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# A new species of *Stenophlebia* (Insecta: Odonata: Stenophlebiidae) from the Nusplingen Lithographic Limestone (Upper Jurassic, SW Germany)

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With 8 Figures

## Summary

A new dragonfly species, *Stenophlebia rolfhuggeri* n. sp. (Odonata: Stenophlebiidae), is described from the Nusplingen Lithographic Limestone in SW Germany. It is the fourth dragonfly species recorded from this Upper Jurassic fossil locality.

#### Zusammenfassung

Eine neue Libellenart, *Stenophlebia rolfhuggeri* n. sp. (Odonata: Stenophlebiidae), wird aus dem Nusplinger Plattenkalk von SW Deutschland beschrieben. Es handelt sich um die vierte Libellenart, die aus dieser oberjurassischen Fossilfundstelle nachgewiesen werden kann.

# 1. Introduction

The fossil dragonfly family Stenophlebiidae is only known from the Upper Jurassic and Lower Cretaceous of the Palaearctic region. FLECK et al. (submitted) describe two new families that are classified with Stenophlebiidae in Stenophlebioptera, but exclude Gondvanogomphidae from the latter group (contra BECHLY 1996). In Stenophlebiidae they describe three new genera, additional to *Stenophlebia* and *Sinostenophlebia* which is considered as an incertae sedis fossil dragonfly. The monophyly of the genus *Stenophlebia* relative to the other stenophlebiid genera is not yet well-established. Except *Stenophlebia* with 5–7 valid species (*S. lithographica* is an Odonata incertae sedis, and *S. corami* is only tentatively attributed to *Stenophlebia*), all other genera are monotypic. The enigmatic *Stenophlebia casta* from the Solnhofen limestone could recently be demonstrated to be no Stenophlebiidae at all, but a heterophlebioid close to Liassophlebiidae (BECHLY, in prep.). The Stenophlebioptera represents an interesting "anisozygopterid" taxon and belong with Pananisoptera to the taxon Trigonoptera that is characterized by the synapomorphic division of the discoidal cell into triangle and hypertriangle in both pairs of wings (BECHLY 1996, 2002; FLECK et al., submitted).

We here describe a new species of the genus *Stenophlebia* from the Upper Jurassic Lithographic Limestone of Nusplingen in SW Germany. It is only the 12<sup>th</sup> fossil insect from this locality, after six other dragonflies of the genera *Urogomphus*, *Aeschnidium*, and *Cymatophlebia* (SCHWEIGERT et al. 1996; BECHLY 1998; BECHLY et al. 2001; unpubl.), one bittacid wing fragment (BECHLY & SCHWEIGERT 2000), one pair of beetle elytrae (SCHWEIGERT & DIETL 2001), two more beetles and a wasp (discovered in 2002–2003 and still unpublished). Even though fossil insects are comparatively rare in this locality, this new fossil dragonfly already represents the second insect species which is only known from this locality (beside *Urogomphus nusplingensis* BECHLY, 1998), and therefore supports the assumption of a certain degree of insect endemism in the isolated areas of dry land during the Upper Jurassic of southern Germany.

For comparison purposes we also include two new figures (Figs. 7–8) of the best preserved specimen known of the very similar species *Stenophlebia amphitrite* from the Solnhofen limestone, also because it was designated as the type species of the genus *Stenophlebia* by NEL et al. (1993) and because its wing venation was never figured completely. The figured specimen was found in the vicinity of Eichstätt.

# 2. Material and methods

The drawings were made with a camera lucida on a Wild M5 binocular microscope. The nomenclature of the dragonfly wing venation is based on the interpretations of RIEK & KUKALOVA-PECK (1984), amended by NEL et al. (1993) and BECH-LY (1996). The used phylogenetic system is based on BECHLY (1996, 2002).

### 3. Systematic Palaeontology

# Class Insecta LINNAEUS, 1758 (= Hexapoda LATREILLE, 1825) Pterygota BRAUER, 1885 Order Odonata FABRICIUS, 1793 Epiproctophora BECHLY, 1996 Family Stenophlebiidae NEEDHAM, 1903

#### Genus Stenophlebia HAGEN, 1866

Type species: Stenophlebia amphitrite HAGEN, 1866.

