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A second chrysopine lacewing from Mexican amber (Insecta: Neuroptera: Chrysopidae)

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Abstract: A new species of chrysopine lacewing assigned to the genus *Chrysopa* is described based on a single individual in Early Miocene amber from Chiapas, Mexico. *Chrysopa danielleae* sp. nov. is the second chrysopine to be formally described from Mexican amber following *Chrysopa prominenta* to which it bears a strong resemblance but differs in a number of notable characters in the venation of both the fore- and hind wings.

Key words: Neuropterida, Hemerobioidea, Chrysopini, taxonomy, fossil insects

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Introduction

Chrysopidae (green lacewings) are a diverse and widespread group of hemerobioid Neuroptera comprising over 1,400 species in more than 80 genera found across the globe (Oswald, 2024). The family is divided into four subfamilies, viz., Apochrysinae, Chrysopinae, Limaiinae (extinct and almost exclusively Mesozoic), and Nothochrysinae. Fossils of the family are not altogether uncommon, with around 81 species in 30 genera described to date (see Chen *et al*., 2023). Most fossil chrysopids, however, are known only from adpressions with adults rarely found in amber (Engel & Grimaldi, 2007; Chen *et al*., 2023).

Three chrysopines were described from Early Miocene Dominican amber by Engel & Grimaldi (2007), namely: *Chrysopa vetula* Engel & Grimaldi; *Chrysopa glaesaria* Engel & Grimaldi; and *Leuchochrysa prisca* Engel & Grimaldi. However, chrysopines were unknown from Early Miocene Mexican amber until very recently, when *Chrysopa prominenta* was described by Chen *et al*. (2023). Here, I describe a second species of the genus *Chrysopa* Leach in Brewster, 1815 from Mexican amber.

Material and Methods

The holotype is deposited in the Illinois Natural History Survey Fossil Collection (INHS-P) at the Illinois Center for Paleontology, Prairie Research Institute, University of Illinois. Photomicrographs were taken using a Keyence VHX 7000 digital microscope and figures compiled using Adobe Photoshop and Illustrator. Measurements were taken using the microscope's built-in analytical software. The age and origin of Mexican amber has been discussed by Solórzano Kraemer (2007, 2010) and Estrada-Álvarez *et al*. (2023). Morphological terminology and vein nomenclature follow that of Breitkreuz *et al*. (2022) as adapted from Breitkreuz *et al*. (2017).

Systematic Paleontology

Genus *Chrysopa* Leach in Brewster, 1815

1815 *Chrysopa* Leach in Brewster, p. 138 [type species: *Hemerobius perla* Linnaeus]
1820 *Aoelops* Billberg, p. 95 [type species: *Hemerobius chrysops* Linnaeus]
1834 *Emerobius* Costa, p. 72 [type species: *Hemerobius chrysops* Linnaeus]
1861 *Melanops* Doumerc, p. 192 [type species: *Chrysopa parvula* Doumerc]
1875 *Chrysopisca* McLachlan in Fedtschenko, p. 23 [type species: *Chrysopisca minuta* McLachlan in Fedtschenko]
1914 *Cintameva* Navás, p. 214 [type species: *Cintameva venulosa* Navás]
1919 *Minva* Navás, p. 288 [type species: *Minva punctata* Navás]
1935 *Polyphleba* Navás, p. 88 [type species: *Polyphleba punctata* Navás]
1964 *Metachrysopa* Steinmann, p. 264 [type species: *Chrysopa septempunctata* Wesmael]
1964 *Nigrochrysopa* Steinmann, p. 264 [type species: *Chrysopa formosa* Brauer]
1983 *Parachrysopa* Séméria, p. 310 [type species: *Hemerobius pallens* Rambur]
1991 *Euryloba* Yang, p. 237 [type species: *Chrysopa zhangi* Yang]

