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A NEW GENUS OF DUSTYWINGS (NEUROPTERA: CONIOPTERYGIDAE) IN LATE CRETAUCEOUS VENDEAN AMBER

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ABSTRACT

A new genus and species of Coniopterygidae is described from a female preserved in Late Cretaceous (Cenomanian to Santonian) amber of Vendée, in northwestern France. Garnaconis dupeorum Perrichot & Nel, n. gen. and sp., displays intermixing features between Aleuropteryginae and Coniopteryginae as currently defined, making its accurate phylogenetic placement difficult. It is tentatively placed in the Aleuropteryginae. A new practical key to the Mesozoic genera of dustywings is proposed.

Keywords: Insecta, Neuropterida, Aleuropteryginae, Mesozoic, France

RÉSUMÉ


Mots-clés: Insecte, Neuroptérida, Aleuropteryginae, Mesózooico, France

INTRODUCTION

Fossil dustywings are almost exclusively found in amber, with 24 species known in 15 genera (10 extinct) from the Neogene Dominican and Mexican ambers, the Palaeogene Baltic, Ukrainian, Indian, and Parisian ambers, and the Cretaceous ambers from Siberia, New Jersey, France, Myanmar, and Lebanon (see the detailed list in Engel & Grimaldi, 2008: appendix 1; and updates in Kupryjanowicz & Makarkin, 2008, Engel, 2010, and Grimaldi & others, 2013). Only two additional, monotypic genera are known as compression fossils, from the Oligocene of France (Nel, 1991) and the Jurassic of Kazakhstan (Meinander, 1975). Two subfossil species were also described from African copal (Meunier, 1910a, 1910b) but are likely synonymous with extant species (Engel, 2004). Finally, several specimens have been reported from Campanian Canadian amber (McKellar & others, 2008) and Albian Spanish amber (Pérez-de la Fuente, 2012), but have yet to be described.

Cretaceous dustywings mostly belong in the Aleuropteryginae, with ten species known in four genera. The Coniopteryginae are known by only two monotypic genera (see the key to Cretaceous genera below).

Herein we report the discovery of a new Coniopterygidae from the Mesozoic, based on a fossil inclusion from Late Cretaceous amber of France.

MATERIAL AND METHODS

The specimen is entombed in a piece of Vendean amber, which derives from a deposit that briefly outcrops between 2002 and 2005...
during construction along the D32 road between La Garnache and Challans, in the department of Vendée, northwestern France. The exact dating of the amber-bearing stratum remains uncertain within the Middle Cenomanian–Early Santonian interval (97–85 Ma), and a discussion with more details on the geology and paleoenvironment of this deposit will be provided elsewhere (see preliminary account in Perrichot & Néraudeau, 2014: 10A in this volume).

The clear yellow amber sliver containing the specimen was originally 7×5×4 mm in size and was polished to maximize close views; polishing used emery papers at different grits (1200 and 2500) on a water-fed grinder. Because some structures were still hidden by large air bubbles, a razor blade was used to remove precise portions with bubbles and the remaining piece was included in Canada balsam between cover glasses; unfortunately the balsam diffused within the amber matrix and caused irreversible damages (lightening...
and/or blurring) to the inclusion cuticle (e.g., Fig. F1.3, F1.7), so embedding of fossiliferous Vendean amber in this natural medium must be strictly avoided and instead, epoxy-embedding should be preferred. Photographs were taken with a Canon 5D Mark II camera attached to Leica microscopes, and HeliconFocus 4.45 software was used to produce multifocus z-stacks so as to achieve sharp focus throughout the images.

We use the morphological terminology proposed by Meinander (1972).

**SYSTEMATIC PALEONTOLOGY**

**Family CONIOPTERYGIDAE** Burmeister, 1839
**Subfamily ALEUROPTERYGINAE** Enderlein, 1905
**Genus GARNACONIS** Perrichot & Nel, new genus

**Type species.** — *Garnaconis dupeorum*, new species, by original and monotypic designation.

**Etymology.** — The new genus-group name is a combination of the name Garnache (the town near which the amber deposit originates) and the Greek *konis* (meaning dust), a common suffix for dustywing genera.