Stenophlebia rolfhuggeri n. sp. Figs. 1–5

Holotype: Specimen no. SMNS 65217 at the Staatliches Museum für Naturkunde in Stuttgart (Germany). It is the only known specimen of this new species. This specimen was discovered during an excavation by SMNS on 5<sup>th</sup> July 2001 by one of the authors (G. S.), and was prepared by Mr M. RIETER (SMNS, Stuttgart).

Type locality: Nusplingen quarry (Fig. 6; property of Gesellschaft für Naturkunde in Württemberg), Westerberg/Großer Heuberg, "Gewann Taubenloch", SW Swabian Alb, Baden-Württemberg, Germany.

Type horizon: Upper Jurassic, Nusplingen Lithographic Limestone (bed C, 40–50 cm from base) (Late Kimmeridgian, Beckeri Zone, Ulmense Subzone).

Derivation of name: Named after Mr Rolf HUGGER (Albstadt-Onstmettingen), in recognition of his enormous help as volunteer co-worker during the now 10 years lasting excavations of SMNS in the Nusplingen Lithographic Limestone.

Diagnosis. – This new species can be distinguished from the other species of the same genus by the following characters: It is significantly larger than all other species except for *S. amphitrite*; it is slightly smaller than *S. amphitrite* but has a much more hypertrophied nodal vein cr which is longer and has about 4–5 crossveins beneath (even more than *S. eichstaettense*). From its size and wing venational features this new species seems to be "intermediate" between *S. amphitrite* and *S. eichstaettense*, probably being most closely related to the latter.

Systematic position. – This new species can be clearly attributed to Stenophlebiidae and the genus *Stenophlebia* because of the following characters: IR2 and RP3/4 arising close together, correlated with a very long and narrow bridge space; base of RP2 not strictly aligned with subnodus (maybe a plesiomorphy); cubito-anal field of hind wings reduced, thus both wings of similar shape; wings very



Fig. 1. *Stenophlebia rolfhuggeri* n. sp., holotype, SMNS 65217, counterplate, left forewing in dorsal aspect. Scale 10 mm.



Fig. 2. Stenophlebia rolfhuggeri n. sp., holotype, SMNS 65217, counterplate, right forewing in ventral aspect (twisted). Scale 10 mm.



Fig. 3. Stenophlebia rolfhuggeri n. sp., holotype, SMNS 65217, plate. Without scale.

long and slender; nodal and subnodal veinlet extremely oblique; stenophlebiid oblique vein between RP1 and RP2; discoidal triangles of unique and similar shape in both pairs of wings (transversely elongated, narrow, and strictly triangular, with a separated triangle and hypertriangle); numerous intercalary veins with a characteristical pattern, e.g. between MA and MP; pterostigmata very elongated and shifted basally.

Description. – It is a plate and counterplate of a completely preserved large dragonfly; the wing veins are partly traced by mangan-oxide dendrites. Nevertheless, the wings are not sufficiently well-preserved to warrant a drawing of the complete wing venation.

Body: The complete body with head, thorax, abdomen, all wings and 4 visible legs. Total body length, 91.0 mm. The abdomen is 71.0 mm long and 3.6 mm wide. The abdomen is distally not dilated, a short ovipositor is visible, and there seems to be no anal angle in the hind wings, thus it is clearly a female specimen. This is the



Fig. 4. Stenophlebia rolfhuggeri n. sp., holotype, SMNS 65217, counterplate. Without scale.

first specimen of the extinct family Stenophlebiidae that shows the ovipositor (Fig. 5). The ovipositor is preserved in ventral aspect, 4.0 mm long, and does hardly extend beyond the apex of the abdomen. No anal appendages are visible.