Remarks. *Chrysopa* comprises some 320 valid species, of which eight are known only from fossils (Chen *et al*., 2023; Oswald, 2024), viz., *C. extensa* Chen, Gao, Makarkin & Liu, 2023 from Eocene Baltic amber; *C. martynovae* Makarkin, 1991, *C. miocenea* Makarkin, 1991, and *C. stavropolitana* Makarkin, 1991 from the Miocene of Russia; *C. sarmatica* Handschin, 1937 from the Miocene of Romania; *C. glaesaria* Engel & Grimaldi, 2007, *C. vetula* Engel & Grimaldi, 2007, and *C. prisca* Engel & Grimaldi, 2007 from Early Miocene Dominican amber; and *C. prominenta* Chen, Gao, Makarkin & Liu, 2003 from Early Miocene Mexican amber. A recent comparison of the fossil species was given by Chen *et al*. (2023).

While *Chrysopa* is reasonably well defined, its separation from other chrysopine genera—and in particular *Chrysoperla* Steinmann, 1964—is achieved primarily through comparison of internal genitalia (Engel & Grimaldi, 2007). Since these features are rarely visible in fossils (even in remarkably well-preserved amber inclusions) the generic assignment of ancient chrysopids can be difficult. With this in mind, and with the absence of any useful genital characters in the holotype, the placement of the new species described below in *Chrysopa* is based primarily on wing venation characters.

Chrysopa danielleae sp. nov.
Figures 1–2

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Holotype. INHS-P5115: a partially preserved adult in a roughly rectangular piece of amber measuring 52 mm long x 38 mm wide x 11 mm thick. Syninclusions: three large ant alates (Hymenoptera:

