AMERICAN MUSEUM
Novitates

PUBLISHED BY THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET, NEW YORK, N.Y. 10024
Number 3140, 7 pp., 17 figures June 29, 1995

Caddis Flies (Trichoptera) from Turonian (Upper Cretaceous) Amber of New Jersey[1]

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ABSTRACT

Three well-preserved caddis flies were discovered in two pieces of Turonian-age amber (Upper Cretaceous, 90–94 million years old [Ma] from central New Jersey. Two of them are the male and female of a new species of the Recent and Oligocene hydroptilid genus *Agraylea* (sensu lato); a new subgenus is described for this species; this very small representative of *Agraylea* may be the oldest known hydroptilid. The third specimen is the male of a species of the Recent, Miocene, Oligocene, and Upper Cretaceous philopotamid genus *Wormaldia,* being the oldest known species certainly belonging to this genus.

INTRODUCTION

The American Museum of Natural History is excavating amber from an unexpectedly rich deposit from the Raritan-Magothy Formation (Upper Cretaceous: Turonian, ca. 90–95 Ma) of central New Jersey. Grimaldi et al. (1989) summarized the paleontology of New Jersey fossil resins. The amber can vary from transparent yellow to red, turbid, and cloudy, from pieces only 2–3 mm in diameter to large pieces 10–15 cm long and 8–12 cm wide. The substance is apparently the fossilized resin of araucarian trees, based on the structure of large pieces of carbonized wood found with the amber as well as on the chemistry of the amber. The site of the excavations is undoubtedly a lagoonal or deltaic deposit, with carbonized wood, conifer needles, stems of Equisetales, and the amber associated with

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ISSN 0003-0082 / Price $1.40

them, representing stranded, redeposited material.

Among the hundreds of amber pieces containing arthropod inclusions, two were found with Trichoptera, described below.

ACKNOWLEDGMENTS

Thanks are expressed to David Grimaldi (AMNH) for providing this interesting material plus photographs, for information on the amber and the site, as well as for editing the manuscript. Thanks are also due to Gerard R. Case, James J. Leggett, and Paul D. Borodin, for their collecting efforts.

SYSTEMATICS

FAMILY HYDROPTILIDAE

Genus *Agraylea* Curtis, 1834

DIAGNOSIS: (s.l., including *Allotrichia* McL., 1880): Mostly relatively large Hydroptilidae; wings relatively broad, apex parabolic; venation fairly complete (f 1, 2, 3 in forewing; 1, 2, 3, 5 or 2, 3, 5 in hindwing); ocelli present; tibial spurs 0, 3, 4 (only in some extinct species 1, 3, 4).

Nanoagraylea, new subgenus

DIAGNOSIS: Very small size: in recent *Agraylea* s.l., the wing expanse is mostly 8–11 mm, 6–8.5 mm in the Oligocene species, and only 4–5 mm in the new Cretaceous species; very short f1 in forewings; f1 in hindwings present or absent; no median process on male sternite VII; no particular formation on female sternite VIII.

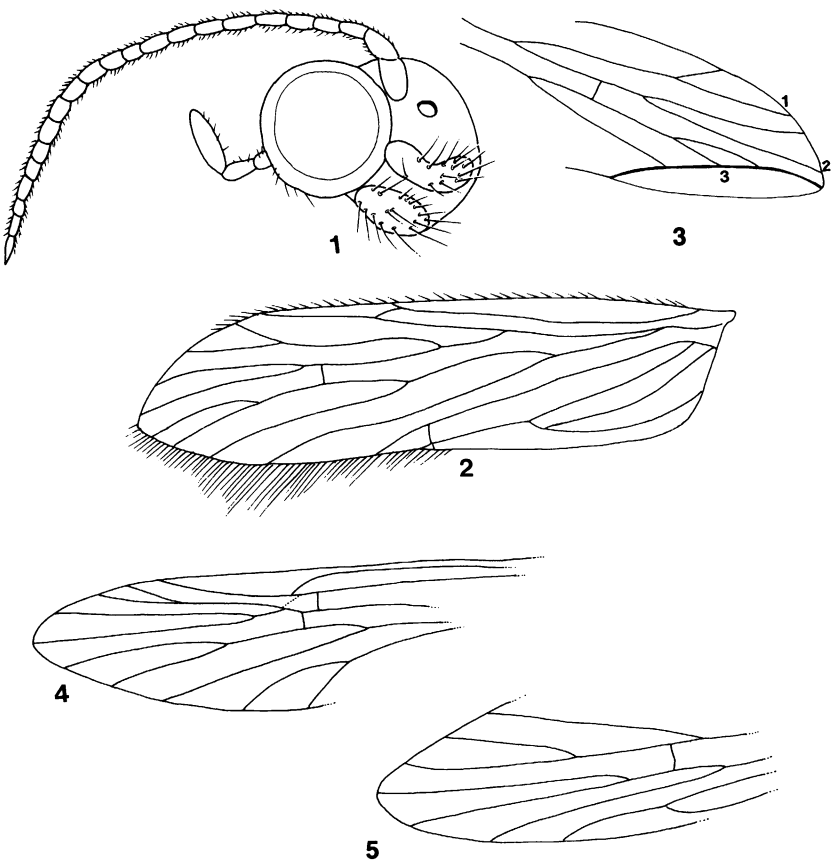
TYPE SPECIES: *Agraylea cretaria,* n. sp.

