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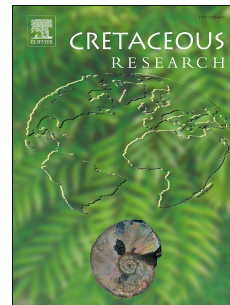
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New genera *Buserphites* and *Mesoserphites* (Hymenoptera: Serphitidae) from mid-Cretaceous amber of Myanmar.

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1 **New genera *Buserphites* and *Mesoserphites* (Hymenoptera: Serphitidae) from mid-**  
2 **Cretaceous amber of Myanmar.**

3

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13

14 **Abstract**

15 Two new genera, *Buserphites* and *Mesoserphites*, belonging to the subfamily Serphitinae  
16 (Serphitidae, Hymenoptera) are described from Burmese mid-Cretaceous amber. Two new  
17 species are erected within *Buserphites* n. gen.: *B. applanatus*, and *B. myanmarensis*, and five  
18 new species are established within *Mesoserphites* n. gen.: *M. annulus*, *M. giganteus*, *M. engeli*,  
19 *M. scutatus*, and *M. viraneacapitis*. These taxa show that the family Serphitidae was highly  
20 diverse in Burmese amber, adding substantially to recent discoveries within the endemic  
21 subfamily Supraserphitinae Rasnitsyn and Ölm-Kühnle. The presence of multiple serphitid  
22 genera in Burmese amber that are unknown from other amber deposits adds support to the idea  
23 that the Western Burma Block supported a fauna with multiple endemic groups as it approached  
24 contact with mainland Asia in the latest Albian or earliest Cenomanian. Despite the growing  
25 number of species recognized from Burmese amber, most of the newly described taxa are  
26 represented by very few specimens, suggesting that we are still within the early stages of  
27 documenting the fauna, or that the collections from this region represent a broader range of time  
28 and habitats than originally thought.

29

30 **Keywords:** Burmese amber; Serphitoidea; taxonomy; Albian-Cenomanian; Mesozoic.

31

## 32 **1. Introduction**

33 The Serphitidae Brues, 1937 are a small family of extinct parasitic wasps that have been assigned  
34 to the clade Bipetiolarida Engel (2005) based on the distinctive arrangement of two petiolar  
35 segments observed in its members (see Rasnitsyn and Ölm-Kühnle, 2019b for alternative  
36 systematic interpretation). The first member of Serphitidae described was *Serphites paradoxus*  
37 Brues, 1937, and the taxon was recognized as part of its own unique family at the time of its  
38 initial description. Although recognition at the family level has varied over time (e.g., Kozlov  
39 and Rasnitsyn, 1979), this small family was widespread during the Cretaceous, ranging from the  
40 Barremian to Campanian through a series several deposits: Serphitidae are known from  
41 Lebanese, Spanish, French, Siberian, Burmese, and Canadian Cretaceous amber (Brues, 1937;  
42 Kozlov and Rasnitsyn, 1979; Engel *et al.*, 2011; McKellar and Engel, 2011; Ortega-Blanco *et al.*,  
43 2011; Engel and Perrichot, 2014; Rasnitsyn and Ölm-Kühnle 2019a, 2019b, 2020a, 2020b).  
44 Currently, the family comprises only three subfamilies, each with a few genera: Serphitinae  
45 Brues, 1937, Microserphitinae Engel, 2015, and Supraserphitinae Rasnitsyn and Ölm-Kühnle,  
46 2018. The Serphitidae in Burmese amber have not been studied in detail until recently, with the  
47 last three years seeing new research by Rasnitsyn and Ölm-Kühnle (2019a, 2019b, 2020a,  
48 2020b) that has resulted in the description of five new species based on unique female  
49 specimens, and the creation of a new subfamily, Supraserphitinae, to accommodate some of  
50 these taxa. These taxa have presented characteristics of both Serphitidae and Archaeoserphitidae  
51 Engel, 2015, leading the authors to question the distinction between the families recognized  
52 within Serphitoidea Brues, 1937; however, these hypotheses remain to be tested through cladistic  
53 analyses. The presence of *Serphites* Brues, 1937 within the deposit has also been mentioned in

54 previous work on Burmese amber serphitids, but these specimens are currently undescribed  
55 (Rasnitsyn and Ölm-Kühnle, 2020b).

56 Mid-Cretaceous Burmese amber is now ranked among the richest deposits of amber,  
57 including considerable faunal and floral biodiversity, and it provides one of the best snapshots of  
58 terrestrial conditions in the Mesozoic. A particularly diverse arthropod assemblage has been  
59 described from the deposit, especially within the orders Hymenoptera, Coleoptera, and Diptera  
60 (e.g., Grimaldi *et al.*, 2002; Ross *et al.*, 2010; Ross, 2019, 2020). The deposit has also been the  
61 source of marginal marine inclusions like ammonites and ostracods (Xing *et al.*, 2018; Yu *et al.*,  
62 2019), and taxa that are seldom preserved in Cretaceous resin, such as vertebrates and gastropods  
63 (e.g., Daza *et al.*, 2016; Xing *et al.*, 2016, 2019).

64 Among the serphitoid wasps, all observations indicate that the seven new species described  
65 herein belong the subfamily Serphitinae. The taxonomic features that distinguish this subfamily  
66 from others have been described at length by Engel (2015) and include possessing antennae with  
67 6 to 8 flagellomeres. This low flagellar article count is a readily apparent characteristic of all  
68 Serphitinae, and it is shared by *Microserphites* Kozlov and Rasnitsyn, 1979 (the sole member of  
69 Microserphitinae). However, the Microserphitinae can be distinguished from Serphitinae, based  
70 on the former group possessing a pronotum that does not reach the tegula, and an indistinct  
71 pterostigma. Supraserphitinae have been described from Burmese amber, and are known  
72 exclusively from female specimens, but all available material demonstrates 10 flagellar articles.  
73 The family Archaeoserphitidae differs in that its members have 12 flagellomeres, a pronotum  
74 reaching the tegula, and a distinct pterostigma. The member of Archaeoserphitidae that was  
75 recently described from Burmese amber (i.e., *Archaeoserphites engeli* Rasnitsyn and Ölm-  
76 Kühnle, 2020a) differs from the type species of the genus and in many details of the generic

77 diagnosis, beyond the extent of sexual dimorphism observed elsewhere in the Serphitoidea,  
78 perhaps warranting the erection of additional taxa within the deposit.

79 Among the Serphitinae, the specimens described herein belong in two new genera:  
80 *Buserphites* and *Mesoserphites*. The new genus *Buserphites* can be distinguished from  
81 previously described Serphitidae based on the presence of an elongate petiolar segment (first  
82 segment is more than three times the length of the second). Meanwhile the new taxon  
83 *Mesoserphites* presents an intermingling of characteristics that have been previously attributed to  
84 the genera *Serphites* and *Aoserphites* Kozlov and Rasnitsyn, 1979. Relationships among the  
85 previously described genera of Serphitinae (*Aoserphites*, *Serphites*, and *Jubaserphites* McKellar  
86 and Engel, 2011) have not been assessed through cladistic analyses because of the low taxon  
87 sampling density that is currently available. However, it is hoped that continued work on  
88 Burmese amber exemplars will provide sufficient material to analyze Serphitidae in detail, and to  
89 assess the extent of faunal overlap or endemism that occurs in the Cretaceous deposits where  
90 they occur.

91

## 92 **2. Material and methods**

93 The insect inclusions in this study come from 13 specimens of mid-Cretaceous Burmese amber.  
94 Seven of these specimens come from the Royal Saskatchewan Museum collection (RSM,  
95 RSKM\_P specimen numbers, Regina, SK, Canada) and contain individual serphitids, with the  
96 exception of RSKM\_P3306.30, which has 3 syninclusions belonging to two different species.  
97 Five additional specimens belong to the American Museum of Natural History (AMNH,  
98 AMNH\_Bu specimen numbers, New-York, NY, USA). All fossil inclusions are commercial  
99 specimens collected in the Hukawng Valley, in Myanmar's Kachin state (Grimaldi *et al.*, 2002;

100 Cruickshank and Ko, 2003; Ross *et al.*, 2010; Li *et al.*, 2018). Radiometric dates ( $^{206}\text{Pb}/^{238}\text{U}$ )  
101 obtained from zircons attached to amber pieces in this mining region have established a date for  
102 the rocks surrounding the Burmese amber deposit that is  $98 \pm 0.62$  Ma, or latest Albian to  
103 earliest Cenomanian (Shi *et al.*, 2012); however, the amber deposit may represent a broader  
104 window of time around this time estimate (e.g., Smith and Ross, 2018, Yu *et al.*, 2019).

105 Amber specimens were polished to create ideal anatomical views of inclusions, and  
106 whenever necessary, specimens were supported by vacuum-injection with epoxy prior to  
107 polishing (following the technique of Nascimbene and Silverstein, 2000). Specimen photographs  
108 were taken with a Canon EOS 7D camera and EF 65 mm macro lens mounted on a Visionary  
109 Digital imaging station. The resulting series of photos taken at different levels were combined  
110 with Helicon Focus software to increase depth of field. Specimen observations were made using  
111 a Leica MZ 12.5 stereomicroscope, and an Olympus CH30 compound microscope was used for  
112 supplementary observations. All measurements were obtained with an ocular micrometre and are  
113 expressed in millimetres in the text. Whenever possible, general measurements were taken in  
114 lateral view to account for curvature of the body, and more precise measurements were taken by  
115 mounting the amber specimen in wax to obtain whatever orientation was required to create an  
116 accurate measurement.

117 The morphological descriptions are based on articles previously published on the  
118 superfamily Serphitoidea, as well as the larger-scale work of Goulet and Huber (1993). Harris  
119 (1979) is used to describe surface sculpturing, and our use of venation terminology is explained  
120 in Figure 1. Anatomical abbreviations include: ba., basitarsus; cx., coxa; fe., femur; fla.,  
121 flagellomeres; mlt., lateral marge between tergites and sternites; msp., mesopleuron; mst.,  
122 mesoscutum; mstl., mesoscutellum; mtn., metanotum; oce., ocellus; OD, ocellar diameter; ped.,



123 pedicel; ppd., propodeum; pro., pronotum; sca., scape; ster., sternite; ta., tarsus; ter., tergite; ti.,  
 124 tibia; tr., trochanter; ver., vertex. Where males and females have been attributed to the same  
 125 species without direct associations (syninclusions), a section at the end of the description details  
 126 differences found in the males.

127

### 128 **3. Identification key to genera of Serphitinae**

129 The key to the genera of Serphitidae is modified from the works of Kozlov and Rasnitsyn  
 130 (1979), Ortega-Blanco *et al.* (2011), and McKellar and Engel (2011) in order to cover recent  
 131 developments within the subfamily Serphitinae. Members of the subfamily Supraserphitinae are  
 132 readily distinguished by their 10 flagellar articles, and are diagnosed in the works of Rasnitsyn  
 133 and Ölm-Kühnle (2019a, 2019b, 2020b).

134

135 1. Flagellum with six articles; vertex with elongate, erect setae [Campanian; Canadian  
 136 amber] .....

137 *Jubaserphites*

138 -- Flagellum with more than six articles; vertex with short, inclined setae, or bare .....

139 2

140

141 2. Pronotum not reaching tegula; pterostigma indistinct, represented by diffuse fuscous area  
 142 at apex of Sc + R; tergum with first three tergites of similar lengths [Albian–Santonian;  
 143 Spanish, Siberian amber, and Burmese amber (pers. obs.)] .....

