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Apterous Phylloxeroidea (Hemiptera, Sternorrhyncha) from Baltic amber

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Abstract. Aphids are marked by their high polymorphism, but species reported from Baltic amber are known only from one morph. Aphids most frequently observed in Baltic amber belong to the genus *Germaraphis* HEIE but only apterous morphs and larval forms are aboundant. On the other hand, the genus *Mindarus* KOCH is known only from alate morphs. Of superfamily Phylloxeroidea (comprising Adelgidae, Elektraphididae and Phylloxeridae) only the extinct family Elektraphididae is known from Baltic amber. Although as many as 10 species have been described, only alate morphs have been reported. In collection of the Museum of the Earth in Warsaw apterous representatives of Adelgidae (*Adelges balticus* sp. n.) and Phylloxeridae (*Acanthochermes longirostris* sp. n.) have been found and described.

Key words: Fossil insects, new species, Aphididae, Phylloxeroidea, Baltic amber.

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I. INTRODUCTION

Aphids are marked by their high polymorphism. Species are often represented by both apterous (males, sexual females, viviparous females) and alate morphs (males, viviparous females). Taphonomic conditions are important factors that determine the chances of fossilisation of particular morphs. Only alate forms, constituting the aeroplankton, are preserved as imprints. Both alate and apterous morphs are found in amber, although with varied frequency. Species reported from Baltic amber (most fossil aphid species have been described from this source) are often known from only one morph. Aphids most frequently observed in Baltic amber belong to the genus *Germaraphis* HEIE, 1967, but only apterous morphs and larval forms are abundant. On the other hand, the genus *Mindarus* KOCH, 1857 is known only from alate morphs. This paradox is the more striking that *Germaraphis* was almost certainly connected with deciduous trees, while *Mindarus* was and still is connected with coniferous trees.

The families Adelgidae, Elektraphididae, Mesozoicaphididae and Phylloxeridae constitute the superfamily Phylloxeroidea. Only the extinct family Elektraphididae is known from Baltic amber. Although as many as 10 species have been described, only alate morphs have been reported to now. Recently also apterous morph have been found, and they are the subject of the present study.

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II. MATERIAL AND METHODS

In the collection of the Museum of the Earth in Warsaw (ME) apterous representatives of Phylloxeroidea were found by R. KULICKA. Material used in the present work consists of Eocene aphid inclusions in pieces of Baltic amber from the Polish coast. The pieces were cut and polished. Description, photographs and drawings were taken with an optical microscope (Olympus SZH, Nikon Microphot -FX). Drawings were made with camera lucida.

All measurements are given in mm.

III. SYSTEMATICS

Family: **Adelgidae** ANNAND, 1928

Genus: ***Adelges*** VALLOT, 1836

Adelges* (*Adelges*) *balticus, sp. n.

D i a g n o s i s. Body covered with gland plates; antennae three segmented, terminated with a long apical seta of approximately the same length as last antennal segment; rostrum reaches mid abdomen, apical rostral segment slender; tarsi with apical setae.

E t y m o l o g y. The name refers to Baltic amber.

H o l o t y p e. 14699 ME; 1st instar larva; dorsal part of thorax, left side and the apex of abdomen, and the base of rostrum clouded with a milky film.

D e s c r i p t i o n. Body elongated (0.52), oval (0.23 in widest point). Anterior margin of head convex, with small incision in middle (Fig. 1a). Between antennae, in ventral view, gland plates with two pairs of short hairs are present, one at head margin, the other at base of antennae. Three segmented antennae inserted ventrally in deep antennal fossae. Length of antennal segments: I-0.02, II-0.04, III-0.04; segments II and III with transverse striae; chaetotaxy visible only on last segment – a single seta at segment base, two subapical setae, and very long (0.05) apical seta (Fig. 1c). Triommatidia placed at sides of head on distinct swellings (Fig. 1b). Clypeus very well developed, covering most of ventral part of head. Rostrum long, reaching abdominal segment V-VI. Second rostral segment with a number of constrictions in apical part (Fig. 1d); third rostral segment 0.04 long. Apical rostral segment slender, more than twice as long (0.07) as wide at base (0.03) with two short setae at apex. Legs short, stout (Fig. 1g). Coxae small (mid pair 0.03 long); femora short and stout, fore and mid pairs 0.07 long, 0.03 wide; tibiae also very short and strong, fore pair 0.05 long, 0.02 wide, hind pair 0.09 long. In apical part of tibiae scarce setae, shorter than segment diameter are present. At base of tarsus a pair of setae placed ventrally, longer than the diameter of the second segment; another pair of shorter setules at the base of claws (Fig. 1g). Apical setae capitate, approximately as long as tarsal segment II (0.03). Dorsal part of abdomen with four rows of gland plates (Fig. 3). Spinal pleural plates placed in two rows, rectangular, with external margins oval. Marginal plates irregular in shape, extending onto ventral part of abdomen. Apical part of abdomen with scarce short hairs at sides, and at its ventral and dorsal portions. Last abdominal sternite rhomboidal.

