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A new Lower Cretaceous Nymphid (Insecta, Neuroptera, Nymphidae) from the Crato Formation of Brazil

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ABSTRACT
The family Nymphidae Rambur 1842 (Neuroptera) has only recently been recorded from the Lower Cretaceous Crato Formation of the Chapada do Araripe, northeast Brazil, with three new genera and species. The new, exceptionally preserved nymphid *Araripenymphes seldeni* n. gen. et sp., comes from the Nova Olinda Member, basal unit of the Crato Formation. The new species shows some unique characteristics in wing venation, such as the cubital area, number of radial cells and *RP* branches, not shared by the other known genera.

Key words: Araripe Basin, fossil, lacewing, Brazil, new genus and species

RESUMO
A Família Nymphidae Rambur 1842 (Neuroptera) foi recentemente registrada para a Formação Crato (Cretáceo Inferior), Bacia do Araripe, nordeste do Brasil, com três gêneros monotípicos. Um novo neuróptero, excepcionalmente preservado, *Araripenymphes seldeni* n. gen. et sp. é aqui proposto e descrito. O material é proveniente do nível de calcário laminado do Membro Nova Olinda, unidade inferior da Formação Crato. As relações morfológicas e diferenças na venação alar entre outros gêneros brasileiros e mesozóicos, também são discutidas.

Palavras-chave: insetos fósseis, Neuroptera, Nymphidae, Formação Crato, Cretáceo Inferior, Bacia do Araripe.

INTRODUCTION

The earliest fossil lacewings (Neuroptera) occur in early Permian strata of Eastern Europe and North America. The oldest described specimen is from the Artinskian of Kansas (Carpenter, 1976); but the group becomes more widespread by the late Permian where it achieves a Worldwide distribution (Rasnitsyn and Quicke, 2002). Most Cretaceous forms are insects with broad wings, narrow at the base and very rich in venation. Most characteristic of this period are the Neuropteran assemblages found in Chinese and Russian sites (Rasnitsyn and Quicke, 2002), and the Myrmeleontoidea fauna of the Araripe Basin in Brazil (Martins-Neto, 2000). The latter includes species belonging to the Myrmeleontidae, Araripeneuridae, Babinskaiidae, Nymphidae, Chrysopidae, Psychopsidae, Berothidae, Sisyridae, Roeslerianaridae, Paleoleontidae, Ascalaphidae, Allopteridae and Nemopteridae (Martins-Neto, 1990a, b, 1994, 1997, 2001, 2002; Martins-Neto and Vulcano, 1989a, b, c, 1990a, b, 1997). Despite being widespread records of Nymphidae in the Cretaceous of Brazil are rather recent and only three genera and species have been described (Martins-Neto, 2004).

The Crato Formation is one of the sedimentary units of the Araripe Basin in northeast Brazil (Martill, 1993, Figure 1). Its base sits on top of older formations, largely the fluvial sediments of the Rio Batateiras Formation. It consists of a sequence of laminated, organic-rich limestones with important outcrops around the towns of Crato and Nova Olinda. The lowermost unit, the Nova Olinda Member, is a sequence of millimetre-scale laminated Plattenkalks, which are quarried for the building industry. The Member bears one of the most impressive arthropod (mainly insect) fossil faunas in the world. Insects, arachnids, crustaceans and myriapods are associated with a high diversity of plants (including angiosperms), frogs, turtles, lizards, pterosaurs, rare feathers and the fish *Dastilbe*. Other fish species also occur. The fossil assemblage is representative of a mainly terrestrial ecosystem; even the aquatic forms, such as insect larvae and freshwater bugs, are thought to be allochtonous (Martill, 1993; Grimaldi, 1990) and were probably introduced by periodic floods of rivers or by the wind. Animals and plants would have been quickly buried, in the anoxic and/or hyper saline lake bottom. The new specimen comes from the Nova Olinda Member, but its exact provenance is unknown. It is likely that it comes from one of the small

