



## Redescription of the remarkable *Zhiltzovaia amabilis* (Jewett, 1958) comb. nov. (Plecoptera, Perlodidae) based on types and new material from Himalaya and Pamir Mountain systems

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### Abstract

*Filchneria amabilis* (Jewett, 1958) is recognized as a species of *Zhiltzovaia* Özdikmen, 2008 with the valid name *Zhiltzovaia amabilis* (Jewett, 1958) **comb. nov.**, and *Z. cachemirica* (Aubert, 1959) is placed as a junior synonym of that species. *Zhiltzovaia amabilis* is redescribed from new material collected from streams of Pamir, Tajikistan, and northwestern Himalaya, northern India. New illustrations of all life stages are presented.

**Key words:** *Zhiltzovaia amabilis*, *Filchneria amabilis*, synonym, *Zhiltzovaia cachemirica*, eversible paraproct lobes, eggs, North West Himalaya, Pamir

### Introduction

Summarizing the results of an entomological survey of the North-West (Punjab) Himalaya, Jewett (1958) described from only adult females, *Perlodes amabilis* from Manali (Himachal Pradesh, bordered by Jammu and Kashmir) (Figs. 1, 2). He noted, that “the shape of the subgenital plate and the color pattern of the head and pronotum distinguish this species from the other described Asian members of *Perlodes*.” After examining additional material from the Alhni River (Beas River Basin, Pir Panjal Range, Western Himalaya, Kashmir), Jewett (1975) based on “many nymphs associated with adults of this species,” treated *P. amabilis* as a member of the genus *Skobeleva* Klapálek, 1912. He noted that these associated nymphs agreed with the nymphal description of *Skobeleva* sp. by Kawai (1963), whose material also came from Baj Gaz Ann, the Punjab Himalaya. Jewett (1975) provided a lateral view of the male terminalia, indicating that “subanal lobes were swollen, and possessed posteriorly directed knobs.”

One year later, Aubert described the male, female and larvae of *Perlodes* (*Skobeleva*) *cachemirica* from Besal, the northwest frontier province of Pakistan in the Himalaya bordering Kashmir (Aubert 1959) (Figs. 3–6). Later, Zwick (1973) synonymized *Skobeleva* with *Filchneria* Klapálek, 1907, and proposed the new combinations of *S. amabilis* = *F. amabilis*, *P. (S.) cachemirica* = *F. cachemirica*.

Zhiltzova (1994) then established the new genus *Aubertiana* Zhiltzova, 1994 based upon differences between *P. (S.) cachemirica* and *Filchneria*. She provided diagnostic details of *Aubertiana* including a light colored and poorly sclerotized tergum 10, posterior margin slightly raised medially, and covered with two groups of short, stout setae. Additionally, she mentioned “Membranous part of the paraprocts protruding, large, elongated with a narrow sclerotized band along median surface. Female subgenital plate transverse, with two tongue-like lobes laterally and a small medial lobe. The arms of the meso-furcasternum short, not reaching to the furcal pits.”

Zhiltzova (1994) included in her newly established genus *Aubertiana* only the type species, *A. cachemirica* because specimens of other central Asian species of *Filchneria* (*Skobeleva*) were not available for examination. However, she assumed that some of them could be possibly placed in *Aubertiana*.

The name *Aubertiana* is preoccupied in the Hymenoptera and Özdikmen (2008) proposed replacement name, *Zhiltzovaia*. Among the Perlodinae, *Zhiltzovaia* is monotypic within the *Perlodes* species group, and characterized

by the combination of secondary loss of the male epiproct, tergum 10 entire, and triangular eggs (Zwick 1997). Abdominal segments 1–3 are divided into terga and sterna by hairless pleural membranes in adults and larvae. Larval inner lacinal margin with a small protrusion below the subapical tooth, and a tuft of short setae near the base of the apical tooth (Zwick 2004).

Recently new adult, larval and egg material were collected from mountain streams of Pamir and Northwestern Himalaya Ranges (Tajikistan and Northern India). We have examined the holotype and paratype of Aubert's (1959) species, described from Besal, Pakistan, North West Himalaya, and the paratype of Jewett's (1958) species from Manali, Himachal Pradesh, West Himalaya. Both species are considered conspecific and belonging to the genus *Zhiltzovaia*. We propose that *F. amabilis* be transferred to genus *Zhiltzovaia* with the valid name *Z. amabilis* **comb. nov.**, and *Z. cachemirica* placed as a junior synonym of that species. Herein, we re-describe all stages of *Z. amabilis* and present new illustrations.

## Materials and methods

All adults were collected by sweeping or handpicking with forceps from stones and preserved in 75% ethanol. Abdomens of males were removed and soaked in 10% NaOH overnight and rinsed with distilled water. Illustrations were produced using a digital camera (Nikon Coolpix 995 and Toup View 3.7 software), stereomicroscope (Olympus SZX16), an additional digital camera (Olympus DP74), and images were stacked using Helicon Focus software. The final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® software. Morphological terminology follows that of Zwick (1997, 2004) and Stewart & Stark (2002).

The holotype and paratypes examined were deposited in Cantonal Museum of Zoology, (Lausanne, Switzerland) and Natural History Museum, California Academy of Sciences (San Francisco, USA). All the recently collected specimens are deposited in the Federal Scientific Center of the East Asia Terrestrial Biodiversity Far Eastern Branch, Russian Academy of Sciences, Russia.

