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New data on the subfamily Hybrizoninae (Hymenoptera: Ichneumonidae) in Baltic Amber

Новые данные по ихневмонидам подсемейства Hybrizoninae (Hymenoptera: Ichneumonidae) в балтийском янтаре

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KEY WORDS: Baltic amber, palaeoentomology, Late Eocene, ant parasitoid, Ichneumonidae.
КЛЮЧЕВЫЕ СЛОВА: Балтийский янтарь, палеоэнтомология, поздний эоцен, паразитоид муравьев, Ichneumonidae.

ABSTRACT. A new genus, *Vorstadt* **gen.n.**, is described from Late Eocene Baltic amber. It includes *V. ambermuseum* **sp.n.** (type species) and *V. groehni* (Tolkanitz et Perkovsky, 2015). Progressive oligomerization of flagellomeres in the Hybrizoninae apparently occurred by pairwise fusion. The genus *Vorstadt* **gen.n.** is likely to occupy an intermediate position between the members of the subfamily with polymerous and oligomerous flagella, i.e., the fossil genus *Ghilarovites* Kasparyan, 1988 as well as *Tobiasites* Kasparyan, 1988, *Paxylommites* Kasparyan, 1988 and recent genera respectively. A key on Hybrizoninae of the Baltic amber is given.

РЕЗЮМЕ. Из балтийского янтаря описан новый род *Vorstadt* **gen.n.**, включающий *V. ambermuseum* **sp.n.** (типовой вид) и *V. groehni* (Tolkanitz et Perkovsky, 2015). Прогрессивная олигомеризация члеников жгутика, видимо, произошла за счет их попарного слияния. Предполагается, что род *Vorstadt* **gen.n.** занимает промежуточное положение между представителями подсемейства с высоким (ископаемый род *Ghilarovites* Kasparyan, 1988) и низким числом члеников жгутика (*Tobiasites* Kasparyan, 1988, *Paxylommites* Kasparyan, 1988 и рецентные роды). Приведена определительная таблица гибризонин балтийского янтаря.

Introduction

Darwin wasps of the subfamily Hybrizoninae are a small group which is relatively rare in the recent fauna. They are distributed mainly in the Holarctic, and only two species, *Hybrizon flavofacialis* Tobias, 1988 and *H. ghilarovi* Tobias, 1988, have been also recorded in the Oriental region [Achterberg *et al*., 2013]. In the recent fauna, 16 species from the genera *Eurypterna* Förster, 1862, *Ghilaromma* Tobias, 1988 and *Hybrizon* Fallen, 1813 are known [Khalaim, 2019].

The subfamily is mainly characterized by reduced wing venation. In addition, vein 2m-cu is absent in most Hybrizoninae; they also have short and high mesosoma as well as other characters which determine typical appearance of these wasps. This subfamily was previously considered either as a group of Braconidae [Townes, 1969; etc.], or as a separate family Paxylommatidae [Kasparyan, 1988; Tobias, 1988, 2000; Marsh, 1989; etc.]. Nowadays, Hybrizoninae are considered a subfamily within Ichneumonidae [Rasnitsyn, 1980]. This conclusion was supported by phylogenetic analysis based on 28S ribosomal DNA [Quicke *et al*., 2000]. A detailed discussion of the history of the systematic position of the Hybrizoninae is given by Kolarov *et al*. [2018].

For a long time, hybrizonines were assumed to parasitize ants (Hymenoptera, Formicidae). Indeed, they were recently identified as parasitoids of ant pupae. Female wasps oviposit into them when the larvae are transported outside the nest by worker ants [Komatsu, Konishi, 2010; Gómez Durán, van Achterberg, 2011; Hisasue *et al*., 2023].

I believe that both Ukrainian and Bitterfeld ambers are re-depositions of the Baltic (Samland) amber [Weitschat, Wichard, 2002], and therefore five fossil genera of Hybrizoninae, including *Vorstadt* **gen.n.**, are currently known from the Baltic amber: (1) *Astigmaton* Kasparyan, 2001 (with one species, *A. ichneumonoides* Kasparyan, 2001), (2) *Ghilarovites* Kasparyan, 1988 (*G. tarsatorius* Kasparyan, 1988), (3) *Tobiasites* Kasparyan, 1988 (*T. striatus* Kasparyan, 1988), (4) *Paxylommites* Kasparyan, 1988 (*P. reticulatus* Kasparyan, 1988), (5) *Vorstadt* **gen.n.** (*V. ambermuseum* Manukyan **sp.n.** and *V. groehni* (Tolkanitz et Perkovsky, 2015), **comb.n.**).

