

Austrini - a new tribe of Tropicuchidae planthoppers from the Eocene Baltic amber (Hemiptera: Fulgoromorpha)

JACEK SZWEDO & ADAM STROIŃSKI

Museum and Institute of Zoology, Polish Academy of Sciences, 64, Wilcza Street, PL00-679 Warsaw, Poland

Abstract. A new tribe Austrini **n. trib.** of Tropicuchidae planthoppers from the Eocene Baltic amber is described to comprise *Austris raffelis* **n. gen., n. sp.** Fossils ascribed to family Tropicuchidae are discussed.

Resumé. Austrini - une nouvelle tribu de Tropicuchidae de l'ambre éocène de la Baltique (Hemiptera : Fulgoromorpha). Une nouvelle tribu Austrini **n. trib.** de Tropicuchidae de l'ambre éocène de la Baltique est décrite sur la base de *Austris raffelis* **n. gen., n. sp.** Les Fossiles attribués aux Tropicuchidae sont discutés.

Keywords: Tropicuchidae, Austrini, *Austris raffelis*, fossils, Eocene Baltic amber.

The family Tropicuchidae Stål 1854 is one of smaller planthopper families comprising less than 400 described species in more than 110 genera (Yang *et al.* 1989; Gnezdilov 2007; Shcherbakov 2006). Most of the representatives of the family may be separated from other planthoppers by the groove or fine line separating the apex of the mesonotum (mesoscutellum) from the rest of the mesonotal disc. These planthoppers belong to the Fulgoroidea with the small second hind tarsus bearing a distinct spine on each side. Tropicuchidae could be in most cases recognized by the overall structure and especially venation. In most representatives, the apex of tegmina, with more numerous veinlets, is set off by the nodal line. Their size ranges from 5 to 13 mm in length (O'Brien & Wilson 1985; O'Brien 2002). Tropicuchidae are distributed in warmer regions across the world, some species are known as crop pests, they feed on shrubs and trees (Fennah 1982; Wilson *et al.* 1994; O'Brien 2002). The most recent higher classification of the family was presented by Fennah (1982) who recognized 15 tribes among recent representatives of the family (three of them divided into subtribes), based on body structure and tegminal venation. This subdivision is primarily based on diagnostic characters without discussion of homology and evolutionary trends (Asche & Wilson 1989). The tribes and subtribes recognized by Fennah (1982) are as follow: Trypetimorphini Melichar 1914, Neomatissini Fennah 1982, Tambiniini Kirkaldy 1907, Turneriolini Fennah 1982, Paricanini Melichar 1914, Isporisini

Fennah 1982, Eporini Fennah 1982 (subtribes Eporina Fennah 1982, Clardeina Fennah 1982), Catullini Melichar 1914, Cyphoceratopini Fennah 1945, Tangiini Melichar 1914 (subtribes Tangiina Fennah 1982, Neotangiina Fennah 1982), Alcestini Melichar 1914, Remosini Fennah 1982, Tropicuchini Melichar 1914, Eutropistini Kirkaldy 1906 (subtribes Duriina Fennah 1982, Kazerunina Dlabola 1977, Eutropistina Fennah 1982) and Cixiopsini Fennah 1982. Later, the extinct tribe Jantaritambiini Szewdo 2000, described from the Baltic amber was added. Shcherbakov (2006) added another extinct tribe Emilianini, based on the imprint of tegmen from the Eocene of Green River, Colorado. Gnezdilov (2007) transferred the Gaetuliina Fennah 1978 from Nogodinidae to Tropicuchidae giving tribal status, and Trienopini Fennah 1954 from Issidae.

Systematics

Ordo Hemiptera L. 1758

Subordo Fulgoromorpha Evans 1946

Superfamilia Fulgoroidea Latreille 1807

Familia Tropicuchidae Stål 1854

Austrini **n. trib.**

Type genus. *Austris* **n. gen.**; here designated.