Agraylea cretaria, new species
(Figures 1–8, 14–16)

TYPES: Female holotype and male allotype in the same piece of yellow amber from Sayreville, Middlesex Co., New Jersey, G. R. Case, coll. AMNH NJ-86. Despite the fact that the male is somewhat larger than the female, I have no doubts about the fact that they belong to the same species.

DESCRIPTION OF FEMALE: Forewing length 1.8 mm, wingspread thus about 4 mm. General color of body and wings dark brown. Specimen generally well preserved. Head with ocelli and two distinct pairs of large, setose warts (the presence of a third pair is not excluded). Antenna with 22 segments, typically hydroptilid, with fine, short setae. Maxillary palpi cannot be well observed, whereas a labial palpus is represented in figure 1. No interesting details of the thorax could be observed. Leg spurs clearly distinct: 1, 3, 4 (foreleg spur well developed; internal spurs much longer than external spurs). Left forewing entirely distinct, but with tip slightly twisted; right forewing not as well preserved, nevertheless with many details distinct; forewings broad, apex not pointed but almost parabolic, setose, with moderately long fringes and thickened setae along SC vein. SC anteapically connected by a transverse vein to R_1; f_1, f_2, and f_3 present; f_1 distinctly shorter (and wider) than f_2; also f_3 shorter than f_2, but longer than f_1 and narrow; transverse vein connecting RS with M distal to bifurcation of M; positions of A_2, A_3, and A_4 rather curious; A_4 joining A_2, and A_3 joining A_4 slightly more proximally (fig. 2). Hindwings less well suited for observation, but essential details are distinct: not strongly pointed; SC joins R_1 at level with bifurcation of RS; f_1 short, distinct in right wing, absent in left; f_2, f_3, f_5 present. Last abdominal segments are very well preserved, allowing examination of their ventral side; sternite VIII without any distinct mediolongitudinal formation, apically with crown of 10 long setae.

MALE: Far less well preserved than the female. Forewing length about 2.2 mm (wing expanse thus about 4.9 mm). General color of body and wings dark brown. Head offering no clear and relevant details. Antenna with 26 segments. Spurs exactly as in female. Wings badly preserved, but nothing in the observable details casts doubt about this specimen belonging to the same species as the female (f_1, f_2, and f_3 can be well observed in the right forewing, and less well in the left one). Apex of abdomen strongly twisted and partly opaque; nevertheless, a fairly good dorsoapical view of the genitalia was obtained. A median process on sternite VII is definitely absent. Segment X very deeply (maybe completely) split medially, the internal borders of its two halves deeply notched in a very characteristic manner; gonopods elongate, rather



