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1 The first amber stenophlebiid damsel-dragonfly (Odonata, Epiproctophora,  
2 Stenophlebiidae) from mid-Cretaceous amber of northern Myanmar

3

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12

13 ABSTRACT

14 *Burmastenophlebia flecki* gen. et sp. nov., first stenophlebiid damsel-dragonfly in mid-  
15 Cretaceous Burmese amber is described and illustrated. It allows to show structures proper to  
16 this family, previously unknown. In particular, the subnodus is enforced by a dorsal chitinous  
17 bracket and the nodal furrow is very weak, suggesting that the stenophlebiid nodal complex is  
18 very particular and did not functioned as in other Odonata.

19

20 *Keywords:* Insecta; Odonata; Stenophlebiidae; Burmese amber; gen. et sp. nov.

21

## 22 **1. Introduction**

23 Burmese amber is currently the most important source of knowledge on the insects from the  
24 mid-Cretaceous. It is especially the case for the Odonata (for a catalogue of described inclusions  
25 in this amber see Ross, 2018). The Zygoptera clearly dominate this assemblage, probably in

26 part because of their smaller sizes and lower capacities to escape the fresh resin than the larger  
27 and stronger Anisoptera. Few more ‘basal’ Epiproctophora (former ‘Anisozygoptera’ or  
28 damsel-dragonflies are also recorded, viz. the Epiophlebioidea Burmaphlebiidae (Bechly and  
29 Poinar, 2013). The discovery of any new taxon of this clade in this amber is of interest because  
30 they can give new characters not observable in the numerous Mesozoic Epiproctophora  
31 preserved as compression fossils. Among these, the Stenophlebioptera are especially important  
32 because they are currently considered as the sister group of the Pananisoptera (Bechly, 2016),  
33 but up to now no fossil stenophlebioid in amber has been recorded. This clade is strictly  
34 Mesozoic but it was clearly widespread in the Jurassic of Europe and Asia, and the Lower  
35 Cretaceous of Europe, Asia, and Brazil. Here we describe the first Stenophlebiidae from the  
36 mid-Cretaceous Burmese amber. Although incomplete, the fossil shows some wing structures  
37 that were unknown.

38

## 39 **2. Material and methods**

40 The amber containing the damselfly was collected in the Hukawng Valley (26° 29’ N, 96° 35’  
41 E) of Kachin Province, Myanmar (locality in Kania et al., 2015: fig. 1). The re-deposition age  
42 of Burmese amber was considered to be  $98.79 \pm 0.62$  Ma (Shi et al., 2012), but palynology and  
43 an ammonite from the amber-bearing layers suggest a late Albian age (Cruickshank and Ko,  
44 2003) which we adopt herein. The amber containing the damselfly is yellow and transparent.  
45 The individual shows a nearly complete fore wing (basal section missing) and fragments of a  
46 hind wing, of thorax, a complete fore leg, a nearly complete middle leg, and two incomplete  
47 hind legs. Photographs were taken using a Zeiss Discovery V20 microscope system.  
48 Photomicrographs with a green or red backgrounds were taken using fluorescence as a light  
49 source attached to the Zeiss Axio Imager 2 light microscope. Six small neuropterans, two  
50 beetles, one dipteran, one psocopteran wing, and one spider co-occurred with this damsel-

51 dragonfly. The specimen is housed in the Nanjing Institute of Geology and Palaeontology,  
52 Chinese Academy of Sciences, China. All taxonomic acts established in the present work have  
53 been registered in Zoo-Bank (see below), together with the electronic publication LSID: xxxx  
54 We follow the wing venation nomenclature of Riek and Kukalová-Peck (1984), amended by  
55 Nel et al. (1993) and Bechly (1996). The higher classification of fossil and extant Odonatoptera,  
56 as well as familial and generic characters followed in the present work are based on the  
57 phylogenetic system proposed by Bechly (1996, 2016) and Fleck et al. (2003) for the revision  
58 of the Stenophlebioptera. Abbreviations for wing venation are as follow: IR = intercalary radial  
59 vein; MA = media anterior; MP = media posterior; N = nodus; Cr = nodal crossing; Pt =  
60 pterostigma; RP = radius posterior; ScP = subcostal posterior; Sn = subnodus.

