

# New Cixiidae and Achilidae fossils from Middle Eocene Baltic amber (Hemiptera: Fulgoromorpha)

FABRICE LEFEBVRE, THIERRY BOURGOIN & ANDRÉ NEL

Département Systématique et Evolution, USM 601 of MNHN & UMR 5202 CNRS, Muséum National d'Histoire Naturelle, CP 50, Entomologie, 45, rue Buffon, F-75005 Paris, France

**Abstract.** Three fossil planthoppers (Hemiptera: Fulgoromorpha) are described from Middle Eocene Baltic amber, viz. *Balticixius* n. gen. (Cixiidae) for a species already described as *Cixius insignis* Germar & Berendt for which a new specimen has been discovered; and two new Achilidae species: *Cixidia christinae* n. sp. and *Angustachilus longirostris* n. gen., n. sp. Some taxonomic data about the genus *Cixidia* are also provided.

**Résumé. Nouveaux Cixiidae et Achilidae de l'ambre éocène moyen de la Baltique (Hemiptera : Fulgoromorpha).** Trois fulgores fossiles (Hemiptera : Fulgoromorpha) sont décrit : *Balticixius* n. gen. (Cixiidae) pour l'espèce déjà décrite comme *Cixius insignis* Germar & Berendt, et deux nouveaux Achilidae *Cixidia christinae* n. sp. et *Angustachilus longirostris* n. gen., n. sp. Des données taxinomiques sur le genre *Cixidia* sont aussi données.

**Keywords:** Fossil, new species, Eocene, Baltic amber, Fulgoromorpha, Cixiidae, Achilidae.

Many specimens of fossil Fulgoromorpha are stored in the collection of Muséum national d'Histoire naturelle, Paris (MNHN), which remain undescribed although some of them are of great interest for future phylogenetic analyses. In this paper we describe three of them within Cixiidae and Achilidae. First is a redescription of a cixiid species already described by Germar & Berendt (1856) for which a new genus is proposed. For the two others, one is referred to an extant achilid genus *Cixidia* Fieber 1866, a taxon already mentioned in the fossil record by Emel'yanov (1983) in his revision of the original description of Germar & Berendt (1856) of a nymph previously placed in the genus *Pseudophana* Burmeister 1835 (Fulgoromorpha, Dictyopharidae). The second also belongs to the Achilidae, and interestingly to the same subtribe Cixidiina Emel'yanov 1992. Wing venation nomenclature follows Anufriev and Emel'yanov (1988) with modification from Bourgoin (1997).

## Family Cixiidae Spinola 1839

### Tribe Cixiini Muir, 1923

#### Genus *Balticixius* n. gen.

**Type species.** *Cixius insignis* Germar & Berendt 1856.

**Etymology.** After Baltic amber and genus *Cixius*.

**Diagnosis.** Head capsule with vertex divided by a transversal

straight carina. Mesonotum with three keels. Hind tibia with two lateral spines. Tegmina with veins bearing setiferous granulae, none between veins at apical margin. Pterostigma elongated, regularly bent on its posterior margin to meet costal margin. Hindwing without incision at the cubital level; MA and MP unbranched, CuA1 forked. Second metatarsomere bearing subapical setae below apical teeth.

**Note.** According to Holzinger's (2002) key, this new genus belong to the Cixiini, and stands between present days genera *Cixius* Latreille 1804 and *Tachycixius* Wagner 1939. From *Tachycixius* it differs by the absence of the setiferous granulae between the apical veins. From *Cixius*, it differs by the straight transverse carina of the vertex and the presence of only one vein reaching the wing margin between CuA2 and MP in the hind wing.

#### *Balticixius insignis* (Germar & Berendt 1856)

n. comb.

(Figs 1–9)