## Results and discussion

### *Zhiltzovaia amabilis* (Jewett, 1958) **comb. nov.**

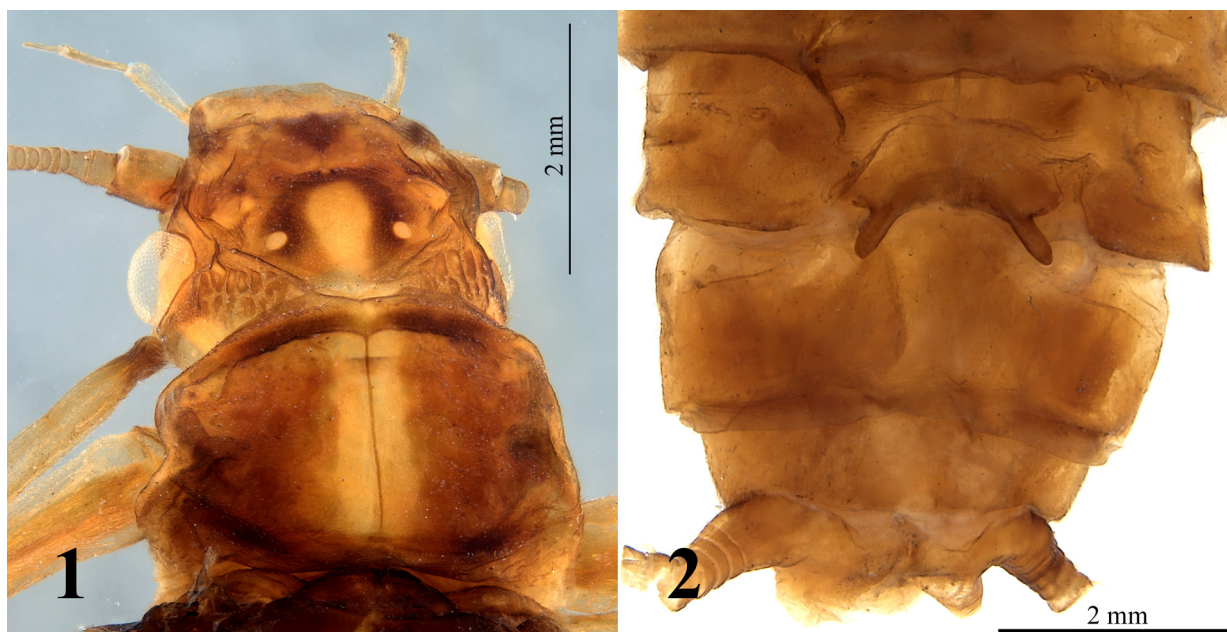
(Figs. 1–28)

Jewett, 1958: 327, fig. 9 (*Perlodes amabilis*);  
Aubert, 1959: 86–88, figs. 81–86 (*Perlodes (Skobeleva) cachemirica*);  
Illies, 1966: 309 (*Skobeleva cachemirica*) (catalog);  
Illies, 1966: 512 (*Perlodes amabilis*) (catalog);  
Zwick, 1973: 229 (*Filchneria amabilis* **comb. nov.**) (catalog);  
Zwick, 1973: 229 (*Filchneria cachemirica* **comb. nov.**) (catalog);  
Jewett, 1975: 5, 7, figs. 4, 4A (*Skobeleva amabilis*);  
Zwick & Sivec, 1980: 112, *Filchneria amabilis*;  
Zhiltzova, 1994: 45–47, figs. 1–5 (*Aubertiana cachemirica* **comb. nov.**);  
Das, 1995: 36, (*Skobeleva amabilis*);  
Özdikmen, 2008: 762 (*Zhiltzovaia cachemirica* **comb. nov.**);  
Chandra *et al.*, 2019: 228 (*Filchneria amabilis*).

**Diagnosis.** Head brown, with yellow M-shaped line, median interocellar area with a large tear-shaped yellow spot, widest anteriorly (Figs. 1, 3, 8, 14). The male of *Z. amabilis* is distinguished by the shape of the paraproct sclerite, which bears a small, narrow, truncated knob dorsally and larger rounded knob ventrally (Figs. 4, 5, 9, 11, 12), the eversible paraproct lobe (EPL) folded inside the paraproct (Figs. 4, 5, 9, 11) in repose. The everted EPL is a long finger-like membranous lobe with a sclerotized band dorsally (Fig. 12). The everted aedeagus is large, a membranous tube with a pair of lateral lobes at the base, two constrictions close to the tip, tip funnel-shaped (Figs. 10, 12). The female is distinguished by the shape of subgenital plate. It is short, wide, and slightly extended below sternum 8; a sclerotized pair of thin, obliquely-directed finger-like lobes posterolaterally; posterolateral edges rounded (Figs. 2, 6, 15). Lateral arms of meso-furcasternum short, not reaching anterior or posterior corners of furcal pits (Fig. 16).

The egg of *Z. amabilis* triangular in cross section, each side swollen near the anterior pole (Fig. 17). Collar short, consists of two horizontal rims, both are flanged and irregularly incised (Fig. 18). Chorionic surface dotted with numerous, raised, large rounded globular bodies and tiny warts (Fig. 20).

