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Mites (Acari) as supposed prey of long-legged flies (Diptera: Dolichopodidae) from Eocene Baltic amber

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Nearly all extant dolichopodids are known (Ulrich, 2004) or suspected to be predators in their imaginal stage and are most probably also as larvae. A striking exception is found in two genera in the Medeterinae Lioy, 1864 *viz*. *Thrypticus* Gerstäcker, 1864 and—according to the morphology of the female ovipositor, also *Corindia* Bickel, 1986. Larvae of *Thrypticus* are phytophagous (Kechval & Pollet, 2024) and no observations on prey consumption by the flies are available. This might relate to a reduction of mouthparts of these dipterans. In his 2004 work, Ulrich listed 13 literature citations in which Arachnida were reported as prey of long-legged flies. Eleven of these definitively refer to mites; as prey mainly of species of *Medetera* Fischer von Waldheim, 1819. Medeterinae are rather common in Eocene amber and eight genera with fossil species preserved in amber are known (Grichanov, 2025a, b) whereas one genus, *Atlatlia* Bickel, 1986, is known to have extant diversity concentrated in the Australian realm and the Polynesian subregion of the Palaeotropic realm (New Caledonia) (Bickel & Martin, 2025). *Medetera* itself is only known from extant species and is the most species rich genus in this subfamily with 424 species worldwide (Yang *et al*., 2006; Schrameyer & Stark, 2026) and many more await description. One of the most common members of Dolichopodidae in Baltic amber is the genus *Palaeomedeterus* Meunier, 1895 in the subfamily Peloropeodinae Robinson, 1970 (Stark, unpubl. pers. observ. by checking thousands of Diptera inclusions over the last 30 years). As to the subfamily-classification of the Dolichopodidae it can only be reiterated that the search for evolutionary lineages, which might be interpreted as subfamilies, is an ongoing process. Several evolutionary-biological phenomena—such as heterobathmy and homoplasies—influence the result. Paying attention to the structure of the mouthparts is important for this classification. However, their form and function are, in themselves, subject to the same premises. Grichanov & Negrobov (2018) adopted Robinson's (1970) subfamilies of Dolichopodidae regarding the contemporary classification of fossil genera. His interpretation of the subfamily should be given here in brief (slightly modified from that published by Grichanov & Negrobov, 2018): arista-like stylus apical to dorsal, postpedicellus often only as long as broad, but sometimes enlarged, triangular, or with two more or less pointed tips; scapus bare, acrostichals uni- to biseriate, scutum with a flattened asetose area apical to the scutellum; R_{4+5} unforked, parallel to subparallel to M_1; mid and/or hind femora with preapicals; hypopygium large or small, often globose in the resting position, loosely folded forward beneath the abdomen (ventroflexion), female tergite 10 with strong acanthophorites.

The only report on fossil long-legged flies with a (lost) prey item goes back to Ulrich & Schmelz (2002). The authors interpreted the common occurrence of an injured enchytraeid worm near the fly likewise encased in amber as traces of a conserved predatory act. The fly was determined as *Gheynia bifurcata* Meunier, 1907. This species was transferred by Grichanov & Negrobov (2018) to *Palaeomedeterus* [as *P. bifurcatus* (Meunier, 1907)] in the subfamily Peloropeodinae. During an intensive study of the mouthparts of recent *Medetera* species the question arises: which evolutionary development of the proboscis of Medeterinae since the Eocene might be verifiable based on fossil evidence?

Material and methods. Current investigations by Ross *et al*. (2026) conclude that Baltic amber from the "Blue Earth" of Samland is of Priabonian age (lower middle Eocene) and was formed 36 My ago. Among the nearly 300 amber pieces with mainly male dolichopodids from Baltic and Bitterfeld amber in the private collection of the author [indicated ACASH (Amber Collection Andreas Stark Halle)] a piece of amber with two Medeterinae flies (ACASH018D—"D" stands for Dolichopodidae) proved to be of particular interest, as one of the specimens was embedded in resin during a feeding act on a mite. This is the first direct evidence of a feeding act by a long-legged fly in amber. Unfortunately, the abdomen is covered by a great bubble, so that it is not clear, if this is a male or female specimen. The second one is a male and of the same species. The size of the amber piece, purchased at the "Münchner Mineralienmesse" 2002, was roughly 25 × 20 × 5 mm. Besides the second specimen of a conspecific fly there are no other syn-inclusions discernable. The amber piece was recently cut with a fret saw and ground by hand with wet-and-dry-sandpaper to achieve precise flat polished surfaces on the diagnostically valuable viewpoints (frontal, lateral, dorsal). The amber piece is now 8 × 6 × 4 mm and stored in distilled water without air bubbles in a 2 µl cryo vial. To take images the amber piece was mounted temporarily with mineral putty on a microscope slide.