**Material.** Specimen MNHN-LP-R. 55188, Museum National d'Histoire Naturelle, Paris.

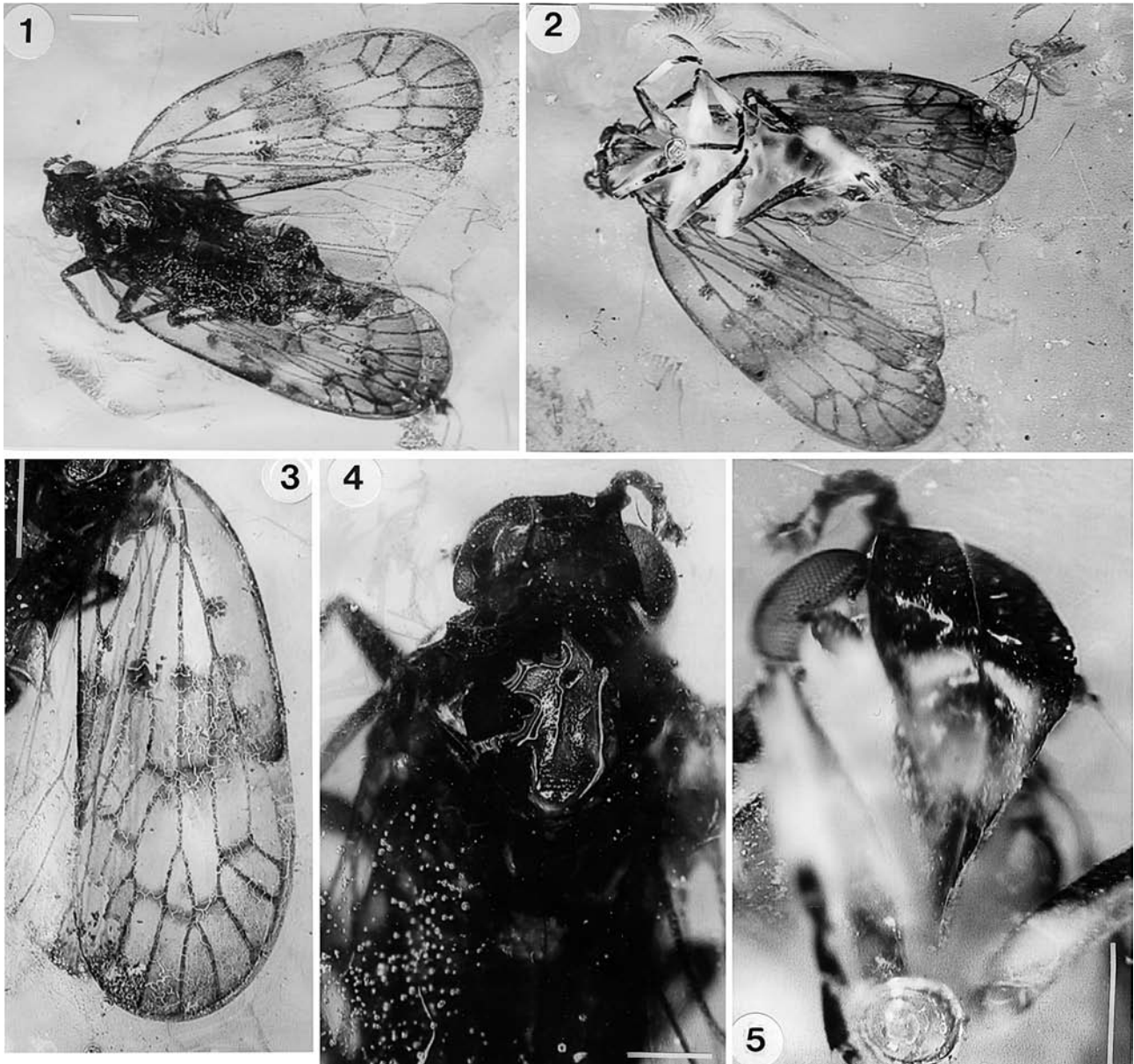
**Age and deposit.** Middle-Upper Eocene (circa 45 Ma), Baltic Amber, Poland.

**Presentation.** The specimen is well preserved. The abdomen and the genitalia are clearly visible. The body is partly covered by a milky cloud of bubble that render the observation delicate. A syninclusion is present (a small unidentified fly) at the end of the left tegmina.

**Description.** The specimen is 5.0 mm long. Head in dorsal view narrower than prothorax. Vertex with a median straight sutural line: anterior part of vertex with a median carina anteriorly marked, posterior part excavated, no median carina, wider than long. Frons with a strong median carina continuing on post- and anteclypeus; median ocellus not visible and very probably absent. Lateral frontal carinae elevated, distinctly higher just at the level of the eyes. Frons and clypeus separated by a strong convex transversal fold. Rostrum long, reaching metacoxae; apical segment longer than wide but shorter than the preceding segment. Prothorax narrow in its middle part;

lateral carinae strongly marked, anteriorly reaching the anterior margin, median carina visible only posteriorly. Mesonotum 3-carinated, the median carina vanishing well before posterior margin. Metatibia with two robust spines. Metatibiotarsal formula: 3-3/8/8. Second tarsomere bearing subapical setae at least below the apical teeth.

