

Two new Ptiloneuridae from Colombian copal (Psocodea: Psocomorpha)

Dany AZAR, André NEL & Alain WALLER

Abstract: *Brisacia colombiensis* nov.gen., nov.sp. and *Euplocania* sp.indet., the only known fossil Ptiloneuridae, are described from the Quaternary copal of Santander, Colombia. An actualised key for ptiloneurid genera is presented.

Key words: Psocodea, Psocoptera, Epipsocetae, Ptiloneuridae, fossil insect, Colombian copal, gen. et sp.nov.

Santrauka: Publikacijoje aprašomi vieninteliai fosiliniai Ptiloneuridae (Psocodea: Psocodomorpha) šeimos atstovai *Brisacia colombiensis* nov.gen., nov.sp. ir *Euplocania* sp. iš Santander, Kolumbija kvartero kopalų. Įvade glaustai analizuojamas būrys. Straipsnyje pateikiamas raktas Ptiloneuridae šeimos gentims apibinti.

Raktiniai žodžiai: Psocodea, Psocoptera, Epipsocetae, Ptiloneuridae, fosilinis vabzdys, Kolumbijos kopalas, gen. et sp.nov.

Introduction

Recent cladistic analyses have revealed the paraphyletic nature of several insect orders, one of the most significant being the order Phthiraptera (lice), which is now included within the Psocoptera to form the Psocodea (JOHNSON et al. 2004; GRIMALDI & ENGEL 2005, 2006a; YOSHIZAWA & JOHNSON 2006).

The Psocodea is a small group of about 10,000 described modern species. They are relatively well represented in the fossil record as both compression fossils and amber inclusions (ENDERLEIN 1911; COCKERELL 1916, 1919; VISHNYAKOVA 1975; SPAHR 1992; GELHAUS & JOHNSON 1996; AZAR 2000; BAZ & ORTUÑO 2000, 2001; POINAR & MILKI 2001; PERRICHOT et al. 2003; AZAR & NEL 2004; GRIMALDI & ENGEL 2006b; etc.).

Although several Permian to Liassic fossils have been attributed to the Psocodea (CARPENTER 1992), MOCKFORD (1993: 2) considered that the earliest definitive fossil psocids are known from Cretaceous amber, but HUANG et al. (2008) show that at least the Jurassic Archipsyllidae are Psocodea.

Currently, Psocodea are divided into three suborders: Troctomorpha, Trogiomorpha and Psocomorpha. Epipsocetae is one of the six infraorders of Psocoptera recognized within the suborder Psocomorpha (YOSHIZAWA 2002). Most genera of Epipsocetae are predominantly pantropical and have an almost worldwide distribution.

Ptiloneuridae is one of the five families (Epipsocidae, Neurostigmatidae, Dolabellopsocidae, Cladiopsocidae, and Ptiloneuridae) listed by SMITHERS (1972) and EERTMOED (1973) in the family-group Epipsocetae. Ptiloneuridae is known from the Neotropical region. This family presently includes 11 genera, viz. *Timnewia* GARCÍA ALDRETE, 2006; *Perucania* NEW & THORNTON, 1988; *Willreevesia* GARCÍA ALDRETE, 2005; *Triplocania* ROESLER, 1940; *Belicania* GARCÍA ALDRETE, 2006; *Euplocania* ENDERLEIN, 1910; *Omilneura* GARCÍA ALDRETE, 2006; *Ptiloneuroopsis* ROESLER, 1940; *Loneurooides* GARCÍA ALDRETE, 2006; *Loneura* NAVÁS, 1927; and *Ptiloneura* ENDERLEIN, 1900 (NEW & THORNTON 1988; GARCÍA ALDRETE 2005, 2006a,b).

We describe herein *Brisacia colombiensis* nov.gen., nov.sp. and *Euplocania* sp.indet., from the copal of Santander, Colombia. They are placed in the family Ptiloneuridae. The age of Colombian copal still remains an open question. For some authors, it is of "Tertiary" age (LANGENHEIM 1990), for others it is Pliocene-Pleistocene. Accurate determinations made by means of ¹⁴C revealed that some pieces of Colombian copal from the region of Santander are in the order of just 200 years old (CLIFFORD et al. 1997), and thus correspond to practically Recent resin. Others feel that some Colombian copals are in the regions of many millions of years.

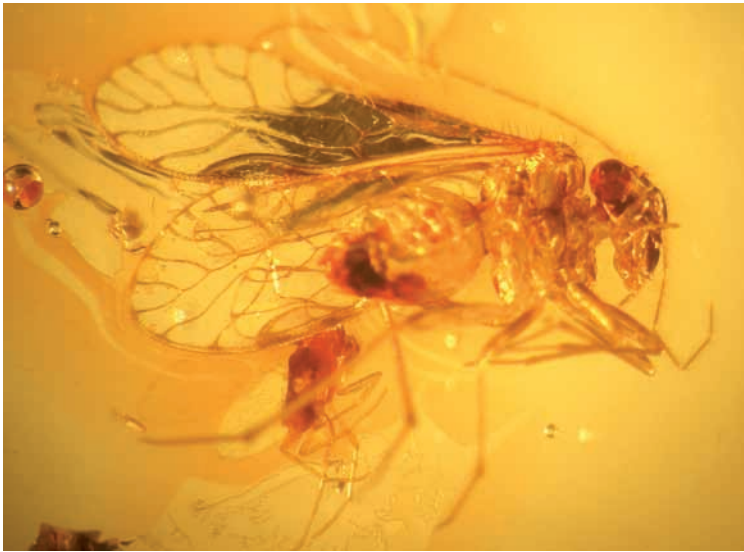


Fig. 1: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, photograph of habitus.