144 *Microserphites*

- 145 -- Pronotum reaching tegula; pterostigma distinct and sclerotized; tergum with first three  
 146 tergites of different lengths.....
- 147 3
- 148
- 149 3. Mesoscutellum slightly convex or straight; first petiolar segment length more than three  
 150 times that of second petiolar segment [Albian-Cenomanian, Burmese amber]  
 151 ..... *Buserphites* **gen. n.**
- 152 -- Mesoscutellum convex or highly convex; first petiolar segment length three times or less  
 153 than that of second petiolar segment ..... 4
- 154
- 155 4. First petiolar segment length two or more times that of second petiolar segment; male  
 156 antenna clubbed; lateral ocellus nearly touching or touching compound eye margin (most  
 157 species), or, if ocellus widely separated, first petiolar segment nearly three times as long  
 158 as second segment (*Serphites kuzminae*) [Albian–Santonian; Spanish, New Jersey,  
 159 Canadian, Siberian, and Burmese amber (pers. obs.)]  
 160 ..... *Serphites*
- 161 -- First petiolar segment length less than twice that of second petiolar segment; male  
 162 antenna not clavate; lateral ocellus not touching margin of compound eye  
 163 ..... 5
- 164 5. Lateral ocellus nearly touching compound eye margin, separated by less than one-half  
 165 ocellar diameter; clypeus dorsoventral length significantly shorter than lateral width;  
 166 antennae arising near ventral margin of compound eye [Albian-Cenomanian, Burmese

167 amber] ..... *Mesoserphites* **gen.**

168 **n.**

169 -- Lateral ocellus separated from compound eye margin by one-half ocellar diameter or  
 170 more; clypeus length similar to width; antennae arise just below mid-height of compound  
 171 eye [Albian–Santonian; Spanish, Siberian amber, and Burmese amber (pers. obs.)] ....

172 ..... *Aposerphites*

173

#### 174 **4. Systematic palaeontology**

175

176 Superfamily Serphitoidea Brues, 1937

177 Family Serphitidae Brues, 1937

178 Subfamily Serphitinae Brues 1937

179

180 Genus *Buserphites* **n. gen.**

181 (urn:lsid:zoobank.org:act:62611C21-654D-4E76-AC29-8FE28FC7523D)

182

183 *Diagnosis.* Flagellum with 7 or 8 flagellar articles; first flagellar article shortest, and flagellum  
 184 broadest near midlength; lateral ocellus separated from compound eye by more than 0.5 OD  
 185 (nearly touching in *Serphites*, and *Mesoserphites* n. gen.); antennae insert near anteroventral  
 186 margin of compound eye; mandibles strongly curved, protuberant when closed; hind wing with  
 187 2Rs reaching 2M; mesoscutellum slightly convex or straight; first petiolar segment length more  
 188 than three times that of second petiolar segment; second petiolar segment nearly cylindrical and  
 189 with faint longitudinal striations.

190 *Etymology.* The new genus name is a combination of the Latin adjective *bu-* meaning “large,  
191 huge, great”, which refers to the proportion between the first petiolar segment length and the  
192 second segment, combined with *-serphites*, a common suffix for Serphitidae, based on the type  
193 species; the name is masculine.

194 *Type species.* *Buserphites applanatus* **gen. et sp. n.**

195 *Included species.* Two species in Albian-Cenomanian Burmese amber: *B. applanatus* **gen. et sp.**  
196 **n.**, and *B. myanmarensis* **gen. et sp. n.**

197 *Remarks.* If members of this genus attained very small body sizes (with reduced venation), they  
198 may be difficult to distinguish from species of *Microserphites*.

199

200

201 ***Buserphites applanatus*** gen. et sp. n.

202 (urn:lsid:zoobank.org:act:F2928524-EDDF-46BB-8519-A3321326F9B2)

203 *Material examined.* Holotype AMNH\_Bu-1512 (female). Polished amber piece including  
204 support epoxy, one of three amber pieces cut from larger amber sample, with dimensions of 11.6  
205 mm x 5.2 mm x 2.7 mm; amber is yellow with flow lines and with high particulate content.

206 *Etymology.* New species name refers to mesosoma-shape, using the Latin adjective *applanatus*,  
207 which means “flattened”.

208 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, near Tanai Village (on Ledo Road  
209 105 km NW of Myitkyna), Myanmar, Upper Cretaceous.

210

211 *Diagnosis.* New species is generally similar to other species of *Buserphites* (*B. myanmarensis*),  
212 but differs in following combination of characters: compound eye occupying approximately one-

213 half of head in lateral view; ocelli almost forming equilateral triangle (possibility affected by  
214 antero-posterior taphonomic head compression); lateral ocelli separated from compound eye  
215 margin by 1 OD, ovate; antennae with 8 flagellomeres (in female); scape somewhat globose, not  
216 reaching vertex, and approximately 2.7 times longer than its greatest width; mandibles deeply  
217 divided, with elongate, pointed teeth; right mandible with 3 teeth, middle tooth shortest, ventral  
218 tooth longer and thinner than others, and with broad base; left mandible with 2 teeth, slender  
219 throughout lengths, with ventral tooth significantly longer than dorsal tooth; transition between  
220 dorsal surface and declivity on propodeum rounded, convex; forewing with nebulous C and  
221 highly sclerotized pterostigma; pterostigma with globose, triangular posterior expansion of  
222 fuscous area adjacent to r-rs and Rs veins; Sc+R not contacting 1Rs; 1Rs forming bulbous  
223 prestigmal expansion, not truncated before contact with pterostigma; M+Cu broad and fuscous  
224 apically, becoming spectral; 1m-cu as wide as Cu, width extending, after reaching 2M; 3M  
225 relatively straight; Cu shorter than combined 1M and 1Rs, and terminates in CuP; vein A with  
226 distal portions slender, spectral, bearing row of thickened, long, inclined microtrichia; hind wing  
227 with only anterior vein visible (Sc+R); metasoma with gaster as long as mesosoma; first petiolar  
228 segment about 3.2 times length of second segment.

229

230 *Description.* Total body length ~1.86 mm; mesosoma ~0.68 mm in length; forewing ~0.94 mm  
231 long and ~0.43 mm wide; hind wing ~0.68 mm long, ~0.34 mm wide; metasoma ~0.73 mm long;  
232 gaster ~0.50 mm long (Fig. 2).

233 Head: appears wider than long, but is taphonomically compressed; compound eye with rounded  
234 margins and apparently globose (also taphonomically compressed), bearing numerous erect, fine  
235 setae; gena gently inflated, bearing numerous semi-erect, fine setae; median ocellus slightly

236 larger than lateral ocellus (greater in diameter), and separated from lateral ocellus by 1 OD;  
237 lateral ocellus ovate, and separated from compound eye by 1 OD; antenna with 8 flagellar  
238 articles that are weakly clavate and broadest near midlength of flagellum; antennae compressed  
239 antero-posteriorly; flagellar articles approximately: 18, 32, 43, 47, 47, 51, 49, and 56  $\mu\text{m}$  in  
240 length; scape approximately 85  $\mu\text{m}$  long and 32  $\mu\text{m}$  wide; pedicel approximately 55  $\mu\text{m}$  long;  
241 first flagellar article semi-clavate and shortest; subsequent flagellar articles flattened and club-  
242 shaped; apical flagellar article longest and terminating in rounded point; pedicel clavate and  
243 relatively short, narrower than flagellar articles. Maxillary palpus nearly as long as mandible,  
244 terminating in long, slender palpomere; labial palpus apparently 3-segmented, with terminal  
245 palpomere spear-shaped, highly inflated, and with acute point.

246 Mesosoma: dorsoventrally compressed, dark and without clear surface structure visible;  
247 mesoscutum with punctuate surface structure, and without notauli visible; mesoscutellum  
248 flattened, sunken compared to mesoscutum; propodeum moderately convex, apparently with  
249 foveolate-rugulose surface structure.

250 Wings: orientation and curvature of wings renders observation difficult. Forewing with  
251 pterostigma shaped like equilateral triangle, with half of anterior margin more deeply pigmented;  
252 pterostigma with convex anterior margin (vein R), slightly concave basal margin (1r-rs), and  
253 nearly straight apical margin (2r-rs); R fuscous; nebulous 2Rs extending adbasally from  
254 pterostigma, forming long prestigmal expansion, and apparently reaching 2M; 3Rs nebulous,  
255 extending apically from pterostigma, short, relatively straight, and reaching near wing apex; 1R  
256 tubular, fuscous, not extending beyond pterostigma; nebulous C and tubular Sc+R, both equal in  
257 width, veins nearly straight, and separated by wide costal cell; costal cell base and apex equal in  
258 width, little more than two times width of C vein; Sc+R and C complete to base of wing; tubular,

259 curved M, equal to Sc+R in width; Sc+R tubular, not fusing apically with bulbous 1Rs; M+Cu  
260 contacting Sc+R midway through its length; 2M thinner basally than apically, reaching wing  
261 margin apically and reaching 2Rs basally; 2M with straight basal section; Cu equal to 1M in  
262 width, and terminating in CuA; CuA tubular, slender, highly curved posteriad basally  
263 (withinapical one-third of posterior wing margin), straight and reaching posterior wing margin  
264 apically. Vein A with distal portions slender, spectral, and bearing row of thicker, long, inclined  
265 microtrichia.

266 Legs: slightly compressed, long; base of legs covered by inclined setae; trochanters extremely  
267 short, especially protochanter, which superficially appears absent; profemur comparatively long,  
268 metafemur slightly shorter than others and significantly broader; tibiae very long; tibial spur  
269 formula 1-2-2, with protibial spur curved, fine, and long, while meso- and metatibial spurs are  
270 relatively straight and slightly shorter; basitarsus shorter than cumulative length of other  
271 tarsomeres; tarsomeres I and IV longer than II and III, and III is shortest tarsomere; pretarsus  
272 long, with short and simple claws.

273 Metasoma: with combined length of petiolar segments slightly less than two-thirds of gastral  
274 length; first petiolar segment markedly long, cylindrical; surface of first petiolar segment with  
275 numerous, prominent, longitudinal carinae separated by fossulate sulci; second petiolar segment  
276 broader than first petiolar segment, but with surface details difficult to observe, apparently  
277 cylindrical with faint longitudinal striations; gaster compressed ventrodorsally, dark and without  
278 clear surface structure visible; gaster ovate in dorsal view; tergum with six apparent tergites, with  
279 first tergite longer than second, and bearing fine punctures and minute, inclined setae; first three  
280 tergites comprise less than half of gastral length; sternum with four apparent sternites, with first  
281 sternite longer than second; lateral margins between tergites and sternites appear to have well-

282 developed laterotergites, visible as bulbous carina with five segments. Female genitalia with  
283 paramere clavate, apex moderately expanded.

284

285

286 *Buserphites myanmarensis* gen. et sp. n.

287 (urn:lsid:zoobank.org:act:4141CD5B-1A6C-4A9C-B99E-6708C144BA73)

288

289 *Material examined.* Holotype RSKM\_P3306.61 (probable female). Polished amber piece  
290 including support epoxy, with dimensions of 8.6 mm x 7.9 mm x 4.7 mm; amber is orange with  
291 multiple, darkly oxidized flow lines.

292 *Etymology.* Species name refers to country of origin, Myanmar.

293 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost  
294 Cenomanian.

