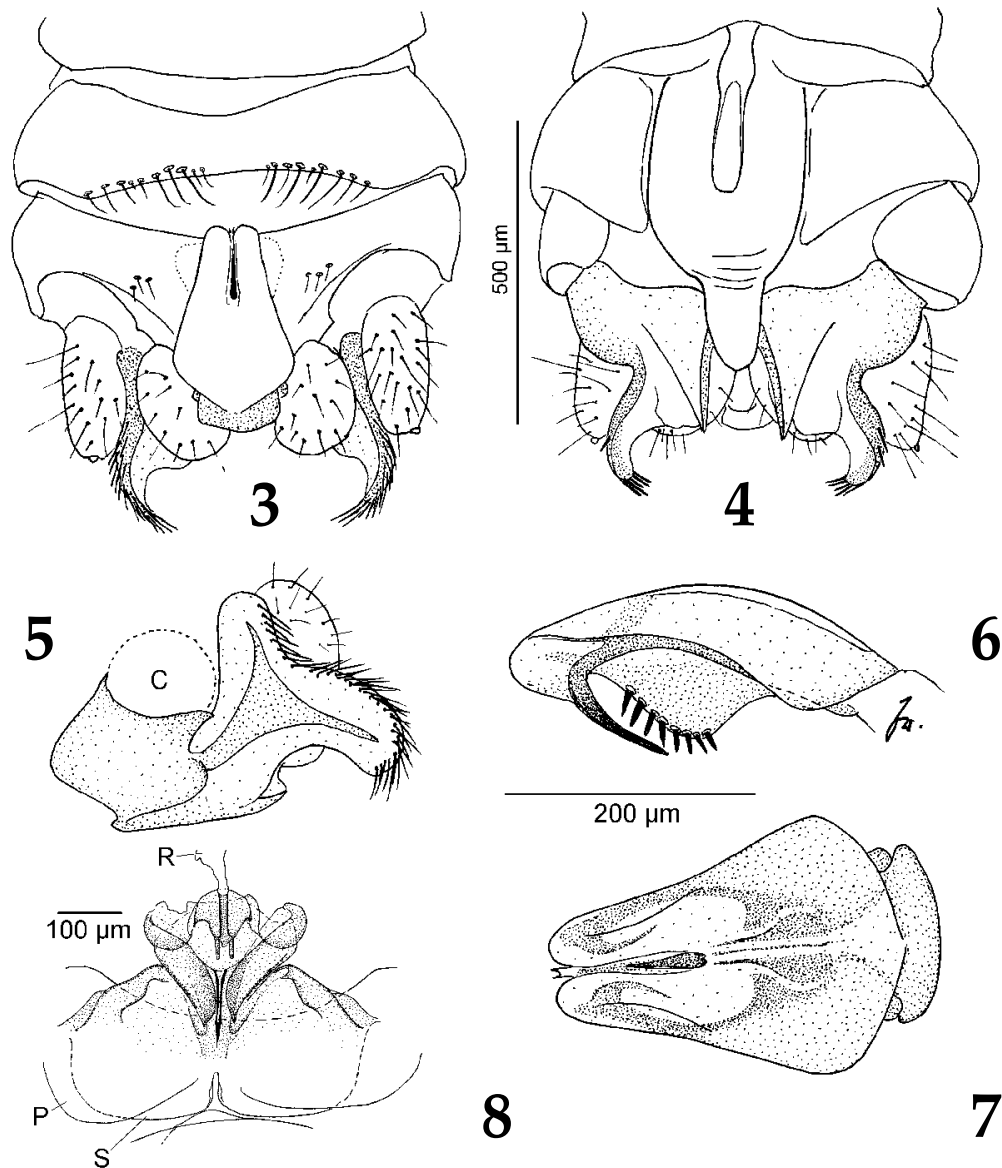
***Amphinemura denstigris* sp. n.**

(Figs. 3-8)

Material examined. REPUBLIC OF KOREA: Holotype ♂, 6 paratype ♂, 2♀, Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24.74'N 127°43.82'E, 6.-27.VII. 2004, Malaise trap in forested area at sunlight; Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 27.VII.-16.VIII. 2004, Malaise trap on small stream, 3♂ paratypes, 1♀; same locality, 16.VIII.-5.IX. 2004, 1 paratype ♂.

Adult habitus. A small, pale brown *Amphinemura*, no pattern. FWL (= fore wing length) 6.6-7.5 mm. The pronotal surface is rough and densely covered with circular little grooves from each of which rises a tiny hair. Distinguished from congeners by the characteristic male and female genitalia.

Male. T9 with medially interrupted fringe of strong, inwardly curved setae. S9: A slender almost parallel-sided tongue-shaped vesicle originates in the middle of the basal sclerite strip. Caudal part of segment divided, the middle portion forms a subparallel subgenital plate that is longer than the sides of the segment and ends in a narrow tongue-shaped



Figures 3-8. *Amphinemura denstigris*, male abdominal tip in dorsal (3) and ventral views (4). 5, lateral view of left paraproct after removal of cercus which occupied the area labelled C; male epiproct in lateral (6) and dorsal (7) views; 8, cleared female genitalia in dorsal view; P, paragenital plate, R, receptacle, S, subgenital plate. Figs. 3-5 and 6-7, respectively, to the same scale.

extension basally delimited by some transverse folds. T10 laterally short, its middle forms a posteriorly directed sclerite plate with a heart-shaped anteromedian paler area overlain by the epiproct which originates at the caudal end of the plate (Fig. 3). S10 reduced, its place occupied by the broad base

of the paraprocts. Cerci simple, one-segmented, inserted dorsolaterally in a curved notch of T10. Terminal wart inconspicuous.

Paraprocts of complex shape. In ventral view (Fig. 4), the triangular inner epiproct lobe with a sharply pointed straight sclerite along its medial edge is seen

by the side of the subgenital plate tip. The middle lobe is membranous and basally bare. On its outside it is connected to the outer lobe. The outer lobe is a narrow sclerite strip that bends outward at right angle at its base and is then gently curved mediad. In side view (Fig. 5), the sclerite band curves dorsad and forks almost like a T. The dorsal face and the caudal end of the forked sclerite are beset with many black spines. The posterior branch of the sclerite curves down, the anterior branch is straight, in dorsal view its blunt end lies between the hairy cercus and the hairy dorsal part of the middle paraproct lobe.

In side view of the epiproct (Fig. 6) the dorsal contour is regularly convex. The ventral paramedian spine-bearing sclerites are basally and apically partly concealed by the overhanging membrane of the dorsal side. The spinose section is deeply downcurved and bears around 10 short, stout black spines. The lateral sclerite of the epiproct forks in the anterior third. The dorsal branch is a delicate strip while the ventral branch is strong and forms a large hook which stands free from the rest and curves back, and mediad. In dorsal view (Fig. 7) this hook is seen by transparency.

In dorsal view the epiproct (Fig. 7) is pear-shaped. It narrows in a gently concave line from the wide parabolic caudal part to the gently bilobed tip which is less than half as wide as the base. A small anterior tube is largely concealed between the lobes. The surface is smooth, with a median furrow in the anterior half. The furrow is occupied by a narrow slender sclerite which anteriorly leads to a very short and inconspicuous dorsally open semi-tube. Ventral sclerites visible by transparency as dark shadows.

Female. S8 with a distinct pregenital plate bulging backward over S9. Subgenital plate on S9 flat, consisting of two transversely truncate lobes (Fig. 8: S) caudally separated for a short distance by a narrow well defined notch. On the sides the flat lobes of the paragenital plates (Fig. 8: P) project distinctly. Dark sclerotized structures inside segments 8 & 9 are visible by transparency.

Inner sclerites are best studied from the dorsal side. A wide sclerotized area is anteriorly delimited by converging uprolled edges. Between them, in front of the narrow notch in the subgenital plate lie ventrally two black, erect closely adjacent crests. Dorsally and laterally from them are two sclerites

resembling narrow leaves that diverge anteriorly, like a funnel. Anterolaterally the funnel supports two anteriorly open hemispheres which in turn support a parabolic sclerite above them. Over this rises anteriorly an approximately heart-shaped shield with two slender fingers caudally and anteriorly at the top a straight sclerotized tube which leads into the membranous spermatheca. This tube and the little tube at the tip of the male epiproct (Fig. 7) are of similar diameter.

Diagnosis. Several Korean *Amphinemura* have rough pronota. Among them is *A. steinmanni*, which also has huge ventral teeth on the epiproct. However, both the T-shaped outer paraproct lobes with their caudally projecting setal fringe, and the pear-shaped epiproct of *A. denstigris* are distinctive and very different from *A. steinmanni*. The tooth-like appendage to the lower face of epiproct relates *A. denstigris* also to *A. rai* but the distinction is again easy, see below under *A. rai*. This small group of species may be related to Far-Eastern *Amphinemura* species possessing large extensions spreading laterally from the antero-ventral area of the epiproct, like *A. pterygoidea* Li & Yang, 2008. In China, there are additional species with remarkable anterolateral projections from the epiproct but details of interconnections between sclerites are undescribed. The female resembles the female of *A. steinmanni* but the subgenital plate lobes of the latter are obliquely truncate (Zwick 1973a: figs. 10, 11). The vaginal sclerites have some similarity with *A. rai* (see below), but in many species these structures are as yet undescribed.

Etymology. The freely projecting tooth-like appendage of the epiproct resembles a tiger fang, hence the name *denstigris*, Latin, *tooth of a tiger*.

***Amphinemura rai* Ham & Lee, 1999**
(Figs. 9-14)

Amphinemura rai Ham & Lee, 1999:119. Holotype ♂, REPUBLIC OF KOREA, Donghaksu, Mt. Keryong (Chonnam National University, Kwangju).

