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PROTOORBELLIA HOFFEINSORUM GEN. AND SP. NOV., A NEW HELEOMYZID GENUS AND SPECIES OF THE TRIBE ORBELLIINI GORODKOV FROM BALTIC AMBER (DIPTERA: HELEOMYZIDAE)

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Abstract.— The first finding of representative of the tribe Orbelliini as inclusion is presented with description of a new genus *Protoorbellia* for a new species *Protoorbellia hoffeinsorum* from Baltic amber. The taxonomic position and relationship within the tribe Orbelliini is discussed. A key to the all genera within the tribe is presented.

Key words.— Diptera, Heleomyzidae, *Protoorbellia*, new genus, new species, phylogeny, Eocene, Baltic amber, Baltic Sea coast, Kaliningrad Region, Yantarnyï district.

Introduction

Heleomyzids (Diptera: Heleomyzidae) in the sense of Gorodkov 1972 are medium sized flies, found in all zoogeographic regions although species richness is highest in the Northern Hemisphere and in the mountainous areas in subtropics and tropics. Fossil representatives of this family are known from Baltic amber (6 species – Hennig 1965, Woźnica and Palaczyk 2005), compression and copal (10 other species – Evenhuis 1994). One species described from copal as *Trixoscelis patefacta* Melander, 1949 is a typical representative of the Trixoscelididae, occasionally considered as a subfamily within Heleomyzidae, but treated as a valid family by Cogan (1977). Among heleomyzids sent for study by Christel and Hans Werner Hoffeins of Hamburg, an undescribed species representing an unknown heleomyzid genus has been found and is described herein. It is placed within the tribe Orbelliini Gorodkov, 1972 of subfamily Heleomyzinae (Gorodkov 1972). The tribe Orbelliini was formed to contain two genera: *Orbellia* Robineau-Desvoidy, 1830 (13 known species) and *Oldenbergiella* Czerny, 1924 (7 species), based on a combination of characters given by Gorodkov (1972: 81). McAlpine (1985) reclassified the Heleomyzidae into 22 tribes and Gorodkov's work has mostly been disregarded. According to the broad tribal concept, McAlpine treated all genera of subfamily Heleomyzinae and Heteromyzinae in the sense of Gorodkov (1972, 1984) synonymously. However, this work has not been generally accepted (Papp 1998, Woźnica 1993, 1998, 2002). In the same year Hackmann and Väisänen (1985) noted the specific type of wing chaetotaxy in two *Orbellia* species (as type A_1 and A_2) contrary to the B_3 type of examined individuals of Heleomyzini and Heteromyzini. The status of Orbelliini is presented and discussed and the autapomorphies for the newly described genus are presented herein. It should be noted that all genera of the tribe are typical representatives of Heleomyzinae in the sense of Gorodkov (1972). Like other representatives of this subfamily the frontal plate is parallel to eye margin, central cheek bristle is absent (contrary to Heteromyzinae), proepimeral bristle is well developed, more than one ventral bristles on mid tibia are present, and anal vein distinctly reaches the wing margins. The morphological terminology and abbreviations follow those proposed by Woźnica (2003).

Materials

Although most specimens for this study are collected at the Department of Zoology and Ecology, Agricultural University, Wrocław (DZEAU), some spec-

imens deposited at the Zoological Institute of Russian Academy of Science, St. Petersburg (ZIRANSP, Russia) and Zoological Museums in Lund and Stockholm (LUZ and NHRS, Sweden) have been analyzed.

Systematics

Order **Diptera** Linnaeus, 1758

Family **Heleomyzidae** Bezzi, 1911

Subfamily **Heleomyzinae** Bezzi, 1911

Tribe **Orbelliini** Gorodkov, 1972

Remark. An application has been made to ICZN by Woźnica and Zatwarnicki in 1990 to validate the family name Heleomyzidae, first used by Bezzi in 1911 (case no. 2743) before Heteromyzidae Fallén, 1820 and Helomyzidae Westwood, 1840, which was based on *Helomyza* sensu Westwood, 1840 (= *Suillia* Robineau-Desvoidy, 1830).