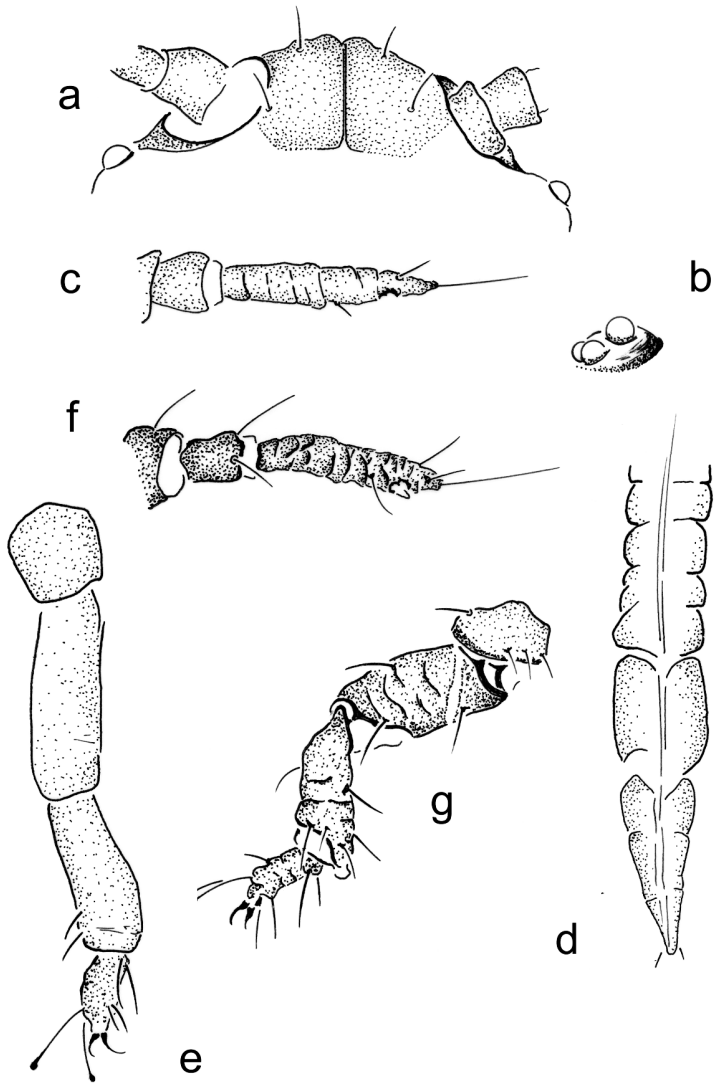

Fig. 1. *Adelges balticus* sp. n., holotype (inv. No. 14699 ME): a – head, b – triommatidium, c – antenna, d – rostrum, e – leg; *Adelges* (*Dreyfusia*) *piceae* (RATZEBURG, 1844): f – antenna g – leg.

R e m a r k s. The developmental cycle of Adelgidae is marked by an overwintering larval stage (1st instar). Antennae in larvae consist of three segments. The antennae in the newly described species bear a long apical seta on the last segment (Fig. 1c), in which they resemble a Recent species of the subgenus *Dreyfusia* BÖRNER, 1908 (Fig. 1f); (classification after BLACKMAN & EASTOP 1994). The new species differs from representatives of this subgenus in the abdominal spinal and pleural plates being fused. The fusion is observed in overwintering larvae (on a secondary host) of the subgenus *Aphrastasia* BÖRNER, 1909. The latter group is closely related with *Dreyfusia*. The described species differs from recent representatives of the family Adelgidae by the long rostrum, with the apical segment considerably longer than its width at base.