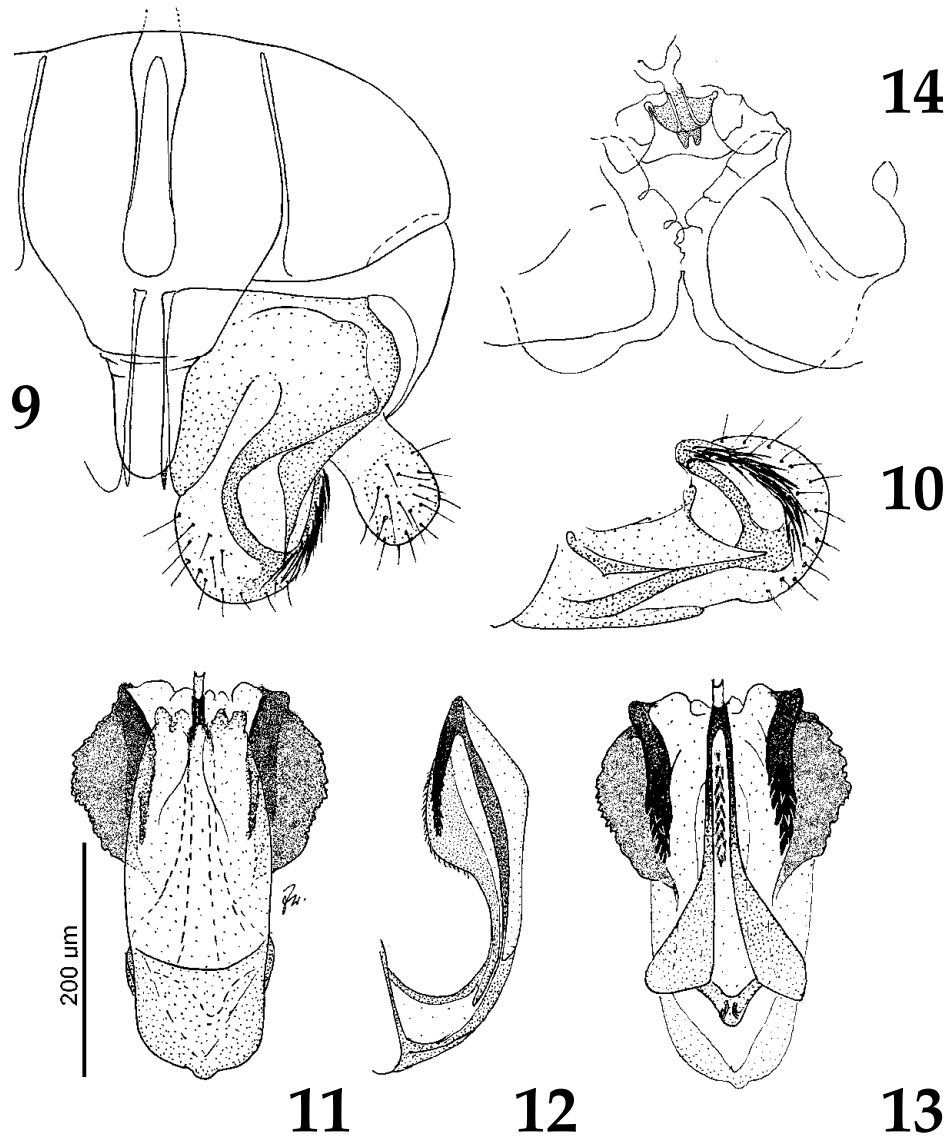
Material examined. REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 4♂; same locality except 400 m,

6.-27.VI. 2004, 1♀. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 500 m, 2.-26.VI. 2006, Malaise trap in forest on small stream, 38♂, 4♀; same locality except 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, 9♂, 7♀. Cloudy Donghaksa Valley, Kyerongsan Mtn, 11.V.

2000, 2♂, leg. et det. S.A. Ham.

Adult habitus. General appearance and structure resemble *A. denstigris*, the pronotal surface is also rough.

Male. Generally similar to *A. denstigris*. S9 is a slender subgenital plate with a narrow, apically widened, ventrally soft, whitish ventral lobe (Fig. 9).



Figures 9-14, *Amphinemura rai*. 9, left half of male abdominal tip in ventral view; 10, left paraproct in lateral view (cercus removed). 11-13, male epiproct in dorsal, lateral, and ventral views. 14, female genital sclerites, cleared, seen from dorsal side; diagrammatic. Figs. 9, 10 and 14 not to scale.

The narrow tip of the plate curves up. The cerci are short, almost globular, membranous and hairless on the medial face.

The inner paraproct lobe is conical, more strongly sclerotized and blade-like along its medial edge which is largely concealed beneath the tip of the subgenital plate. The middle lobe is supported by a narrow sclerite strip extending first backward and then forward and up. Along its upper and rear face the apex of the lobe has a dense fringe of black bristles (Fig. 10). The outer paraproct lobe forms an acutely pointed sclerite whose tip lies across the loop of the sclerite strip of the middle lobe.

The epiproct (Figs. 11-13) is distinguished by a wide, flat sclerotized lateral flange in the anterior half. At the tip, the flange is connected to the base of a blackish sinuous appendage with prickly surface. The pointed tip of the appendage is free from the main body of epiproct but lies close to it. A little apical tube concealed between the lateral lobes of the epiproct is best seen in slide mounts.

Female. The few females taken together with the males agree with figure 1E of Ham & Lee (1999). The lobes of the subgenital plate are caudally sinuous, the outer part a little longer than the inner. The inner genital sclerites (Fig. 14) are attached to the medial margin of the largely concealed paragenital plates and consist of a series of sclerotized areas separated by folds¹. Together, the plates form an arch supporting anteriorly a transverse little shield with two short caudal fingers. A sclerotized central tube leads to the primary genital organs.

Diagnosis. An obvious relative of *A. steinmanni* and *A. denstigris* with similar anterolateral appendages to the lower face of epiproct. However, in the related species the appendages diverge strongly from the body of the epiproct while in *A. rai* they lie close to it. The paraprocts of the three related species differ also strikingly. The inner genital sclerites of female *A. denstigris* agree in the funnel-shaped structure with central tube and two caudal fingers. However, the sclerites lining the copulatory pouch differ greatly, which was to be expected in view of the different shapes of epiprocts.

¹ The specimen was cleared in hot KOH. It could be that folds subdividing the lateral sclerites supporting the funnel-shaped structure are an artifact caused by this treatment. The female of *A. denstigris* was cleared in cold KOH.

Notes. The new material resembled illustrations in the original description. However, these do not show the ventrolateral appendages and the apical tube of the epiproct. Apparently depending on activity and condition of specimens at the moment of preservation the dark lateral flanges of the epiproct may diverge a little (like in the present figures), or be parallel to each other. Width of the epiproct differs accordingly, the little apical tube being more or less exposed or concealed. There may also be some individual variation in this common species (Dr. Ham in a letter). The initially tentative identifications was confirmed by comparison with two authentic specimens donated by Dr. Ham.

Zapada quadribanchiata (Zhiltzova, 1977)

Amphinemura quadribanchiata Zhiltzova, 1977:63. Holotype ♂, RUSSIAN FAR EAST, South Primorje, Kedrovaya pad (Museum St. Petersburg).

Material examined. REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 500 m, 2.-26.VI.2006, Malaise trap in forest on small stream, 2♂; same data except 750 m, 1♂. Chungnam, Keumsan, Gunbuk-Myeon, Sanan-2-li, 7.-20.IV. 2005, 2 Malaise traps on small stream, 8♂; same locality, 20.IV.-8.V. 2005, 1♂, 2♀. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 3♂.

Notes. The only Asian species of the genus *Zapada* is new for Korea.

Genus *Nemoura*

The Korean species of *Nemoura* belong to several different groups. Males of some, especially *N. despinosa* and *N. geei*, are readily identified from the excellent illustrations in synopses of the Russian fauna (Zhiltzova 2003, Teslenko & Zhiltzova 2009).

Several new species were discovered in a group including also Arctic or circumpolar species (for example, *N. arctica* Esben Petersen, *N. sahlbergi* Morton, *N. viki* Lillehammer, *N. trispinosa* Claassen). Because of resemblances in shape of paraprocts and cerci structural details of the epiproct are particularly important but were so far not described in all. The

caudal view of the cercus apex provides useful supplementary information to separate the species. It should be remembered that in species whose apical epiproct sclerite is semi-erect and oriented essentially in the sagittal plane the sclerite may look very different, depending on the degree of flattening in microscope preparations.

Most females in this group can at best be identified tentatively. Females definitely associated with males of the new species are not available. Females in the studied collection remain unidentified and are not recorded.

***Nemoura despinosa* Zhiltzova, 1977**

Nemoura despinosa Zhiltzova, 1977:5. Holotype ♂, RUSSIAN FAR EAST, Primorje, near Chuguevka (Museum St. Petersburg).

Material examined. REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24.74'N 127°43.82'E, 6.-27.VI. 2004, Malaise trap in forested area at sunlight, 14♂, 16♀. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 1♂; same locality, 8.V.-5.VI. 2004, 1♂; 27.VII.-16.VIII. 2004, 2♂; 16.VIII.-5.IX. 2004, 1♂.

Notes. The species was known from the Russian Far East and Hokkaido but is new for Korea.

***Nemoura geei* Wu, 1929**

Nemoura geei Wu, 1929:200. Holotype ♂, CHINA, Peking; not located (Shimizu 1997).

Material examined. REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 500 m, 2.-26.VI. 2006, Malaise trap in forest on small stream, 7♂; same data except 750 m, 3♀. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 2♂. Chungnam, Keumsan, Gunbuk-Myeon, Sanan-2-li, 20.IV.-8.V. 2005, 2 Malaise traps on small stream, many ♂, ♀.

Notes. Originally described from Beijing, subsequently recorded from the Russian Far East, the Kurile Islands, and Sachalin (Zhiltzova 2003),

recently also from Korea (Ham 2009, under the name *Nemoura brevicercia* Zhiltzova).

***Nemoura sahlbergi problematica* Zwick, 1973;
*nomen dubium***

Nemoura sahlbergi problematica Zwick, 1973a:162. Holotype ♂, PEOPLE'S REPUBLIC OF KOREA, Prov. Kanwon, Diamond Range, Hotel Go-song (Museum Budapest).

Status of the taxon. At the time of description of the only specimen ever recorded, similarity in the narrow conical epiproct tip suggested conspecificity with *N. sahlbergi* Morton, 1896. Because the cerci differed (in particular, the Korean specimen lacked the anteriorly directed dorsal point present in typical *N. sahlbergi*) the specimen was described as a subspecies of *N. sahlbergi*. The latter was never recorded from the Far East and I am now convinced the Korean specimen belonged to some other species.

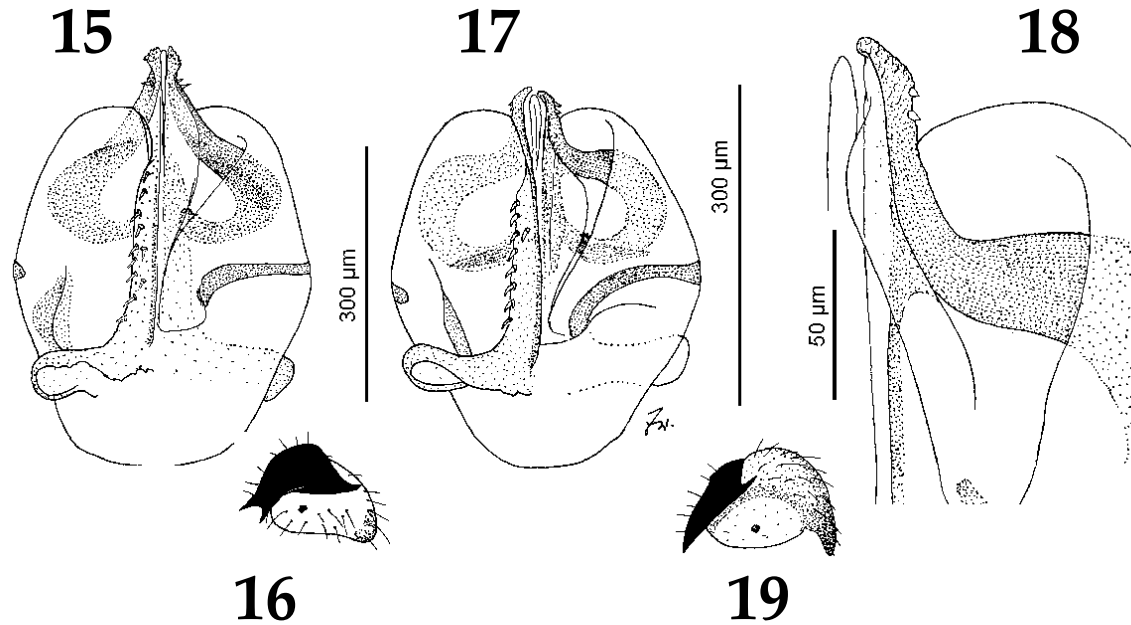
In the meantime, several new species with epiprocts superficially resembling *N. sahlbergi* were named from the area. I cannot reliably identify them from the cerci alone.