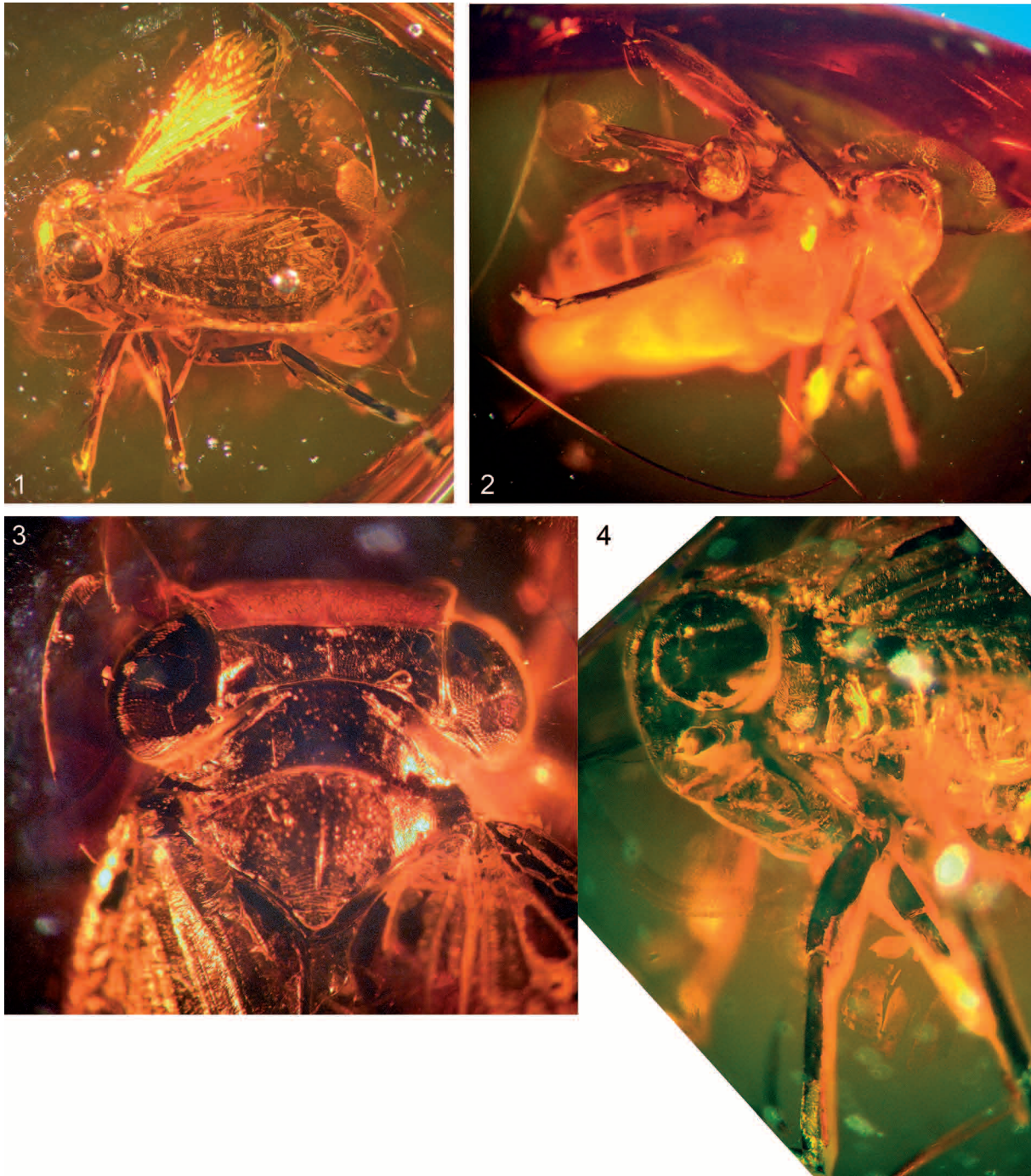
Diagnosis. The new tribe differs from the others by the following combination of characters: vertex distinctly wider than long in mid line, tegmina not exceeding apex of abdomen, stems Sc+R, M and CuA forked distinctly basad of half of tegmen length, clavus exceeding 2/3 of tegmen length, costal area, nodal and apical lines absent. Hind tibia with three lateral spines. Genital style symmetrical, separated.

