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Systematic palaeontology (Invertebrate palaeontology)

A new Mesozoic Chinese genus of aeshnopteran dragonflies (Odonata: Anisoptera: Progobiaeshnidae)

Un nouveau genre de libellule aeshnoptère du Mésozoïque de Chine (Odonata : Anisoptera : Progobiaeshnidae)

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ABSTRACT

Mongoliaeshna sinica gen. et sp. n., third record of the Mesozoic aeshnopteran family Progobiaeshnidae is described from the Lower Cretaceous of Yixian Formation in Liutiaogou (Ningcheng County, Inner Mongolia, China).

Mots clés :
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RÉSUMÉ

Mongoliaeshna sinica gen. et sp. n., troisième fossile de la famille mésozoïque d'aeshnoptère Progobiaeshnidae est décrit de la Formation Yixian du Crétacé inférieur (Liutiaogou, Ningcheng County, Mongolie intérieure, Chine).

1. Introduction

The clade Aeshnoptera ('aeshnid' dragonflies sensu lato) was very diverse during the Late Jurassic and the Early Cretaceous, with numerous families now extinct (Bechly, 1996; Bechly et al., 2001). China can now be considered as a 'hot spot' of diversity for this group during the Mesozoic with several new families and genera recently described

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(Bechly et al., 2001; Huang et al., 2003; Lin et al., 2002; Lin et al., 2004; Zhang et al., 2008a; Zhang et al., 2008b). Among these taxa, the small family Progobiaeshnidae is currently based on two species in two genera from the Early Cretaceous of Outer Mongolia and the Chinese Liaoning Province. Here we described a third new genus and species from the locality near the Liutiaogou Village, Xiangyang Township, Ningcheng County, Inner Mongolia, China.

2. Systematic palaeontology

We follow the wing venation nomenclature of Riek and Kukalová-Peck (Riek and Kukalová-Peck, 1984), amended by Nel et al. (Nel et al., 1993) and Bechly (Bechly, 1996). The higher classification of fossil and extant Odonatoptera, as well as familial and generic characters followed in the present work, is based on the phylogenetic system proposed by Bechly (1996) and Bechly et al. (2001) for the Mesozoic Aeshnoptera. We use the following standard abbreviations: anal vein (AA), anal posterior (AP), primary antenodal cross-veins (Ax0 Ax1 Ax2), distal branch of cubitus anterior (CuAa), proximal branch of cubitus anterior (CuAb), intercalary radial veins (IRi), pseudo-IR1 (p-IR1), distal branch of median anterior (MAa), posterior branch of median anterior (MAb), median posterior (MP), nodus (N), oblique vein (O), pterostigma (Pt), radius anterior (RA), radius posterior (RP), trigonal planate (tp), anal loop (a.l.), discoidal cell (c).

Order Odonata Fabricius, 1793.

Clade Aeshnoptera Bechly, 1996.

Family Progobiaeshnidae Bechly et al. (2001).

Type genus. *Progobiaeshna* Bechly et al. (2001), other genera. *Gobiaeshna* Pritykina, 1977, *Mongoliaeshna* gen. n.

Genus *Mongoliaeshna* gen. n.

2.1. Type species

Mongoliaeshna sinica sp. n.

2.2. Etymology

After Mongolia and *Aeshna*.

2.3. Diagnosis

Mongoliaeshna differs from *Progobiaeshna liaoningensis* Bechly et al. (2001) in the anal loop divided into five cells instead of nine cells, forewing vein PsA angled with three cells in subdiscoidal space instead of two, basal part of area between MP and CuA with a longer zone with two rows of cells in hindwing, and basal part of area between RP1 and RP2 with two rows of cells just distal of second oblique vein, as in *Gobiaeshna occulta* Pritykina, 1977. *Mongoliaeshna* differs from this latter taxon in the subdiscoidal space three-celled. A further difference with both *Progobiaeshna* and *Gobiaeshna* is the free hypetriangle in *Mongoliaeshna*, instead of being crossed by two or three cross-veins.

Mongoliaeshna sinica sp. n. (Figs. 1–5).

2.4. Description

Head 2.8 mm long, 3.0 mm wide, with eyes meeting for about 2 mm long; thorax 8.0 mm long, 6.0 mm wide; four abdominal segments preserved, no expanded lobed on abdominal segments 3 and 4, unlike in *Cymatophlebia* species (Bechly et al., 2001).

