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A new species of the genus *Archaeoheilus* Legalov, 2018 (Coleoptera: Curculionidae) from the Paleocene of Menat (France)

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ABSTRACT
A new molytine species, *Archaeoheilus gallicus* n. sp. from the Paleocene of Menat (France) is described and illustrated. The new species is similar to *A. provectus* (Scudder, 1876), *A. scudderi* Legalov, 2018, *A. ovalis* Legalov, 2018 from the early-middle Eocene Green River Formation, and *A. lacoei* (Scudder, 1893) from the late Eocene Florissant Formation. But it differs from them in the narrow elytral interstriae. The new species differs also from *A. scudderi* in the thicker rostrum, larger body size, and wider tarsomeres 2 and 3; and also from *A. provectus*, *A. ovalis*, and *A. lacoei* in the thinner rostrum; from *A. provectus* and *A. lacoei* in the smaller body size, and from *A. ovalis* in the larger body size and antennal scrobes reaching eyes. The key to species of the genus *Archaeoheilus* Legalov, 2018 is given. The links between the weevil faunas of America and Europe in the Paleogene are discussed.

KEY WORDS
Molytinae,
diagnostics,
key to species,
France,
new species.

RÉSUMÉ
Une nouvelle espèce du genre Archaeoheilus *Legalov, 2018 (Coleoptera: Curculionidae) dans le Paléocène de Menat (France).*
La nouvelle espèce de Molytinae *Archaeoheilus gallicus* n. sp. est décrite et illustrée du Paléocène de Menat (France). Elle est similaire à *A. provectus* (Scudder, 1876), *A. scudderi* Legalov, 2018, *A. ovalis*

MOTS CLÉS
Molytinae,
diagnostiques,
clef des espèces,
France,
nouvelle espèce.

Legalov, 2018 de la formation du Green River (Éocène inférieur à moyen), et *A. lacoei* (Scudder, 1893) de la formation de Florissant (Éocène terminal). Mais elle en diffère par les interstries élytrales étroites. La nouvelle espèce diffère également d'*A. scudderi* par le rostre plus épais, la taille du corps plus grande et les tarsomères 2 et 3 plus larges ; et aussi de *A. provectus*, *A. ovalis* et *A. lacoei* par son rostre plus fin ; de *A. provectus* et *A. lacoei* par son plus petit corps, de *A. ovalis* par sa plus grande taille et les scrobes antennaires atteignant les yeux. Une clef des espèces du genre *Archaeoheilus* Legalov, 2018 est proposée. Les liens entre les faunes de charançons d'Amérique et d'Europe au Paléogène sont discutés.

INTRODUCTION

The weevil fauna of the Paleocene is the least studied among those of the Paleogene. This is primarily because there are so few Paleocene localities with fossil remnants accessible for study. Up to now Paleocene weevils have been found in five localities (Heer 1870; Cockerell 1925, 1926, 1936; Piton 1940; Williams 1943; Legalov 2010; Legalov *et al.* 2017), in France (Menat), Starostin (Norway, Svalbard), Arkhara (south of the Russian Far East), and Hong Kong (Ping Chau Formation, dated from the Paleocene by Li & Lee [1997], and from the early Cretaceous by Wang *et al.* [2019]), and Sunchal (Argentina). In total, 27 weevil species have been described from the Paleocene, but among them 18 species known from Starostin, Sunchal, and Mirs isolated elytra (Heer 1870; Cockerell 1925, 1926, 1936; Cockerell *in* Williams 1943; Legalov 2020b). Only eight species represented by complete impressions have been described from Menat, Selandian-Thanetian of France (Piton 1940; Legalov *et al.* 2017), where representatives of the families Ithyceridae, Attelabidae, Brentidae, and Curculionidae are recorded.

The new species described here is the first representative of the Molytinae in the fauna of Menat. At the same time, it is also the first species of the genus *Archaeoheilus* Legalov, 2018 known from fossil faunas of the Eastern Hemisphere.

MATERIAL AND METHODS

The holotype of the new species is deposited in the Menat Town Museum, Village of Menat, Puy-de-Dôme (further MTM). The specimen was studied using a stereomicroscope Olympus SCX9 in MNHN.

