



New species of caddisflies (Insecta, Trichoptera) from the Rovno Amber

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Abstract

A new genus and seven new species of the caddisfly families Polycentropodidae, Ecnomidae, Hydroptilidae, Phryganeidae and Leptoceridae (*Archaeotinodes malickyi* sp. nov., *Archaeoneureclipsis martynovi* sp. nov., *Polycentropus grigorenkoi* sp. nov., *Oxyethira lurida* sp. nov., *Orthotrichia umbra* sp. nov., *Eotrichostegia retrograda* gen. & sp. nov., *Erotosis bessylenon* sp. nov.) from the Rovno Amber (Upper Eocene, Ukraine) are described. A list of fossil Trichoptera known from the Rovno Amber is given.

Key words: Fossil, resins, Late Eocene, *Archaeotinodes*, *Archaeoneureclipsis*, *Polycentropus*, *Oxyethira*, *Orthotrichia*, *Eotrichostegia*, *Erotosis*

Introduction

Amber fossils are well known for their perfect preservation, providing sufficient data for proper identification of species and recognizing fine body structures. There are several amber deposits since Late Mesozoic time with insects and other animals preserved in the fossil resins. Trichoptera are not uncommon among the fossils, although their numbers are usually lower than some other ubiquitous insect groups like small Diptera. Abundance and diversity of Trichoptera in the Baltic Amber were described by Ulmer (1912). His study was based on the old collections, mostly private ones, from the shores of the Baltic Sea. The Baltic Amber is dated as Late Eocene, some 40 MYBP (Rasnitsyn & Quicke 2002; Perkovsky *et al.* 2007, Wichard *et al.*, 2009). There are other resins found in Europe along with a rich fauna in Paleogene deposits: Saxonian (Germany) and Rovno (Ukraine) Ambers (Erichson & Weitschat 2001).

Our study is based on a collection of Trichoptera from the I.I. Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine (IZSK). Totally the collection includes 176 pieces of Rovno Amber with 192 specimens of Trichoptera; 174 of them are determined to the family, genus or species. All fossils described here are deposited in the I.I. Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine (Kiev).

Previously we have described one new genus and 15 new species from the Rovno Amber from the families Philopotamidae, Polycentropodidae, Psychomyiidae, Ecnomidae, Hydroptilidae, Lepidostomatidae and Leptoceridae (Melnitsky & Ivanov 2010, 2013b, 2016). Here we describe one new genus and 7 new species of Trichoptera: *Archaeotinodes malickyi* new species, *Archaeoneureclipsis martynovi* new species, *Polycentropus grigorenkoi* new species, *Oxyethira lurida* new species, *Orthotrichia umbra* new species, *Eotrichostegia retrograda* new genus & new species, *Erotosis bessylenon* new species. Some of the new species found in this collection are retained for subsequent publications because their proper taxonomic position and affinities require additional studies.

Systematics

Order TRICHOPTERA Kirby 1813

Suborder HYDROPSYCHINA Sukatsheva 1980

Family ECNOMIDAE Ulmer 1903

Genus *Archaeotinodes* Ulmer 1912

Archaeotinodes malickyi Melnitsky & Ivanov new species

(Fig. 1 A–C)

Description. Head, antennae, palpi and wings brown; legs dark brown. Antennae shorter than forewings. Hair warts on head and thorax with long sheaves of hairs. Sternites and tergites of abdomen brown, pleurites yellowish. Spur formula 3.4.4. Measurements: body length 3.7 mm; length of each forewing 4.1 mm.

Male genitalia (Fig. 1B, C). Segment X long, sclerotized laterally. Preanal appendages (cerci) very long and slightly curved, enlarged apically; their terminal parts without long black spines, exceeding length of dorsal lobes of inferior appendages more than twice. Numerous very long hairs covering lateral part of outer surfaces of preanal appendages. Lateral margins of preanal appendages heavily sclerotized. Inferior appendages (gonopods) small, subdivided into dorsal and ventral lobes (branches). Dorsal lobes in lateral view oblong, each with rounded pit at apex, outer surface near pit covered with numerous (about 10–12) small setae. Ventral lobe of each gonopod short. Aedeagus strong and sclerotized, rounded, with subapical extension, enlarged and bent downwards at apex.

Comparison. The new species is similar to *Archaeotinodes reveraverus* Melnitsky & Ivanov 2010 from Rovno Amber, differing in the shape of the dorsal lobes of the inferior appendages. In contrast to the new species, *A. reveraverus* is smaller, has the dorsal lobes of inferior appendages without pits, and the aedeagus is not enlarged apically.

Holotype male. IZSK, № K–4080, Rovno Amber, Bartonian, Eocene.

Etymology. The species is named in honor of the Austrian trichopterologist Hans Malicky.

Family POLYCENTROPODIDAE Ulmer 1903

SUBFAMILY Polycentropodinae Ulmer 1903

Genus *Archaeoneureclipsis* Ulmer 1912

Archaeoneureclipsis martynovi Melnitsky & Ivanov new species

(Fig. 2 A–C)

Description. Wings pale yellowish. Legs brown, abdomen light brown. Measurements: body length 2.9 mm; length of each forewing 3.4 mm.

Male genitalia (Fig. 2B, 2C). Segment X long and narrow, somewhat longer than aedeagus. Preanal appendages small, each with wide base and narrow apex. Inferior appendages consisting of dorsal and ventral lobes articulated basally. Ventral lobes of left and right appendages bent and sharpened, covered with long pale hairs, touching each other apically; dorsal lobes somewhat longer than ventral, enlarged and pointed apically. Aedeagus robust, almost equal to gonopods in length. Ventral surface of aedeagus with numerous spines, apex rounded in ventral view.

Comparison. The new species is similar to *Archaeoneureclipsis geminata* Ulmer 1912 from Baltic Amber, differing in the shape of inferior and preanal appendages. In *A. geminata* the inferior appendages have ventral lobes straight with rounded apices not approximating each other; preanal appendages are larger, extended caudad, and narrower basally.

Holotype male. IZSK, № K–8540, Rovno Amber, Bartonian, Eocene.

Etymology. The species is named in honor of the late Russian trichopterologist Andrey Vasilievich Martynov.

