

New Nothochrysinæ from the Spanish Miocene (Neuroptera, Chrysopidae)

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Résumé. - *Pronothochrysa vivesi* n. gen., n. sp., est décrit du Miocène inférieur. Ce genre fossile a été découvert dans "La Rinconada", un gisement près de Ribesalbes en Espagne. *Pronothochrysa* n. gen. est considéré comme un Chrysopidae Nothochrysinæ et comparé avec les genres actuels et fossiles de cette sous-famille. Le nouveau genre est considéré comme le genre-frère de *Nothochrysa* McLachlan, 1868.

Summary. - *Pronothochrysa vivesi* gen. nov., sp. nov., is described from the Lower Miocene. This fossil genus has been discovered in "La Rinconada", an outcrop from Ribesalbes in Spain. *Pronothochrysa* gen. nov. is placed in the Chrysopidae: Nothochrysinæ and compared with the Recent and fossil genera of the subfamily. The new genus is considered as the sister-genus of *Nothochrysa* McLachlan, 1868.

Mots clés. - Neuroptera, Chrysopidae, Nothochrysinæ, n. gen., n. sp., Fossile, Miocène inférieur, Espagne.

Numerous recent works have greatly increased the knowledge on fossil Chrysopidae with the discoveries of new fossil taxa in the European Cenozoic (NEL & SÉMÉRIA, 1986; SÉMÉRIA & NEL, 1990; WILLMANN, 1993; WILLMANN & BROOKS, 1991), but also in the Brazilian Cretaceous (MARTINS-NETO & VULCANO, 1989) and the Lower Jurassic of Europe (ANSORGE & SCHLÜTER, 1990; NEL & HENROTAY, 1994).

Recently, a specimen has been discovered in "La Rinconada" (fig. 1), an outcrop from Ribesalbes (Lower Miocene of Castellón, Spain). The specimen, herein described, is related to genera *Nothochrysa* McLachlan, 1868, which is represented by two Tertiary and three Recent species, and *Dyspetochrysa* Adams, 1967, from the upper Oligocene of Florissant, Colorado, U.S.A., with one species, *D. vetuscula* (Scudder, 1890).

The Ribesalbes fossil insects site is placed in the Ribesalbes-Alcora Basin (Iberian Chain). This basin dated as Lower Miocene is a complex graben limited by normal faults. The fossil insects appear in oil shales which were formed from the sediments of a stratified (meromictic) lake. Bioturbation cannot be observed, but tectonic deformations are frequent. Both, the extraordinary fossil preservation and the strong lamination of the sediments, suggest the action of algal or microbial mats. The preservation is typical of a *Konservat-Lagerstätten*. Some interesting taphonomical features of the fossil insects are: a low decay degree, a large amount of articulated remains and a good preservation of very delicate structures. Apart from insects, others fossil remains have been found: Anura and Urodela amphibians, bird feathers, Gasteropoda, Ostracoda and a high number of leaves, flowers and seeds. Fossil insect orders are abundant in Ribesalbes site. Apart from Neuroptera, other thirteen orders have been identified: Odonata, Isoptera, Grylloptera, Orthoptera, Psocoptera, Thysanoptera, Heteroptera, Homoptera, Trichoptera, Lepidoptera, Coleoptera, Hymenoptera and Diptera (PEÑALVER *et al.*, in press). The Ribesalbes fossil insects site is a type locality for three fossil insect species, one dragonfly and two flies (GIL COLLADO, 1926). As concern to fossil insects, adult specimens, aquatic and terrestrial forms, are the most numerous, but larval and pupal stages are also present.