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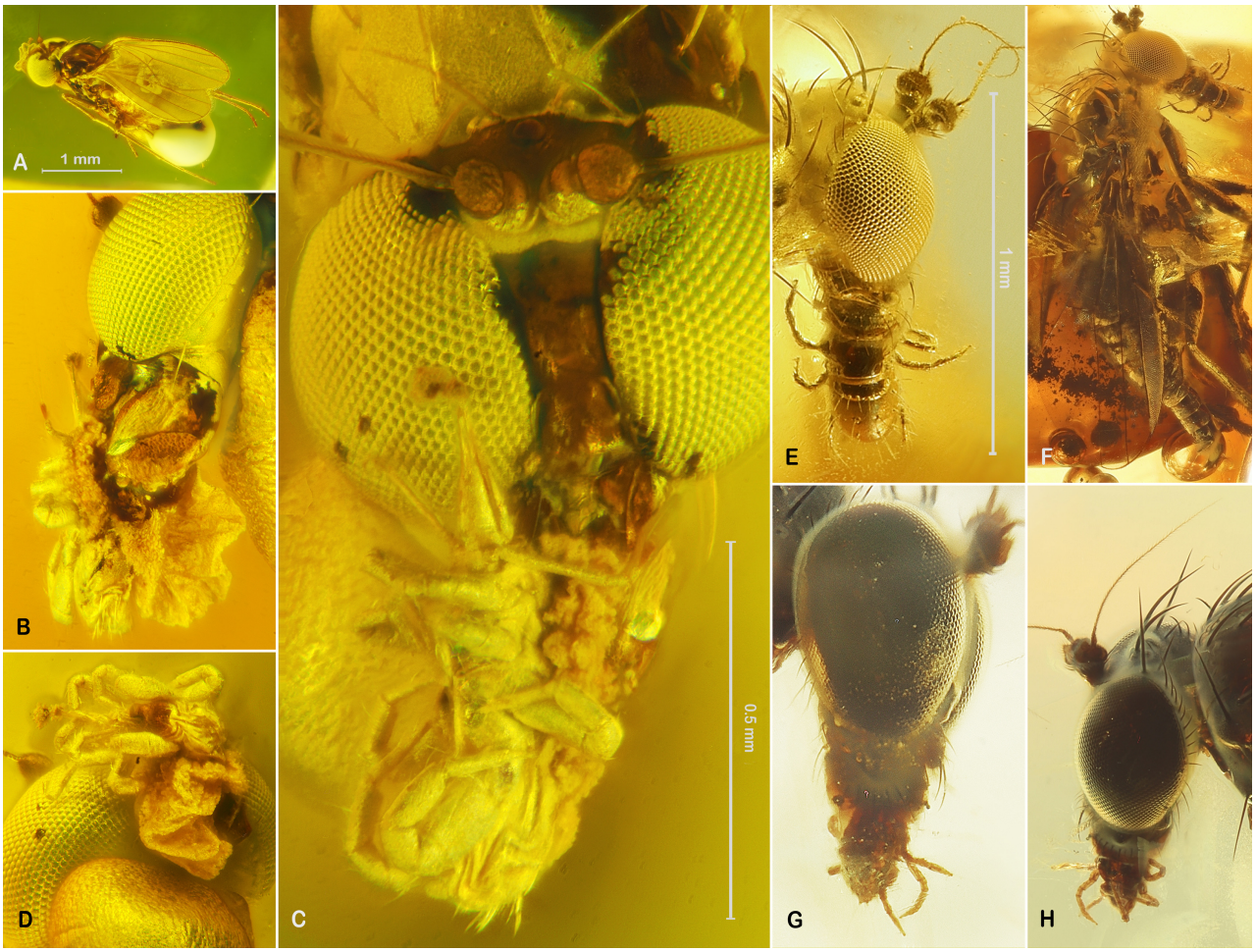

FIGURE 1. Dolichopodid flies in Baltic amber with mites in their mouthparts. **A**–**D**, *Medeterites molestus* (Meunier, 1907), sex unknown, with a mite of the family Bdellidae ("snout mites") as prey. **A**, Habitus dorsal, **B**–**D**, Head with prey, **B**, Lateral, **C**, Frontal, **D**, Ventral. **E**–**H**, Two species of *Palaeomedeterus* (Meunier, 1907) with mites of Mesostigmata in their mouthparts. Scale bar of **F** for comparison **E**–**H**. Photographs for **A**–**D** by A. Stark, **E**–**H** by courtesy of J. Damzen (Talino, Lithuania).