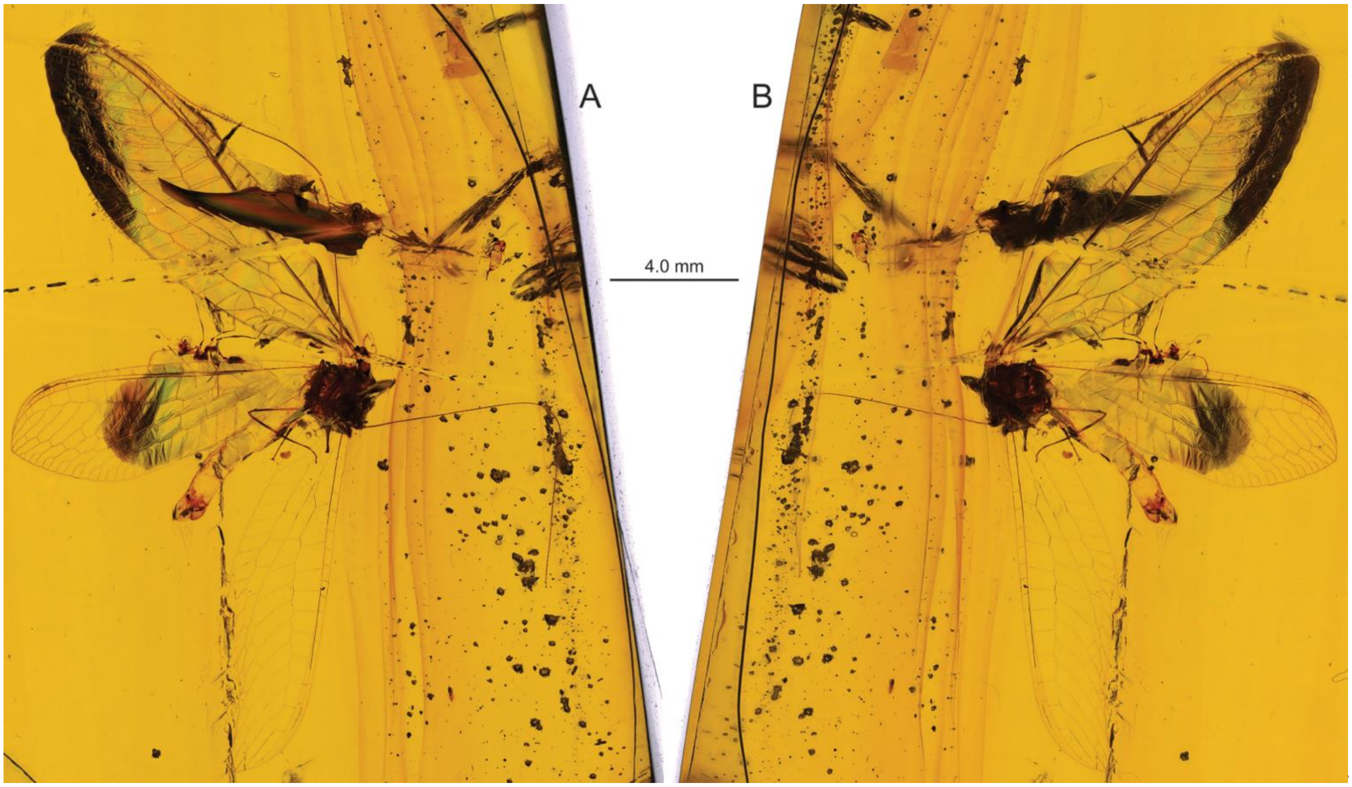

Figure 1. Photomicrographs of *Chrysopa danielleae* sp. nov. holotype (INHS-P5115): **A**, oblique right lateral view; **B**, oblique left lateral view.

Formicidae); four hump-backed flies (Diptera: Phoridae); one caddisfly (Trichoptera); one indeterminate cercopoid (Hemiptera: Cercopoidea); and one springtail (Collembola).

Type Locality and Horizon. Amber from Minas Campo La Granja, N of Simojovel de Allende, Chiapas, Mexico, 17.1469, -92.7084. La Quinta Formation, Finca Carmitto Member (Lower Miocene: Aquitanian).

Etymology. The specific epithet honors my friend and colleague Danielle Ruffatto in recognition of her tireless work in science communication, and in thanks for her support and friendship over the years.

Diagnosis. The new species is very similar to *C. prominenta* (also from Mexican amber) but can be distinguished from the latter by the following. Forewing: subcostal area narrow proximally, gradually widening distally [wider proximally and narrowing towards midwing in *C. prominenta*]; 1sc-ra almost exactly in line with 1ma-cua [distal of 1ma-cua in *C. prominenta*]; 1ma-cu exactly in line with CuA-CuP separation [distal of CuA-CuP separation in *C. prominenta*]; *dcc* almost sub-triangular [pentagonal in *C. prominenta*]. Hind wing: costal space with 17 crossveins [15 in *C. prominenta*]; subcostal area extremely narrow with Sc and RA very closely approximated in proximal half of wing [subcostal area broader in *C. prominenta* with Sc and RA well separated]; inner gradate series comprising three crossveins [two in *C. prominenta*]; CuA three-branched [four-branched in *C. prominenta*].

Description. Body (Fig. 1A,B): approx. 7.16 mm long as preserved. Head and thorax rather poorly preserved, split by a crack in the amber, and obscured by debris; abdomen near complete, hollow, terminalia indistinct. Eyes globose, typical of the genus. Mouthparts completely obscured. Antennae filiform, highly