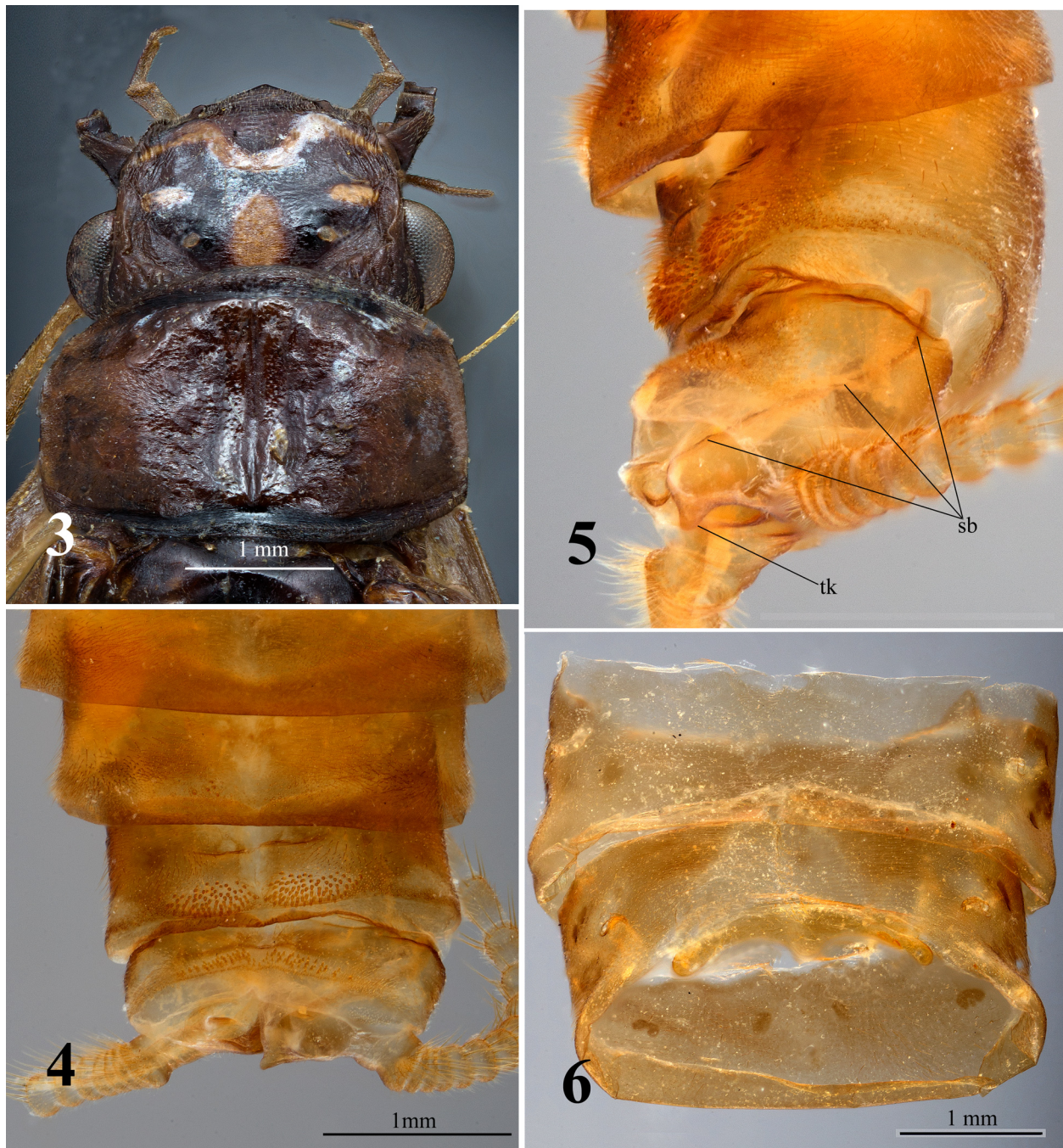
**Adult habitus.** Males are brachypterous (Fig. 7), females macropterous. Body brown, yellow and black, some areas glabrous (Fig. 7). Head brown, with a distinct yellow transverse M-shaped line interrupted at base, tentorial callosities on the clypeus yellow, a pair of yellow marks above the lateral ocelli with small black spots inside (Figs. 8, 14). Median interocellar area with a large tear-shaped yellow spot, widest anteriorly. Anterolateral margins of head with dark area extending from base compound eyes to the clypeus. Occipital area with a yellow transverse band connected medially and anteriorly forming a triangular medial area along the epicranial suture (Figs 7, 8, 14). Submental gills small. Antennae light brown, scape and pedicel dark brown, palpi yellowish. Pronotum brown with a broad median longitudinal light band (Figs. 7, 8 & 14), rugosities and meso- and metanota dark brown (Fig. 8). Lateral arms of meso-furcasternum short, not reaching anterior or posterior corners of furcal pits; dark beak-like spots at the inner edges of each furcal pit; transverse suture on mesosternum thin and light brown (Fig. 16). Abdomen covered with short brownish clothing hairs. Abdominal segments 1–3 divided by hairless pleural membrane laterally, remaining segments undivided. Legs with contrasting dark brown and yellow bands and spots, femur brown with a diffuse yellow band along outer edge and a yellow spot apically delimited with dark brown band. Tibia brown with diffuse darker brown band in the basal  $\square$  (Fig. 7) and a yellow spot basally. Cerci bicolored, segments with a thick transverse yellow bands basally, and thin dark brown lines on the apical margins (Figs. 7, 10, 15).



**FIGURES 1–2.** Paratype of *Zhiltzoaia amabilis* (Jewett, 1958), female. 1. Head and pronotum. 2. Subgenital plate. (Photos by C. Grinter and R. Diaz-Bastin).

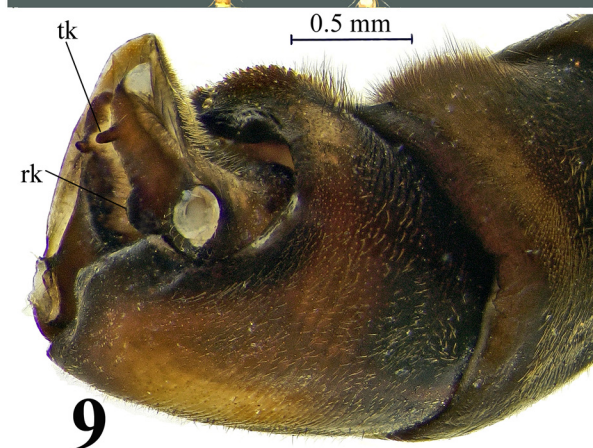
**Male.** Body length 15.5–17.5 mm. Wings short. Fore wings reach the posterior margin of tergum 2, hind wings not exceed the posterior margin of tergum 4 (Fig. 7). Abdominal terga 7–8 dark, slightly depressed medially, swollen posterolaterally and densely covered with brown hairs. Tergum 9 deeply depressed medially with thin, light pigment area; paired transverse and rectangular yellow protrusions posteriorly, covered with thick sensilla basiconica and short fine hairs (Fig. 10). Sternum 9 brown, with oval pale patch medially, posterior margin scope-shaped, extending backward and curving upward, sub-equal to  $\frac{1}{3}$  length of sternum 10 (Figs. 7, 9, 10). Tergum 10 entire, pale, less sclerotized, with membranous narrow band along median line not reaching the posterior margin; in lateral view posteromedial margin up curved, obtusely angled and covered with two patches of reddish sensilla basiconica and sparse fine brown hairs (Figs 7, 9–11). Paraproct consists of sclerite and membranous eversible lobe (Figs. 9–12). Paraproct sclerite wide and heavily sclerotized basally, pointed distally, bears a small, narrow truncated knob dorsally and a large rounded knob ventrally (Figs. 9, 11, 12). In repose, eversible paraproct lobe is in-folded more than twice inside the paraproct and hidden (Fig. 11). The naturally everted EPL arises from a membranous fold near the narrow truncated knob of the sclerite, enlarges into a long finger-like membranous lobe, with a narrow sclerotized

