

# A new tribe of Dictyopharidae planthoppers from Eocene Baltic amber (Hemiptera: Fulgoromorpha: Fulgoroidea), with a brief review of the fossil record of the family

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## Abstract

The new genus and species *Worskaito stenexi* n. gen., n. sp. is described and figured on the basis of a specimen from Eocene Baltic amber. It does not correspond to any known group of Dictyopharidae and therefore it is placed in a new tribe Worskaitini n. trib. within the subfamily Dictyopharinae. *Worskaito* n. gen. is most similar to the extinct genus *Netutela* EMELJANOV, 1983 and extant genus *Cladodiptera* SPINOLA, 1839, but differs in the pattern of tegmen venation. A key to extant and fossil tribes of Dictyopharidae is provided. The fossil record of the Dictyopharidae is briefly discussed.

Keywords: *Worskaito stenexi* n. gen., n. sp., Worskaitini n. trib., Dictyopharinae, Dictyopharidae, tribal classification, Eocene, Baltic amber, fossil record, phylogeny, classification.

## Zusammenfassung

Aus dem Eozänen Baltischen Bernstein wird die neue Gattung und Art *Worskaito stenexi* n. gen., n. sp. beschrieben und abgebildet. Sie gehört zu keiner der bekannten Gruppen der Dictyopharidae und wird daher in die neue Tribus Worskaitini n. trib. der Unterfamilie Dictyopharinae gestellt. *Worskaito* n. gen. ist der ausgestorbenen Gattung *Netutela* EMELJANOV, 1983 und der rezenten Gattung *Cladodiptera* SPINOLA, 1839 sehr ähnlich, unterscheidet sich aber von diesen in der Art der Tegmen-Aderung. Ein Bestimmungsschlüssel für die rezenten und fossilen Triben der Dictyopharidae wird vorgestellt und der Fossilbericht der Dictyopharidae kurz diskutiert.

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## 1. Introduction

The fossil record of the family Dictyopharidae reaches to the Upper Cretaceous (EMELJANOV 1983) of Taimyr Peninsula, with other fossils described from the Eocene/Oligocene of the Florissant Formation, Colorado, USA (SCUDDER 1890) and Miocene of Stavropol, Russia (BECKER-MIGDISOVA 1964). Further specimens that had been attributed to the family Dictyopharidae belong to other groups: Tropicididae, Achilidae and Cicadomorpha: Cicadellidae (EMELJANOV 1983; SZWEDO et al. 2004). Not formally described yet, Dictyopharidae are also recorded in the Palaeocene Fur Formation of Denmark, Lowermost Eocene Oise amber of France and Eocene/Oligocene strata of Isle of Wight, UK (SZWEDO in prep.), but these represent other tribe of Dictyopharinae – Netutelini.

Recently, the family Dictyopharidae comprises about

700 species in about 150 genera, distributed worldwide, from temperate to subtropical and tropical zones (MELICHAR 1912; METCALF 1946; EMELJANOV 1983; FLOW 2007). It is divided into two subfamilies Dictyopharinae and Orgeriinae. The planthopper subfamily Orgeriinae, a distinct lineage within the family Dictyopharidae, is mainly characterized by morphological reduction and adaptation to arid conditions and distributed in the Holarctic (EMELJANOV 1969, 1980, 2006; EMELJANOV et al. 2005). The second subfamily, the Dictyopharinae, is of worldwide distribution (MELICHAR 1912; METCALF 1946; EMELJANOV 1983; FLOW 2007). Currently, analyses of the phylogenetic relationships among the higher taxa of the family as a whole are lacking (DONOVALL & BARTLETT 2005), even though there has been a karyosystematic attempt to it (KUSNETSOVA 1985). The phylogenetic relationships and evolution of Orgeriinae tribes was proposed by EMELJANOV

(1980) and EMELJANOV et al. (2005). The subfamily Dictyopharinae now comprises 11 tribes (EMELJANOV 1983, 1997). Herein a revised key to the fossil and recent tribes of Dictyopharidae is provided, including the description of a new tribe, genus and species.

#### Acknowledgements

I am indebted to the company STENEX (Gdańsk, Poland) and its owner Mr. STEFAN PLOTA (Gdańsk, Poland), the original owner of this fossil, who kindly donated the holotype to the Museum of Amber Inclusions, University of Gdańsk. I also thank Dr. ELŻBIETA SONTAG (Museum of Amber Inclusions, University of Gdańsk) who made the examination of the fossil possible. Last but not least, I thank Professor ALEXANDR F. EMELJANOV (Zoological Institute RAN, St. Petersburg), Dr. THIERRY BOURGOIN (Museum national d'Histoire naturelle, Paris) and an anonymous reviewer for very helpful comments and discussions. I wish also acknowledge Dr. LOIS B. O'BRIEN (Sunnyvale, Arizona, USA) and Dr. GÜNTER BECHLY (Staatliches Museum für Naturkunde, Stuttgart) for the comments and language improvement of the paper.

## 2. Methods

Studies were made using a stereo microscope OLYMPUS SZH10, using normal and polarized light. Drawings were prepared using a camera lucida. The photos have been made with a digital camera, with normal and polarised light, colour filters and the CombineZ software. All figures have been improved with the Adobe Photoshop imaging software. The nomenclature of the planthopper tegmina and wing venation is based on a slightly modified interpretation from EMELJANOV (1977, 1987), DWORAKOWSKA (1988), ANUFRIEV & EMELJANOV (1988) and BOURGOIN & SZWEDO (2008). Genital structures terminology follows BOURGOIN (1993). The phylogenetic classification of planthoppers is based on BOURGOIN et al. (2004).

## 3. Systematics

### 3.1. Descriptions of new taxa

Class Insecta LINNAEUS, 1758 (= Hexapoda LATREILLE, 1825)

Subclass Pterygota BRAUER, 1885

Order Hemiptera LINNAEUS, 1758

Suborder Fulgoromorpha EVANS, 1946

Superfamily Fulgoroidea LATREILLE, 1807

Family Dictyopharidae SPINOLA, 1839

Subfamily Dictyopharinae SPINOLA, 1839

Tribus Worskaitini n. trib.

Type genus: *Worskaito* n. gen.