295

296 *Diagnosis.* New species similar to other species of *Buserphites*, but differs in following  
297 combination of characters: compound eye occupying approximately one-third of head in lateral  
298 view; ocelli forming isosceles triangle; lateral ocelli separated from compound eye margin by 0.5  
299 OD, ovate, canted posterolaterally, and separated by 4 OD from median ocellus; antennae  
300 (female) with 7 flagellomeres; scape approximately four times longer than its greatest width;  
301 mandibles deeply divided, with pointed, stout, elongate, and highly curved teeth, and bearing  
302 relatively long setae on both outer and inner surfaces of teeth; right mandible apparently bears  
303 three teeth, with dorsal and middle teeth diminutive, and ventral tooth most prominent, long and  
304 slender; left mandible appears to have two teeth and narrow base; mesosoma with transcutellar



305 furrow bearing two broad foveae medially, and with finer punctures laterally; transition between  
306 dorsal surface and declivity on propodeum marked by strong lateral protuberance; forewing with  
307 pterostigma weakly sclerotized and tubular C vein; pterostigma with wide, long, tubular posterior  
308 expansion of fuscous area adjacent to r-rs crossvein and Rs vein; Sc+R contacting 1Rs and  
309 forming bulbous prestigmal expansion, slightly truncated before contact with pterostigma; M+Cu  
310 spectral; 1m-cu may be present, but spectral; 3M sinuous; Cu length equal to that of 1M and 1Rs  
311 combined; Cu not terminating in CuP; vein A apparently absent; legs with trochanters long and  
312 globose, with two longitudinal carinae; basitarsus slightly shorter than cumulative length of other  
313 tarsomeres; metasoma with gaster slightly longer than mesosoma; first petiolar segment  
314 comparatively long, about 3.4 times length of second segment; first tergite extending ventrally,  
315 partially enclosing second petiolar segment.

316  
317 *Description.* Total body length ~1.97 mm; mesosoma ~0.70 mm in length; forewing ~1.21 mm  
318 long, and ~0.30 mm wide; hind wing ~0.42 mm long, and ~0.10 mm wide; metasoma ~1.09 mm  
319 in length; gaster ~0.75 mm long (Fig. 3).

320 Head: wider than long; compound eye teardrop-shaped, slightly globose posteriorly, with  
321 relatively straight margin adjacent to gena, and bearing numerous, erect, fine setae; gena  
322 flattened, with areolate-rugulose surface structure; frons straight, and not sunken relative to  
323 compound eyes; vertex mounded between lateral ocelli with few punctations; median ocellus  
324 same size as lateral ocellus, and separated from lateral ocellus by 3 OD; antenna 9-segmented,  
325 and weakly clavate; scape approximately 136  $\mu\text{m}$  long and 33  $\mu\text{m}$  wide, scape length  
326 approximately four times its greatest width; pedicel approximately 67  $\mu\text{m}$  long, pear-shaped, and  
327 slightly longer than third flagellar article; flagellar articles with flattened posterior edge, and

328 measuring approximately: 50, 55, 64, 61, 59, 61, and 90  $\mu\text{m}$  in length; first flagellar article semi-  
329 clavate and shortest; second flagellar article clavate; subsequent flagellar articles chalice-like and  
330 equant; apical flagellar article elongate, and terminating in acute point. Maxillary palpus  
331 apparently shorter than mandible, four-segmented, and geniculate between second and third  
332 palpomeres, terminal palpomere longest, with acute point.

333 Mesosoma: with pronotum steeply sloping anteriorly, almost concealed by mesoscutum in dorsal  
334 view, and with tiny foveate surface structure; mesoscutum highly convex, shield-shaped, with  
335 lateral margins angular, with tiny foveate surface structure, and with notauli; notauli broad,  
336 shallow, and difficult to observe, apparently with curved line of fovea in sulcus; notauli  
337 converging posteriorly, forming broad V-shape, which is pointed near anterior margin of  
338 mesoscutellum; mesoscutellum flattened, sunken compared to mesoscutum, with areolate-  
339 rugulose surface structure anteriorly and foveate-reticulate posteriorly, with fine carina  
340 separating mesoscutellum from propodeum; metanotum present as very fine lip posterior to  
341 mesoscutellum; propodeum slightly convex, situated well ventral to metanotum, with broad  
342 foveate surface structure, and with strong posteriorly sloping declivity.

343 Wings: difficult to observe due to orientation and curvature. Forewing with pterostigma shaped  
344 like equilateral triangle, with weakly sclerotized and slightly concave basal margin (1r-rs),  
345 convex anterior margin (R), slightly concave basal margin (1r-rs), and nearly straight apical  
346 margin (2r-rs); pterostigma with wide, long, tubular, posterior expansion of fuscous area adjacent  
347 to r-rs and Rs veins; 2Rs extending adbasally from pterostigma, forming slender, long expansion,  
348 and apparently reaching 2M; 3Rs extending apically from pterostigma, slightly curved (convex  
349 anteriorly), short, and nearly reaching wing anterior margin apically; 1R tubular, fuscous, not  
350 extending beyond pterostigma; tubular C and tubular Sc+R, both equal in width and nearly

351 straight, separated by wide costal cell; costal cell base and apex equal in width, slightly more  
352 than two times width of C vein; Sc+R and C extending basally to reach wing margin; 1M  
353 tubular, equal to Sc+R in width, relatively straight; M+Cu contacting Sc+R midway through its  
354 length; Cu equal to 1M+1Rs in width, and terminating in CuA; CuA tubular, slender, slightly  
355 curved posteriad basally, straight apically, and reaching posterior wing margin apically. Hind  
356 wing difficult to observe; basal wing with anterior (probable Sc+R) and posterior (probable A)  
357 vein, but both appear to fade quickly adapically.

358 Legs: covered by numerous, inclined, fine, short setae; mesocoxa ovate, and metacoxa elongate  
359 with strong longitudinal depression in basal half of ventral surface; pro- and meso-trochanter  
360 slightly bell-shaped while metatrochanter ovate with protuberance in middle; femora short, and  
361 broad, especially in apical area, which is laterally compressed; tarsi longer than corresponding  
362 femora; all tibiae flared apically; pro- and mesotibiae laterally compressed, metatibia swollen  
363 apically; protibia with two carinae extending longitudinally along dorsal surface; protibia with  
364 single apical spur that is straight and as long as tibial apex is wide; mesotibia with two apical  
365 spurs, anterior spur length approximately equal to apical tibial width, posterior spur  
366 approximately double this length; metatibia with two short, robust spurs that appear to be shorter  
367 than apical width of metatibia; pro- and metabasitarsus slightly shorter than cumulative length of  
368 other tarsomeres, while mesobasitarsus shorter than cumulative length of other tarsomeres;  
369 tarsomeres I and IV longer than II and III, and III is shortest tarsomere

370 Metasoma: with combined length of petiolar segments slightly less than two-thirds of gastral  
371 length; first petiolar segment comparatively shorter, about 3.4 times length of second; first  
372 petiolar segment with fine longitudinal carinae, and expanded posteriorly, with concave ventral  
373 margin; second petiolar segment, difficult to observe, apparently cylindrical with faint

374 longitudinal striations, segment may be slightly inset into dorsal margin of first petiolar segment;  
375 gaster in dorsal view teardrop-shaped, and in lateral view it appears slightly flattened dorsally  
376 and convex ventrally; tergum with six apparent segments, with second tergite longest, and first  
377 tergite extensively overlapping second petiolar segment (forming hood-like cover), with patch of  
378 foveate integument; other tergites with punctured surface structure, and second tergite with  
379 transverse row of fovea along posterior margin; sternum with four apparent (visible) segments,  
380 with second sternite longest; lateral margin between tergites and sternites apparently separated  
381 by carina that extends posteriorly from lateral margins of tergite 1. Genitalia not everted, but  
382 apex of ovipositor visible; very short ovipositor sheath appears to be protruding from distal end  
383 of metasoma (probable female specimen).

384

385

386 **Genus *Mesoserphites*** n. gen.

387 (urn:lsid:zoobank.org:act:0B5A649F-9A39-465E-BEC9-71FA4023FE59)

388

389 *Etymology.* The new genus name is a combination of the Latin adjective *meso* meaning “middle”  
390 refers to the mixture of characters between the genera *Serphites* and *Aposerphites*, combined  
391 with *-serphites* a common suffix for Serphitidae; the name is masculine.

392 *Diagnosis.* Lateral ocellus nearly touching or touching compound eye margin; clypeus inclined  
393 and dorsoventrally short; antennae insert near anteroventral margin of compound eye; mandibles  
394 overlap when closed, non-protuberant; pronotum reaching tegula and pterostigma distinct; first  
395 petiolar segment less than 2 times length of second segment; gaster with different lengths  
396 between first three terga, which cover more than half of gastral length.

397 *Type species. Mesoserphites annulus gen. et sp. n.*

398 *Included species.* Five new species in Burmese Albian-Cenomanian amber described herein: *M.*

399 *viraneacapitis, M. engeli, M. giganteus, M. annulus, and M. scutatus.*

400

401 Key to species of *Mesoserphites n. gen.*

402

403 1. Head slightly longer than wide; first petiolar segment length less than 1.5 times length of  
 404 second petiolar segment; first petiolar segment rimmed anteriorly; first petiolar segment  
 405 with ring-like expansion posteriorly; first petiolar segment without hamulus  
 406 anterodorsally [Albian-Cenomanian, Myanmar] ..... *M.*  
 407 *viraneacapitis n. sp.*

408 -- Head as long as wide, or wider than long; first petiolar segment length more than 1.5  
 409 times that of second petiolar segment; first petiolar segment not rimmed anteriorly; first  
 410 petiolar segment without ring-shaped posterior expansion; first petiolar segment with  
 411 hamulus ..... anterodorsally  
 412 ..... 2

413

414 2. Gaster longer than mesosoma; second petiolar segment with broad hook-like projection  
 415 posteroventrally; sulcus near transscutal line shallow and weakly developed [Albian-  
 416 Cenomanian, Myanmar] ..... *M. engeli n.*  
 417 *sp.*

418 -- Gaster shorter than mesosoma; second petiolar segment without broad hook-like  
 419 projection posteroventrally; sulcus along transscutal line broad and well-developed  
 420 ..... 3

- 421
- 422 3. Tarsi slightly shorter than corresponding femora; total body length more than 3 mm;
- 423 second petiolar segment without ring-like expansion posteriorly [Albian-Cenomanian,
- 424 Myanmar] ..... *M.*
- 425 *giganteus* **n. sp.**
- 426 -- Tarsi as long as or longer than corresponding femora; total body length less than 2.5 mm;
- 427 second petiolar segment with ring-like expansion posteriorly .....
- 428 4
- 429
- 430 4. Mesocoxa with two central longitudinal carinae on lateral surface; second petiolar
- 431 segment cylindrical with broad ring-like expansion posteriorly; total body length less
- 432 than 1 mm [Albian-Cenomanian, Myanmar] ..... *M.*
- 433 *annulus* **n. sp.**
- 434 -- Mesocoxa without two central longitudinal carinae on lateral surface; second petiolar
- 435 segment cylindrical with narrow collar posteriorly; total body length less than 2 mm
- 436 [Albian-Cenomanian, Myanmar] ..... *M. scutatus* **n.**
- 437 **sp.**

438

439

440 *Mesoserphites annulus* gen. et sp. n.

441 (urn:lsid:zoobank.org:act:BA204CB5-3BB8-41A0-B3E5-C754358F51E0)

442

443 *Material examined.* Holotype RSKM\_P3306.60 (male). Polished amber piece including support  
444 epoxy, one of four amber pieces cut from original block, with dimensions of 17.1 mm x 10.0 mm  
445 x 6.9 mm; amber is clear yellow-orange and flow lines indicate runnel on one side of piece.

446 *Etymology.* The new species name refers to the ring-like expansion present near the posterior  
447 margin of the second petiolar segment. It is based on the Latin word for “ring or circle”, *annulus*;  
448 name is masculine.

449 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost  
450 Cenomanian.