band along median surface, and the shape is curved upward (Fig. 12). Naturally everted aedeagus protrudes from the apex of sternite 10 as a membranous tube with a pair of lateral lobes at the base and two weak constrictions in the second half of the length (Figs. 7, 10, 12). The aedeagal apex is funnel-shaped with cuticular swellings (Figs. 7, 10, 12).



**FIGURES 3–6.** Holotype and Paratype of *Zhiltzovaia amabilis* (Jewett, 1958). 3. Holotype, male, head and pronotum. 4. Holotype, male, abdominal tip, dorsal. 5. Holotype, male, abdominal tip, lateral: tk—truncated knob of paraproct sclerite; sb—narrow sclerotized band of eversible paraproct lobe through transparent body wall. 6. Paratype, female, subgenital plate. (Photos by M. Satori).

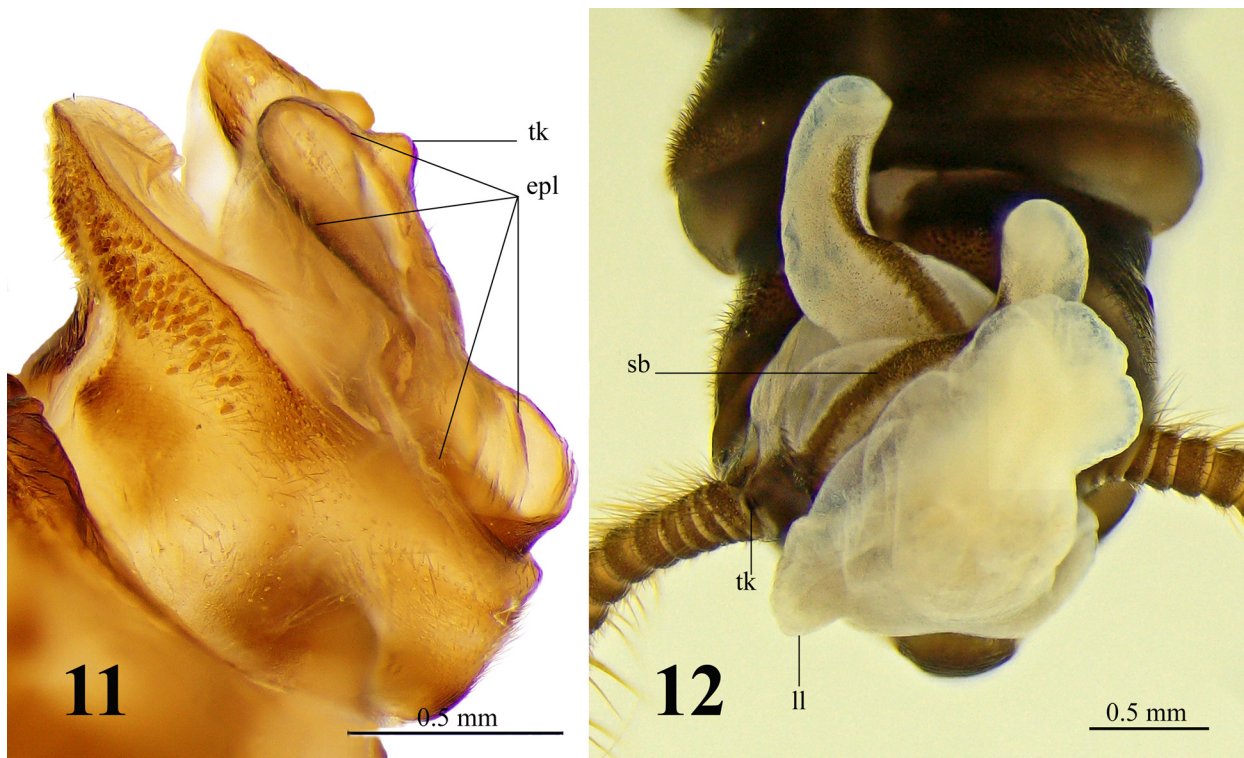
**Female.** Body length 21.2–23.5 mm, macropterous, forewing length 20.6–21.4 mm, wingspan 44.0–45.8 mm. Wings darkly infuscated, outer half of fore wing grey brown, inner half hyaline with yellow veins, costal area mostly light yellow, venation includes an irregular net near the apex sometimes consisting of three rows of cells (Fig. 13). Four cross veins between *C* and *Sc*; two veins between *Sc* and *R*<sub>1</sub> (Fig. 13). *Rs* bears five apical branches, six veins between *M* and *Cu*<sub>2</sub>; four anal veins (Fig. 13). Hind wings similarly colored, anal area large, *A*<sub>2</sub> and *A*<sub>6</sub> forked.



**FIGURES 7–10.** *Zhiltzovaia amabilis* (Jewett, 1958), male. 7. Habitus, dorsal. 8. Head and pronotum. 9. Abdomen and paraprocts, lateral: tk—truncated knob, rk—rounded knob of paraproct sclerite. 10. Abdominal tip with aedeagus, dorsal.

