

Far Eastern Entomologist

Дальневосточный энтомолог

Journal published by Far East Branch
of the Russian Entomological Society
and Laboratory of Entomology, Federal
Scientific Center of the East Asia
Terrestrial Biodiversity, Vladivostok

Number 403: 1-12

ISSN 1026-051X

March 2020

<https://doi.org/10.25221/fee.403.1>

<http://zoobank.org/References/355AB608-E0A9-47FE-8751-041759EA32F3>

A NEW GENUS OF DICTYOPHARIDAE (HOMOPTERA) FROM BITTERFELD AMBER BASED ON A NYMPH

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Summary. *Bathymyza longirostris* **gen. et sp. n.** (Dictyopharinae: Orthopagini?) is described from an early instar nymph from Eocene Bitterfeld amber. The new genus is similar to *Alicodoxa* Emeljanov et Shcherbakov, 2011 based on nymphs from Eocene Rovno and Baltic ambers.

Key words: Fulgoroidea, planthoppers, Dictyopharinae, Orthopagini, fossil, Bitterfeld amber, Eocene.

А. Ф. Емельянов, Д. Е. Щербаков. Новый род Dictyopharidae (Homoptera) для нимфы из биттерфельдского янтаря // Дальневосточный энтомолог. 2020. N 403. С. 1-12.

Резюме. *Bathymyza longirostris* **gen. et sp. n.** (Dictyopharinae: Orthopagini?) описан по молодой нимфе из эоценового биттерфельдского янтаря. Новый род близок к *Alicodoxa* Emeljanov et Shcherbakov, 2011, установленному для нимф из эоценового ровенского и балтийского янтаря.

INTRODUCTION

The planthopper family Dictyopharidae is poorly represented in the fossil record. Its earliest known member has been described from the Late Cretaceous (Santonian) amber of Taimyr and assigned to the extinct tribe Netutelini (Emeljanov, 1983). Szwedo (2008) described a monotypic genus from Baltic amber and placed it in a tribe of its own, Worskaitini, which he considered closely related to Netutelini. Several other Cenozoic genera have been attributed to the family, but most of them need re-examination to determine their systematic position in more detail (Szwedo *et al.*, 2004). Based on dictyopharid nymphs from Rovno and Baltic ambers, the monotypic genus *Alicodoxa* Emeljanov et Shcherbakov, 2011 was established in the extant tribe Orthopagini (Emeljanov & Shcherbakov, 2011). A similar nymph from Bitterfeld amber is described below as a new monotypic genus and tentatively assigned to the same tribe.

Bitterfeld amber from Saxony-Anhalt in Germany (Dunlop, 2010) and Rovno amber from NW Ukraine (Perkovsky *et al.*, 2010) in their chemical composition and fossil assemblages are similar to Baltic amber and were often considered merely redeposited Baltic amber, transported by glaciers (Weitschat & Wichard, 2010). The age estimates for these three ambers varied from Eocene to Oligocene (and even Miocene). Recent geochemical studies demonstrated that all three ambers are coeval, Eocene in age, and their source tree assemblages were similar, though Bitterfeld and Rovno ambers originated much farther south than Baltic amber (Wolfe *et al.*, 2016; Mänd *et al.*, 2018). The differences in floras and faunas of these ambers are chiefly due to their distinct source areas, separated in the Eocene by the North Sea and the future Paratethys: Baltic amber derived from the southern slopes of Fennoscandian High, whereas Bitterfeld and Rovno ambers from the northern slopes of Bohemian High and Volhynian High, respectively (Popov *et al.*, 2004, Dunlop *et al.*, 2018; Sokoloff *et al.*, 2018). Present-day swampy forests in Florida were suggested as a possible analogue for the Bitterfeld amber forest (Dunlop, 2010).

The amber specimen described below was collected along with other amber inclusions from the opencast lignite mine Goitzsche, processed by VEB Ostseeschmuck Ribnitz-Damgarten and then transferred to and deposited in the Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung in Berlin (MB). Morphological terminology follows Emeljanov (1994, 1995). Photographs were taken using a Leica M165C stereomicroscope with a Leica DFC425 digital camera and processed with Helicon Focus 5.1.