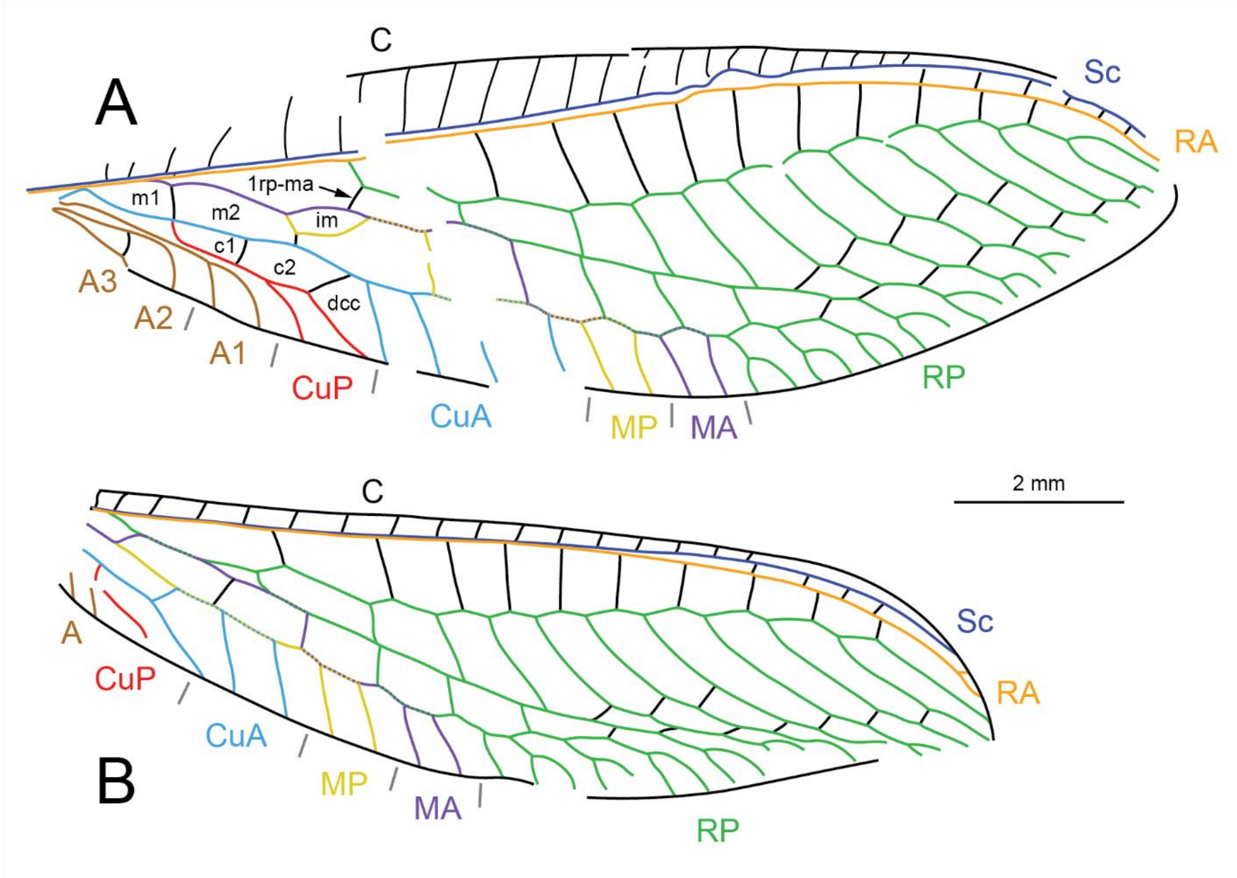

Figure 2. Wing venation of *Chrysopa danielleae* sp. nov., drawn from the holotype (INHS-P5115): **A**, forewing; **B**, hind wing. Abbreviations: **C**, costa; **Sc**, subcostal; **RA**, anterior radius; **RP**, posterior radius; **MA**, anterior media; **MP**, posterior media; **CuA**, anterior cubitus; **CuP**, posterior cubitus; **A**, anal; **1rp-ma**, first rp-ma crossvein; **m1**, first median cell; **m2**, second median cell; **im**, intramedial cell; **c1**, first cubital cell; **c2**, second cubital cell; **dcc**, distal cubital cell. Setae are omitted for clarity.

setose, longer than forewings; scape and pedicel somewhat inflated compared to flagellomeres which are around 2.5 times as long as wide. Thorax apparently robust but damaged by a large crack in the amber; divisions between pro-, meso-, and metathoraces indiscernible. Legs long, slender, typical of the genus; tarsi with five tarsomeres; first tarsomere markedly longer than the others which are equal in length; pretarsus lacking long apical setae; pretarsal claws simple, long, somewhat inflated basally but distally very slender, terminating in a sharp, curved tip.