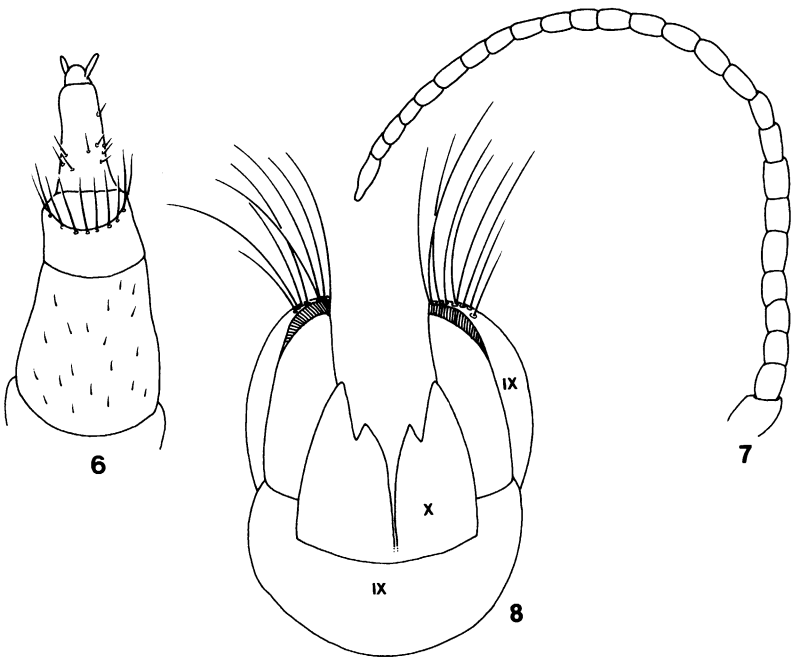
Figs. 1–5. *Agraylea* (*Nanoagraylea*, n. sg.) *cretaria*, n. sp., female holotype. **1**: Head, lateral. **2, 3**: Left forewing and distal parts of right forewing. **4, 5.** right and left hindwings.

narrow, apparently of simple shape and apically thickened; long tufts of strong setae arise from below, probably inserted on sternite IX.

ETYMOLOGY: Subgenus: *Nanus* (L.) = dwarf; species: *cretarius* (L.) = belonging to chalk (an early name for the Cretaceous).

DISCUSSION: At present there are 15 species belonging to the family Hydroptilidae Stephens, 1836, that have been described from fossil material. These species were described in the following genera (here chronologically arranged): *Burminoptila* Botosaneanu, 1981 (genus extinct, one species in Burmese amber of unknown age, but probably lower Tertiary); *Hydroptila* Dalman, 1819 (genus surviving; one species from Eocene of Colorado not surely belonging to this genus or even to the family); *Palaeagapetus* Ulmer, 1912 (genus surviving, with one species from Baltic Oligocene amber); *Agraylea* Curtis, 1834 (genus surviving, one species from Baltic Oligocene amber); *Allotrichia* McLachlan, 1880 (two species from Baltic Oligocene amber; *Allotrichia* is considered here only as a surviving subgenus of *Agraylea*); *Electrotrichia* Ulmer, 1912 (genus extinct, one species from Baltic Oligocene amber); *Leucotrichia* Mosely, 1934 (genus surviving, one species from Early Miocene Dominican amber); *Ochrotrichia* (sg. *Ochrotrichia*) Mosely, 1934 (genus surviving; 6 species—one of them not named, one still surviving—from Early Miocene Dominican amber, but age of one of them given as "Oligocene"); *Alisotrichia* Flint, 1964 (genus surviving, one species from Early Miocene Dominican amber).

Agraylea (*Nanoagraylea*) *cretaria*, n. sp., is probably the oldest known representative of the Hydroptilidae; there is a hydroptilid from Burmese amber (see above), unfortunately of



Figs. 6–8. *Agraylea* (*Nanoagraylea,* n. sg.) *cretaria,* n. sp. **6.** Terminalia of female holotype, ventral. **7.** Antenna of male allotype. **8.** Genitalia of male allotype, dorsoapical view.

uncertain age (Tertiary or Upper Cretaceous) (Botosaneanu, 1981).