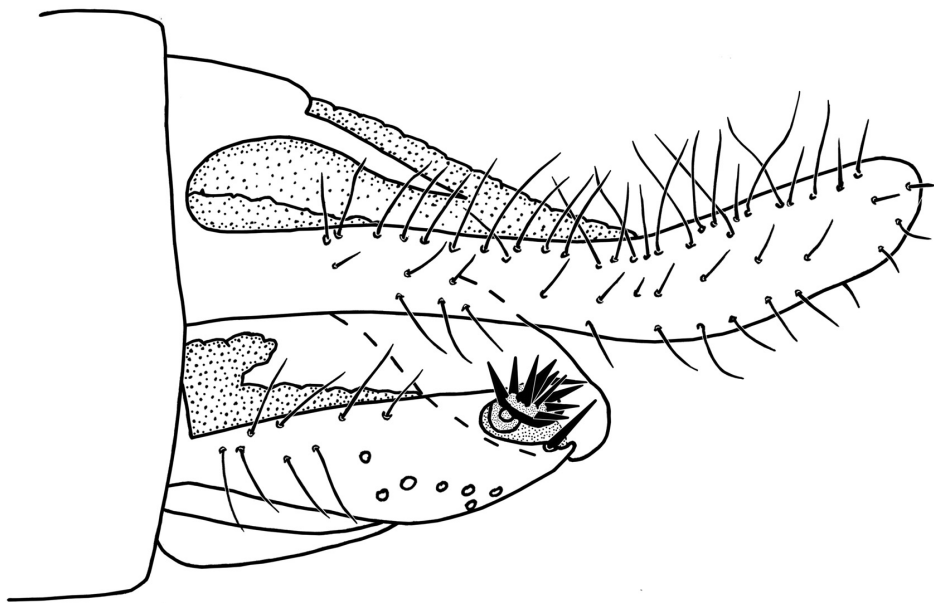
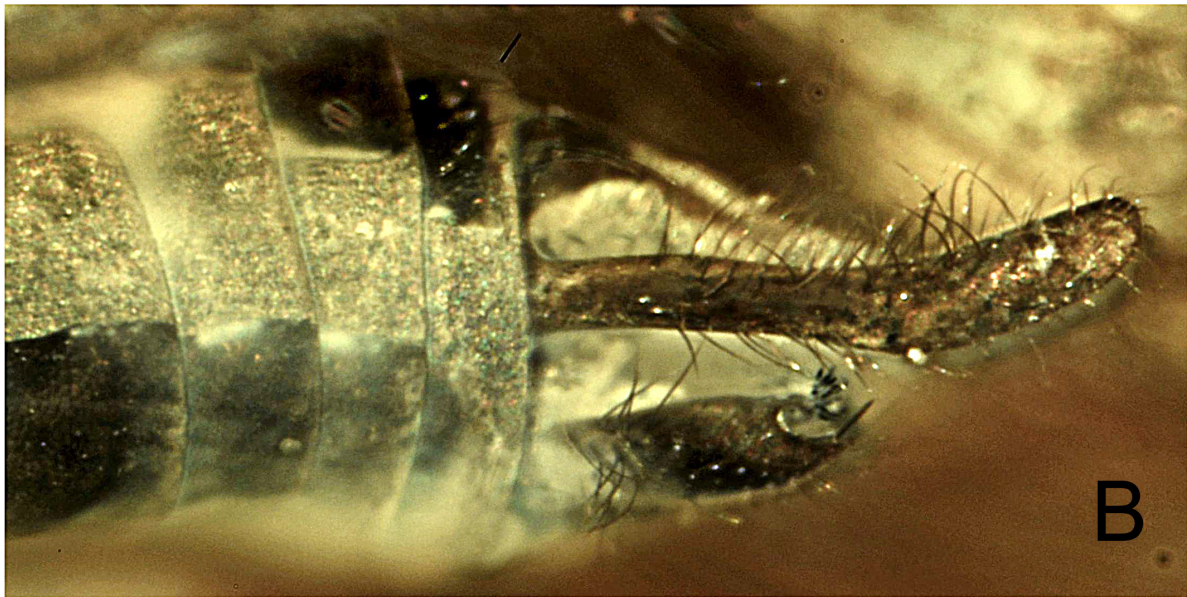
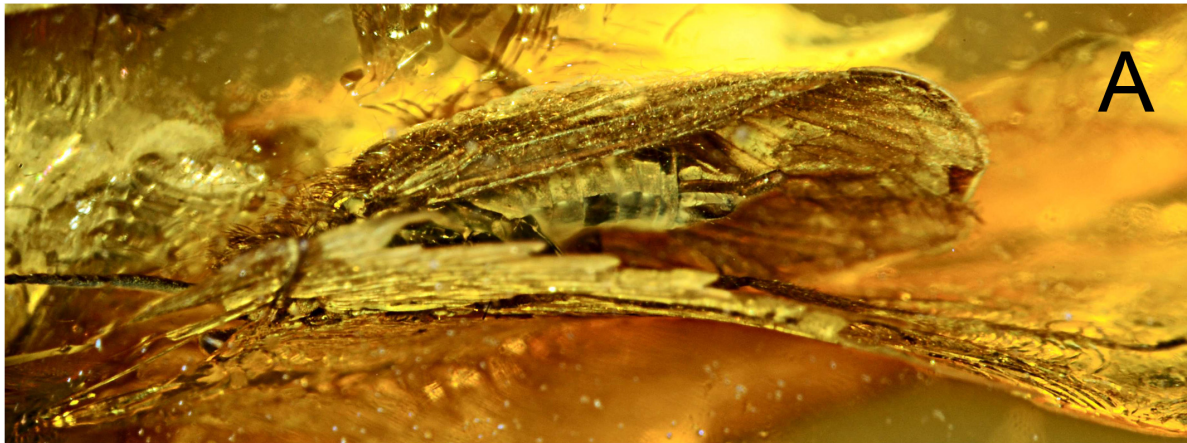


FIGURE 1. *Archaeotinodes malickyi* new species, male: A, general view; B, genitalia, left lateral, photograph; C, the same, drawing.