Tegmina hyaline but darker medially and apically, with traces of coloration around the transverse veins; extending much beyond apex of abdomen, 4.6 mm long, width between pterostigma and apex of anal area 1.9 mm; two dark spots in costal area, one on mid part of M before nodal line, a darker one at first



**Figures 1–5**  
*Balticixius insignis* (Germar & Berendt 1856). 1. Habitus, dorsal side. 2. Habitus, ventral side. 3. Right tegmina. 4. Head capsule and thorax, dorsal view. 5. Head capsule, anteroventral view (scale bars figs 1–3 = 1 mm; figs 4–5 = 0.5 mm).

branching of CuA. Basal cell well developed. Main veins bearing traces of setiferous granulae, absent between veins at apical margin. Pterostigma elongated. Sc+R branching at first quarter of wing. M bifurcated at nodal line level reaching wing margin by five branches. CuA branching just distal of Sc+R branching, C5 almost twice as long as C4. CuA1 and CuA2 unforked, both distally curved. CuP simple, reaching anal margin. Hind wings well developed. Sc+RA simple parallel to costal margin. RP with two branches basal of costal margin, separated from MA near coupling lobe. Six apical cells present. Hind wing not incised at cubital level. Only one vein between M and Cu; CuA1 not forked.

Male specimen. Left gonostylus well visible, basally rod-like, long, apically subrectangular.

**Note.** The type of this species is probably lost but according to the drawings of Germar & Berendt (1856), it looks very similar to our specimen. Additional information could be found in Szwedo *et al.* (2004: 42).

### Family Achilidae Stål 1866

#### Subtribe Cixidiina Emel'yanov 1992

#### Genus *Cixidia* Fieber 1866

#### *Cixidia christinae* n. sp. (Figs 10–20)

**Material.** Holotype specimen BA 4455, Muséum National d'Histoire Naturelle, Paris.

**Age and deposit.** Middle-Upper Eocene (circa 45 Ma), Baltic Amber, Poland.

**Etymology.** Named after Christine Lefebvre, first author's wife.

**Description.** Body large and slender. Vertex broader than long, flattened, with a median carina darker; posterior margin convex, situated at the level of the first fourth of the compound eyes. Frons and vertex forming an acute angle. Frons and postclypeus concolor dark brown; however a probable detachment of the tissue from the tegument makes the frons looking paler excepted for two thin transverse dark line across face dividing frons into equal thirds. Frons with a strong median carina continuing on postclypeus; in frontal view, lateral carinae regularly rounded, not concave at eye level. Labium long, surpassing by far metacoxae and reaching 8th sternite; apical segment nearly twice shorter than preapical one. Pronotal disc trapezoidal, with a strong median carina, anterior margin more or less straight; lateral carinae of disc almost straight, elevated, so disc depressed on each side of median carina. Dorsally, mesonotum with a strong median carina and indefinite lateral carinae. Hind tibia armed with a robust spine. Metatibiotarsal formula: 3-2-5/ 9?/9; apical metatarsal segment with seven setae below teeth; probably four on preapical segment.

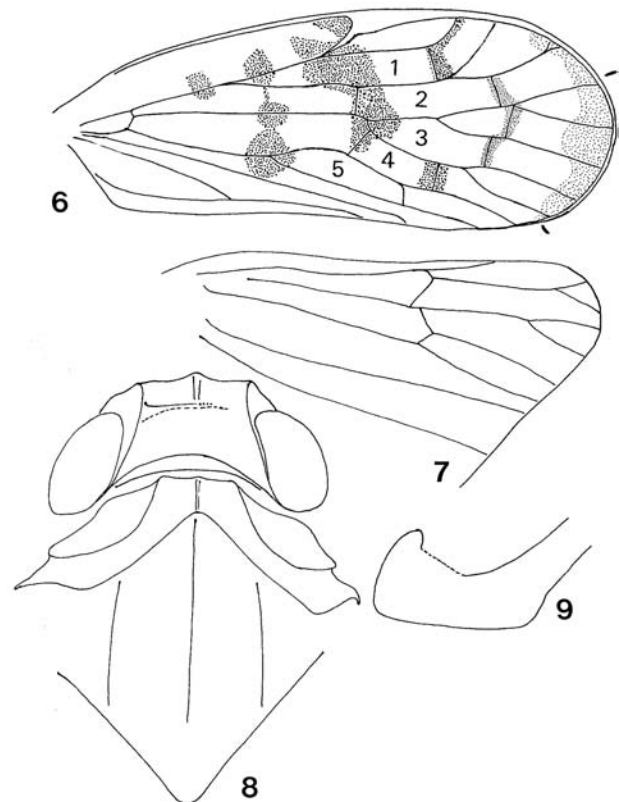
Tegmina showing traces of coloration, 6.6 mm long, width between pterostigma and apex of anal area 2.60 mm. Basal cell well developed and long. Sc and R basally fused into a common stalk; M branched on the basal cell. RA with six branches, RP 3-branched. M forking at nodal level, M1+2 and M3+4 very

short, forking basally, M1 two branched. CuA branching just after Sc and RP. CuA2 2-branched apically. A subapical line of transverse veins between RP branches to CuA2 forking. Cells C1, C2, C3 and C4 of almost equal length; C5 almost twice as long as other cells. A perpendicular cross-vein reaching posterior margin. CuA1 and first branch of CuA2 diverging apically.