Wings hyaline; forewing 45.0 mm long, 11.3 mm wide; distance from base to arculus 5.0 mm; from arculus to nodus 15.0 mm; from arculus to base of RP3/4 9.3 mm; no secondary antenodal cross-vein basal of Ax1, at least two antenodal cross-veins of first row and one of second row between Ax1 and Ax2, nine of first row and nine of second row distal of Ax2; distance from wing base to Ax1 3.6 mm, between Ax1 and Ax2 4.5 mm; Ax2 basal of apex of discoidal triangle; RP and MA strongly separated in arculus; hypertriangle 4.5 mm long, 0.9 mm, free; discoidal

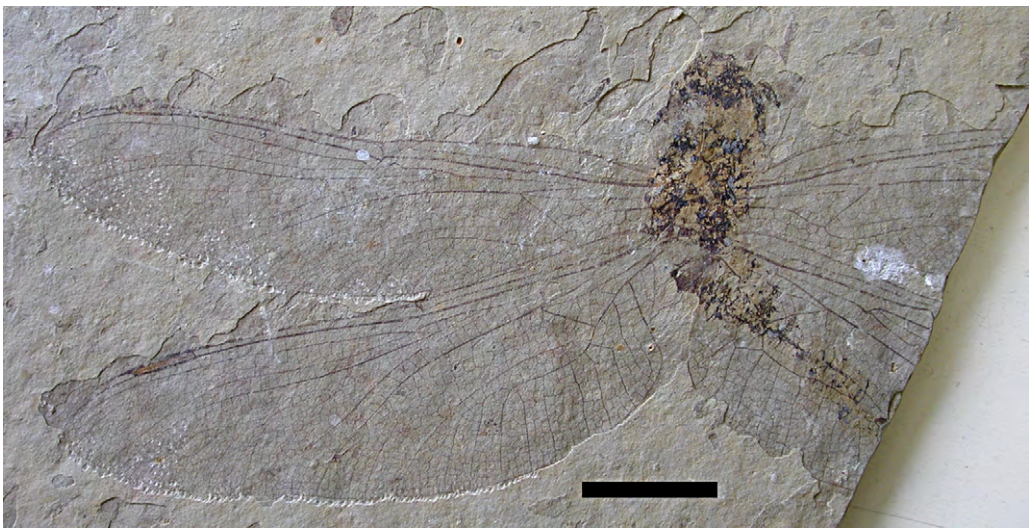

Fig. 1. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photograph of habitus (scale bar represents 10 mm).
Fig. 1. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photographie de l'habitus (la barre d'échelle représente 10 mm).

Fig. 2. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photograph of forewing (scale bar represents 10 mm).
Fig. 2. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photographie de l'aile avant (la barre d'échelle représente 10 mm).

Fig. 3. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photograph of hindwing (scale bar represents 10 mm).
Fig. 3. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, photographie de l'aile arrière (la barre d'échelle représente 10 mm).

triangle 0.7 mm distal of arculus, divided into five smaller cells, elongate, with basal side 2.3 mm long, anterior side 3.8 mm long, and MAb 4.1 mm long; no angle in MAb and no convex trigonal planate; postdiscoidal area with 3-4 rows of cells; no Mspl; no pseudo-ScP distal of nodus; basal part of area between RA and RP with five cross-veins basal of RP3/4, and four distal of base of RP3/4 and basal of subnodus; area between RP and MA with ten cross-veins basal of RP3/4; two oblique veins 'O', first two cells distal of base of RP2 and second six cells distally; RP2 with a weak

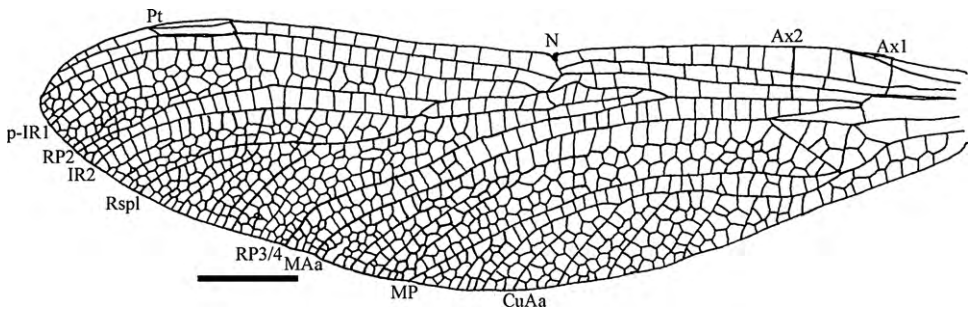

Fig. 4. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, drawing of forewing (scale bar represents 5 mm).
Fig. 4. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, dessin de l'aile avant (la barre de l'échelle représente 5 mm).