To decide if *N. sahlbergi problematica* is identical with one of these recently named species a re-examination of the epiproct is indispensable. Unfortunately, the microscope preparation cannot be found in the museum and appears to be lost. Dr. D. Muranyi was extremely helpful and re-examined and drew the holotype, but the identity of the taxon remains unresolved. *N. sahlbergi problematica* renders justice to its name: I regard it as a *nomen dubium*.

***Nemoura gemma* Ham & Lee, 1998
(Figs. 15, 16)**

Nemoura gemma Ham & Lee, 1998:357. Holotype ♂, REPUBLIC OF KOREA, Tugyas National Park, Chollabuk-do (Chonnam National University, Kwangju).

Material examined. REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 125°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 4♂. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream,



Figs. 15-19, *Nemoura* spp., males. 15, 16, *N. gemma*, epiproct in combined ventral (left side) and dorsal view (right side), and tip of left male cercus in caudal view. 17-19, *N. jilinensis*, epiproct in combined ventral (left side) and dorsal view (right side), with detail of right apical sclerite in dorsal, and tip of left male cercus in caudal view. Cercus tips not to scale.

ca.20♂; same locality but Alt. 500 m, 2.-26.VI. 2006, Malaise trap in forest on small stream, 9♂.

Supplementary description. The paraproct possesses an entire elongate apex. The cercus has a double outer tooth extending slightly further backward than the single inner tooth. In caudal view the edge of the sclerotized area over the membranous cercus apex is angled, the rudimentary 2nd cercus segment lies directly below the angle. The soft part extends far mediad and is at the tip irregularly pigmented (Fig. 16).

The beak-like shape of the anterior portion of the short and stout male epiproct is distinctive (Fig. 15). The dark, shining apical sclerites appear like a forward extension of the looped sclerite, not like a structure attaching to it. The slender tip bears some fine asperities. The sharply pointed setae which in most species sit on the lower face of the apical sclerite are clearly visible on the side of the beak-like apex.

The cercus of *N. gemma* somewhat resembles two

new species (*N. rugosa*, *N. lazoensis*) which, however, differ strogly in paraproct and epiproct, see below.

***Nemoura jilinensis* Zhu & Yang, 2003**
(Figs. 17-19)

Nemoura jilinensis Zhu & Yang, 2003:477. Holotype ♂, CHINA, Jilin: Hunjiang (China Agricultural University, Peking).

Material examined. REPUBLIC OF KOREA: Kangwondo, Chuncheon Nam-Myeon, Magog-li along Hongcheon river, Alt. 70 m, 37°43.786'N 127°34.589'E, 25.V.-12.VI. 2004, in larch planted forest with dense shrub layer + 1 trap in recent clearing, 28♂, ca 45 presumed ♀. Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24.74'N 127°43.87'E, 6.-27.VI. 2004, Malaise trap in forested area at sunlight, 1♂.

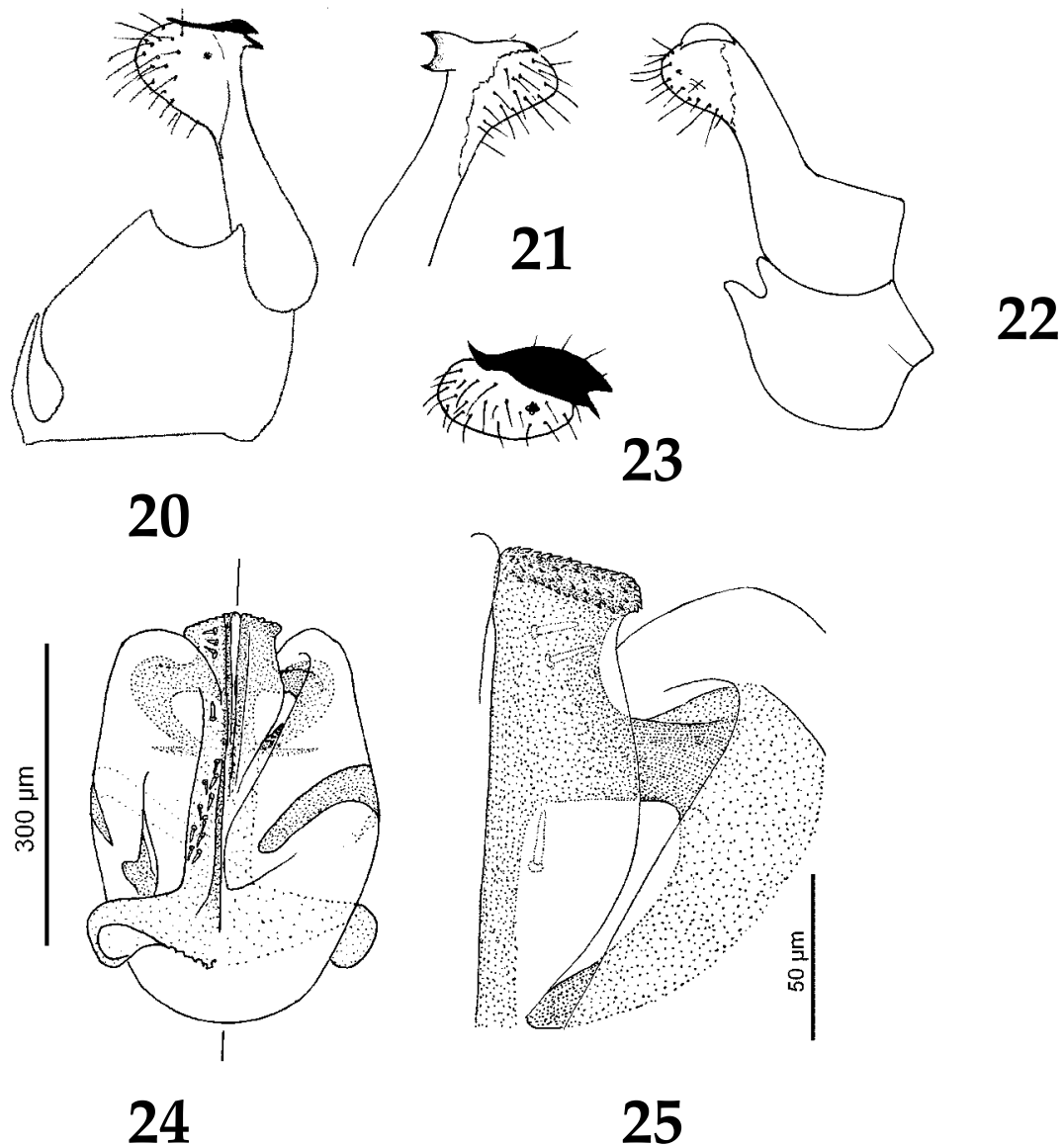
Supplementary description. The tip of the male paraproct is excised, the rounded medial lobe is

longer than the inner. The cercus has a single outer tooth. In caudal view of the cerci the strongly sclerotized dark cap has a straight edge in very oblique position, the inner and outer teeth are very unequal. The soft medial end portion is large. It is increasingly pigmented and sclerotized towards the down-hanging medio-ventral apex which forms a blunt point (Fig. 19).

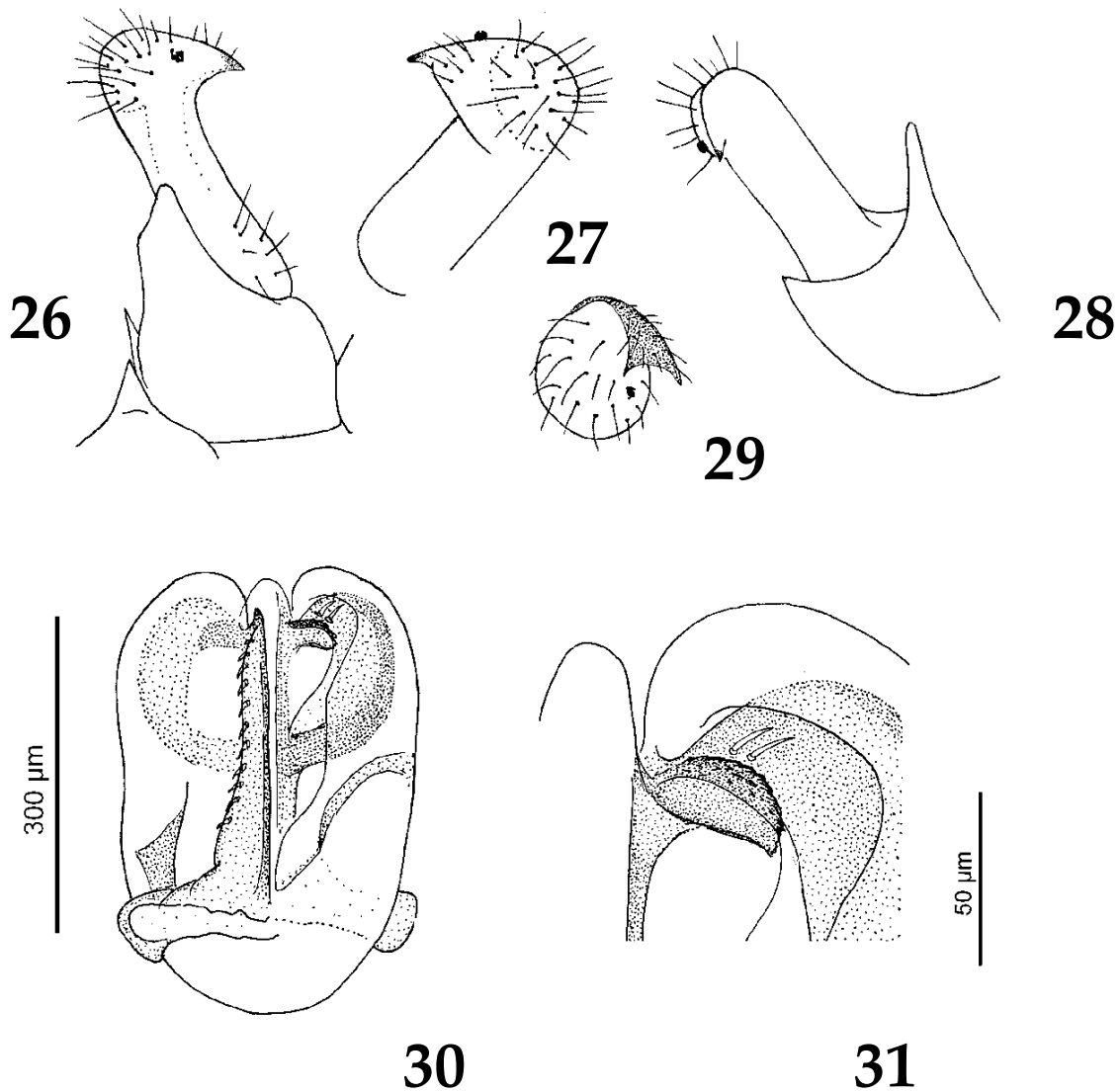
The epiproct contour is almost rhomboid (Figs.