Head and pronotum pigment patterns similar to male, anterior margin of head with large yellow and rectangular occipital spot (Fig. 14); yellow M-line sometimes interrupted at the two highest points; and clypeus with a solid yellow stripe with the apices directed forward. Abdominal terga brown; sterna yellowish-brown except sterna 1–3 which are brownish with lateral membranous pale folds. Sternum 8 with a pair of large oval and oblique dark brown spots anteromedially (Fig. 15). Subgenital plate pale medially, short, partially extending beyond sternum 8,

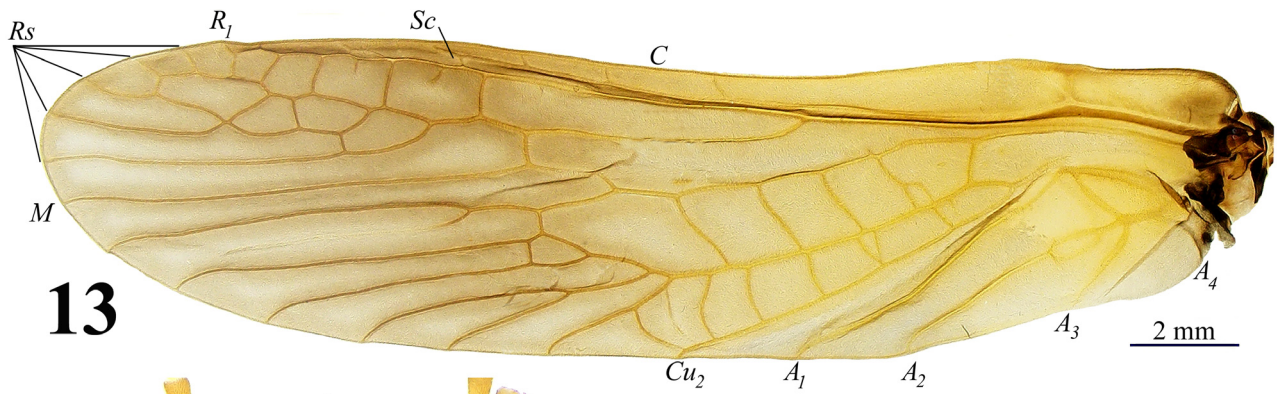
posteriorly with thin transverse wrinkles which are concentrated at the base, posteromedial margin almost truncate; a distinct pair of thin obliquely directed finger-like lobes project posterolaterally; lateral margins rounded, sharply incurved in the posterior 1/3 with dark brown spots near the anterior margin and above the fingerlike lobes (Fig. 15). Abdominal sternum 9 unmodified, brown with a lateral pair of large, oval, dark brown spots.



**FIGURES 11–12.** *Zhiltzovaia amabilis* (Jewett, 1958), male. 11. Abdomen and paraprocts, in repose, lateral: epl—folded eversible paraproct lobe, tk—truncated knob of paraproct sclerite. 12. Abdomen with the erected eversible paraproct lobe, dorsal: sb—narrow sclerotized band; aedeagus, ventral, ll—lateral lobe.

**Egg.** Trilateral (Fig. 17), size is 727 X 485  $\mu\text{m}$ , dark brown, heavily sclerotized. Longitudinal ridges delimit the three sides of the egg, each side swollen close to the anterior pole (Fig. 17). Anchor mushroom-shaped with short and strong pedicel (Figs. 17, 19), anchor plate entirely covered with dense globular bodies, the margin of the anchor covers the collar completely (Fig. 17). Collar short with two transverse rims, both are flanged and irregularly incised (Fig. 18). The sides of the collar between rims bear short longitudinal carinae (Fig. 18). A row of 3–6 micropyles is found near the swelling close to anterior pole on each side, orifices small with distinct short lips (Fig. 20). Chorionic surface dotted with numerous, raised, large globular bodies and tiny warts (Fig. 20).

**Larvae.** Mature female length 26.7 mm. Color generally yellow-brown in dorsal view (Fig. 21). Body covered with short black clothing hairs, a dorsomesal band of erect silky white setae more pronounced on the head behind arms of ecdysial suture and thorax than on abdomen (Fig. 22). Antennae yellow. Head slightly wider than pronotum; M-line yellow, distinct; interocellar area brown with narrow oval central yellow spot, closed posteriorly (Figs. 21, 22), a small oval-shaped pale spot laterally from each posterior ocellus. Tentorial callosities on the clypeus above posterior ocelli pale. Occiput with brown reticulate markings posteriorly, a diffuse band of small light yellow spots close to epicranial arms and bordered sinuate brownish pattern behind each eye (Figs. 21, 22). A few small short and scattered spines in post-ocular row. Submental gills small, length 0.2 mm. Labrum yellow with light brown outer edge. Right lacinia (Fig. 23) bidentate, apically narrow, basal half expanded, with a small rectangular angle below subapical tooth bearing 3 stout marginal setae; marginal row of approximately 14 sparse stout setae along  $\frac{3}{4}$  of inner margin; apical tooth about 0.4 times total outer lacinial length, subapical tooth about 0.5 times length of apical tooth; two long transparent axillary setae between bases of apical and subapical teeth; palm of lacinia with a median ventral patch of more than 25 dark clothing setae. Galea reaches the base of the subapical tooth. Left mandible large (Fig. 24), strongly sclerotized and partially cleft, mandibular teeth without serrations, and a median patch of setae; a marginal band of golden acanthae extending from below the last small tooth to near the base (Fig. 24). Pronotum