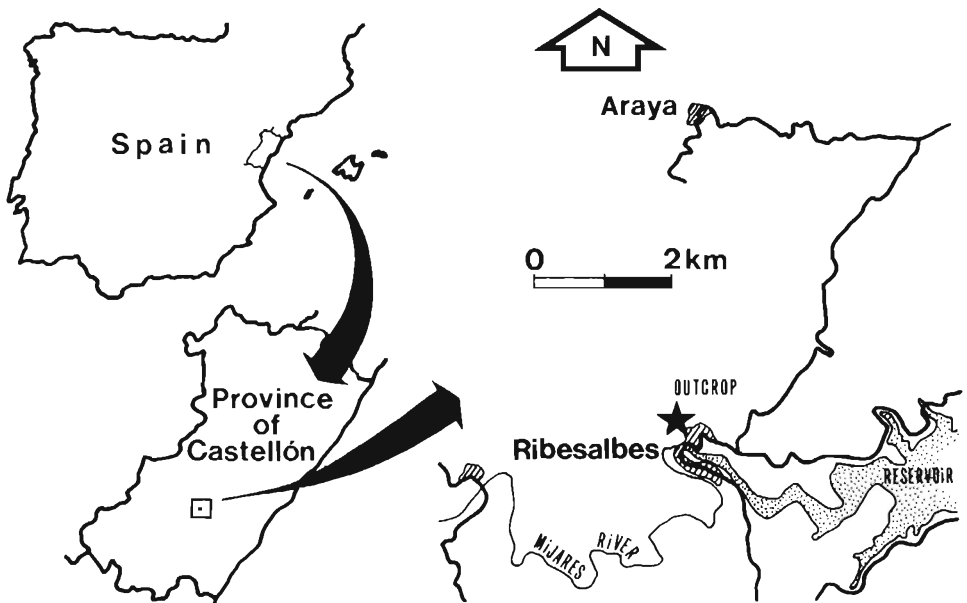


Fig. 1. – Geographical setting of "La Rinconada" outcrop from Ribesalbes.

Pronothochrysa gen. nov.

We follow the nomenclature of wing venation of ADAMS (1967) rather than BROOKS & BARNARD (1990).

Type species. – *Pronothochrysa vivesi* sp. nov. here designated.

Gender. – Feminine. *Species composition.* – Monotypic genus.

Diagnosis. – This new fossil genus is closely related to *Nothochrysa* from which it differs in the structure of the cells of the radial area : in the new genus, cells between R_s and i.g. are all very long and narrow, even longer than those between i.g. and o.g. On the contrary, in *Nothochrysa*, the more distal cells between R_s and i.g. are distinctly shorter than those between i.g. and o.g. A less important difference is the narrower wing of *Pronothochrysa* gen. nov. but this last character is more of specific than generic value within the Chrysopidae.

Pronothochrysa vivesi sp. nov. (fig. 2–5)

HOLOTYPE. Specimen MNCNI–21642 in *Museo Nacional de Ciencias Naturales*, section of fossil invertebrates (Madrid, Spain), adult.

Locus typicus. "La Rinconada", Ribesalbes, Province of Castellón, Spain.

Stratum typicum. Specimen discovered in lacustrine oil shales from the Lower Miocene of Ribesalbes-Alcora Basin (Iberian Chain).

Etymology. The species is named after Mr. Juan Antonio García Vives who discovered the type specimen.

Remarks. The type specimen is fossilized with the wings superposed (fig. 2, 3); only one preserved impression. The body is badly preserved. There is some remain of carbon cuticle. The tectonic deformation can be neglected though this phenomenon is frequent in Ribesalbes site.

Description. – Only the wings are preserved with detail (fig. 4, 5).

Forewing length, 16.9 mm; width, 4.0 mm. The wing is clearly narrower than for *Nothochrysa* spp. Ratio L/l is 4.2 for this new species, 3.0 for *Nothochrysa fulviceps* (Stephens, 1836) and *N. californica* Banks, 1892, 2.8 for *N. capitata* (Fabricius, 1793), for *N. stampieni* Nel & Séméria, 1986 and for *N. praeclara* Stätz, 1936.

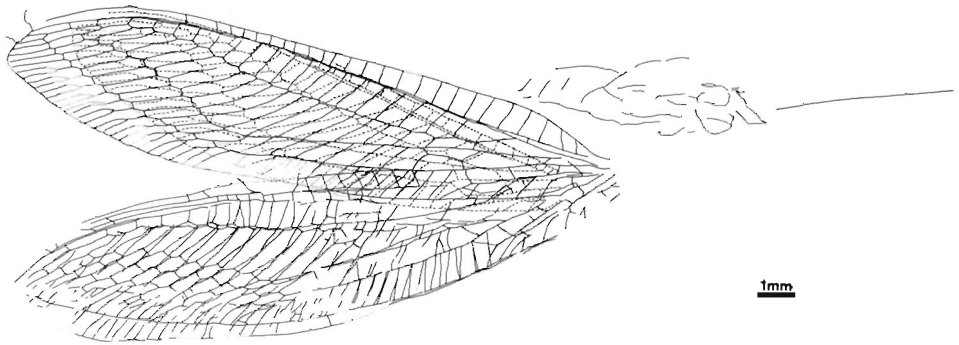


Fig. 2, 3. – *Pronotochrysa vivesi* gen. nov., sp. nov., holotype, specimen MNCNI-21642.