Hind wings well developed. RP and M 2-branched; CuA1 3-branched. CuA1 and its posterior branch parallel to CuA2 and CuP. A1 separating in two branches at same level on anal fold. Posterior branch anastomosing with A2 bearing six blind branches vanishing in membrane except last one which reaches wing margin.

**Note.** According to the keys to Achilidae of Emel'yanov (1992, 1993) this specimen belongs without doubt to the subtribe Cixidiina Emel'yanov 1992: the second anal vein A2 is branched and several branches do not reach the wing margin, the branches of A1 diverge from the first anal fold at the same point. The labium is long and surpassing the metacoxae, and subapical setae are present on the first and second segment of the hind tarsi.

Despite the heterogenous nature of the genus *Cixidia* (a very probable non-monophyletic unit that needs



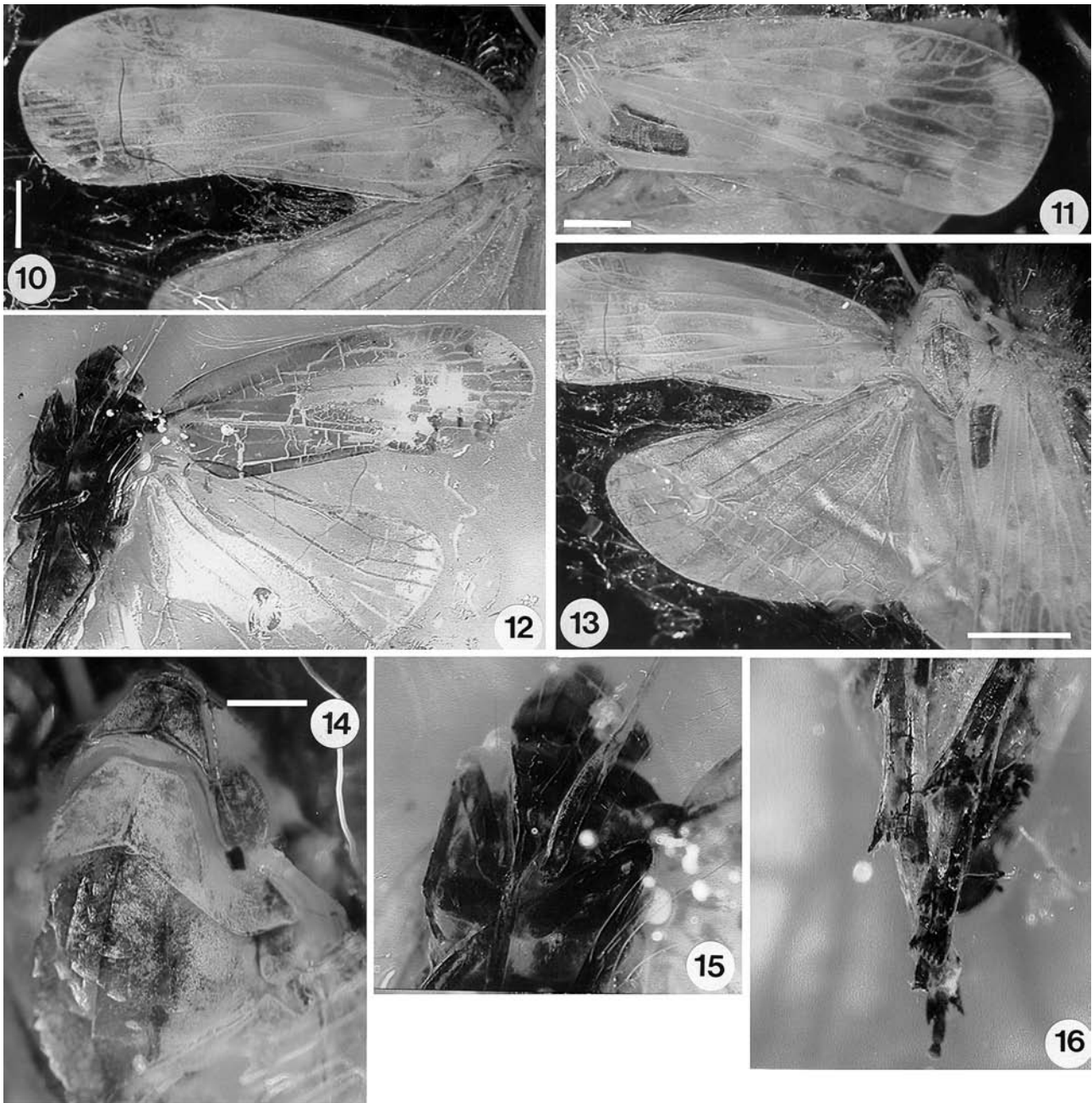
**Figures 6–9**

*Balticixius insignis* (Germar & Berendt 1856). **6.** Right tegmina (cells are numbered according to Bourgoïn, 1997). **7.** Right metathoracic wing, apical part. **8.** Head capsule and thorax, dorsal view. **9.** Left male gonostylus, apical part.