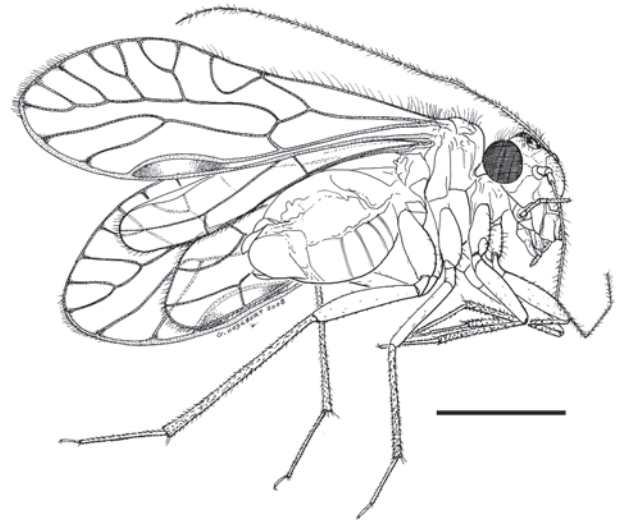


Fig. 2: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of habitus (scale bar represents 1 mm).



Fig. 3: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, photograph of head, frontal view.

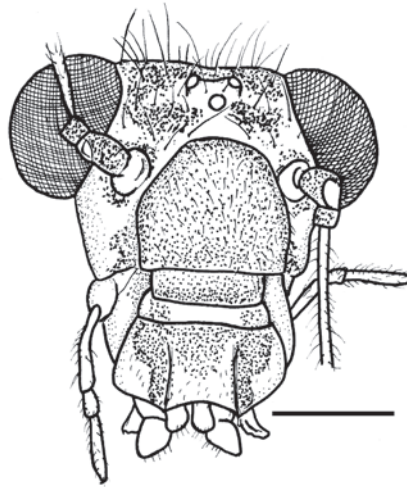


Fig. 4: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of frontal view of head (scale bar represents 0.3 mm).

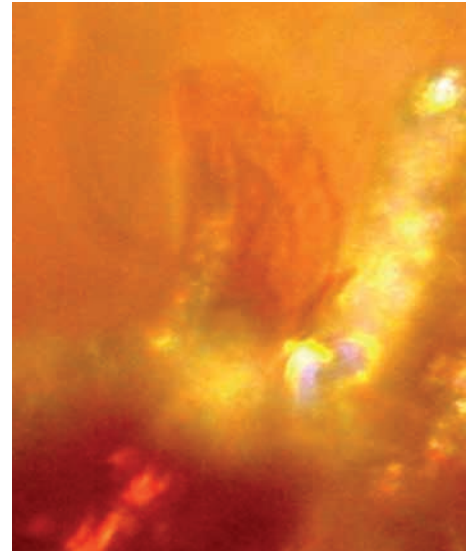


Fig. 5: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, photograph of lacinia.



Fig. 6: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of lacinia (scale bar represents 0.1 mm).

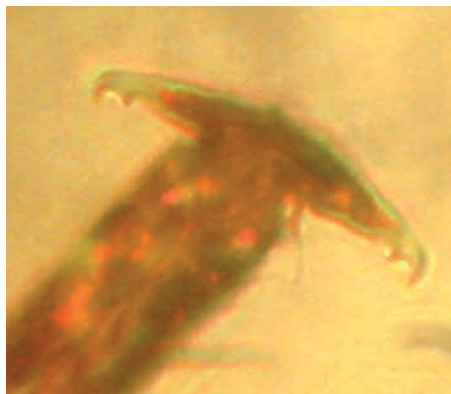


Fig. 7: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, photograph of tarsal claw.

Systematic palaeontology

Classification and terminology follow SMITHERS (1972, 1990), MOCKFORD (1993) and LIENHARD (1998). Structures which are described as "absent" are truly not present in the specimen; structures which may be present but may simply be obscured are described as "not visible".

Suborder Psocomorpha ROESLER, 1944

Family Ptiloneuridae EERTMOED, 1973

***Brisacia* nov.gen.**

Type species: *Brisacia colombiensis* nov.gen., nov.sp.

Etymology: After our friend Patrick Brisac, who gave us part of this material for study.

Diagnosis: Antenna with 11 filiform flagellomeres. Head elongate with a pair of sclerotized rods running the entire length of the labrum. Legs with three-segmented tarsi, distal tarsi bearing claws with one preapical tooth. Forewing setose with pterostigma thickened and setose; M five-branched and presenting seven terminal branches reaching costal wing; Areola postica free, strongly curved, and nearly as long as wide. Presence of well developed rs-m cross-vein; one anal vein. Hind wing with M bifurcated into M1 and M2.

***Brisacia colombiensis* nov.gen. et nov.sp.**
(Figs 1-11)

Material: Holotype specimen COLOMBIA-1A (♂), AZAR collection, deposited in the Muséum National d'Histoire Naturelle, Paris.

Type locality and horizon: Colombian Quaternary copal, probably from Santander, Colombia, South America.

Etymology: After Colombia

Diagnosis: As for the genus.

Description: Total body length 2.45 mm. Head elongate, a pair of sclerotized rods running entire length of the labrum (Figs 3-4). Antenna with 11 flagellomeres, 2.85 mm long, flagellomeres filiform, elongate, and decreasing progressively in length. The first flagellomere being the longest 0.35 mm long, the shortest the last one 0.20 mm. Pedicel and scape nearly cylindrical, respectively 0.15 and 0.10 mm long. Compound eyes very gibbous, rounded with 0.35 mm diameter. Three large ocelli disposed in a prominent triangle between compound eyes. Maxillary palps four-segmented, with mx2 the longest; mx1 0.1 mm long and 0.07 mm wide; mx2 0.2 mm long and 0.04 mm wide; mx3 0.06 mm long and 0.04 mm wide; mx4 0.17 mm long and 0.03 mm wide. Labial palps two-segmented. Visible part of lacinia 0.15 mm long, with enlarged tip as shown in Figs 5-6.