The new species certainly belongs, by all genitalic and nongenitalic characters, to the Palearctic and Nearctic genus *Agraylea* (sensu lato, i.e., including *Allotrichia*: see Marshall, 1979: 193, 197; Botosaneanu, 1992: 50). Three species of *Agraylea* and *Allotrichia* were very well described or redescribed from Oligocene Baltic amber by Ulmer (1912): *Agraylea spathifera* Ulmer, 1912; *Allotrichia ampullata* Ulmer, 1912; and *Allotrichia succinica* Hagen, 1856. The new species described here from New Jersey amber (Turonian, 90–94 Ma) is about 50 m.y. older, but shares with the Oligocene *Allotrichia* species an f_1 in the forewings shorter than f_2; in one of the hindwings of the female specimen, f_1 is present (for earlier authors this was a diagnostic character of *Agraylea*), while it is absent in the opposite hindwing ("character of *Allotrichia*"). It is difficult to discern affinities based on male genitalia, whereas the structure of the female last abdominal segments is almost certainly like present-day sg. *Allotrichia.* The existing paleontological evidence, incomplete as it may be, is additional evidence that *Allotrichia* cannot be considered a distinct genus from *Agraylea.*

It is interesting to note that the new species shares with one of the Oligocene species, *Agraylea* (*Allotrichia*) *succinica,* a well-developed spur on the forelegs, which is lost in all other known species of *Agraylea* s.l., extinct or recent.

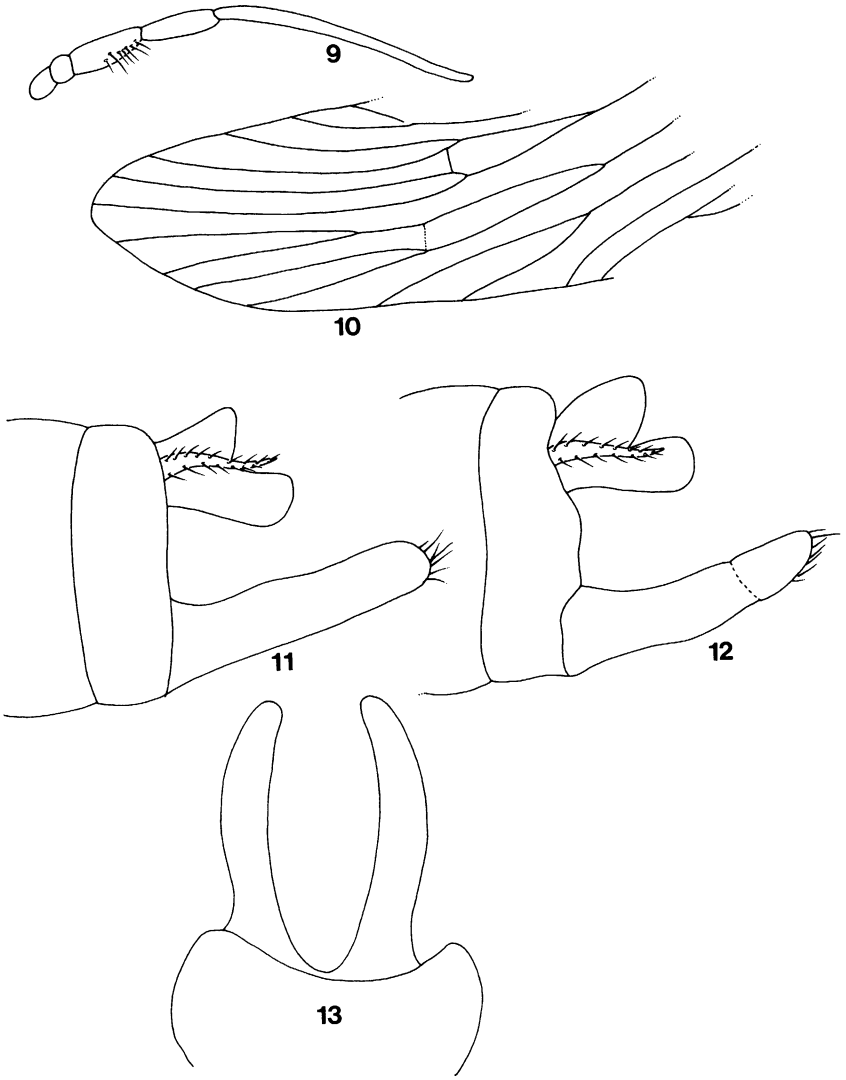
FAMILY PHILOPOTAMIDAE

Genus *Wormaldia* MacLachlan, 1865

DIAGNOSIS: Medium-sized Philopotamidae; 2nd segment of maxillary palpi short; tibial spurs 2, 4, 4; tibiae and tarsi of legs of female not dilated; inferior appendages of male simple, clearly bisegmented (coxopodite and harpago).