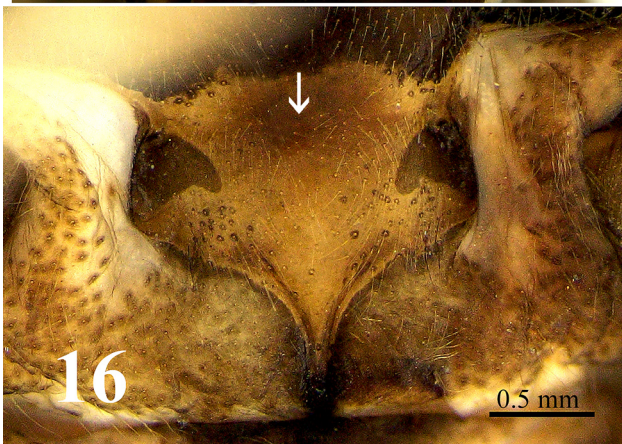
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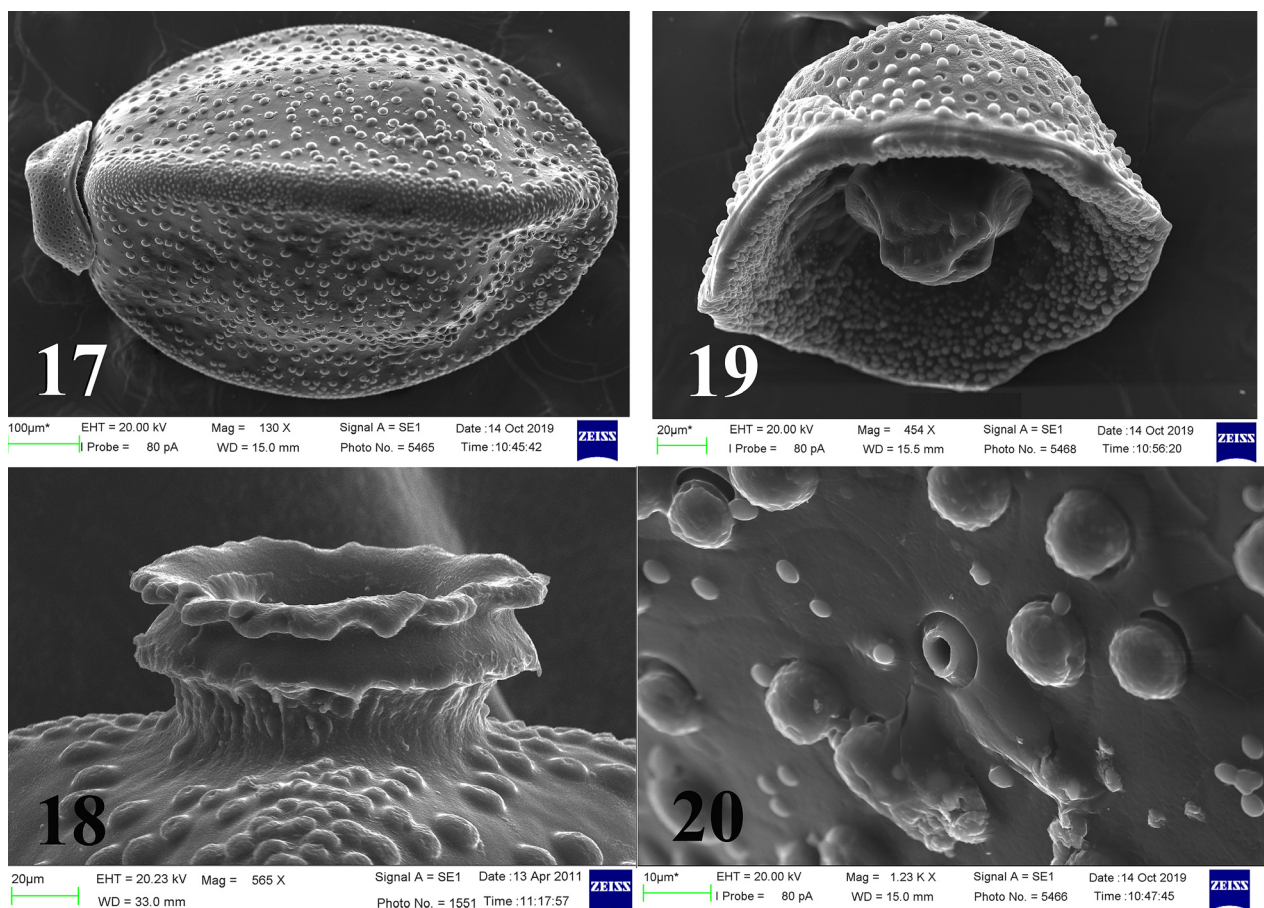


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**FIGURES 13–16.** *Ziltzoiaia amabilis* (Jewett, 1958), female. 13. Forewing, C, Sc,  $R_1$ , Rs, M,  $Cu_2$ ,  $A_1$ ,  $A_2$ ,  $A_3$ ,  $A_4$ —veins. 14. Head and pronotum, dorsal. 15. Abdomen with subgenital plate, ventral. 16. Meso-furcasternum with short arms, and transverse suture (arrow) ventral.

oval, brown with thin yellow lateral margins with a yellow pattern and dark clothing hairs (Figs. 21, 22); pronotal discs fringed with bristles of the mixed lengths, interrupted laterally and longer on anterior and posterior pronotal margins.

Mesosternum Y-arms short not connected to the posterior corners of furcal pits. Meso- and metanota with yellow median band widened posteriorly and with a few longitudinal narrow light yellow stripes, base of the wing pads brown (Fig. 21). Legs light brown, covered with black clothing hairs; femur with wide longitudinal yellow band close to outer margin and dark brown band distally; tibia with a short narrow and dark brown stripe basally (Fig. 28). Surface of femur and tibia with scarce brown bristles, inner margins of femora and tibia covered with short spine-like brown bristles. Outer margins of femur, tibia and tarsus with a fringe of fine, silky, colorless hairs (Figs. 21, 28).



**FIGURES 17–20.** *Zhiltzovaia amabilis* (Jewett, 1958), egg. 17. Habitus, dorsal. 18. Collar, dorsal. 19. Anchor, dorsoventral. 20. Chorion and micropyle with lip.