SITE DESCRIPTION

The middle Paleocene Menat fossil site (Menat Basin, Puy-de-Dôme, France) is a volcanic maar containing a paleolake *c.* 1 km in diameter (46°06'N, 2°54'E), which contains sedimentary rocks (spongo-diatomites) with remains of diverse aquatic and terrestrial flora and fauna (Piton 1940; Vincent *et al.* 1977; Nel 1989, 2008; etc.). The composition of faunal and floral remains suggests that the lake was surrounded by a mainly deciduous forest and that the palaeoenvironment was warm and humid (Wedmann *et al.* 2018). Following the pollen, mammalian stratigraphic and radiometric K/Ar analyses, the age of Menat outcrop was estimated as 59 Ma (Kedves & Russel 1982; Nel 2008). However, the new estimate based on macroflora postulated its age within 60-61 Ma (Wappler *et al.* 2009). Some preliminary results of studies on the beetle fauna from Menat outcrop were published by Nabozhenko & Kirejtshuk (2014, 2017), Kirejtshuk *et al.* (2016), Legalov *et al.* (2017, 2019a) and Kirejtshuk & Nel (2018).

SYSTEMATICS

Family CURCULIONIDAE Latreille, 1802
Subfamily MOLYTINAE Schoenherr, 1823
Tribe MOLYTINI Schoenherr, 1823
Subtribe HYLOBIINA W. Kirby, 1837
Genus *Archaeoheilus* Legalov, 2018

Archaeoheilus gallicus n. sp.
(Figs 1; 2)

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ETYMOLOGY. — The name derives from the Latin name of France (Gallia).

TYPE LOCALITY AND STRATUM. — Menat Basin, Puy-de-Dôme, France. Middle Paleocene (46°06'N, 2°54'E), collected in a new, small outcrop near the south-east of the village of Menat.

HOLOTYPE. — MNT-Nel 2002 (well preserved on the piece of rock; the specimen shows the main parts of body sclerites in dorso-lateral view but antennae are missing), stored in the collection of the town of Menat.

DIAGNOSIS. — Body glabrous; rostrum curved, longer than pronotum; eyes transverse oval; antennal scrobes lateral, directed to eye; antennae inserted subapically; elytra convex, with narrow interstriae; prosternum without rostral channel; pygidium covered by elytra; metacoxae transverse elongate; tibiae almost uncinate.

DESCRIPTION OF HOLOTYPE

Body black and glabrous. Rostrum rather thick, slightly curved, slightly longer than pronotum, finely punctured, 4.2 times as long as wide at apex, 3.2 times as long as wide in middle and at base, 1.2 times as long as pronotum. Forehead

slightly narrower than rostrum base wide, densely punctured. Eyes large, transverse oval, 0.5 times as long as wide. Temples subequal to eye length. Antennal scrobes long, lateral, oblique, directed to basal third of eye, reaching one. Antennae inserted in apical part of rostrum. Pronotum about 0.8 times as long as wide at apex, about 0.6 times as long as wide in middle and at base. Pronotal disc flattened, densely punctured. Elytra weakly convex, 3.8 times as long as pronotum. Elytral base weakly concave. Humeral calli convex. Striae quite wide, with large oval points. Interstriae narrow, weakly convex, punctured, 1.2-1.7 times as long as wide of striae. Prosternum with postorbital lobes, without rostral channel. Precoxal part of prosternum long. Postcoxal part of prosternum narrow. Mesepimera medium-sized. Metaventrite 2.8 times as long as metacoxal length, flattened, densely punctured. Metepisternum about 3.5 times as long as wide in middle. Abdomen convex. Ventrite 1 1.6 times as long as metacoxa. Ventrite 2 as long as ventrite 1. Ventrite 3 0.5 times as long as ventrite 2. Ventrite 4 0.8 times as long as ventrite 3. Ventrite 5 2.7 times as long as ventrite 4. Pygidium not exposed. Legs long. Procoxae conical. Metacoxae transverse elongate. Femora thickened, toothless. Profemora about 3.7 times as long as maximal wide. Mesofemora about 3.0 times as long as maximum wide. Metafemora about 3.3 times as long as maximum wide. Tibiae almost straight, with large uncus at apex. Protibiae about 4.8 times as long as wide. Mesotibiae about 6.9 times as long as wide. Metatibiae about 6.3 times as long as wide, reaching ventrite 3. Tarsi long. Tarsomere 1 conical. Tarsomere 2 wide conical. Tarsomere 3 bilobed. Tarsomere 5 long. Metatarsomere 1 about 1.5 times as long as wide at apex. Metatarsomere 2 0.8 times as long as wide at apex, 0.7 times as long as and 1.3 times as wide as tarsomere 1. Metatarsomere 3 0.7 times as long as wide at apex, subequal in length with and 1.2 times as wide as metatarsomere 2. Metatarsomere 5 6.0 times as long as wide at apex, 2.3 times as long as and 0.3 times as wide as metatarsomere 3.