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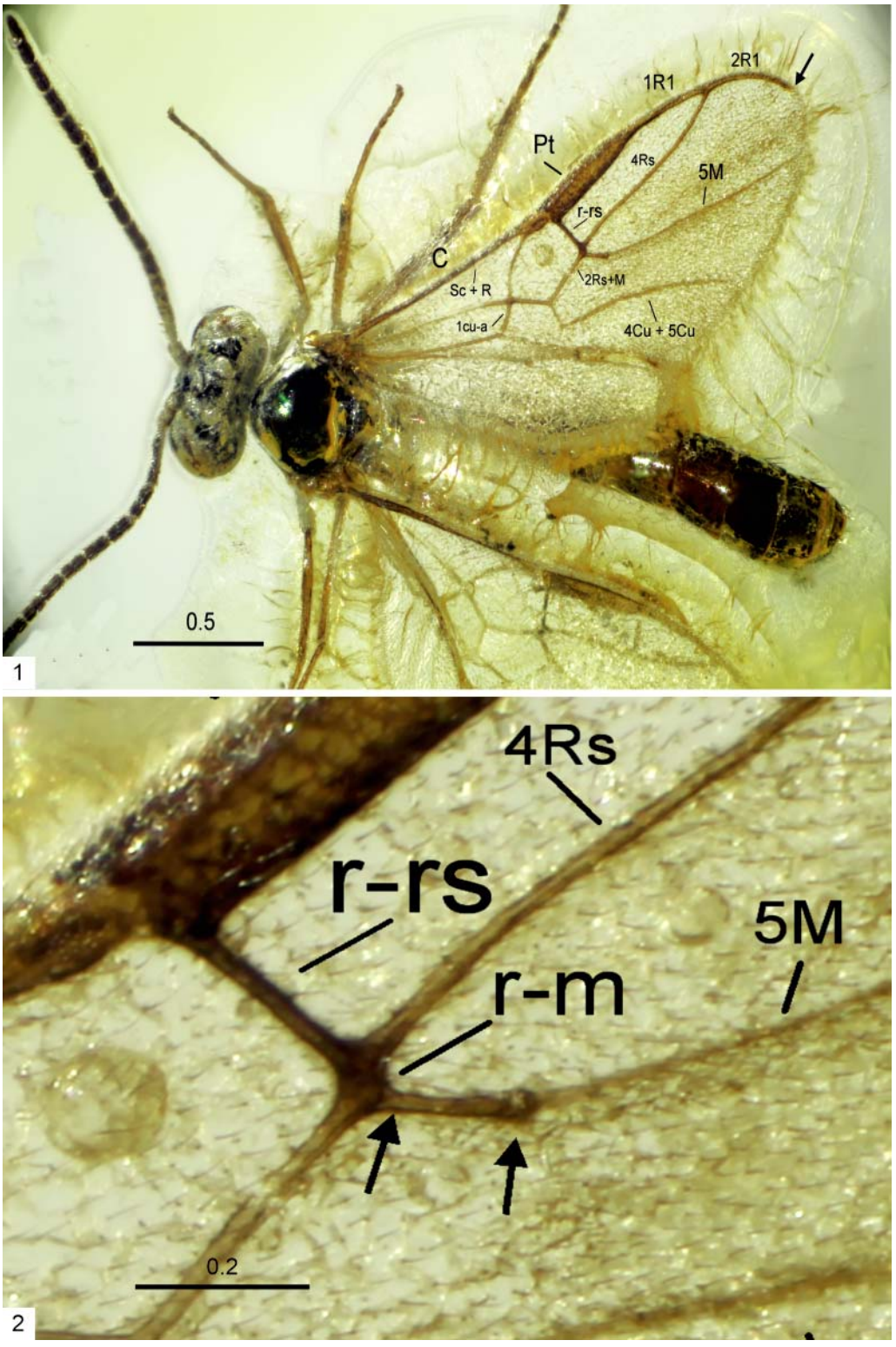
The latter species was initially classified as a member of *Paxylommites*. In addition, the monotypic genus *Paxylobembra* Khalaim, 2014 with a single species, *P. kozlovi* Khalaim, 2014, was described from Bembridge Marls (Isle of Wight, UK, latest Eocene, Priabonian) [Paleobiology Database, 2023].



