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

Vincent Perrichot,1,2* Romain Garrouste,3 Dany Azar,4 Didier Néraudeau1, and André Nel3*

1 UMR CNRS 6118 Géosciences and Observatoire des Sciences de l’Univers de Rennes, Université Rennes 1, 263 avenue du Général Leclerc, 35042 Rennes, France, vincent.perrichot@univ-rennes1.fr, didier.neraudeau@univ-rennes1.fr, 2 University of Kansas Biodiversity Institute, Division of Entomology (Palaentomology), Lawrence, Kansas 66045, USA, 3 Muséum National d’Histoire Naturelle, Institut de Systématique, Evolution, Biodiversité, ISYEB, UMR 7205 CNRS UPMC EPHE, CP50, 45 rue Buffon, F-75005 Paris, France, anel@mnhn.fr, and 4 Lebanese University, Faculty of Sciences II, Department of Natural Sciences, Fanar - Matn – P.O. Box 26110217, Lebanon, azar@mnhn.fr

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, Neuropterida, Aleuropteryginae, Mésozoïque, 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 & 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 outcropped 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

Figure F1. Photomicrographs of *Garnaconis dupeorum* Perrichot & Nel, n. gen. and sp., holotype female IGR.GAR-2, in Late Cretaceous Vendean amber. 1, 2, profile views; 3, head and mesosoma in left profile view, as preserved after embedding in Canada balsam; 4, fore femur; 5, hind tarsi; 6, plicature on fourth abdominal segment (arrow); 7, genitalia with indication of the 9th segment (IX), ectoproct (epr), 10th sternite (X), and gonapophyses laterales with two curved setae visible (gl+st); 8, left forewing; 9, left hindwing (above) and forewing (below); 10, forewing median area with indication of the two stiff setae.
Perrichot and others—A new dustywing in Cretaceous French amber

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 basal forewings. Metathorax 0.05 mm long. Forewing (Figs. F1.8–F1.10, F2) 1.1 mm long, 0.48 mm wide; Sc1 long and parallel to costal margin in its basal two thirds; fork Sc1 and Sc2 (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 R1 and Rs after a distance of 0.17 mm; Rs 0.41 mm long before its fork; R2+3, 0.27 mm long; crossvein r-rs slightly sinuate, 0.15 mm long, basal to fork of R2+3 and its apex 0.26 mm; M 0.48 mm long before its fork into M1+2 and M3+4; M1+2 curved; crossvein r-m connected to M1+2 0.05 mm distally of fork of M1+2–M3+4; M setae approximately equidistant on each side of m-cu (Fig. F1.10); M3+4 weakly curved, 0.15 mm long; Cu bifurcating into Cu1 and Cu2, 0.12 mm from wing base; Cu1 curved, reaching wing margin 0.74 mm from wing base; Cu2 curved, distal half nearly parallel to Cu1, reaching wing margin 0.63 mm from wing base; no visible crossvein between Cu1 and Cu2; crossveins cua-cua and cu-aubneulous. Hind wing (Fig. F1.9) slightly shorter than forewing, 0.98 mm long, 0.41 mm wide; Sc1 rather long and parallel to costal margin, approaching costal margin 0.95 mm from wing base; fork of R–Rs not clearly visible but in a very basal position, just distal base of M; Rs bifurcating into R2+3 and R4+5 0.79 mm from wing base; R2+3 slightly curved, 0.19 mm long; r-rs 0.13 mm long, basal fork of Rs; distance between base of R4+5 and tip of R4+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; M1+2 slightly curved; crossvein between R4+5 and M1+2 0.07 mm from base of M1+2; M3+4 0.11 mm long; Cu bifurcating into Cu1 and Cu2 very basally; Cu1 curved; a crossvein m-cu present; Cu2, Cu3, Cu4 curved, nearly parallel to Cu1. 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

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 CONIOPTERYGIIDAE 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 crossoveins; crossoveins sc-r and r-rs aligned, r-rs meeting Rs distinctly basad fork of R2+3–R4+5 (i.e., r-rs connected to Rs); no crossovein between Rs and M (i.e., only distal crossovein r-m between Rs and M1+2), about 2.5x as long as basal absissa of R; medial vein with two branches, with thickened setigerous spot distal to crossvein cua-cua2. Small plicatures visible particularly swollen basally, distinctly larger than others, and 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 material._

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) hypogonathous, 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 x 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,
elongated. Abdomen flattened and probably deformed by air bubbles, 0.46 mm long, 0.23 mm wide, including genitalia; a plication 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 Meinder, 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
3. Antennae with 25 or more flagellomeres (25–30 where known); R1a, distinctly angling anteriorly at distalmost r-s-m crossvein; media branching strongly distal of basal r-m crossvein (Early–Late Cretaceous) ............................................ Apoglaesoconis Engel

Key to Cretaceous Coniopterygidae

3. Antennae with less than 20 flagellomeres; R1a, not angling anteriorly at distalmost r-s-m crossvein; media branching strongly distal of basal r-m crossvein (Late Cretaceous–Early Cretaceous) ............................................ Apoglaesoconis Engel

4. Forewing crossveins r-rrs, r-s, r-m, and cu, -cu, absent; R1a, not connected to M1+2; m-cu, near bifurcation of M ............... Phthanoconis Engel

5. Forewing crossvein r-rrs meeting Rs; 2r-m subequal to basal abscissa of R4+5; cu1-cu2, present; 24 flagellomeres (Early Cretaceous) .......................................................... Libanosemidalis Azar, Nel, & Solignac

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; cu, -cu, absent; 17 flagellomeres (Late Cretaceous) ...................................................... Garnaconis n. gen.

7. 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-cu2, 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 Meinder (1972). **Garnaconis** n. gen. has only one radio-medial crossvein on forewing, a character currently considered as proper to Coniopteryginae (Meinder, 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 (Mantispidae + (Dilaridae + (Rhabicerotidae + Berothidae)))); while Aspöck, Haring, & Aspöck (2012) proposed them as sister group of the (Dilaridae + (Mantispidae + (Rhabicerotidae + 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 plication at least on the third and fourth abdominal segments (see Fig. F1.5). Meinder (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 Meinder (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 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 Meinder (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 plication. 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 dustyring 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\textsubscript{2,3} and R\textsubscript{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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