Thorax 0.85 mm wide.

Legs with tarsi three-segmented. Second tarsi very small. Distal tarsi bearing claws with one preapical tooth (Fig. 7) and a setiform pulvillus.

Fore wing 3.26 mm long and 1.20 mm wide (Fig. 8). Most of the veins evanescent except in their terminal

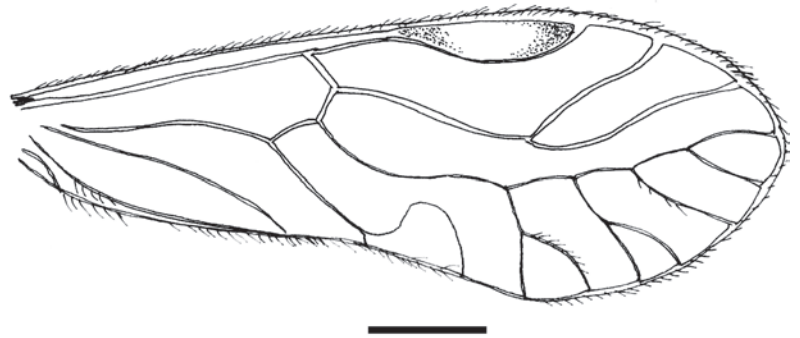


Fig. 8: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of fore wing (scale bar represents 0.5 mm).

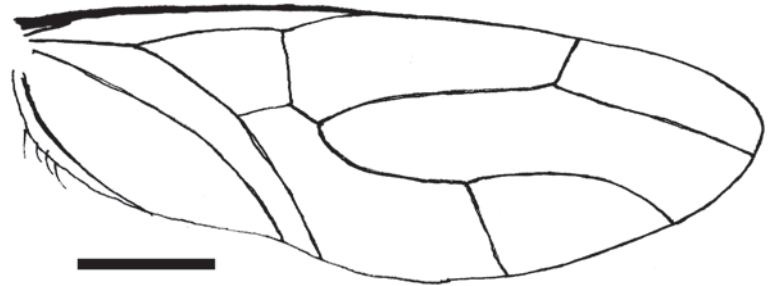


Fig. 9: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of hind wing (scale bar represents 0.5 mm).

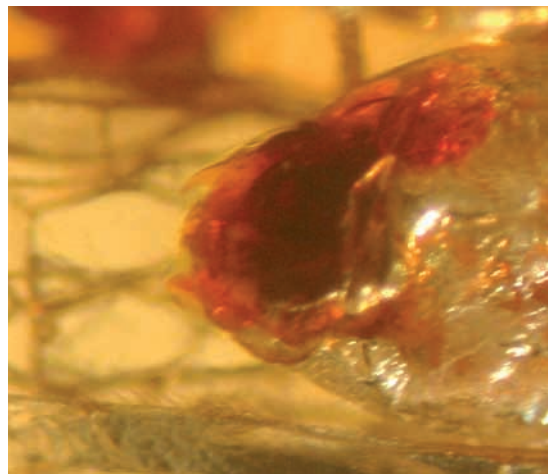


Fig. 10: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, photograph of male genitalia.



Fig. 11: *Brisacia colombiensis* nov.gen., nov.sp., holotype COLOMBIA-1A, drawing of male genitalia (scale bar represents 1 mm).

parts. Pterostigma darker than the remaining wing membrane, thickened, convex and not connected to Rs by a cross-vein. R1 simple reaching costal margin at 2.44 mm from wing base. Fork of R2+3 and R4+5 2.17 mm distal of wing base; R2+3 and R4+5 reaching wing margin respectively at 2.74 and 3.08 mm from wing base. M five-branched with the two last branches bifurcated, with seven terminal branches reaching costal wing as shown in Fig. 8. Fork of Cu1 (sensu SMITHERS 1972, Cu of LIENHARD 1998) into Cu1a and Cu1b 1.58 mm (sensu SMITHERS 1972, Cu1 and Cu2 respectively of LIENHARD 1998) from wing base; Cu1a strongly curved and longer than Cu1b. Areola postica (AP) free; no cross-vein between AP cell and M. A distinct nodulus present at 1.28 mm from wing base. 1A vein strongly curved. 2A curved.

Hind wing hyaline, smaller than forewing, with setose margin, 2.22 mm long and 0.76 wide (Fig. 9). R fused basally with M and Cu. R1 reaching anterior wing margin at 1.11 mm from wing base. Basi-radial cell closed. Bifurcation of Rs into R2+3 and R4+5 1.60 mm from wing base. Fork of M into M1 and M2 1.41 mm from wing base. Cu1 (of SMITHERS 1972, Cu of LIENHARD 1998) reaching posterior wing margin 1.11 mm from wing base. Cu2 (of SMITHERS 1972, pcu of LIENHARD 1998) reaching wing margin 1.0 mm from wing base. Anal vein strongly curved and reaching wing margin 0.64 mm from wing base.

Abdomen 1.20 mm long and 0.60 mm wide. Male appendages as shown in Figs 10-11.

Discussion: According to the keys proposed by MOCKFORD (1993), LIENHARD (1998), *Brisacia colombiensis* nov.gen. et nov.sp. falls in the suborder Psocomorpha because of the following characters: forewing with thickened and sclerotized pterostigma; no scales on wings and body. The character "thickened and sclerotized pterostigma" is considered as being apomorphic of Psocomorpha by YOSHIKAWA (2002) and MOCKFORD (1967).