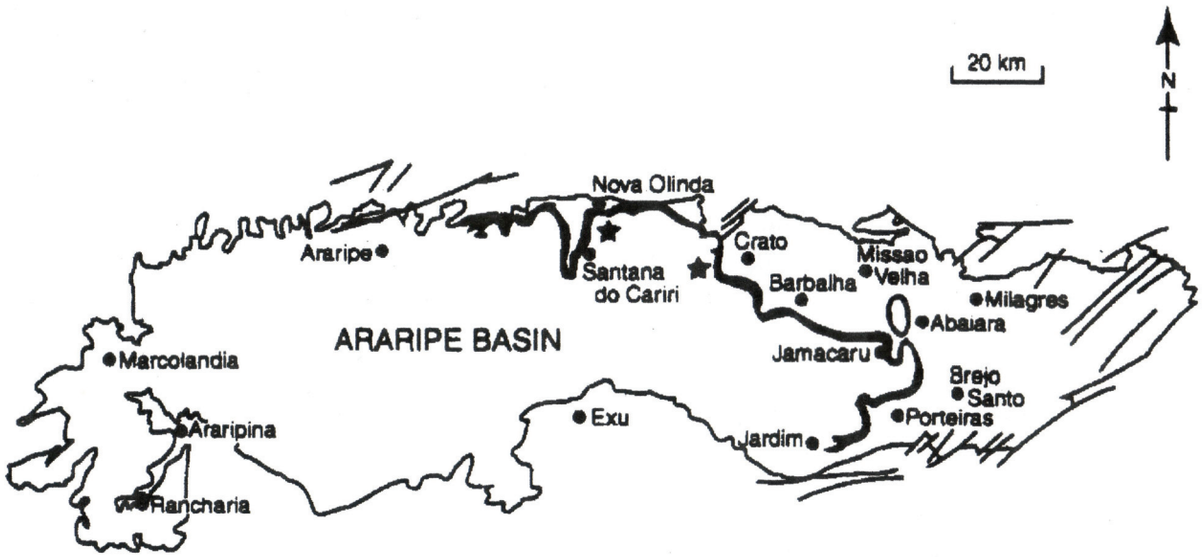

Figure 1. Outline of the Araripe Basin; outcrop of the Crato Formation shown in bold (after Martill, 1993).

quarries near Nova Olinda, Ceará State. The specimen is deposited in the collection of the Sociedade Brasileira de Paleoartropodologia (SBPr –I–2365), São Paulo.

MATERIAL AND METHODS

The lacewing occurs on a slab of typical laminated limestone, preserved as a limonitic replacement after pyrite (Martill, 1995), with the typical orange/brown colour of these fossils. Local workers made an initial preparation of the specimen on site, and preparation was subsequently completed in the Palaeontology Research Laboratory of the University of Manchester using an aeroneedle (Selden, 2003). Not all the sediment surrounding the fossil could be removed without damaging the fossil. Drawings were made with a camera lucida attached to an Olympus SZH stereomicroscope, and digital photographs were taken with a Sony DCS-717 camera at 2560 ´ 1920 pixel resolution.

The wing venation terminology used in the text and figures follows Martins-Neto (2000): *RA*: anterior radial; *RP*: posterior radial; *MA*: anterior median; *MP*: posterior median; *CuA*: anterior cubital; *CuP*: posterior cubital; *Cr*: radial cells; *AcS*: subcostal area; *Ap*: posterior anal vein; *h*: hipostigmal cell; *ac* costal area. All measurements are in milimeter.

SYSTEMATIC PALAEONTOLOGY

Order NEUROPTERA Linnaeus, 1758
Family NYMPHIDAE Rambur, 1842

Comments. Insects belonging to this family, as well as Osmylidae, Polystoechotidae and Myrmeleontidae, have the typical 'osmylid-like' wing venation: medium size, *Sc* and *RA* fused apically and numerous pectinate branches of *RP* (Lambkin, 1988). The distinguishing features of Nymphidae are the absence of the oblique vein, the small veinlet between *MP1* and *MP2*, and the presence of at least one basal subcostal cross vein, usually accompanied by numerous others: *MP* forked near wing base or simple, origin of *R* near wing base and anal field small; in the hind wings the origin of *R* close to the base or more distally placed.

Araripenymphes gen. nov.