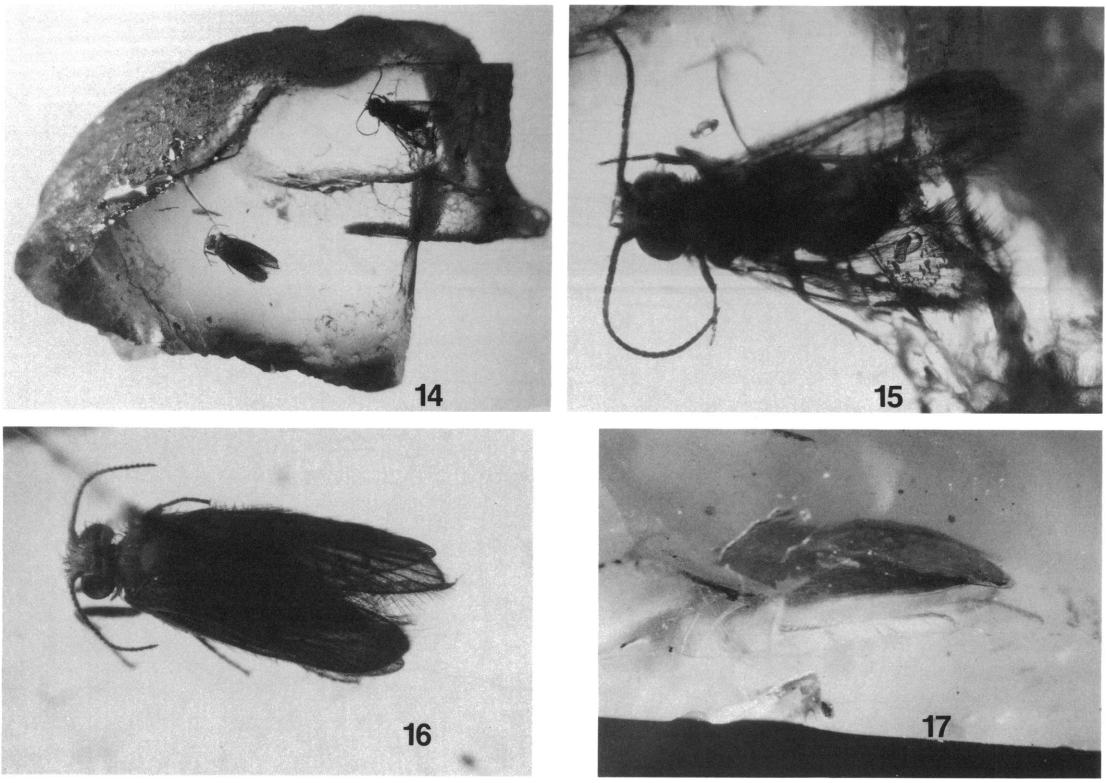
Wormaldia praecursor, new species
Figures 9–13, 17

TYPE: Male holotype in a piece of yellow amber from Sayreville, Middlesex Co., New Jersey, coll. Aug.–Nov. 1993, Case, Leggett, and Borodin; AMNH NJ-87A.



Figs. 9–13. *Wormaldia praecursor,* n. sp., male holotype. **9.** Maxillary palpus. **10.** Distal parts of left forewing. **11-12.** Genitalia, lateral, under very slightly different angles. **13.** Inferior appendages in ventral view.

DESCRIPTION: Forewing length 4 mm. Head very opaque (ocelli, for instance, cannot be seen), but palpi distinct. Maxillary palpi with first two segments very short, segments 3 and 4 much longer and of about the same length, segment 5 extremely long (longer than all others together). Spurs 2, 4, 4. Venation of left forewing not entirely distinct, but what can be seen (fig. 10) is extremely clear, leaving no doubt about this species being a typical philopotamoid; discoidal and median cells closed, median cell extended more distal than discoidal cell, but bases of the two cells at the same level; f_{1-5} present (f_1, f_2, and f_4 sessile; f_3 relatively slightly petiolate). No relevant details visible in hind wing. Appendage on sternite VII cannot be seen. Fine details of genitalia not observable, but general structure easily observed in lateral view: superior appendages very slender, slightly sinuous, pointed, setose; segment X stout, rather high, without a distinct point; phallus can be seen;