Figs 1–2. *Vorstadt ambermuseum* **sp.n.**, holotype, female: 1 — dorsal view; 2 — fragment of front wing.
Рис. 1–2. *Vorstadt ambermuseum* **sp.n.**, голотип, самка: 1 — вид сверху; 2 — фрагмент переднего крыла.

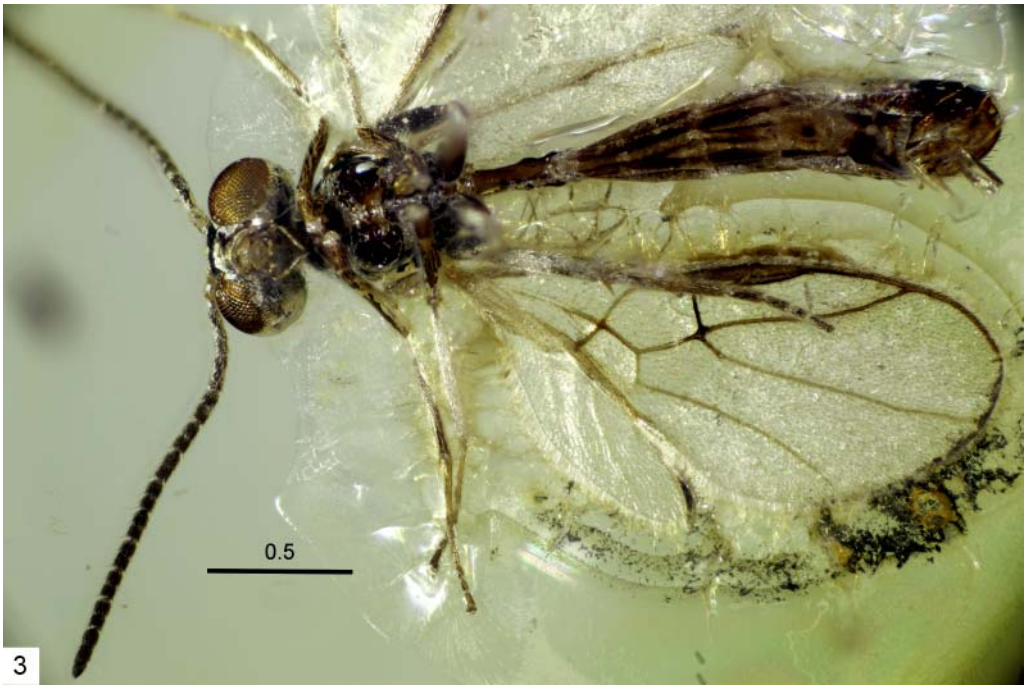


Fig. 3. *Vorstadt ambermuseum* **sp.n.**, holotype, female, ventral view.
Рис. 3. *Vorstadt ambermuseum* **sp.n.**, голотип, самка, вид снизу.

Material and Methods

Names of the body structures are given according to Broad et al. [2018]; venation according to Kopylov [2009]; designation of veins and cells are shown in Figs 1–2. Photos are prepared using a Canon EOS 6D camera connected to Leica M60 stereomicroscope. For focus stacking, the Helicon Focus 8.2.2 program was used. All measurements are given in mm. Sample size 17 x 13 x 4 mm; the pieces of Baltic amber studied in this work were found in the Primorsky quarry of the Kaliningrad deposit (town of Yantarnyi, RF; 54.9°N, 19.9°E; paleocoordinates 53.9°N, 15.2° E; according to Paleobiology Database [2023]. This amber is of Priabonian (Late Eocene) age. The holotype is deposited in the Kaliningrad Amber Museum (KAM).