Etymology. *Araripe* from the Chapada do Araripe where it was found; *nymphes*, derived from the family name Nymphidae.
Type species. *Araripenymphes seldeni* n. sp., designated here.
Diagnosis. Fore wing with costal area notably narrow at wing base. *RP* with at least 16 branches, and 17 *cr*.; hispostigmal cell (*h*) long and narrow; *RP* origin close to the wing base. *MP1* distally fused to *MA* and *RP16*; *CuP* is long, distally fused with *MP2+CuA*
Etymology. after Dr Paul Selden of the University of Manchester.
Diagnosis. as for genus
Holotype. SBPr–I–2365, held in Sociedade Brasileira de Paleoartropodologia, Ribeirão Preto, SP, Brazil.
Type locality. Nova-Olinda, Ceará, Brazil.
Stratum typicum. Nova Olinda Member, lower unit of Crato Formation, Araripe Basin. Lower Cretaceous (Upper Aptian).
Description. Adult Neuroptera. Head wider (2.5) than long (1.5). Eyes large (0.5), prominent, situated laterally and

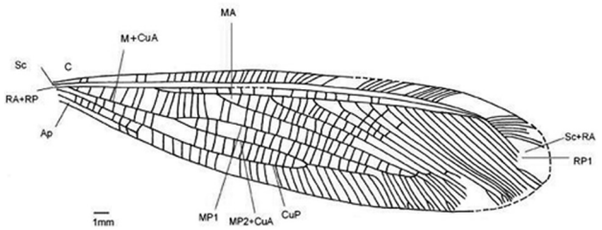

Figure 2. *Araripenymphes seldeni* n. gen. et sp., forewing venation reconstructed from right forewing. Many cross-veins in the marginal and costal area are not preserved.

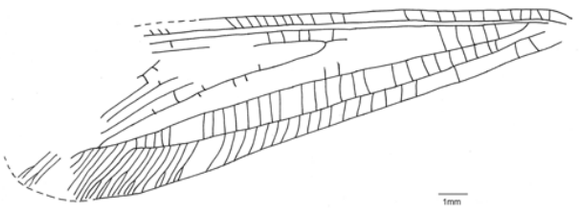

Figure 3. *Araripenymphes seldeni* gen. et sp. n. hindwing venation, reconstructed form left hindwing. Distal marginal area not preserved, and some veinlets are missing in the anal area.

occupying nearly half the width of the head. Antennae long, multisegmented. Prothorax square (1.0 ´ 1.0). Mesothorax + metathorax oval, 4.0 long ´ 2.0 wide. Abdomen stout, composed of nine segments, 14.0 long ´ 1.2 (max.) wide. Forewings 28.0 long, 7.0 wide near margins; hindwings 26.0 long, 5.8 wide near margins. Forewing (Figure 2): oblique vein absent; *Sc* distally fused to *RA*; *ac* narrow near wing base, widening towards wing margin, larger than *ar* and with numerous, apparently non-dichotomous, cross-veins; *ASc* without cross-veins; origin of *RA+RP* situated at less than one third of the length from the wing base; *cr* numerous (e"17), the terminal one is long and narrow; 16 branches of *RP* not all dichotomous; sectorial area is consequently very large; origin of *MA* at approximately one third of wing length; origin of *M+CuA* situated near wing base; *M+CuA* subsequently dichotomizes into *MP1* and *MP2+CuA* level with distal end of first radial cell; *MP1* simple, unbranched, joins *MA* and the last branch of *RP* at approximately one third of length from wing margin; *CuP* long, curved, joins *MP2+CuA* midway along the wing; anal area very small, only one strong, short *AP* discernible. Hindwing venation less clear; marginal area incompletely preserved (Figure 3).