The selected side was moistened with a drop of (ethanol-based) hand sanitizer gel and covered with a microscopic coverslip (0.17 mm). Images were captured using an Olympus OM-D E-M10III camera mounted on a Wild M20 microscope body, utilizing Nikon Plan 4× and 10× objectives, as well as a Leica EF L 20× objective. Helicon Focus 8.2.2 was used for focus stacking, and subsequent image processing was performed using Adobe Photoshop®.

Results. The fly with prey is a specimen of unknown sex and belongs to *Medeterites molestus* (Meunier, 1907). Determination follows Grichanov (2010, 2025a). It is 2.2 mm long. Dorsally and laterally the fly is well visible, but ventrally it is covered by large bubbles (Fig. 1A). Under high magnification one may see (Fig. 1B–D) that the mite is held in the mouthparts of the fly. The labellae cover a part of the mite's shrunken idiosoma. A remarkable feature of this *Medeterites* species—others must be checked for this—is, that the labrum is well sclerotised and protruding between the palpi. It is not smooth and/or retracted below the clypeus and not connected with an extended clypeal membrane like in extant *Medetera* (Stark, unpublished). In Fig. 1B the praementum of the fly's mouthpart is well visible in the centre of the photograph. The prey is a member of snout mites (Bdellidae) as there is the gnathosoma consisting of an elongated subcapitulum, the accompanying apical chelicerae are clearly visible, and the pedipalps are elongated and elbowed (Fig. 1C). The tibiotarsus of the pedipalp (the last segment of the pedipalp) bears two bristles and seems to have preserved a contrast of pigmentation with the genu and other basal segments of the pedipalps (morphology after Hernandes *et al*., 2016) which are not dark. Unfortunately, the number and shape of eyes are not ascertainable, as these are important for further classification. Compared to the adult bdellids illustrated in Hernandes *et al*. (2016), it is striking that the basifemorae—particularly that of the hind leg—are strongly thickened. It is not clear, if this mite represents one of the three nymphal stages or if it is an adult, as the habitus of these is—as far as recent species is concerned—very similar and discernible only by the number of different bristles at the body (Wu *et al*., 2022). A summary of morphological terms used here is given in Fig. 2.

Discussion. Snout-mites are predators. They feed on Collembola, spider mites and scale insects (Hernandes *et al*., 2016). According to the same authors only five fossil Bdellidae

species were named at that time from Cretaceous and Eocene amber. The oldest representative of this family was described a few years ago (Porta *et al*., 2020) from Myanmar amber ("Burmite"). Its age is supposed to be nearly 100 My. An impressive graphic given by (Klimov *et al*., 2025: 8, fig. 5) illustrates that mites already exhibited great diversity during the Eocene epoch.

It is almost unanimously accepted that Medeterinae of Priabonian age were tree-trunk-dwellers as are recent species, especially of *Medetera* (Grichanov, 2025a). On the other hand, Pollet *et al*. (2022) described several *Medetera* species from the Mediterranean that are ground dwellers. Snout mites are rather restricted to plants or surfaces near the ground (Hernandes *et al*., 2016). Photographs of Bdellidae (*e.g*. in Hernandes *et al*., 2016) give the impression that most species are rather soft-bodied. Striking is the predominant red base color of extant species (Hernandes *et al*., 2016). According to Vikhrev (2007) *Medetera jacula* (Fallén, 1823)—one of the most common inhibitors of tree trunks in temperate climate of the Palaearctic realm grasps bdellid mites with its labellae but does not feed on them.

Vikhrev (2007) suspected that they are poisonous to the flies (?). It is important here to mention that only in few Hydrophorinae genera, *e.g*., *Aphrosylus* Haliday, 1851, raptorial legs—modified front legs—occur, and are used to manipulate prey. From my point of view, stout labellae with strong sclerotised pseudotracheae and the strong, somewhat posteriorly directed, curved and protruding hypopharynx avoid direct clasping of prey. Other parts of the body—modified legs—must mostly support prey catching activities. Ulrich (2004) mentioned the use of front legs but did not establish a connection to the construction of the mouthparts. It is evident also that in, *e.g*., *Aphrosylus* the front coxae are somewhat prolonged and dorsally covered with numerous short and stout bristles in both sexes. These can serve as abutments for holding worm-like prey, into which the hypopharynx can penetrate. Members of other subfamilies capture prey only with the labellae. This is evident also in the remarkable *Melanderia mandibulata* Aldrich, 1922 in the subfamily Hydrophorinae, where the "mandibulae" are modified sclerites of the labellum (Snodgrass, 1922) and this may be interpreted as a re-emergence of old capabilities through different morphological means.