17, 18). The looped sclerite joins the median tooth-bearing sclerite at an oblique angle. The apical sclerite is slender and semi-erect. The tip may turn slightly mediad, its surface is covered with delicate wrinkles. Along the outer edge there are two or three very short and stout spines.

Notes. *N. jilinensis* was described after a single male taken in China, near the northern border of the Korean peninsula. It is new for Korea.



Figs. 20-25, *Nemoura rugosa* sp.n., male. 20, 22, right cercus and paraproct in ventral and lateral views; 21, 23, right cercus in dorsal and caudal views; 24, epiproct in combined ventral (left side) and dorsal view (right side); 25, detail of apical epiproct sclerite. Paraproct and cercus not to scale.



Figs. 26-31, *Nemoura tripotini* sp.n., male. 26, 28, right cercus and paraproct in ventral and lateral views; 27, 29, right cercus in dorsal and caudal views; 30, epiproct in combined ventral (left side) and dorsal view (right side); 31, detail of apical epiproct sclerite. Paraproct and cercus not to scale.

Nemoura rugosa sp. n.
(Figs. 20-25)

Material examined. ♂ holotype, 6♂ paratypes: REPUBLIC OF KOREA: Gangwondo, Pyeongchang, Yongpyeong-Myeon, Nodong-li, Nodong valley, Alt. 900m, 5.-16-VI. 2006, 37°42.08'N 128°28.89'E, 3 Malaise traps in forest in shade.

Adult habitus. A normal-looking *Nemoura* without

pattern or other distinctive traits, except the genitalia. The present males are fully pigmented, with black head and pronotum. The slightly infusate fore wings are 7.2-7.9 mm long.

Male. The paraproct is apically deeply excised, ending in two sclerotized acute tips. The slender cerci are in dorsoventral views almost straight, with a large membraneous apex (Figs. 20, 21). In side view (Fig. 22) the slender distal part stands at an angle to

the wide base. The outer apical spine is double, the median one single, a little upcurved. In caudal view of the cercus tip, the sclerotized cap is almost horizontally placed over the pale unsclerotized end of cercus with the inconspicuous terminal wart (Fig. 23).

The epiproct is elongate oval (Fig. 24). Its looped sclerite joins the longitudinal spine-bearing sclerite at a right angle. The wide apical sclerite (Fig. 25) lies almost flat in the frontal plane and does not change appearance when slide-mounted. It has a blunt nose on the outside. The anterior edge bears coarse scales and is rough. On the ventral face of the apical sclerite are 2-3 strong outwardly directed spines. The ventral longitudinal sclerites bear several spines, the first points forward, the other backward, as usual.

Female. Not known.

Diagnosis. The wide flat-lying apical sclerite of epiproct reminds one of *N. arctica*. However, the sclerite of *N. arctica* is transverse and along its outer edge armed with some short strong spines (see Lillehammer 1988, fig. 172), the anterior edge is not rough. Other Korean species with bifid paraprocts and two outer cercus teeth differ strikingly in the epiproct.

Etymology. The specific name alludes to the rough (Lat. rugosa) surface of the apical epiproct sclerite.

Nemoura tripotini sp. n.
(Figs. 26-31)

Material examined. ♂ holotype, 3♂ paratypes, REPUBLIC OF KOREA: Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 125°38.50'E, 27.VII.-16.VIII. 2004, Malaise trap on small stream. Jirisan, Hamyang-gun, Munsu-Sa, Songjeong-li, Alt. 400 m, 35°24.74'N 127°43.87'E, 27.VI.-27.VII. 2004, Malaise trap in forested area at sunlight, 2♂ paratypes.

Adult habitus. Structure typical of genus *Nemoura*, not distinctive. Brownish, no pattern. The front wing is 8.3 mm long.

Male. Apex of paraproct entire, resembling a slender tongue (Fig. 26). Cercus almost straight, plump, with large membranous apex and prominent terminal wart (Figs. 26-28). The apical points are single and small, only the lateral one projects distinctly. Medial tooth appressed to soft surface of the apex, barely

apparent (Fig. 29).

The epiproct is oval, anteriorly narrowed, with recessed tip (Fig. 30). The apical sclerite is transverse and stands erect on the wide poorly defined looped sclerite. The front of the apical sclerite is rough. The slender arched setae which normally sit beneath the apical sclerite are freely exposed anterolaterally from it (Fig. 31). The ventral sclerite is narrow and bears numerous spines.

Female. Not known.

Diagnosis. Because of the recessed epiproct tip the present species was first believed to be *N. ussuriensis* Zhiltzova, 1997 (in Teslenko & Zhiltzova 1997) whose dorso-apical epiproct sclerite was not described in detail. However, the illustration of the holotype shows a short and wide ventral sclerite with only six stout spines. V.A. Teslenko kindly provided microphotographs of the epiproct of an additional specimen. *Nemoura ussuriensis* is distinct from the present species. On the other hand, from the description *N. esepa* Ham & Lee, 1999 is very similar to *N. ussuriensis* and possibly its junior synonym.

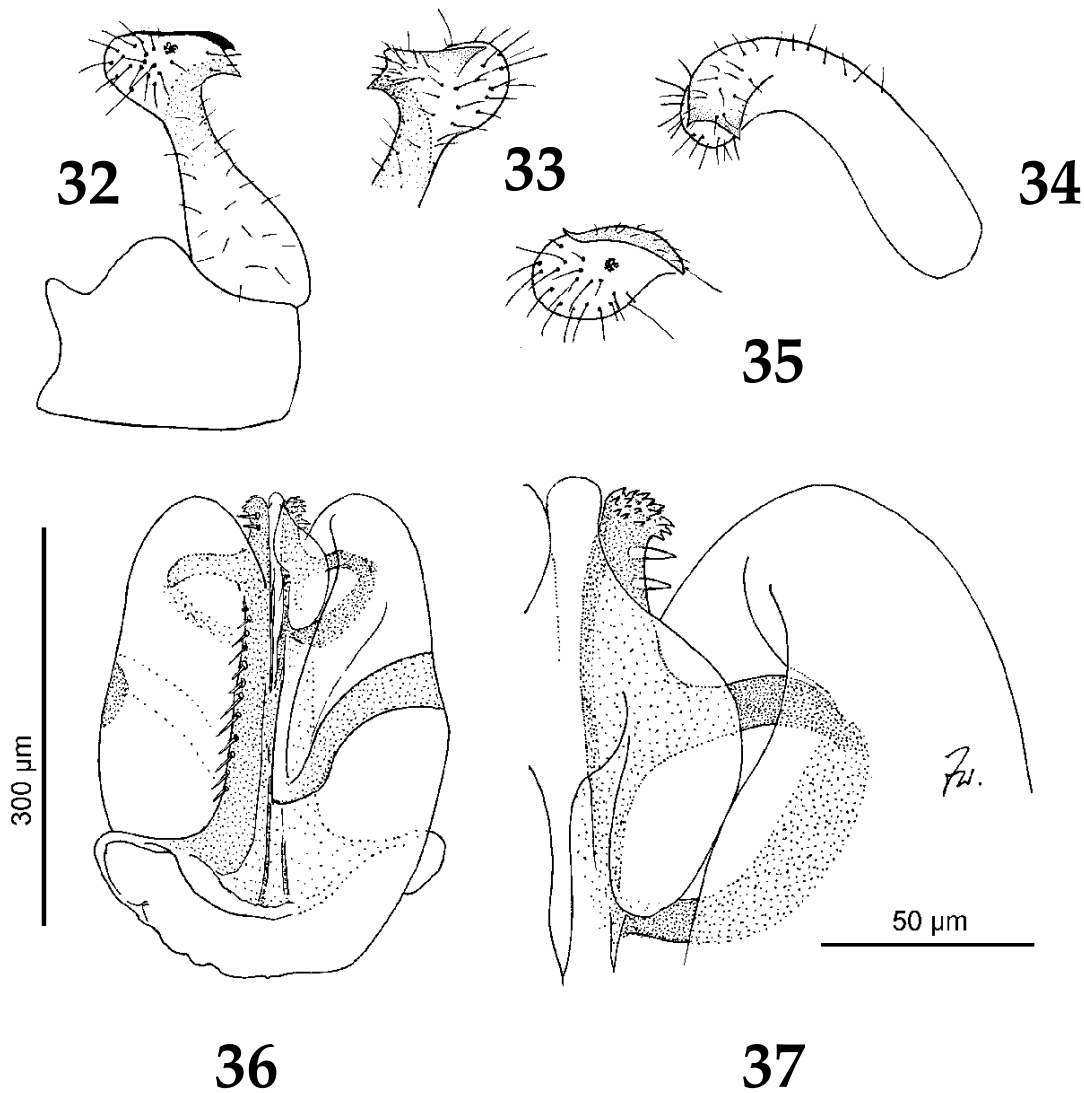
Etymology. Named for Pierre Tripotin, a French hymenopterist who collected the present interesting material and gave it to USNM, Washington D. C.

Nemoura lazoensis sp. n.
(Figs. 32-37)

Material examined. Holotype ♂, paratype ♂, RUSSIA, Primorje, little spring seeps on the banks of Lazovska reka ca 50 km W of Lazo [43°28'N, 133°44'E], 13.6.1998, leg.P. Zwick. Some larvae taken together with the males are probably conspecific. Presently in coll. Zwick, Schlitz.

Adult habitus. The teneral specimens are typical of genus *Nemoura* and possess no distinctive traits, apart from the genitalia. The front wing is 7.2 mm long.

Male. Subgenital plate normal, with slender ventral vesicle and short pointed tip resting between the paraprocts. Paraproct transverse, short, apex bifid. The short medial lobe is narrow and separated from the broad external lobe by an angular notch (Fig. 32). Cercus in lateral view (Fig. 34) basally straight, apically regularly downcurved, sclerotization ending in two widely separate short points. Medially from them appears the large bulbous setose apex which is



Figs. 32-37, *Nemoura lazoensis* sp.n., ♂ holotype. 32, 34, right cercus and paraproct in ventral and lateral views; 33, 35, right cercus in dorsal and caudal views; 36, epiproct in combined ventral (left side) and dorsal view (right side); 37, detail of apical epiproct sclerite. Paraproct and cercus not to scale.

membraneous. In ventral view (Fig. 32) the cercus gently tapers from the base to a neck-like section supporting the large apex resembling a bird head. The caudal end of the dorsal sclerite and the outer point together appear as a narrow caudal edge. In dorsal view (Fig. 33) appears an indistinct mediocaudal point, in addition to the two lateral points. In caudal view (Fig. 35) the sclerite forms a flat cap over the cercus tip and both the mediocaudal point and the external caudal point are seen.