451

452 *Diagnosis.* Unique characters of the new species that distinguish it from congeners include:  
453 scape approximately 1.6 times longer than its greatest width; tarsi as long as corresponding  
454 femora; pronounced lateral sulcus between tergites and sternites, which may overarch  
455 laterotergites (narrow carina present in *M. giganteus*, and *M. viraneacapitis*); second petiolar  
456 segment with slender, ring-like posterior margin (not present in all other *Mesoserphites*).  
457 Differential characters include: total body length ~2.1 mm; head wider than long; compound eye  
458 occupying approximately two-thirds of head in lateral view; ocelli forming weakly isosceles  
459 triangle; right mandible with three teeth progressively elongated ventrally, with gap between  
460 ventral and middle tooth; left mandible with two broad-based teeth, and with ventral tooth  
461 slightly more robust and elongate; gaster significantly shorter than mesosoma; sternum with six  
462 visible segments; first petiolar segment shorter, about 1.7 times length of second segment; first  
463 petiolar segment without globose, ring-like posterior part, and not rimmed anteriorly; first  
464 petiolar segment with hamulus anterodorsally.

465

466 *Description.* Total body length ~2.10 mm; mesosoma ~1.05 mm in length; forewing ~1.03 mm  
467 long, and ~0.52 mm wide; hind wing ~0.58 mm long, and ~0.21 mm wide; metasoma ~0.83 mm  
468 in length; gaster ~0.43 mm long (Fig. 4).

469 Head: wider than long; in lateral view, compound eye rounded and globose, bearing numerous,  
470 small, erect, fine setae; frons straight, slightly sunken; vertex with scabrous surface structure  
471 (possibly due to taphonomic deformation), and highly mounded between lateral ocelli; gena  
472 moderately inflated laterally, with punctured surface structure, and bearing suberect, short, fine  
473 setae; gena moderately inflated near vertex; median ocellus apparently twice size of lateral  
474 ocellus, and separated from lateral ocellus by 4 OD; lateral ocelli nearly touching compound eye  
475 margin, and separated by 5 OD; antenna 9-segmented, and clavate; flagellar articles measuring  
476 approximately: 80, 61, 57, 62, 69, 66, and 113  $\mu\text{m}$ ; pedicel measuring approximately 82  $\mu\text{m}$ ;  
477 scape measuring approximately 137  $\mu\text{m}$  long and 86  $\mu\text{m}$  wide; first flagellar article longest and  
478 bell-shaped semi-clavate; subsequent flagellar articles nearly square in outline, with rounded-  
479 edge; apical flagellar article terminates in rounded, blunt point; pedicel slightly longer than first  
480 flagellar article. Mandibles robust and deeply divided, with elongate and pointed teeth; right  
481 mandible with teeth that progressively diminish in size dorsally, with ventral tooth longest and  
482 slender, and middle tooth broader; left mandible with long and curved teeth; maxillary palpus  
483 four-segmented, and geniculate between second and third palpomere, with terminal palpomere  
484 forming elongate, acute point; maxillary palpus significantly longer than labial palpus, but only  
485 three-quarters of length of mandible.

486 Mesosoma: has mesoscutum with areolate-rugulose to minutely colliculate surface structure;  
487 mesoscutellum with areolate-rugose surface structure; mesopleuron flattened in ventral half, with  
488 row of fovea in external outline, and swollen in dorsal half with rugulose-lacunose surface



489 structure; metanotum with scrobiculate surface structure (transverse row of shallow foveae  
490 separated by strong carinae); propodeum with rugulose surface structure.

491 Wings: forewing with pterostigma shaped like equilateral triangle, with 1rs-r curved and 2rs-r  
492 straight; pterostigma with slender and long, posterior expansion of fuscous area adjacent to r-rs  
493 and Rs; 2Rs nebulous, extending straight adbasally from pterostigma, vein long but expanding,  
494 and fading before reaching M; 3Rs extending apically from pterostigma, forming curved  
495 expansion and reaching anterior wing margin apically; C nebulous, straight and broad; costal cell  
496 wider apically, with width approximately three times that of C, and narrower basally (slightly  
497 more than one width of C); tubular 1M slightly wider than tubular Sc+R; Sc+R, straight, fusing  
498 apically with bulbous 1Rs, and truncated in contact with pterostigma; Sc+R basally reaching C  
499 before bend; M+Cu spectral, curved and reaching 1M and Cu apically; 2M distally nebulous and  
500 straight; 1m-cu spectral; Cu relatively straight and terminating in CuP and CuA; CuA nebulous,  
501 basally straight, fuscous, and broad, then curving posteriad, thinning gradually to reach wing  
502 apex; CuP fading before reaching A; A nearly straight and tubular. Hind wing lanceolate;  
503 nebulous Sc+R nearly straight; R wider than Sc+R, with three hamuli; Rs crossvein spectral and  
504 fading rapidly basally.

505 Legs: moderately robust; pro- and mesotrochanter long and bell-shaped, while metatrochanter  
506 slightly longer and more clavate; protibia with two, long, straight spurs; calcar bifid near apex;  
507 metatibia with one straight apical spur, which is finer and shorter than mesotibial spur; metatibia  
508 wider than mesotibia apically, also with rows of spines near apex, which become elongate  
509 (almost equal to length of spur) near posteroventral margin; basitarsus with sparse, semi-erect  
510 setae; meso- and metabasitarsus as long as other tarsomeres' combined length, while  
511 probasitarsus shorter; tarsomeres I and II longer than III and IV, and III smallest tarsomere; pro-

512 and mesopretarsi with claws as long as arolium, while metapretarsus with finer and shorter  
513 claws.

514 Metasoma: with gaster more ovate than teardrop-shaped in ventral view; gaster bare, swollen  
515 anterodorsally, and straight ventrally in lateral view; tergum with five segments visible, first  
516 slightly longer than second; length of petiolar segments equal to gastral length; first petiolar  
517 segment cylindrical, with few, prominent, longitudinal carinae, and with fossulate, wide, deep,  
518 sulci between, approximately one on each edge; first petiolar segment slightly wider anteriorly,  
519 with pronounced anterior lip on dorsalmost margin; second petiolar segment cylindrical with  
520 punctures. Male genitalia with parameres clavate, apex moderately expended; penis valves  
521 gently swollen posteriorly.

522

523

524 *Mesoserphites giganteus* gen. et sp. n.

525 (urn:lsid:zoobank.org:act:A596C263-1C97-485A-99A0-3C41E07E4641)

526

527 *Material examined.* Holotype RSKM\_P3306.63 (female); paratype AMNH\_BU 667 (male).  
528 RSKM\_P3306.63 is polished amber piece including support epoxy, one of four amber pieces cut  
529 from original amber specimen, with dimensions of 21.0 mm x 15.3 mm x 8.4 mm; amber is clear  
530 yellow-orange with multiple layers. AMNH\_BU 667 is polished amber piece embedded in  
531 support epoxy with dimensions of 11.1 mm x 7.7 mm x 4.3mm; amber is clear yellow-orange  
532 with multiple layers and minor particulate content.

533 *Etymology.* The new species name refers to total body length, which is greatest of all known  
534 Serphitidae. Epithet based on Latin word for “gigantic”, *giganteus*.

535 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost  
536 Cenomanian.

537

538 *Diagnosis.* Unique characters for new species include: total body size more than 3.46 mm  
539 (significantly shorter in all other *Mesoserphites*); combined length of petiolar segments relatively  
540 long, three-quarters of gastral length (although apex of gaster is not preserved); tarsi shorter than  
541 corresponding femora; broad and deeply impressed sulcus near transscutal line interrupted by  
542 raised areas posterior to notauli. Differential characters that separate new species from other  
543 members of *Mesoserphites* include: head wider than long; ocelli forming weakly isosceles  
544 triangle; compound eye occupying approximately one-third of head in lateral view; scape  
545 approximately 2.2 times longer than its greatest width; right mandible with three teeth; left  
546 mandible with two teeth; mesoscutellum convex; gaster apparently much shorter than mesosoma  
547 in length; first petiolar segment comparatively short, about 1.9 times length of second segment;  
548 first petiolar segment without globose, ring-like posterior part, and not rimmed anteriorly; first  
549 petiolar segment with hamulus anterodorsally.

550

551 *Description.* Holotype total body length more than ~3.46 mm (specimen incomplete with  
552 posterior metasoma missing); mesosoma ~1.76 mm in length; forewing ~0.94 mm long  
553 (incomplete), and ~0.53 mm wide; hind wing ~0.96 mm long (incomplete), and ~0.34 mm wide;  
554 metasoma ~1.44 mm in length; gaster ~0.79 mm long (incomplete) (Figs. 5–6).

555 Head: globose; gena slightly inflated; vertex highly mounded between lateral ocelli; frons  
556 broadly concave; ocelli apparently forming isosceles triangular; median ocellus appears equal in  
557 size to lateral ocellus, and separated from lateral ocellus by 2 OD; lateral ocelli rounded and

558 nearly touching compound eye margin, separated by 4 OD; antenna 10-segmented and  
559 proportionally short; flagellar articles measuring approximately: 106, 94, 101, 93, 99, 97, 87, and  
560 105  $\mu\text{m}$ ; pedicel measuring approximately 151  $\mu\text{m}$ ; scape measuring approximately 333  $\mu\text{m}$  long  
561 and 155  $\mu\text{m}$  wide; first flagellar and apical flagellar articles longest and equal in length;  
562 flagellum flattened along posterior margin, and slightly serrated along anterior margin; first  
563 flagellar article clavate or rounded anteriorly, and subsequent flagellar articles chalice-shaped;  
564 apical flagellar article bud-shaped, and terminating in acute point; pedicel pear-shaped, and  
565 approximately one-quarter length of scape; torulus slender, curved, and well-defined. Mandibles  
566 deeply divided, with elongate and pointed teeth on robust mouthparts; right mandible with  
567 middle tooth shorter than two others, ventral tooth longer and wider than dorsal tooth; left  
568 mandible with ventral tooth much wider and longer than dorsal tooth; maxillary and labial palpi  
569 not clearly visible, terminal maxillary palpomere broad and flattened, with acute point.

570 Mesosoma: has pronotum with costate surface structure; mesoscutum and mesoscutellum, shield-  
571 shaped, and highly convex; mesoscutum with coriarius surface structure between curved  
572 notauli; notauli forming V-shape which comes to point near anterior margin of mesoscutum;  
573 mesoscutellum with middle part (between wings) forming transverse mounded strip, with  
574 anterior row of foveate-reticulate sculpture then foveate surface structure; mesoscutellum slightly  
575 concave adjacent to transverse raised strip, with confused rugulose surface structure;  
576 mesopleuron nearly triangular, with row of fovea on anterior and posterior margins, and broadly  
577 notched on posterodorsal margin; metanotum dorsally broad, concave, and with rugulose surface  
578 structure; propodeum convex, with alveolate-rugulose surface structure separated by high  
579 carinae.

580 Wings: with incomplete preservation. Forewing without triangular pterostigma visible, missing  
581 apical two-thirds; Irs-r convex; C nebulous, straight; Sc+R tubular not reaching C basally; Sc+R,  
582 slightly curved; Sc+R reaching bulbous 1Rs before contact with pterostigma; M+1Rs tubular,  
583 basal abscissa as wide as Sc+R; 2M curved in contact with 1m-cu and spectral, highly slender;  
584 M+Cu slender tubular, broader apically than basally, not reaching Sc+R basally, and broader  
585 than M basally, slightly curved; Cu (basal abscissa) straight, as wide as 1M, terminating in CuP;  
586 CuA (distal abscissa) spectral; A tubular, short, slender, and fading midway toward base of wing.  
587 Hind wing with Sc+R tubular, broader, relatively straight, and reaching Rs; Rs (basal abscissa)  
588 nebulous, short, and straight; R tubular, as wide as Sc+R, slightly curved, and terminating in  
589 bulbous expansion with three hamuli.