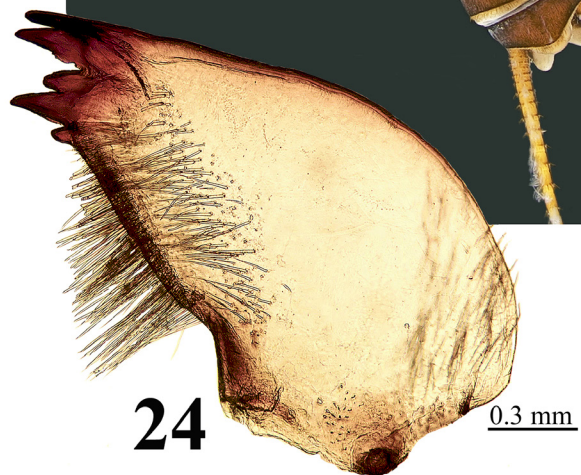
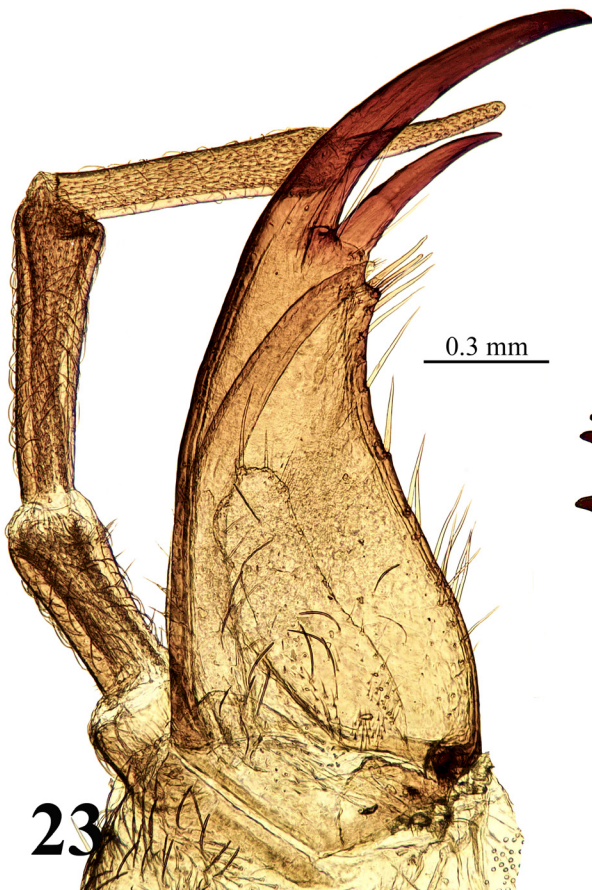
Abdominal terga brown with median dark brown stripe covered with a few short, stout, brownish bristles; segments 1–3 divided by hairless pleural membrane, remainder undivided, having a continuous posterior fringe of small brown setae. Terga 1–5 with a transverse row of six small, yellow spots grouped in three pairs anteriorly, this pattern is not obvious on terga 6–10 (Fig. 21). Paraprocts long, apex rounded. Cercus yellow-brown with dorsal fringe of fine silky and colorless setae, the setal length decreasing near apical segments (Figs. 21, 25–27). Cercal segments with an apical whorl of short brown setae, a few intercalary setae appeared on segments on apical half (Figs. 26, 27).

**Material examined.** *Perlodes amabilis* Jewett, 1958. Paratype, female: Manali, 6500 ft, 25-VI-55, V. K. Gupta (SGJ, Jr.). North-West Himalaya, deposited in California Academy of Sciences, San Francisco, California, USA.

*Filchneria cachemirica* Aubert, 1959.

Holotype No 215. Male, Pakistan (NWFP), Besal, 10715 ft, 8–9.VII. 1953. F. Schmid leg. *Skobeleva cachemirica* det. J. Aubert, 1959.

*Perlodes cachemirica* Aubert, 1959, Det. Aubert, 1959.



**FIGURES 21–24.** *Zhiltzovaia amabilis* (Jewett, 1958), larvae, female. 21. Habitus, dorsal. 22. Head and pronotum, dorsal. 23. Right maxilla, ventral. 24. Left mandible, ventral.

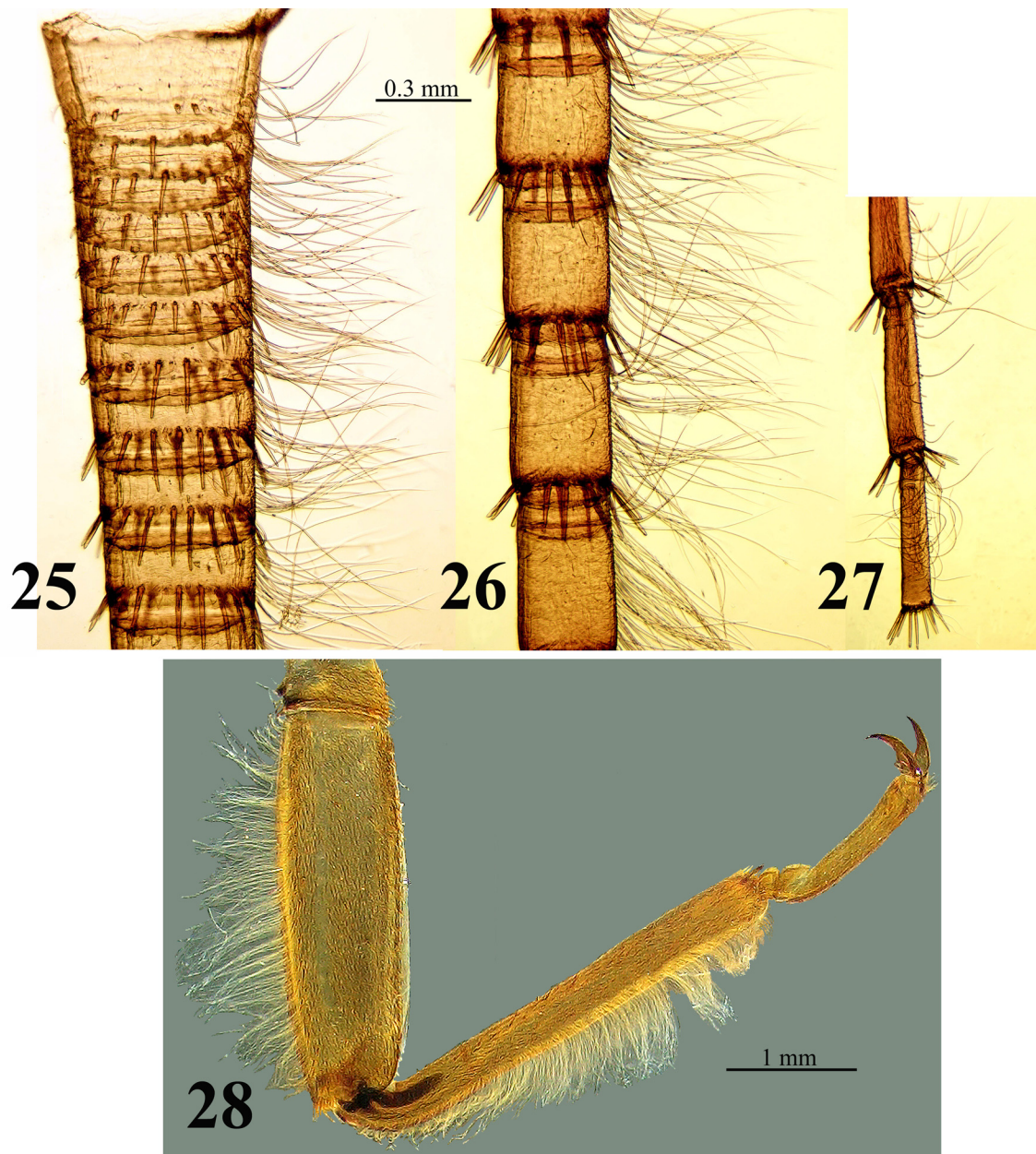
Paratype No 117. Female, Pakistan (NWFP), Besal, 10715 ft, 24.VII. 1953. F. Schmid leg., *Perlodes cachemirica* Aubert, 1959, Det. Aubert, 1959.