The epiproct is oval, a little restricted anteriorly from midlength (Fig. 36). The narrow ventral sclerite bears about 10 slender spines. The rod-like apical sclerite extends forward but does not reach beyond the general contour of the epiproct. The sclerite's apex is rough, basally from it the tips of two outwardly directed straight spines are exposed. Apical sclerite and looped sclerite stand at a right angle to each other and are connected in a regular curve. The looped sclerite forms an oval ring.

Female. Not known.

Diagnosis. Paraproct and cercus resemble *N. gemma*, and details of the apical sclerite have also some resemblance. However, in *N. gemma* the epiproct contour is almost rhomboid. Its apical sclerites are obliquely connected to the looped sclerites and form a cone projecting far beyond the epiproct apex.

Etymology. The name refers to the township of Lazo after which the beautiful stream along which the types were collected is named.

Nemoura tau Zwick, 1973

Nemoura tau Zwick, 1973b:150. Holotype ♂, PEOPLE'S REPUBLIC OF KOREA, Hamhyung-si: Hyngpong-ri. distr. Hamdžu (Institute of Zoology, Polish Academy of Sciences, Warsaw).

Material examined. REPUBLIC OF KOREA: Chungnam, Keumsan, Gunbuk-Myeon, Sanan-2-li, 20.IV.-8.V.2005, 2 Malaise traps on small stream, 40♂, many ♀. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 500 m, 2.-26.VI. 2006, Malaise trap in forest on small stream, ca 40♂; same data except 750 m, 2♂. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, 1♂; same locality, 8.V.-5.VI. 2004, 1♂.

Notes. So far known only from Korea (Zwick 1973a, b).

Leuctridae

Paraleuctra malaisei sp. n.

(Figs. 38, 39)

Material examined. ♂ holotype, ♂ paratype, 1♀, REPUBLIC OF KOREA, Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream,. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, 1♀.

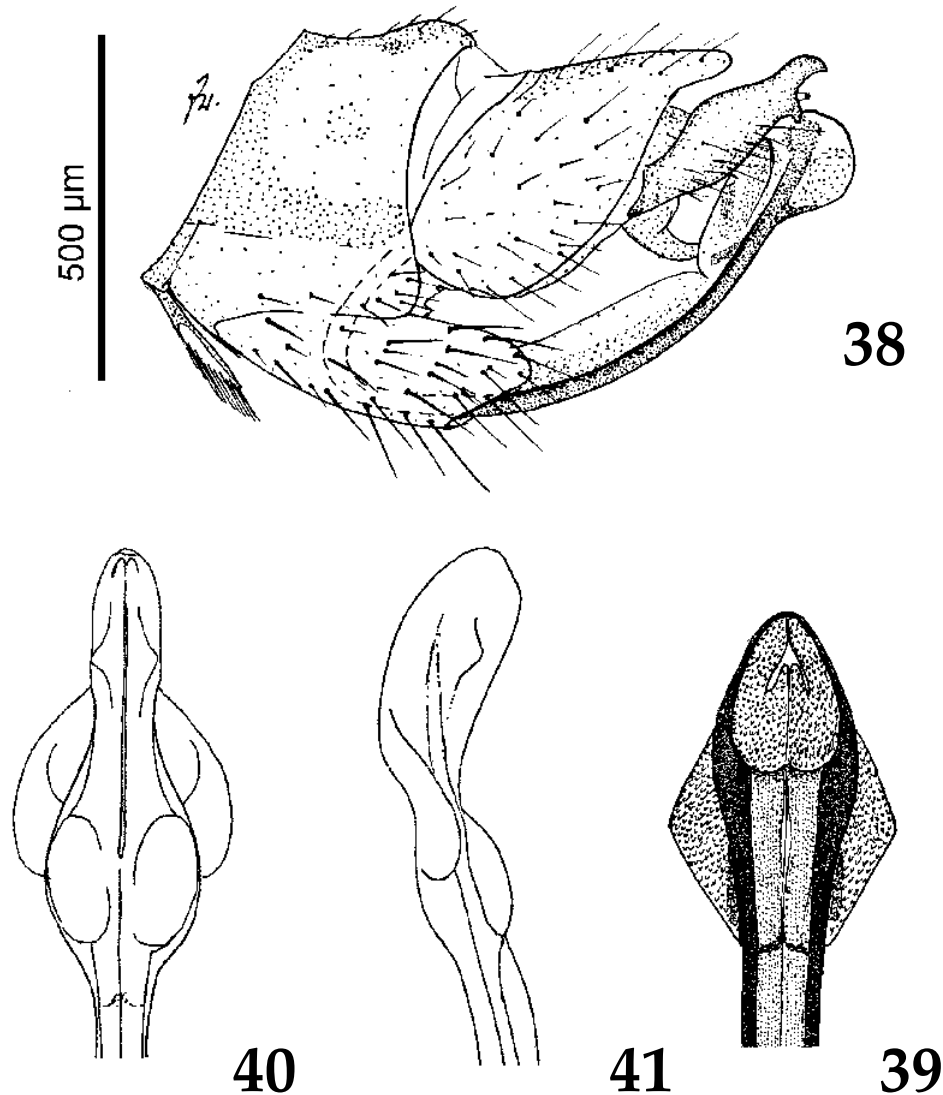
Adult habitus. A typical slender *Paraleuctra* of the occidentalis-group. FWL male, 2.7-2.8 mm, female, 3.1 mm.

Male. T9 caudally slightly raised. Flat hairy ventral lobe on S9 almost circular in ventral view (Fig. 38). S9

forms a subgenital plate with deep and wide U-shaped caudal notch. T10 with recessed antecosta and a median furrow that ends caudally in a deep bracket-shaped notch separating two lobes, each about 1/3 segment width, distally rounded. Epiproct a simple strongly upcurved sharp hook. Cercus slender, with dorsal bulge, tip distinctly emarginate, the rudimentary 2nd segment located in the middle of a notch separating two unequal teeth (Fig. 38). The dorsal tooth is larger and directed dorso-caudad, the ventral tooth points ventrad. In caudal view, the inner edge of cercus appears straight, and both apical teeth point mediad.

In lateral view, the U-shaped base of the subanal probe is by transparency seen inside segment 9. The slender exposed part curves up regularly between the lobes of S9. The posterior face of the probe ends in a membranous semicircular caudal projection and anteriorly in an elongate swelling extending further basad than the other structure (Fig. 38). In caudal view of the probe tip (Fig. 39), the dark lateral sclerites form a narrowly parabolic loop surrounding the rearward pointing membranous part. The anterior membranous part is rhomboid. The membranous scaly parts at the probe tip are covered with numerous small downwardly pointing spicules. **Female.** At present, the female cannot be distinguished from *P. okamotoa* (Claassen) (= *gracilis* Kawai, after Shimizu 2000), from Hokkaido and Sachalin. In both, sternite 9 is patterned in a similar way and ends in a broad, gently bilobed subgenital plate (Zhiltzova 2003: fig. 876).

Diagnosis. *Paraleuctra malaisei* belongs to the occidentalis-species-group as defined by Stark & Kyzar (2001). By the slender but apically notched male cercus, the American *P. occidentalis*, *P. jewetti*, *P. alta*, and *P. projecta* are more similar to *P. malaisei* than the Asian members of the group which have only a medially bent nipple-like apex of male cercus (Shimizu 2000, Zhiltzova 2003, Li et al. 2010). By the shape of the subanal probe (which is the copulatory organ) *P. malaisei* differs clearly from all American (see figures in Baumann et al. 1977, Baumann & Stark 2009) and Asian species (Shimizu 2000, Li et al. 2010). The two Asian mainland species of the group differ strongly. In Zhiltzova's (2003) excellent figures the apex of the subanal probe of *P. okamotoa* is concealed in lateral view and is therefore shown here (Figs. 40, 41).



Figs. 38-41, *Paraleuctra* spp., males. *P. malaisei*, lateral view of abdominal tip (38), epiproct tip concealed; 39, caudal view of apex of subanal probe. *Paraleuctra okamotoa* (= *gracilis* Kawai), apex of subanal probe of a male from Sachalin in caudal (40) and lateral (41) views. Figures 39-41 not to scale.

Etymology. Named for René Malaise (1892-1978), dipterist and Swedish inventor of the efficient trap with which the present collections were made. René Malaise worked for years on the fauna of the Far East.

***Paraleuctra cercia* (Okamoto, 1922)**
(Figs. 42, 43)

Leuctra cercia Okamoto, 1922:37. Syntypes from JAPAN,

Sapporo, Shiribeshi, and Iburi provinces in coll. Okamoto not located (Shimizu 2000).

Material examined. REPUBLIC OF KOREA: Gangwondo, Pyeongchang, Yongpyeong Myeon, Nodong-li, Nodong Valley, Alt. 900 m, 5.-14.6. 2008, 37°42.08. N' 128°28.89'E, 3 Malaise traps in shade at small stream, 1♀. Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, 15♀.

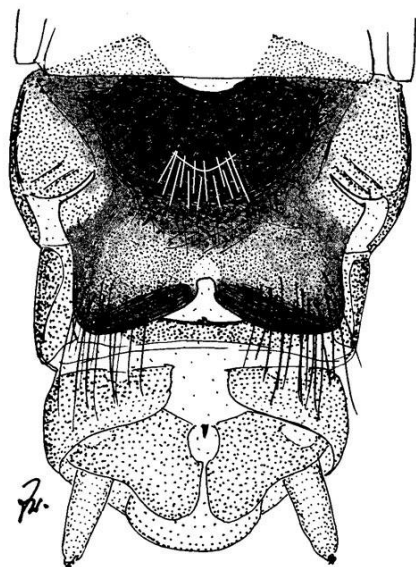
Notes. The identification of the present material is not without doubt. Descriptions and illustrations (Okamoto 1922, Zhiltzova 1974, 2003, Shimizu 2000) are of a female with basally smooth subgenital plate. Conspicuous pilosity occurs only on the caudal lobes. The female from Nodong Valley listed above agrees with this description. The Korean specimens from near Doma Pass differ by a setose crest which in lateral view rises medially from the anterior third of S8, resembling a cone (Figs. 30, 31). Its strong setae are strikingly apparent in lateral view.