Figs. 14–17. Photomicrographs of New Jersey amber Trichoptera. **14.** Entire piece of amber with male and female of *Agraylea* (*Nanoagraylea,* n. sg.) *cretaria,* n. sp. **15.** Habitus of male allotype. **16.** Habitus of female holotype. **17.** *Wormaldia praecursor,* n. sp.

inferior appendages reaching beyond all other parts of the genitalia, parallel-sided, apex obtuse (like a pointed arch at certain angles); a biarticulation of the inferior appendages is merely surmised, especially because of a superimposed leg, but I have no doubts about its existence (2nd joint short).

ETYMOLOGY: *Praecursor* (L.) = forerunner.

DISCUSSION: At present there are 21 species described, or at least mentioned, from fossil material, belonging to this family. It should be mentioned that there are obscure or controversial generic and even familial attributions of some of these species. Fossil philopotamids were described in the following genera, here more or less chronologically arranged: *Prophilopotamus* Sukatsheva, 1973 (genus extinct, one species from the Triassic of Kirgisia); *Baga* Sukatsheva, 1992 (genus extinct, two species from the Middle Jurassic and, respectively, from the Upper Jurassic-Lower Cretaceous of Mongolia); *Dajella* Sukatsheva, 1990 (genus extinct, one species from Mesozoic deposits of the Tchita region of southern Siberia); *Arkharia* Sukatsheva, 1982 (genus extinct, one species from the Upper Cretaceous–Maastrichtian/Danian of the Amur region, Far Eastern Russia); two possible representatives of the family, not named, are known from the Upper Cretaceous (Turonian) of Kazakhstan and respectively from the Upper Cretaceous amber (Turonian-Coniacian?) of Taimyr Peninsula; *Dolophilus* McLachlan, 1868 (presently considered a synonym of the surviving genus *Wormaldia* McLachlan, 1865, but for one of the fossil species the genus *Ulmerodina* Ross, 1956, was created; five species, all extinct, were described in *Dolophilus,* one from the Upper Cretaceous amber of Tennessee, four from Baltic Oligocene amber; and two extinct species described in *Wormaldia,* from Saxonian

Miocene amber); *Philopotamus* Stephens, 1829 (genus surviving, one species from Baltic Oligocene amber); *Electracanthinus* Ulmer, 1912 (genus extinct, one species from Baltic Oligocene amber); *Chimarra* Stephens, 1829 (genus surviving, five species from Dominican amber, lower Miocene/upper Oligocene). I could not find the description of *Archiphilopotamus* Sukatsheva, mentioned in the bibliography from the Upper Jurassic of Siberia, Krasnoiarsk region.

Wormaldia praecursor, n. sp., is the oldest known species definitely belonging to the genus *Wormaldia.* In this multiform genus with tens of recent species, there are also three species from Oligocene Baltic amber: *W. aequalis* (Hagen, 1856), *W. media* (Ulmer, 1912), and *W. congener* (Ulmer, 1912). In Ulmer's monograph (1912) these species were put under *Dolophilus,* a synonym of *Wormaldia.* Two other species of the genus were described (Mey, 1986) from Saxonian amber (Miocene, ca. 22 Ma): *W. angularia* Mey, 1986 and *W. contigua* Mey, 1986—both considered to be in the same species group as the Baltic amber species. The new species clearly differs from all five by the proportions of the articles of the maxillary palpi, the venation of the forewings, and genitalic characters. It is quite possible that "*Dolophilus* (?) *praemissus*" Cockerell, 1916, from Upper Cretaceous amber from Tennessee also belongs to *Wormaldia. Dolophilus praemissus* was, up to now, the only trichopteran described from North American amber. It was described from only a forewing (Cockerell, 1916).

Additional Note

In the amber piece containing the specimens of *Agraylea,* there is also a pair of wings of a very small caddisfly; they are, unfortunately, almost entirely superimposed, and it is impossible to make out the venation in a reliable manner. The very small size, and the fact that the vein SC in the hindwing seems to be blackened, point to Hydroptilidae; the hindwing is, nevertheless, too broad and its tip too blunt, somehow reminiscent of the hindwing of *Lype* (Psychomyiidae).

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