Following the keys of SMITHERS (1990), based on the modern psocids, *Brisacia* falls in the Ptiloneuridae after the following characters: macropterous insect; legs with trimerous tarsi; body and wings without flattened scales; fore wing venation complex; pterostigma thicker and more opaque than the rest of the membrane; head elongate and labrum with two ridges from base to anterior margin; no spurs on fore wings.

If we follow the keys to genera of GARCÍA ALDRETE (2006b), *Brisacia* would fall in the genus *Loneura* NAVÁS, 1927 after the following characters: hind wing M with two to five branches; fore wing with areola postica free, high, with apex rounded; pterostigma long smooth; fore wing with M five to seven branched. *Brisacia* results to be different from all the species of *Loneura* by having

hind wing M with only two branches, whereas all the species included in *Loneura* have hind wing M with three to five branches (MOCKFORD 1993; GARCÍA ALDRETE 1995, 1997, 2003, 2004; CASTRO 2007). This structural difference in the hind wing venation justifies the creation of the new genus *Brisacia*.

Euplocania ENDERLEIN, 1910

Type species: *Euplocania amabilis* ENDERLEIN, 1910.

Diagnosis: Characters as in *Ptiloneura* ENDERLEIN, 1910, but in fore wing M is four-branched (not 6-8 branched). Branches of M strongly sinuous. Areola postica long, but tall due to Cu1a being strongly sinuous. Hind wing with M simple and unbranched. Fore wing veins with single row of setae. Hind wing veins in distal part of wing with single row of setae, basal part glabrous.

Euplocania sp.indet. (Figs 12-22)

Material: Specimen n. COLOMBIA-2A (♀), BRISAC collection, deposited in the Muséum National d'Histoire Naturelle, Paris.

Type locality and horizon: Colombian Quaternary copal, probably from Santander, Colombia, South America.

Description: Total body length 3.75 mm (Figs 12-13). Head elongate with pair of sclerotized angled rods of the labrum running the entire length of the labrum. Antenna with 11 flagellomeres, 5.25 mm, flagellomeres filiform, elongate, and decreasing progressively in length. The first flagellomere being the longest, 0.9 mm long, the shortest the last one 0.35 mm. Pedicel and scape nearly cylindrical, respectively 0.15 and 0.1 mm long. Compound eyes gibbous, rounded with 0.42 mm diameter. Three large ocelli disposed in prominent triangle between compound eyes. Maxillary palps four-segmented, with mx4 the longest; mx1 0.15 mm long; mx2 0.2 mm long; mx3 0.15 mm long; mx4 0.3 mm long. Labial palps two-segmented. Visible part of lacinia 0.1 mm long, with tip as shown in Figs 16-17.

Thorax 0.85 mm wide.

Legs with tarsi three-segmented, distal tarsi bearing claws with one preapical tooth (Fig. 18), a setiform pulvillus present.

Fore wing patterned, 4.50 mm long, 1.72 mm wide (Fig. 19). Pterostigma dark, thickened and setose, not connected to Rs by a cross-vein. R1 simple, reaching costal margin 3.50 mm from wing base. Fork of R2+3 and R4+5 3.0 mm distal of wing base; R2+3 and R4+5 reaching wing margin respectively 3.95 and 4.40 mm from wing base. R2+3 sinuous. M presenting four simple branches reaching costal wing as shown in Fig. 19.



Fig. 12: *Euplocania* sp. indet., COLOMBIA-2A, photograph of habitus.

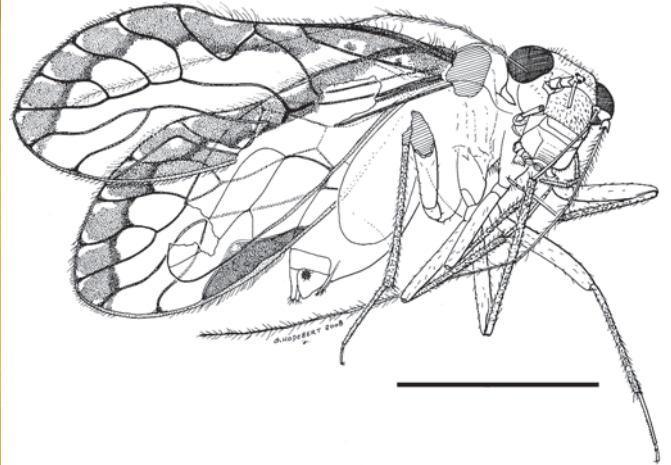


Fig. 13: *Euplocania* sp. indet., COLOMBIA-2A, drawing of habitus (scale bar represents 1 mm).

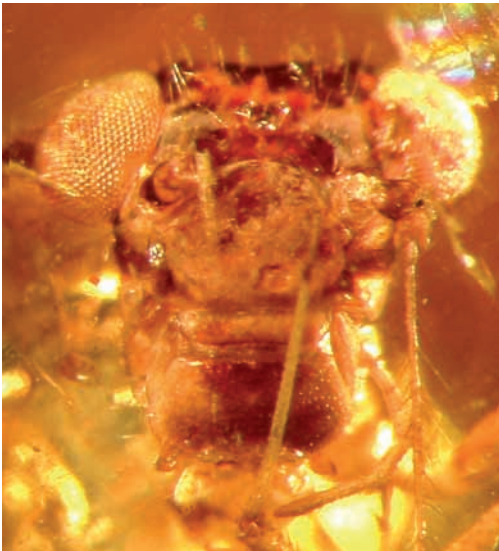


Fig. 14: *Euplocania* sp. indet., COLOMBIA-2A, photograph of head, frontal view.