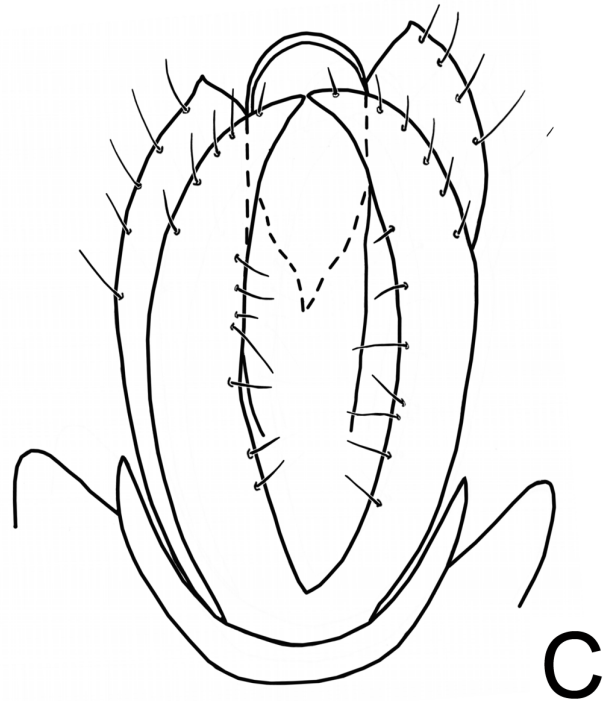
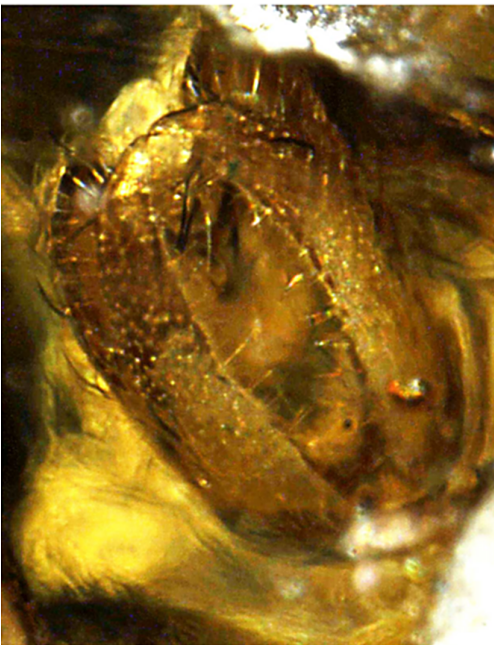


FIGURE 2. *Archaeoneureclipsis martynovi* new species, male: A, general view; B, genitalia, ventral, photograph; C, the same, drawing.

Genus *Polycentropus* Curtis 1835

Polycentropus grigorenkoi Melnitsky & Ivanov new species (Fig. 3 A–C)

Description. The head, antennae, palpi and legs light brown; wings and abdomen brown. Spur formula 3.4.4. Measurements: body length 4.4 mm; length of each forewing 4.6 mm.

Male genitalia (Fig. 3B, C). Segment IX with protruding ventral part. Dorsal parts of genitalia with two large horns (presumably intermediate appendages shifted dorsally) curved inwards and covered with long setae. Segment X inconspicuous. Preanal appendages small, rounded, situated below horn bases. Pair of slender sclerotized projections below preanal appendages (presumably ventral branches of preanal

appendages similar to other polycentropodids) surrounding aedeagus. Aedeagus robust and very wide, long, sclerotised, acute. Inferior appendages large and heavily sclerotized, divided to curved dorsal and wide ventral lobes.

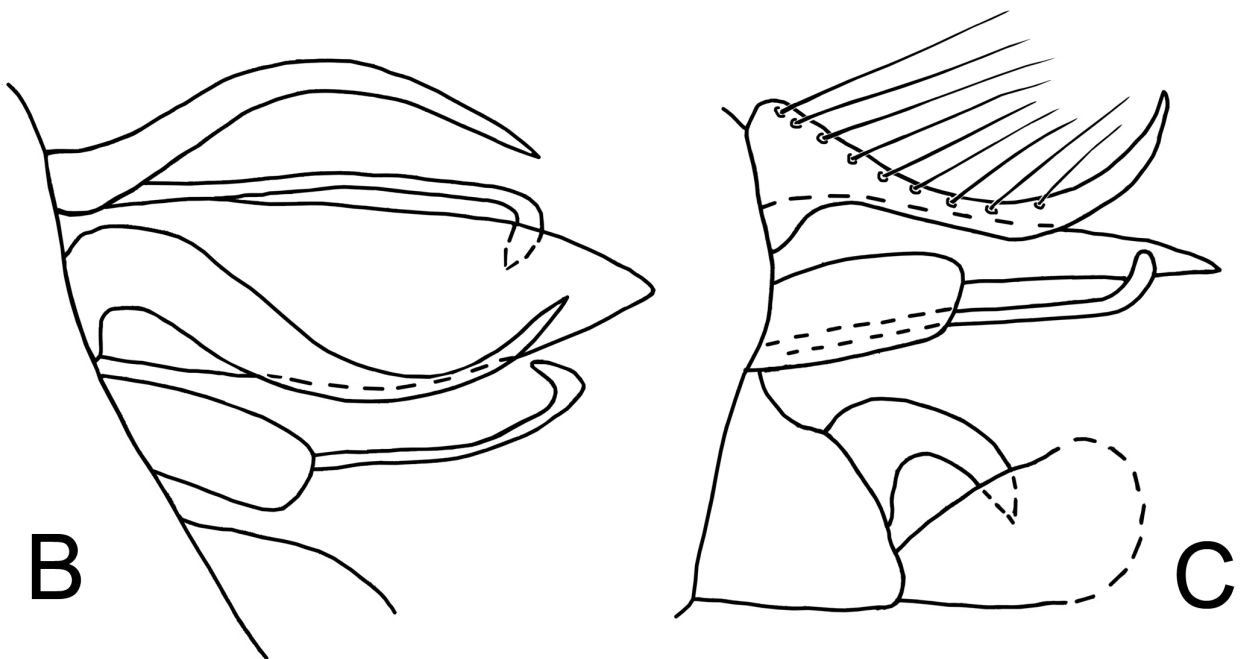


FIGURE 3. *Polycentropus grigorenkoi*, new species, male: A, general view, photograph; B, genitalia, left dorsolateral; C, genitalia, left lateral, drawing.