Veins Sc and R are completely separated. The wing apex is more acute than for the *Nothochrysa* spp. The costal area (between C and Sc), with twenty-five preserved transverse straight crossveins, is widened rather abruptly near the base of the wing and distally narrowed. The maximal width of the costal area is 0.8 mm. Presence of the transverse vein bsx (basal subcostal crossvein) between Sc and R, 2.4 mm distad of the base of the wing. Vein bsx is proximal of the division between Rs + MA and R. The humeral vein, at the base of the costal area, is similar to the other crossveins between C and Sc. The maximal width between Sc and R is 0.2 mm. No visible tympanal organ at the base of the vein R+M. The vein Rs+MA begins on R + M 2.8 mm distad of the base of the wing. The vein MA separates from Rs+MA 2.2 mm distad of this point and is a small oblique transverse vein between Rs and MP. The MA vein is 0.4 mm long and is distally fused with MP into the vein psm (pseudo-median vein). Rs is a sinuous vein but it is clearly less curved than for the *Nothochrysa* spp. Vein Rs has eighteen branches rx, all well parallel. Vein MP separates from R + M 1.2 mm distad of the base of the wing. Presence of the transverse vein between MP and CuA which divides the two cells m1 and m2. The length of m1 cannot be determined but the cell m2 is clearly longer than m1. Length of m2, 2.5 mm; maximal width, 0.5 mm. Vein MP is divided into two branches MP1 and MP2 3.6 mm distad of the base of the wing. Vein MP2 is not distally fused with MP1 but it closes posteriorly the cell im (intermedial cell) and it is distally fused with CuA. The cell im is long and quadrangular (length, 1.5 mm; maximal width, 0.3 mm), similar to the im of the *Nothochrysa* spp. (minimal distance between im and CuA, 0.2 mm). Vein MP1 is distally fused with MA and more distally with the six proximal branches of Rs in order to constitute the vein psm. Vein psm is absolutely straight and reaches the wing margin at the 48% of the wing length. The inner gradate veins (i.g.) are in direct continuity with vein psm. These veins i.g. are very regularly disposed and are well aligned (clearly less curved than for the *Nothochrysa* spp.), parallel with the outer gradate veins (o.g.).