Fig. 15: *Euplocania* sp. indet., COLOMBIA-2A, drawing of head (scale bar represents 0.3 mm).

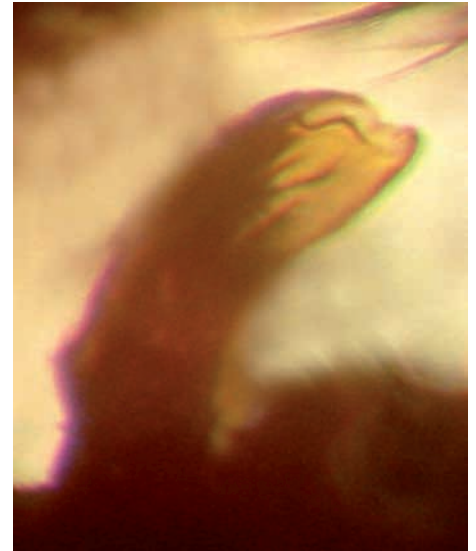


Fig. 16: *Euplocania* sp. indet., COLOMBIA-2A, photograph of lacinia.

Fork of Cu1 (of SMITHERS 1972, Cu of LIENHARD 1998) into Cu1a and Cu1b (of SMITHERS 1972, Cu1 and Cu2 respectively of LIENHARD 1998) 2.0 mm from wing base; Cu1a strongly curved nearly triangular shaped and longer than Cu1b. Areola postica (AP) free; no cross-vein between AP cell and M. A distinct nodulus present at 1.6 mm from wing base. Anal vein strongly curved.

Hind wing hyaline, smaller than forewing, with setose margin, 3.12 mm long and 1.05 wide (Fig. 20). R fused basally with M and Cu. R1 reaching anterior wing margin 2.1 mm from wing base. Bifurcation of Rs into R2+3 and R4+5 2.12 mm from wing base. M simple, reaching wing margin 2.95 mm from wing base. Cu1



Fig. 17: *Euplocania* sp. indet., COLOMBIA-2A, drawing of lacinia (scale bar represents 0.1 mm).

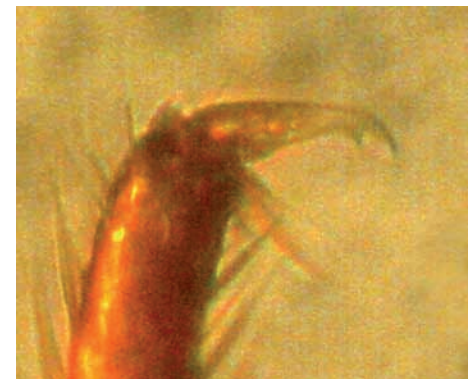


Fig. 18: *Euplocania* sp. indet., COLOMBIA-2A, photograph of tarsal claw.

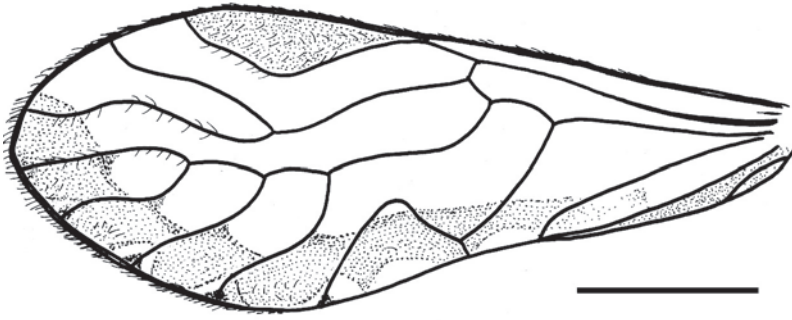


Fig. 19: *Euplocania* sp. indet., COLOMBIA-2A, drawing of fore wing (scale bar represents 1 mm).

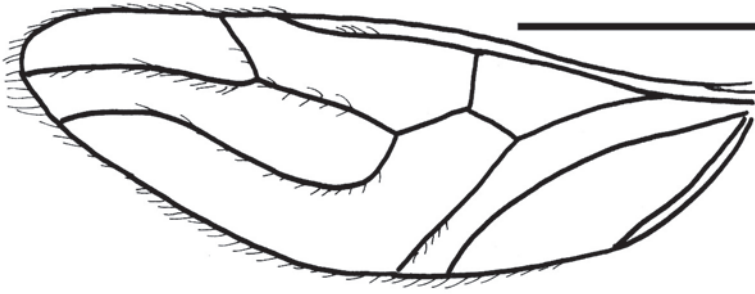


Fig. 20: *Euplocania* sp. indet., COLOMBIA-2A, drawing of hind wing (scale bar represents 1 mm).

Fig. 21: *Euplocania* sp. indet., COLOMBIA-2A, photograph of female genitalia.