61

### 62 **3. Systematic Palaeontology**

63 Order Odonata Fabricius, 1793

64 Infraclass Stenophlebioptera Bechly, 1996

65 Superfamily Stenophlebioidea Pritykina, 1968

66 Family Stenophlebiidae Needham, 1903

67

68 Genus *Burmastenophlebia* gen. nov.

69 (urn:lsid:zoobank.org:act:E656B6E7-3F01-46E5-9165-64A0DB80BC08)

70 Type species: *Burmastenophlebia flecki* sp. nov.

71 *Etymology*. Named after Burma, ancient name for Myanmar, and *Stenophlebia*.

72 *Diagnosis*. Wing venation characters only. No secondary longitudinal vein just basal of base of  
73 RP2, between RP1/2 and IR2; pterostigma covering two cells and a half, nodal Cr receiving  
74 one postnodal crossvein and one antenodal crossvein, subnodus receiving no antesubnodal  
75 crossveins; IR1 basally quite straight; three antenodal crossveins of first row between nodus

76 and level of base of RP3/4; a straight Mspl; a straight supplementary longitudinal vein of  
77 postdiscoidal space.

78

79 ***Burmastenophlebia flecki* sp. nov.**

80 (urn:lsid:zoobank.org:act:128A9528-0465-45BE-8E94-6AA989E5CFE3)

81 Fig. 1

82 *Diagnosis.* Ratio length/width of pterostigma = 5; wing 5.7 mm wide, rather small.

83 *Burmastenophlebia flecki* is among the smallest Stenophlebiidae, its wing dimensions being  
84 comparable to those of *Gallostenophlebia incompleta* Nel et al., 2015.

85 *Etymology.* Named after Dr. Günther Fleck, for his numerous contributions to Odonatology.

86 *Holotype.* NIGP168834, Nanjing Institute of Geology and Paleontology, Chinese Academy of  
87 Sciences, China.

88 *Locality and Horizon.* Hukawng Valley, Kachin Province, Myanmar; late Albian, late Lower  
89 Cretaceous.

90 *Description.* Four legs (two hind legs are incomplete), a fragment of the base of the abdomen  
91 and posterior part of thorax and two incomplete wings with base missing; three pair of legs very  
92 similar in shape and size; fore coxae rather small, trochanter thin, femora (3.0 mm long) slightly  
93 longer than tibia, almost straight, slightly protruding at median section, armed with two series  
94 of moderately long, asymmetric ventral spines, spines of one side obviously larger than those  
95 of the other side, sizes of spines increasing from basal section to middle and posterior sections,  
96 several long spines alternatively arranged with short spines in distal third; tibia (2.9 mm long)  
97 armed with two series of spines, nearly symmetrical, spines of median section larger than basal  
98 and distal spines, long spines and short spines alternatively arranged in one side only; tarsi (0.7  
99 mm long) three-segmented, armed with two series of spines, each tarsomere armed with two  
100 spines in one side, the basal one distinctly smaller than distal one, first tarsomere short and

101 oblique apically, third tarsomere longer than second one; tarsal claws moderately large, curved  
102 and sharp, with a tiny tooth near apex; middle femora (4.0 mm long) distinctly longer than tibia,  
103 clearly protruding at median section, long and short ventral spines alternatively arranged in  
104 basal section, long spines rather sparse in middle and distal sections, characters of tibia and tarsi  
105 similar to those of fore legs, middle tibia (2.7 mm long) slightly shorter than fore tibia, middle  
106 tarsi 0.7 mm long; hind femora (5.0 mm long) nearly straight, distinct longer than middle  
107 femora, two series of spines nearly symmetrical, long and short ventral spines alternatively  
108 arranged, longest spines in middle section, rather sparse in distal section; the basal two  
109 abdominal segments are preserved, no trace of secondary genital structures on segment 2; length  
110 of preserved part of wing 22.6 mm; wing ca. 30-33 mm long, width 5.7 mm; pterostigma 2.5  
111 mm long, 0.5 mm wide; covering two cells and a half; pterostigmal ornamentation apparently  
112 wrinkled-like (*sensu* Bechly, 1996); basal side of pterostigma with a crossvein ending in it, and  
113 much more oblique than distal side; no pterostigmal brace; a vein *Msp1* and a long secondary  
114 longitudinal convex vein in postdiscoidal area beginning near or on *MAB*; vein *ScP* clearly  
115 fused with costal margin; nodal furrow very weak; nearly no interruption of costal margin; vein  
116 *Cr* very oblique and directly aligned with general trend of *ScP*; one postnodal crossvein and  
117 one antenodal crossvein of second row reaching *Cr*; subnodus (*Sn*) very oblique and aligned  
118 with *Cr*, with no crossvein reaching it; base of *RP2* slightly distal to *Sn*; no secondary  
119 longitudinal ‘stenophlebiid veinlet’ between *RP1+2* and *IR2* below subnodus; antenodal area  
120 only partly preserved; primary antenodal cross-vein *Ax1* and *Ax2* not preserved, 10 secondaries  
121 between *C* and *ScP* not aligned with the 10 preserved antenodal crossveins of second row  
122 between *ScP* and *RA*; 20 postnodal crossveins, not aligned with the 15 postsubnodals; bases of  
123 *RP3/4* and *IR2* close together, between nodus and arculus, probably closer to nodus (only three  
124 cells basal to nodus) than to arculus; a very long and narrow bridge space; oblique vein “O”  
125 absent; *IR1* well defined, straight and proximally parallel to *RA*; numerous secondary