Taxonomy

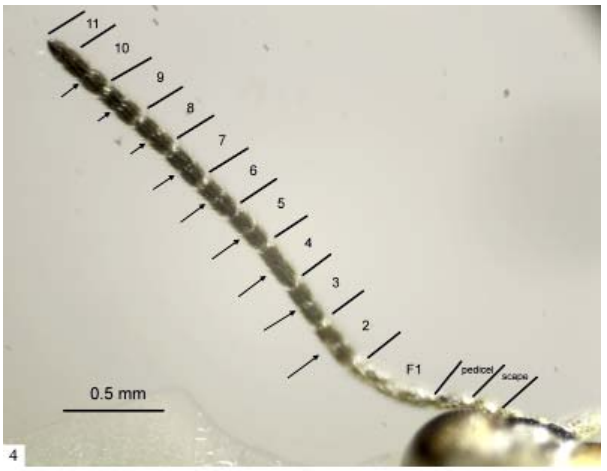
Family Ichneumonidae Latrelle, 1802
Subfamily Hybrizoninae Blanchard, 1845

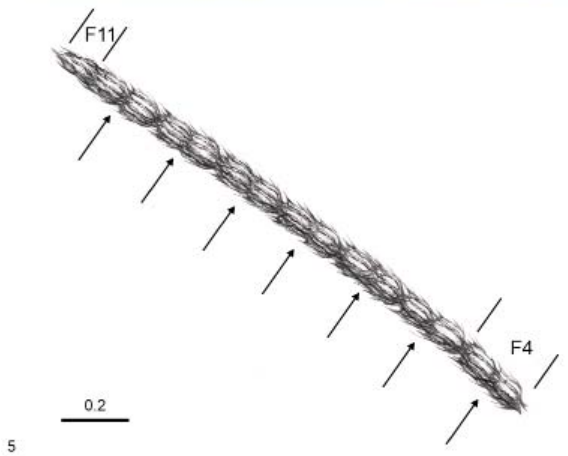
Genus *Vorstadt* Manukyan, **gen.n.**

Type species: *Vorstadt ambermuseum* Manukyan, **sp.n.**

ETYMOLOGY. The genus name comes from the German word meaning "suburb". This was the name of the Jewish district in Königsberg where the famous Amber Manufactory was located.

DIAGNOSIS. It is distinguished from other genera of recent and fossil Hybrizoninae by flagellomeres with distinct





Figs 4–5. *Vorstadt ambermuseum* **sp.n.**, holotype, female: 4 — flagellomeres of left flagellum, arrows indicate constrictions; 5 — 4th to 11th flagellomere of left flagellum, arrows indicate constrictions.
Рис. 4–5. *Vorstadt ambermuseum* **sp.n.**, голотип, самка: 4 — левый жгутик, стрелками показаны перетяжки; 5 — 4–11-й членики левого жгутика, стрелками показаны перетяжки.

Fig. 6. *Vorstadt ambermuseum* **sp.n.**, holotype, female, head and mesoscutum, dorsal view.
Рис. 6. *Vorstadt ambermuseum* **sp.n.,** голотип, самка, голова и среднеспинка, вид сверху.

constriction in the middle, and also by three-segmented maxillary palps. The genus *Paxylobembra* with unknown morphology of antennae and palpi resembles *Vorstadt* **gen.n.** by absence of notauli and S-curved vein 4Rs. However, the latter genus differs from *Paxylobembra* by much larger body size and presence of vein r-m.

Type species. *Vorstadt ambermuseum* Manukyan **sp.n.**, by present designation.

Species composition. *Vorstadt ambermuseum* Manukyan **sp.n.**; *V. groehni* (Tolkanitz et Perkovsky, 2015).

DESCRIPTION. Flagellum 11–13-segmented, all flagellomeres including first one with distinct medial constriction (Figs 4–5). Occipital carina obliterated. Small obscure area at level of stemmaticum (area bounded by the ocelli) probably preserved. Maxillary palps 3-segmented, long, not reduced; segment 2 not widened at apex; labial palps reduced, 2-segmented. Forewings with vein 2m-cu (Figs 1–2). Length of vein 4Rs 4-5.2 times as long as vein r-rs. Vein 1cu-a (nervulus) interstitial. Fore tarsi as long as middle tarsi. Base of 1T distinctly above base of hind coxae. 1T and basal half of 2T probably longitudinally striated.

NOTE. Accurate determination of the number of apical flagellomeres is problematic because the difference between constrictions and segment boundaries is unclear.

