Cretaceous Research 56 (2015) 237–243

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

New damselfly genera in the Cretaceous Burmese amber attributable to the Platystictidae and Platycnemididae Disparoneurinae (Odonata: Zygoptera)

Diying Huang [a], Dany Azar [b], Chenyang Cai [a], André Nel [c, *]

[a] State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, People's Republic of China
[b] Lebanese University, Faculty of Sciences II, Department of Biology, Fanar Matn P.O. Box 26110217, Lebanon
[c] Institut de Systématique, Évolution, Biodiversité, ISYEB, UMR 7205, CNRS, MNHN, UPMC, EPHE, Muséum national d'Histoire naturelle, Sorbonne Universités, 57 rue Cuvier, CP 50, Entomologie, F-75005 Paris, France

ARTICLE INFO

Article history:
Received 13 March 2015
Accepted in revised form 7 May 2015
Available online 7 June 2015

Keywords:
Insecta
Zygoptera
Cretaceous
Myanmar
South-East Asia
New genera
New species

ABSTRACT

Two new damselfly genera and species *Mesosticta burmatica* and *Cretadisparoneura hongi*, are described from the mid Cretaceous Burmese amber. They are respectively tentatively attributed to the Platystictidae and to the Platycnemididae: Disparoneurinae. These discoveries confirm that the Zygoptera of the coenagrionomorphan clade with shortened median posterior and cubitus anterior were already rather diverse during the Early Cretaceous.

1. Introduction

The strongly shortened veins MP and CuA is a spectacular specialization that occurred several times in the 'coenagrionid' damselflies but also in some damselfly-like Odonatoptera (Nel et al., 2012). Since recently the 'coenagrionid' damselflies with this structure were grouped in the Platystictidae Laidlaw, 1924 and the Protoneuridae Jacobson & Bianchi, 1905. Pessacq (2008) demonstrated the paraphyly of the latter family, so that it is currently reduced to the sole Neotropical Protoneurinae. The former Paleotropical protoneurid damselflies are now considered as subfamilies of the Platycnemididae Jacobson & Bianchi, 1905, based on the molecular phylogeny of Dijkstra et al. (2014).

The fossil record of the protoneurid-like damselflies is very scarce, with only the Early Cretaceous Eoprotoneurinae Carle & Wighton, 1990 (*Eoprotoneura hyperstigma* Carle & Wighton, 1990), originally assigned to the Protoneuridae, but either belonging to the Isostictidae Fraser, 1955 (Bechly, 2007), or to the stem group of the Neotropical Protoneurinae (Poinar et al., 2010); and the late Eocene genus and species *Angloprotoneura emilielacroixi* Nel & Fleck, 2014 (Isle of Wight, UK) (Nel & Fleck, 2014). This last taxon is known after an isolated wing that could be distinguished from all the modern genera but its exact affinities within Protoneuridae remain uncertain. Consequently the fossil record of the former 'Paleotropical protoneurid damselflies' is extremely reduced. In particular no fossil representative of the Platystictidae Laidlaw, 1924 or of the Disparoneurinae Fraser, 1957 is known. As the Cretaceous Burmese amber Palaeodisparoneurinae Poinar et al., 2010 are currently considered as the sister group of this clade (Poinar et al., 2010), the Disparoneurinae should be also Cretaceous. Here we describe three fossil damselflies within two new genera and species from the Burmese amber that we tentatively attributed to the Platystictidae and the Disparoneurinae.

2. Material and method

The specimens are preserved in pieces of relatively clear, yellow amber. Piece NIGP161758, containing the holotype of *Mesosticta*

* Corresponding author.
E-mail addresses: dyhuang@nigpas.ac.cn (D. Huang), azar@mnhn.fr (D. Azar), caichenyang1988@163.com (C. Cai), anel@mnhn.fr (A. Nel).

http://dx.doi.org/10.1016/j.cretres.2015.05.004
0195-6671/

burmatica, is 1.0 cm long and 0.5 cm wide while amber piece NIGP161759 with paratype is 1.2 cm mm long and 0.5 cm wide. Amber piece NIGPAS161888, containing the holotype of *Cretadisparoneura hongi* is 2.0 cm long and 1.9 cm wide. The amber pieces were ground and polished before being examined and photographed. The piece NIGP161758 has been included in a glass coffin with Canada balsam. Fossils were examined and measured using an incident light stereomicroscope (Olympus SZX9), a stereomicroscope (Nikon SMZ 1500) and a Leitz Wetzlar binocular microscope. Photographs were taken using a Zeiss Discovery V20 microscope system and combined using Adobe Photoshop software. Optical instruments are equipped by drawing tubes and digital camera.

The material is stored in the Nanjing Institute of Geology and Paleontology, Academia Sinica, China (NIGP).

The fossils come from Hukawng Valley, Kachin State, Myanmar (Burma). The exact locality of the fossils cannot exactly be determined as they were acquired from fossil traders. Until recently, the precise age of the amber of Myanmar (Burmite) has been elusive. Recently an absolute age of 98.79 ± 0.62 Ma (earliest Cenomanian) was established for the majority of Burmese amber outcrops based on U–Pb dating of zircons inside the amber (Shi et al., 2012). The history of this amber has been reviewed by various authors (see Cruickshank and Ko, 2003). This deposit arguably contains the greatest diversity of inclusions among the Cretaceous ambers (Grimaldi et al., 2002).