E-mail: szwedo@miiz.waw.pl, adam@miiz.waw.pl

Accepted le 24 septembre 2009

Description. Head with compound eyes wider than pronotum; vertex transverse with margins carinate; frons unicarinate. Antennal fovea elevated. Antennal segment II (pedicel) elongate, without microsetae, a few plate organs present only on the top of pedicel. Ocelli present. Compound eyes elongate in lateral view, with

posterior calus. Apical segment of rostrum longer than broad, reaching the level between mid and hind coxae, covered with short hairs; subapical segment longer than apical one. Scutellum bluntly angulate, separated from disc of mesonotum by transverse fine line. Tegmen subcoriaceous, not exceeding apex of abdomen,



Figures 1–4

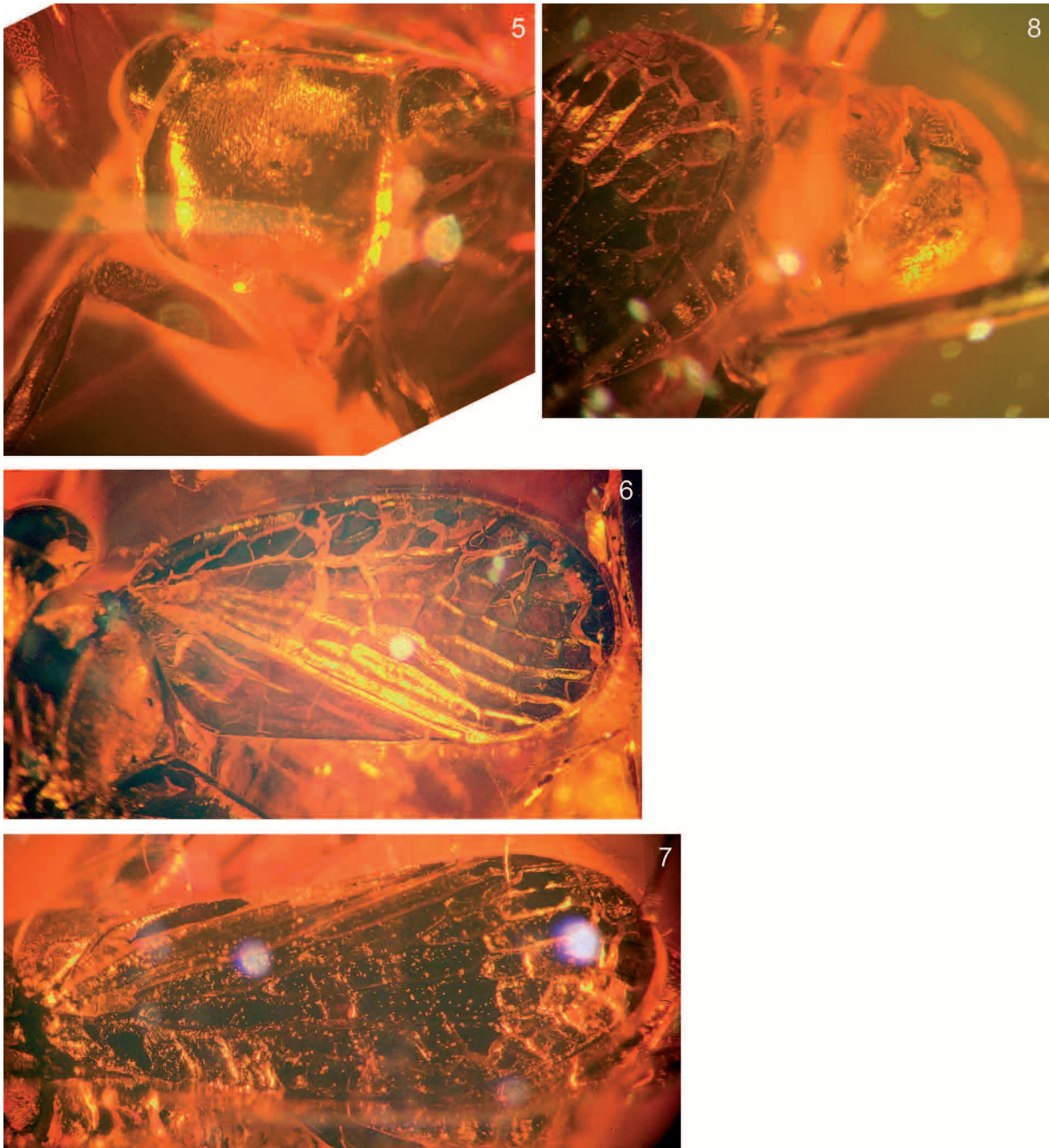
Austris raffelis n. gen., n. sp. 1, left lateral view of holotype in amber. 2, right lateral view of holotype in amber. 3, anterior portion of body in dorsal view. 4, the same in left lateral view.