Comparison. Genitalia of this species combine various patterns known for Polycentropodidae. We place this species provisionally into the genus *Polycentropus* because of the similarity of its genitalia to some New World *Polycentropus* species, for example, *P. maculatus* Banks with soft segment X, long dorsal branches of intermediate appendages, and preanal appendages with additional outgrowths. No similar species have been found in ambers previously.

Holotype male. IZSK, № K–6954b, Rovno Amber, Bartonian, Eocene. *Paratype male:* IZSK, № K–6954a in the same piece of resin.

Etymology. The species is named in honor of the late Russian–Ukrainian trichopterologist Vladislav Nikolaevich Grigorenko.

Suborder PHRYGANEINA Sukatsheva 1980

Family HYDROPTILIDAE Stephens 1836

SUBFAMILY Hydroptilinae Stephens 1836

Tribe Hydroptilini Stephens 1836

Genus *Oxyethira* Eaton 1873

***Oxyethira lurida* Melnitsky & Ivanov new species**

(Fig. 4 A–C)

Description. Spur formula is 0.3.4, ocelli absent. Wings, body and head pale yellowish with light brown long hairs on head. Wing venation poorly visible, the vein traces are similar to the wing venation in *Oxyethira*. Measurements: body length 2 mm; length of each forewing 2.5 mm.

Female genitalia (Fig. 4B, C). Only segments VIII and X are visible, segment IX is retracted. Segment X almost rectangular, with small notch on posterior margin; two long cerci attached to its posterior angles. Length of cerci approximately 2/3 of segment X.

Comparison. This is the first *Oxyethira* species known from the Eocene ambers of Europe. This species resembles a large variety of species of this genus from the recent fauna. Since the taxonomy of the genus *Oxyethira* is based on the male genitalia and females are poorly studied, we refrain from further discussion of the position of this species.

Holotype male. IZSK, № K–24370, Rovno Amber, Bartonian, Eocene.

Etymology. From the Latin *luridus* (yellowish pale).

SUBFAMILY Orthotrichiinae Nielsen 1948

Genus *Orthotrichia* Eaton 1873

***Orthotrichia umbra* Melnitsky & Ivanov new species**

(Fig. 5 A–C)

Description. Spur formula 0.3.4. Ocelli present. Body and wings brownish, legs yellow with dark spurs. Antennal segments more slender than in other *Orthotrichia*, with apparent serration. Abdominal sternum V with pair of small anterolateral projections probably associated with pheromone gland openings; sternum VII with thin acute projection at posterior margin. Measurements: body length 2 mm; length of each forewing 2.1 mm.

Female genitalia (Fig. 5C). Segments VIII–X with slight asymmetry. Segment VIII with sternal suture on left side and incision of its posterior margin on right side. Segment IX shifted to left relative to segment VIII, short, with 2 large ventral lobes directed caudad at right side. Segment X longer on left side than on right depending on the caudal margin of segment IX, with semicircular suture and 2 short thin cerci.

Comparison. This is the first *Orthotrichia* from the Eocene ambers of Europe. Females of this genus are insufficiently studied and the comparison with other species is difficult. The asymmetry of the genitalia justifies the placement of this species into *Orthotrichia*.

Holotype male. IZSK, № K–26172, Rovno Amber, Bartonian, Eocene.

Etymology. From the Latin *umbra* (uninvited guest).