Measurements

Body length (without rostrum) 4.0 mm. Rostrum length 1.0 mm.

Comparison with other *Archaeoheilus* species

Archaeoheilus gallicus n. sp. is similar to *A. provectus* (Scudder, 1876), *A. scudderi* Legalov, 2018, *A. ovalis* Legalov, 2018 from Green River, and *A. lacoei* (Scudder, 1893) from Florissant with transverse eyes, which width is about two times longer than length. However, it differs generally from all compared species in the narrow elytral interstriae. But the new species also differs from individual species in the following features: from *A. scudderi* – in the thicker rostrum, larger body sizes, and wider tarsomere 2 and 3 –; from *A. provectus*, *A. ovalis* and *A. lacoei* – in the thinner rostrum –; from *A. provectus* and *A. lacoei* – in the smaller body sizes –, from *A. ovalis* – in the larger body sizes and antennal scrobes reaching eyes. *Archaeoheilus gallicus* n. sp. is also distinguished from *A. packardii* (Scudder, 1893) from Green River in the transverse eyes, thinner rostrum, narrow elytral interstriae and smaller body size and from *A. deleticius* (Scudder, 1893) from White River in the thinner rostrum, less transverse eyes, and narrow elytral interstriae.

Additional notes

Archaeoheilus gallicus n. sp. belongs to the subfamily Molytinae, because its tibiae have a large uncus, its rostrum is rather thick, and also its antennae are inserted at the apical third of the rostrum. The prosternum without any rostral channel, the convex body, the conical tarsomere 2, the elytral base weakly concave, the mesepimera not enlarged, the pronotum less than half of elytral length, the pygidium not exposed, the antennal scrobes oblique, the metacoxae transverseelongate, and the large transverse eyes a placement in the tribe Molytini. Distinct humeri allow it to be placed in the subtribe Hylobiina. Antennae are missing in the type specimen and the structure of its club not observable, which is one of the characters for separating Plintini and Molytini, but the Plintini are characterized by the rounded or not large transverse eyes, which makes a position in this tribe unlikely. *Archaeoheilus gallicus* n. sp. should be put in the genus *Archaeoheilus* because of its toothless femora, quite short and thick rostrum, and small body size. The small body size is not characteristic of the genera of Molytini. The genus *Archaeoheilus* with a body length within 3.4 and 5.8 mm is the smallest in this tribe.

DISCUSSION AND CONCLUSIONS

Piton (1940) described six Curculionidae from Menat, viz. *Phytonomus punctatus* Piton, 1940, *Rhysosternum punctatolineatum* Piton, 1940, *Curculio elegans* Piton, 1940, *Centrinus longipes* Piton, 1940, *Hipporhinus ventricosus* Piton, 1940, and *Lixus ligniticus* Piton, 1940. The study of the holotypes of *Curculio elegans* and *Hipporhinus ventricosus* showed that they belong to the tribes Curculionini (Curculioninae) and Naupactini (Entiminae) respectively (Legalov *et al.* 2017). The types of the other species have not yet been found, but the evaluation of the original descriptions, drawings, and materials from Menat made it possible to conclude that "*Phytonomus*" *punctatus* belongs to the family Attelabidae, "*Rhysosternum*" *punctatolineatum* to the family Rhynchitidae, "*Centrinus*" *longipes* to the subfamily Curculioninae of the family Curculionidae, and that the systematic position of *Lixus ligniticus* was correctly identified in the original description. Thousands of additional specimens of Curculionoidea were recently found in the Menat outcrop, which wait to be studied.

