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Description of a new species of *Nannogomphus* (Insecta: Odonata: Nannogomphidae) from the Upper Jurassic Solnhofen Limestone in Germany

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With 2 Figures

Summary

A new species of Nannogomphidae, *Nannogomphus buergeri* n. sp., is described from the Upper Jurassic Solnhofen Limestones of Germany. The diagnosis of the genus is amended with a list of autapomorphies.

Zusammenfassung

Eine neue Art der Nannogomphidae, *Nannogomphus buergeri* n. sp., wird aus den oberjurassischen Solnhofener Plattenkalken von Deutschland beschrieben. Die Diagnose der Gattung wird durch eine Liste der Autapomorphien ergänzt.

1. Introduction

The tiny dragonfly species, *Nannogomphus bavaricus* Handlirsch, 1906, from the Upper Jurassic Solnhofen Limestone was recently re-described by Bechly et al. (1996), who already indicated the presence of a putative new species (Bechly et al., 1996: 52). In this work I describe this new species of the genus *Nannogomphus*, based on a perfectly preserved specimen that shows more details than any specimen of this genus discovered before. Consequently, the generic diagnosis can be amended accordingly, and the phylogenetic position suggested by Bechly (2002) and Bechly & Ueda (2002) can be confirmed.

2. Methods

The drawings were made with a camera lucida and a binocular microscope, while the photo of the type specimen (Fig. 2) was made by directly scanning the fossil with

a flatbed scanner with a resolution of 1200 dpi. The nomenclature of the dragonfly wing venation is based on the interpretations of RIEK & KUKALOVÁ-PECK (1984), amended by NEL et al. (1993) and BECHLY (1996), and the phylogenetic classification of Odonata is based on BECHLY (1996, 2002). The systematic analysis is based on the principles of consequent Phylogenetic Systematics (sensu HENNIG, 1966, 1969, and BECHLY, 2000).

3. Systematic Palaeontology

Class Insecta LINNEAUS, 1758 (= Hexapoda LATREILLE, 1825)
Pterygota BRAUER, 1885
Order Odonata FABRICIUS, 1793
Suborder Anisoptera SELYS in SELYS & HAGEN, 1854
Nannogomphidae BECHLY, 1996

Genus *Nannogomphus* HANDLIRSCH, 1906

Type species: *Nannogomphus bavaricus* HANDLIRSCH, 1906, by original designation.

Autapomorphies. – Forewing Ax1 shifted basal of the level of the distal angle of the discoidal triangle; in both pairs of wings Ax1 and Ax2 are relatively close together with not more than one secondary antenodal crossvein between them; midfork of hind wing developed as a triadic branching into RP1/2, IR2, and RP3/4.

Phylogenetic position. – The phylogenetic position of *Nannogomphus* was recently discussed by BECHLY (1996, 2002) and BECHLY & UEDA (2002), who demonstrated that Nannogomphidae has a relatively basal position within Cavilabiata (= cordulegastroid and libelluloid dragonflies), as sistergroup of all Anisoptera with a so-called "libelluloid gap" (new taxon Paucipostnodalia BECHLY & UEDA, 2002). The characters of the new species described in this work are completely compatible with this phylogenetic position (e.g. the presence of a "cordulegastrid gap", an elongated gaff, and an enlarged anal loop, as well as the absence of a "libelluloid gap").

Nannogomphus buergeri n. sp.

Figs 1–2

Holotype: A perfectly preserved female specimen, no. SMNS 65225 (ex coll. BÜRGER), Staatliches Museum für Naturkunde Stuttgart, Germany.

Other material: According to BECHLY et al. (1996: 52) specimen no. 1983/2625 at the Jura-Museum in Eichstätt does also have more distinctly braced pterostigmata and less diverging RP1 and RP2, and thus could belong to this new species as well.

Derivation of name: After the original owner of the type specimen, Mr PETER BÜRGER (Bad Hersfeld), who kindly donated this important fossil from his private collection to SMNS.

Type locality: Eichstätt, southern Frankonian Alb, Bavaria, Germany.

Type horizon: Solnhofen Lithographic Limestone, Solnhofen Formation (Malm zeta 2b, "oberer Weißjura"), Hybonotum Zone, Upper Jurassic, Lower Tithonian.