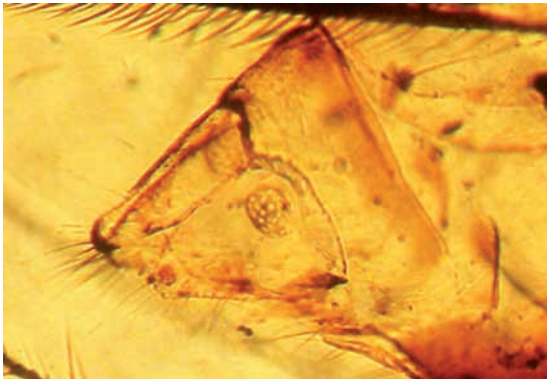
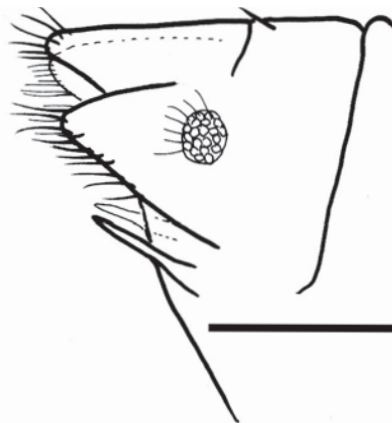


Fig. 22: *Euplocania* sp. indet., COLOMBIA-2A, drawing of female genitalia (scale bar represents 0.3 mm).



reaching posterior wing margin at 1.67 mm. Cu2 (of SMITHERS 1972, pcu of LIENHARD 1998) reaching wing margin at 1.42 from wing base. 1A curved and reaching the wing margin at 0.8 mm from wing base.

Abdomen 2.25 mm long and 0.75 mm wide. Female appendages as shown in Figs 21-22.

Discussion: Following the keys of MOCKFORD (1993), LIENHARD (1998), and SMITHERS (1990), based on the modern psocids, our fossil falls in the Ptiloneuridae for the same characters as listed above for *Brisacia*.

If we follow the keys to genera of GARCÍA ALDRETE (2006b), our fossil would fall in the genus *Willreevesia* GARCÍA ALDRETE, 2005, after hind wing with M one-branched, fore wing with 2A joining wing margin; no cross-veins between 1A and wing margin; areola postica high, with apex rounded; labral sclerites complete, reaching anterior margin of labrum (GARCÍA ALDRETE 2005). The comparison with *Willreevesia dominica* GARCÍA ALDRETE, 2005 from Dominica (the only known species of the genus *Willreevesia*) demonstrates a great structural difference in the fore wing venation as *Willreevesia* has M five-branched with six terminal veins reaching the wing margin, whereas our fossil has M four-branched as in *Euplocania* (GARCÍA ALDRETE 1998). GARCÍA ALDRETE (2005) considered this last character as an autapomorphy of *Euplocania*. But our fossil differs from this genus in the labral sclerites complete. GARCÍA ALDRETE (2005) indicated that this last character is only present in *Willreevesia* among the Ptiloneuridae but the same author (pers. comm., 2008) precised that some recent *Euplocania* species have the labral sclerites curved and reaching the labral margin. Thus the completeness of the labral sclerite is not sufficient to separate our fossil from the genus *Euplocania* of the "*Euplocania picta* complex", viz. *E. picta* NEW, 1980 (Brazil), *E. pictatoides* GARCÍA ALDRETE, 1998 (Peru), and *E. badonneli* NEW & THORNTON, 1988 (Brazil, Peru) (sensu GARCÍA ALDRETE, pers. comm.). It shares with this group the wing venation and the pattern of the forewing, i.e. "the upper border of pigmented band of fore wing sinuous" and well defined slender, distal fenestrae, on apices of veins R4+5 to Cu1 (GARCÍA ALDRETE 1998). The same author separates these three species on the basis of the male genital appendages, which are not available in our fossil. Thus it is not possible to create a new species for this fossil even if it represents the first fossil representative of this genus and the first record in Colombia.

Key to genera of Ptiloneuridae

(modified from GARCÍA ALDRETE 2006b).

- 1 Hind wing M one-branched 2
- Hind wing M two- to five-branched 8
- 2 Fore wing 2A joining wing margin; no cross-veins between 1A and wing margin 3
- Fore wing 2A joining 1A; one cross-vein between 2A and wing margin; two cross-veins between 1A and wing margin *Timnewia* GARCÍA ALDRETE
- 3 Fore wing areola postica high, with apex rounded . 4

- Fore wing areola postica low, very long
 *Perucania* NEW & THORNTON
- 4 Labral sclerite incomplete, not reaching anterior margin of labrum 5
- Labral sclerites complete, reaching anterior margin of labrum (although present in some *Euplocania*), fore wing M five- to six-branched
 *Wilbreevesia* GARCÍA ALDRETE
- 5 Fore wing M three-branched, occasionally M3 forked 6
- Fore wing M more than three-branched 7
- 6 Hypandrium formed by a central sclerite, which may bear central or lateral apophyses, with a smaller sclerite on each side *Triplocania* ROESLER
- Hypandrium formed by a single sclerite, with postero-lateral, slender projections
 *Belicania* GARCÍA ALDRETE
- 7 Fore wing M four-branched
 *Euplocania* ENDERLEIN
- Fore wing M six-branched
 *Omilneura* GARCÍA ALDRETE
- 8 Fore wing areola postica free, high, with apex rounded 9
- Fore wing areola postica high, rigidly triangular, joined to M by a cross-vein . . . *Ptiloneuropsis* ROESLER
- 9 Fore wing 2A simple, pterostigma long, smooth . .10
- Fore wing 2A with one cross-vein to wing margin, pterostigma long, distinctly spurred
 *Loneuroides* GARCÍA ALDRETE
- 10 Fore wing M five- to seven-branched; hind wing M two- to five-branched 11
- Fore wing M eight branched; hind wing M five branched *Ptiloneura* ENDERLEIN
- 11 Hind wing two-branched *Brisacia* AZAR et al.
- Hind wing three- to five-branched
 *Loneura* NAVÁS

Conclusions

During the last decade the number of species and genera of Ptiloneuridae increased greatly after the works of GARCÍA ALDRETE (1995-2007). The discovery of two new fossil ptiloneurids is of great interest for the understanding of the diversity of this group. When we first found these fossils, we thought that if we had modern species it would be a nice occasion to determine more accurately the age of the Colombian copal, as this material is considered as very recent by several researchers. Our results led to the discovery of two new taxa, leaving the questions on the Colombian copal age open, i.e. either it could be older than what it is currently admitted, or these insects are still present in the Colombian ptiloneurid fauna, which is far from being fully explored.