Vorstadt ambermuseum Manukyan **sp.n.**
Figs 1–9.

MATERIAL. Holotype, female, KAM no. BX 37/23.1, Baltic amber, Late Eocene of the Baltic region. No syninclusions.

ETYMOLOGY. The species named after Kaliningrad Amber Museum which holds a significant collection of Hymenoptera inclusions in Baltic amber.

DIAGNOSIS. *Vorstadt ambermuseum* **sp.n.** differs from *V. groehni* by the presence of vein r-m (lost in *V. groehni* because RS and M are fused), weakly reclival vein 1cu-a (nervulus; antefurcal in *V. groehni*), as well as by the smooth (polished) sculpture of the body (reticulate in *V. groehni*).

DESCRIPTION. **Female** (Figs 1–3). Head distinctly transverse, slightly narrowed posteriorly. Face narrowed downwards, distinctly convex in the middle. Clypeus small, convex and strongly protruding forwards, anterior margin flat, without notch in the middle. Occipital carina obliterated. Eyes large, without notch at level of antennae. Stemmaticum considerably elevated above head surface. Distance from the hind ocelli to eyes is equal to the diameter of the ocelli. Scapus and pedicel short, subspherical in shape; length of scapus almost equal to width, length of pedicel about 1.5 times width and 1.8 times length of scapus. Flagellum with 11 flagellomeres (Figs 4–5), densely pubescent, each flagellomere with medial constriction resembling intersegmental articulation; multiporous plate sensilla present on all flagellomeres, well expressed, stretching mostly for the whole length of flagellomere, less often ceasing at constriction.

Mesonotum more or less quadrangular (Fig. 6), with uniformly convex surface; situated in side view distinctly above the level of scutellum; notauli absent. Mesopleurae slightly compressed laterally, not punctured; epicnemial (prepectal) carina complete, sternauli absent; postpectal carina complete. Scutellum comparatively large, convex, bordered by carinae up to apex.

In the forewing, veins 2Rs+M and r-rs not fused on external margin of discoidal cell, vein r-m present. Vein 4Rs 5.2 times as long as r-rs. Vein 1cu-a (nervulus) interstitial and slightly reclival. Hind legs longer and distinctly thicker than fore and middle ones.

Metasoma with T1–3 elongated, T3 longer than the following ones, which are distinctly transverse. Ovipositor short (Fig. 9), slightly more than half the height of metasoma at apex, broad at base, gradually narrowed towards apex, without apical dorsal notch. Sheaths scale-shaped, narrow at base, widening towards apex, 0.65 times as long as ovipositor. Sheaths shifted to the apex, considerably distant from ovipositor.

Body dark brown, antennae black, anterior tibiae yellow. Body without hairs, except for fine and sparse pubescence on sides and apex of metasoma. Flagellum densely pubescent.

Approximate measurements: body 3.1, forewing 2.8, ovipositor 0.3, sheath 0.2.