costal area absent, costal cell with transverse veinlets reaching anterior margin; nodal and subapical lines absent, veinlets on corium and membrane not forming lines; clavus long, exceeding 2/3 of tegmen length. Stems Sc+R, M and CuA simple, leaving basal cell separately, forking basad of half of tegmen length. Hind tibia with three lateral spines, in the middle and two basad of half of hind tibia. Genital style symmetrical, separated.

***Austris* n. gen.**

Type species. *Austris raffelis* n. sp., here designated.

Diagnosis. Frons at upper margin wider than long in mid line, perpendicular to vertex in lateral view. Vertex with median carina, clypeus with median carina, pronotum with keel-shaped postocular carinae, mesonotum with transverse anterior carina-

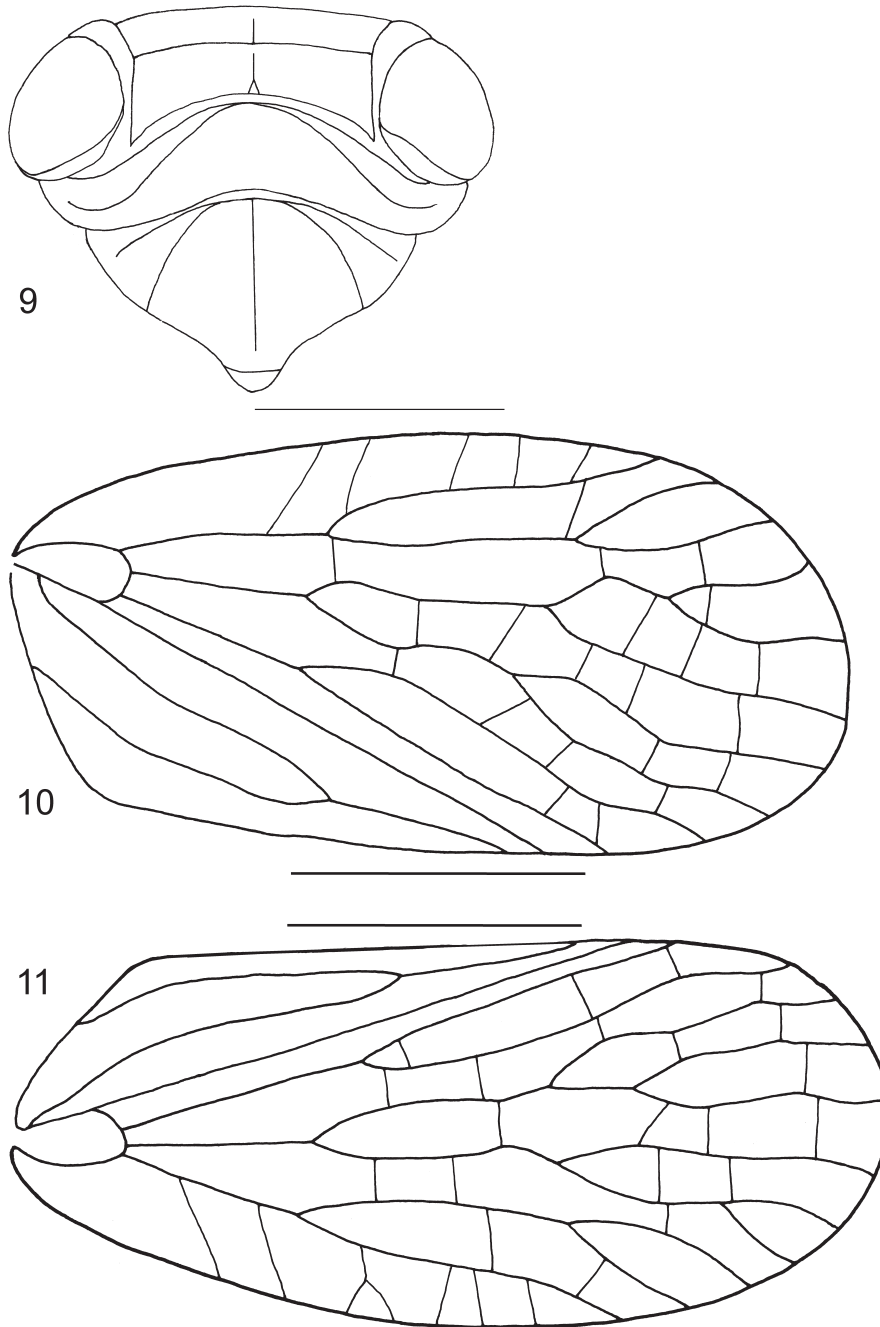


Figures 5–8
Austris raffelis n. gen., n. sp. **5**, face in frontolateral view. **6**, right tegmen in dorsal view. **7**, left tegmen in dorsolateral view, image distorted by amber polishing. **8**, apical portion of male genital capsule.

tion uniting longitudinal carinae, clypeus with median carina. Hind wings hyaline, elongate, not wider than tegmen, with anal lobe very narrow, longitudinal veins with single terminals, only vein CuA with three terminals; single veinlet m-cua present.

Description. Frons subquadrate, at upper margin wider than long in mid line, with median carina, perpendicular to vertex in lateral view. Vertex with median carina, anterior margin

elevated in median portion, posterior margin elevated along. Clypeus with median carina. Pronotum with keel-shaped post-ocular carinae, median carina absent. Mesonotum triangular; with three carinae, connected anteriorly by transverse carina; lateral carinae reaching posterior margin of mesonotum; posterior portion of mesonotum concave, with transverse wrinkles and two shallow depressions mediad of lateral carinae. Tegmen