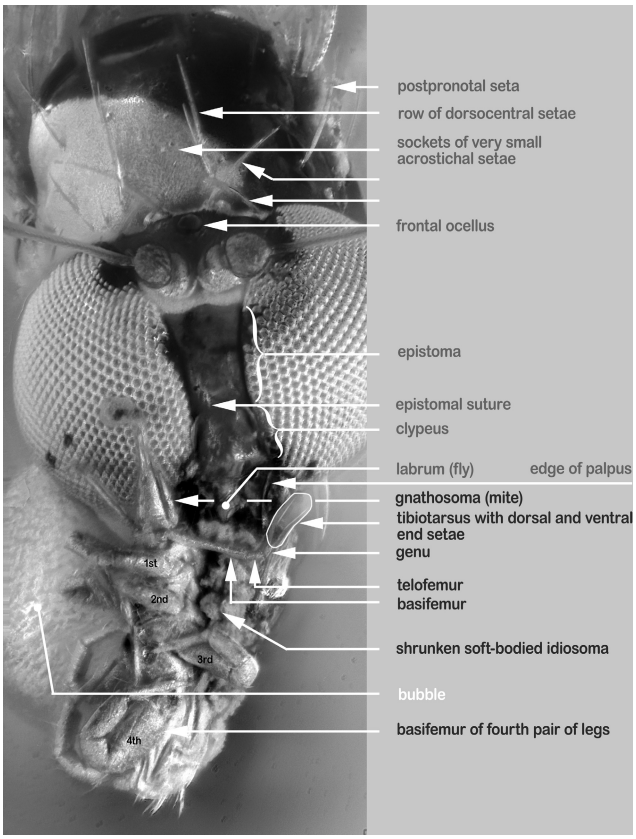

FIGURE 2. Frontal view of the head of *Medeterites molestus* (Meunier, 1907) and its prey, a bdellid mite and explanations. Compare Fig. 1C.

In two other cases, the author could study only a series of high-resolution photographs found on a commercial amber trading website. Both are female flies of the subfamily Peloropeodinae, and both belong to species of *Palaeomedeterus* (Fig. 1E–H). As far as the visibility of characters of the prey allows, the mites belong to the order Mesostigmata. In Fig. 1E, F probably a mite of Parasitidae was captured, whereas in Fig. 1G, H a Amblyseiinae mite serves as prey. In adult animals of Parasitidae, the dorsal shield is typically divided into an anterior (podosomal) and a posterior (opisthosomal) shield (Fig. 1E). Amblyseiinae have long and slender legs. Prominent macrosetae (elongated tactile hairs) are typically present on the fourth pair of legs (not visible here).

As the morphology of the mouthparts of both flies is considered, a circlet of strong and stiff setae of nearly equal length is visible at the base of the labellae. One should avoid making overly far-reaching assumptions, particularly since a whole range of preconditions would need to be met. Many of the *Palaeomedeterus*-inclusions contain particles of wood or debris. Therefore, the suggestion that these flies preferred strata near the ground level is obvious. Perhaps the stiff bristles avoid including light voluminous particles during feeding.

Mites are known to use other arthropods as means of transport (phoresy). Others are ectoparasites of insects and are attached with their mouthparts to the host. Amber inclusions are known that show both phenomena (*e.g*., Dunlop *et al*., 2011; Arce *et al*., 2024). Generally, two ways to attach to the host are known: by a so called "sucker plate" as a distinct attachment organ on the underside of the body (Dunlop *et al*., 2011) or by the mouthparts (Arce *et al*., 2024). The question arises if in the case of the photographs of *Palaeomedeterus* a more likely explanation might be evidence of phoretic behaviour as well. Attachment to the abdomen can be excluded. As recent dolichopodids are extremely agile and active it is very unlikely, that mites can enter the open labella to be attached as "passenger" in this dangerous morphological vicinity. Figures 1G, H show, that the mite is taken by its idiosoma, hence no attachment is ongoing, as the gnathosoma is free.

Ulrich (2004: 388) wrote on behalf of the behaviour of extant species that "Observations of predator with prey are still rare exceptions". This statement is today true as well, but modern photographic techniques and a broad "citizen science"

movement in connection with different internet platforms very likely increases the number of verifiable observations (compare also Vikhrev, 2007). Seen in this light, such "action" inclusions—flies with prey incorporated between the labella—are one of the rarest fossil records in amber.

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