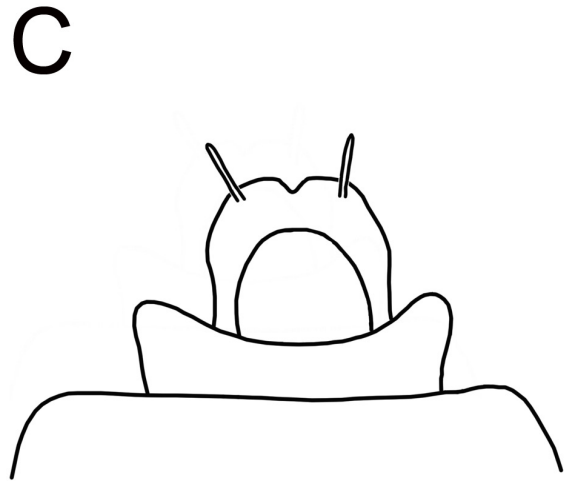
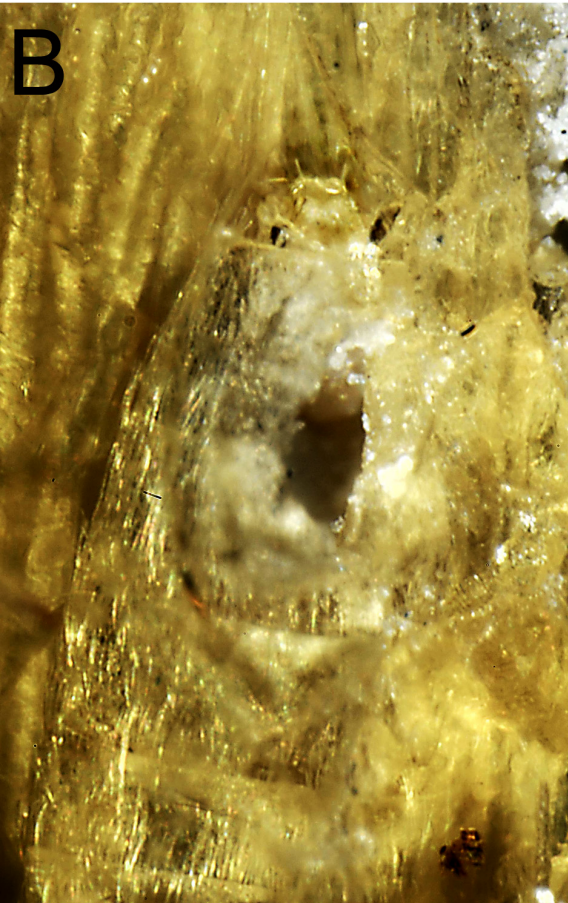
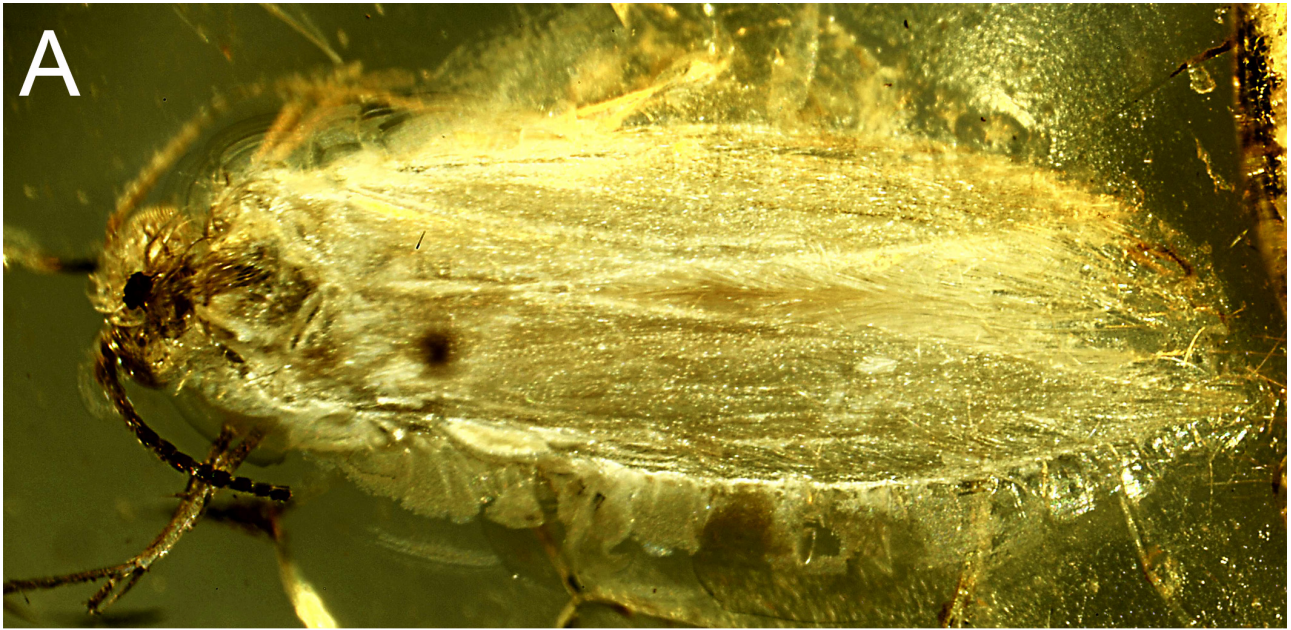


FIGURE 4. *Oxyethira lurida*, new species, female: A, general view, dorsal; B, end of abdomen, ventral, photograph; C, end of abdomen, ventral, drawing.

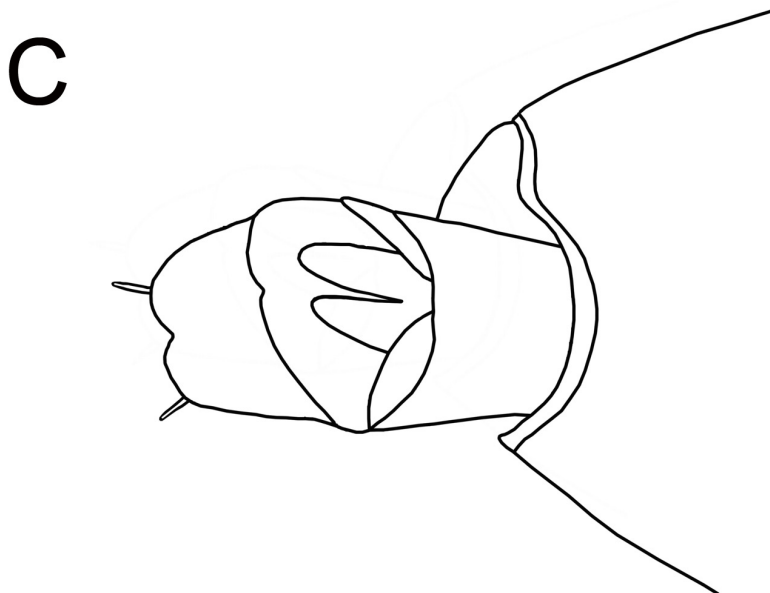
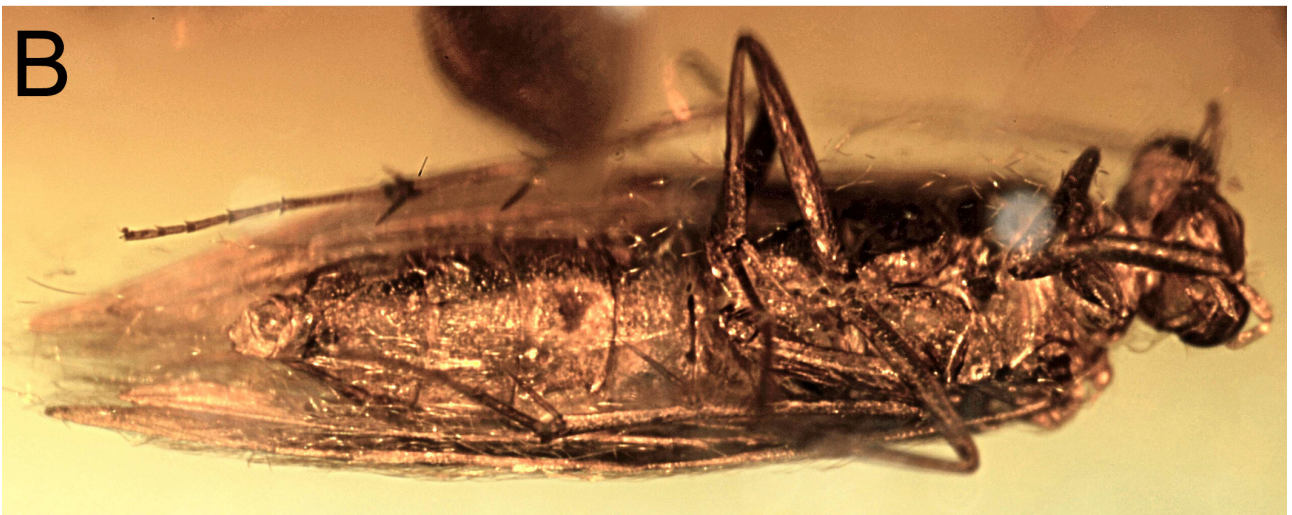
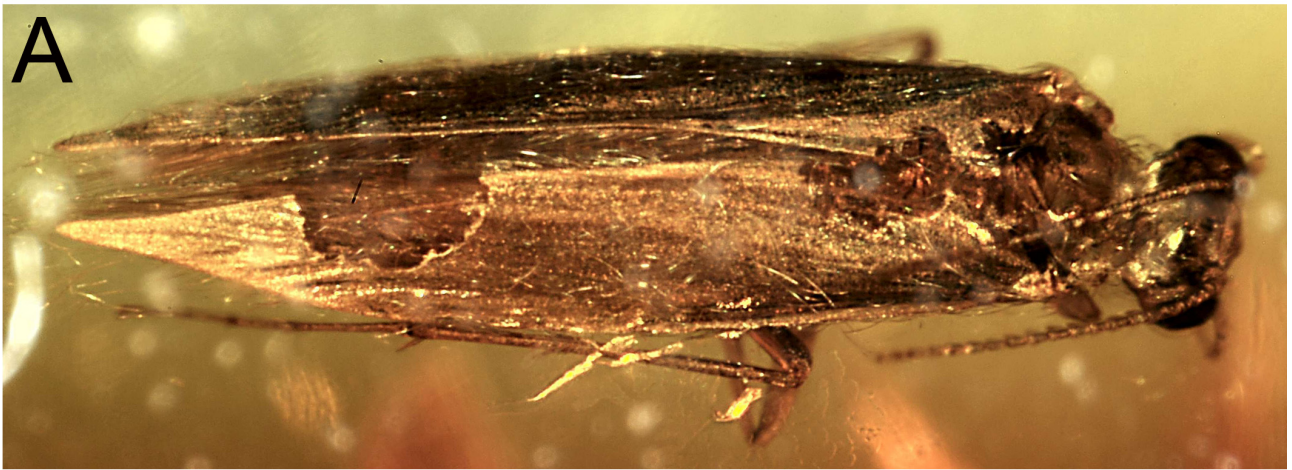


