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Original article

# Discovery of the first lacewings (Neuroptera: Permithonidae) from the Guadalupian of the Lodève Basin (Southern France)☆

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ABSTRACT

Lacewings and their relatives (Neuroptera) are one of the ancient holometabolous insect order reaching spectacular diversity during the Mesozoic and Cenozoic, but with a surprisingly sparse record during the Late Palaeozoic. Here, we describe the first members of the stem-group Permithonidae from the middle Permian (Guadalupian) of Salagou Formation in the Lodève Basin (Languedoc region, Southern France): *Lodevothone pectinata* nov. gen., nov. sp., and *Lodevosisyra reducta* nov. gen., nov. sp. Both diagnoses are based on unique wing venation patterns. Discovery of these two new permithonid species in the Lodève Basin fits well with the distribution of other taxa known from the Permian of Euramerica, Siberia, and Gondwana. The fossil record of Permithonidae is documented and briefly discussed in respect of stratigraphical range and geographical distribution. A check-list of all taxa including their synonymy is provided.



## 1. Introduction

Neuropterida together with sister-group Coleopterida represent a holometabolan insect clade so called Neuropteroida, well supported by phylogenetic analyses of morphological, molecular and phylogenomic data with history dated back at least to the late Pennsylvanian (Trautwein et al., 2012; Nel et al., 2013; Misof et al., 2014). Palaeozoic lacewings (Neuroptera) are currently classified into two families: Permithonidae recorded from the early to late Permian deposits of Euramerica, Siberia, and Gondwana (Fig. 1), and Archeosmylidae known from the late Permian and Triassic (Novokshonov, 1996; Makarkin et al., 2014). However, the main radiation of this order took place after the PT boundary, then followed by a marked peak in diversity during the Jurassic (Jepson and Penney, 2007). Novokshonov (1996) provided a critical systematic revision and synonymized the Permian neuropteran families Sialidopsidae, Palaeomerobiidae, and Permosisyridae with Permithonidae. Makarkin et al. (2014) confirmed the position of Archeosmylidae based on the study of the Middle Jurassic osmylid *Archaeosmylidia fusca* Makarkin, Yang et Ren, 2014 in Daohugou (China), bearing number of plesiomorphic characters in wing venation and supporting the close relationship between Archeosmylidae and Osmylidae. The latter family encompasses members from the Early Jurassic to extant species. It should be noticed that this hypothesis about a relationship between these two families was already proposed by Riek (1976).

The Lodève Basin is situated in the department of Hérault (Languedoc region, Southern France); it is an important Permian insect locality from the Southwestern Europe territory. Insect fossils are found in the Guadalupian Salagou Formation exposed in several outcrops close to the town of Lodève (Garric, 2000; Nel et al., 2009). The depositional palaeoenvironment is interpreted as a playa with ephemeral pools controlled by climate oscillations (Lopez et al., 2008). Insects are commonly preserved as isolated wings or body fragments caused probably by a long decay and *post mortem* transportation, or due to the activity of aquatic predators like crustaceans and amphibians (Gand et al., 1997). With more than fifty insect species described from the Salagou Formation assigned to thirteen orders or higher rank clades, Lodève demonstrates rather diversified insect communities with some taxa directly linked to early and late Permian ones known from assemblages in Euramerica and Russia (e.g., Prokop and Nel, 2011; Prokop et al., in press).

The present contribution deals with the formal description of two new neuropteran taxa of Permithonidae, including a discussion of

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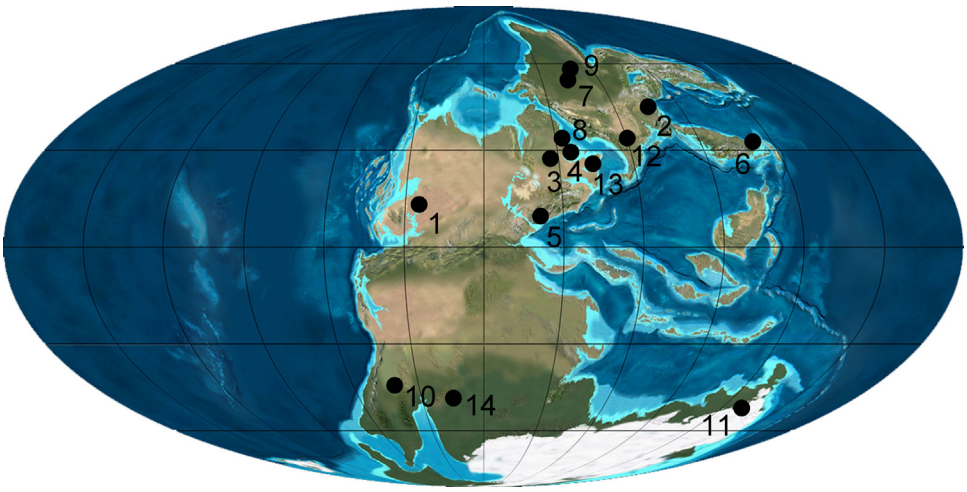