**Diagnosis.** — Female. Antenna with 17 flagellomeres. Forewing entirely fuscous, without any clouds over crossveins; crossveins sc- r and r-rs aligned, r-rs meeting Rs distinctly basad fork of R_{1+2}-R_{4+5} (i.e., r-rs connected to Rs); no crossvein between Rs and M (i.e., only distal crossvein r-m between R_{4+5} and M_{1+2}), about 2.5× as long as basal abscissa of R_{4+5}; medial vein with two branches, with thickened setigerous spot on each side of m-cu; Cu2 with one thickened setigerous spot distal to crossvein cua-cua2. Small plicatures visible at least on third and fourth abdominal segments. Abdominal segment 9 very long.

**GARNACONIS DUPEORUM**, Perrichot & Nel, new species

**Type material.** — Holotype female IGR.GAR-2, in Late Cretaceous (Middle Cenomanian to Late Santonian, 97–85 Ma) Vendean amber; deposited in the Geological Department and Museum of the University Rennes 1, France.

**Type locality.** — La Robinière, departmental road D32, about 2.5 km south-west of La Garnache, Vendée, France.

**Etymology.** — The specific epithet is a patronym honoring Fanny and André Dupé who collected this and most of the Vendean amber; deposited in the Geological Department and Museum of the University Rennes 1, France.

**Diagnosis.** — As for the genus (see above).

**Description.** — Body length ca. 0.8 mm (measured from tip of the head to tip of genitalia). Head (Fig. F1.2, F1.3) hypognathous, elongate, ca. 0.24 mm long. Compound eyes well developed and oval, smallest diameter 0.07 mm, largest diameter 0.09 mm. Intercellular distance equal to smallest eye diameter. Antenna 0.74 mm long, with all articles bearing scattered sensilla (Fig. F1.3); flagellomeres cylindrical, f1–f3 about twice as long as broad, f14–f17 about 1.6× as long as broad; f1 and f2 not distinctly longer than following flagellomeres, f1 0.02 mm long, 0.01 mm wide. Maxillary palps five-segmented, about 0.19 mm long; third segment slightly longer than first, second, and fourth; fifth segment particularly swollen basally, distinctly larger than others, 0.07 mm long and 0.02 mm wide. Galea and lacinia obscured. Labial palps three-segmented, with third segment very large, 0.1 mm long, distinctly larger than first two segments. Thorax 0.27 mm long. Prothorax short, 0.12 mm long. Mesothorax 0.1 mm long, bearing two prominent tubercules dorsally, and two distinct lateral shoulders basad forewings. Metathorax 0.05 mm long. Forewing (Figs. F1.8–F1.10, F2) 1.1 mm long, 0.48 mm wide; Sc_{1} long and parallel to costal margin in its basal two thirds; fork Sc_{1} and Sc_{2} (or sc-r) at 0.82 mm from wing base; sc-r 0.85 mm long, aligned with r-rs at 0.26 mm from wing apex; R branching off from R+M at 0.2 mm from wing base, then bifurcating into R_{1} and Rs after a distance of 0.17 mm; Rs 0.41 mm long before its fork; R_{2+3}, 0.27 mm long; crossvein r-rs slightly sinuate, 0.15 mm long, basal to fork of R_{4+5} and its apex 0.26 mm; M 0.48 mm long before its fork into M_{1+2} and M_{3+4}; M_{1+2} curved; crossvein r-m connected to M_{1+2}; 0.05 mm distally of fork of M_{1+2}; M_{3+4}; M setae approximately equidistant on each side of m-cu (Fig. F1.10); M_{1+2} weakly curved, 0.15 mm long; Cu bifurcating into Cu_{1} and Cu_{2}, 0.12 mm from wing base; Cu_{1} curved, reaching wing margin 0.74 mm from wing base; Cu_{2} curved, distal half nearly parallel to Cu_{1}, reaching wing margin 0.63 mm from wing base; no visible crossvein between Cu_{1} and Cu_{2}; crossveins cua-cua_{1}, and cua nebulosus. Hind wing (Fig. F1.9) slightly shorter than forewing, 0.98 mm long, 0.41 mm wide; Sc_{1} rather long and parallel to costal margin, approaching costal margin 0.95 mm from wing base; fork of R_{1}–Rs not clearly visible but in a very basal position, just distal base of M; Rs bifurcating into R_{2+3} and R_{4+5}, 0.79 mm from wing base; R_{2+3}, slightly curved, 0.19 mm long; r-rs 0.13 mm long, basad fork of Rs; distance between base of R_{4+5} and tip of R_{4+5}, 0.16 mm; M (0.5 mm long before its fork) branching off from R+M very basally; M and Cu distinctly separated, not touching; M_{1+2} slightly curved; crossvein between R_{4+5} and M_{1+2}, 0.07 mm from base of M_{1+2}; M_{3+4} 0.11 mm long; Cu bifurcating into Cu_{1} and Cu_{2} very basally; Cu_{1} curved; a crossvein m-cu present; Cu_{2} curved, nearly parallel to Cu_{1}. Legs slender and densely covered by microtrichiae; fore femur with 13–14 stiff erect setae on posterior surface (Fig. F1.4); tibiae rather long, covered with regular rows of regularly spaced setae; tarsi five-segmented, covered with setae (Fig. F1.5); first tarsomere long, slightly shorter than remaining tarsomeres; second and third tarsomeres nearly equal in length; fourth tarsomere shorter than others, broad and dorsally hollowed around base of fifth tarsomere; fifth tarsomere...
elongated. Abdomen flattened and probably deformed by air
bubbles, 0.46 mm long, 0.23 mm wide, including genitalia; a
plicature visible at least on the third and fourth abdominal seg-
ments (Fig. F1.6), with a dark spot inside abdomen corresponding
to each of them. Genitalia (Fig. F1.7) partly obscured and delicate
to interpret because these organs are much internalized in the
Coniopterygidae, male or female. Nevertheless, it seems most
likely that they correspond to female genitalia for their striking
similarities with those of a female Coniocoma (see Meinander,
1972: fig. 45 C); the main diagnostic character is the very elongate
segment 9 (s9) that extends far beyond the gonapophyses laterales
gl) which bear strongly curved setae; other genital structures are
hidden inside abdomen.