Forewing (Fig. 2A): 13.92 mm long; 4.31 mm wide at widest point. Costal space markedly dilated near wing base but narrows significantly towards wing apex, with at least 22 simple crossveins; Sc simple, ending in wing apex; subcostal space very narrow, 1sc-ra weakly sclerotized, slightly distal of origin of MA, at least six additional crossveins apically; RA simple, closely approximating Sc for much of its length, diverging slightly in apical third of wing before ending in wing apex; intraradial space broad, with ten crossveins; RP zigzagged, with 11 branches, almost all bifurcating distally, the basal four entering PsM; inner gradate series comprising five crossveins; outer gradate series comprising seven crossveins; PsM almost straight; PsC somewhat zigzagged; 1rp-ma long, situated in distal half of *im* but proximal of *im* apex; *im* subtriangular, without crossveins; *m1* approximately half the length of *m2*; MA and MP both bifurcated distally; 1m-cu situated at divergence of CuA and CuP; CuA strongly curved basally, with four distal branches; CuP bifurcated distally; *c1* shorter than *c2*; *dcc* almost triangular in shape with apices of CuA1 and CuP2 ending in wing margin rather close to one another; A1 long, bifurcated distally; A2 and A3 simple; a2-a3 long, curved towards wing apex.

Hind wing (Fig. 2B): 11.17 mm long; 3.23 mm wide at midwing; markedly shorter and narrower than forewing. Costal space narrow, with at least 17 simple crossveins; Sc and RA very closely approximated, though not fused, separating slightly around midwing; Sc simple, ending just proximal of wing apex; RA mostly simple, though with very small distal bifurcation; intraradial space broad, with ten crossveins; RP zigzagged, with 11 branches, almost all bifurcated distally, the basal four entering PsM; inner gradate series comprising three crossveins; outer gradate series comprising six crossveins; PsM almost straight; PsC zigzagged; MA and MP both bifurcated distally; CuA with three branches; CuP simple; anal veins only partially visible though appear simple, A1 possibly fused with CuP for a short distance.

Discussion

The taxonomy of modern chrysopine genera is based almost entirely on internal genitalic characters. This makes the accurate assignment of fossil chrysopines difficult since such structures are very rarely preserved and/or are not visible, even in well-preserved amber inclusions. Nevertheless, there are a number of reliable wing venation characters that can be useful in generic determination (Engel & Grimaldi, 2007; Chen *et al*., 2023). Assignment of *C. danielleae* to *Chrysopa* is supported by the presence of two gradate series of crossveins with the basal-most crossvein of the inner gradate series entering PsM in both the fore- and hind wings (Brooks & Barnard, 1990; Breitkreuz *et al*., 2017, 2022; Chen *et al*., 2023). In addition, crossvein 1rp-ma is situated basally with respect to the apex of cell *im* (Fig. 2A). The close affinity of *C. danielleae* with *C. prominenta* (also from Mexican amber) is outlined in the diagnosis of the former presented above, and the assignment of the latter to Chrysopini and *Chrysopa* sensu lato is well laid out by Chen *et al*. (2023).

Chrysopidae are generally very rare in amber, so the discovery of a second *Chrysopa* species in Mexican amber is significant. Moreover, the neuropteran assemblage of Mexican amber is almost entirely unknown. Aside from *C. prominenta* and *C. danielleae*, only two other neuropterans have been reported from Mexican amber: (1) *Dicromantispa electromexicana* (Mantispidae) described by Engel & Grimaldi (2007); and (2) an undescribed owlfly larva (Ascalaphidae) documented by Haug *et al*. (2021). Thus, the recent discovery of two new *Chrysopa* species is of significant interest and hints at a greater diversity of Mexican amber Neuroptera awaiting discovery. Further study of Mexican amber collections will undoubtedly yield additional neuropteran material that will help further elucidate our knowledge of the group from this important and understudied amber deposit.

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