126 longitudinal veins between the main veins; all longitudinal veins curved near posterior wing  
127 margin; veins with fine and short spines.

#### 128 **4. Discussion**

129 This fossil is attributable to the Stenophlebiidae because of the following  
130 synapomorphies (Fleck et al., 2003): IR2 and RP3/4 arising close together; a very long and  
131 narrow bridge space; a long and not zigzagged (or slightly zigzagged) secondary longitudinal  
132 convex vein in postdiscoidal area, parallel to MP, its base being close to discoidal triangle; a  
133 long and not zigzagged concave Mspl; wings elongate and slender; nodal veinlet extremely  
134 oblique and very long; nodal furrow reduced; numerous intercalary veins with a characteristic  
135 pattern between MA and MP (described in Fleck et al., 2003); presence of numerous antenodal  
136 crossveins distal of Ax2.

137 The Stenophlebioptera Bechly, 1996 comprise some other families: affinities with the  
138 Liassostenophlebiidae Fleck et al., 2003 are excluded because of the absence of the oblique  
139 vein 'O', the long pterostigma, the long and straight IR1, and the long convex secondary  
140 longitudinal vein in postdiscoidal area. The presence of numerous secondary antenodal  
141 crossveins of first row distal of Ax2, the long nodal Cr and subnodus exclude affinities with the  
142 Prostenophlebiidae Fleck et al., 2003. Bechly (1996, 2016) included the Gondwanogomphidae  
143 Bechly, 1996 in the Stenophlebioptera, but Fleck et al. (2003) discussed this hypothesis and  
144 considered it as weakly supported. *Burmastenophlebia* gen. nov. is definitely not related to  
145 *Gondwanogomphus* Schlüter and Hartung, 1982.

146 Among the Stenophlebiidae, *Burmastenophlebia* differs from *Yixianstenophlebia* Nel and  
147 Huang, 2015, *Stenophlebia* Hagen, 1866, *Hispanostenophlebia* Fleck et al., 2003,  
148 *Sinostenophlebia* Hong, 1984, and *Gallostenophlebia* Nel et al., 2015 in the absence of a  
149 secondary longitudinal vein just basal of base of RP2, between RP1/2 and IR2 (Fleck et al.,  
150 2003; Bechly et al., 2003; Nel et al., 2015; Nel and Huang, 2015; Zheng et al., 2016a,b).

151 *Cretastenophlebia* Fleck et al., 2003 and *Mesostenophlebia* Fleck et al., 2003 also lack this  
152 secondary longitudinal vein. The pterostigmata of *Cratostenophlebia* and *Cretastenophlebia*  
153 cover much more cells than in *Burmastenophlebia*, their nodal Cr receive several antenodal and  
154 postnodal crossveins, their subnodus receive two antesubnodal crossveins, and the IR1 of  
155 *Cretastenophlebia* is basally zigzagged instead of being quite straight in *Burmastenophlebia*  
156 (Fleck et al., 2003; Bechly, 2007; Zheng et al., 2018). *Mesostenophlebia* has 11 antenodal  
157 crossveins of first row between the nodus and the level of the base of RP3/4, instead of only  
158 three in *Burmastenophlebia* (Fleck et al., 2003). *Burmastenophlebia* is difficult to compare to  
159 *Liaostenophlebia* Zheng et al., 2016 because there are very few comparable preserved parts  
160 (*Burmastenophlebia* is known by distal wing structures, while *Liaostenophlebia* is known by  
161 basal structures). Nevertheless, *Burmastenophlebia* has straight Mspl and supplementary  
162 longitudinal vein of postdiscoidal space while these veins are slightly zigzagged in  
163 *Liaostenophlebia* (Zheng et al., 2016a).