Diagnosis. – The following differences to the re-description of the holotype of *Nannogomphus bavaricus* warrant the description of a new species: Pterostigmal brace more distinct but shifted slightly distal of basal margin of pterostigma; vein

pseudo-IR1 is more distinct; RP1 and RP2 less divergent; IR2 clearly originating on RP1/2 in forewing; forewing hypertriangle is not divided by a crossvein; arculus is less kinked, being rather straight; Ax1 and Ax2 more widely separated in forewing, and with a secondary antenodal in-between; CuAa with distinct posterior branches in both pairs of wings.

Description

A completely and very well preserved fossil dragonfly (female). Only the legs are not visible. The complete wing venation is traced by iron oxide dendrites.

Body: Total body length 42 mm; width of head 4.9 mm (eyes apparently not much separated); length of abdomen 30 mm; width of abdomen 1.6 mm.

Forewing: Length, 23.9 mm; width at nodus, 6.0 mm; distance from base to nodus, 12.6 mm (the nodus is situated in a relatively distal position at about 53 % of the wing length); distance from nodus to pterostigma, 6.6 mm; distance from base to arculus, 3.5 mm; Ax1 and Ax2 are aligned and stronger than the other antenodals (bracket-like); Ax1 is 0.8 mm basal of arculus and Ax2 is 2.8 mm distal of Ax1; a single non-aligned secondary antenodal crossvein between Ax1 and Ax2; distal of Ax2 there are 3 visible secondary antenodal crossveins between the costal margin and ScP, not aligned with the 5 corresponding secondary antenodals between ScP and RA; 3–4 antesubnodal crossveins in the middle of the antesubnodal area with a distinct gap near the arculus and a long "cordulegastrid gap" (sensu BECHLY, 1996) directly basal of the subnodus; 5 postnodal crossveins between nodus and pterostigma, non-aligned with the 5 corresponding postsubnodal crossveins; no "libelluloid gap" (sensu BECHLY 1996) of the postsubnodal crossveins directly distal of the subnodus; the pterostigma is 2.4 mm long and max. 0.8 mm wide; its distal side is much more oblique than its basal side; the pterostigma is distinctly braced and covers only one and a half cell; the pterostigmal brace vein is somewhat distally displaced, thus not exactly aligned with the basal margin of the pterostigma; arculus is closer to Ax1 and weakly kinked; bases of veins RP and MA (sectors of arculus) separated at the arculus; the hypertriangle is 3.1 mm long and max. 0.4 mm wide; the hypertriangle is free; discoidal triangle transverse and free; length of basal side of discoidal triangle, 1.4 mm; length of its costal side, 2.0 mm; length of its distal side MAb, 2.3 mm; MAb is straight; a well-defined pseudo-anal vein PsA (= AA0) delimits an unicellular subdiscoidal triangle (length, 1.7 mm; basal width, 1.3 mm; distal width, 0.2 mm); basal space free; cubital cell free (except for CuP-crossing and PsA); CuP-crossing is 1.1 mm basal of arculus; anal area max. 1.4 mm wide with two rows of cells; cubito-anal area max. 1.4 mm wide with 2–3 rows of cells; CuA with 4 posterior branches; subdiscoidal veinlet 0.2 mm long; MP ends only slightly distal of the level of the nodus; basal postdiscoidal area with two rows of cells; postdiscoidal area narrow (width near discoidal triangle, 1.7 mm; width at hind margin, 3.1 mm); no Mspl and no other intercalary veins in the postdiscoidal area; RP3/4 and MA are somewhat undulating, but parallel with only one row of cells between them, except distally were they diverge with 2–4 cells between them; first branching of RP (= midfork) 4.2 mm basal of subnodus (second branching of RP); IR2 originates on RP1/2; RP2 aligned with subnodus; only one lestine oblique vein 'O' between RP2 and IR2, 1.4 mm and one and a half cell distal of subnodus; a single bridge crossvein between RP2 and IR2 basal of subnodus; the basal area between RP3/4 and IR2 is very narrow up to the level of the nodus; RP2 and IR2 are divergent, with basally one row

off cells in-between, and distally 2–4 rows of cells in-between; no Rspl and no intercalary veins between IR2 and RP3/4; RP1 and RP2 basally parallel with only one row of cells between them, but near the pterostigma they become divergent with two rows of cells between them (even 4 cells at wing margin); pseudo-IR1 is well-defined and originates on RP1 distal of pterostigma; one row of cells between pseudo-IR1 and RP1, and two rows of cells between pseudo-IR1 and RP2.