Initially, these crested specimens were thought to represent a new species. However, V. Teslenko (in litt.) kindly translated the key passage to females of this group (Zhiltzova 2003) which reads:

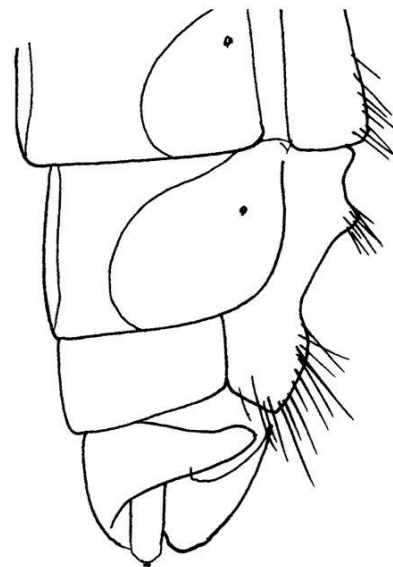
- ... Lateral margins of lobes of subgenital female plate truncated obliquely, basal part of subgenital plate transfers to distal part without distinct projection *araleuctra zapekinae*

- ... Lateral margins of lobes of subgenital female plate are parallel, basal part of subgenital plate narrow, separated from wide distal part by distinct projection *Paraleuctra cercia*

A sample I took near Sidima, Khabarovsk Territory, Russian Far East, in June 1998 includes the nicely distinct males of both species. Of the 6 females, 4 have a smooth subgenital plate as published in the literature. However, one female resembles the Korean specimens (Figs. 42-43) and the last specimen is intermediate.



42



43

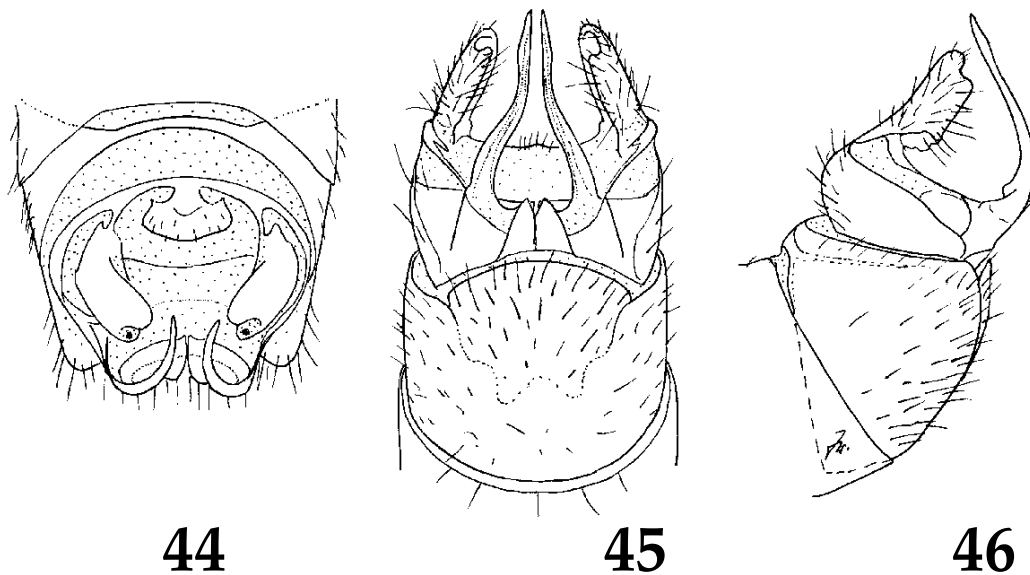
Figs. 42-43. *Paraleuctra cercia*, aberrant Korean female with a cone on the subgenital plate. 42, abdominal tip in ventral, 43, in lateral view. Not to scale.

***Despaxia asiatica* sp. n.**
(Figs. 44-46)

Material examined. REPUBLIC OF KOREA: ♂ holotype, Gangwondo, Pyeongchang, Yongpyeong-Myeon, Nodong-li, Nodong valley, Alt. 900 m, 1.X.-

11.XI. 2006, 37°42.08'N 128°28.89'E, 3 Malaise traps in forest in shade.

Adult habitus. A typical dark leuctrid with strongly infusate wings. FWL 6.5 mm. The male abdominal tip distinguishes it from other members of the family and evidences its membership in genus *Despaxia*.



Figs. 44-46, *Despaxia asiatica*, ♂ holotype, abdominal tip in oblique dorso-caudal, ventral and lateral view (from left); not to scale. Pale unsclerotized areas lightly stippled.

Male. Tergites 3-9 with black, strongly sclerotized antecosta, remainder lightly sclerotized. Anterior tergites possess 4 indistinct darker spots in a transverse row. T9 caudally deeply excised, medially remains no more than the very strong antecosta. Laterally the antecosta divides to form the sclerotized anterior and posterior edges of the lateral portion of the segment. T10 is medially no more than a narrow sclerite to which the cerci and the epiproct are attached (Fig. 44). The epiproct is a transverse finely pilose sclerite with short stalk. Cerci straight, with small ventrocaudal notch, the wart-like second segment is located on top of the lobe, beneath the notch. Middle of S9 caudally arched, forming a slightly projecting subgenital plate with some long setae. Laterally (Fig. 46) the subgenital plate is demarcated by short folds originating in narrow caudo-lateral notches. No ventral lobe. Middle of segment 10 medially occupied by the wide paraprocts. In ventral view (Fig. 45) they form two paramedian weakly sclerotized triangles concealing the bases of the strongly outwardly curved specilla whose inner tube is faintly visible by transparency. More caudally the specilla converge again, their ends lie parallel to each other. The specilla enclose an

approximately heart-shaped open space between them. The specillum tip is pointed, with a faint subterminal swelling. In dorso-caudal view the curved sperm tubes inside the paraprocts are seen to turn towards the midline but remain narrowly separated. Anteriorly from the outwardly curved base of specillum the lateral part of paraproct forms a simple flat plate. In lateral view the specilla curve away from the body and are distally straight. Near the base appears a little swelling over the sperm duct.

Female. Unknown.

Diagnosis. The only other species in the genus is the west-Nearctic *D. augusta* (Banks) which was compared. The general similarity of the two species is striking, compare Figs. 44-46 to figures 3 and 4 of Kondratieff & Lechleitner (2002). However, the basally divergent and widely separate specilla formed by the inner paraproct lobes distinguish the new species immediately from *D. augusta* where the same lobes are parallel and lie close together over their entire length. *D. augusta* has an unsclerotized ventrocaudal edge of cercus carrying the rudimentary 2nd segment but there is no notch. In *D. augusta*, the antecosta of T8 is medially distinctly

recessed, and the epiproct has a faint midline.

Notes. The flight period is apparently autumnal, same as in the American relative (Kondratieff & Lechleitner 2002).

Etymology. The discovery of the new species provides yet another example of genera shared between the Palearctic Far East and Western North America. In the Leuctridae, *Megaleuctra*, *Perlomyia*, and *Paraleuctra* share the same general distribution. The specific name refers to the range of the new species and emphasizes the transoceanic disjunction from *D. augusta*.

***Perlomyia levanidovae* (Zhiltzova, 1975)**

Rhopalopsale levanidovae Zhiltzova, 1975: 225. Holotype ♂, RUSSIAN FAR EAST, South Primorje, Gakkelevskogo klyutsha, basin of river Barabashevka (Museum Petersburg).

Material examined. REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, 1♂, 2♀.

Notes. The species is new for Korea.

***Perlomyia mahunkai* (Zwick, 1973)**

Rhopalopsale mahunkai Zwick, 1973a:163. Holotype ♂, PEOPLE'S REPUBLIC OF KOREA, Prov. Kanwon, Diamond Range, Hotel Go-song (Museum Budapest).

Material examined. REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V.2006, 2 Malaise traps in forest on small stream, many ♂, ♀; same data except 500 m, 3♀. Chungnam, Kaungsan Gunbuk-Myeon, Sanan-2-li, 20.IV.-8.V. 2005, 2 Malaise traps on small stream, numerous ♂, ♀. Jirisan, Hamyang-gun, Macheon-Myeon, Samjeon-li, Alt. 700 m, 35°20.93'N 127°38.50'E, 11.IV.-8.V. 2004, Malaise trap on small stream, numerous ♂, ♀.

Notes. The species is also known from the southern part of the Russian Far East (Levanidova & Zhiltzova 1979, Zhiltzova 2003, Teslenko & Zhiltzova 2009).

***Megaleuctra* Ham et Bae, 2002**

Megaleuctra saebat Ham et Bae, 2002:338. ♂ Holotype,

Republic of Korea, Jeollabuk-do, Namwon, Jirisan (Mt.) Seseokpyeongjeon (Seoul Women's University).

Material examined. REPUBLIC OF KOREA: Gangwondo, Pyeongchang, Yongpyeong-Myeon, Nodong-li, Nodong valley, Alt. 900 m, 5.-14.VI. 2006, 37°42.08'N 128°28.89'E, 3 Malaise traps in shade at small stream, 1♂, 1♀; det. B. Kondratieff.

Notes. This is only the second record of the sole extant Palearctic species.

Capniidae

***Paracapnia recta* Zhiltzova, 1984**

Paracapnia recta Zhiltzova, 1984:78. Holotype ♂, RUSSIAN FAR EAST, South Primorje, Kedrovaya pad (Museum St. Petersburg).

Material examined. REPUBLIC OF KOREA: Chungnam, Keumsan, Gunbuk-Myeon, Sanan-2-li, 20.IV.-8.V. 2005, 2 Malaise traps on small stream, 1♂.

Notes. *Paracapnia recta* was reported from Korea by Kim et al. (1998) who found that a larva known by the informal designation *Capnia* Kua (Yoon and Aw 1986) belongs to this species.

Perlodidae

***Arcynopteryx polaris* Klapálek, 1912**

Arcynopteryx dichroa polaris Klapálek, 1912:20. Male lectotypus (design. Zhiltzova (1995)), Russia, Halbinsel Bykow, Lena-Mündung, and several male and female paralectotypes from various localities in North Russia; all in Mus. St. Petersburg.

Material examined. REPUBLIC OF KOREA: Gangwondo, Pyeongchang, Yongpyeong-Myeon, Nodong-li, Nodong valley, Alt. 900 m, 5.-14.VI. 2006, 37°42.08'N, 128°28.89'E, 3 Malaise traps in shade at small stream, 1♂.

Notes. The species is widespread in Asia (Teslenko & Zhiltzova 2009) but new for Korea.

***Stavsolus japonicus* (Okamoto, 1912)**

Isogenus japonicus Okamoto, 1912:111. Female syntypes from JAPAN, Yamaguchi, Nikko, and Harima

provinces (in coll. Univ. Sapporo and coll. Okamoto) not located.

Material examined. REPUBLIC OF KOREA: Gangwondo, Odaesan near Dong-daesan, Alt. 800 m, 37°44.31'N 128°35.71'E, 3.-21.VI. 2006, 4 Malaise traps in old Korean fir forest, 1♀.