a revision as clearly shown by d'Urso & Guglielmino 1995) *C. christinae* appears to fall within the present generic definition. Therefore it is provisionally placed in this genus. Currently, about 12 different extant species have been already reported from the Palaearctic region and about 15 others from the Nearctic region under the genus *Epiptera* Metcalf 1922 (see Beirne 1950), which

has been recognized as a subgenus of *Cixidia* by Anufriev (1969).

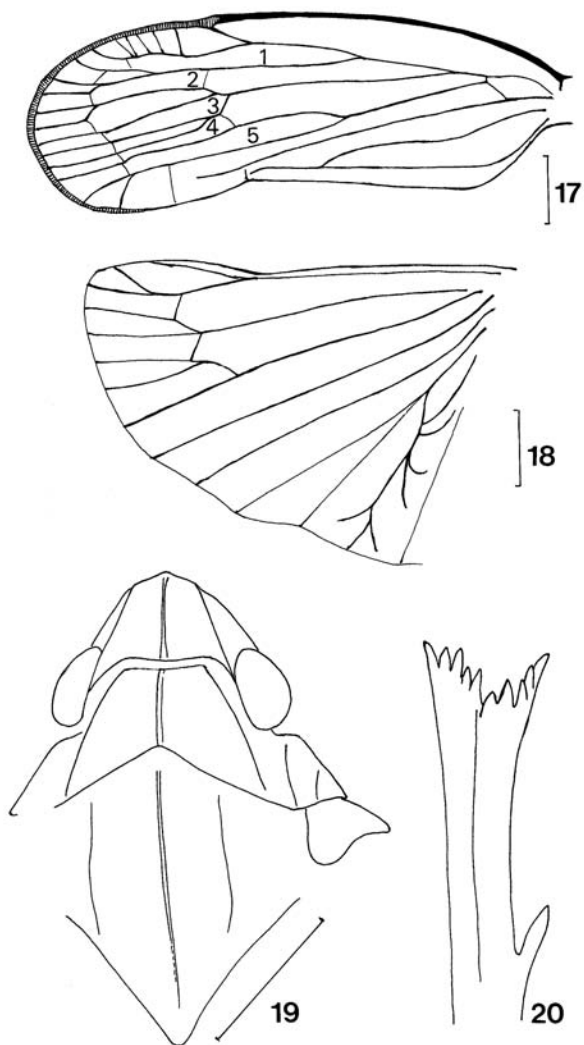
The two different subgenera, *Cixidia* s. str. (type species: *Cixius confinis* Zetterstedt 1840) and *Epiptera* Metcalf 1922 (type species: *Flata opaca* Say 1830), are separated according to head capsule and male genitalia characters. The frons and the vertex forming an acute



**Figures 10–16**

*Cixidia christinae* n. sp. **10.** Left tegmina. **11.** Right tegmina. **12.** Habitus, ventral side. **13.** Habitus dorsal view. **14.** Head capsule and thorax. **15.** Head capsule and thorax, ventral view. **16.** Metathoracic legs, ventral view (scale bars figs 10, 13 = 1 mm; 14–16 = 0.5 mm).

angle would allow to place *C. christinae* among the species of *Epiptera*. However d'Urso & Guglielmino (1995) have shown that this division was not supportable. Clearly, other set of characters should be also taken in consideration, as the prothoracic disc shape, the tegmina venation (particularly the fork level of M branches), and the anal veins distribution in the hind wing. As for many achilid genera, the results of such a study will be probably the redistribution of the currently known species among several smaller genera. For these reasons this new species is left under the genus *Cixidia* and not formally linked to the subgenus *Epiptera* which status needs to be re-evaluated.



**Figures 17–20**  
*Cixidia christinae* n. sp. **17.** Tegmina (cells numbered according to Bourgoin 1997). **18.** Forewing. **19.** Head capsule and thorax. **20.** Apical part of metatibia (scales = 1 mm).

The key to the Canadian species of *Epiptera* of Beirne (1950) leads to couplet 9: '*Epiptera*' *variegata* (Van Duzee 1908) from which *C. christinae* differs by a longer medio-carinated vertex. With *E. variegata* and *E. slossoni* (Van Duzee 1908) the fossil shares the regular convexity of the lateral margin of the frons, concave in the other Nearctic species.