Key to the identification of the genera of tribe Orbelliini Gorodkov

1. Costal spines minutely or reduced, presutural dorsocentrals absent (0+3), anterior scutellar bristles much shortened (2 pairs only) . . . . . ***Oldenbergiella*** Czerny, 1924
–. Costal spines distinct, especially before subcostal break, presutural bristles present, 2 pair of scutellars equal in length or 3 pairs of its **2**
2. One preapical bristle on midtibia, two proepimeral seta present, 1 +3 dorsocentrals. . . . . ***Protoorbellia*** gen. nov.
–. Two preapical bristles on midtibia, one proepimeral seta only, 5 or more dorsocentrals. . . . . ***Orbellia*** Robineau-Desvoidy, 1830

Protoorbellia gen. nov.

Type species. *Protoorbellia hoffeinsorum* sp. nov.; present designation.

Diagnosis. *Protoorbellia* appears to be closely related to *Orbellia* Robineau-Desvoidy, 1830 but differs distinctly from it by having two proepimeral bristles, one preapical bristle on mid tibia and in the number of dorsocentrals (1+3 pairs only). *Protoorbellia* differs from *Oldenbergiella* Czerny, 1924 by having well developed presutural dorsocentral bristles, two proepimeral bristles, two well developed katepisternals, and 2 pairs of uniformly developed scutellars. The characters of the proepimeron and mesonotum chaetotaxy constitute the autapomorphies of *Protoorbellia*.

Etymology. The name is derived from Greek 'protos' means 'first' and the genus name *Orbellia*. Gender: feminine.

Protoorbellia hoffeinsorum sp. nov.
(Figs 1–4)

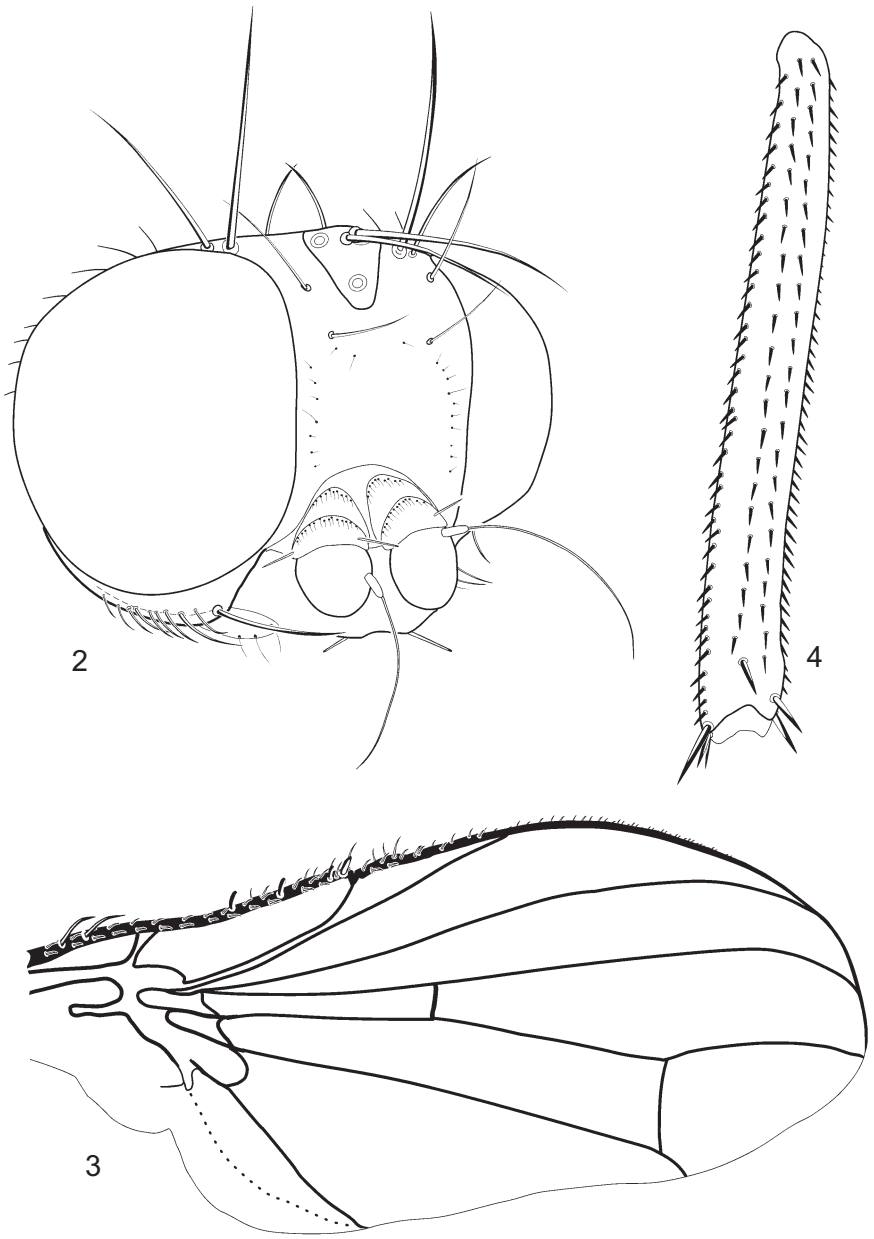
Diagnosis. As for the genus, as it is the only included species.