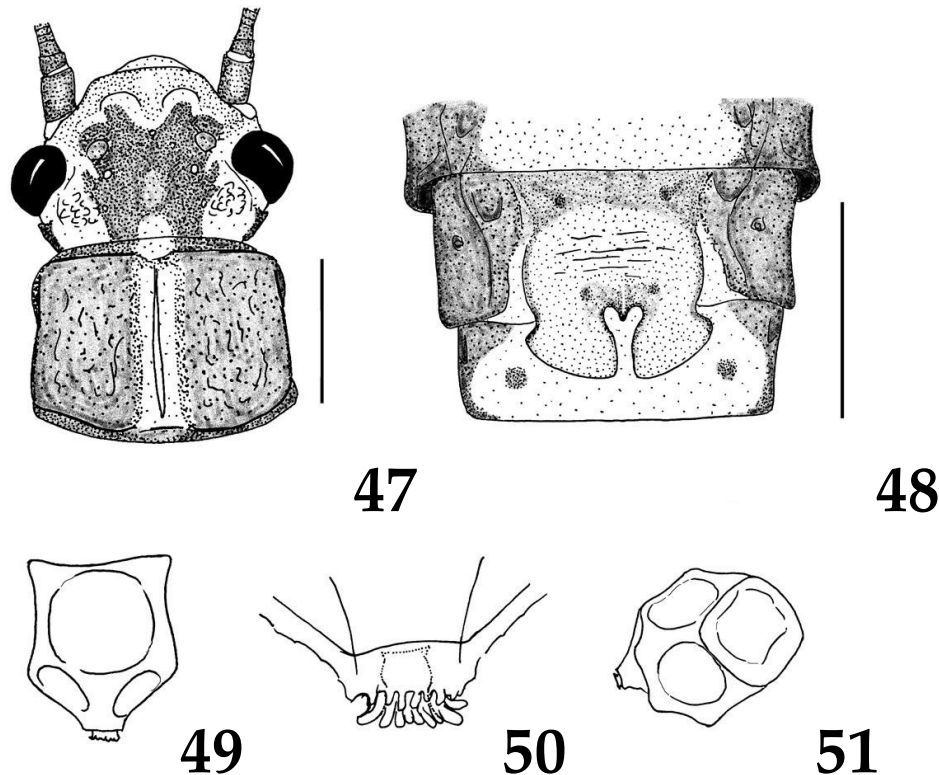
Notes. Apparently widespread in South Korea (Kim et al. 1998). A single turtle-shaped egg recovered from the abdomen confirms the identification of the present specimen. The North Korean specimen illustrated by Zwick (1973a) is certainly also this species.

Megarcys teslenkonis sp. n.
(Figs. 47-51)

Material examined. ♀ Holotype, REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream; 2 eggs recovered from the abdomen were slide mounted.

Adult habitus. Slightly brachypterous, FWL 20 mm, BL 18 mm. Dorsal face and sides of body very dark brown. There is a yellow head pattern and a yellow median band on the pronotum (Fig. 47). Mesonotum with yellow patch in middle, middle of metathorax and of first two abdominal tergites medially also lighter than remaining dorsal surface. Ventral side mainly yellow, thoracic sternites light ochre. Antennae and cerci almost black. Femora dorsally brown, ventrally light brown, with yellow knee ring. Light brown patches in the basal part of front and rear face of femur grow successively larger from front- to hind-leg where they occupy about 2/3 of the total length. Tibiae dark brown from base to subgenual organ, then abruptly yellow but grading again to dark brown towards tip. Tarsal segment 1 lighter brown than 2 and 3.

Submental gill a short slender cone, gill on lower front corner of pronotum also small. The curved downhanging lateral single gills at the front of meso- and metathorax are larger, about as long as in *M. ochracea*, but not as thick.



Figs. 47-51, *Megarcys teslenkonis*, ♀ holotype. 47, head and pronotum; 48, sternites 7-9, ventral view; 49-51, egg in lateral view (49), detail of collar (50), and oblique dorsolateral view (51). Scale lines are 2 mm. Figs. 49-51 not to scale.

Male. Not known.

Female. The yellow S8 forms a rounded slightly convex subgenital plate ending in two long lobes extending over half of S9 (Fig. 48). The medial gap separating the lobes is anteriorly heart-shaped, caudally approximately parallel. At the level of the S9 hind margin each lobe is on the outside constricted and then strongly expanded so that a prominent lateral lobe is formed from where the convex contour curves regularly towards the median gap.

Egg. Large, 400 µm long. Quadrilateral with flat opercular area, in side view (Fig. 49) resembling a cube to one side of which is attached a short pyramid supporting the collar. Each side of the cube and of the pyramid is distinctly concave. In oblique views (Fig. 51), the egg therefore appears to be of some irregular shape. The collar appears double, the shorter outer and the longer and narrower inner ring both ending in a number of pearls or short fingers (Fig. 50). Chorion with hexagonal follicle cell impressions. The limits between cells are corrugated and a bit raised, at high magnifications the egg contour appears rough. Opercular line, micropyles, and anchor not observed.

Diagnosis. The subgenital plate with its large lobes resembles *M. magnilobus* Zhiltzova, 1988 from the Russian Far East, the west-nearctic *M. signata* (Hagen, 1874), and *Sopkalia yamadae* (Okamoto, 1917) from Japan. In *S. yamadae* (which was compared) the gap separating the lobes of the subgenital plate is also heart-shaped but is wider. None of the similar species possesses outwardly directed angles at the base of each lobe (Okamoto 1917, Ricker 1952, Van Wieren et al. 2001, Zhiltzova 1988, Teslenko & Zhiltzova 2009), and all differ in pigmentation and pattern of the fore body. Known *Megarcys* eggs (van Wieren et al. 2001, and my own observations of *M. ochracea* (Klapálek, 1912) and also the egg of *S. yamadae* (Isobe 1988) have a double collar. Several have a somewhat battered appearance because of concave areas on the egg surface. However, *M. teslenkonis* is the only species with a flat-topped quadrilateral egg.

Etymology. This large beautiful species is dedicated in friendship to Valentina Teslenko (Vladivostok) who contributed importantly to the knowledge of stoneflies of the East Palearctic region. The name is

treated like a Latin noun of the O-declension, in the genitive case.

Nomenclatural note. When checking the descriptions of additional nominal Asian species of genus *Megarcys* (Illies 1966) the correct original spelling of one name was found to be *Megarcys lepneva* (Šámal, 1939), not *lepnevae* as used in the literature. Šámal spelled *lepneva* both in the description and the figure legend, the spelling was clearly not a lapse.

Chloroperlidae

Sweltsa zhiltzovae sp. n.

(Figs. 52-56)

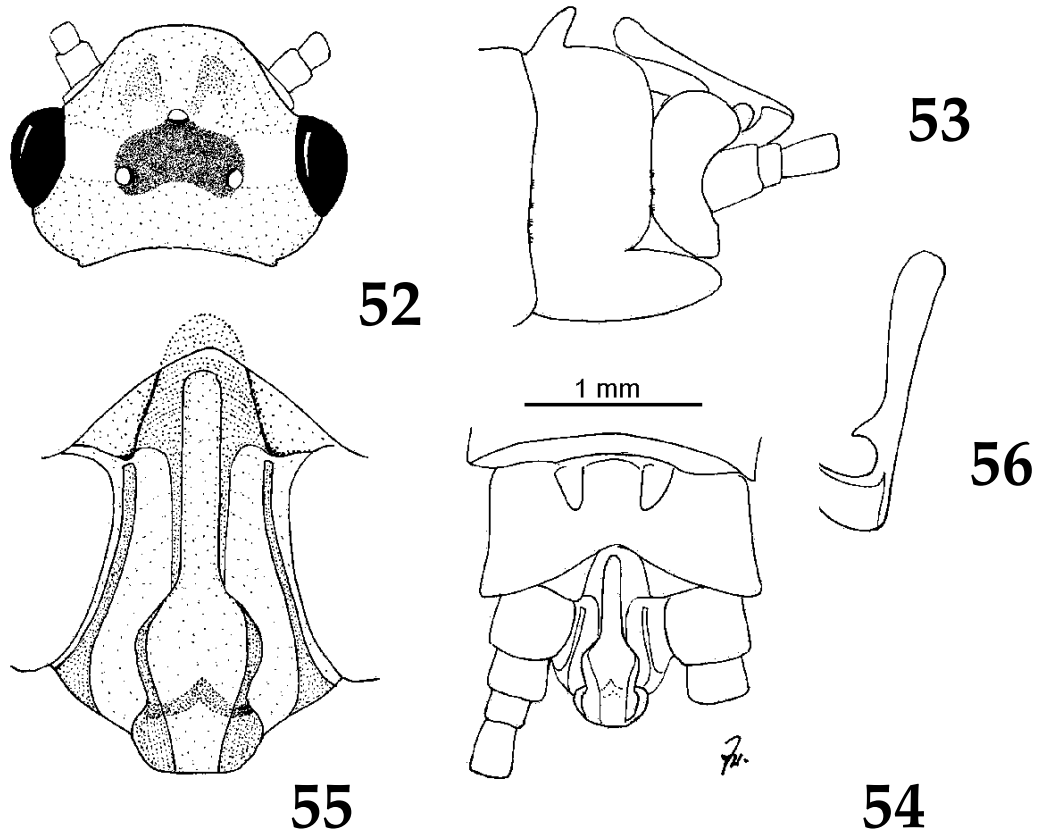
Material examined. ♂ holotype, 2♂ paratypes, REPUBLIC OF KOREA, Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream.

Adult habitus. A pale yellowish species, FWL 8.7 mm. The head has a wide chocolate brown angled mark connecting the ocelli (Fig. 52). The area between this mark and the eyes is white and paler than the yellowish rest of the head. Pronotum, antennae, legs, and cerci are unicolorous. Meso- and metathorax have the usual narrow U-shaped mark, and a narrow brown line along the pleural suture. On the abdomen, T1 has a dark antecosta and a narrow brown longitudinal mark in the middle. Tergites 2-7 each have a wider brown longitudinal mark. Each is much wider in front than behind. Together they form a brown dorsal band with serrate edges.

Male. Middle part of antecosta 9 sclerotized but flat, separating two steeply rising back-curved fleshy cones (Figs. 53, 54). Caudal margin of T9 triangularly excised, base of epiproct partly exposed. T10 completely divided into simple hemitergites by the large epiproct rising from a deep cowl (Fig. 55). The scooped front part is laterally articulated and from this point on forms a basal rod in the bottom of the cowl. By transparency, its upcurved caudal end appears as a dark V-shaped mark in the base of the forward-bent part of the epiproct. The remarkably large and wide base of this part occupies about 1/3 of the length. The anterior 2/3 have in dorsal view the shape of a straight finger. In side view appears a strong triangular extension of the ventral contour

line (Fig. 56). The finger widens gently towards the rounded apex. The dorsal contour of the epiproct is indistinctly concave, almost straight. Between the

hemitergites the lateral edges of the epiproct cowl are strengthened by distinct slender paragenital sclerites. No penial armature noticed.



Figures 52-56. *Sweltsa zhiltzovae*, ♂ holotype. 52, head, dorsal; 53, abdominal tip, lateral; 54, the same, . dorsal; 55, dorsal view of epiproct and its cowl; 56, distal part of epiproct in side view. Not to scale.

Female. Not known.