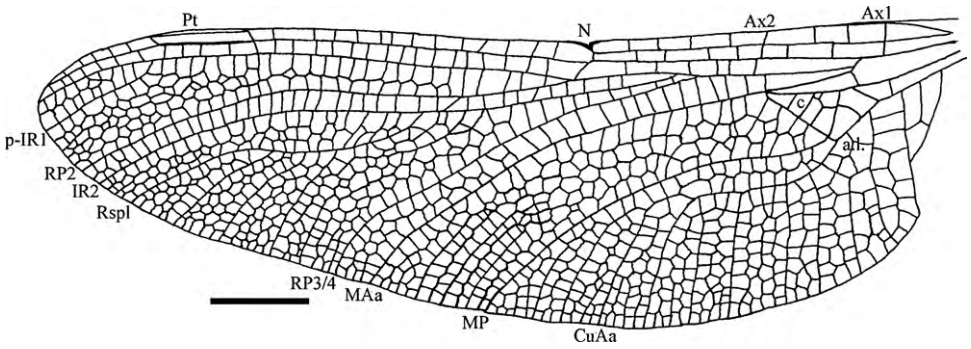

Fig. 5. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, drawing of hindwing (scale bar represents 5 mm).
Fig. 5. *Mongoliaeshna sinica* gen. n., sp. n., holotype NIGP 140800, dessin de l'aile arrière (la barre d'échelle représente 5 mm).

curve just basal of pterostigma; IR2 with a weak curve; 1-2 rows of cells between RP2 and IR2; area between RP1 and RP2 basal of pterostigma narrow but with two rows of cells; pseudo-IR1 very short; Rspl well defined with three rows of cells between it and IR2; RP3/4 and MA with a weak double curve and with space between them widened near posterior wing margin; pterostigma rather short, 3.8 mm long, 0.9 mm wide, covering four cells; pterostigmal brace not very oblique but aligned with basal side of pterostigma; 13 postnodal cross-veins not aligned with 17 postsubnodal cross-veins; 1-2 rows of cells between MP and CuAa; median area free; submedian area crossed by CuP-crossing; subdiscoidal space divided into three cells; PsA angled; two rows of cells between AA and posterior wing margin; cubito-anal area broad, with seven rows of cells between CuAa and posterior wing margin; CuAa with six posterior branches.

Hindwing 50.4 mm long, 14.3 mm wide; distance from base to arculus 5.2 mm; from arculus to nodus 13.2 mm; from arculus to base of RP3/4 7.5 mm; no secondary antenodal cross-vein basal of Ax1, at least two antenodal cross-veins of first row and two of second row between Ax1 and Ax2, four of first row and four of second row distal of Ax2; distance from wing base to Ax1 3.8 mm, between Ax1 and Ax2 5.7 mm; Ax2 opposite apex of discoidal triangle; RP and MA strongly separated in arculus; hypertriangle 4.3 mm long, 1.0 mm, free; discoidal triangle 0.9 mm distal of arculus, divided into five smaller cells, elongate, with basal side 2.0 mm long, anterior side 3.4 mm long, and MAb 4.3 mm long; no angle in MAb and no convex trigonal planate; postdiscoidal area with four rows of cells; no Mspl; no pseudo-ScP distal of nodus; basal part of area between RA and RP with three cross-veins basal of RP3/4, and three distal of base of RP3/4 and basal of subnodus; area between RP and MA with four cross-veins basal of RP3/4; two oblique veins 'O', first two cells distal of base of RP2 and second five cells distally; RP2 with a weak curve just basal of pterostigma; IR2 with a weak curve; 1-2 rows of cells between RP2 and IR2; area between RP1 and RP2 basal of pterostigma narrow but with two rows of cells; pseudo-IR1 very short; Rspl well defined with three rows of cells between it and IR2; RP3/4 and MA with a weak double curve and with space between them widened near posterior wing margin; pterostigma rather short, 4.7 mm long, 0.9 mm wide, covering four cells; pterostigmal brace not very oblique but aligned with basal side of pterostigma; 13 postnodal cross-veins not aligned with 16 postsubnodal cross-veins; two rows of cells between MP and CuAa; median area free; submedian area crossed by CuP-crossing; subdiscoidal space crossed by one cross-vein, PsA nearly straight; posterior wing margin angular at base with a long three-celled anal triangle (male specimen); anal area broad, with two posterior branches of AA directed towards posterior wing margin, and eight rows of cells between AA and posterior wing margin; anal loop rather small, not elongate, pentagonal, posteriorly closed, divided into five cells; cubito-anal area broad, with ten rows of cells between CuAa and posterior wing margin; CuAa with seven posterior branches.