Figures 9–11
Austris raffelis n. gen., n. sp. **9**, anterior part of body; **10**, right tegmen venation pattern; **11**, left tegmen venation pattern. Scale bar 1 mm.

elongate, anterior margin almost parallel to posterior margin, subcoriaceous, with veins elevated, claval and apical angle widely angulate, clavus without transverse veinlets. Costal margin thickened. Basal cell narrow and elongate. Veinlets on costal cell merely oblique. No transverse veinlets up to the level of first forkings of stem Sc+R, M and CuA. Stem Sc+R forked at same level as M. Claval veins Pcu and A₁ joined distinctly apicad of half of length of clavus. Hind wings hyaline, elongate, not wider than tegmen, with anal lobe very narrow, vein ScRA with single terminal, vein RP with single terminal, vein M with single terminal, vein CuA with three terminals: CuA₁ single, CuA₂ forked, CuP with single terminal, Pcu with single terminal A₁ with single terminal; single veinlet m-cua present. Hind tibiae narrow, not widened apicad with three lateral spines and single row of apical teeth; basitarsomere with a single row of apical teeth.

Etymology. The generic name is derived from the name of the dwarf of the Eastern corner of the world from the Nordic mythology—*Austris*. Gender: masculine; III declension: austris, ~is.

Austris raffelis n. sp.

Diagnosis. Vertex four times as wide as long in mid line. Median carina of frons not reaching frontoclypeal suture, thickened and elevated in upper portion at margin of vertex, slightly exceeding half of frons length, obsolescing ventrad. Tibio-tarsal formula of hind legs 7(8) : 8 : 2+0.