The subfamily Molytinae is a diverse group of weevils (Lyal 2014; Legalov 2018c). The earliest records of the representatives of this subfamily are known from the Late Cretaceous (Maastrichtian). *Hylobiites cretaceus* Scudder, 1895 was found in Assiniboine, Canada and *Dorotheus guidensis* Kuschel, 1959 is documented in Magallanes, Chile (Scudder 1895; Kuschel 1959; Legalov 2015). Unfortunately, both of them are known only from isolated elytra and their systematic positions within the subfamily is poorly constrained. The Molytinae *Archaralites zherichini* Legalov, 2010, based on

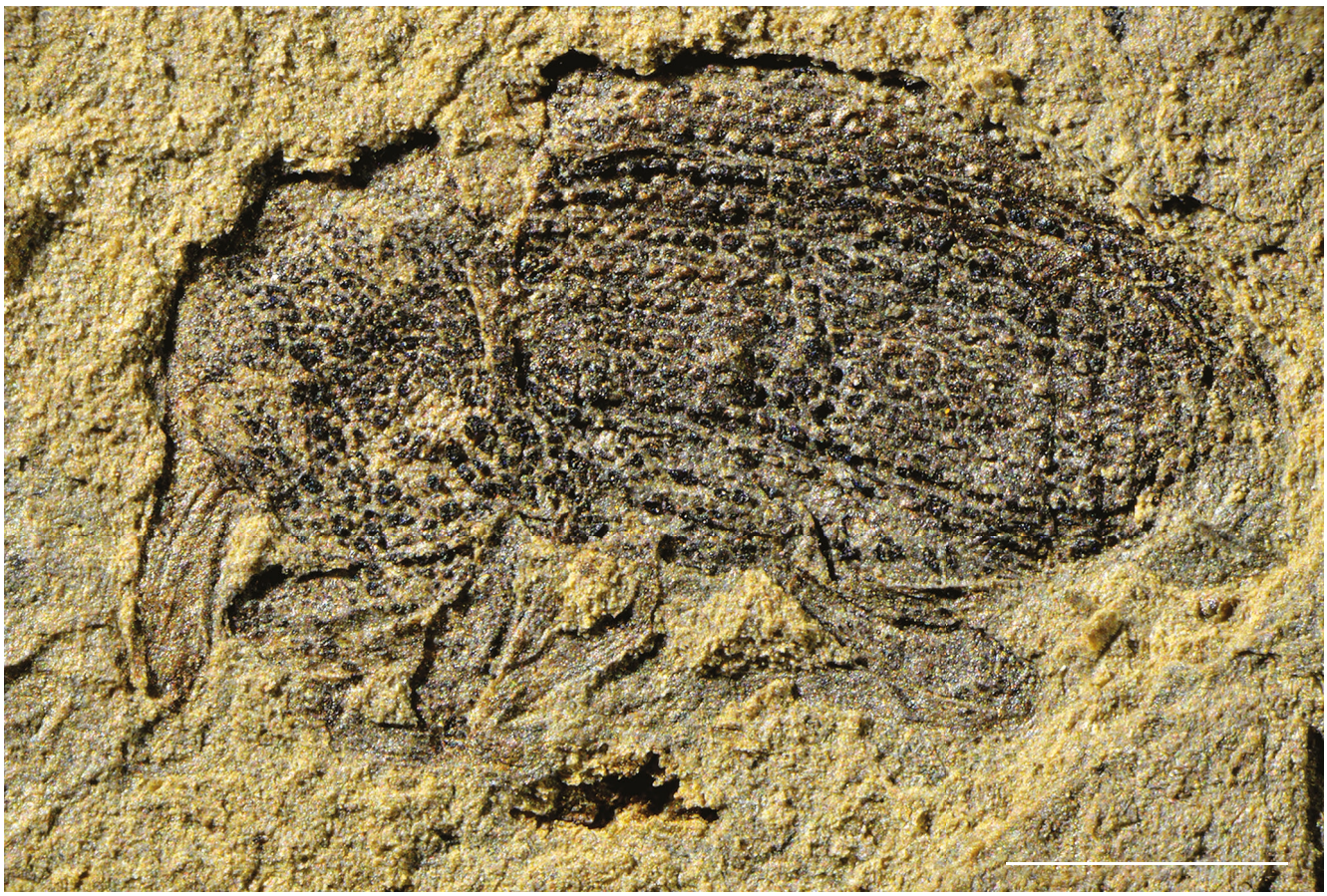

Fig. 1.— *Archaeoheilus gallicus* n. sp. from Paleocene of Menat, holotype, body, lateral view. Scale bar: 1.0 mm.