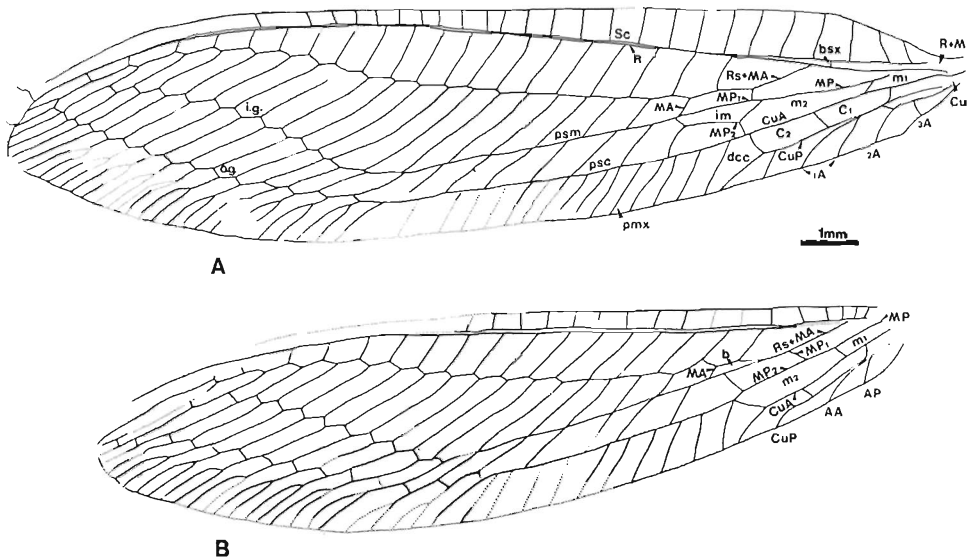


Fig. 4. – *Pronothochrysa vivesi* gen. nov., sp. nov.: A, Forewing; B, hindwing. (A=anal vein; AA=anterior anal vein; AP=posterior anal vein; bsx=basal subcostal crossvein; Cu=cubital vein; CuA, CuP=anterior and posterior cubital vein; i.g.=inner gradate veins; im=intermedial cell; M=media vein; m1, m2=medial cells; MA=median anterior vein; MP=median posterior vein; o.g.=outer gradate veins; pmx=posterior median crossvein; psc=pseudo-cubital vein; psm=pseudo-median vein; R=radial vein; Rs=radial sector; Sc=Subcosta).

Vein Cu begins very near of the base of the wing. It is divided into CuA and CuP 1.4 mm distad of the base of the wing. CuP makes a right angle with Cu. Distally, it becomes parallel with CuA. These veins delimitate the two cells C1 and C2. Length of C1, 1.4 mm; width, 0.4 mm; length of C2, 1.2 mm; width, 0.4 mm. Cell C2 is shorter than C1. Cell dcc is posteriorly opened. Vein CuP with only two small posterior branches ending the posterior margin of the wing. CuA is distally fused with MP2 into the vein psc (pseudo-cubital vein). This last vein is very straight, nearly parallel with the posterior margin of the wing and with psm. The proximal veins pmx (posterior median crossvein) between psc and the posterior margin are nearly all simple, not bifurcate, 1.1 mm long. The o.g. crossveins are in direct continuity with the vein psc. Veins o.g. are very regularly disposed and parallel with the posterior wing margin. The distal veins pmx between the posterior margin and the veins o.g. are, almost all, bifurcate.

The cells between the main branch of Rs and i.g. are all, even the more distal ones, at least as long as the cells between i.g. and o.g. and between o.g. and the posterior wing margin. There is only one row of cells between Rs and i.g. but also between i.g. and o.g. and between o.g. and the posterior wing margin.

The vein 1A is bifurcate. The structures of the veins 2A and 3A are similar to those of the *Nothochrysa* spp.

Hindwing. Length of the wing, 14.4 mm; width, 3.7 mm. The hindwing is similar to the forewing, especially in the structures of the distal half of the wing (Rs area, veins i.g. and o.g., psm, psc and pmx).

The costal area is narrower than in the forewing (maximal width, 3.7 mm). It is not abruptly widened, with seventeen preserved straight crossveins (probably thirty on the living insect).

The Rs+MA separates from R+M 0.9mm from the base of the wing. The svx crossvein between Rs+MA and MP1 is absent because MP1 is clearly fused with Rs+MA main branch for 0.4mm. The cell b is 1.7mm distad of the base of Rs+MA. It is 1.0 mm long and 0.1 mm wide. It is more quadrangular than those of the *Nothochrysa* spp. which are almost triangular in shape. MA separates from Rs+MA and it distally closes the cell b. It is 0.2mm long and distally fused with MP1 into the vein psm. Length of psm, 4.3mm. Rs has fifteen long parallel branches, the four proximal arrive on the vein psm. MP begins very near of the base of the wing. It separates into MP1 and MP2 1.7mm distally. MP1 is an oblique transverse vein between Rs+MA and MP, 0.4mm long.

The vein psc is a long, straight vein, parallel with the posterior wing margin. CuA is parallel with MP (and MP2). The maximal distance between CuA and MP is 0.4 mm. CuA presents one posterior branch which arrives on the posterior wing margin. CuA is distally fused with MP2 by a transverse branch 3.2 mm from the base of the wing. There are two cells m1 and m2 between MP and CuA. Length of m1 unknown; width, 0.2 mm; length of m2, 2.0 mm; width, 0.4 mm. Vein Cu is separated into CuA and CuP 0.8 mm distad of the base of the wing.