Description. Total length 4.8 mm. Vertex 0.23 mm long in mid line, vertex length in mid line width ratio 1 : 4.2, lateral margins parallel, 1.7 times longer than vertex in mid line. Frons at upper margin flattened, in median portion more convex; lateral margins of frons distinctly elevated, in upper portion almost straight, in lower portion merely converging mediad. Frontoclypeal suture distinctly arcuate. Clypeus with median carina, slightly convex in median portion. Rostrum with apex reaching between mid and hind coxae, apical segment shorter than subapical one (0.33 mm and 0.48 mm respectively). Ocelli present, placed close to compound eyes. Compound eyes in lateral view elongated, with very small posterior callus.

Antennal fovea distinctly elevated, scapus short, pedicel subcylindrical, widened in apical portion, first flagellar segment with flagellum merely shifted from centre.

Pronotum 0.35 mm long in mid line, 1.6 times longer in mid line than vertex. Anterior margin in median portion strongly convex; posterior margin sinuate in median portion, widely and shallowly concave; anterior and posterior margins at about same level. Disc of pronotum with postocular carinae. Postocular carinae in basal half distinctly keel-shaped, at distal portions obsolete, reaching to half of compound eye width. Lateral parts of pronotum without longitudinal carinae.

Mesonotum long in mid line, triangular, tricarinate, 0.78 mm long in mid line, 1.24 mm wide, longer in mid line than cumulative length of vertex and pronotum in mid line. Median carina reaching almost to scutellum.

Fore and mid legs with tibiae quadrangular in cross section. Fore femur 1 mm long, fore tibia 1.05 mm long, Mid femur 1.03 mm long, mid tibia 1.33 mm long. Hind femur 1.15 mm long, subquadrangular in cross section. Hind tibia 1.97 mm long, narrow, not widening apicad, with three lateral spines in lower portion and an apical row of 7(8) teeth. Basitarsomere 0.38 mm long, longer than mid tarsomere, its combined length

as cumulative length of mid and apical tarsomere, with a row of 8 apical teeth, mid tarsomere 0.2 mm long, with distinct lateral spines, median portion with a bunch of setae, apical tarsomere 0.2 mm long, with distinct tarsal claws.

Tegmen 3 mm long, 1.46 mm wide, apex of clavus reaching 0.7 of tegmen length.

Male pygofer distinctly shorter than high in lateral view, with distinct apical acute process below the lower margin of anal tube. Anal tube short, about as wide as long in mid line, suboval in dorsal view, anus round

Age and occurrence. 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 ± 1.1 Ma) and is thus significantly older than previously assumed (Wappler 2003, 2005). Limnic sediments of Eckfeld Maar, aged 44.3 ± 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 ± 3 Ma) age of Prussian Formation is preferred.

Etymology. The specific epithet is derived from Nordic words: *raf* – amber and *fela* – to embed.

Type material. Holotype. Male (Figs. 1–11). Labeled [Naturhistorisches Museum in Wien, Akquisition: 1938, No. 49 / Homoptera / (Zikaden) / Geologisch-paläontologische Abteilung]. Piece of Baltic amber, dark brown in colour, right side of the inclusion covered with milky veil, left side, with partly removed (polished) hind leg; several cracks in amber reaching to the inclusion. Some details of coloration, dark spots in the apical portion of left tegmen (Figs. 1 & 7), seem to be related to preservation of the specimen not to its original colour pattern.

Discussion

The fossil Tropiciduchidae are known since the Eocene (Szwedo *et al.* 2004). There are three tribes recorded: the recent Gaetulini Fennah 1978 (Baltic amber and Eocene/Oligocene Bembridge Marls) and extinct tribes: Jantaritambini Szwedo 2000 (Baltic amber and Eocene/Oligocene Bembridge Marls) and Emilianini Shcherbakov 2006 from Green River deposits of North America (Szwedo & Stroiński 1999; Szwedo 2000, Shcherbakov 2006). The new tribe described above differs from all extant and extinct tribes ascribed to Tropiciduchidae by the combination of characters. The transverse vertex, i.e. vertex distinctly wider than long in mid line, is present also in representatives Gaetuliini, transferred from Nogodinidae by Gnezdilov (2007). The tegmina not exceeding apex of abdomen seems to be apomorphic condition of genus *Austris* n. gen. and possible also the whole tribe. Absence of costal area, nodal and apical lines, but presence of transverse veinlets on the costal cell between costal margin and Sc+R stem, seems to be unique combination of features