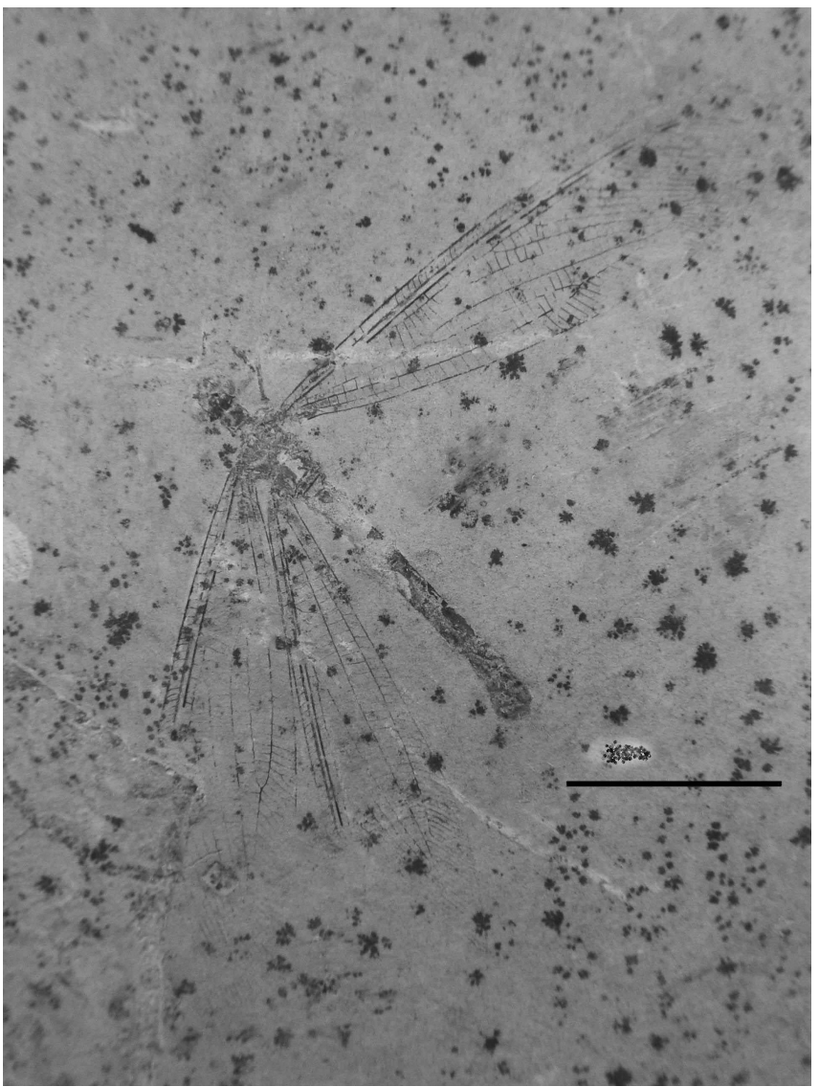

Figure 4. Specimen SBPr - I - 2365: holotype of *Araripenymphes seldeni* gen et sp. n. Scale bar = 10 mm.

DISCUSSION

The preservation of the new neuropteran is exceptional (Figure 4). Wing

venation details are clearly discernible in the right forewing and the left hindwing. Details and characteristics of the body are less clear: the cuticle and head features, such as antennae, are missing in various places, probably stripped away with the counterpart or lost during preliminary preparation on site. Furthermore, there are numerous clusters of MnO_2 which partially obscure morphological details.

The new specimen can be placed in the family Nymphidae by: absence of the oblique vein, presence of many *cr*, pectinate veins near the margins, and the general 'osmilyd-like' appearance. The wings are very narrow at the base, which is frequent among Mesozoic Neuroptera (Rasnitsyn and Quicke, 2002). Despite the fact that the Myrmeleontidae assemblage shows many endemic features, typical only of the Brazilian palaeoentomofauna, the Nymphidae family is unmodified in general appearance and shows the same characteristics as seen in other Mesozoic fossil sites. This possibly signifies that the family was a uniform and natural group widespread throughout Pangaea at the time. *Mesonymphes* Handlirsch, 1906, is the genus that most resembles the new fossil, but *Araripenymphes* differs from all the other Mesozoic nymphids in the posterior cubital area: in no other does *CuP* join *MP2+CuA* in the forewing. *Mesonymphes rohdendorfi* Panfilov, 1980, from the late Jurassic of Kazakhstan, is very similar to *Araripenymphes seldeni* but differs from it in overall size, and in the number of *RP* and *cr*. The other two Brazilian nymphids, described recently (Martins-Neto, 2004), also differ in the number of *RP* branches and radial cells. *Olindanymphes makarkini* Martins-Neto, 2004 is smaller and shows dichotomous cross veinlets in the costal area, only ten branches of *RP* and 14 radial cells. *Santananymphes ponomarrenkoi* Martins-Neto, 2004 is characterized by having ten relatively small radial cells and only nine *RP* branches.

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