From *C. lapponica* (Zetterstedt 1840) as illustrated by Emel'yanov (1993: figs 27–28), our species differs by CuA of the tegmen branching closer to Sc+R+M and the apical venation with few transverse veins forming only one subapical line. In the hind wing, it differs by the unbranched MA, the 3-branched CuA and the more apical last branching of A2.

From *C. confinis* (Ossianilsson 1978: fig. 711–712) and *C. (Epiptera) fusca* (Fennah 1950: fig. 6d), it differs by the early branching of M3+4 at the nodal line level.

From the three species studied by d'Urso & Guglielmino (1995), it shares with *C. marginicollis* (Spinola 1839) the strong frontoclypeal median carina absent in *C. pilatoi* d'Urso & Guglielmino 1995 and *C. sikaniae* d'Urso & Guglielmino 1995 and with this last species the conformation of the pronotum. Unfortunately, the genitalia are very difficult to observe to add further information on the relationships of this fossil with the extant '*Cixidia*' species.

The only other taxon to which our fossil could be compared is probably the achilid fossil *Protepiptera kaweckii* Usinger 1939. The too brief description of the latter without illustration, and the non availability of the specimen for a new examination, make such a comparison difficult. However, according to Usinger's description, *P. kaweckii* is probably not congeneric with *C. christinae* described here. Nevertheless some other extant *Cixidia* species could be congeneric with *Protepiptera*. In any cases this fossil would have to be re-analyzed in any future revision of the non-monophyletic genus *Cixidia*, as *Protepiptera* could have priority in description of new generic taxa for some of the species already described in *Cixidia*.

The presence of an insect taxon in the Eocene Baltic amber that is closely related to a group of genera present in North America and Europe is not surprising. It is already recorded for Odonata (Nel & Arillo 2006), and suggests that many insects with a recent holarctic distribution have an ancient history, much older than the Pleistocene.

### Genus *Angustachilus* n. gen. (Figs 21–27)

**Type species.** *Angustachilus longirostris* n. sp.

**Diagnosis.** Head capsule with vertex anterior to eyes, not separated by a transverse carina from frons. Frons

mediocarinated. Frontoclypeal fold absent. Labium very long, surpassing abdomen. Mesonotum bulged, 3-carinated. Hind tibia with one lateral spine. Metatarsomeres bearing subapical setae below apical teeth. Tegmina without setiferous granulae. Metathoracic wing with A1 branches diverging from first anal fold almost at same point.

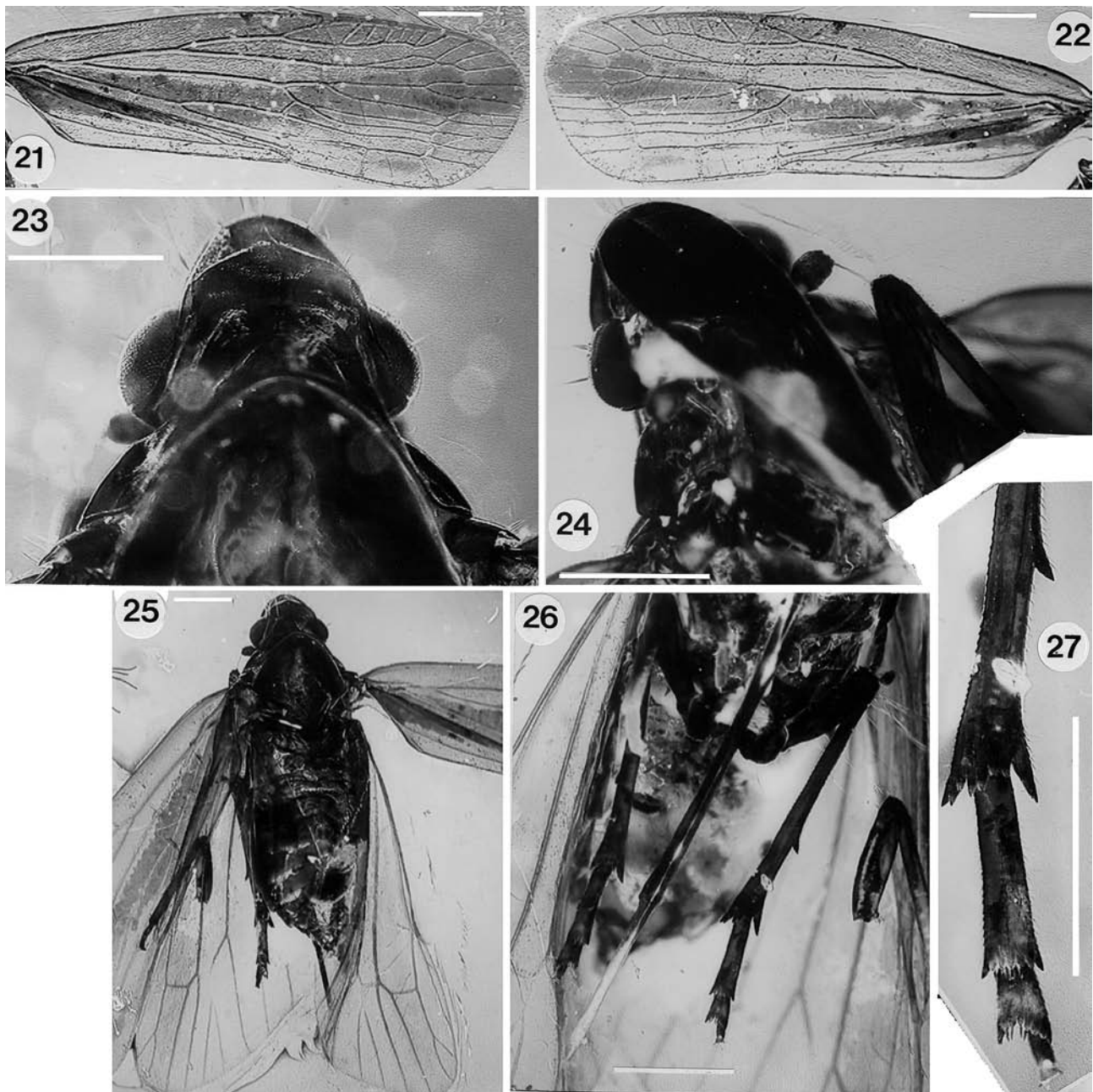
*Angustachilus longirostris* n. sp.