**Diagnosis.** – Tegmen with stems Sc+R and M leaving basal cell at same point (as in Netutelini, short common stem in Cladodipterini); first forking of the stem M placed at level of stem Sc+R forking (stem M forked distinctly apically of stem Sc+R forking in Netutelini, distinctly basally of Sc+R forking in Cladodipterini); stem CuA forked distinctly basally of stems Sc+R and M forking (apically in Cladodipterini); two rows of veinlets forming nodal and subapical lines (as in Netutelini and Cladodipterini, three rows in other Dictyopharinae tribes); cells C2, C3, C3a, C4 and C5 long and subequal. Fore and mid basitarsomere and mid tarsomere with a pair of long apical acutellae. Basitarsomere and mid tarsomere of hind leg with subapical platellae, except the external teeth. Anal tube of female with long specialised setae at margin, setae on tubercles.

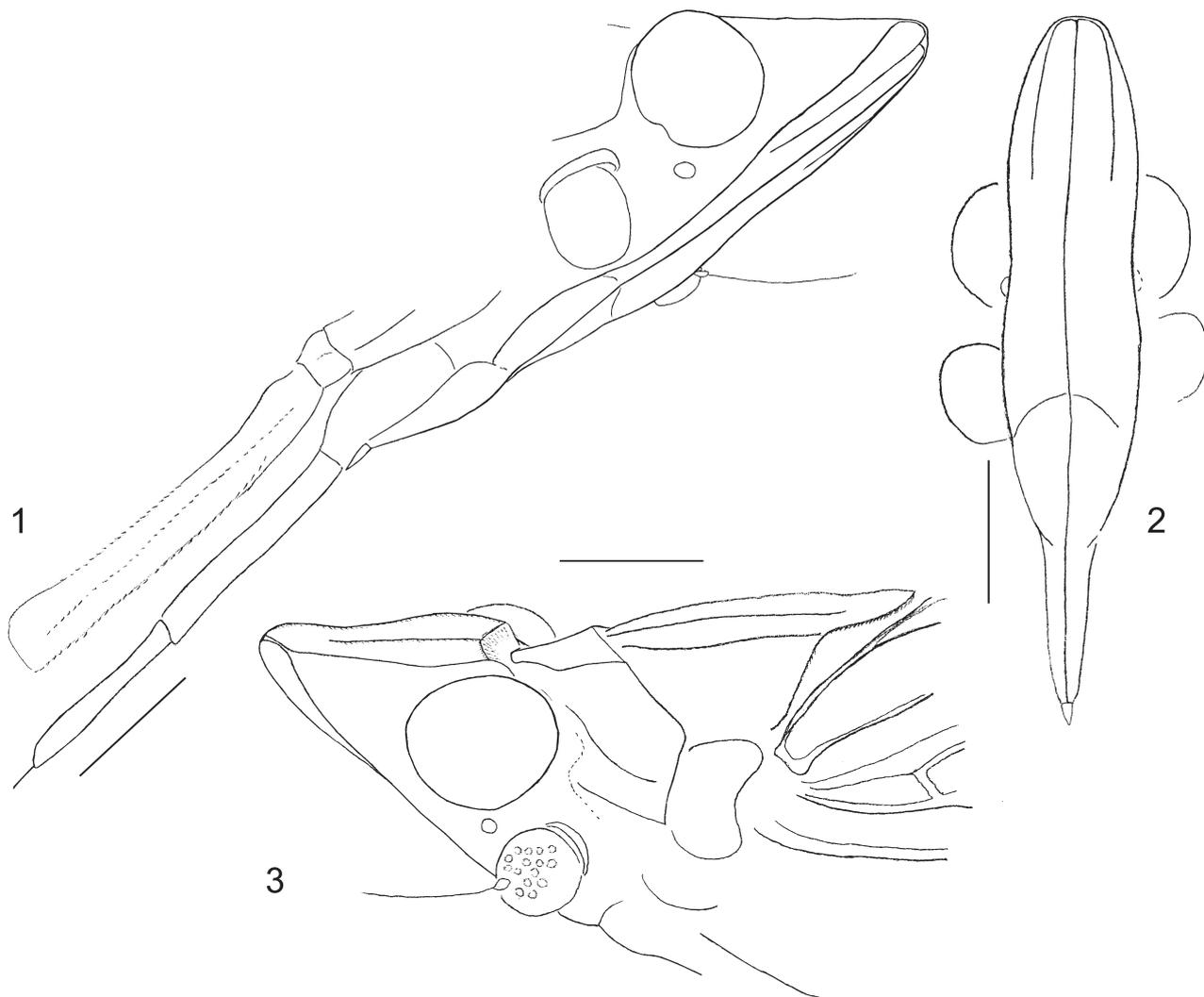
**Description.** – Laterally compressed planthoppers, with head somewhat elongate. Head without trigons. Lateral carinae of frons incomplete; median carina of frons distinct, lateral margins of frons carinate. Apical segment of rostrum slightly shorter than preapical one. Two lateral carinae between compound eye and tegula. Tegmina fully developed, membranous, with two rows of transverse veinlets. Tegmen with forking of stems Sc+R and M at same level, stem CuA forked distinctly more basally. Membrane between branch terminals of branches of M with longitudinal folds. Branch CuA<sub>1</sub> with two terminals. Clavus without transverse veinlets. Hind wings fully developed. Legs slender, basitarsomere and mid tarsomere of fore and mid legs with a pair of long apical acutellae. Hind tibia with lateral spines and row of apical teeth, genicular spine (knee spine) absent. Basitarsomere longer than combined length of mid and apical tarsomeres. Basitarsomere and mid tarsomere with a row of apical teeth, with subapical platellae below, except for the external ones. Anal tube of female with long specialised setae at ventral margin, each seta on tubercle.

Genus *Worskaito* n. gen.

Type species: *Worskaito stenexi* n. gen., n. sp.; here designated.

**Derivation of name.** – Generic name is derived from the name of god from the Old Prussian mythology – Worskaito. Gender: masculine.