Description. Body color is orange-brownish and shiny (Fig. 1). Body length: ca. 4.15 mm (without antennae).

Head ratio about 1.1 (Fig. 2). One vibrissa is present, peristomal setulae are well developed and slightly greater near the vibrissa, in one irregular row. Eyes round, without silver-grayish dusting around eye margin. Cheeks are small (cheek-eye ratio less than 0.3). Face is similar in color to the cheeks area. Hypostom orange-brownish, palpus thin, regularly broad and rounded apically, uniformly colored (more brownish than genal part) with some setulae on the lower margin.

The antennal bauplan is similar to that in *Orbellia* with a deflexed antenna between scape and pedicel. Scape and pedicel slightly paler in color than first flagellomere. Pedicel with big apical seta anterodorsally. First flagellomere large, round and more brownish than remaining segments (first flagellomere to cheek ratio more than 1.0). Arista bare, shorter than height of the head, brownish in color, with swollen basal part. Frons is covered by few and small setulae, and entirely orange in color. Frontal plate is elongated, with two orbital bristles, the anterior about half as long as the posterior. The distance between these bristles is shorter than the distance from anterior orbital bristle to frontal margin. A pair of strong ocellar bristles present. Vertical bristles are well

Figure 1. *Protoorbellia hoffeinsorum* sp. nov. Habitus.



Figures 2–4. *Protoorbellia hoffeinsorum* sp. nov. (2) Head; (3) wing; (4) midtibia.

developed, the inner one distinctly longer than the outer one. Postocellar setae medium sized and cruciate.

Thorax. Mesonotum shows typical chaetotaxy (as in *Orbellia),* except for the number of dorsocentrals, and acrostichals. One, well developed postpronotal bristle, two notopleural bristles, one presutural, one supra-alar and two post-alar bristles are present. Mesonotum and pleurae are entirely orange-brown. Mesonotum is sparsely setulosed with a few but irregular rows (4–6) of acrostichal setulae. Four pairs of dorsocentral bristles are present; all of them are not arising from spots. Dorsocentral bristle relatively strong, but last two distinctly stronger. A pair of prescutellar bristles is well developed. Scutellum is bare, except for two pairs of almost equal-sized scutellars. Scutellum broad, not pointed apically, and orange-brown in color. Proepimeron setulose with two well developed proepimerals. One stigmatal seta with no additional setae in anterior corner of anepisternum is present. Anepisternum and meron entirely bare. Katepisternum is bare, except for the setulosed margins between coxae. Two distinct katepisternal bristles, the anterior weaker and about half as long as the posterior one, and with a few small hair-like setulae anteriorly.