DESCRIPTIONS OF NEW TAXA

Superfamily Fulgoroidea Latreille, 1807

Family Dictyopharidae Spinola, 1839

Subfamily Dictyopharinae Spinola, 1839

Tribe Orthopagini? Emeljanov, 1983

Genus *Bathymyza* Emeljanov et Shcherbakov, gen. n.

<http://zoobank.org/NomenclaturalActs/DB120ACE-89FB-4CC1-BBA8-C511FAB1CEF6>

Type species: *Bathymyza longirostris* Emeljanov et Shcherbakov, **sp. n.**

DIAGNOSIS. Nymph (early instar). Similar to the extinct genus *Alicodoxa*, but distinct (character states of *Alicodoxa* in parentheses) in the longer rostrum reaching beyond the apex of the abdomen (beyond hind coxae), median carina of metope vestigial (distinct), fore legs not flattened (tibiae flattened), hind tibiae without lateral teeth (with five teeth), abdominal tergites VI–VIII without an additional small upper wax plate, and less numerous sensory pits.

COMPOSITION. Type species.

REMARKS. In the late instar holotype nymph of *Alicodoxa rasnitsyni* Emeljanov et Shcherbakov, 2011 a low median carina is developed on the metope and clypeus (not mentioned in the original description).

ETYMOLOGY. From Greek *bathys* (deep) and *myzo* (suck); gender feminine.

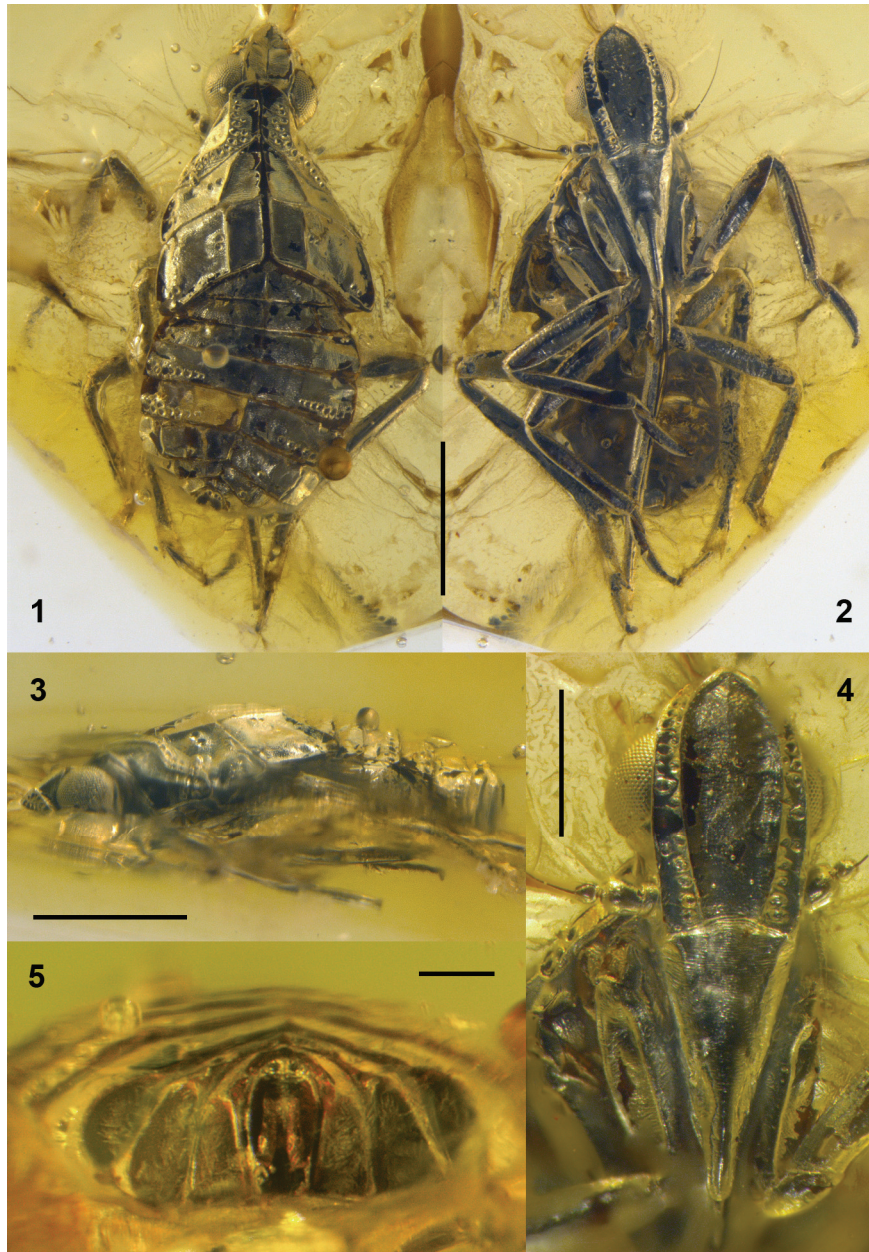
***Bathymyza longirostris* Emeljanov et Shcherbakov, sp. n.**