**Diagnosis.** – Vertex twice as long as wide at base, median carina of vertex not reaching anterior margin of vertex. Face narrow, lateral margins of frons carinate; lateral carinae of frons, from above, not reaching half of frons length; median carina distinct, reaching frontoclypeal suture and continuing on postclypeus and anteclypeus; postclypeus with lateral carinae. Tegmen relatively broad, slightly wider at the nodal line, about 3.35 times as long as broad; clavus reaching 0.6 of tegmen

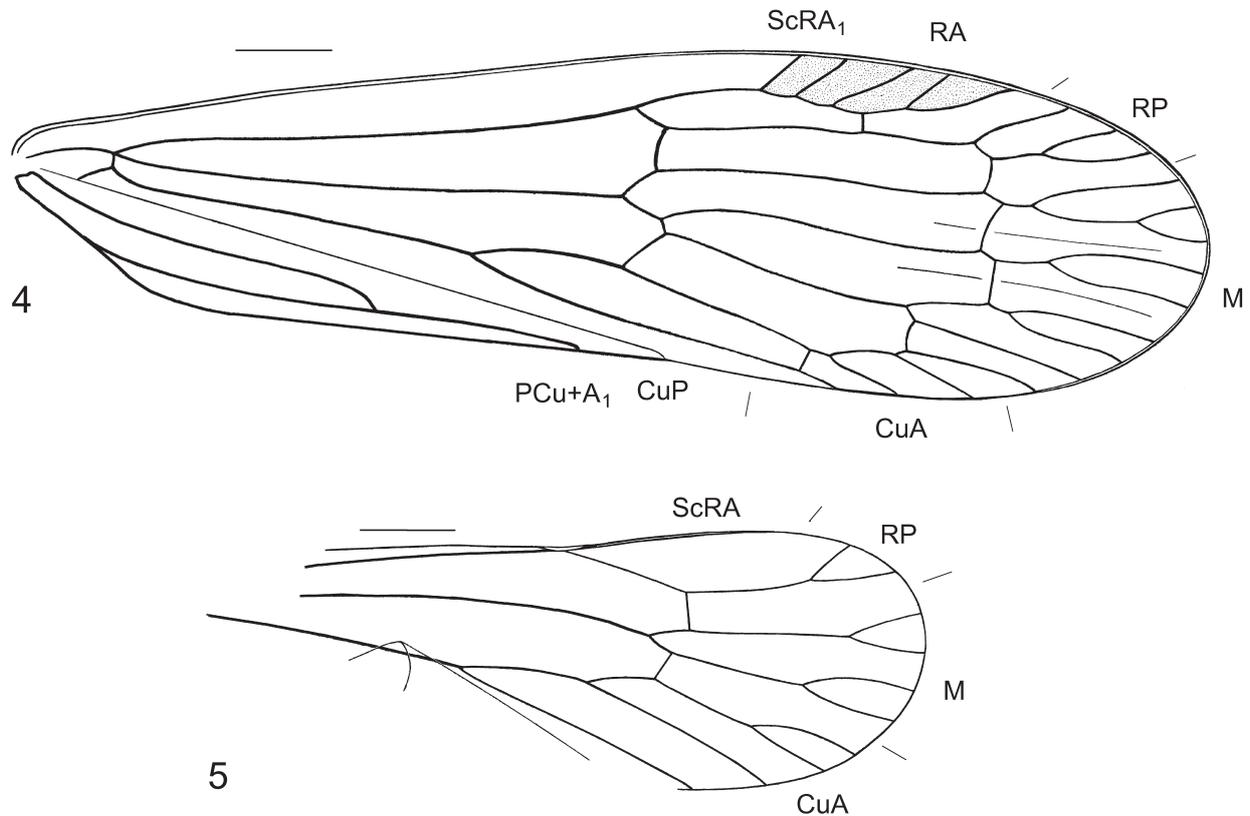


**Figs. 1–3.** *Worskaito stenexi* n. gen., n. sp., holotype, female, MIB 5277 (Museum of Amber Inclusions, University of Gdańsk). – 1. Head capsule in left laterofrontal view. 2. Face. 3. Anterior part of body in right lateral view. – Scale bar: 1 mm.

length; stigmal area pigmented, intersected by a few veins, posterior margin of stigma not distinctly arcuate (distinctly arcuate in *Netutela* EMEJANOV, 1983); two longitudinal, medial folds on tegmina in cells C3 and C3a (remigium with 5 folds on medial cells and one fold on radiomedial cell C2 in *Netutela*); apical cells shorter than subapical ones. Fore and mid legs elongate, slender, not flattened or dilated, fore and mid tarsi with apical acutellae; hind tibia lacking genicular lateral spine, with three lateral spines, hind basitarsomere and mid tarsomere with subapical plattellae, except the external teeth.

**Description.** – Head (Figs. 1–3, 11–13) with compound eyes narrower than pronotum, produced anteriorly, with compound eyes bulging. Vertex in mid line twice as long as wide at base, lateral margins elevated, slightly

shorter than length of vertex in mid line, converging anteriorly; posterior margin elevated; disc of vertex flat, with incomplete median carina exceeding half of its length from posterior margin. Frons narrow, about 2.75 times as long in mid line as wide at widest point, at level of antennae; lateral margins of frons elevated, carinate, converging dorsally, slightly diverging at level of antennae; lateral carinae of frons incomplete, not reaching half of its length from apex; median carina distinct, carinated, reaching frontoclypeal suture, continuing on postclypeus and anteclypeus; frontoclypeal carina convex; postclypeus distinctly convex, with median and lateral carinae, lateral carinae not contiguous on anteclypeus; anteclypeus with median carina. Antennae with short scape, pedicel globular, covered with sensory sensillae. Rostrum with apex



**Figs. 4–5.** *Worskaito stenexi* n. gen., n. sp., holotype, female, MIB 5277 (Museum of Amber Inclusions, University of Gdańsk). – 4. Tegmen (restored). 5. Part of wing, anal portion superimposed. – Scale bar: 1 mm.

slightly exceeding hind coxae, apical segment shorter than subapical one.

Thorax (Figs. 2, 12): Pronotum with disc slightly elevated, slightly tectiform, delimited by lateral carinae, reaching posterior margin of pronotum, with distinct median carina, median carina somewhat cristate, lateral portion of pronotum sloping downwards; two carinae between compound eye and tegula. Tegulae huge.