Wing (Fig. 3) is longer than total length of the body, ca. 4.35 mm, width ca. 1.7 mm. Wing membrane is transparent with well developed anal vein. Costa with short and weak costal spines dorsally, especially anterior to subcostal break, in the type 'A', as classified in Hackmann and Väisänen (1985: 81). Subcostal cell is similar to those of *Orbellia* species, while subcostal vein is ending behind anterior cross-vein. Longitudinal veins are pale-brown in color. Cross-veins are not darkened, *r-m* and *dm-cu* well developed and, *dm-cu* slightly oblique. Medial vein ratio ca. 1.165 (left wing). Halteres are not visible, totally covered by wings.

Legs normal, mainly short setulose and orange brown in color. All legs typically with setulosity as in other genera of Orbellini. Fore femur with two rows of strong bristles antero-, and posterodorsally. Mid femur is noted with one well developed anterodorsal bristle and with longer hair-like setae posteroventrally, thicker in the apical part. Hind femur with two distinct dorsolateral bristles is observed. All tibiae short setulose, each with well developed, but single preapical bristle. Mid tibia revealed a few ventral, apical setae (Fig. 4). Tarsomeres are not darkened. First tarsomere of all tarsi is longer than the second one (first tarsomere of foreleg is much longer; at least twice as long as the second segment). Pulvilli are small and whitish.

Abdominal segments orange-brownish and shiny. Their number of segments is very difficult to establish, since in great part, they are covered by the wing and even

slightly molded. They are rather short and sparsely setulose with weak lateral marginal bristles. Epandrium is orange-brownish in color, big and rounded, short and sparsely setulose. Anus is big, with slightly elongated cerci. One pair of elongated dististyli is present. Dististyli are symmetrical, flattened with a regular tapering. Distiphallus is probably broad (apex poorly visible), probably with a complex structure, and not band-like as in the tribe Heleomyzini in the sense of Gorodkov (1984).

Type material. Holotype male; to be deposited in Deutsches Entomologisches Institut (DEI) at Zentrum für Agrarlandschafts und Landnutzungsforschung ZALF e. V., Müncheberg (formerly Eberswalde), Germany. Labelled: No. 1551b / Balt. Amber. Coll. Christel and Hans Werner Hoffeins. Fam. Heleomyzidae ?Heteromyza (white)/ *Protoorbellia hoffeinsorum* Woźnica gen. et sp. n. [M] (red).

Etymology. The new species is dedicated to Christel and Hans Werner Hoffeins, for their enthusiasm, to collect and work out the fascinating arthropods specimens preserved in amber as inclusions.

Discussion

The newly described genus (Figs 1–4), is a typical representative of the subfamily Heleomyzinae and bears the following characters: distinct preapical bristles present on all tibiae, wings with well developed costal spines and anal vein reaching wing margin, as well as one pair of dististyli only. It is a representative of Orbelliini (with typical elongated subcostal cell), which differs from all known genera by the presence of two proepimeral bristles, four pairs of dorsocentrals and one preapical bristle on midtibia. Some of the characters, which distinguish *Protoorbellia* from other Heleomyzidae can be recognized as homoplasies in different taxa (i.e. the subcostal vein ending behind anterior cross-vein is typical for the genus *Heteromyza* Fallén, 1820, two preapical bristles are respectively an excellent differential character in some species of *Eccoptomera* Loew, 1862). The shape of distiphallus which is broad and with a complicated structure in Orbelliini is present in the tribe Oecotheini (Gorodkov 1972, Woźnica 1993). Presence of one preapical bristle on midtibia, and distinct stigmatal seta constitute plesiomorphic characters states of the genus. The apomorphic characters are as follows: two proepimeral setae, minute acrostichals, only four pairs of dorsocentrals. *Protoorbellia* is closely related to the extant genus *Orbellia*. Like in *Orbellia,* the *Protoorbellia* has two orbitals, which are unequal in length (but not extending from the frontal plate and not as long as in *Oldenbergiella*) and similar wing venation. Gorodkov (1972) described some new *Orbellia* species and noted a high variability in number of dorsocentral bristles in some specimens of *O. tetracheta* and *O. montana*. The number of dorsocentrals could be really various, but the total number of it is until the end of time five pairs or more. It should be noted that the specimens of *Orbellia* examined are in agreement with those described by Czerny (1924, 1937), Gill (1962) and Gill and Peterson (1987) and have on the mesonotum two distinct presutural dorsocentral bristles.