Family: **Phylloxeridae** HERRICH-SCHAEFFER, 1857

Genus: ***Acanthochermes*** KOLLAR, 1848

Acanthochermes longirostris sp. n

D i a g n o s i s. Dorsal part of body covered with microsculpture; antennae three segmented, last segment with two apices – a genuine apex of antenna and a pointed nib formed by a strongly projecting rhinarium; rostral segments III and IV extend beyond end of body; one-segmented tarsi with capitate apical setae.

E t y m o l o g y. The name refers to the long rostrum.

H o l o t y p e: 17410 ME; 1st instar larva; well preserved inclusion with a mite larva in the same piece.

D e s c r i p t i o n. Body elongated (0.33), oval (0.17 in widest point), dorsally covered with distinct microsculpture (Figs 2d, 4.). Anterior margin of head convex, with two pairs of capitate setae between antennae. Antennae three segmented, inserted ventrally (Fig. 2b). Length of antennal segments: I- 0.02, II- 0.03, III- 0.08; first segment with single hair, second segment with two hairs. Third segment with distinct transverse striae, in its apical part a small granule with single long seta at base (twice longer than segment's width) and three shorter setae (shorter than segment diameter). Rhinarium on third segment strongly produced apically (Fig. 2b). Triommatidia placed at sides of head. Clypeus very well developed, covering most of ventral part of head. Rostrum very

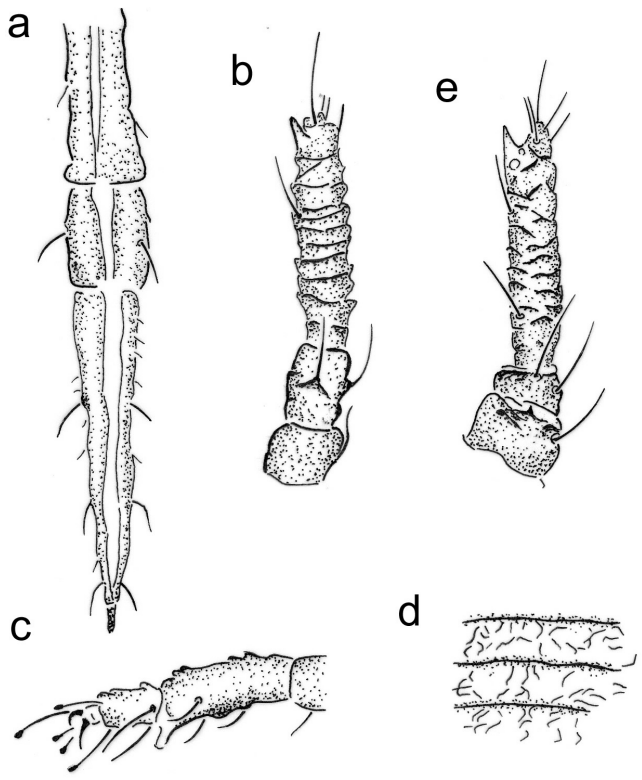

Fig. 2. *Acanthochermes longirostris* sp. n., holotype (inv. No. 17410 ME); a – rostrum, b – antenna, c – leg, d – microsculpture; *Acanthochermes quercus* KOLLAR: e – antenna (after GRASSI). Measurements in text.

long, extending beyond body (Fig. 4); segment III 0.04 long, 0.03 wide; IV: 0.10 long, 0.02 wide at base. Last rostral segment with row of short hairs and three pairs of longer hairs along sides (Fig. 2a). Legs (Fig. 2c) short and stout. Mid coxae 0.03 long, with a single seta; fore and mid femora 0.06 long, 0.02 wide, femora with 2-3 setae not longer than segment width; tibiae with numerous setae, in apical part with a characteristic expansion on ventral surface, which facilitates leg's adhesiveness; fore and mid tibiae 0.05 long, 0.02 wide. Tarsi one-segmented, length of fore tarsus 0.03. Tarsi with three pairs of hairs; pointed hairs placed ventrally at base of tarsus, long capitate hairs situated both ventrally and dorsally at base of claws, and another single long capitate hair observed on dorsal part of last segment. Abdomen with a distinctly marked segmentation, with very short setae (shorter than hairs on apical segment of rostrum) at sides in apical part. Tergite of last abdominal segment semicircular, distinctly narrower than others.