FIGURE 5. *Orthotrichia umbra* new species, female: A, general view, dorsal; B, general view, ventral, photograph; C, end of abdomen, ventral, drawing.

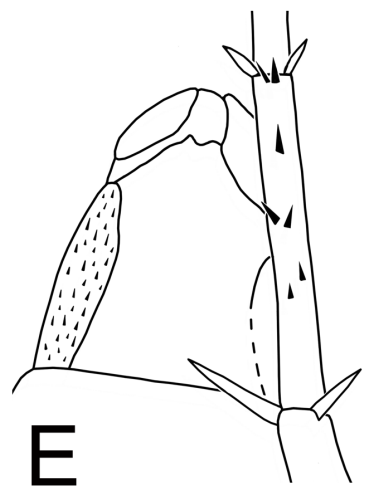
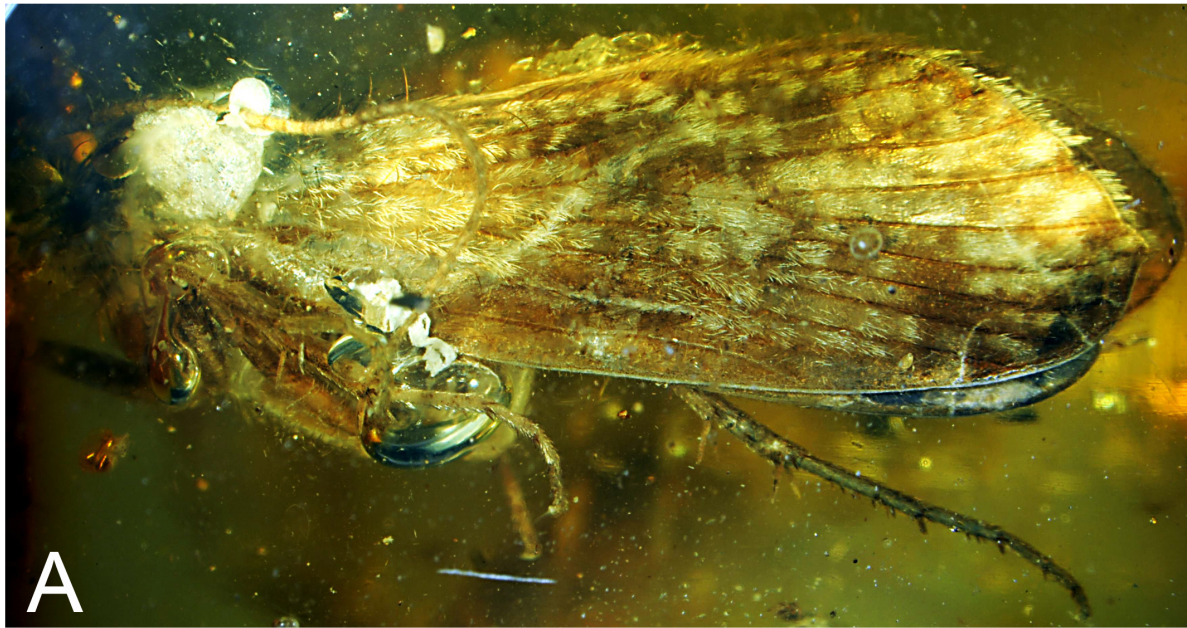


FIGURE 6. *Eotrichostegia retrograda* new species, female: A, general view, left lateral; B, general view, ventral; C, abdomen (segments III–VII), left lateral; D, thorax and wings, dorsal, photograph; E, genitalia, ventral, drawing.