an incomplete impression from the Priamurye, is the earliest Paleocene Molytinae (Legalov 2010). *Archaeoheilus gallicus* n. sp. is the second representative of Paleocene Molytinae. It is known from complete impression on which most of the diagnostic characters are visible. The Eocene Molytinae are more diverse (Legalov 2015). Representatives of the tribes Molytini (*Furhylobius* Legalov, 2015), Camptorhinini Lacordaire, 1865 (*Camptorrhinites* Britton, 1960, *Korystina* Britton, 1960), Cryptorhynchini Schoenherr, 1826 (*Oisecalles latosquamosus* Legalov, Kirejtshuk & Nel, 2019 and *Taylorius* Britton, 1960), and Sciabregmini Legalov, Kirejtshuk & Nel, 2019 (*Sciabregma* Scudder, 1893) were found in the early Eocene (Scudder 1893; Britton 1960; Legalov 2015; Legalov *et al.* 2019b). Two genera, *Lutago* Britton, 1960 and *Pissodites* Britton, 1960, of unknown tribal affinities, have been described from the early Eocene deposits of Great Britain (Britton 1960). The early-middle Eocene Molytinae from the Green River Formation are represented by species of the genera *Archaeoheilus*, *Rhysosternum* Scudder, 1893, *Sciabregma* Scudder, 1893, and also formally placed in the genera "*Magdalis*" and "*Cryptorhynchus*" (Scudder 1893; Cockerell 1921; Legalov 2015, 2018b). Thirteen species of Molytinae have been found in the middle and late Eocene deposits and seven species were recovered in Baltic amber (Scudder 1893; Wickham 1912; Hustache 1942; Haupt 1950; Zherikhin 1971; Legalov 2016, 2020a, 2020b; Bukejs *et al.* 2020).

The new species belongs to a genus previously known from the Green River Formation and the latest Eocene of Florissant (Scudder 1876, 1893; Legalov 2018b). It was not known from the Eocene deposits and amber of Europe. The genus *Archaeoheilus* is similar to the genus *Lutago*. The differences between them are mainly in the thin rostrum and small size (2.2-2.6 mm) of the latter genus.

The discovery of a new *Archaeoheilus* species allows us to discuss probable faunal links between Eastern and Western hemispheres. Such links are already known for many other insect orders, especially in the Odonata (see Garrouste & Nel 2019). Europe and America were joined in the Mesozoic (Boucot *et al.* 2013). However, the main divergences among the Curculionidae could have occurred only in the Late Cretaceous, since the first known representatives of this family are from the end of the early Cretaceous (Legalov 2014a). Only representatives of the most 'primitive' subfamily Erirhininae were found in the Cenomanian and Turonian deposits (Legalov 2014b, 2018a; Legalov & Poinar 2015). Land bridges between North America through Greenland and Scandinavia, on the one hand, and the British Isles, on the other, existed in the Paleocene (Wen *et al.* 2016). The bridge through Greenland remained in the Eocene, but Scandinavia at that time was separated from Western Europe (Boucot *et al.* 2013; Wen *et al.* 2016). Menat and Green River were located the Boreo-tropical belt, but the