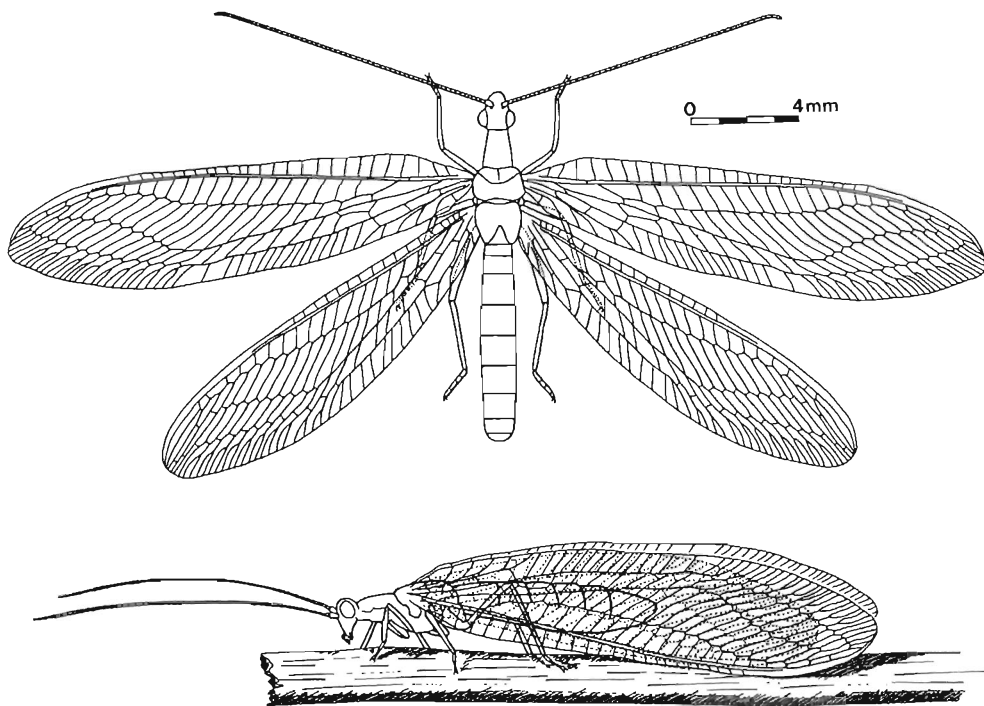


Fig. 5. – Reconstruction of *Pronothochrysa vivesi* gen. nov., sp. nov. The body is idealized.

Vein CuP is parallel with CuA. Presence of a transverse vein between CuA and CuP 2.0 mm distad of the base of the wing. The veins AA and AP are simple but not very well-preserved.

Discussion. – In spite of the lack of some characters, especially those of the costo-apical area, the venation clearly shows that it is a Neuroptera: Chrysopidae and is very similar to the *Nothochrysa* with which it shares the following characters:

- (1) the tympanal organ is absent;
- (2) the quadrangular forewing cell im is well defined;
- (3) the veins R and Sc are well-separated;
- (4) there is a complete fusion of MP1 and Rs+MA, with the lack of any vein svx in the hindwing;
- (5) the veins i.g. and o.g. are in exact continuity with the veins psm and psc;
- (6) vein psm never meets the veins o.g.;
- (7) there are a great number of branches of Rs;
- (8) there is only one row of cells between Rs and i.g., between i.g. and o.g. and between o.g. and the posterior wing margin;
- (9) psm is a well-defined, absolutely straight, non zigzagged vein.

The characters of venation proper to Nothochrysinæ are considered by BROOKS & BARNARD (1990) as symplesiomorphies (characters 1 and 6), it is difficult to attribute *Pronothochrysa* gen. nov. to this subfamily. Evenly, Nothochrysinæ is probably a paraphyletic group (ADAMS & PENNY, 1992). Nevertheless, the character 9 is a specialized character, a highly probable synapomorphy, common to *Pronothochrysa* gen. nov., *Nothochrysa* McLachlan, 1868 and *Dyspetochrysa* Adams, 1967, within the Nothochrysinæ (ADAMS & PENNY, 1992).