Family PHRYGANEIDAE Leach, 1815

Genus *Eotrichostegia* Melnitsky & Ivanov new genus

Type species: *Eotrichostegia retrograda* Melnitsky & Ivanov

Diagnosis. Head, thorax and wings with long thick setae. Sensory fields on antennae poorly developed. Labial palps short and flattened (compressed from sides); terminal segment globular, larger than 1st and 2nd. Maxillary palps long, terminal segment acute and attenuate. Incision of antecostal suture on abdominal segment V not developed. Setose warts on mesonotum compact. Anal loop on each forewing long, A3 coalescent to A2 close to the wing margin so terminal stalk of anal loop very short.

Comparison. The new genus is similar to the recent monotypic genus *Trichostegia* in size and has some similarities to the females of amber *Phryganea* described by Ulmer (1912) from Baltic Amber. The very short terminal stalk of the anal loop and the absence of an antecostal incision separates it from all other phryganeids. The long setae, especially on setose warts, wing bases, and head are also peculiar.

Eotrichostegia retrograda Melnitsky & Ivanov new species

(Fig. 6 A–E)

Description. Spur formula 2.4.4. Measurements: body length 9 mm; length of each forewing 10 mm. Wing color brown; forewings with patches of white hairs sometimes coalescent to larger white fields, and with white hair fringes on wing margins. Anal loop veins with very long dark setae. Hind wings pale with dark marks apically. Abdominal gland openings clearly visible on small projections.

Female genitalia (Fig. 6E). Dorsal part of segment IX short, dark brown; covering ventrolateral parts from top and sides. Ventrolateral parts of this segment (vaginal plate) flattened, short, not attenuate at apex.

Comparison. This is the type species of a monotypic genus; its genitalia resemble those of the genus *Trichostegia*, and the wing coloration looks plesiomorphic for Phryganeidae.

Holotype male. IZSK, № K–7354, Rovno Amber, Bartonian, Eocene.

Etymology. From the Latin *retrograda* (retrograde).

Family LEPTOCERIDAE Leach 1815

SUBFAMILY Leptocerinae Leach 1815

TRIBE Triaenodini Morse 1981

GENUS *Erotesis* McLachlan 1877

Erotesis bessylenon Melnitsky & Ivanov new species

(Fig. 7 A–C)

Description. Forewings uniformly dark brown, body apparently pale but its coloration obscured. Measurements: body length 3.9 mm; length of each forewing 4.2 mm.

Male genitalia (Fig. 7B, C). Segment IX poorly visible. Segment X with 2 preanal appendages at base and slender caudal projection. Long curved structure visible below segment X; its main part consisting of strong hook turned downwards. Additional projections faintly visible below it. Only one gonopod visible as long ventral appendage curved at apex.

Comparison. This species differs from *E. aequalis* Ulmer 1912 (Baltic Amber) in number, shape and length of projections in male genitalia: There are no evident additional hooks originating from segment X as in *E. aequalis*, preanal appendages in the new species are much shorter, gonopods (ventral appendages) are slender and C-shaped in the new species, but wider and S-shaped with additional branches in Ulmer's species.

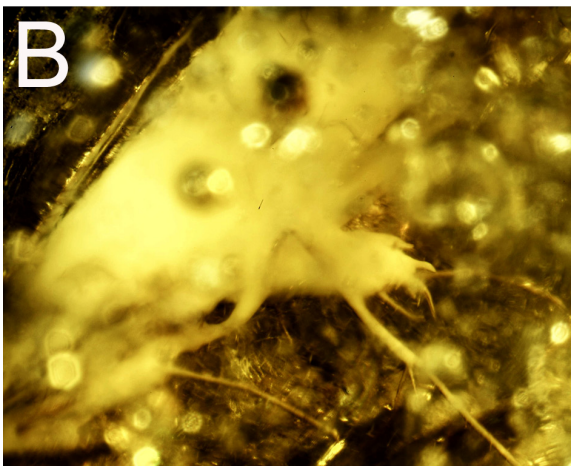


FIGURE 7. *Erolesis bessylenon* new species, male: A, right wings, ventrolateral view; B, general left lateral, photograph; C, end of abdomen, left lateral, drawing.

Holotype male. IZSK, № G-9, Rovno Amber, Bartonian, Eocene.

Etyymology. From the Russian *bessilen on* (he is powerless).

Discussion

The fauna of Baltic Amber comprises 211 described species (Wichard *et al.* 2009; Melnitsky & Ivanov 2013a, 2016; Ivanov & Melnitsky 2013; Wichard, 2013) whereas only 39 species (Tabl. 1) are known from the Rovno Amber (Melnitsky & Ivanov 2010, 2013b, 2016, and present publication). The Rovno Amber has the same age as other European ambers; it occurs in several deposits north of Rovno and Zhitomir Regions within the Ukraine Polesie.

The paleogeography of this area varied in the Paleogene: The land masses separated by the Tethys Ocean sometimes were united by bridges, and sometimes were divided into many small islands, especially the southwestern subcontinent that eventually became Western Europe (Pożaryska 1977; Rögl 1999). One hypothesis (Dlussky & Perkovsky 2002) is that the sea currents could have moved Baltic resins from the northeastern shore of Tethys southwesterly to form recent deposits in Ukraine. On the other hand, there is

evidence that the Rovno Amber is autochthonous (Dlussky & Perkovsky 2002; Perkovsky *et al.*, 2003, 2007). The periods of separate land masses could have been times when speciation occurred on the local islands, and the periods when the islands were connected by bridges or coalescent into larger subcontinents could have been times when the faunas were mixed and partial extinctions occurred. Presently, there are more than 20000 arthropod inclusions found in Rovno Amber, and most of them are insects (Perkovsky *et al.* 2003). Preliminary analysis suggests similarity of Rovno fossils to the Baltic and Saxonian Ambers (Perkovsky *et al.* 2007). Nonetheless many endemic species were described in some insect taxa from the Rovno Amber (Perkovsky *et al.* 2007; Melnitsky & Ivanov 2010, 2013b, 2016). The resin-bearing layers accumulated near the southern shore of the Tethys Ocean opposite to the Baltic Shore and belong to the same large subcontinental island as Saxonian Amber.

TABLE 1. Species of caddisflies known from Rovno Amber, Eocene of Ukraine.