of the newly described tribe. Austrini **trib. n.** is giving further data to the discussion about the limits and subdivisions within complex of families Nogodinidae-Tropicuchidae-Issidae. Emeljanov (1999) redefined several families related to Issidae, and transferred Bladininae, including also Bladinini: Gaetulina *sensu* Fennah 1978 (as subfamily) from Nogodinidae to Issidae. However, Gnezdilov (2003) stated that placement Bladinini *sensu* Fennah 1978 within Issidae is problematic and that Bladinini is a combined group. Gnezdilov (2007) discussed the limits and subdivisions of Issidae, Acanaloniidae, Nogodinidae and Tropicuchidae. In his statement Gaetuliini are to be placed among Tropicuchidae, in respect of the ovipositor structure. Shcherbakov (2006), following Gnezdilov's (2003) view stated that based on venation and habitus, it seems impossible to make a distinction between Bladinini and Nogodinidae *s. str.*, so for compression fossils, with ovipositor characters usually unknown. He suggested using concept of Nogodinidae *s. l.* including Bladinini. O'Brien and Wilson (1985) noted that Gaetuliina takes an intermediate position between Issidae and Nogodinidae. Recent molecular research based on 16S rDNA (Yeh *et al.* 2005) and DNA nucleotide sequences: 18SS rDNA, 28S rDNA, Histone 3 and Wingless (Urban & Cryan 2007) not resulted in solution of the problem. Two subfamilies of Issidae – Hemisphaeriinae Melichar 1906 and Issinae do not cluster together, as well as the tribes of Nogodinidae – Varcini Fennah 1978 and Pisachini Fennah 1978 (Yeh *et al.* 2005). The monophyly of Nogodinidae was also not supported in Urban & Cryan (2007) analyses. Bladinini: Bladinina are placed close to Tettigometridae Germar 1821 but this placement could be an artifact (Urban & Cryan 2007). Second subtribe of Bladinini – Gaetulina is placed as sister taxon to Tropicuchidae. Lipocallini Fennah 1984 are placed as sister taxon to clade containing Issidae: Issinae, and both are sister clade to Varcini: Sassulina Fennah 1978. Nogodinini Schmidt 1912 are sister group to Acanaloniidae. According to Shcherbakov (2006) the controversy over the Issidae/Nogodinidae boundary may be resolved by uniting them into paraphyletic Issidae in the broadest sense. The placement of several taxa at the transition zone among Nogodinidae, Issidae and Tropicuchidae is still not clear.

Acknowledgements. We wish to thank Geologisch-Paläontologische Abteilung, Naturhistorisches Museum in Wien for the privilege of studying material from their collection. We wish also thank Dr. Vladimir M. Gnezdilov (St. Petersburg, Russia) for the valuable suggestions concerning Issidae and Tropicuchidae and reviewers for the comments on the manuscript.