590 Legs: covered by semi-erect setae; procoxa equal in length and width, while mesocoxa slightly  
591 longer than wide and metacoxa elongate; protrochanter bell-shaped, with meso- and  
592 metatrochanter rectangular; femurs spindle-shaped; pro- and mesotibia elongate bell-shaped, and  
593 metatibia bulbous posteroapically with numerous, long, semi-erect, broad setae; pro- and  
594 mesotibia with two spurs, with posterior spur longer and more slender than anterior spur, and  
595 without metatibial spur apparent; metabasitarsus significantly longer than cumulative length of  
596 other tarsomeres; pretarsus long with broad arolium between two simple, long, broad claws.

597 Metasoma: with gaster flattened ventrally and swollen dorsally (in lateral view); preservation is  
598 incomplete, but two terga and three sterna are perceptible; lateral margins between tergites and  
599 sternites without broad separation, difficult to observe boundaries; first petiolar segment shorter  
600 in length, longitudinally carinate, with row of fovea between carina, and with notched  
601 anterodorsal edge; second petiolar segment quadrangular, slightly curved dorsally and with two  
602 straight edges between corners ventrally.

603 Male: paratype AMNH\_BU 667 does not have genitalia exposed externally, but it is very similar  
604 in overall appearance to holotype specimen. As with other males in *Mesoserphites*, it possesses  
605 seven flagellar articles and appears to be smaller than corresponding female. Highly curved  
606 preservation position within surrounding amber gives male more pronounced ‘hunch-backed’  
607 appearance which may not be representative; posture also complicates measurements, male  
608 apparently with ~2.31 mm total body length, ~354 µm head length, ~875 µm mesosomal length,  
609 ~521 µm petiolar length, ~563 µm gastral length. Darker preservational colour of cuticle,  
610 combined with bubbles adhering to surface of mesosoma, highlight coarser surface sculpture of  
611 punctures on mesoscutum.

612

613

614 *Mesoserphites engeli* gen. et sp. n.

615 (urn:lsid:zoobank.org:act:49CE3893-D002-43D9-B7CC-A51959EE9821)

616

617 *Material examined.* Holotype RSKM\_P3306.62 (female); paratype AMNH\_Bu 1356 (male).

618 Holotype within polished amber piece including support epoxy, one of two amber pieces cut

619 from original block with dimensions of 10.3 mm x 9.3 mm x 4.4 mm; amber is clear yellow with

620 flow lines delimiting runnel around specimens. Paratype within 12.8 mm x 16.9 mm x 5.9 mm

621 block of epoxy embedded amber, and very well preserved with partially everted genitalia.

622

623 *Etymology.* The new species name is a patronym for Dr. Michael Engel, in recognition of his

624 substantial contributions to the Serphitidae.

625 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost  
626 Cenomanian.

627

628 *Diagnosis.* Unique characters for species include: ocelli clearly forming equilateral triangle  
629 (isosceles triangle in all other *Mesoserphites* spp.); head as long as wide or slightly transverse  
630 (elongate in *M. viraneacapitis*, and more transverse in all other *Mesoserphites* spp.); mesoscutum  
631 without visible notauli, highly convex, and in lateral view appearing somewhat mounded,  
632 lacking pronounced sulcus along transscutal line; second petiolar segment with hamulus  
633 posteroventrally (without hamulus posteroventrally in all other *Mesoserphites* spp.). Differential  
634 characters for new species include: total body length ~1.96 mm; compound eye relatively large,  
635 occupying approximately two-thirds of head in lateral view; lateral ocelli ovate, separated from  
636 compound eye margin by less than 0.5 OD (nearly touching compound eye margin), and canted  
637 posterolaterally, with lateral edge recessed into vertex; scape approximately 4.7 times longer  
638 than its greatest width; combined length of petiolar segments relatively short, equal to one-third  
639 of gastral length; sternum with four visible segments; first petiolar segment proportionally  
640 longer, about 1.9 times length of second segment; first petiolar segment without globose, ring-  
641 like posterior part, and not rimmed anteriorly; first petiolar segment with hamulus  
642 anterodorsally; gaster slightly longer than mesosoma.

643

644 *Description.* Total body length ~1.96 mm; mesosoma ~0.69 mm in length; forewing  
645 approximately 0.94 mm long (incomplete), and ~0.34 mm wide; hind wing ~0.72 mm long, and  
646 ~0.18 mm wide; metasoma ~0.96 mm in length; gaster ~0.66 mm long (Fig. 7).

647 Head: with compound eye globose and rounded in lateral view, bearing minute, erect, fine setae;  
648 gena moderately inflated; head with slight taphonomic distortion in holotype, width 1.2 times  
649 length (proportion closer to 1.3 in male paratype) vertex slightly mounded between lateral ocelli  
650 and with posterior margin rounded; frons slightly convex; median ocellus slightly smaller than  
651 lateral ocellus, and separated from lateral ocellus by approximately 3 OD; antenna 10-  
652 segmented; flagellar articles measuring approximately: 75, 42, 40, 54, 52, 57, 58, and 83  $\mu\text{m}$ ;  
653 pedicel measuring approximately 70  $\mu\text{m}$ ; scape measuring approximately 164  $\mu\text{m}$  long and 35  
654  $\mu\text{m}$  wide; first flagellar article bell-shaped; subsequent flagellar articles appear shorter and nearly  
655 chalice-like; apical flagellar article terminates in rounded acute point; pedicel pear-shaped,  
656 approximately two-fifths of length of scape, and broader than first flagellar article. Mandibles  
657 deeply divided with elongate, pointed teeth; details of closed mandibles not clearly  
658 distinguishable; right mandible apparently with three stout teeth visible in holotype, teeth  
659 progressively diminishing in size dorsally; left mandible apparently with two teeth visible in  
660 holotype; maxillary palpus apparently as long as mandible, or perhaps longer than mandible,  
661 four-segmented, and geniculate between second and third palpomere, with terminal palpomere  
662 slender, long, and with acute point; labial palpus approximately half length of maxillary palpus,  
663 apparently three-segmented and geniculate between first and second palpomere, with terminal  
664 palpomere possessing highly inflated acute point.

665 Mesosoma: dark and without clear surface structure visible; mesoscutellum slightly convex  
666 dorsally; mesopleuron bud-shaped, rounded along dorsal margin; metanotum convex, sunken  
667 deeply in mesosoma; propodeum with many scabrous surface mounds.

668 Wings: not completely preserved. Forewing with triangular pterostigma equilateral in shape, and  
669 with slender, elongate, posterior expansion of fuscous area adjacent to r-rs and Rs; C nebulous



670 and Sc+R tubular; Sc+ R fusing apically with bulbous 1Rs+1M, equal to width of adjacent costal  
671 cell; 1Rs+1M and Sc + R both dark and truncated in contact with pterostigma; 3Rs dark and  
672 narrow tubular, basal curved towards anterior part of wing.

673 Legs: with moderately dense cover of fine setae; procoxa rounded, length and width equal, while  
674 meso- and metacoxa longer than wide, and with two longitudinal carinae on lateral surface  
675 equidistant from each other and from external margins of coxa; trochanters equal in length, and  
676 appear laterally compressed; profemur shorter and wider than meso- and metafemur; tarsi longer  
677 than corresponding femora; tibial spur formula 1-2-2, with protibial spur slightly longer than  
678 meso- and metatibial spurs; probasitarsus equal to cumulative length of other tarsomeres; pro-  
679 and metatarsomeres I, II and IV subequal in length and longer than mesotarsomeres; pretarsus  
680 with short arolium, and long, thin claws.

681 Metasoma: gaster more ovate than teardrop-shaped, with punctured surface structure in dorsal  
682 view; gaster slightly flattened ventrally in lateral view; tergum apparently with five segments,  
683 with first tergite longer than second; second petiolar segment somewhat rectangular (ventrally  
684 and dorsally straight) with hook-like posteroventral lip. Genitalia not everted, but apex of  
685 ovipositor sheathe appears to be protruding from distal end of metasoma, probable female  
686 specimen.

687 Male: paratype specimen is very similar to female holotype; male differences include having  
688 seven flagellar articles, with first article slightly shorter than apical article; maxillary palpus as  
689 long as mandible; head slightly transverse; first petiolar segment 2.1 times length of second, as  
690 opposed to 1.9 times in type specimen; total body length ~ 1.4 mm. Parameres exposed in  
691 paratype are clavate with two terminal setae that are elongate and erect; small, mound-like  
692 projections anterior to parameres bear five, erect, apical setae, but details of region are unclear.

693

694

695 *Mesoserphites scutatus* gen. et sp. n.

696 (urn:lsid:zoobank.org:act:DF1E1F2C-3C8B-497E-9607-93651773B394)

697

698 *Material examined.* Holotype RSKM\_P3306.30a (female, wings partially folded and obscured);

699 paratypes RSKM\_P3306.30b (male), RSKM\_P3306.30c (partial, probably female based on size),

700 AMNH\_BU 676 (female weathered specimen with exposed ovipositor apex). RSKM\_P3306.30a

701 and RSKM\_P3306.30b within polished amber piece including support epoxy, one of three amber

702 pieces cut from original block, with dimensions of 10.4 mm x 7.6 mm x 6.5 mm; amber is orange

703 with high particulate content. RSKM\_P3306.30c in polished amber piece including support

704 epoxy, one of three amber pieces cut from original block, with dimensions of 10.4 mm x 7.6 mm

705 x 6.5 mm; amber is orange with high particulate content; specimens preserved alongside

706 syninclusion of *M. viraneacapitis* (RSKM\_P3306.30d). AMNH\_BU 676 is one of three pieces

707 cut from larger amber sample, embedded in epoxy block with dimensions of 6.3 mm x 6.4 mm x

708 2.3 mm.

709

710 *Etymology.* The new species name refers to mesosoma-shape, which is inflated and shield-711 shaped, using the Latin adjective *scutatus*, which means “shield-shaped”.712 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost

713 Cenomanian.

714

715 *Diagnosis.* Unique characters for the new species include: broad transcutellar furrow separating  
716 mesoscutum from mesoscutellum and isolating distinctive shield-shaped mesoscutellum; first  
717 petiolar segment with posterior margin notched dorsally to accept part of second segment (not  
718 present in other *Mesoserphites* spp.). Differential characters include: head wider than long;  
719 compound eye occupying approximately one-half of head in lateral view; lateral ocellus removed  
720 from margin of compound eye by 0.5 OD; left mandible with two large teeth, more robust and  
721 broad-based than teeth on right mandible; right mandible with three large teeth diminishing in  
722 size dorsally, and with dorsal and middle tooth closely spaced; antenna with eight flagellar  
723 articles, and first article is longest, slightly longer than pedicel; tarsi significantly longer than  
724 corresponding femora; gaster slightly shorter than mesosoma; sternum with six visible segments;  
725 first petiolar segment relatively short, about 1.6 to 1.8 times length of second segment; first  
726 petiolar segment without globose or ring-like posterior part, and not rimmed anteriorly first  
727 petiolar segment with hamulus anterodorsally.

728  
729 *Description.* Female holotype RSKM\_P3306.30a, with total body length ~1.96 mm; mesosoma  
730 ~0.67 mm in length; metasoma ~0.93 mm in length; gaster ~0.65 mm long. Male paratype  
731 RSKM\_P3306.30c slightly more gracile, with total body length ~1.92 mm (angled within  
732 amber); mesosoma ~0.65 mm in length; metasoma ~0.94 mm in length; gaster ~0.62 mm long  
733 (Fig. 8).