**Material.** Holotype specimen BA 4502, coll., Muséum National d'Histoire Naturelle, Paris.

**Age and deposit.** Middle-Upper Eocene (circa 45 Ma), Baltic Amber, Poland.

**Presentation.** This specimen is well preserved. The hind wings cannot be clearly observed in their anal part.

**Description.** Female specimen of general appearance of the body large and slender; unicolorous brown, except tegminae



Figures 21–27

*Angustachilus longirostris* n. sp. 21 and 22. Right tegmina from above and below. 23. Head capsule and thorax. 24. Head capsule, ventral view. 25. Habitus, dorsal view. 26. Apex of labium and abdomen in ventral view. 27. Left metatibia and tarsus (scale bars = 1mm).

paler with a longitudinal dark band. Head capsule with vertex not limited anteriorly but continuous into frons; flattened with a short median carina. Posterior margin angular, anterior to level of the anterior margin of eyes. Face large and flat. Frons long, thin and flat, its wider width at level of eyes, dorsal to antennae. A median carina evanescent at clypeus. Frontoclypeal fold absent and suture not visible. Clypeus long, postclypeus somewhat longitudinally medially inflated in its ventral part. Anteclypeus reaching level of procoxae. Labrum long and thin, surpassing level of mesocoxae. Labium very long extending far behind genitalia; preapical segment twice as long as apical segment. Pronotal disc anteriorly almost straight, flat with a median carina. Lateral carinae of disc slightly turning laterad, not reaching posterior margin of pronotum, evanescent laterally; a lateral carinae in front of each tegula. Mesonotum strongly bulged with a short median carina on anterior half of mesonotum, lateral carinae feebly marked, short not reaching anterior nor posterior margins. Metatibia with one lateral spine. Metatibiotarsal formula 5-2-2/8/9; second and third tarsomeres with 4 and 4-6 (?), hardly visible) setae below the row of spines.

Tegmina elongated; length 8.4 mm. Sc+R+M in a common stalk. RA with seven branches. RP with three branches. M branching first at nodal level, M1+2, short branching shortly after M3+4. M1 2-branched. CuA forking at same level as Sc + R. CuA1 unbranched; CuA2 2-branched. A longitudinal dark band between M and Pcu, slightly bended toward costal margin distal of the nodal line level. The hind wings are difficult to observe in their anal part folded along the body. RP and M 2-branched; CuA1 3-branched. CuA1 and its posterior branch parallel to CuA2 and CuP. A1 divided into two branches. Wings folded after anal fold and posterior branch of A1 difficult to observe. Anterior branch of A1 well visible, separating from anal fold shortly after posterior branch; this last branch apparently 2-branched more distally, but apical portion of wing missing. A2 anastomosing with posterior branch of A1.

**Note.** According to the anal venation in the hind wing this genus belongs to the supertribe Achilites recognised by Emel'yanov (1992, 1993). The long labium is characteristic of the Achilini Stål 1866. Blind branches in the anal system seem probable, while it not clearly observable due to the folding of the wing just at this level. The anterior branch of A1 emerges from the anal fold almost at the same place as A1 posterior, which leads us to place this new genus within the Cixidiina Emel'yanov 1992. This placement is also in agreement with the presence of subapical setae on the first and second segments of metatarsi.