Diagnosis. The pattern of the new species is distinctive. In case of doubt, the strong cones on T9, the acutely triangular ventral extension, and the wide and large base of the epiproct identify it immediately. *Sweltsa lepnevae* Zhiltzova from Primorje seems to be most similar but differs in pattern (Teslenko & Zhiltzova 2009), females were available for comparison. Their head mark is only about half as wide, the distal 2/3 of antennae are dark brown, and there is a narrow dark margin along the front and sides of the pronotum. Males of *S. lepnevae* (from the description) have lower cones on T9, the epiproct has a narrow base and in side view no

ventral extension. Its tip is slightly sinuous but essentially downcurved.

Etymology. The species is named in honour of Lidija Andrejevna Zhiltzova (St. Petersburg), my much admired colleague and dear friend, in recognition of her outstanding contributions to the knowledge of stoneflies, in particular of Asia.

Sweltsa colorata Zhiltzova et Levanidova, 1978

Sweltsa colorata Zhiltzova et Levanidova, 1978:20; Holotype ♂: RUSSIAN FAR EAST, Primorje, Kedrovaya pad (Museum St. Petersburg).

Material examined. REPUBLIC OF KOREA: Chungbuk, Sangchon-Myeon, Dungeon-li near Doma Pass, Alt. 750 m, 2.-26.V. 2006, 2 Malaise traps in forest on small stream, 6♂, many ♀; same locality and date, but altitude 500 m, 2.-26.VI. 2006, Malaise trap in forest on small stream, 12♂, 52 ♀.

Notes. Kim et al. (1998) recorded numerous Korean specimens of this widespread species. Teslenko & Zhiltzova (2009) do not accept the synonymy with *Sweltsa nikkoensis* (Okamoto, 1912) proposed by Kim et al. (1998).

ACKNOWLEDGMENTS

I am very grateful to Dr Oliver Flint (USNM, Washington D.C.) for the loan of this interesting material which Prof. Boris Kondratieff (Fort Collins, COL) had brought to my attention. Prof. Kondratieff provided me with interesting comparative North American material and he and Prof. Bill. P. Stark (Clinton, MS) are also thanked for useful suggestions. My study was much facilitated by donations of comparative material by the late Dr Albert Lillehammer (Oslo), and especially Far East Asian material with which Dr Lidija A. Zhiltzova (St. Petersburg) donated to me over the years for which I am very grateful. Dr Valentina A. Teslenko (Vladivostok) was very helpful by providing important advice, publications, and translations of Russian texts; I thank her sincerely. Sincere thanks are also extended to Dr David Muranyi (Budapest) for his dedicated help, to Dr. Sung A. Ham (Chonnam) for important information and comparative specimens, and to Prof. Ding Yang (Beijing) and Dr Weihei Li (Xinxiang) for helpful pre-publication information on Chinese species of *Paraleuctra*.

REFERENCES

Baumann, R.W. & B.P. Stark. 2009. *Paraleuctra alta* (Plecoptera: Leuctridae), a new stonefly from Alberta, Canada. *Illiesia*, 5:30-33.
 Baumann, R.W., A.R. Gaufin, & R.F. Surdick. 1977. The stoneflies (Plecoptera) of the Rocky Mountains. *Memoirs of the American Entomological Society*, 31:1-208.
 Ham, S.A. 2008. Two species of Chloroperlidae (Insecta: Plecoptera) new to Korea, with adult keys to species of the family in Korea. *Korean Journal of Systematic Zoology*, 24:185-189.
 Ham, S.A. 2009. *Nemoura phasianusa*, a new species of

Nemouridae (Insecta: Plecoptera) from Korea. *Korean Journal of Systematic Zoology*, 25:95-98.
 Ham, S.A. & J.Y. Bae. 2002. The stonefly genus *Megaleuctra* (Plecoptera: Leuctridae) new to East Palearctic region, with description of *Megaleuctra saebat* new species. *Entomological News*, 113 (5):336-341.
 Ham, S.A. & J.B. Lee. 1998. *Nemoura gemma*, a new species of the Nemouridae (Insecta: Plecoptera) from Korea. *Korean Journal of Systematic Zoology*, 14:357-360.
 Ham, S.A. & J.B. Lee. 1999. Four new species of Nemouridae (Plecoptera: Insecta) from Korea. *Korean Journal of Biological Sciences*, 3:119-125.
 Illies, J. 1966. Katalog der rezenten Plecoptera. Das Tierreich. Lieferung 82: I-XXX; 1-632.
 Isobe, Y. 1988. Eggs of Plecoptera from Japan. *Biology of Inland Waters*, 4:27-39.
 Kim, J.S., Y.J. Bae, & L.A. Zhiltzova. 1998. Bibliographic review, systematic status, and biogeographic notes on Korean and Far East Russian stoneflies (Insecta: Plecoptera) with their new Korean records. *Korean Journal of Biological Sciences*, 2:419-425.
 Klapálek, F. 1912. Plécoptères I. Fam. Perlodidae. *Collections Zoologiques du Baron Edm. de Sélys-Longchamps*, 4 (1):1-66.
 Kondratieff, B.C. & R.A. Lechleitner. 2002. Stoneflies (Plecoptera) of Mount Rainier National Park, Washington. *Western North American Naturalist*, 62:385-404.
 Levanidova, I.M. & L.A. Zhiltzova. 1979. An annotated list of the stoneflies (Plecoptera) of the Soviet Far East. *Internationale Revue der Gesamten Hydrobiologie*, 64:551-576.
 Li, W., Y. Wang, & D. Yang. 2010. Synopsis of the genus *Paraleuctra* (Plecoptera: Leuctridae) from China. *Zootaxa*, 2350:46-52.
 Lillehammer, A. 1988. Plecoptera Fauna of Fennoscandia and Denmark. *Fauna Entomologica scandinavica*, 21. E. Brill, Leiden. 163 pp.
 Okamoto, H. 1912. Erster Beitrag zur Kenntnis der Japanischen Plecopteren. *Transactions of the Sapporo Natural History Society*, 4 (1911-1912):105-170.
 Okamoto, H. 1917. *Megarcys yamadae* sp.n., die dritte Art der Gattung. *Entomological Magazine* (Kyoto), 3 (2):79-81-

- Okamoto, H. 1922. Zweiter Beitrag zur Kenntnis der Japanischen Plekopteren. Bulletin of the Agricultural Experiment Station, Government General of Chosen, Suigen, 1(1):1-46 + pls I-VI.
- Ricker, W.E. 1952. Systematic studies in Plecoptera. Indiana University Publications, Science Series, 18:1-200.
- Šámal, J. 1939. Contribution à l'étude de la faune des Plécoptères d'Altai. Vestník Československé Společnosti Zoologické, 6/7:419-426.
- Shimizu, T. 1997. The species of the *Nemoura ovocercia* group (Plecoptera: Nemouridae). Aquatic Insects, 19:193-218.
- Shimizu, T. 2000. *Paraleuctra* (Insecta: Plecoptera: Leuctridae) from Japan, with taxonomic notes on the Japanese Leuctridae. Species Diversity, 5:285-303.
- Stark, B.P. 2010. Studies on Korean stoneflies (Insecta: Plecoptera) with descriptions of two new species. *Illiesia*, 6 (1):1-10.
- Stark, B.P. & J.W. Kyzar. 2001. Systematics of nearctic *Paraleuctra* with description of a new genus (Plecoptera: Leuctridae). Tijdschrift voor Entomologie, 144:119-135.
- Teslenko, V.A. & L.A. Zhiltzova. 1997. New and little known species of stoneflies (Plecoptera: Nemouridae and Perlodidae) from the Russian Far East. Aquatic Insects, 19:23-35.
- Teslenko, V.A. & L.A. Zhiltzova. 2009. Keys to the stoneflies (Insecta, Plecoptera) of Russia and adjacent countries. Images and larvae. Dalnauka, Vladivostok, 382 pp.; in Russian. <http://www.biosoil.ru/files/00008625.pdf>
- Van Wieren, B.J., B.C. Kondratieff, & B.P. Stark. 2001. A review of the North American species of *Megarcys* Klapálek (Plecoptera: Perlodidae). Proceedings of the Entomological Society of Washington, 103:409-427.
- Wu, C.F. 1929. A second species of stonefly from Peiping. China Journal of Science and Arts, 10:200-201
- Yoon, I.B. & S.J. Aw. 1986. A taxonomic study on the stonefly (Plecoptera) nymphs of Korea (II): Leuctridae, Taeniopterygidae, Capniidae, Perlodidae. Entomological Research Bulletin, 12:7-27.
- Zhiltzova, L.A. 1974. [Rare genera of the family Leuctridae (Insecta: Plecoptera) in the fauna of the USSR.]. Zoologicheskii Zhurnal, 53 (3):359-364; in Russian.
- Zhiltzova, L.A. 1975. [*Rhopalopsole*, a genus of Plecoptera new for the USSR (Plecoptera: Leuctridae).]. Zoologicheskii Zhurnal, 54 (2):221-230.
- Zhiltzova, L.A. 1977. New species of Stoneflies (Plecoptera) from Primorye Territory. Trudi Zoologicheskoi Institut Akademii Nauk SSSR, 70:3-9.
- Zhiltzova, L.A. 1984. [A new species of genus *Paracapnia* Hanson (Plecoptera: Capniidae) in Primorje.]. pp. 78-80 in Levanidova, I.M., E.A. Markatchenko & A.Yu. Setentchejko (eds)., Biology of the Fresh Waters of the Far East, Academia Nauk SSSR, Vladivostok; in Russian.
- Zhiltzova, L.A. 1988. New species of stoneflies (Plecoptera) of the family Perlodidae from the Far East. pp. 7-11 in: Fauna, Systematics and Biology of the Freshwater Invertebrates, Academy of Sciences, Far Eastern Scientific Centre, Nauka, Vladivostok: 7-11; in Russian.
- Zhiltzova, L.A. 1995. Catalogue of type specimens in the collection of the Zoological Institute, Russian Academy of Sciences. Stoneflies (Plecoptera). - St. Petersburg, Zoological Institute, 38 pp., in Russian.
- Zhiltzova, L.A. 2003. Plecoptera Gruppe Euholognatha. Fauna of Russia and Neighbouring Countries, Insecta Plecoptera, 1(1): 537 + 7 unnumbered pages; Russian Academy of Sciences, Zoological Institute, St. Petersburg, Nauka, in Russian.
- Zhu, F. & D. Yang. 2003. Two new species of *Nemoura* from China (Plecoptera, Nemouridae). Acta Zootaxonomica Sinica, 28 (3):474-477.
- Zwick, P. 1973a. Plecoptera from Korea. Annales historico-naturales Musei nationalis Hungarici, 65:157-169.
- Zwick, P. 1973b. On the stoneflies from Korea (Insecta, Plecoptera). Fragmenta faunistica, Warszawa, 19:149-157.
- Zwick, P. (1973c): Insecta Plecoptera. Phylogenetisches System und Katalog. Das Tierreich 94: I-XXXII, 1-465.

Received 22 March 2010, Accepted 14 April 2010, Published 28 April 2010

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Illiesia](#)

Jahr/Year: 2010

Band/Volume: [06](#)

Autor(en)/Author(s): Zwick Peter

Artikel/Article: [New species and new records of Plecoptera from Korea and the Russian Far East. 75-97](#)