734 Head: in female holotype globose in lateral view, with rounded compound eye; gena broad and  
735 slightly inflated; ocelli not clearly visible in holotype, apparently forming isosecles triangle with  
736 gentle mounding between ocelli; antenna 10-segmented in female, unknown in male; scape  
737 approximately 133  $\mu\text{m}$  long and 61  $\mu\text{m}$  wide; pedicel ~82  $\mu\text{m}$  long and swollen apically,

738 significantly broader than basal flagellar article; flagellar articles measure approximately 97, 66,  
739 51, 41, 46, 46, 51, and 56  $\mu\text{m}$  in length, and become gradually broader from pedicel to  
740 flagellomere six, then taper to acutely pointed apical flagellomere; flagellomere seven with  
741 inclined stiff setae apically; left mandible bearing two broad-based teeth, plus diminutive dorsal  
742 tooth, and bearing long setae; right mandible with three broad-based teeth that gradually increase  
743 in length ventrally in series; maxillary palpus four-segmented and geniculate at midlength,  
744 palpus approximately two-thirds of mandibular length; labial palpus either three- or four-  
745 segmented, and approximately half of length of mandible.

746 Male: paratype similar to female but missing some details, with left side of head missing; gena  
747 slightly inflated; antennae missing; mandibles deeply divided, with left mandible bearing two  
748 broad-based teeth, plus diminutive dorsal tooth, and bearing long setae; right mandible not  
749 distinguishable.

750 Mesosoma: with pronotum convex, with punctured surface structure; pronotum with row of  
751 fovea surrounding external edges; mesoscutum highly convex, shield-shaped, with row of fovea  
752 on anterior margin; notauli appear strongly curved and removed from lateral margins of  
753 mesoscutum; mesoscutellum with scrobiculate surface structure anteriorly, and with rugose  
754 surface structure posteriorly, separated from mesoscutum by broad transverse sulcus along  
755 transscutal line; mesopleuron bud-shaped, flattened dorsally, with posterodorsal margin bearing  
756 broad row of fovea; metanotum with scrobiculate surface structure, and apparently seven  
757 depressions; propodeum convex with scabrous surface structure.

758 Wings: folded and incomplete in female holotype, with many details only visible in partial wings  
759 (missing apices) preserved in male paratype —details provided here are based predominantly on  
760 paratype, but appear consistent in holotype. Forewing with C nebulous, and costal cell very wide,

761 width approximately five times that of nebulous Sc+R; Sc+R as wide as 1M, nebulous adbasally;  
762 Sc+R fused apically with bulbous 1Rs, and truncated in contact with pterostigma; 2M faintly  
763 pigmented, broad, fuscous basally, but fading rapidly towards apex; Cu slightly concave.

764 Legs: covered by inclined setae; procoxa length and width equal, mesocoxa more ovate and  
765 metacoxa elongate; procoxa with two central longitudinal carina on lateral surface equidistant  
766 from each other and from external margins of coxa; pro- and mesotranchanter longer and broader  
767 than metatrochanter; pro- and mesofemur shorter and narrower than metafemur; metafemur with  
768 longitudinal depression on posterior surface; probasitarsus longer than, and metabasitarsus as  
769 long as cumulative length of other tarsomeres; tarsomeres I and IV longer than II and III, and III  
770 is smallest tarsomere; pretarsus with short arolium between two long, simple claws.

771 Metasoma: with combined length of petiolar segments equal to one-half of gastral length; gaster  
772 covered with fine punctures and minute, erect setae; gaster in lateral view convex dorsally, and  
773 nearly straight ventrally; tergum with five apparent tergites, and with second tergite longest,  
774 slightly longer than first tergite; sternum without clear surface structure visible; lateral margins  
775 between tergites and sternites difficult to observe; first petiolar segment nearly cylindrical, and  
776 slightly curved, with anterodorsal expansion/pronounced anterodorsal lip; surface of first petiolar  
777 segment with few, prominent, longitudinal carinae separated by fossulate sulci; second petiolar  
778 segment bulbous, with flattened dorsal surface. Apex of ovipositor sheathe appears to be  
779 protruding from distal end of metasoma, holotype probably female.

780 *Remarks.* Specimen AMNH\_BU 676 is smaller than other female exemplars, with a total body  
781 length of approximately 1.75 mm; and it has moderately dense, suberect setae on the first and  
782 second petiolar segments, with setae lengths equal to about half of the adjacent petiolar width.  
783 These differences may suggest that the specimen belongs to a different species, but there is

784 limited evidence to support this—the specimen exhibits significant taphonomic distortion and  
785 weathering which may affect apparent dimensions, and highlight setae that are more subtle in  
786 other representatives.

787

788

789 *Mesoserphites viraneacapitis* gen. et sp. n.

790 (urn:lsid:zoobank.org:act:BB62F301-6CBF-4124-995A-DB0BBDE62F0E)

791

792 *Material examined.* Holotype RSKM\_P3306.30d (male); paratype AMNH\_BU 312 (male).  
793 Holotype in polished amber piece including support epoxy, one of three amber pieces cut from  
794 original block, with dimensions 10.4 mm x 7.6 mm x 6.5 mm; amber is orange with high  
795 particulate content; preserved alongside syninclusions of *M. scutatus* (RSKM\_P3306.30a–c).  
796 Paratype in epoxy-embedded amber piece polished to dimensions of 10.9 mm x 11.4 mm x 4.3  
797 mm; amber is pale orange, clear, with prominent flow lines.

798 *Etymology.* The new species name refers to the head-shape which is similar to the mask of the  
799 fictional character “Spider-Man”; it is a combination of the Latin noun *vir-* meaning “man”  
800 combined with *aranea* meaning “spider”, and *capitis* for the head-shape.

801 *Type locality.* Hukawng Valley, Kachin State, in Myanmar, upper Albian-lowermost  
802 Cenomanian.

803

804 *Diagnosis.* Unique characters among *Mesoserphites* species include: head longer than wide  
805 (equant in *M. engeli* and transverse in all other *Mesoserphites*); frons straight and sunken  
806 compared to eye, and highly slender (not sunken, and wider in all other *Mesoserphites* spp.);

807 clypeus subvertical (inclined in all other *Mesoserphites* spp.) and mandibles with relatively low  
808 anterior projection when closed; mesoscutellum flattened (convex in all other *Mesoserphites*  
809 spp.); first petiolar segment relatively short, about 1.4 times length of second segment; first  
810 petiolar segment with globose ring-like posterior part and apparently rimmed anteriorly (not  
811 ring-like posterior part and not rimmed anteriorly in all other *Mesoserphites* spp.); first petiolar  
812 segment without hamulus anterodorsally (with hamulus anterodorsally in all other *Mesoserphites*  
813 spp.). Compared to other *Mesoserphites* species, new species has differential characters that  
814 include: total body length ~1.85 mm; compound eye occupying approximately one-third of head  
815 in lateral view; ocelli forming weakly isosceles triangle; left mandible with two long teeth; scape  
816 approximately 3.1 times longer than its greatest width; gaster slightly longer than mesosoma;  
817 combined length of petiolar segments slightly less than two-thirds of gastral length; sternum with  
818 five visible segments.

819  
820 *Description.* Total body length ~1.85 mm; mesosoma ~0.58 mm in length; forewing  
821 approximately 1.13 mm long, and ~0.55 mm wide; hind wing ~0.78 mm long, and ~0.19 mm  
822 wide; metasoma ~0.95 mm in length; gaster ~0.60 mm long (Fig. 9).

823 Head: with compound eye forming high teardrop-shape, globose eyes bearing numerous, erect,  
824 fine setae; gena more inflated, especially near compound eye ventral margin and moderately  
825 inflated near vertex; median ocellus markedly larger than lateral ocelli; lateral ocelli nearly  
826 touching compound eye margin, weakly rounded, canted posterolaterally; antenna 9-segmented;  
827 flagellar articles measuring approximately: 89, 73, 75, 67, 73, 59, and 78  $\mu\text{m}$ ; pedicel measuring  
828 approximately 78  $\mu\text{m}$ ; scape measuring approximately 188  $\mu\text{m}$  long and 60  $\mu\text{m}$  wide; first  
829 flagellar article clavate; second flagellar article shorter, clavate, and following articles almost

830 rectangular in outline; apical flagellar article terminates in acute point; pedicel elongate, pear-  
831 shaped, and approximately one-fifth length of scape; scape length equal to height of compound  
832 eye. Mandible closed, and bearing numerous, long, erect, fine setae; left mandible apparently  
833 with two very long, pointed teeth, with dorsal tooth thinner than ventral tooth; right mandible not  
834 clearly visible; maxillary palpus geniculate and terminating in slender and long rounded point,  
835 only apical two segments visible, but palpus significantly shorter than mandible.

836 Mesosoma: without clear surface structure visible; mesoscutum, convex and slightly shield-  
837 shaped, with punctate-reticulate surface structure; mesoscutellum with scabrous surface  
838 structure; propodeum relatively straight, with scabrous surface structure.

839 Wings: forewing with equilateral triangle-shaped pterostigma, with 1rs-r and 2rs-r curved while  
840 R is straight; pterostigma with globose, triangular, posterior expansion of fuscous area adjacent  
841 to r-rs and Rs; 2Rs nebulous, extending adbasally from pterostigma, forming long, straight  
842 expansion reaching 2M (or seems to pass between 2M and 1m-cu crossvein and fading before  
843 Cu); 3Rs straight, extending apically from pterostigma, expanding and reaching anterior wing  
844 margin apically; C nebulous, straight, with basal curvature; costal cell wider apically, with width  
845 approximately three times that of C, and narrower basally, less than half as wide as C; tubular  
846 1M wider than Sc+R; tubular Sc+R, fusing apically with bulbous 1Rs, and truncated in contact  
847 with pterostigma; Sc+R basally reaching C before bend; M+Cu spectral, reaching apically 1M  
848 and Cu in lowest point, straight; 2M fuscous and straight; 1m-cu crossvein slightly broader than  
849 2M; Cu curved and terminating in CuP and CuA distally; CuA straight, fuscous, and wider  
850 basally, then curved and gradually thinning to wing apex; CuP fading before reaching A; A  
851 slightly curved and tubular. Hind wing lanceolate; nebulous Sc+R relatively straight; R wider



852 than Sc+R, with three hamuli; Rs crossvein spectral and fading rapidly; posterior margin of wing  
853 has small nebulous patch that may represent A, with patches erect setae along vein.

854 Legs: moderately robust and covered by numerous, inclined, fine setae; procoxa and mesocoxa  
855 slightly longer than wide, and metacoxa elongate; protrochanter slightly shorter than  
856 mesotrochanter and both are bell-shaped, while metatrochanter is elongate and globose;  
857 metafemur with shallow and broad central depression; pro- and mesofemur more slender than  
858 metafemur; profemur with rounded expansion on posterior surface; tibial spur formula 1-2-2,  
859 with protibial spur fine and long, and meso- and metatibial spurs shorter; protibia shorter than  
860 meso- and metatibia; basitarsus shorter than cumulative length of other tarsomeres; pretarsus  
861 short, with heart-shaped arolium, and broad, long claws.

862 Metasoma: gaster covered with fine punctures and minute, semi-erect setae, ovate in dorsal view,  
863 convex dorsally, and straight ventrally in lateral view; tergum with five segments, first tergite  
864 longer than second; lateral margins between tergites and sternites difficult to distinguish, only  
865 visible as fine line; first petiolar segment somewhat cylindrical, with anterior width slightly  
866 greater than two-thirds of posterior width; first petiolar segment with numerous, fine carinae  
867 separated by fine fossulae; second petiolar segment bulbous, with slightly flattened dorsal  
868 surface. Male genitalia with parameres semi-clavate, apex moderately expanded; penis valves  
869 gently swollen basally, and moderately separated.

870 *Remarks.* Paratype specimen AMNH\_BU 312 differs from the holotype in having a head that  
871 appears slightly transverse, as well as a body that appears more gracile, smaller (~1.63 mm in  
872 total body length), and more setose. However, most of these differences can be attributed to  
873 taphonomic distortion, because the specimen has shrivelled in the surrounding amber and  
874 developed a wrinkled cuticle, as well as dark cuticle preservation highlighting translucent

875 structures like setae. Observations of the paratype are limited to only one side, due to cracks and  
876 syninclusions in the surrounding amber, but it is more parsimonious to consider this specimen  
877 part of the *M. viraneacapitis* series, than a unique exemplar of a different species.