<http://zoobank.org/NomenclaturalActs/90c513ef-fb2a-4d91-9191-b39f2539d77a>

Figs 1–11

MATERIAL. Holotype, MB.I.1548, 1st (2nd?) instar nymph; Goitzsche near Bitterfeld; Bitterfeld (Saxonian) amber; Eocene.

DESCRIPTION. Young nymph of medium-sized planthopper. Dark brown (mostly covered with silvery gas film), moderately elongate, 3.2 mm long, 1.4 mm wide; head projecting forwards; dorsum finely transversely shagreened. Coryphe somewhat longer than wide, depressed towards median line, V-shaped in cross-section, with well-developed lateral carinae and median groove and vestigial transverse groove in distal half; its lateral and anterior margins forming nearly regular parabola, and posterior margin situated about eye midlength in dorsal aspect. Metope with vestigial median carina; intermediate carinae arched laterad; medial area broad, lancet-arched above, widest at 1/3 length from head apex, narrowed to clypeus; lateral areas parallel-sided, comparatively narrow, dorsally widened and faced laterad, with two rows of sensory pits; inner row of sensory pits reaching upper margin of clypeus, outer row incomplete ventrally, ending near lower eye margin, far from clypeus; both rows shortly interrupted slightly dorsal to lower eye margin (see Discussion). Boundaries of metope and postclypeus (epistomal suture) and of post- and anteclypeus arched dorsad, medially obsolete. Postclypeus with lateral carinae, without median carina, tapered apically, about as long as anteclypeus. Rostrum very long, reaching well beyond apex of abdomen, apical segment much shorter than subapical one. Pedicel thrice longer than scape, with at least 3 sensory plaque organs, third segment (base of flagellum) large, wider than 1/2 of pedicel (see Discussion).



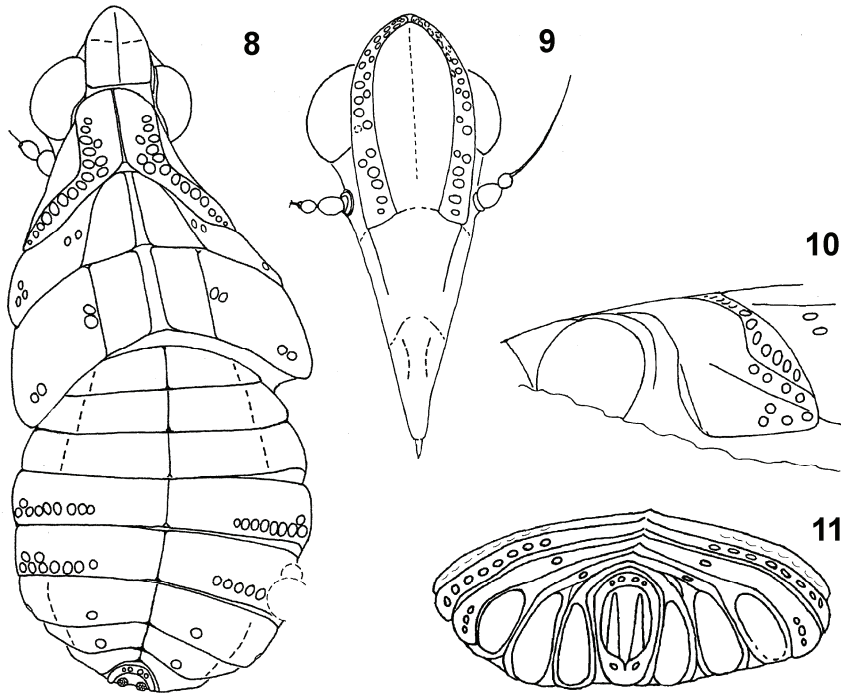
Figs 1–5. *Bathymyza longirostris* sp. n., holotype: 1 – habitus, dorsal view; 2 – habitus, ventral view; 3 – habitus, lateral view; 4 – head, ventral view; 5 – abdomen, caudal view. Scale bars, 1 mm (1–3), 0.5 mm (4) and 0.2 mm (5).