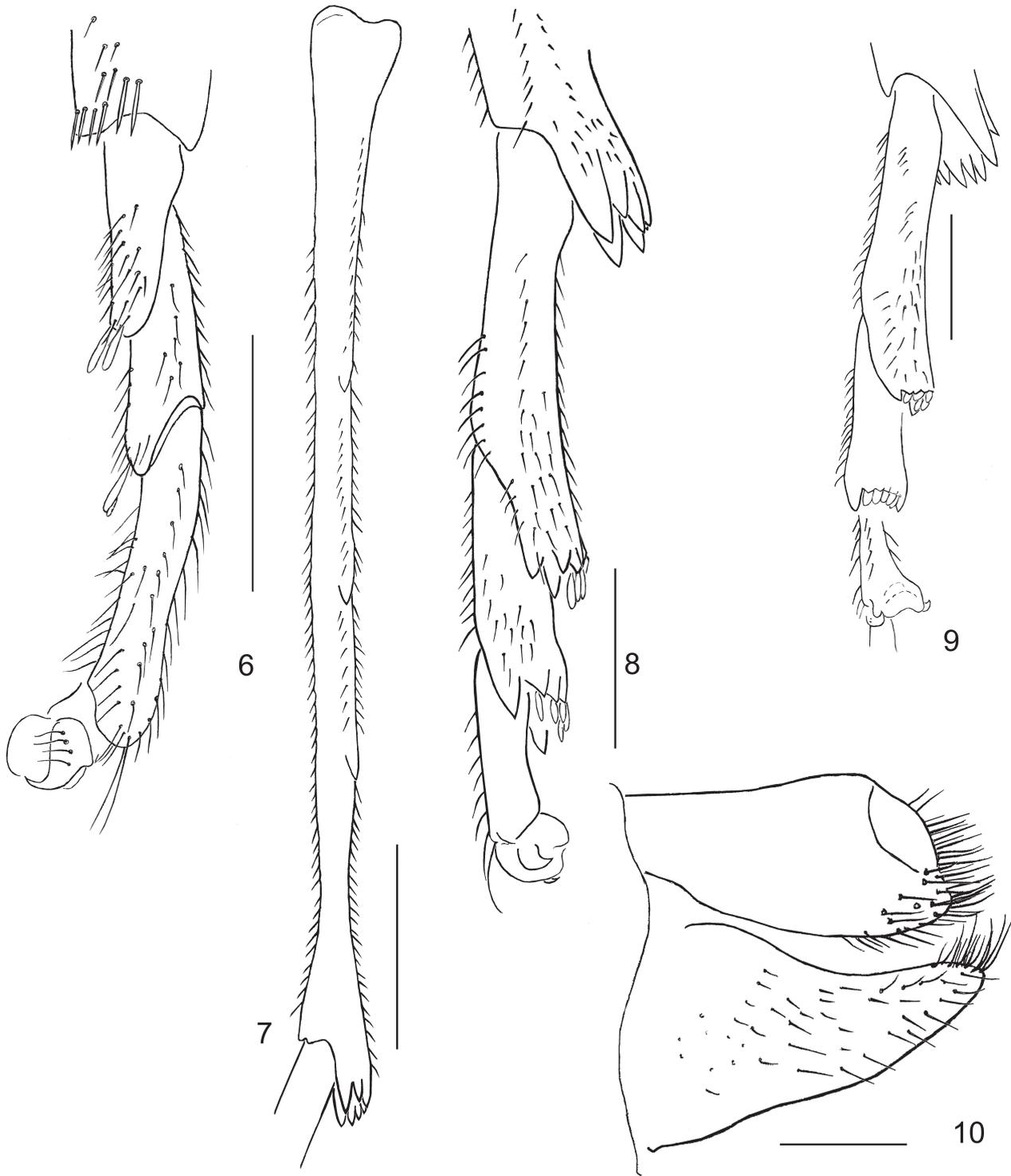
Mesonotum with disc flattened, lateral carinae subparallel, reaching posterior margin of mesonotum, median carina distinct, not continued on scutellum; lateral portions of mesonotum sloping downwards.

Legs (Figs. 6–9, 13–17) slender, not flattened or dilated. Fore leg with coxa elongate, carinate; femur shorter than fore tibia, with rows of delicate setae along margins; fore tibia quadrangular in cross section, with rows of delicate setae along margins, basitarsomere shorter than mid tarsomere, mid tarsomere with a pair of apical acutellae, apical tarsomere with claws and arolium longer than combined length of basi- and mid tarsomeres. Mid coxa shorter than fore coxa, mid femur shorter than fore femur, distinctly shorter than mid tibia; tibia quadrangular in cross section, with rows of delicate setae along margins, basitar-

somere and mid tarsomere of same length, apical tarsomere with tarsal claws and arolium slightly longer than cumulative length of preceding tarsomeres.

Hind coxa elongate, hind femur shorter than hind femur of mid leg, distinctly shorter than hind tibia; hind tibia roundly subquadrangular in cross section, outer margins and ventral inner margin with rows of short setae, genicular spine lacking, three lateral spines, seven apical teeth; basitarsomere the longest, with row of seven apical teeth, with subapical platellae, with exception of external ones, shorter than combined length of mid and apical tarsomeres; mid tarsomere as long as apical tarsomere with row of eight apical teeth with subapical platellae with exception of external ones; apical tarsomere with distinct tarsal claws and wide arolium, tarsal claws with four lateroventral setae.

Tegmen (Figs. 4, 11) membranous, basal portion relatively narrow, widening apicad. Longitudinal veins distinct, two rows of transverse veinlets – nodal and subapical present. Costal margin slightly thickened, merely curved at base, then mildly curved, apical portion wider, rounded, claval apex reaching 0.6 of tegmen length; stigmal area pigmented, not distinctly arcuate, intersected by



**Figs. 6–10.** *Worskaito stenexi* n. gen., n. sp., holotype, female, MIB 5277 (Museum of Amber Inclusions, University of Gdańsk). – 6. Left fore leg tarsus. 7. Right hind tibia. 8. Right hind leg tarsus. 9. Left hind leg tarsus. 10. Female genital block. – Scale bar: 1 mm for Fig. 7, 0.5 mm for the rest.

three veins. Basal cell narrow, stems Sc+R and M leaving basal cell at common point; branch ScRA with five terminals, branch RP with five terminals; branch M with nine terminals; branch CuA with three terminals. Cell C1 distinctly shorter than cells C2, C3a, C3b and C4 that remain subequal.