Forewing (Figs. 1–2): Length, 80.0 mm; width at nodus, 13.4 mm; distance from base to nodus, 36.8 mm (the nodus is situated at 46 % of the wing length); distance from nodus to pterostigma, 25.0 mm; distance from base to arculus, 6.9 mm; Ax1 and Ax2 are not clearly preserved; numerous visible secondary antenodal crossveins between the costal margin and ScP, not aligned with the corresponding secondary antenodals between ScP and RA; numerous postnodal crossveins between nodus and pterostigma, non-aligned with the corresponding postsubnodal crossveins; no "libelluloid gap" (sensu BECHLY 1996) of the postsubnodal crossveins directly distal of the subnodus; the pterostigma is 7.0 mm long and max. 1.1 mm wide; the pterostigmal brace vein is not preserved; the hypertriangle is divided by a single crossvein; discoidal triangle transverse and divided by two crossveins; MAb is straight; pseudo-



Fig. 5. Stenophlebia rolfhuggeri n. sp., holotype, SMNS 65217, counterplate, ovipositor (arrow). Without scale.

anal vein PsA (= AA0) not well-defined; basal space free; cubital cell divided by several crossveins; CuA with 5–6 posterior branches; MP ends distinctly basal of the level of the nodus; postdiscoidal area basally narrow but distally strongly widened; several intercalary veins in the postdiscoidal area; RP3/4 and MA are parallel with only one row of cells between them, except distally were they diverge; IR2 originates on RP1/2 close to the midfork; RP2 not strictly aligned with subnodus; the nodal vein cr is hypertrophied, 4.2–4.8 mm long, with about 4 crossveins beneath it; the subnodal veinlet is very oblique and elongate, with a single crossvein beneath it; the primary and secondary origins of RP2 are separated by 2–4 cells; lestine oblique vein 'O' absent or not preserved; bridge space very long and narrow; several bridge crossveins between RP2 and IR2 basal of subnodus. The rest of the wing venation is poorly preserved, but agrees with that of *S. amphitrite* as far as visible.

Hind wing: Length, 76.0 mm; width at nodus, 15.0 mm; the anal area is wider than in the forewing; at the anal wing margin there is no anal angle; the rest of the wing venation is poorly preserved, but agrees with that of *S. amphitrite* as far as visible.

# 4. Geological setting and age

The Upper Jurassic Nusplingen Lithographic Limestone is located in the southwestern part of the Swabian Alb, west of the village of Nusplingen. Since the middle of the 19<sup>th</sup> century it is famous for its exceptional preservation of fossils (pterosaurs, marine crocodiles, sharks etc.), similar to those of the Lithographic Limestones of Solnhofen and Eichstätt in Franconia, but unique in the Upper Jurassic in Swabia.



Fig. 6. Finding level of *Stenophlebia rolfhuggeri* n. sp. in the lithographic limestone unit C (arrow) at the eastern edge of the Nusplingen quarry. Note unconformity between unit C and overlying unit B.

Recently, the Nusplingen Lithographic Limestone is excavated by the State Museum of Natural History Stuttgart (SMNS) in two small quarries just for scientific interest. The Nusplingen Lithographic Limestone was deposited in 2 rather small but almost 100 m deep lagoonal basins surrounded by sponge/microbial bioherms, some of them probably elevated above sea level at the time of laminate deposition. The lithographic limestone section of the current excavation site in the Nusplingen quarry exhibits a total thickness of about 10 m, of which the upper half is actually exposed, the lower half is known from cores of a drilling. Several turbidite layers are developed throughout the basin and enable a correlation of the exposed sections and several nearby drillings (DIETL et al. 1998; BANTEL et al. 1999). Apart from the turbidites and few bioturbated layers in the lowermost part of the section, the limestones are finely laminated. The matrix of the laminates is rich in calcareous debris, besides other components like radiolaria, sponge spicules, and ossicles of the planktonic crinoid *Saccocoma* (BANTEL et al. 1999).

The ammonite fauna of the Nusplingen Lithographic Limestone is typical of the *hoelderi* faunal horizon, which is part of the Late Kimmeridgian (Beckeri Zone, middle Ulmense Subzone, see SCHWEIGERT 1998; SCHWEIGERT & ZEISS 1999). Comprehensive overviews on the rich flora and fauna of this fossil lagerstaette were recently presented by DIETL & SCHWEIGERT (1999, 2001).