164

## 165 **5. Concluding remarks**

166 This fossil is the first amber record of the clade Stenophlebioptera. Thus it is of interest for  
167 some morphological structures not discernable in compression fossils. In particular, the  
168 subnodus of *Burmastenophlebia* is enforced by a dorsal chitinous bracket and the nodal furrow  
169 is very weak, suggesting that the stenophlebiid nodal complex is very particular and did not  
170 functioned as in other Odonata. Possibly the nodus of *Burmastenophlebia* could not be bent as  
171 in modern Libellulidae (Fauziyah et al., 2014), and the nodal Cr and subnodus had a more  
172 important function in the strengthening of the whole nodal complex than in other Odonata.

173 *Burmastenophlebia* has long ‘L spines’ on the main veins and crossveins in dorsal view but no  
174 ‘S spine’ is visible on the veins. The spines of the costal edge are looking like those of an  
175 Anisoptera Petaluridae, viz. long scale-like structures separated by indentations of the margin

176 (see Bechly, 1996: 303, fig. 54). This character would support the current attribution of the  
177 Stenophlebioptera as sister-group of the Pananisoptera (Bechly, 2016).

178 The Stenophlebiidae were clearly widespread during the Lower Cretaceous, as they have been  
179 found in Brazil, Europe, and Central Asia. The region of Myanmar was probably an island  
180 during the mid-Cretaceous, period of deposition of the Burmese amber (Rasnitsyn and Öhm-  
181 Kühnle, 2018). This island separated from the Gondwana during the Lower Cretaceous. This is  
182 congruent with the presence of the Stenophlebiidae in the central part of Gondwana (Brazil)  
183 during the Aptian. The Stenophlebiidae were probably present also in Africa at that time but  
184 they remain to be found. The whole clade was no longer recorded after the Cenomanian.

185

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190

## 191 **References**

192 Bechly, G., 1996. Morphologische Untersuchungen am Flügelgeäder der rezenten Libellen und  
193 deren Stammgruppenvertreter (Insecta; Pterygota; Odonata), unter besonderer  
194 Berücksichtigung der Phylogenetischen Systematik und des Grundplanes der Odonata. *Petalura*  
195 Special Volume 2, 1-402.

196 Bechly, G., 2007. Chapter 11.5 Odonata: damselflies and dragonflies. pp. 184-222. *In*: Martill,  
197 D., Bechly, G., Loveridge, R., (eds). *The Crato fossil beds of Brazil: Window into an ancient*  
198 *world*. Cambridge University Press, Cambridge: 624 pp.

199 Bechly, G. 2016. Phylogenetic systematics of Odonata. - homepage on Internet site:  
200 <https://bechly.lima-city.de/phylosys.htm>

201 Bechly, G., Dietl, G., Schweigert, G., 2003. A new species of *Stenophlebia* (Insecta: Odonata:  
202 Stenophlebiidae) from the Nusplingen Lithographic Limestone (Upper Jurassic, SW Germany).  
203 Stuttgarter Beiträge zur Naturkunde (B) 338, 1-10.

204 Bechly, G., Poinar, G.O.Jr., 2013. *Burmaphlebia reifi* gen. et sp. nov., the first anisozygopteran  
205 damsel-dragonfly (Odonata: Epiophlebioptera: Burmaphlebiidae fam. nov.) from Early  
206 Cretaceous Burmese amber. Historical Biology, an International Journal of Paleobiology 25,  
207 233-237.

208 Cruickshank, R.D., Ko, K., 2003. Geology of an amber locality in the Hukawng Valley,  
209 northern Myanmar. Journal of Asian Earth Sciences 21, 441-455.

210 Fauziyah, S., Alam, C., Soesilohadi, R.C.H., Retnoaji, B., Alam, P., 2014. Morphological and  
211 mechanical characterisation of the hindwing nodus from the Libellulidae family of dragonfly  
212 (Indonesia). Arthropod Structure & Development 43, 415-422.