Wing (Figs. 5, 18) membranous; stem Sc+R forked near the wing coupling apparatus, apically of stem CuA forking, basally of stem M forking; branch ScRA subparallel to anterior margin of wing, reaching margin basally of wing apex; branch RP with two terminals; Stem M forked basally of veinlets r-m and m-cua, with four terminals; stem CuA forked basally of stem Sc+R forking, branch CuA<sub>1</sub> forked basally of stem M forking, CuA<sub>2</sub> not forked, vein CuA with four terminals; stem CuP single.

Female genital block (Figs. 10, 19) with anal tube slightly elongate, covered apically with setae, ventral margin covered with specialized setae, placed on tubercles, apical portion of anal tube wider than basad, slightly lobe-like, apex of anal tube not exceeding length of ovipositor. Gonapophysis IX subtriangular, ventral margin arcuately convex, dorsal margin slightly concave, surface of gonapophysis IX covered with short setae, a bunch of longer setae at the apex.

Male unknown.

*Worskaito stenexi* n. sp.

Holotype: Female included in Baltic amber; specimen number MIB 5277, deposited in the Museum of Amber Inclusions, University of Gdańsk, Gdynia, Poland.

Derivation of name: The specific epithet is derived from the name of the company – STENEX, whose owner, Mr. STEFAN PLOTA, kindly offered the specimen for examination and to the scientific collection of Museum of Amber Inclusions, University of Gdańsk.

Type horizon and age: Baltic amber, Eocene. This fossil resin has an age range of 38–47 Ma (RITZKOWSKI 1997; PERKOVSKY et al. 2007). Absolute dating analyses of glauconites from Sambia Peninsula show that the “blue earth” formation (amber bearing Prussian Formation) is allocated to the Middle Eocene (Lutetian:  $44.1 \pm 1.1$  Ma) and is thus significantly older than previously assumed (WAPPLER 2003, 2005). Limnic sediments of Eckfeld Maar, aged  $44.3 \pm 0.4$  Ma, correlate with K-Ar radiometric data from the Sambia Peninsula and contain insect genera known only from Baltic amber (WAPPLER 2005). However, assumptions on the Middle Eocene age of Baltic amber is argued by PERKOVSKY et al. (2007), and the Upper Eocene (Bartonian/Priabonian:  $37.7 \pm 3$  Ma) age of Prussian Formation is preferred.

Diagnosis. – Median disc of pronotum tectiform, with median carina slightly elevated, somewhat cristate; tegmen with three veins intersecting stigmal area; branch RP with three terminals, branch M<sub>1</sub> with three terminals, branches M<sub>2</sub>, M<sub>3</sub> and M<sub>4</sub> with two terminals respectively, branch CuA<sub>1</sub> with two terminals; hind tibia with three lateral spines, one above, and two below half of its length, tibio-metatarsal formula 7 : 2+(5) : 2+(6).

Description. – The inclusion is covered partly with a milky veil and gas bubbles; part of inclusion (tip of left tegmen and wing) missing, because of crack and cavity on the amber surface.

Head (Figs. 3, 12) with vertex in mid line about twice as long as wide at base, lateral carinae of vertex slightly elevated, posterior margin slightly elevated. Frons narrow, about 2.75 times as long in mid line as wide at widest point, at level of antennae, upper portion of disc of frons, between lateral carinae slightly elevated (Figs. 2, 13).

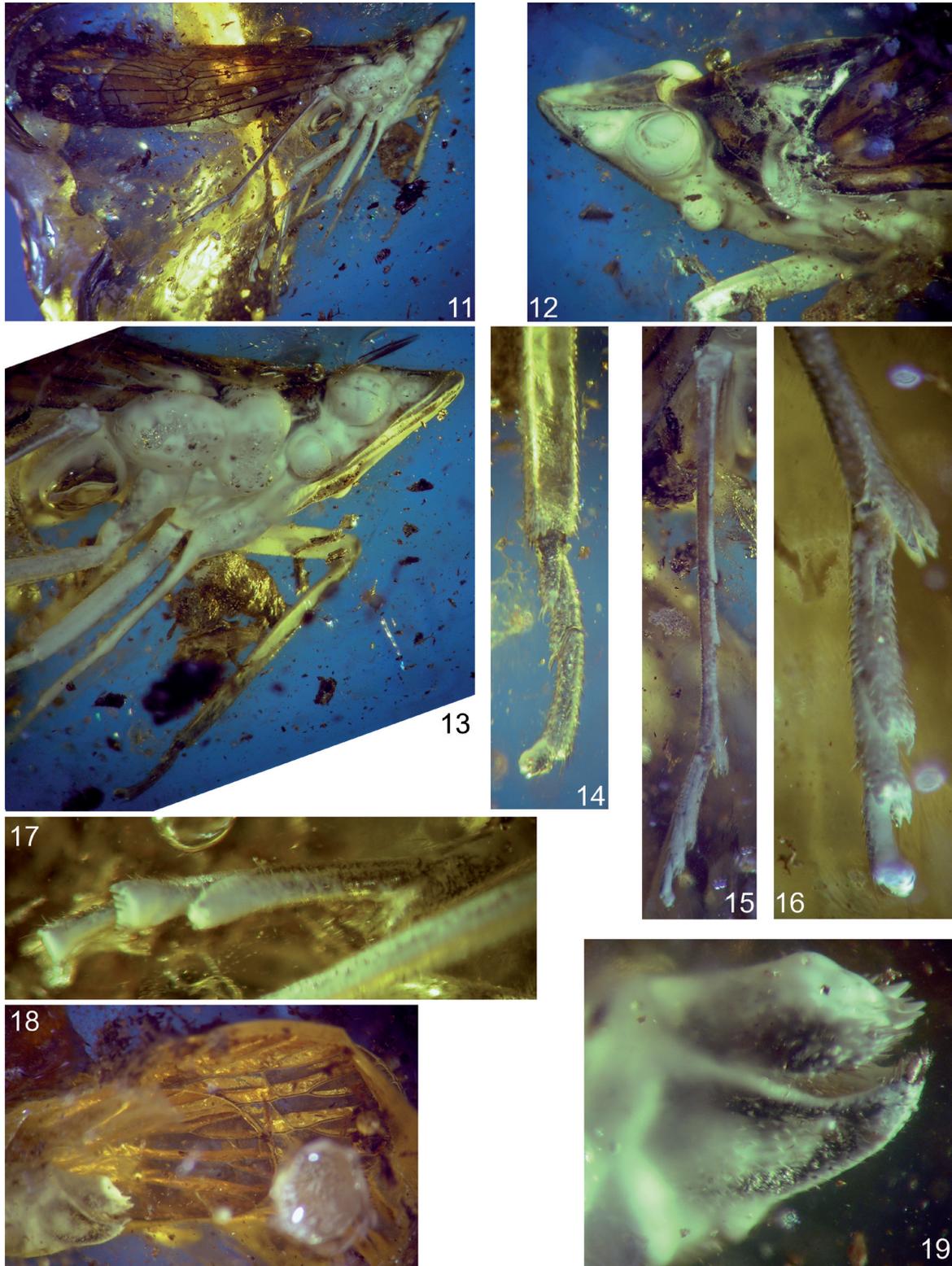
Thorax: Pronotum (Figs. 3, 12) with slightly tectiform median portion, with somewhat cristate median carina. Mesonotum with median disc between lateral carinae flat, slightly below the plane of median portion of pronotum.