Fig. 7. Stenophlebia amphitrite, specimen no. 4D in coll. D. KUMPEL (Wuppertal) that will be inherited to the Jura Museum in Eichstätt. Scale 10 mm.

# 5. Lithology and fossil content of the beds containing the finding level

The upper parts of the Nusplingen Lithographic Limestone section in the Nusplingen quarry are only poorly known from the new excavations. In larger areas these beds are eroded or have been already quarried in the last centuries. Within bed C, that contains the finding level of the new dragonfly, several small turbidites and few thin marly layers are intercalated. The thickness of this unit is very inconstant (30–60 cm) over short lateral distances, because it has been capped by submarine erosion during a dramatic event, when the surrounding sponge/microbial bioherms collapsed and slumped into the lagoon deforming pre-lithified laminates. The boundary between units C and B is formed by a marked unconformity (Fig. 6). At its present top, unit C is abruptly followed by the allochthonous unit B in which the original stratification of the laminates is strongly disturbed, showing folding, boudinage, lateral compression, and repetition by stapling.

Hitherto, only few square metres of unit C could be observed during the recent excavations, so that it is impossible to give a reliable statistical analysis of its fossil content or distribution. The ammonite fauna of these beds yields several records of exotic Tethyan elements, like *Taramelliceras* and *Hybonoticeras* besides the more common genera *Metahaploceras*, *Silicisphinctes*, *Sutneria*, *Physodoceras*, and *Ochetoceras*. In contrast to many other parts of the section, unit C lacks any endobenthic ichnofossils. Benthic organisms are always allochthonous, like small oysters which were often found as overgrowth on ammonites that have sunk down to the sea floor, and which are also attached to the thorax of *S. rolfhuggeri*. The planktonic crinoid *Saccocoma* is common and well preserved on several bedding plains, together with *Lumbricaria* and other coprolites. Additionally, the fauna of the lithographic limestone unit C is characterised by a relative abundance of teuthoid squids (*Trachyteuthis*) and various fishes, whereas decapods are very rare. Remains of land



Fig. 8. Stenophlebia amphitrite, specimen no. 4D in coll. D. KUMPEL (Wuppertal) that will be inherited to the Jura Museum in Eichstätt. Scale as indicated by the scale bar.

plants (conifers, pteridosperms) are also quite common and found to be much more diverse than in the lower part of the section. The reason for this may be an enlargement of the islands in the surroundings of the Nusplingen lagoon by accumulation of calcareous debris in the shallow areas around the islands or a shallowing trend in general. Other land-derived fossils which were recorded from unit C are a fossil beetle, a recently discovered wasp, and a geophilomorph centipede (SCHWEIGERT & DIETL 1997, 2001). The exact bedding plain that yielded the new dragonfly described herein was excavated over approximately 5 m<sup>2</sup>. However, no other fossil was found on this surface apart from a few fish scales.

# 6. Acknowledgements

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#### 7. References

- BANTEL, G., SCHWEIGERT, G., NOSE, M. & SCHULZ, H.-M. (1999): Mikrofazies, Mikro- und Nannofossilien aus dem Nusplinger Plattenkalk (Ober-Kimmeridgium, Schwäbische Alb). – Stuttgarter Beiträge zur Naturkunde, Serie B, **279**: 1–55.
- BECHLY, G. (1996): Morphologische Untersuchungen am Flügelgeäder der rezenten Libellen und deren Stammgruppenvertreter (Insecta; Pterygota; Odonata), unter besonderer Berücksichtigung der Phylogenetischen Systematik und des Grundplanes der \*Odonata. – Petalura, special volume, 2: 1–402.
- BECHLY, G. (1998): A revision of the fossil dragonfly genus Urogomphus, with description of a new species (Insecta: Odonata: Pananisoptera: Aeschnidiidae). – Stuttgarter Beiträge zur Naturkunde, Serie B, 270: 1–47.