Pronotal disc strongly projecting forwards (more than 1/2 of its median length situated anterior to level of posterior eye margins), its anterior margin arcuately convex, anterolateral angles obtuse, lateral margins anteriorly parallel, then curved, posteriorly diverging backwards. Posterior margin of pronotum with deep, nearly right-angled emargination reaching almost 1/4 of pronotal disc length. Pronotal disc slightly



Figs 6–7. *Bathymyza longirostris* sp. n., holotype: 6 – body, dorsal view; 7 – body, ventral view. Scale bar, 0.5 mm.

wider than, and about as long along midline as, coryphe, bordered with distinct carinae along anterior and anterolateral margins; median carina distinct; posterolateral discal carinae absent, boundary between discal and paradiscal areas traceable only as flexure of surface plane (posterior ends of these flexures close to points where lateral carinae of mesonotal disc approach pronotal margin). Sensory pits of pronotal



Figs 8–11. *Bathymyza longirostris* sp. n., holotype: 8 – body, dorsal view; 9 – head, ventral view; 10 – pronotum, lateral view; 11 – abdomen, caudal view.

disc and paradiscal areas forming one entity: disc with row of 6 larger pits along lateral margin and 3 smaller pits in second, more medial row; paradiscal area with 7 pits in marginal row. Humeral area with 4 pits in row; pectoral group of 4 pits near posterior margin of paranotal lobe. Lateral and collateral carinae distinct. Mesonotal disc arrow-shaped anteriorly, discal carinae converging there nearly at right angle, running parallel to posterior pronotal margin; median carina double; 2 pits in oblique row laterad of discal carinae. Paradiscal area of mesonotum near lateral margin posteriorly with 3 pits (in triangle). Wing pads not developed yet; lateral margin of mesonotum shorter than that of metanotum. Metanotal disc rectangular, about 1.2 times as wide as long, with all carinae distinct; median carina double; 2 pits in oblique or subtransverse row laterad of discal carinae (similar to that on mesonotum); paradiscal area near lateral margin subapically with 2 pits in oblique row. Fore legs

not flattened, similar to, and slightly longer than, mid legs. Fore femora without subapical tooth on posteroventral carina. Fore and mid tibiae not widened, relatively slender. Hind tibiae without lateral spines, with 4 spaced apical teeth. Hind tarsus two-segmented, tarsomere I with 4 spaced apical teeth, tarsomere II much shorter than I, without lateral teeth; claws small.

Abdomen with well-developed middorsal carina, weak intermediate carinae (absent on tergites IV–V), and without sublateral carinae. Tergites I–III without pits. Tergites IV–V with long (complete) rows of 9–10 pits, 8th pit (from body midline) displaced anteriorly (sometimes there are 2 such pits, 6th and 8th, forming rudimentary second row anteriorly – see Fig. 8). Tergite VI with 1 pit medially and 3 pits laterally, VII with 1 pit medially, VIII without pits. Laterotergite VIII not enlarged. Tergite IX with 2 medial pits dorsally and 1 pit ventrally (at each side). Wax plates situated in subtriangular posterolateral areas of tergites VI–VIII, separated from rest of tergite by carina and facing posteriad. Wax plates of uniform structure, large, crescent-shaped (VI) to subtriangular, with individual wax filaments discernible.

ETYMOLOGY. From Latin *longus* (long) and *rostrum* (bill, beak).

DISCUSSION

Instar of the holotype nymph

The character changes from instar to instar are similar and comparatively well studied in Dictyopharidae and Delphacidae (Lindberg, 1939; Emeljanov, 1980, 1994, 1995, 2001; Wilson & McPherson, 1981a, b; Wilson & Tsai, 1984, 1991; Wilson, 1985; Calvert & Wilson, 1986; Tsai & Wilson, 1986; Wilson & Wheeler, 1986; Calvert *et al.*, 1987a, b; Holder & Wilson, 1992; Wilson *et al.*, 1992; McPherson & Wilson, 1995). Some characters of the *B. longirostris* **sp. n.** holotype are more or less instar-specific.