Order TRICHOPTERA Kirby 1813

Suborder HYDROPSYCHINA Sukatsheva (1980)

Family PHILOPOTAMIDAE Stephens 1829

Genus *Wormaldia* McLachlan 1865

Wormaldia nasticentia Melnitsky *et* Ivanov 2010

Wormaldia pobeda Melnitsky *et* Ivanov, 2016

Family ECNOMIDAE Ulmer 1903

Genus *Archaeotinodes* Ulmer 1912

Archaeotinodes reveraverus Melnitsky *et* Ivanov 2010

Archaeotinodes malickyi Melnitsky *et* Ivanov, 2016

Family PSYCHOMYIIDAE Walker 1852

Genus *Lype* McLachlan 1878

Lype essentia Melnitsky *et* Ivanov 2013

Lype sericea (Pictet 1856)

Lype sp. n. *aff. sericea* (Pictet 1856)

Family POLYCENTROPODIDAE Ulmer 1903

Genus *Archaeoneureclipsis* Ulmer, 1912

Archaeoneureclipsis martynovi Melnitsky *et* Ivanov, 2016

Genus *Electrocyrnus* Melnitsky *et* Ivanov 2010

Electrocyrnus perpusillus Melnitsky *et* Ivanov 2010

Genus *Holocentropus* McLachlan 1878

Holocentropus affinis (Pictet 1856)

Holocentropus flexiflagrum Melnitsky *et* Ivanov 2010

Holocentropus incertus (Pictet 1856)

Holocentropus curvatus Ulmer, 1912

Holocentropus kobodok Melnitsky *et* Ivanov 2013

Holocentropus zhiltsovae Melnitsky *et* Ivanov 2013

Holocentropus sp. n. *aff. consobrinus* Ulmer 1912

Holocentropus sp. n. *aff. flexiflagrum* Melnitsky *et* Ivanov 2010

Genus *Nyctiophylax* Brauer 1865

Nyctiophylax terreusbos Melnitsky *et* Ivanov 2013

Nyctiophylax varians Ulmer 1912

Genus *Plectrocnemia* Stephens 1836

Plectrocnemia barbata Ulmer 1912

Plectrocnemia lata (Pictet 1856)

Plectrocnemia nastigermania Melnitsky *et* Ivanov 2013

Plectrocnemia ucrainum Melnitsky *et* Ivanov 2013

Plectrocnemia sp. n. *aff. barbata* Ulmer 1912

Plectrocnemia sp. n. *aff. nastigermania* Melnitsky *et* Ivanov 2013

Plectrocnemia sp. n. *aff. tubulosa* Ulmer 1912

Plectrocnemia sp. n.

Genus *Polycentropus* Ulmer 1905
Polycentropus grigorenkoi Melnitsky et Ivanov, 2016

Suborder PHRYGANEINA Sukatsheva (1980)

Family HYDROPTILIDAE Stephens 1836

Genus *Agraylea* Curtis 1834
Agraylea electroscentia Melnitsky et Ivanov 2010
Genus *Oxyethira* Eaton 1873
Oxyethira lurida Melnitsky et Ivanov, 2016
Genus *Orthotrichia* Eaton 1873
Orthotrichia umbra Melnitsky et Ivanov, 2016

Family PHRYGANEIDAE Leach 1815

Genus *Eotrichostegia* Melnitsky et Ivanov, 2016
Eotrichostegia retrograda Melnitsky et Ivanov, 2016

Family LEPIDOSTOMATIDAE Ulmer 1903

Genus *Lepidostoma* Rambur 1842
Lepidostoma quasitypica Melnitsky et Ivanov 2013

Family BERAЕIDAE Wallengren, 1891

Genus *Beraeodes* Eaton, 1867
Beraeodes pectinatus Ulmer, 1912

Family CALAMOCERATIDAE Ulmer 1905

Calamoceratidae gen. sp.

Family LEPTOCERIDAE Leach 1815

Genus *Triplectides* Kolenati 1859
Triplectides palaeoslavicus Melnitsky et Ivanov 2010
Genus *Ceraclea* Stephens 1829
Ceraclea sp.
Genus *Leptocerus* Leach 1815
Leptocerus solifemella Melnitsky et Ivanov 2010
Genus *Erotosis* McLachlan 1877
Erotosis aequalis Ulmer 1912 (female specimen)
Erotosis bessylenon Melnitsky et Ivanov, 2016

The list of Rovno Amber Trichoptera (Tabl. 1) includes families Philopotamidae (*Wormaldia*; 2 specimens), Polycentropodidae (*Archaeoneureclipsis*, *Electrocyrnus*, *Holocentropus*, *Plectrocnemia*, *Polycentropus*, *Nyctiophylax*; totally 123), Psychomyiidae (*Lype*; 23), Ecnomidae (*Archaeotinodes*; 8), Hydroptilidae (*Agraylea*, *Oxyethira*, *Orthotrichia*; totally 7), Leptoceridae (*Ceraclea*, *Leptocerus*, *Erotosis*, *Triplectides*; totally 5), Lepidostomatidae (*Lepidostoma*; 2), Phryganeidae (*Eotrichostegia* gen. n.; 1), Beraeidae (*Beraeodes*; 4), Calamoceratidae (genus undetermined; 1), representing 88 males and 39 females. It is clear from the list that the majority (90%) of Trichoptera is represented in the Rovno Amber by superfamily Psychomyioidea, with the family Polycentropodidae constituting some 72% of the total number of determined specimens. Some of the listed species are not determined to species: They are either new or poorly preserved. The species *Erotosis aequalis* is determined by a female specimen according to Ulmer (1912). The association of fossil males and females deposited separately cannot be done with certainty, hence this female from the Rovno Amber might belong to *E. bessylenon*, but we postpone all revisions for future. Family Calamoceratidae in the Rovno Amber is represented by a single specimen with only wing venation incompletely visible; the preserved structures are inadequate to make correct determinations.

There is apparent resemblance of Baltic and Rovno fossil caddisflies, although the material available from Rovno is much smaller than from Baltic deposits. Continuous collecting of fossils from both localities, especially from Ukraine, will permit comparison of these faunas in the future.

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