A new genus of dustywings (Neuroptera: Coniopterygidae) in Late Cretaceous Vendean amber

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A NEW GENUS OF DUSTYWINGS (NEUROPTERA: CONIOPTERYGIDAE) IN LATE CRETACEOUS 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

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 Paleogene 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 & 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, 2012). 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 outcropped between 2002 and 2005.
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 Garnaché (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<sub>4+5</sub>-R<sub>1+2</sub> (i.e., r-rs connected to Rs); no crossvein between Rs and M (i.e., only distal crossvein r-m between R<sub>4+5</sub> and M<sub>1+2</sub>), about 2.5× as long as basal abscissa of R<sub>1+2</sub>; 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 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 southwest 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 material.

Diagnosis.—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-f13 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 tubercles 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<sub>1</sub> long and parallel to costal margin in its basal two thirds; fork Sc<sub>1</sub> and Sc<sub>2</sub> (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<sub>1</sub> and Rs after a distance of 0.17 mm; Rs 0.41 mm long before its fork; R<sub>2+3</sub>, 0.27 mm long; crossvein r-rs slightly sinuate, 0.15 mm long, basal to fork of R<sub>2+3</sub> and its apex 0.26 mm; M 0.48 mm long before its fork into M<sub>1+2</sub> and M<sub>3+4</sub>; M<sub>1+2</sub> curved; crossvein r-m connected to M<sub>1+2</sub> 0.05 mm distally of fork of M<sub>1+2</sub>-M<sub>3+4</sub>; M<sub>1+2</sub> setae approximately equidistant on each side of m-cu (Fig. F1.10); M<sub>3+4</sub> weakly curved, 0.15 mm long; Cu bifurcating into Cu<sub>1</sub> and Cu<sub>2</sub>, 0.12 mm from wing base; Cu<sub>2</sub> curved, reaching wing margin 0.74 mm from wing base; Cu<sub>2</sub> curved, distal half nearly parallel to Cu<sub>1</sub>, reaching wing margin 0.63 mm from wing base; no visible crossvein between Cu<sub>1</sub> and Cu<sub>2</sub>; crossveins cua-cua<sub>1</sub> and cua nebulous. Hind wing (Fig. F1.9) slightly shorter than forewing, 0.98 mm long, 0.41 mm wide; Sc<sub>1</sub> rather long and parallel to costal margin, approaching costal margin 0.95 mm from wing base; fork of R<sub>1</sub>–Rs not clearly visible but in a very basal position, just distal base of M; Rs bifurcating into R<sub>2+3</sub> and R<sub>4+5</sub> 0.79 mm from wing base; R<sub>2+3</sub> slightly curved, 0.19 mm long; r-rs 0.13 mm long, basad fork of Rs; distance between base of R<sub>4+5</sub> and tip of R<sub>4+5</sub> 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<sub>1+2</sub> slightly curved; crossvein between R<sub>4+5</sub> and M<sub>1+2</sub> 0.07 mm from base of M<sub>1+2</sub>; M<sub>3+4</sub> 0.11 mm long; Cu bifurcating into Cu<sub>1</sub> and Cu<sub>2</sub> very basally; Cu<sub>2</sub> curved; a crossvein m-cu present; Cu<sub>1</sub> curved, nearly parallel to Cu<sub>1</sub>. 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 segments (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 Coniopteryx (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. Forewing without stiff setae proximally on media ............... 3
   Forewing with two stiff setae situated on thickenings of media (Late Cretaceous) ............................................ Apoglaesoconis Grimalli
3. Antennae with 25 or more flagellomeres (25–30 where known); R₄₊₅ distinctly angling anteriorly at distalmost r-s m crossvein; media branching strongly distad of basal r-m crossvein (Early–Late Cretaceous) ............................................. Glaesoconis Meinander
   Antennae with less than 20 flagellomeres; R₄₊₅ not angling anteriorly at distalmost r-s m crossvein, instead continuing straight to wing margin; media branching at basal r-m crossvein (Early–Late Cretaceous) ................................................... Libanosemidalis Engel
4. Forewing crossveins rs-rs, r-m, and cu₁-cu₄ absent; R₄₊₅ not connected to M₁₋₂; m-cu₁ near bifurcation of M ............... Phthanoconis Engel
   Forewing crossveins r-r, r-m present, cu₁-cu₄ present or absent; R₄₊₅ connected to M₁₋₂; m-cu₁ strongly basad bifurcation of M ....... 5
5. Forewing crossvein r-rs meeting bifurcation of Rs; 2r-m subequal to basal abscissa of R₄₊₅; cu₁-cu₄ present; 24 flagellomeres (Early Cretaceous) ....................................................... Libanosemidalis Azar, Nel, & Solignac
   Forewing crossvein r-rs not meeting Rs at bifurcation R₄₊₅-R₄₊₅; antennae with 20 or less flagellomeres ................................................. 6
6. Forewing crossvein r-rs meeting Rs distinctly basad bifurcation R₂₋₃-R₄₊₅ (i.e., connected to Rs); only one crossvein between Rs and M; cu₁-cu₄ absent; 17 flagellomeres (Late Cretaceous) .................................................... Garnaconis n. gen.
   Forewing crossvein r-rs meeting R strongly distad bifurcation R₂₋₃-R₄₊₅ (i.e., connected to R₄₊₅); two crossveins between Rs and M; cu₁-cu₄ 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 Coniopteryginae (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 bruchiserine genus, while *Bruchiser 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 ‘Coniopterygidae + 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 (Mantisidae + (Dilaridae + (Rhachiberothidae + Berothidae))); while Aspöck, Haring, & Aspöck (2012) proposed them as sister group of the (Dilaridae + (Mantisidae + (Rhachiberothidae + Berothidae))). 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 Bruchiserinae. But Zimmermann, Klepal, and Aspöck (2009) hypothesized the following relationships between the three subfamilies: (Bruchiserinae + 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 *Bruchiser* seems to have no clear specialized setae on M. The genital appendages of *Garnaconis* n. gen., although showing similarities with those of the females Coniopteryx (Aleuropteryginae), are too obscured 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 *Libanosemidalis* 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.

ACKNOWLEDGEMENTS

We are deeply grateful to Fanny and André Dupé (Arrthon-en-Retz) who collected and provided the amber piece containing the new fossil. We also thank the anonymous reviewers for valuable remarks and suggestions on the first version of the paper. Partial support was provided by French National Research Agency grant n° BLAN07-1-184190 (project AMBRACE) and CNRS-INSU grant Intervic NOVAMBRE 2 (both to D. Néraudeau). This work is a contribution of the Division of Entomology, University of Kansas Biodiversity Institute, and a contribution to the team project “Biodiversity: Origin, Structure, Evolution, and Geology” allotted to D. A. by the Lebanese University.

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