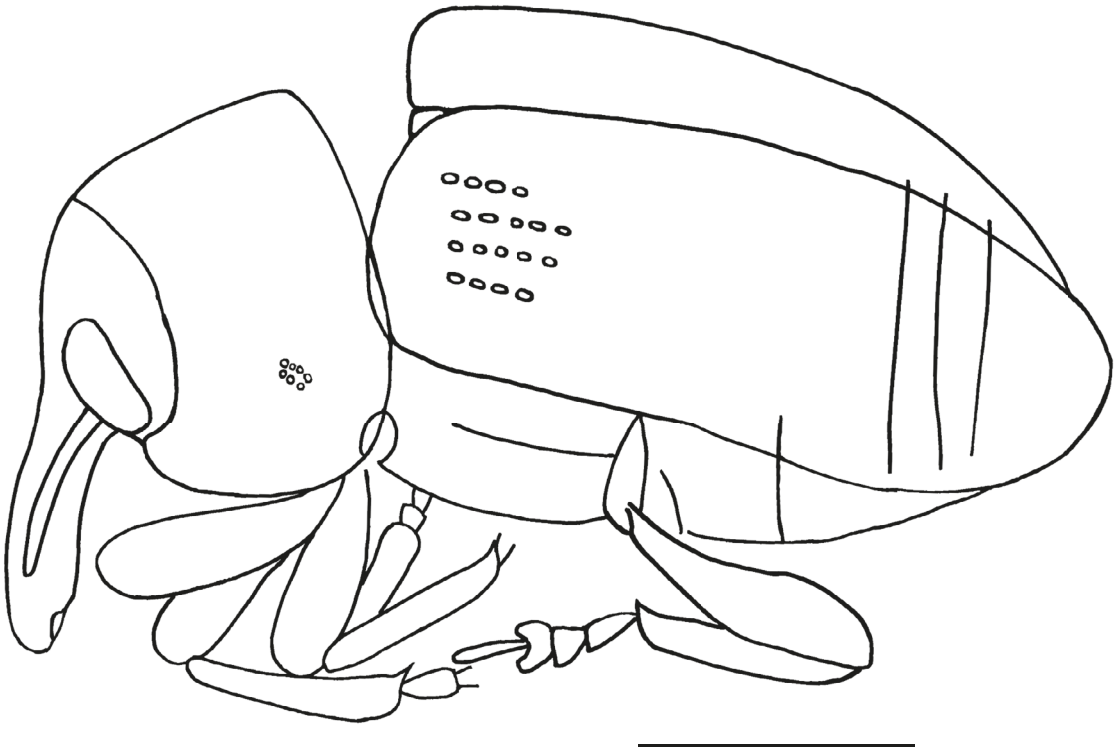

FIG. 2.— *Archaeoheilus gallicus* n. sp. from Paleocene of Menat, holotype, reconstruction drawing of body, counterpart, lateral view. Scale bar: 1.0 mm.

connection between America and Europe was by the warm temperature belt (Baltic amber was in this belt) in the Eocene (Boucot *et al.* 2013). Accordingly, Curculionidae could freely move between these continental plates. Species from four genera are shared by the past faunas of Europe and America: *Archaeoheilus* is found in the Paleocene of France (present study) and the Eocene of the United States (Legalov 2018b), *Sciabregma* in the early Eocene of France (Legalov *et al.* 2019b) and the early-middle Eocene of the United States (Scudder 1893; Cockerell 1921), *Limalophus* in the middle Eocene amber of Europe (Legalov 2020a) and the early-late Eocene of the United States (Scudder 1893), *Toxorhynchus* in the middle Eocene of Europe (Bukejs & Legalov 2020) and the late Eocene of the United States (Scudder 1893; Legalov 2013), as well as in Miocene Dominican amber (Poinar & Legalov 2015) and the Recent fauna of the New World (Bukejs & Legalov 2020). The Neotropical subtribe Prionomerina and Oriental Zherichinixenina are found

KEY TO SPECIES OF THE GENUS *ARCHAEOHEILUS* LEGALOV, 2018

1. Eyes rounded. Body length 6.4 mm ..... *A. packardii* (Scudder, 1893)
— Eyes transverse oval 2

2. Elytral interstriae narrow, 1.2-1.7 times as long as wide as striae. Body length 4.0 mm ..... *A. gallicus* n. sp.
— Elytral interstriae wide, 3.0-5.8 times as long as wide as striae 3

3. Eye width/length ratio 1.7. Body length 3.8 mm ..... *A. deleticius* (Scudder, 1893)
— Eye width/length ratio 1.9-2.1 4

4. Rostrum slender, 3.7 times as long as wide in the middle. Body length 5.8 mm ..... *A. scudderi* Legalov, 2018
— Rostrum more robust, 2.4-2.9 times as long as wide in the middle 5

5. Smaller. Body length 3.4 mm ..... *A. ovalis* Legalov, 2018
— Larger. Body length 5.0-7.3 mm 6

6. Smaller. Rostrum 2.9 times as long as wide in the middle. Body length 5.0 mm .....
..... *A. provectus* (Scudder, 1876)
— Larger. Rostrum 2.4 times as long as wide in the middle. Body length 7.3 mm ..... *A. lacoei* (Scudder, 1893)

in the Eocene of the United States (Scudder 1893) and Baltic amber (Legalov 2020a). The mostly American tribe Naupactini was found in the Paleocene of France (Legalov *et al.* 2017) and the middle Eocene amber (Yunakov & Kirejtshuk 2011; Bukejs & Legalov 2019). The presence of the Neotropical tribe Anypotactini can be noted in the middle Eocene of Europe (Yunakov & Kirejtshuk 2011; Legalov 2015; Legalov *et al.* 2019c). Its representatives have not yet been found either in the Eocene of the United States or in the Paleocene of Europe (Legalov 2015), but will probably be found in the future.

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