**Key to Cretaceous genera of Coniopterygidae**
(modified from Engel, 2004)

1. Media in forewing with three branches .................................. 2
2. Media in forewing with two branches .................................. 4
3. Forewing without stiff setae proximally on media ............. 3
   Forewing with two stiff setae situated on thickenings of media
   (Late Cretaceous) .................................... Apoglaesconis Grimaldi
3. Antennae with 25 or more flagellomeres (25–30 where known);
   Rs, cu, distinctly angling anteriorly at distalmost rs-m crossvein;
   media branching strongly distal of basal r-m crossvein (Early–
   Late Cretaceous) .................................... Glaseconis Meinander
4. Forewing crossveins r-rs, r-m, and cu, absent; Rs, not connected
to M, m-cu, near bifurcation of M .................. Phthanoconis Engel
   Forewing crossveins r-rs, r-m, present, cu, present or absent;
   Rs, connected to M, m-cu, strongly basad bifurcation of M ..... 5
5. Forewing crossveins r-rs meeting bifurcation of Rs; 2r-m subequal
to basal abscissa of Rs, cu, present; 24 flagellomeres (Early
   Cretaceous) ......................................... Libanosemidalis Azar, Nel, & Solignac
   Forewing crossveins r-rs not meeting Rs at bifurcation R
   antennae with 20 or less flagellomeres ................................. 6
6. Forewing crossveins r-rs meeting Rs distinctly basad bifurcation
   Rs, i.e., connected to Rs); only one crossvein
   between Rs and M; cu, absent; 17 flagellomeres (Late
   Cretaceous) .......................................... Garnaconis n. gen.
   Forewing crossveins r-rs meeting Rs strongly distad bifurcation
   Rs, i.e., connected to R, two crossveins between
   Rs and M; cu, absent; 20 flagellomeres (Early
   Cretaceous) ........................................... Alboconis Nel, Perrichot & Azar