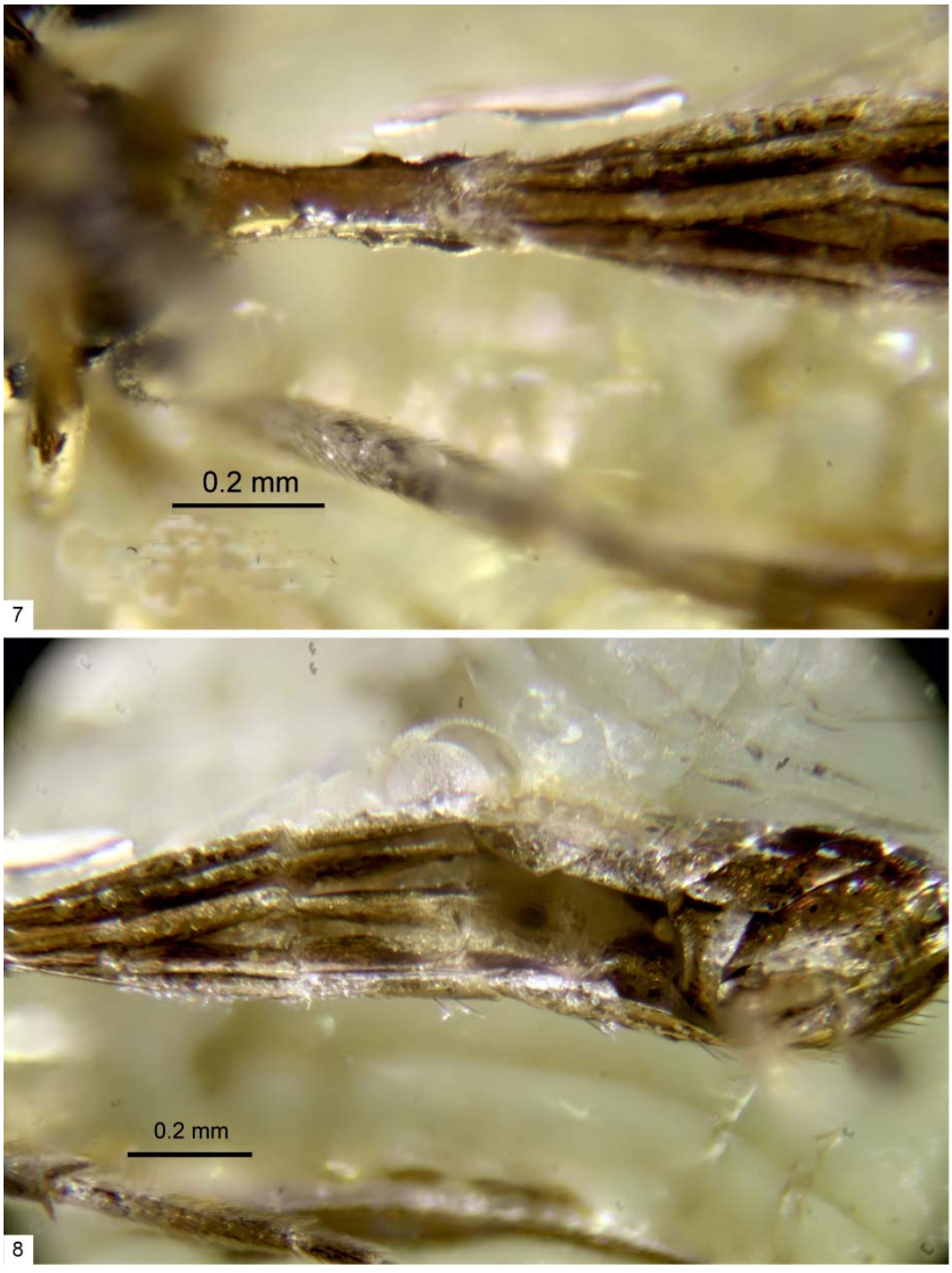


Fig. 7–8. *Vorstadt ambermuseum* **sp.n.**, holotype, female, metasoma, ventral view: 7 — first segment; 8 — second to eighth segment
Рис. 7–8. *Vorstadt ambermuseum* **sp.n.**, голотип, самка, метасома, вид снизу: 7 — первый сегмент; 8 — второй–восьмой сегменты.

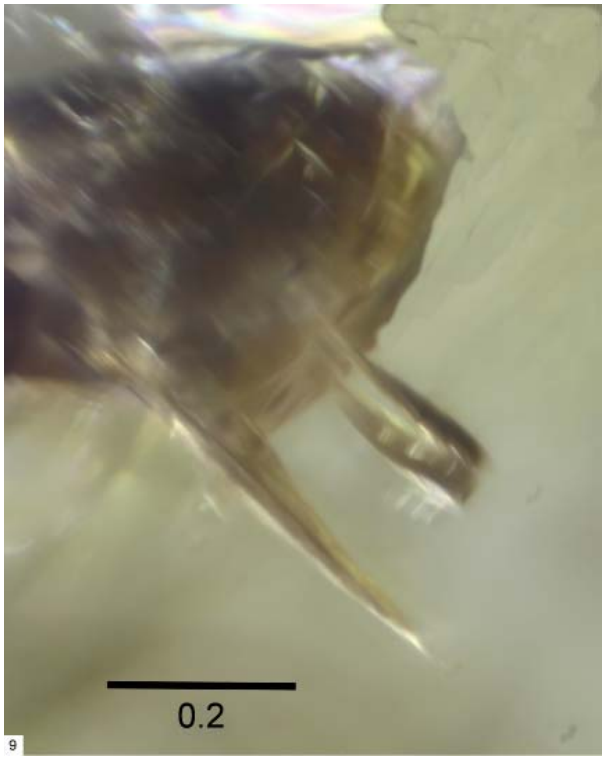


Fig. 9. *Vorstadt ambermuseum* **sp.n.**, holotype, female, ovipositor and sheaths.
Рис. 9. *Vorstadt ambermuseum* **sp.n.**, голотип, самка, яйцеклад и ножны.