878 In general, *M. viraneacapitis* displays some characteristics of Supraserphitinae, including  
879 the subvertical clypeus and petiolar segments that are closer to being even (first segment is only  
880 1.4 times length of second). However, the seven flagellar articles preclude the *M. viraneacapitis*  
881 males described here from being the unknown male form of *Supraserphites*, which would  
882 presumably have nine flagellar articles.

883

## 884 **5. Discussion**

885 Discovery of the two new genera *Buserphites* and *Mesoserphites* extends the diversity of the  
886 family Serphitidae and builds upon the known diversity in Burmese mid-Cretaceous amber.  
887 Despite the large number of serphitids that are commercially available from this deposit, the  
888 diversity of these specimens seems to outstrip the samples that are currently available within the  
889 AMNH and RSKM collections. Most of the new species discovered are only known from a  
890 unique specimen (singleton), or very small specimen sets within museum collections. This may  
891 lead to taxonomic uncertainty, and a lack of connection between males and females of each  
892 species, until larger sample sets are described. Taxonomic uncertainty is exacerbated in our study  
893 because many of the specimens in Burmese amber have undergone weak compression or  
894 taphonomic shrivelling. This cuticle deformation varies between specimens, but it appears to be  
895 more significant in small-bodied taxa, such as some of the species described herein. Distortion is  
896 noticeable on cuticle surface structures within some specimens, so we have tried to emphasize  
897 large-scale structural differences and specify regions of uncertainty within our descriptions.

898 Many of the new species proposed herein have both female and male specimens assigned  
899 to them. These associations are difficult to support in cases where the sexes are not found as  
900 syninclusions. Consequently, future work and large sample sets may show that some of these  
901 specimens belong to unrecognized species, instead of being sexually dimorphic forms within the  
902 species proposed here. In previous work on Upper Cretaceous serphitid wasps (e.g., McKellar  
903 and Engel, 2010), males appear to have seven flagellar articles while females possess eight, and  
904 males appear to be slightly smaller or more gracile than their female counterparts. For the time  
905 being, and with the limited sample set that is available, we have refrained from erecting  
906 additional species in all cases where these features were the main differences between  
907 specimens.

908 The new species within *Buserphites* **n. gen.** clearly differ from all known Serphitoidea in  
909 having: a flagellum with seven or eight segments (six-segmented in *Jubaserphites*, eleven-  
910 segmented in *Supraserphites*, and twelve-segmented in Archeoserphitidae); a lateral ocellus that  
911 is separated from the compound eye by 0.5 OD (nearly touching compound eye in *Serphites*, and  
912 *Mesoserphites* **n. gen.**); a pronotum that extends to reach the tegula, and a pterostigma that is  
913 distinct (pronotum not reaching tegula, and forewing with pterostigma indistinct in  
914 *Microserphites*); a first petiolar segment that is 3.4 times the length of the second segment (two  
915 times or less in *Mesoserphites* **n. gen.**, *Aposerphites*, and *Microserphites*, or between two and  
916 three times in *Serphites*); and a second petiolar segment with faint longitudinal striations  
917 (apparently unique in Serphitoidea). The new species within *Mesoserphites* **n. gen.** can be  
918 distinguished from other Serphitoidea based on having the following combination of  
919 characteristics: a flagellum with seven or eight articles (six articles in *Jubaserphites*, and ten  
920 articles in *Supraserphites*); the lateral ocellus nearly touching the compound eye (separated from

921 eye by 1 OD in *Aposerphites*, and separated from eye by 0.5 OD in *Buserphites* **n. gen.**); a  
922 pronotum that reaches the tegula, and a pterostigma that is distinct (pronotum not reaching  
923 tegula, and the forewing with pterostigma indistinct in *Microserphites*); a first petiolar segment  
924 that is less than two times the length of the second segment (more than two times in *Serphites*,  
925 3.4 times in *Buserphites* **n. gen.**); and a gaster with different lengths between first three terga  
926 (first three terga similar in length in *Aposerphites*). An extensive cladistic analysis of  
927 Serphitoidea will be necessary to fully test the limits and relationships of these genera, and to  
928 determine which characteristics are phylogenetically informative or autapomorphies that may  
929 refine our diagnoses. However, with the pace of recent work on this deposit, and the large  
930 number of terminal taxa that still need to be described, this type of analysis would be better  
931 performed after a preliminary account of all serphitoids has been completed.

932         The two new genera reported here have not been found in other Cretaceous amber  
933 deposits, despite the fact that Serphitoidea have been one of the most extensively studied groups  
934 of Hymenoptera in these assemblages. It remains unclear whether the Burmese amber  
935 assemblage's important taxonomic and morphological diversity is most probably a consequence  
936 of a particular palaeoenvironment, time averaging as a result of sampling multiple strata in the  
937 Hukawng Valley, or palaeogeographic constraints that existed prior to the mid-Cretaceous in  
938 Myanmar. The palaeoenvironment for this region during the Cretaceous was more tropical than it  
939 is today, with average temperatures between 32 and 55°C south of 40°N latitude (Spicer *et al.*,  
940 1996; Grimaldi *et al.*, 2002). In general, the Cretaceous was a hothouse interval with extensive  
941 tropical belts. It seems that Burmese amber captured one of the most diverse terrestrial  
942 assemblages in the Cretaceous, because it combined a large amount of resin production with a  
943 diverse tropical fauna, and not because it represents an unusual coastal habitat (e.g., Xing *et al.*,

944 2018; Yu *et al.*, 2019) conditions. Although many taxa are shared between Myanmar and other  
945 Cretaceous sites (Grimaldi *et al.*, 2002; Ross, 2019, 2020), or make a case for faunal exchange  
946 between the Burmese amber forest and Asia (e.g., Oliveira *et al.*, 2016; Fu *et al.*, 2019), recent  
947 research has suggested that groups such as Hymenoptera show substantial endemism. Eight  
948 families of wasps are known solely from Burmese amber, and within Serphitidae the subfamily  
949 Supraserphitinae is also restricted to this deposit (Zhang *et al.*, 2018; Rasnitsyn and Ölm-Kühnle  
950 2018, 2019a, 2019b). This points toward the development of endemic groups as the Western  
951 Burma Block drifted toward its contact with Asia during the Cretaceous (Liu *et al.*, 2016). The  
952 new findings among Serphitidae reported herein seem to add further support to this pattern of  
953 endemism at the genus-level; however, additional data are required from Asia to fully understand  
954 the timing and direction of faunal exchanges in the region. Additional work will also be required  
955 on the geology surrounding Burmese amber, to determine whether our impressions of this  
956 assemblage are being shaped by a significantly longer depositional time or broader range of  
957 depositional environments than other Cretaceous amber deposits with lower serphitid diversity.

958

## 959 **6. Conclusions**

960 This study expands the known diversity of the family Serphitidae in Burmese amber, through the  
961 discovery of 7 new species, leading to the definition of two new genera. These new genera seem  
962 to be endemic to the amber deposit, much like members of the recently described subfamily  
963 Supraserphitinae. Moreover, this deposit appears to have preserved members of the small family  
964 Serphitidae in large numbers and with greater diversity than the other Cretaceous amber deposits  
965 where this family has been recovered. It is unclear whether this is a result of greater diversity and  
966 abundance of serphitids in the Burmese amber forest, or if it is merely a result of the deposit

967 being commercially mined on such a large scale. The presence of many singleton species within  
968 our study seems to point toward diversity, as opposed to specimen availability, being the  
969 dominant factor in this deposit. Overall, Burmese amber now contains the most species from the  
970 family, with 12 species reported (including the studies of Rasnitsyn and Ölm-Kühnle, 2019a,  
971 2019b, 2020a, 2020b). Additionally, preliminary work on existing museum collections suggests  
972 that Burmese amber contains many additional new species within the family Serphitidae that  
973 await description.

974

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982

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1092 **Figure Captions.**

1093

1094 **Fig. 1.** (A) General serphitid wasp wing terminology. (B) General serphid wasp anatomical  
 1095 terminology, based on the drawing of *M. engeli* **gen. et sp. n.** Abbreviations of veins: A, Anal;  
 1096 C, Costal; Cu, Cubital; CuA, Cubital apical; CuP, Cubital posterior; 1M, Median 1 (basal); 2M,  
 1097 Median 2 (apical); M+Cu, between Median 1 and Cubital; 1m+cu, between Median 1 and 2, and  
 1098 Cubital; R, Radial; 1Rs, Radial zone 1; 2Rs, Radial zone 2; 3Rs, Radial zone 3; 1r-rs, costal cell  
 1099 margin + pterostigma basal vein + pterostigma expansion; 2r-rs, pterostigma apical margin; Sc,  
 1100 Subcostal. Abbreviations of anatomy: ba., basitarsus; cx., coxa; fe., femur; fla., flagellomeres;  
 1101 mlt., lateral margin between tergites and sternites; msp., mesopleuron; mst., mesoscutum; mstl.,  
 1102 mesoscutellum; mtn., metanotum; oce., ocellus; ped., pedicel; ppd., propodeum; pro., pronotum;  
 1103 sca., scape; ster., sternite; ta., tarsus; ter., tergite; ti., tibia; tr., trochanter; ver., vertex.

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1106 **Fig. 2.** *Buserphites applanatus* **gen. et sp. n.** holotype AMNH\_Bu-1512 (probable female).

1107 (A) Lateroventral habitus view. (B) Specimen illustration showing venation. (C) Laterodorsal  
 1108 habitus view, arrow indicating right mandible. (D) Posterodorsal habitus view, , arrow indicating  
 1109 left mandible. Scale bars 1 mm in (A–D).

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1111

1112 **Fig. 3.** *Buserphites myanmarensis* **gen. et sp. n.** holotype RSKM\_P3306.61 (probable female).

1113 (A) Dorsal habitus view. (B) Specimen illustration showing venation and cuticular sculpture. (C)  
 1114 Lateral habitus view, partly masked by high particulate content in amber. (D) Ventral habitus

1115 view, arrow indicating posterior extent of tergite 1 on ventral surface of gaster. Scale bars 1 mm  
1116 in (A–D).

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1119 **Fig. 4.** *Mesoserphites annulus* **gen. et sp. n.** holotype RSKM\_P3306.60 (male).

1120 (A) Posterodorsal habitus view. (B) Specimen illustration showing venation and cuticular  
1121 sculpture. (C) Detailed view of gaster and wing venation in A, arrow indicates posterior extent of  
1122 tergite 1 on ventral surface of gaster. (D) Anterolateral habitus view. (E) Predominantly ventral  
1123 habitus view, arrows indicate muscle tissue preserved within legs. (F) Predominantly dorsal  
1124 habitus view, partly obscured by drying lines in amber. Scale bars 1 mm in (A, B, D–F), 0.25  
1125 mm in (C).

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1127

1128 **Fig. 5.** *Mesoserphites giganteus* **gen. et sp. n.** holotype RSKM\_P3306.63 (female).

1129 (A) Dorsolateral habitus view. (B) Specimen illustration showing venation and cuticular  
1130 sculpture. (C) Posterodorsal habitus view, showing surface of gaster truncated by polished edge  
1131 of amber piece and infilled by clay minerals (arrow), and details of propodeal sculpture. (D)  
1132 Lateral habitus view of body and ventral view of head. (E) Detailed view of wing venation and  
1133 dorsal mesosomal sculpture from A. Scale bars 1 mm in (A–D), 0.25 mm in (E).

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1136 **Fig. 6.** *Mesoserphites giganteus* **gen. et sp. n.** paratype AMNH\_BU 667 (male).