Hind wing: Length, 23.0 mm; width at nodus, 7.8 mm; distance from base to nodus, 10.0 mm (the nodus is situated basal of midwing at about 43 % of the wing length); distance from nodus to pterostigma, 8.6 mm; distance from base to arculus, 3.2 mm; Ax1 and Ax2 are aligned and stronger than the other antenodals (bracket-like); Ax1 is 0.7 mm basal of arculus and Ax2 is 2.8 mm (right wing) or 3.1 mm (left wing) distal of Ax1; a single non-aligned secondary antenodal crossveins between Ax1 and Ax2; distal of Ax2 there are only two secondary antenodal crossveins between the costal margin and ScP that are strictly aligned with the corresponding two secondary antenodals between ScP and RA; only one (maybe 3) antesubnodal crossveins with a long "cordulegastrid gap" (sensu BECHLY, 1996) directly basal of the subnodus; 7 postnodal crossveins between nodus and pterostigma, non-aligned with the 5 corresponding postsubnodal crossveins; no "libelluloid gap" (sensu BECHLY, 1996) of the postsubnodal crossveins directly distal of the subnodus; the pterostigma is 2.0 mm long and max. 0.7 mm wide in the right wing, and 2.2 mm long and max. 0.8 mm wide in the left wing; its distal side is much more oblique than its basal side; the pterostigma is distinctly braced and covers only one and a half cell; the pterostigmal brace vein is slightly distally displaced, thus not exactly aligned with the basal margin of the pterostigma; arculus is closer to Ax1 and only weakly kinked; the bases of RP and MA (sectors of arculus) are separated at the arculus; the hypertriangle is 3.1 mm long and max. 0.5 mm wide; the hypertriangle is free; the discoidal triangle is free and more elongate than in the forewing; length of basal side of discoidal triangle, 1.5 mm; length of its costal side, 2.5 mm; length of its distal side MAb, 2.7 mm; MAb is straight; pseudo-anal vein PsA is less pronounced than in the forewing, and defining an unicellular subdiscoidal triangle (length, 1.2 mm; basal width, 1.1 mm; distal width, 0.2 mm); basal space free; cubital cell free (except for CuP-crossing, 1.3 mm basal of arculus); anal area max. 4.9 mm wide with 5 rows of cells; cubito-anal area max. 3.2 mm wide with 3–4 rows of cells; CuAa strongly curved and short with only 3 posterior branches (plus CuAb); subdiscoidal veinlet short (0.2 mm); gaff 1.6 mm long and slightly curved; anal loop well-defined, transversely elongate (length, 3.3 mm; width, 1.4 mm), divided into 4 cells; MP is strongly curved, ending slightly distal of level of nodus; the area between CuA and MP is basally somewhat wider than distally, but with only one row of cells except near the wing margin (2–4 cells); two rows of cells in the basal part of the postdiscoidal area; the postdiscoidal area is distally widened (width near discoidal triangle, 1.8 mm; width at hind margin, 3.6 mm); no Mspl and no intercalary veins in postdiscoidal area; RP3/4 and MA only slightly undulated and parallel with only one row of cells between them up to the hind margin; first branching of RP (= midfork) 3.5 mm basal of subnodus (second branching of RP); IR2 originates on RP1/2 very close to or even at the midfork, which therefore appears to be a triadic branching; RP2 aligned with subnodus; only one lestine oblique vein 'O' between RP2 and IR2, 1.8 mm and 2–2.5 cells distal of subnodus; a single bridge crossvein is visible between RP2 and IR2 basal of subnodus; RP2 and IR2 are divergent with one row of cells between