Male. Unknown.

REMARKS. Original description [Tolkanitz, Perkovsky, 2015] indicates presence of a medial transverse impression on the mesonotum. However, I believe this is the result of deformation of the cuticle during fossilization.

Key to genera and species of Hybrizoninae from Baltic amber

1. Flagellum 11–13-segmented (may look multisegmented if segments constricted medially). Mandibles strongly reduced, their apices without distinct teeth and not touching each other (because of strong reduction). Notauli absent ..... 2.
– Flagellum has more than 13 (i.e., 23) segments (Figs 10–11). Mandibles bidentate, not reduced, their apices touching each other. Notauli present, sharp..... ..... *Ghilarovites tarsatorius* Kasparyan, 1988
2. Flagellomeres with distinct constrictions (Figs 4–5); maxillary palps long, not reduced (Fig. 3) *Vorstadt* **gen.n.** ....3.
– Flagellomeres without constrictions; maxillary palps reduced or complete ..... 4.
3. Vein r-m absent. Occipital carina complete. Body sculpture reticulate ..... *V. groehni* (Tolkanitz et Perkovsky, 2015)
– Vein r-m presents (Fig. 2). Occipital carina obliterated. Body uniformly smooth (polished) ..... *V. ambermuseum* **sp.n.**
4. Occipital carina obliterated or absent. Visible number of segments of maxillary palps 2; their penultimate (also, probably first) segment strongly widened at apex; labial palps not visible, probably reduced. Forewings with 2m-cu distinct, although depigmented; r-m lost. In male, fore tarsi shorter than middle ones. Base of T1 situated a little above base of hind coxae. T1 and basal 0.6 of T2 longitudinally striate ..... *Tobiasites striatus* Kaspayan, 1988
– Occipital carina distinct. Visible number of segments of maxillary palps 3, labial palps 2; penultimate segment of maxillary palps moderately thickened at apex. Fore wings without vein 2m-cu; r-m present. In female, fore tarsi somewhat longer than middle ones. Base of 1T situated considerably higher than base of hind coxae. Sculpture of 1T and basal 0.6 of 2T roughly cellular ....*Paxylommites reticulatus* Kaspayan, 1988 (Figs 10–11).

Conclusion

The structure of flagellomeres of *Vorstadt* **gen.n.** has certain features, which suggest that oligomerization of the flagellum occurred by pairwise fusion of the flagellomeres. First, in some flagellomeres, multiporous plate sensilla stretch beyond the constrictions. Second, the presence of upward setae on the tips of the constrictions creates "crown-shaped" structures typical of true flagellomeres. The genus *Vorstadt* **gen.n.** is therefore likely to occupy an intermediate position between the members of the subfamily with polymerous and oligomerous flagella, i.e., *Ghilarovites* as well as *Tobiasites*, *Paxylommites* and recent genera respectively. Progressive oligomerization of the flagellum of Hybrizoninae probably occurs against the background of general pumilization (miniaturization), which is accompanied by reduction of wing venation, occipital carina and other structures of the body. We assume that the genus *Paxylobembra* described from deposits of similar age belongs to the same extinct lineage. I believe that in *Paxylobembra* decrease in the body size reached its limit among all Hybrizoninae. Regretfully, the main diagnostic character, i.e., presence/absence of constrictions on flagellomeres in *Paxylobembra* cannot be evaluated because of lack of antennae in the type specimen. Assignment of the latter genus *Paxylobembra* to the same lineage with *Vorstadt* **gen.n.** is therefore hypothesized based on the similarity of wing structure.

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Fig. 10 –11. *Ghilarovites tarsatorius*, holotype, female: 10 — left lateral view; 11 — apical flagellomeres.
Рис. 10 –11. *Ghilarovites tarsatorius*, голотип, самка: 10 — вид слева; 11 — апикальные членики жгутика.

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