2.5. Material

Holotype specimen NIGP 140800 (print and counterprint of a body with two complete wings and bases of the two other wings attached), housed in Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, China.

2.6. Type locality

Liutiaogou Village, Ningcheng County, Inner Mongolia, NE China.

2.7. Type strata

Lower Cretaceous, Yixian Formation.

2.8. Etymology

Named after Sinica, Latin name for China.

3. Discussion

Mongoliaeshna gen. n. can be attributed to the Aeshnoptera Bechly, 1996 on the basis of the following synapomorphies: RP1 and RP2 basally parallel up to the pterostigma with a narrow area between them; Rspl present; RP3/4 and MA more or less undulating. The presence of posteriorly closed anal loop excludes affinities with the enigmatic genus *Cymatophlebiella* Pritykina, 1968. *Mongoliaeshna* has not the synapomorphies of the

Mesuropetaloidea (sensu Bechly et al., 2001), i.e. arculus shifted very close to first primary antenodal Ax1; RP3/4 and MA closely parallel up to the wing margin in both pairs of wings; but it has those of their sister-group Aeshnomorpha Bechly et al., 2001, i.e. forewing discoidal triangle longitudinal elongate, therefore the discoidal triangles of both pairs of wings of similar shape; RP2 at least slightly undulating; Rspl better defined.

Within this clade, *Mongoliaeshna* has not the synapomorphies of the Austropetaliida Bechly et al., 2001, viz. pterostigmata secondarily shortened; pterostigmal brace vein not aligned with its basal side; IR1 very long; insertions of CuP-crossing and PsA on AA very close to each other; basal true lestine oblique vein reduced or completely suppressed; but it has several synapomorphies of the sister-group Panaeshnida Bechly et al., 2001, i.e. Rspl very well-defined (not zigzagged) in both pairs of wings; discoidal triangles divided into more than two cells.

The relationships of *Mongoliaeshna* within this clade are more delicate to establish. It shows strong similarities with both the Rudiaeschnidae Bechly et al., 2001 (*Rudiaeschna* Ren and Guo, 1996, *Fuxiaeschna* Lin et al., 2004), and the Progobiaeshnidae (*Progobiaeshna* and *Gobiaeshna*) (Bechly et al., 2001; Lin et al., 2004; Pritykina, 1997; Ren and Guo, 1996).

Affinities of *Mongoliaeshna* with the Cymatophlebiidae Handlirsch, 1906 are excluded for the veins IR2 and RP2 with very weak undulations. Affinities with the Paracymatophlebiidae Bechly et al., 2001 are also excluded for a similar reason plus the veins RP3/4 and MA only weakly undulating, and the absence of a distinct Mpsl. Affinities with the Euaeshnida Bechly, 1996 are also excluded for its RP2 and IR2 parallel, forewing subdiscoidal triangle not unicellular; distal side MAb of discoidal triangles not angled at all.

Temaeshna Zhang et al. is a Chinese Mesozoic genus of uncertain affinities that shares several characters with the Rudiaeschnidae and the Progobiaeshnidae (Zhang et al., 2008b). *Mongoliaeshna* differs from it in the narrower areas between IR2 and RP2 and between RP2 and RP1. *Telmaeshna* has also a very short pseudo-IR1 but this character is rather uncertain because the type wing is probably teratological in the wing apex.

In the Rudiaeschnidae, RP2 and IR2 are distally distinctly diverging, the basal gaff of CuA is rather prolonged, and Mpsl is present (even if rather rudimentary), which is not the case in *Mongoliaeshna* and *Progobiaeshna*. *Gobiaeshna* has also RP2 and IR2 closely parallel but its structures of Mpsl and gaff are unknown.

Mongoliaeshna has also several synapomorphies of the Progobiaeshnidae, viz. pterostigmal brace vein transverse, not oblique like basal side of pterostigma; pseudo-IR1 strongly reduced (very short and originating distinctly distal of pterostigma); several rows of cells between IR2 and Rspl which are more or less parallel; hindwing subdiscoidal triangle two-celled.

The present discovery of this third genus of Progobiaeshnidae confirms the high diversity of the the clade Aeshnoptera in central Asia during the Early Cretaceous. This family remains to be discovered in the European outcrops of similar ages (Wealdian of UK, Late Jurassic of Germany, Early Cretaceous of Spain), where the clade Aeshnoptera is very diverse (Bechly et al., 2001). Up to date we lack information to precise the palaeogeographic distribution of the various Mesozoic aeshnopteran families. As an example, the Cymatophlebiidae were only known from Europe but we recently discovered it in the Middle Jurassic of Inner Mongolia, China (Huang & Nel, pers. obs.).

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