1. In *Bathymyza* **gen. n.**, lateral areas of metope bear two rows of sensory pits, the complete inner row reaching the epistomal suture and the ventrally incomplete outer row, ending far from clypeus, as usual in Dictyopharidae. In late instars of some Orthopagini (*Orthopagus* Uhler, 1897; *Tenguna* Matsumura, 1910) the outer row of sensory pits is extended towards the clypeus, but these are secondary, smaller pits reaching slightly ventral to antennae (not quite accurately shown by Yang & Yeh, 1994). It is noteworthy that in the *B. longirostris* **sp. n.** holotype nymph both these rows of sensory pits are interrupted dorsal to the lower eye margin. This feature appears in the first instar nymphs: in some higher Orgeriinae (*Ototettix* Oshanin, 1913; *Repetekia* Oshanin, 1913), and to a lesser degree in some Dictyopharinae (*Nersia florens* Stål, 1862, Nersiini; Emeljanov, 1994, figs 12, 17, 21).

2. The third antennal segment (base of flagellum) is wider than 1/2 of the pedicel in the first instar nymphs of Delphacidae (Lindberg, 1939; Asche, 1985) and Dictyopharidae (Emeljanov, 1980, 1994). In the second instar it is slightly narrower than the pedicel. In later instars, the third segment gradually becomes smaller compared to the second, so that in adults it is almost equal in thickness to the flagellum.

3. Sensory plaque organs of the pedicel usually appear in the second instar, except for e.g. *Phylloscelis pallescens* Germar, 1839 (Phylloscelini) having 3 plaques already in the first instar (McPherson & Wilson, 1995).

4. Position of the wax plates is not reliable enough to determine instars. In younger instars of Dictyopharidae they usually lie in the plane of the upper surface of the abdomen, and in the later (IV–V) instars in the transverse subvertical plane (Emeljanov, 1980, 1994).

5. The number of apical teeth on hind tarsomere I and hind tibia is 4 (2+2) in the first instar and 6 (3+3) in the second (Emeljanov, 2001).

6. The number of sensory pit rows in discal-paradiscal area of the pronotum: one (second row absent) in the first instar; two (*Dictyophara pannonica* (Germar, 1830); Emeljanov, 1980) or one (*Nersia florens*; Wilson & McPherson, 1981a) in the second instar; always two in the third instar.

7. Development of wing pads: the difference between I–III instars in the relative length of fore and hind wing pads is not clearly expressed.

8. Lateral spines of hind tibiae are absent in the first instar and as a rule appear already in the second instar, though they may be very small, as in *Asiraca clavicornis* (Fabricius, 1794) (Delphacidae; Asche, 1985).

In the *Bathymyza longirostris* **sp. n.** holotype nymph, characters 1, 2, 5, and possibly 8 point to the first instar, 3 to the second (or maybe first), 6 to the second, and 4 rather to some later instar. Despite such a discordance, we suppose that this is most probably the first instar nymph.

In the fifth instar nymphs of many genera of various Dictyopharinae tribes, including *Alicodoxa*, a small upper wax plate was discovered adjacent to the large one (Emeljanov & Shcherbakov, 2011). The absence of these small wax plates in *Bathymyza* **gen. n.** may be due to its early instar. The early instars of extant Orthopagini are still unstudied.

According to our data, in planthoppers the body length of the fifth instar is nearly twice larger than that of the second (AFE, pers. obs.). Therefore, the adults of *B. longirostris* **sp. n.** were medium-sized planthoppers, with the body length over 1 cm. The adults of *Alicodoxa rasnitsyni* were smaller (body length of the fourth instar holotype nymph is 4.1 mm).