**Fig. 1.** (Colour online). Palaeogeographical map of the Late Permian (260 Ma) showing the position of sites with described lacewings (Permithonidae) indicated by dots (based on Ron Blakey's original paleomap; http://cpgeosystems.com/). **1**. Elmo (Kansas, USA); **2**. Kuznetsk Basin (Russia); **3**. Iva-Gora, Soyana River (Russia); **4**. Tchekarda, Sylva River (Russia); **5**. Lodève Basin (France); **6**. Russky Island (Russia); **7**. Kureika River (Russia); **8**. Tikhiye Gory (Republic of Tatarstan); **9**. Ilimpeya River (Russia); **10**. Rio Grande do Sul (Brasil); **11**. Newcastle, N.S.W. (Australia); **12**. Karaungir (Kazakhstan); **13**. Kargala, Orenburg reg. (Russia); **14**. Mooi River, Natal (South Africa).

their systematic position and a broader evaluation of the fossil record of this family. The checklist of all taxa attributed to family Permithonidae with their geographical and stratigraphical origin is given for clear arrangement.

## 2. Material and methods

The three neuropteran specimens described below come from the Guadalupian deposits of the Salagou Formation in the Lodève Basin (Hérault, Southern France), which are well known thanks to the long-term sampling effort by one of us (JL). The material (including type specimens) resulting from these collects is housed at the Musée Fleury (Lapeyrie collection, prefix "Ld LAP") in Lodève (Hérault, France).

All specimens were observed under an Olympus SZX-9 stereomicroscope in a dry state. Line drawings of venations were obtained directly, using a coupled camera lucida. Photographs were taken using a digital camera Canon D550 with a reverse lens MP-E 65 mm, then processed using the image-editing software Adobe Photoshop CS.

We follow the systematics of Permithonidae as proposed by Novokshonov (1996). The venational symbols used here are specified as follows (symbols in capitals denote the longitudinal veins): ScP, subcosta posterior; RA/RP, radius anterior/posterior; MA/MP, media anterior/posterior; CuA/CuP, cubitus anterior/posterior; 1A/2A, first/second anal vein.

## 3. Systematic palaeontology

Order NEUROPTERA Linnaeus, 1758
Family PERMITHONIDAE Tillyard, 1922
**Included genera:** see Table 1.

Genus ***Lodevothone*** nov.

**Derivation of the name**: named after the Lodève Basin and *Permithone*, type genus of the Permithonidae. Gender feminine.

**Type species**: *Lodevothone pectinata* nov. gen., nov. sp.

**Diagnosis**: Forewing elongate; MA pectinate with seven long posterior branches covering a very broad zone (apomorphy); interadial space very broad near its base, broader than space between ScP and RA and nearly as broad as costal area; RP pectinate with seven straight posterior branches (plus MA); CuP simple; wing apex with intercalary folds markedly corrugated.

*Lodevothone pectinata* nov. gen., nov. sp.
Figs. 2, 3

**Derivation of the name**: Named after the pectination of vein MA in the forewing.

**Material**: Holotype specimen Ld LAP 312 A-B (print and counterprint of a forewing), Lapeyrie coll., stored in the Musée Fleury, Lodève, France.

**Age and outcrop**: Middle Permian, Guadalupian, Mérifons Member, Salagou Formation; around the Salagou lake, Lodève Basin, France.

**Measurements of the holotype**: Wing: 11.7 mm long, 5.8 mm wide; width of costal area: 0.9 mm; width of area between ScP and RA: 0.3 mm; max. width of intraradial area: 0.5 mm.

**Description** (Fig. 2): holotype forewing elongate, more than two times as long as wide, widest beyond mid length, narrowly rounded apically, with anterior margin slightly curved, especially in apical quarter; no crossvein visible in main part of the wing, except for the anterior branches of ScP; apex of wing corrugate because of the presence of intercalary folds along apical margin, especially between RP branches; costal area regularly broad, not expanded in its mid part, slightly wider than intraradial space in proximal half of wing, with numerous simple, weakly-curved ScP branches; trichosors and nygmata not preserved, if originally present; RA beyond junction with ScP slightly arched along and gradually converging with wing margin, but not reaching wing apex; intraradial space greatly widened basally, without visible crossveins; MA visible as a very short vein emerging from M, reaching RP and re-appearing as its most proximal branch, distally pectinated with seven parallel posterior branches; RP with seven simple parallel posterior branches (plus MA); MP divided into two main branches, anterior forked MP1 and posterior three-branched MP2; CuA divided into two main branches, forked CuA1 and three-branched CuA2; CuP simple; CuA separating from CuP 1.9 mm from base of preserved part of the wing; 1A forked and 2A pectinate with four short terminal branches.

**Remarks**: *Lodevothone* nov. gen. belongs to the family Permithonidae due to the vein RA distally straight close to wing apex and CuP simple, unlike in Archeosmylidae. *Lodevothone* nov.