*Skobeleva cachemirica* det. J. Aubert, 1959. The holotype and paratype deposited in Cantonal Museum of Zoology, Lausanne, Switzerland.

**India:** Uttarakhand, Chamoli District: 2 nymphs, Nayachutii Vill., Ganges R. Basin, Alaknanda R., 1924 m a. s. l., 30°38.637' N 79°32.019' E, 10.05.2018, coll. D. Palatov; 4 ♂, 1 ♀, 2 nymphs, Ganges R. Basin, Badrinath, Rishi Ganga River, tributary of the Alaknanda R., 3128 m a. s. l., 30°44.444' N 79°29.325' E, 12.05. 2018, coll. D. Palatov; 3 ♂, 1 ♀, 1 nymph, 2 ex., below Badrinath, Ganges R. Basin, Alaknanda River, 3093 m a. s. l., 30°44.1726' N 79°29.333' E, 13.05.2018, coll. D. Palatov;

Utar Pradesh: 1 ♀, 5 nymphs, Gobindghat, 1750–1900 m a. s. l., 30°37.5' N 79°33.5' E, 17–23.05.1999, coll. Yu. Marusik;

Himachal Pradesh: 1 nymph, Darcha Vill., Bhaga River, Ind R. Basin, 2300–3400 m a. s. l., 32°40.6' N 77°11.9' E, 15.06.1999, coll. Yu. Marusik; 1 ♂, Rohtang Pass & Marhi Vill., 3800–3950 m a. s. l., 32°21.9' N 77°14.7' E, 03.06.1999, coll. Yu. Marusik.



**FIGURES 25–28.** *Zhiltzovaiia amabilis* (Jewett, 1958), larvae, female. 25. Left cercus, basal segments, lateral. 26. Left cercus, mesal segments, lateral. 27. Left cercus, apical segments, lateral. 28. Right foreleg, dorsal.

**Tajikistan:** 1♂, Gorno-Badakhshan A.R., Ishkoshim District, Panj R. Basin, Pamir R. Basin, an unnamed stream along the road Langar-Rachiv, steeply falls to the Pamir R., 3515 m a. s. l., 37°10.315' N 72°44.371' E, 30.06.2016, coll. D. Palatov.

**Distribution.** *Zhiltzovaia amabilis* is considered an endemic to Asia with limited distribution in the high mountain belt of the transfer zone between the East Palaearctic and the Oriental regions (Zhiltzova 1994, Li & Murányi 2015). It occurs in the Hindu Kush, Pamir, Karakoram and northwestern Himalaya Ranges (Tajikistan, Afghanistan, Pakistan, and northwest of India). Inhabits the streams and rivers of the alpine zone at 1750–3950 m a. s. l., width 1.5–20 m, bottom with rocky substrate, boulders, small stones, and pebbles; velocity 0.1–1.2 m/s, water temperatures 8–15°C; (high mountain sources in the Amu Darya, Indus, and Ganges R. Basins). Adults present in May–July.

**Comments.** The holotype and paratype of *A. cachemirica* (Figs. 3–6) and the paratype of *P. amabilis* (Figs. 1, 2) agree well with the original descriptions by Aubert (1959) and Jewett (1958), respectively. The types are in good condition, although both descriptions are relatively brief and characteristic features of the internal structures were not originally described. Visible through the cleared integument of the holotype of *A. cachemirica*, is the folded EPL with a narrow sclerotized band (Fig. 5). There is a slight difference in the shape of the female subgenital plate of fresh material and original description of paratypes of *A. cachemirica* and *P. amabilis*, where the posteromedial margin bears a small lobe according to Jewett (1958) and Aubert (1959). Possibly, the appearance of a small medial lobe on the posteromedial edge of subgenital plate is associated with the laying of large eggs and the female maturity. Apparently, age and maturity of adults may also explain the differences in the color pattern of head and pronotum of the holotype of *A. cachemirica* (Fig. 3), which does not have a distinct pronotal yellow medial band; probably old specimens can be relatively dark, and unicolorous (Fig. 82 Aubert, 1959).

Considering *P. amabilis* paratype characters such as the remarkable shape of the female subgenital plate, the color pattern of the head, pronotum, legs (Figs. 1, 2), and the relative proximity of the type locality to Kashmir, *P. amabilis* is transferred to *Zhiltzovaia* with the valid name *Z. amabilis*. *Zhiltzovaia cachemirica*, based on overlapping and agreement of characters of the respective original descriptions, is placed as a junior synonym of *Z. amabilis*.



**FIGURE 29.** *Zhiltzovaia amabilis* (Jewett, 1958), distribution.

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