- BECHLY, G. (2002): Phylogenetic Systematics of Odonata. Website on the Internet (URL: http://www.bechly.de/anisozyg.htm).
- BECHLY, G. (in prep.): A re-description of *Stenophlebia casta* (Odonata: Stenophlebiidae) from the Upper Jurassic Solnhofen Limestone (Germany). – Stuttgarter Beiträge zur Naturkunde, Serie B.
- BECHLY, G., NEL, A., MARTÍNEZ-DELCLOS, X., JARZEMBOWSKI, E. A., CORAM, R., MARTILL, D., FLECK, G., ESCUILLIÉ, F., WISSHAK, M. M. &. MAISCH, M. (2001): A revision and phylogenetic study of Mesozoic Aeschnoptera, with description of numerous new taxa (Insecta: Odonata: Anisoptera). – Neue paläontologische Abhandlungen, 4: 1–219.
- BECHLY, G. & SCHWEIGERT, G. (2000): The first fossil hanging flies (Insecta: Mecoptera: Raptipedia: Cimbrophlebiidae and Bittacidae) from the Limestones of Solnhofen and Nusplingen (Upper Jurassic, Germany). – Stuttgarter Beiträge zur Naturkunde, Serie B, 287: 1–18.
- DIETL, G. & SCHWEIGERT, G. (1999): Nusplinger Plattenkalk. Eine tropische Lagune der Jura-Zeit. – Stuttgarter Beiträge zur Naturkunde, Serie C, 45: 1–64; Stuttgart.
- DIETL, G. & SCHWEIGERT, G. (2001): Im Reich der Meerengel Fossilien aus dem Nusplinger Plattenkalk. 144 pp., 209 figs.; München (Pfeil).
- DIETL, G., SCHWEIGERT, G., FRANZ, M. & GEVER, M. (1998): Profile des Nusplinger Plattenkalks (Oberjura, Schwäbische Alb). – Stuttgarter Beiträge zur Naturkunde, Serie B, 265: 1–37.
- FLECK, G., BECHLY, G., MARTÍNEZ-DELCLOS, X., JARZEMBOWSKI, E. A., CORAM, R. & NEL, A. (submitted): Phylogeny and classification of the Stenophlebioptera. (Insecta, Odonata, Epiproctophora). – Annales de la Societé entomologique de France.
- NEL, A., MARTÍNEZ-DELCLOS, X., PAICHELER, J.-C. & HENROTAY, M. (1993): Les "Anisozygoptera" fossiles. Phylogénie et classification. (Odonata). – Martinia, numéro horssérie, 3: 1–311.
- RIEK, E. F. & KUKALOVA-PECK, J. (1984): A new interpretation of dragonfly wing venation based upon early Carboniferous fossils from Argentina (Insecta: Odonatoidea) and basic character states in pterygote wings. – Canadian Journal of Zoology, 62: 1150–1166.
- SCHWEIGERT, G. (1998): Die Ammonitenfauna des Nusplinger Plattenkalks (Ober-Kimmeridgium, Beckeri-Zone, Ulmense-Subzone, Schwäbische Alb). – Stuttgarter Beiträge zur Naturkunde, Serie B, 267: 1–61.
- SCHWEIGERT, G., DIETL, G., KAPITZKE, M., RIETER, M. & HUGGER, R. (1996): Libellen aus dem Nusplinger Plattenkalk (Oberjura, Ober-Kimmeridgium, Baden-Württemberg). – Stuttgarter Beiträge zur Naturkunde, Serie B, 236: 1–12.
- SCHWEIGERT, G. & DIETL, G. (1997): Ein fossiler Hundertfüßler (Chilopoda, Geophilida) aus dem Nusplinger Plattenkalk (Oberjura, Südwestdeutschland). – Stuttgarter Beiträge zur Naturkunde, Serie B, **254**: 1–11.
- SCHWEIGERT, G. & DIETL, G. (2001): Erstnachweis eines K\u00e4fers im Nusplinger Plattenkalk (Oberjura, Schw\u00e4bische Alb). – Jahreshefte der Gesellschaft f\u00fcr Naturkunde in W\u00fcrt temberg, 157: 117–120.
- SCHWEIGERT, G. & ZEISS, A. (1999): Lithacoceras ulmense (OPPEL) (Ammonitina) eine wichtige Leitart des Ober-Kimmeridgiums. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, 211: 49–73.

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