Systematic position

The new genus is similar to *Alicodoxa* and likewise assigned to the subfamily Dictyopharinae based on the general habitus and presence of typical wax plates on the VI–VIII abdominal tergites (undeveloped in another subfamily, Orgeriinae), and to the tribe Orthopagini based on the arrow-shaped anterior convergence of the lateral carinae of the mesonotal disc, combined with one or few sensory pits being displaced forwards (or forwards and backwards) from rows on the abdominal tergites IV–V (see Yang & Yeh, 1994; the latter character is found only in Orthopagini, the former also in Nersiini). The subapical tooth on the fore femur is characteristic of most Orthopagini but absent in several species of *Centromeria* Stål, 1870, *Alicodoxa*, and the new genus. The early instar nymphs of Nersiini differ from *B. longirostris* **sp. n.** by less numerous sensory pits, absence of the collateral carina of pronotum, and laterotergites VIII extended medially.

However, two features make placement of the new genus in Orthopagini somewhat doubtful. An unusual character of *Bathymyza* **gen. n.** is the presence of sensory pits (2 pairs) on the dorsal side of tergite IX medially. Such pits are characteristic of Delphacidae, Cixiidae and Achilidae (Yang & Yang, 1986; Yang, 1989; Yang & Yeh, 1994) standing lower than Dictyopharidae in the phylogeny of Fulgoroidea. Achilidae likewise show 2 pairs of these pits, and some Fulgoridae as well [2 pairs according to the text in “Fulgoridae sp. 2” of Yang & Yeh (1994), identified as *Pyrops* sp. by Emeljanov (2009)]. These pits are absent in all studied nymphs of Dictyopharidae.

The dorsal pits on the tergite IX and the abovementioned discordance in the instar-specific characters may indicate that *Bathymyza* **gen. n.** and *Alicodoxa* belong to an extinct primitive tribe of Dictyopharidae.

The only extinct tribe of Dictyopharidae recorded in the Cenozoic is Worskaitini known from a single specimen. The nymphs of *Alicodoxa rasnitsyni* and *B. longirostris* **sp. n.** differ from the adult of *Worskaito stenexi* Szwed, 2008 by the wider, less elongate head (the head elongation in Dictyopharinae, if it occurs, proceeds gradually from instar to instar) and also by the flattened fore tibia (*A. rasnitsyni*) or longer rostrum (*B. longirostris*). However, this extinct tribe, like the existing ones, may include taxa with different head shapes, so it cannot be ruled out that both genera based on nymphs belong to Worskaitini.

Biology

The exceptionally long rostrum reaching beyond the apex of the abdomen in *Bathymyza* **gen. n.** is consistent with the assumption that these nymphs dwelt on the bark of amber-producing trees. In the Mesozoic such extremely long rostra were rather common among Auchenorrhyncha (e.g. Palaeontinidae, Tettigarctidae, Fulgoridiidae, Mimarachnidae, Dorytocidae), indicating that in the past feeding on trees with thick and rough bark was more widespread than today (Shcherbakov & Popov, 2002; Shcherbakov, 2017; Emeljanov & Shcherbakov, 2018). In the Cenozoic and recent fauna similar rostra are found only in a few planthoppers, e.g. in some Cixiidae (*Mnemosyne* Stål, 1866 and other Mnemosynini; Szwed *et al.*, 2006), some Dictyopharinae (*Pippax* Emeljanov, 2008), and some Orgeriinae (*Ticrania chamberlini* (Van Duzee, 1923)) — these latter do not live on typical trees, but are reported e.g. from tree-like *Yucca brevifolia* (*Ticida* Uhler, 1891 and *Yucanda* Ball et Hartzell, 1922 – Emeljanov, 1980: 39; Schneider, 2020). A similar trait occurred in aphids: very long rostra, sometimes much longer than the body, are found in many Cretaceous and Paleogene genera in different families, whereas today *Stomaphis* Walker, 1870 is the only genus with extremely long rostrum (Heie & Wegierek, 2009) – twice the body length or more, enabling these aphids to probe through the bark crevices.

ACKNOWLEDGEMENTS

We are deeply grateful to Christian Neumann (Museum für Naturkunde, Berlin) for providing photographs of amber planthoppers and arranging the loan of the

specimen, Vladimir Gnezdilov (Zoological Institute RAS, St.-Petersburg) for bringing the specimen to us, and Roman Rakitov (Paleontological Institute RAS, Moscow) for valuable comments. The study was supported by the Russian Foundation for Basic Research grants 16-04-01143 and 18-04-00322.

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