**DISCUSSION**

Until now there has been no clear phylogenetic analysis of the
Coniopterygidae, except for the preliminary proposal of Meinander
(1972). Garnaconis n. gen. has only one radio-medial crossvein
on forewing, a character currently considered as proper to Conioptery-
ginae (Meinander, 1972). Nevertheless, Garnaconis n. gen. has the
hind wing base of Rs very close to that of M, which is a character
present in Aleuropteryginae and in Flintoconis Sziráki, second bru-
cheiserine genus, while Brucheiser Navás, has highly modified fore
and hind wing venation delicate to interpret (Riek, 1975). The
polarity of this character remains controversial because even the
sister-group relationships of Coniopterygidae within the Neuroptera
remain debatable: Aspöck, Plant, and Nemeschkal (2001) supported
a ‘Coniopterygidae + Sisyridae’ clade, while Haring and Aspöck
(2004) and Aspöck and Aspöck (2008) supported a ‘Conioptery-
gidae + dilarid clade’ (see summary in Aspöck & Aspöck, 2007);
Winterton, Hardy, and Wiegmann (2010) found Coniopterygidae as
sister group of all other Neuroptera; Beutel, Friedrich, and Aspöck
(2010) considered that the position of this family remains uncertain;
Zimmermann and others (2011) considered them as sister group to
the clade (Mantispidae + (Dilaridae + (Rhachiberotidae + Berothi-
daes))); while Aspöck, Haring, & Aspöck (2012) proposed them as
sister group of the (Dilaridae + (Mantispidae + (Rhachiberotidae +
Berotidae))). Note that this last hypothesis, as for the sisyrid or
dilarid hypotheses, is congruent with a basal position of Rs as a
plesiomorphy for the Coniopterygidae.

**Garnaconis** n. gen. also shows a plicature at least on the third
and fourth abdominal segments (see Fig. F1.5). Meinander (1972)
considered the presence of abdominal plicatures as a potential
synapomorphy of the Aleuropteryginae. They are also present in
Brucheiserinae. But Zimmermann, Klepal, and Aspöck (2009) hy-
pothesized the following relationships between the three subfamilies:
(Coniopteryginae + Coniopteryginae) + Aleuropteryginae, on the basis
of potential synapomorphies in the larvae. They concluded that the
presence of abdominal plicatures could rather be a plesiomorphy.
Garnaconis n. gen. also has the two stiff setae on median vein, a
character considered by Meinander (1972:17-18) as an apomorphy
of the Aleuropteryginae, absent in Coniopteryginae. Note that
Flintoconis has no ‘outstanding setae of M’, but ‘somewhat stronger
bristle at about the basal third of M’ that could correspond to a ‘remnant
of one of these stiff setae’ (Sziráki, 2007), while Brucheiser seems
to have no clear specialized setae on M. The genital apppendages
of Garnaconis n. gen., although showing similarities with those of the
females Coniocoma (Aleuropteryginae), are too obscure to be safely
used because many diagnostic features (Aspöck & Aspöck, 2008;
Zimmermann, Klepal, & Aspöck 2009) are not visible. Consequently,
Garnaconis n. gen. could be attributed to the Aleuropteryginae
in the basis of the set of characters considered by Meinander (1972)
as apomorphic to this subfamily. Nevertheless the polarity of these
characters remains debatable because of the lack of a more recent
phylogenetic analysis of the family. The present attribution to the
Aleuropteryginae is tentative and will need verification when such
analysis will become available.

Among the Cretaceous Coniopteryginae, Libanosemidalis shares
with Garnaconis the hind wing with vein Rs branching from R very
near the wing base, but Libanosemidalis has no stiff setae on M and
no plicature. The second Mesozoic coniopterygine genus Phthanoconis
has a hind wing Rs branching far from wing base, as in modern
representatives of the subfamily. Garnaconis n. gen. also differs from
other Cretaceous dustywings except Libanosemidalis, Phthanoconis,
and Alboconis, by the presence of only two (as opposed to three)
terminal branches of the media on the forewing. It differs from Libanos-
midalis and Alboconis by the number of antennal flagellomeres, which
is 17 in Garnaconis, as opposed to 24 in Libanosemidalis, and 20 in
Alboconis – erroneously mentioned with 18 flagellomeres in the
original description by Nel, Perrichot, & Azar (2005); the vertex not prominent; and the forewing with Rs branching into R$_{2+3}$ and R$_{4+5}$ distally of crossvein r-rs.

The new fossil adds significantly to the scant geological record of dustywings, and it displays intermingled features of both Aleuropteryginae and Coniopteryginae as currently defined, such that it might help to refine the limits of both subfamilies once incorporated in a phylogenetic analysis.

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