The Recent genus *Dictyochrysa* Esben-Petersen, 1917 has a zigzagged psm, many rows of cells between Rs and o.g. and no well-defined cell im. *Hypochrysa* Hagen, 1866, *Asthenochrysa* Adams & Penny, 1992 and *Kimochrysa* Tjeder, 1966 (Recent genera) also present a zigzagged psm, few branches of Rs and a triangular cell im. *Pamochrysa* Tjeder, 1966, *Triplochrysa* Kimmins, 1952 and *Pimachrysa* Adams, 1956 (Recent genera) present a very different cell im, a Rs area with few branches and a zigzagged psm. The Recent genus *Leptochrysa* Adams & Penny, 1992 has a zigzagged psm, but a still not fused MP and Rs+MA in the hindwing. Its forewing cell im is distinctly broader than those of *Nothochrysa* and *Pronothochrysa* gen. nov. The fossil genus *Archaeochrysa* Adams, 1967 presents a small crossvein between MP and Rs + MA in the hindwing and a clearly zigzagged "psm". MA is connected with MP by a small crossvein (CARPENTER, 1935; ADAMS, 1967). *Paleochrysa* Scudder, 1890, *Tribochrysa* Scudder, 1890, *Cimbochrysa* Schlüter, 1982, *Danochrysa* Willmann, 1993 and *Stephenbrooksia* Willmann, 1993 (fossil genera) also present a zigzagged forewing psm (SCUDDER, 1890; ADAMS, 1967; SCHLÜTER, 1982; WILLMANN, 1993). The very "primitive" Eocene genus *Protochrysa* Willmann & Brooks, 1991 has a very long cell im and no vein psm (WILLMANN & BROOKS, 1991).

The fossil genus *Dyspetochrysa* Adams, 1967 is the only other genus within Nothochrysinæ with a straight psm in the forewing but it presents in the hindwing a Rs + MA never basally fused with MP but clearly connected with it by a small crossvein (CARPENTER, 1935: fig. 1). ADAMS (1967: 229) considers that *Dyspetochrysa vetuscula* (SCUDDER, 1890) is the same species as *Paleochrysa sensu stricto* Carpenter, 1935 figured by CARPENTER (1935: fig. 1). The type specimen of *Dyspetochrysa vetuscula* figured by SCUDDER (1890) and ADAMS (1967) lacks the hindwing, but the specimen figured by Carpenter presents fore- and hindwings. The more distal cells between Rs and i.g. and between i.g. and o.g. are not very elongated in *Dyspetochrysa* and *Nothochrysa*. The basal subcostal crossvein arises distad of the origin of Rs+MA in *D. vetuscula*. It arises basad of the origin of Rs+MA in *Nothochrysa* and *Pronothochrysa* gen. nov.

The great similarity between the venation of *Pronothochrysa* gen. nov. with that of *Nothochrysa* allow us to consider that they are closely related. As already seen, all the other genera of the subfamily greatly differ from them.

Finally, the Eocene fossil "Chrysopidae species A", described by JARZEMBOWSKI (1980), only known by a forewing apex, could be related to *Nothochrysa*. It differs from *Pronothochrysa* gen. nov. by its very short cells between Rs and i.g., just like the former.

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André NEL, Antonio ARILLO & Vicente M. ORTUÑO. – Découverte du premier Libellulidae Trameinae de l'Oligocène d'Espagne (Odonata, Anisoptera)

Les Libellulidae sont une des familles les plus fréquentes d'Odonata dans les gisements du Cénozoïque européen, particulièrement en France et en Allemagne (NEL & PAICHELER, 1993). Néanmoins, ce groupe est très mal connu dans le Tertiaire espagnol avec seulement une espèce décrite (*Trithemis pseudodistanti* Nel, 1991 du Miocène supérieur de la Cerdaña espagnole). La découverte récente d'une aile antérieure attribuable à cette famille dans le gisement d'Izzara est donc très intéressante. Ce site a déjà livré de nombreuses larves, en bon état de conservation, attribuables aux Libelluloidea et très probablement aux Libellulidae, bien caractérisées par le masque concave, conservées en volume dans des nodules. Une d'elles a été étudiée par ARILLO (1994). L'étude stratigraphique du gisement a été réalisée dans le même travail.

N.B.: Ces recherches sont subventionnées par la Diputación Foral de Ávala et le Museo de Ciencias Naturales de Ávala. Nous utilisons la nomenclature de la nervation alaire employée par NEL & PAICHELER (1993).