Tegmen (Figs. 4, 11) with terminal of stem ScRA<sub>1</sub> slightly oblique, distally terminal RA<sub>5</sub> almost sigmoid, three terminals (RA<sub>5</sub>–RA<sub>4</sub>) intersecting stigmal area; stem Sc+R forked slightly basally of claval apex, common branch Sc+RA relatively long, stem ScRA<sub>1</sub> subparallel to costal margin, five terminals of RA; branch RP with three terminals. Stem M forked at same level as stem Sc+R, slightly basally of claval apex; branches M<sub>1</sub> and M<sub>2</sub> not forked before the apical line, branch M<sub>1</sub> with three terminals, branch M<sub>2</sub> with two terminals; branch M<sub>3+4</sub> forked slightly apically of claval apex; branch M<sub>3</sub> with two terminals, branch M<sub>4</sub> with two terminals. Stem CuA forked distinctly more basally than stems Sc+R and M, slightly apically of claval veins junction; branch CuA<sub>1</sub> forked slightly apically of veinlet icua, branch CuA<sub>2</sub> not forked before apex. Claval veins Pcu and A<sub>1</sub> fused at half of clavus length. Nodal veinlets at level of claval apex, veinlet r-m slightly convex proximally, veinlet m-cua slightly oblique; apical line of veinlets with veinlet ir placed distinctly proximally, basally of veinlet icua; apical line veinlets r-m and im at more or less same level; apical line veinlet icua placed more basally; postclaval veinlet icu at level of veinlet ir.

Female genital block (Figs. 10, 18–19): Gonapophysis IX subtriangular, ventral margin arcuately convex, dorsal margin slightly concave, surface of gonapophysis IX covered with short setae, a bunch of longer setae at the apex.

Other features as for genus as it is the only included species.

Total length 14.8 mm. Head with compound eyes 1.75 mm wide. Length of vertex in mid line 1.38 mm, length in lateral line 1.33 mm, width of vertex at base 0.7 mm, width of apex of vertex ca. 0.38 mm. Frons in mid line 2.57 mm long, in lateral margins 2.7 mm, maximum width of frons at level of antennae 0.86 mm; length of postclypeus in mid line 1.13 mm, length of anteclypeus in mid line 0.9 mm, clypellus 0.23 mm long; rostrum 3.07 mm long, subapical segment 1.76 mm, apical segment 1.36 mm;



**Figs. 11–19.** *Worskaito stenexi* n. gen., n. sp., holotype, female, MIB 5277 (Museum of Amber Inclusions, University of Gdańsk). – **11.** Right general view. **12.** Anterior part of body, left laterodorsal view. **13.** Anterior part of body, right lateral view. **14.** Left fore leg tarsus. **15.** Right hind leg. **16.** Right hind leg tarsus. **17.** Left hind leg tarsus. **18.** Apical portions of right tegmen and wing. **19.** Genital block, left lateral view. – For scales see Figs. 1–10.

antenna 1.58 mm long, second segment globular, ca. 0.5 mm in diameter and 0.5 mm long.

Pronotum 0.55 mm long in mid line, 0.75 mm wide at posterior margin of pronotal disc, 2.3 mm wide as a whole. Mesonotum 2.05 mm long, 2.2 mm wide at base.

Length of tegmen 11.7 mm, width of tegmen 3.5 mm.

Fore femur 2.75 mm long, fore tibia 3.9 mm long, fore tarsus 1.15 mm long, basitarsomere 0.33 mm long, mid tarsomere 0.44 mm, apical tarsomere 0.76 mm long, combined length of basitarsomere and mid tarsomere of fore leg 0.51 mm.

Mid coxa 1.0 mm, mid femur 2.15 mm, mid tibia 3.65 mm, mid tarsus 1.04 mm, basitarsomere 0.36 mm, mid tarsomere 0.36 mm, apical tarsomere 0.61 mm, combined length of basi- and mid tarsomere 0.51 mm.

Hind coxa 1.32 mm long; hind femur 1.65 mm, hind tibia 5 mm long, hind tarsus 2 mm long, basitarsomere 0.8 mm, mid tarsomere 0.5 mm long, apical tarsomere 0.5 mm, combined length of mid- and apical tarsomere 1.18 mm. Tibio-metatarsal formula 7 : 2+(5) : 2+(6).

Anal tube 1.17 mm long, gonapophysis IX 1.36 mm long, 1.0 mm high at base.

### 3.2. Key to the tribes of the family Dictyopharidae (after EMELJANOV 1969, 1983, modified)

Most tribes currently recognized among Dictyopharidae are distinguished by their tegmina venation or other external morphological features, but some similar tribes can only be differentiated on the basis of genital structures.