213 Fleck, G., Bechly, G., Martínez-Delclòs, X., Jarzembowski, E.A., Coram, R., Nel, A., 2003.  
214 Phylogeny and classification of the Stenophlebioptera (Odonata, Eiproctophora). Annales de  
215 la Société Entomologique de France (N.S.) 39, 55-93.

216 Kania, I., Wang, B., Szwed, J., 2015. *Dicranoptycha* Osten Sacken, 1860 (Diptera,  
217 Limoniidae) from the earliest Upper Cretaceous Burmese amber. Cretaceous Research 52, 522-  
218 530.

219 Nel, A., Fleck, G., Garcia, G., Gomez, B., Ferchaud, P., Valentin, X., 2015. New dragonflies  
220 from the lower Cenomanian of France enlighten the timing of the odonatan turnover at the Early  
221 - Late Cretaceous boundary. Cretaceous Research 52, 108-117.

222 Nel, A., Huang, Di-ying, 2015. A new genus and species of damsel-dragonfly (Odonata:  
223 Stenophlebiidae) from the Lower Cretaceous of Inner Mongolia, China. Cretaceous Research  
224 56, 421-425.

225 Nel, A., Martínez-Delclòs, X., Paicheler, J.-C., Henrotay, M., 1993. Les ‘Anisozygoptera’  
226 fossiles. Phylogénie et classification (Odonata). *Martinia* Numéro Hors Série 3, 1-311.

227 Rasnitsyn, A.P., Öhm-Kühnle, C., 2018. Three new female *Aptenoperissus* from mid-  
228 Cretaceous Burmese amber (Hymenoptera, Stephanoidea, Aptenoperissidae): unexpected  
229 diversity of paradoxical wasps suggests insular features of source biome. *Cretaceous Research*  
230 91, 168-175.

231 Riek, E.F., Kukalová-Peck, J., 1984. A new interpretation of dragonfly wing venation based  
232 upon Early Carboniferous fossils from Argentina (Insecta: Odonatoidea) and basic characters  
233 states in pterygote wings. *Canadian Journal of Zoology* 62, 1150-1166.

234 Ross, A.J. 2018. Burmese (Myanmar) amber taxa, on-line checklist v.2017.4

235 Shi, G., Grimaldi, D.A., Harlow, G.E., Wang, J., Wang, J., Wang, M., Lei, W., Li, Q., Li, X.,  
236 2012. Age constraint on Burmese amber based on U-Pb dating of zircons. *Cretaceous Research*  
237 37, 155-163.

238 Zheng, Daran, Nel, A., Wang, Bo, Jarzembowski, E.A., Chang, Su-Chin, Zhang, Haichun,  
239 2016a. The first Early Cretaceous damselfly (Odonata: Stenophlebiidae: *Stenophlebia*)  
240 from western Liaoning, China. *Cretaceous Research* 61, 124-128.

241 Zheng, Daran, Wang, He, Jarzembowski, E.A., Wang, Bo, Chang, Su-Chin, Zhang, Haichun,  
242 2016b. New data on Early Cretaceous odonates (Stenophlebiidae, Aeschnidiidae) from  
243 northern China. *Cretaceous Research* 67, 59-65.

244 Zheng, Daran, Zhang, Haichun, Wang, Bo, Chang, Su-Chin, 2018. A new species of damselfly  
245 dragonfly (Odonata: Stenophlebiidae: *Cretastenophlebia*) from the Lower Cretaceous of the  
246 Jiuquan Basin, northwestern China. *Earth and Environmental Science Transactions of the*  
247 *Royal Society of Edinburgh* 107, 185-189.

248

249 Fig. 1. *Burmastenophlebia flecki* gen. et sp. nov. Holotype NIGP168834. a, general view of  
250 wing; b, mid part of wing; c, pterostigmal region; d, wing base, legs and body fragments; e,  
251 general view of amber piece, f, middle tarsi with arrow indicating the joints under fluorescence  
252 light; g, detail of nodus under fluorescence light; h, pterostigma under fluorescence light. Scale  
253 bars = 2.0 mm (a, e), 1 mm (b, c, d), 0.5 mm (g, h), 0.2 mm (f).