References

- Asche M., Wilson M. R. 1989. The palm-feeding planthopper genus *Ommatissus* (Homoptera: Fulgoroidea: Tropicuchidae). *Systematic Entomology* **14**: 127-147.
- Emeljanov A. F. 1999. Notes on delimitation of families of the Issidae group with description of a new species of Caliscelidae belonging to a new genus and tribe (Homoptera, Fulgoroidea). *Zoosystematica Rossica* **8** (1): 61-72.
- Fennah R. G. 1982. A tribal classification of the Tropicuchidae (Homoptera: Fulgoroidea), with the description of a new species on tea in Malaysia. *Bulletin of Entomological Research* **72**: 631-643.
- Gnezdilov V. M. 2003. A new tribe of the family Issidae with comments on the family as a whole (Homoptera: Cicadina). *Zoosystematica Rossica* (2002), **11** (2): 305-309.
- Gnezdilov V. M. 2007. On the systematic positions of the Bladinini Kirkaldy, Tonginae Kirkaldy, and Trienopidae Fennah (Homoptera, Fulgoroidea). *Zoosystematica Rossica* (2006) **15** (2): 293-297.
- O'Brien L. B. 2002. The wild wonderful world of Fulgoromorpha, p. 83-102 in: Holzinger, W. (ed.), *Zikaden - Leafhoppers, Planthoppers and Cicadas* (Insecta: Hemiptera: Auchenorrhyncha). *Denisia* **4**, zugleich Kataloge des OÖ. Landesmuseums, Linz, Neue Folge Nr. 176.
- O'Brien L. B., Wilson S. W. 1985. Planthopper Systematics and External Morphology, p. 61-102 in: Nault L. R., Rodriguez J. G. (eds.), *The Leafhoppers and Planthoppers*. John Wiley & Sons, New York.
- Perkovsky E. E., Rasnitsyn A. P., Vlaskin A. P., Taraschuk M. V. 2007. A comparative analysis of the Baltic and Rovno amber arthropod faunas: representative samples. *African Invertebrates* **48** (1): 229-245.
- Ritzkowski S. 1997. K-Ar-Altersbestimmung der Bernsteinführenden Sedimente des Sammlandes (Paläogen, Bezirk Kaliningrad). *Metalla* (Sonderheft) **66**: 19-23.
- Shcherbakov D. E. 2006. The earliest find of Tropicuchidae (Homoptera: Auchenorrhyncha), representing a new tribe, from the Eocene of Green River, USA, with notes on the fossil record of higher Fulgoroidea. *Russian Entomological Journal* **15** (3): 315-322.
- Szwedo J. 2000. First fossil Tropicuchidae with a description of a new tribe Jantaritambini from Eocene Baltic amber (Hemiptera: Fulgoroidea). *Annales de la Société entomologique de France* (N.S.) **36** (3): 279-286.
- Szwedo J., Stroiński A. 1999. Redescription of *Tritophania patruelis* Jacobi, 1938 from Eocene Baltic amber (Hemiptera: Nogodinidae). *Annales Zoologici* **49** (3): 203-207.
- Szwedo J., Bourgoïn T., Lefebvre F. 2004. *Fossil Planthoppers (Hemiptera: Fulgoromorpha) of the World. An annotated catalogue with notes on Hemiptera classification*. Studio 1, Warszawa, 199 p. + 8 pls.
- Urban J. M., Cryan J. R. 2007. Evolution of the planthoppers (Insecta: Hemiptera: Fulgoroidea). *Molecular Phylogeny and Evolution* **42**: 556-572.
- Wappler T. 2003. Die Insekten aus dem Mittel-Eozän des Eckfelder Maeres, Vulkaneifel. *Mainzer Naturwissenschaftliches Archiv* **27**: i-viii + 1-234.
- Wappler T. 2005. The age of Baltic amber: could Eckfeld resolve this problem? *Fossils X3, Insects – Arthropods – Amber. Programme and Abstracts, 3rd International Congress of Palaeoentomology with 2nd International Meeting on Palaeoarthropodology and 2nd World Congress on Amber and its Inclusions, 7th to 11th February 2005, Pretoria, South Africa*: 53.
- Wilson S. W., Mitter C., Denno R. F., Wilson M. R. 1994. Evolutionary Patterns of Host Plant Use by Delphacid Planthoppers and Their Relatives, p. 7-113 in: Denno R. F., Perfect T. J. (eds.), *Planthoppers. Their Ecology and Management*. Chapman & Hall, New York - London.
- Yang J. T., Yang C. T., Wilson M. R. 1989. Tropicuchidae of Taiwan (Homoptera: Fulgoroidea). *Taiwan Museum Special Publication Series* **8**: 65-115.
- Yeh W. B., Yang C. T., Hui C. F. 2005. A molecular phylogeny of planthoppers (Hemiptera: Fulgoroidea) inferred from mitochondrial 16S rDNA. *Zoological Studies* **44** (4): 519-535.