- 1 Tegmina fully developed, membranous, very rarely shortened and flat; hind wing with secondary fold; tegulae present, exceptionally lacking; abdominal tergites III–VII with weak to lacking median carina, abdominal tergites lacking sensory pits; tarsal arolium usually with four basiconical sensillae (subfamily Dictyopharinae SPINOLA, 1839) . . . . . **2**
  - Tegmina always brachypterous, coriaceous, with venation or secondary keels visible, tegulae absent; abdominal tergites III–VII with distinct median carina, and supplementary carinae; tergites with sensory pits; tarsal arolium with less than four basiconical sensillae (subfamily Orgeriinae FIEBER, 1872) . . . . . **13**
- 2 Tegmina membranous, held in flat or tectiform position; tegmen with stem Sc+R forked into ScRA and RP basad of stigmal area, with branch RP forked before apex; common stalk of claval veins Pcu and A<sub>1</sub> long, occupying at least half length of clavus . . . . . **3**
  - Tegmina shortened, flat, without venation visible . . . . . **11**
- 3 Tegmen with only two rows of transverse veinlets, forming nodal line and subapical line . . . . . **4**
  - Tegmen with at least three rows of transverse veinlets, veinlets usually not aligned, but in each field running along its length; the number of veinlets in each field not less than three; first forking of stem M placed apically of first forking of stem Sc+R, but basally of first forking of stem CuA . . . . . **6**
- 4 Tegmen with first forking of the stem M placed distally of

- first forking of the stem CuA; clavus of tegmen without transverse veinlets . . . . . **5**
  - Tegmen with first forking of the stem M placed basally of first forking of stem Sc+R and basad of first forking of stem CuA; clavus of tegmen with transverse veinlets; subapical row of transverse veinlets subparallel to apical margin of tegmen . . . . . **Cladodipterini** METCALF, 1938
- 5 Tegmen with first forking of M distinctly apically of forkings of stems Sc+R and CuA; stem CuA forked basally of stem Sc+R forking; subapical row of veinlets more or less straight and not parallel to apical margin of tegmen. . . . . **Netutelini** EMELJANOV, 1983
  - Tegmen with first forking of the stem M placed at level of stem Sc+R forking, stem CuA forked distinctly basally of stems ScR and M forking; subapical row of veinlets straight, veinlets subperpendicular to longitudinal veins . . . . . **Worskaitini** n. trib.
- 6 Tegmen with stems Sc+R and M leaving basal cell separately from the same point, but diverging immediately; anterior branch of stem CuA forked considerably distally to nodal line of transverse veinlets, or not forking; nodal transverse veinlet r–m placed basally of first forking of stem Sc+R, but distally of first forking of stem CuA . . . . . **7**
  - Tegmen with stems Sc+R and M leaving basal cell with a common stalk, longer (usually distinctly longer) than arculus; anterior branch of stem CuA forked basally of nodal transverse veinlet m–cu; nodal transverse veinlet r–m placed apically of first forking of branch M<sub>1+2</sub>, or at level of this forking, or merely basad; branch RP with 4–5 terminals . . . . . **8**
- 7 Lower vesicles (inflating processes) of theca of aedeagus without denticles; basitarsomere and mid tarsomere of fore and mid leg with no more than two specialized sclerotised setae with acute apex (acutellae) . . . . . **Orthopagini** EMELJANOV, 1983
  - Lower vesicles (inflating processes) of theca of aedeagus with denticles; plantar surface of basitarsomere and mid tarsomere of fore and mid leg pigmented setae replaced with acutellae . . . . . **Dictyopharini** SPINOLA, 1839
- 8 Pterostigmal area wide, with posterior margin S-shapedly curved . . . . . **Lappidini** EMELJANOV, 1983
  - Pterostigmal area narrow, not broader than costal cell, posterior margin slightly arcuate and not projecting posteriorly . . . . . **9**
- 9 Ovipositor of raking (burying-mixing) type, lower portion of gonoplares sclerotised in typical degree, in most portions relatively short and wide . . . . . **10**
  - Ovipositor secondarily of piercing-sawing type, narrow and tapering; apical portion of gonoplares strongly sclerotised, very narrow, enveloping gonapophyses VIII and IX as case . . . . . **Taosini** EMELJANOV, 1983
- 10 Lower portion of gonoplares without outwardly bent membranous margin in apical portion; anal tube of female without specialised setae . . . . . **Nersiini** EMELJANOV, 1983
  - Lower portion of gonoplares with outwardly bent membranous margin in apical portion; anal tube of female with specialised bristle at ventral margin, each bristle on tubercle . . . . . **Hastini** EMELJANOV, 1983
- 11 Tegmina shortened, sclerotised, convex, venation varies notably from one individual to another; stem Sc+R not forked, with only oblique, weak veinlets; common stem Pcu+A<sub>1</sub> short . . . . . **12**
  - Tegmina elytra-like, strongly shortened, flat, without keels and traces of venation; tegulae absent; head with well delimited trigons; boundary between clypeus and frons nearly straight; fore femora and tibiae dilated, foliate; basitarsomere and mid tarsomere of hind legs with platellae instead of