*Angustachilus* looks rather different from all described species of the *Cixidia* group, by its pronotum conformation and particularly its disc, the strongly bulged mesonotum, the very long face, and the labium extending far behind the genitalia. With *Protepiptera*, *Angustachilus* shares a vertex distinctly placed anteriorly to the eyes (but it is also the case of *Cixidia sikaniae* d'Urso & Guglielmino 1995) but the other characters listed by Usinger (1939) require this new fossil to be placed in a different genus.

As for *C. christinae* n. sp., *Angustachilus longirostris* n. sp. will have to be compared to the extant *Cixidia* species, in a future revision of the Cixidiina.

**Acknowledgements.** We sincerely thank Dr Jacek Szwedo for his kind help and remarks.

## References

- Anufriev G. A. 1969.** Notes on the synonymy of some homopterous insects from Eastern Asia (Homoptera, Auchenorrhyncha). *Bulletin of the Polish Academy of Science, Biological Science* 17: 179-180.
- Anufriev G. A., Emel'yanov A. F. 1988.** Suborder Cicadinea (Auchenorrhyncha). Fulgoromorpha, p. 319-495 in: *Opredelitel' nasekomykh Dal'nego Vostoka SSSR*. Nauka, Leningrad, 495 p.
- Beirne B. P. 1950.** The Canadian species of Epiptera (Homoptera: Achilidae). *Canadian Entomologist* 82: 186-190.
- Bourgoin Th. 1997.** The Meenoplidae (Hemiptera, Fulgoromorpha) of New Caledonia, with a revision of the genus *Eponisia* Matsumura, 1914, and new morphological data on fore wing venation and wax plate areas. In **Matile, L., Najt J., Tillier S.** (eds), *Zoologia Neocaledonica, 3. Mémoires du Muséum national d'Histoire naturelle (Zoologie)* 171: 197-250.
- Burmeister H. 1835.** Schnabelkerfe. Rhynchota. *Handbuch der Entomologie*, 2 (1): 1-396.
- Emel'yanov A. F. 1983.** Nosatka iz mela Taïmyra (Insecta, Homoptera). [Dictyopharidae from the Cretaceous deposits on the Taïmyr Peninsula (Insecta, Homoptera)]. *Paleontologicheskii Zhurnal* 17 (3): 79-85. [In Russian]
- Emel'yanov A. F. 1992.** Toward the problem of the limits and subdivisions of Achilidae (Homoptera: Cicadina). *Entomological Review* 71 (1): 53-73.
- Emel'yanov A. F. 1993.** Description of tribes of the subfamily Achilinae (Homoptera: Achilidae) and revision of their composition. *Entomological Review* 72 (6): 7-27.
- Fennah R. G. 1950.** A generic revision of the Achilidae (Homoptera: Fulgoroidea) with descriptions of new species. *Bulletin of the British Museum of Natural History, Entomology* 1 (1): 1-169.
- Germar E. F., Berendt G. C. 1856.** Die im Bernstein befindlichen Hemipteren und Orthopteren der Vorwelt, p. ii + 1-40. In: **Berendt, G.C.** (ed.), *Die im Bernstein befindlichen organischen Reste der Vorwelt*, Commission der Nicolai schen Buchhandlung, Berlin 2 (1).
- Holzinger W. E. 2002.** A review of the European planthopper genus *Trirhacus* and related taxa, with a key to the genera of European Cixiidae (Hemiptera: Fulgoromorpha). *European Journal of Entomology* 99: 373-398.
- Metcalf Z. P. 1922.** On the genus *Elidiptera* (Homoptera). *Canadian Entomologist* 54: 263-264.
- Nel A., Arillo A. 2006.** The first Baltic amber dysagrionine damselfly (Odonata: Zygoptera: Thaumatozauridae: Dysagrioninae). *Annales de la Société Entomologique de France (n.s.)* 42(2): 179-182.
- Ossiannilsson F. 1978.** The Auchenorrhyncha (Homoptera) of Fennoscandia and Denmark. Part 1: Introduction, infraorder Fulgoromorpha. *Fauna Entomologica Scandinavica* 7 (1): 222 pp.
- Szwedo, J., Bourgoin Th., Lefebvre F. 2004.** *Fossil Planthoppers (Hemiptera: Fulgoromorpha) of the world. An annotated catalogue with notes on Hemiptera classification*. Warsaw, 199 p.
- d'Urso V., Guglielmino A. 1995.** Taxonomic remarks on Italian *Cixidia* with description of two new species (Insecta, Homoptera, Auchenorrhyncha, Achilidae). *Spixiana* 18 (1): 49-64.
- Usinger R. L. 1939.** *Protepiptera*, a new genus of Achilidae from the Baltic amber (Hemiptera, Fulgoroidea). *Psyche* 46 (2) : 65-67.