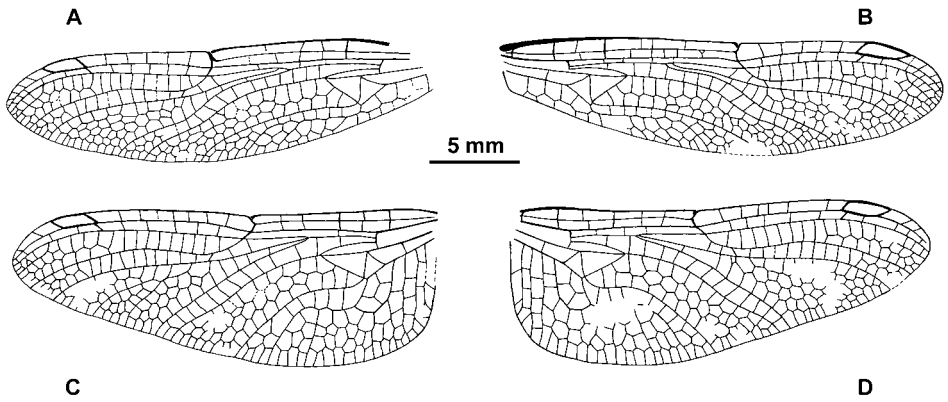

Fig. 1. *Nannogomphus buergeri* n. sp., female holotype specimen no. SMNS 65225 (ex coll. BÜRGER); A: right forewing from below; B: left forewing from below; C: right hind wing from below; D: left hind wing from below. Scale 5 mm.

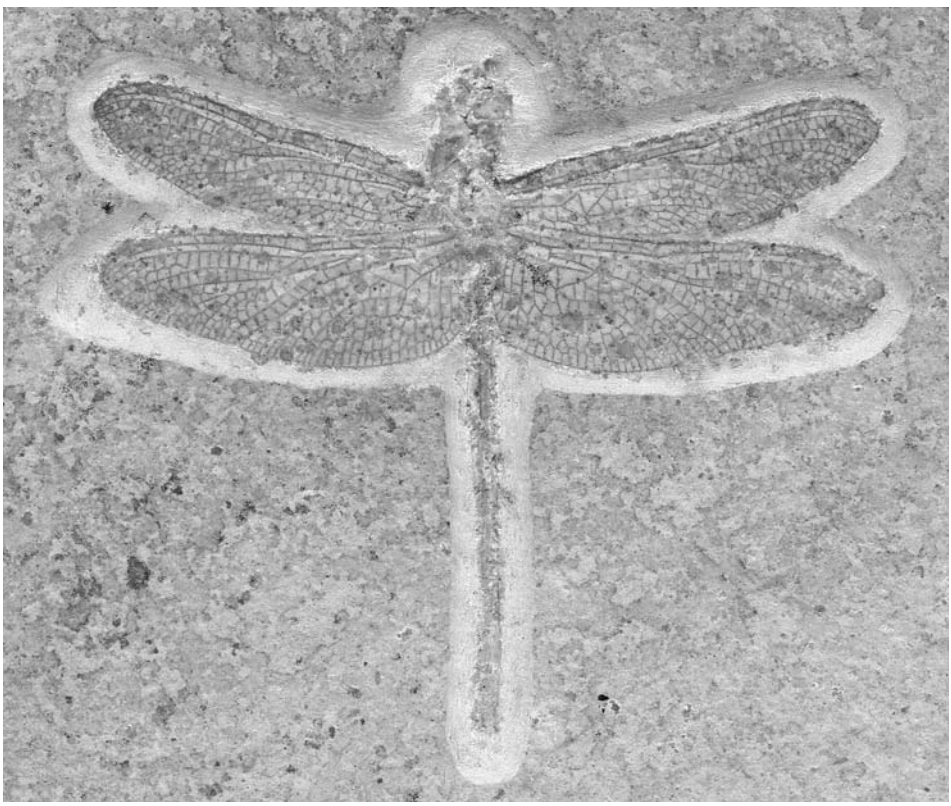

Fig. 2. *Nannogomphus buergeri* n. sp., female holotype specimen no. SMNS 65225 (ex coll. BÜRGER). Without scale.

them up to the level of pterostigma, but with 2–3 rows of cells between them more distally; no Rspl, but two intercalary veins originating on IR2; RP1 and RP2 basally parallel with only one row of cells between them, but near the pterostigma they become divergent with 2–3 rows of cells between them; pseudo-IR1 is well-defined and originates on RP1 distal of pterostigma; one row of cells between pseudo-IR1 and RP1 and two rows between pseudo-IR1 and RP2; at the anal wing margin there is neither an anal angle nor an anal triangle, thus it must be a female specimen; 3 posterior branches of anal vein between anal loop and basal wing margin; no membranule is visible.

4. Acknowledgements

I am most grateful to Mr P. Bürger (Bad Hersfeld) for the kind loan of the wonderful excellent type specimen of *Nannogomphus buergeri* n. sp. and its donation to SMNS, and to Dr G. Bloos (SMNS, Stuttgart) for his careful proof-reading of this manuscript.

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