- spines; lateral lobe of gonoplags without appendix; medial lobes of gonapophyses VIII and IX with two nervures; lateral lobes with bidentate apex . . . . .
- Cleotychini** EMELJANOV, 1997
- 12 Tegmina with sharply carinate longitudinal veins, of which stem CuA, running along claval suture, is markedly less distinct . . . . . **Scoloptini** EMELJANOV, 1983
- Tegmina with convex, but not carinate longitudinal veins; stem CuP (claval suture) developed normally . . . . . **Phylloscelini** EMELJANOV, 1983
- 13 Median carina of abdominal tergites III–VII single; hind tibia with apical row of 8 teeth; tarsal claws with four setae; gonapophysis VIII with endogonocoxal process with complete margin, anterior connective lamina with group of apical teeth arranged in oblique longitudinal row . . . . . **Ranissini** EMELJANOV, 1969
- Median carina of abdominal tergites III–VII doubled; hind tibia with 7 (6) apical teeth; tarsal claws with at least three setae; gonapophysis VIII with endogonocoxal process with ventral margin with four teeth, anterior connective lamina with group of apical teeth arranged in oblique transverse row . . . . . 14
- 14 Frons flat, lateral fields of frons below the upper line of compound eyes placed in plane with median field; imago with sensory pits lacking . . . . . **Colobocini** EMELAJNOV, 1969
- Frons transversely convex, lateral fields of frons shifted laterally from the plane of median field; imago with lateral fields of frons, pronotum, lateral fields of mesonotum, abdominal tergites with sensory pits . . . . . 15
- 15 Sensory pits on mesonotum delimited anteriorly by transverse carina, united with lateral carina, sensory pits arranged irregularly, often in groups, at least second pit distinctly shifted posteriorly; sensory pits of external group on abdominal tergite, at least three on each side of tergite, arranged in group; sublateral carinae of abdominal tergite often indistinct or obsolete, but on each tergite, anteriorly of sensory pits distinct, transverse carina-like elevation or transverse carina present . . . . . **Orgeriini** FIEBER, 1872
- Sensory pits of mesonotum not limited anteriorly by carina, if indistinct carina visible, not reaching to lateral carinae of mesonotum; sensory pits arranged in regular transverse row, posteriorly with separate pit, or only this pit present, or sensory pits lacking; sensory pits of external group on abdominal tergite lacking or single (rarely two) pits present; sublateral carinae of abdomen distinct; abdominal tergite lacking transverse carina or carina-like elevation anteriorly of sensory pits . . . . . **Almanini** KUSNETZOV, 1936

#### 4. Discussion

##### 4.1. Review of the fossil record of Dictyopharidae

The oldest fossil Dictyopharidae are representatives of an extinct tribe Netutelini EMELJANOV, 1983. The first taxon of this unit, *Netutela annunciator* EMELJANOV, 1983, was described from the Upper Cretaceous (Santonian) Taimyr amber (EMELJANOV 1983). Only tegmina and wings are preserved, while other features are unavailable for study. The youngest known representative of this tribe is an imprint of a tegmen in Eocene/Oligocene deposits of Isle of Wight, United Kingdom, representing another genus (SZWEDO in preparation).

The Palaeocene record of the family comprises the species *Limfjordia breineri* WILLMANN, 1977. This species had been originally described as Mecoptera (WILLMANN 1977) from the Fur Formation of Mors Island, Denmark, but was subsequently (WILLMANN 1984) proposed to be transferred to Fulgoroidea. Its tribal assignment is also not clear, the specimen awaits reexamination and redescription. Other, undescribed Dictyopharidae are recorded from the same locality (RUST 1999; SZWEDO unpublished data).

Some not yet described Dictyopharidae are recorded in the Lowermost Eocene Oise amber of France (SZWEDO unpublished data).

*Wedelphus dichopteroides* SZWEDO & WAPPLER, 2006, described from the Eocene Messel Maar, Germany (WAPPLER 2004; SZWEDO & WAPPLER 2006), is a member of the tribe Dichopterini MELICHAR, 1912, which now is placed in the family Fulgoridae (EMELJANOV 1979; SHCHERBAKOV & POPOV 2002), the sister group of Dictyopharidae (EMELJANOV 1979; YEH et al. 2005; URBAN & CRYAN 2007).

The Eocene Baltic amber inclusions once placed in Dictyopharidae (GERMAR & BERENDT 1856; METCALF & WADE 1966) under the name *Pseudophana reticulata* GERMAR & BERENDT, 1856 had been discussed by EMELJANOV (1983). These had been proposed to be transferred to other Fulgoroidea families – a specimen originally described as “larva” to Tropiciduchidae, and a specimen originally described as “pupa” [sic!] to Achilidae. Unfortunately, the type material was probably lost during the Second World War.

Another fossil, *Florissantia elegans* SCUDDER, 1890, comes from the Oligocene (Chattian) deposits of Florissant, Colorado, USA (SCUDDER 1890; SZWEDO et al. 2004). It belongs to Dictyopharinae, but its tribal placement is not clear. In the original description, it was compared with *Cladodiptera* SPINOLA, 1839, however, the structure of the stigmal area and forking pattern of stems Sc+R and M exclude it from Cladodipterini.

Neogene records of Dictyopharidae comprise taxa described as *Chanithus vishneviensis* BECKER-MIGDISOVA, 1964 and *Dictyophara* sp. (BECKER-MIGDISOVA 1962, 1964; SZWEDO et al. 2004). Both taxa originate from Middle Miocene (Serravalian) deposits of Vishnevaya Balka (Valley) near Stavropol’ in Russia. It is noteworthy that the generic name *Chanithus* KOLENATI, 1857 is now treated as a junior synonym of *Dictyophara* GERMAR, 1839. However, based on original figures and description tribal assignment of these fossils remains unclear.

##### 4.2. Position of Worskaitini n. trib.

The new tribe described above presents several features believed to be plesiomorphic not only for the family

Dictyopharidae, but for Fulgoroidea as a whole. The structure of the head of the tribe Worskaitini is typical of other Dictyopharinae. The elevated, tectiform median disc of the pronotum, with somewhat cristate median carina seems to be one of the peculiar features of the genus *Worskaito*, or the whole tribe (apomorphic condition?). In the general pattern of tegmen venation, with two rows of veinlets, the tribe Worskaitini n. trib. is similar to Netutelini and Cladodipterini. However, the pattern of longitudinal stems forking clearly separates these tribes. Presence of pairs of subapical acutellae on fore and mid tarsi seems to be a rather plesiomorphic condition, however it is still weakly elaborated among Dictyopharinae and other Fulgoroidea as well (EMELJANOV 1982). Not less than six different types of setae and several different sensilla may be distinguished on the tarsal segments of Dictyopharidae (EMELJANOV 1982). Acutellae are found also in some Cixiidae SPINOLA, 1839 (DLABOLA 1988; EMELJANOV 1987). The basitarsomere and mid tarsomere of hind leg with subapical platellae are known among the Cretaceous extinct family Lalacidae (HAMILTON 1990; SZWEDO 2007), as well as among some Cixiidae and some Achilidae (EMELJANOV 1971, 1987, 1991, 1992; SZWEDO 2006). This feature is also present among various Dictyopharinae (EMELJANOV 1982, 2001).

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