We follow the wing venation nomenclature of Riek & Kukalová-Peck (1984), amended by Nel et al. (1993) and Bechly (1996). The higher classification of fossil and extant Odonatoptera, as well as familial and generic characters followed in the present work are based on the phylogenetic system proposed by Bechly (1996, 2014) at least for the definitions of the damselfly families. More recent works have questioned the phylogeny of the Zygoptera (Dumont et al., 2010; Davis et al., 2011; Dijkstra et al., 2014). They have been taken into account. Abbreviations for wing venation are as follow: ScP = subcostal posterior; RA = radius anterior; RP = radius posterior; IRxx = intercalary radial veins; MA = media anterior; MP = media posterior; CuA = cubitus anterior; CuP = cubitus posterior; AA = analis anterior; N = nodus; Sn = subnodus; Pt = pterostigma.

3. Systematic palaeontology

Order Odonata Fabricius, 1793
Suborder Zygoptera Selys, 1854
Family Platystictidae Laidlaw, 1924 (tentative attribution)
Genus *Mesosticta* gen. nov.
Type species. *Mesosticta burmatica* sp. nov.
Etymology. Named after the genus suffix *sticta* frequently used for the generic names in Platystictidae, and the Mesozoic period. Gender feminine.
Diagnosis. Wing venation characters only: base of RP3/4 just basal of subnodus; base of RP2 only three cells distal of subnodus; MA long but ending one cell distal of level of base of IR1; MP three- to four-cells long; basal position of CuP; presence of a crossvein basally closing subdiscoidal cell, different from CuP; subdiscoidal cell posteriorly closed by AA and not by posterior wing margin.

Mesosticta burmatica sp. nov. (Figs. 1–2)

Etymology. After Burma, old name of Myanmar.
Material. Holotype specimen NIGP161758 (thorax with head still attached, legs, plus two-third of left wings preserved, preserved with an Hemiptera: Fulgoromorpha). Paratype specimen NIGP161759 (thorax with head still attached, legs, plus two-third of left wings preserved).
Horizon and locality. Lowermost Cenomanian (Shi et al., 2012), Tanai Village, Hukawng Valley, northern Myanmar.
Diagnosis. As for the genus (*vide supra*).
Descriptions.
Holotype specimen NIGP161758. Head apparently uniformly dark, without spots on dorsal surface, broader than long, 2.6 mm wide, with eyes well separated, distance between eyes ca. 1.4 mm; ocelli disposed on a low protuberance between the eyes; antenna three segmented; fore, mid and hind legs of the same size, femora and tibia armed with more or less paired long spines 0.4 mm long and 0.3 mm distant, length of spines decreased from base to apex of tibia, tarsi three-segmented, first tarsomere small, third one longer than first two tarsomeres together, tarsi armed with more than 10 pairs of small spines; claws forked, with distal small tooth. Wings uniformly hyaline; forewing ca. 12.0 mm long (preserved part 10.0 mm long), 1.9 mm wide, 1.0 mm wide at nodus level; distance from base to arculus 2.6 mm, from arculus to nodus 1.5 mm; petiole very long and narrow, 2.1 mm long, 0.5 mm wide; distance from base to Ax1 1.6 mm, from Ax1 to Ax2 0.9 mm, Ax2 opposite arculus, no secondary antenodal crossvein distal of Ax2; antesubnodal space free; seven preserved postnodal crossveins, the most basal ones being well aligned with postsubnodal crossveins; pterostigma not preserved; bases of RP3/4 and IR2 below subnodus, IR2 not apparently arising on RP3/4; area between RP and MA between arculus and subnodus free; base of RP2 three cells distal from subnodus; base of IR1 three cells distally; no oblique crossvein 'O' between IR2 and RP2; MA long ending one cell distal of base of IR1; subarculus (ventral part of arculus) ending MA just distal of RP-MA fork; discoidal cell without inner crossveins, rectangular, with MAb of inverted obliquity; subdiscoidal space without inner crossveins, elongate, with its posterior margin AA not fused with posterior margin of wing; CuP between M + Cu and posterior wing margin in a very basal position, a supplementary crossvein between M + CuA and AA basally closing the subdiscoidal space; CuA very short; MP three cells long, ending on posterior wing margin one cell distal of subnodus. Hind wing nearly identical to the forewing, with the following differences: wing ca. 12.0 mm long (preserved part 11.0 mm long), 2.1 mm wide, 1.1 mm wide at nodus level; distance from base to arculus 2.9 mm, from arculus to nodus 1.6 mm; petiole very long and narrow, 2.4 mm long, 0.5 mm wide; distance from base to Ax1 1.9 mm, from Ax1 to Ax2 0.9 mm; MP four-cells long; subdiscoidal space crossed; pterostigmal brace visible together with a weak kink of RP1 at its level, situated eight cells distal of subnodus.
The paratype has the same venation as the holotype.
Discussion. Within the Zygoptera, *Mesosticta* gen. nov. clusters with groups that have strongly shortened veins MP and CuA and a rectangular discoidal cell (viz. Protoneurinae, Eoprotoneurinae, Caconeurinae, Disparoneurinae, Isostictidae, Platystictidae, Palaeodisparoneurinae, and Lestoideidae).

Affinities with the Neotropical Protoneuridae Jacobson and Bianchi, 1905 are excluded because *Mesosticta* has not the synapomorphy of this clade, viz. its subarculus (ventral part of arculus) is slightly distal to the bifurcation RP-MA (Pessacq, 2008). Also the Protoneuridae have not two crossveins between Cu + M and posterior wing margin in petiole, unlike *Mesosticta*.

Mesosticta differs from the Eoprotoneurinae Carle and Wighton, 1990 (Early Cretaceous Brazilian *Eoprotoneura* Carle and Wighton, 1990) in the longer MP (three cells long instead of one cell), Ax2 aligned with the arculus, subdiscoidal cell posteriorly separated from hind wing margin by AA, base of RP3/4 distinctly basal of