Zusammenfassung

Aus kolumbianischem Kopal werden die ersten fossilen Vertreter der Familie der Ptiloneuridae (Ordnung Psocodea, Staub- und Tierläuse) beschrieben. Die hiermit verbundene Hoffnung, den häufig als quartärzeitlich eingestuftem Kopal durch das Vorhandensein rezenter Arten verlässlicher zu datieren, wurde allerdings nicht erfüllt. Die gefundenen Fossilien erforderten die Einführung einer neuen Gattung und Art, *Brisacia colombiensis* nov.gen., nov.sp., sowie die Beschreibung einer weiteren, unbestimmten Art der Gattung *Euplocania*. Obwohl nicht ausgeschlossen werden kann, dass diese fossilen Arten keine rezenten Vertreter in der kolumbianischen Fauna haben, da diese weit davon entfernt ist, hinreichend bekannt zu sein, muss eine zweifelsfreie Entscheidung über das Alter des kolumbianischen Kopal vertagt werden. Die Autoren diskutieren die Bedeutung der Fossilien für die Biodiversität und Evolution dieser Gruppe, und präsentieren einen aktualisierten Bestimmungsschlüssel der ptiloneuriden Gattungen.

Acknowledgments

We are grateful to Patrick BRISAC, who offered the material of *Euplocania* species for study. We thank Dr. A.N. GARCÍA ALDRETE for his help, and Sam HEADS for his helpful criticism on the first version of the manuscript. This work was supported by the French Research Agency (ANR), project "AMBRACE" n° BLAN07-1-184190. This paper is a contribution to the project "The Study of the Fossil Insects and their Outcrops: Geology of the Outcrops – Historical and Biodiversity Evolution" accorded by the Lebanese University to DA.

References

- AZAR D. (2000): Les ambres mésozoïques du Liban. — Ph.D. thesis, Université Paris XI, Paris, France.
- AZAR D. & A. NEL (2004): Four new Psocoptera from Lebanese amber (Insecta: Psocomorpha: Trogiomorpha). — Ann. Soc. entomol. France **40** (2): 185-192.
- BAZ A. & V.M. ORTUÑO (2000): Archaeatropidae, a new family of Psocoptera from the Cretaceous amber of Alava, Northern Spain. — Ann. Entomol. Soc. America **93**: 367-373.
- BAZ A. & V.M. ORTUÑO (2001): New genera and species of empheriids (Psocoptera: Empheriidae) from the Cretaceous amber of Alava, northern Spain. — Cret. Res. **22**: 575-584.
- CARPENTER F.M. (1992): Superclass Hexapoda. — In: MOORE R.C. & R.L. KAESLER (Eds), Treat. Invert. Paleontol., Arthropoda **4** (3/4): 1-655.
- CASTRO M.C.M. DE (2007): Revisão taxonômica e filogenia do gênero neotropical *Loneura* NAVÁS, 1927 (Psocoptera: Ptiloneuridae). — M.Sc. thesis, INPA/UFAM, Manaus, Brasil.
- CLIFFORD D.J., P.G. HATCHER, R.E. BOTTO, J.V. MUNTEAN, B. MICHELS & K.B. ANDERSON (1997): The nature and fate of natural resins in the geosphere. VIII. NMR and Py-GC-MS characterization