Distribution. Gorodkov (1972) presented the current distribution of Orbelliini and suggested that all of them are distributed in the Northern Hemisphere only, where the climate has well distinguished seasons with relatively long spring and a rather mild winter. In the past (Late Eocene) the Northern Region was covered with mixed forests (coniferous and broadleaves plants) and mixed forests with subtropical elements, such as some palms genera (Archibald and Farell 2003). Gorodkov (1972: 76) suggested that the hypothetical ancestor of Orbelliini was living where the climate changed seasonally, and by relatively long but mild winter. He pointed out that true cold-adapted Heleomyzidae cannot live in hard and cold climate with very long and frosty winter. This is in agreement with the opinion of Archibald and Farrell (2003) as for the climate changes in the Late Eocene. According to Gorodkov (1972: 76, Fig. 14 and p. 79, Fig. 15) one of the centres of its current distribution correlates well with the appearance of "amber forests" in the Late Eocene (Central and Northern part of Europe). At present the Orbelliini are restricted to a few refugees (one large refugium in the Nearctic Region and most in Europe, widely separated by the continental Asian Plate from the Amurian–Japanese refugee).

Phylogenetic considerations. The phylogenetic analysis was performed by using Hennig86, a computerized algorithm that produces cladograms by parsimony with Tree Gardener 2.2 for Windows. Character data were polarized by using outgroup procedures. Using the ie* (implicit enumeration*) option of Hennig86, which is a complete search, a single most parsimonious tree was generated from the analysis of the 9 characters. The genus *Oldenbergiella* was considered the outgroup in the phylogenetic analysis.

Characters used in the phylogenetic analysis (running count in parentheses)

1. Orbital bristles: (0) both pair similar in length and directed outwardly; (1) orbitals unequal in length (a synapomorphy for *Protoorbellia* and *Orbellia*).

2. Distance between anterior and posterior orbitals: (0) similar or distinctly wider than the distance from anterior orbital to frontal margin; (1) distinctly smaller than the distance from anterior orbital to frontal margin.

3. Cheek-eye ratio: (0) if more than 0.5; (1) if less than 0.3.

4. Proepimeral bristles: (0) if only one present; (1) if more than one (an autapomorphy for *Protoorbellia*).

5. Dorsocentral bristles: (0) if more than 4 pairs (*Orbellia* species); (1) if four pairs only; (2) presutural bristle absent (0+3).

6. Katepisternal bristles: (0) if one only; (1) if more bristles or additional bristle-like setae present (a synapomorphy for *Protoorbellia* and *Orbellia*).

7. Preapical bristles on midtibia: (0) if one only; (1) if two present (an autapomorphy for *Orbellia*).

8. Scutellar bristles: (0) if two pair or more than rather equal in length; (1) anterior pair distinctly shorter.

9. Hind tarsus: (0) normally developed; (1) first tarsomere shortened in the male (an autapomorphy for *Oldenbergiella*).

Presented here results of the phylogenetic analysis (Fig. 5) confirmed all facts that *Protoorbellia* is closely related to *Orbellia* and more distantly related to *Oldenbergiella*. The monophyly of the *Protoorbellia* clade is established by following apomorphies: mesonotum with 1+3 dorsocentrals, two proepimeral bristles present, the position of Aor near the Por and not distinctly outwards the frontal plate.

Table. 1. Matrix of characters and taxa used in the cladistic analysis of Orbelliini (numbers for characters correspond with those used in the text).

Taxa	Characters
	1 2 3 4 5 6 7 8 9
Oldenbergiella	0 0 0 0 2 0 0 1 1
Orbellia	1 0 0 0 0 1 1 0 0
Protoorbellia	1 1 1 1 1 1 0 0 0

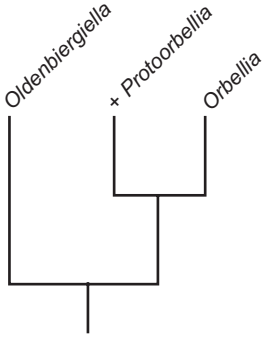


Figure 5. Hypothetical relationship within the tribe Orbelliini

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