R e m a r k s. The structure of the last antennal segment (rhinarium projected in the form of a process) is characteristic of larvae of the genus *Acanthochermes* (Fig. 2e). The new species has a very long rostrum; in Phylloxeridae the longest rostrum is observed in representatives of the genus *Phylloxerina* BŐRNER, 1908, but it does not extend beyond the body.

IV. DISCUSSION

The oldest representatives of the aphid superfamily Phylloxeroidea are already known from Canadian amber (Campanian Stage, 82-70 million years ago) (HEIE & PIKE 1992). Species described from this source have been placed in the fossil Cretaceous family Mesozoicaphididae HEIE. Representatives of this group (only apterous morphs are known) differ from the representatives of the other three families (Elektraphididae, Adelgidae, Phylloxeridae) in the long rostrum and the elongated second segment of antennae (HEIE & PIKE 1992). Another fossil family are Elektraphididae, with the oldest representatives known from Taimyr amber (Coniacian-Santonian) (KONONOVA 1976). Most of the species described in this family come from Baltic amber (HEIE 1967; STEFFAN 1968; WĘGIEREK 1996). The group died out in the Upper Pliocene (HEIE 1968). Until recently, the families Adelgidae and Phylloxeridae have not been reported from Baltic amber. The oldest Adelgidae are known from the Upper Pliocene (HEIE 1968), while Phylloxeridae from the Lower Miocene (HEIE & PEÑALVER 1999).

Of the superfamily Phylloxeroidea only representatives of the family Elektraphididae have been described from Baltic amber. It would seem then that the apterous morphs of Phylloxeroidea found in the Museum of the Earth represent species described within Elektraphididae on the basis of alate morphs (only such are known). However, an analysis of the structure of rostrum, its length, and the shape of the last segment shows considerable differences between the described species and the representatives of Elektraphididae. At the same time, a very characteristic structure of antennae in *Adelges balticus* sp. n. (Fig. 1c, 3.) and *Acanthochermes longirostris* sp. n. (Fig. 2b,4.), and their affinity with recent genera, *Adelges* (*Dreyfusia*) and *Acanthochermes* respectively, suggest that the new species should be placed in the recent families Adelgidae and Phylloxeridae.

Little is known about the biology of Elektraphididae. Their close relationship with Adelgidae (HEIE 1976) suggests a holocyclic life cycle, with both alate and apterous morphs (STEFFAN & SNCHLÜTER 1981). The fact that so far no apterous morphs of Elektraphididae have been found in amber, and that, until recently, Adelgidae (now connected only with Pinaceae) were not known from inclusions, may be due to their life cycle being largely confined to galls. Representatives of the two families had different life cycles. In Elektraphidide the flight occurred in warm seasons, when resin was viscous. Hence, representatives of this family are rather frequent in Baltic amber. In Adelgidae the flight of alate morphs occurred in colder seasons, which corresponds to the distribution of recent representatives of the family in colder climatic zones of the Holarctic (BLACKMAN & EASTOP 1994).

Fig. 3. *Adelges balticus* sp. n., holotype (inv. No. 14699 ME), dorsal view.

Fig. 4. *Acanthochermes longirostris* sp. n., holotype (inv. No. 17410 ME), dorsal view.

Recent representatives of the family Phylloxeridae also occur in the Holarctics. However, this group is connected with dicotyledons (mostly Juglandaceae and Fagaceae). The genus *Acanthochermes* is represented by a single species *Acanthochermes quercus* KOLLAR 1848 which occurs from Europe (GRASSI 1912); the only species of the family Phylloxeridae whose females retained the ovipositor (a plesiomorphic feature). It lives on oaks, which are very often found in the amber forest. The fact that representatives of this group are so rare in the fossil record may be explained by an extreme simplification of their life cycle. *Acanthochermes* has only two generations a year, fundatrices and sexuales. The fundatrices induce small ring-shaped galls on the upper surface of the leaf. The life cycle terminates as early as in the beginning of summer with laying winter eggs on twigs.

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