- of soluble labdanoid polymers, isolated from Holocene class I resins. — *Org. Geochem.* **27** (7/8): 449-464.
- COCKERELL T.D.A. (1916): Insects in Burmese amber. — *American J. Sci.* **42**: 135-138.
- COCKERELL T.D.A. (1919): Insects in Burmese amber. — *Entomologist* **52**: 241-243.
- EERTMOED G. (1973): The phenetic relationships of the Epipsoctae (Psocoptera): the higher taxa and the species of two new families. — *Trans. American Entomol. Soc.* **99**:393-414.
- ENDERLEIN G. (1911): Die Fossilen Copeognathen und ihre Phylogenie. — *Palaeontographica* **58**: 279-360.
- ENDERLEIN G. (1900): Die Psocidenfauna Perus. — *Zool. Jb. (Abt. Syst.)* **14**: 133-160.
- ENDERLEIN G. (1910): Eine Dekade neuer Copeognathengattungen. — *Sitzungsber. Ges. Naturf. Freunde Berlin* **1910** (2): 63-77.
- GARCÍA ALDRETE A.N. (1995): A new species of *Loneura* (Psocoptera: Ptiloneuridae) from Yucatan, Mexico. — *Folia Entomol. Mexicana* **93**: 25-30
- GARCÍA ALDRETE A.N. (1997): A new species of *Loneura* (Psocoptera: Ptiloneuridae) from Chiapas, Mexico. — *J. New York Entomol. Soc.* **105** (3-4): 186-189.
- GARCÍA ALDRETE A.N. (1998): On the genus *Euplocania* Enderlein (Psocoptera: Ptiloneuridae) with description of a new species. — *Proc. Entomol. Soc. Washington* **100** (4): 724-730.
- GARCÍA ALDRETE A.N. (2003): New species of *Loneura* (Ptiloneuridae: Psocoptera), from Argentina, Nicaragua and Mexico. — *An. Inst. Biol. Univ. Nac. Auton. Mexico, Ser. Zool.* **74** (1): 11-19
- GARCÍA ALDRETE A.N. (2004): New species of *Loneura* (Psocoptera: Ptiloneuridae), from Venezuela and Nicaragua. — *An. Inst. Biol. Univ. Nac. Auton. Mexico, Ser. Zool.* **75** (1): 143-148.
- GARCÍA ALDRETE A.N. (2005): A new ptiloneurid genus (Psocoptera: Ptiloneuridae) from Dominica. — *Proc. Entomol. Soc. Washington* **107** (2): 267-272.
- GARCÍA ALDRETE A.N. (2006a): New genera of Psocoptera (Insecta), from Mexico, Belize and Ecuador (Psoquillidae, Ptiloneuridae, Lachesillidae). — *Zootaxa* **1319**: 1-14
- GARCÍA ALDRETE A.N. (2006b): Two new ptiloneurid genera (Psocoptera: Ptiloneuridae) from South America. — *Studies Neotrop. Fauna Environm.* **41** (2): 133-137.
- GARCÍA ALDRETE A.N. (2007): A pair of new sister species of *Loneura* from Nicaragua and Venezuela (Psocoptera: Ptiloneuridae). — *Rev. Mexicana Biodiv.* **78**: 99-104.
- GELHAUS J.K. & R. JOHNSON (1996): First record of crane flies (Tipulidae: Limoniinae) in Upper Cretaceous Amber from New Jersey, U.S.A. — *Trans. American Entomol. Soc.* **122**: 55-65.
- GRIMALDI D. & M.S. ENGEL (2005): *Evolution of the Insects.* — Cambridge University Press, Cambridge.
- GRIMALDI D. & M.S. ENGEL (2006a): Fossil Liposcelididae and the lice ages (Insecta: Psocodea). — *Proc. R. Soc., London* **273**: 625-633.
- GRIMALDI D. & M.S. ENGEL (2006b): Extralimital Fossils of the "Gondwanan" Family. Sphaeropsocidae (Insecta: Psocodea). — *American Mus. Nov.* **3523**: 1-18.
- HUANG D.-Y., A. NEL, D. AZAR & P. NEL (2008): Phylogenetic relationships of the Mesozoic paraneopteran family Archipsyllidae (Insecta: Psocodea). — *Geobios* **41**: 461-464.
- JOHNSON K.P., K. YOSHIZAWA & V.S. SMITH. (2004): Multiple origins of parasitism in lice. — *Proc. R. Soc., London* **271**: 1771-1776.
- LANGENHEIM J.H. (1990): Plant resins. — *American Sci.* **78**:16-24.
- LIENHARD C. (1998): Psocoptères euro-méditerranéens. — *Faune de France, Féd. Française Soc. Sci. Nat., Paris* **83**: 1-517.
- MOCKFORD E.L. (1967): The electrentomoid psocids (Psocoptera). — *Psyche* **74**: 118-165.
- MOCKFORD E.L. (1993): North American Psocoptera (Insecta). — *Flora & Fauna Handbk* **10**: 1-455.
- NEW T.R. (1980): Epipsocetae (Psocoptera) from the Reserva Ducke, Amazonas. — *Acta Amazonica* **10**: 179-206.
- NEW T.R. & I.W.B. THORNTON (1988): Epipsocetae (Psocoptera) from Peru. — *Studies Neotrop. Fauna Environm.* **23**: 225-250.
- PERRICHOT V., D. AZAR, D. NÉRAUDEAU & A. NEL (2003): New Psocoptera in the Lower Cretaceous ambers of southwestern France and Lebanon (Insecta: Psocoptera: Trogiomorpha). — *Geol. Mag.* **140**: 669-683.
- POINAR G.O. & R. MILKI (2001): Lebanese amber. The oldest ecosystem in fossilized resin. — Oregon State University Press, Corvallis.
- SMITHERS C.N. (1972): The classification and phylogeny of Psocoptera. — *Australian Mus. Mem.* **14**: 1-351.
- SMITHERS C.N. (1990): Keys to the families and genera of Psocoptera (Arthropoda, Insecta). — *Tech. Rep. Australian Mus.* **1990**: 1-82.
- SPAHR U. (1992): Ergänzungen und Berichtigungen zu R. KEILBACHS Bibliographie und Liste der Bernsteinfossilien. Klasse Insecta (Ausgenommen: Apterygota, Hemipteroidea, Coleoptera, Hymenoptera, Mecopteroidea). — *Stuttgarter Beitr. Naturk., (B)* **182**: 1-102.
- VISHNYAKOVA V.N. (1975): Psocoptera in Late Cretaceous insect-bearing resins from the Taimyr. — *Entomol. Rev.* **54**: 63-75.
- YOSHIZAWA K. (2002): Phylogeny and higher classification of suborder Psocomorpha (Insecta: Psocodea: Psocoptera). — *Zool. J. Linnean Soc.* **136**: 371-400.
- YOSHIZAWA K. & K.P. JOHNSON (2006): Morphology of male genitalia in lice and their relatives and phylogenetic implications. — *Syst. Entomol.* **31**: 350-361.

Address of authors:

Dany AZAR
Lebanese University
Faculty of Sciences II
Department of Biology
Fanar – Matn, P.O. box 26110217, Lebanon
E-Mail: azar@mnhn.fr

André NEL & Alain WALLER
CNRS UMR 5202
Muséum National d'Histoire Naturelle
CP 50, Entomologie
45 rue Buffon
75005, Paris, France
E-Mail: anel@mnhn.fr

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Denisia](#)

Jahr/Year: 2009

Band/Volume: [0026](#)

Autor(en)/Author(s): Azar Dany, Nel André, Waller Alain

Artikel/Article: [Two new Ptiloneuridae from Colombian copal \(Psocodea: Psocomorpha\) 21-28](#)