1137 (A) Predominantly ventral habitus view of curled specimen. (B) Specimen illustration  
1138 demarcating body regions in A. (C) Predominantly dorsal habitus view, highlighting details of  
1139 mesosomal sculpture. (D) Lateral habitus view. Scale bars 1 mm in (A–D).

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1142 **Fig. 7.** *Mesoserphites engeli* gen. et sp. n. specimens.

1143 RSKM\_P3306.62 (female) holotype (A–F): Dorsolateral habitus view (A). Specimen illustration  
1144 showing venation and body segmentation (B). Oblique anterior view of head, arrow indicates  
1145 outer margin of closed mandibles (C). Detailed dorsal view of head in A, arrow indicates lateral  
1146 ocellus (D). Detailed view of mesosomal dorsal surface in A (E). Ventrolateral habitus view (F).  
1147 AMNH\_Bu 1356 (male) paratype (G–I): Dorsal habitus view with wings bent over body, and  
1148 wing from nearby aphidoid syninclusion (arrow) (G). Ventral habitus view, with inset of gastral  
1149 apex (H). Lateral habitus view through significant overlying amber (I). Scale bars 1 mm in (A, B,  
1150 F–I), 0.25 mm in (C–E).

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1153 **Fig. 8.** *Mesoserphites scutatus* gen. et sp. n. specimens.

1154 RSKM\_P3306.30a (female) holotype (A,B): Ventrolateral habitus view with wings folded over  
1155 specimen and obscured, horizontal arrow indicates right mandible, vertical arrow marks left  
1156 mandible (A). Dorsolateral habitus view through thick overlying amber (B). RSKM\_P3306.30b  
1157 (male) paratype (C, D): Dorsolateral habitus view, with wings truncated by polished surface of  
1158 amber piece near their midlengths, and head truncated on left side (C). Specimen illustration  
1159 highlighting surface sculpture (D). RSKM\_P3306.30c (partial, probable female based on size)

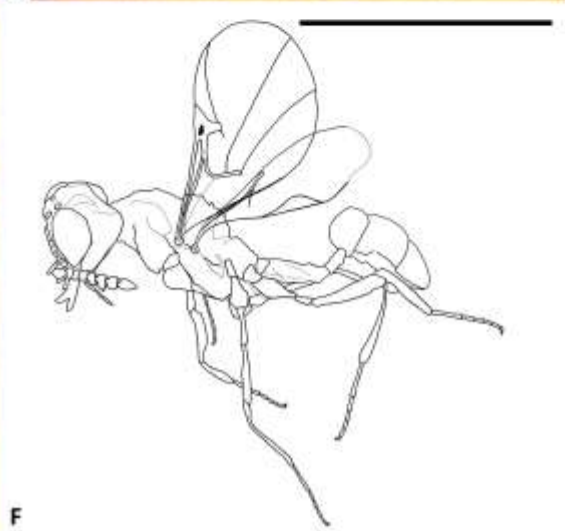
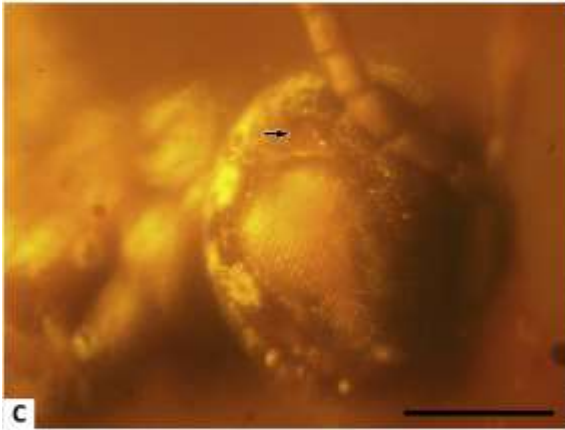
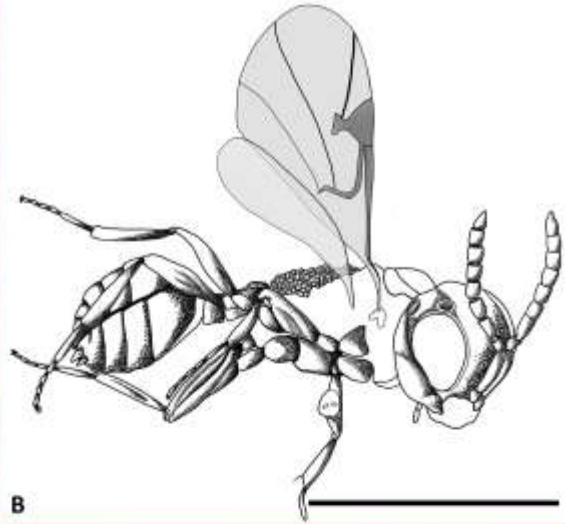
1160 paratype (E): Anterior view of head, body missing beyond middle of mesosoma, arrow marks  
1161 right mandible. AMNH\_BU 676 (female) paratype (F): Dorsolateral habitus view of weathered  
1162 specimen with exposed ovipositor apex (arrow). Scale bars 1 mm in (A–D, F), 0.25 mm in (E).

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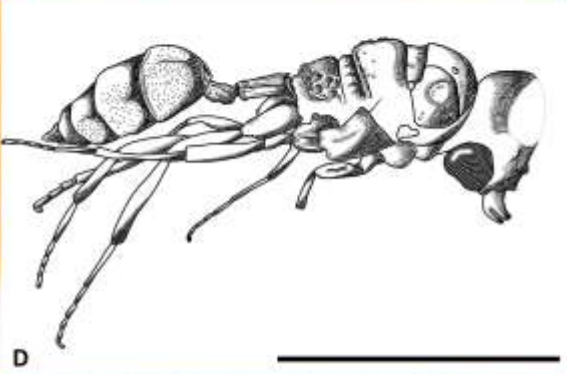
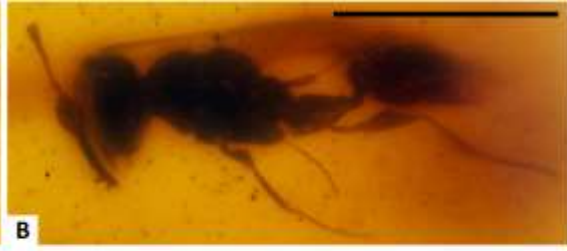
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1165 **Fig. 9.** *Mesoserphites viraneacapitis* **gen. et sp. n.** specimens.

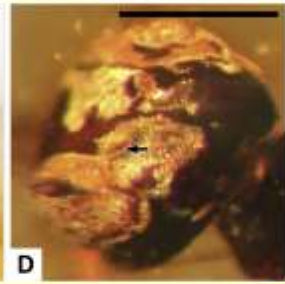
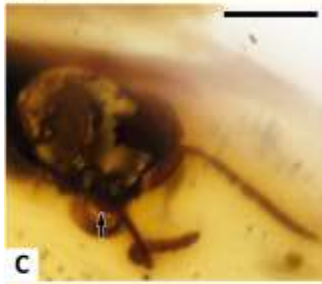
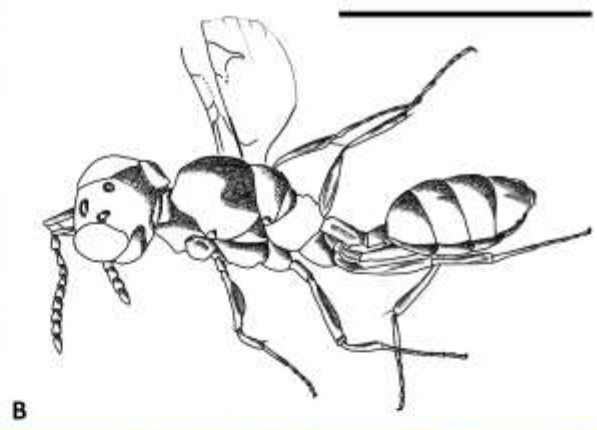
1166 RSKM\_P3306.30d (male) holotype (A–D): Ventrolateral habitus view (A). Specimen illustration  
1167 showing venation and cuticular sculpture (B). Detailed view of head in A, with lateral ocellus  
1168 marked by arrow (C). Posterodorsal habitus view. AMNH\_BU 312 (male) paratype (E, F):  
1169 Lateral habitus view (E). Specimen illustration outlining body regions and venation (F). Scale  
1170 bars 1 mm in (A, B, D–F), 0.25 mm in (C).





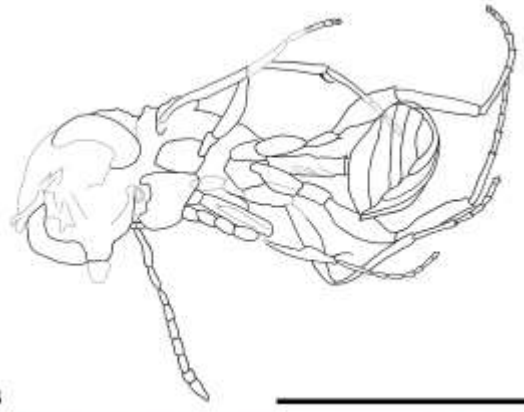


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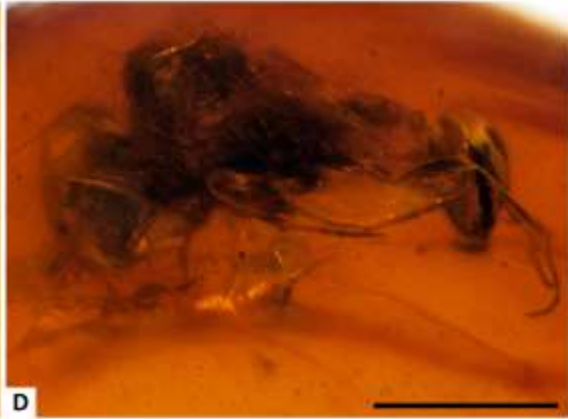
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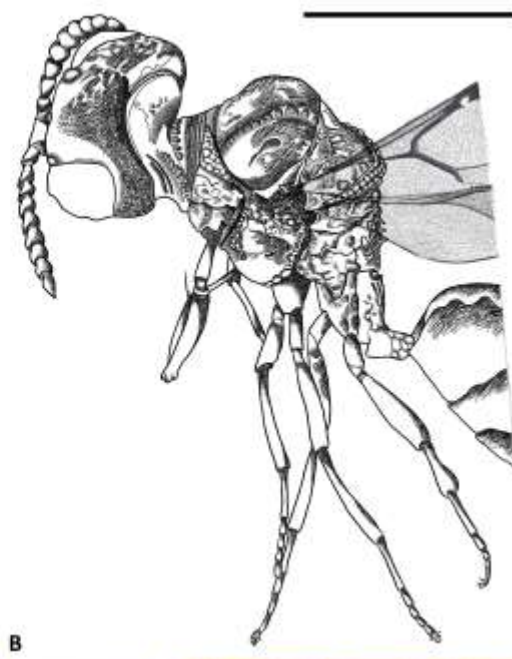
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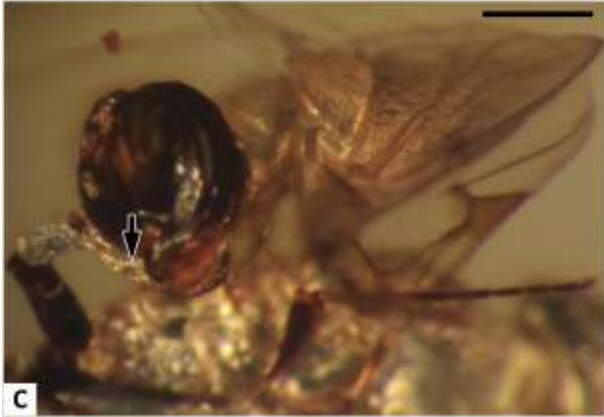
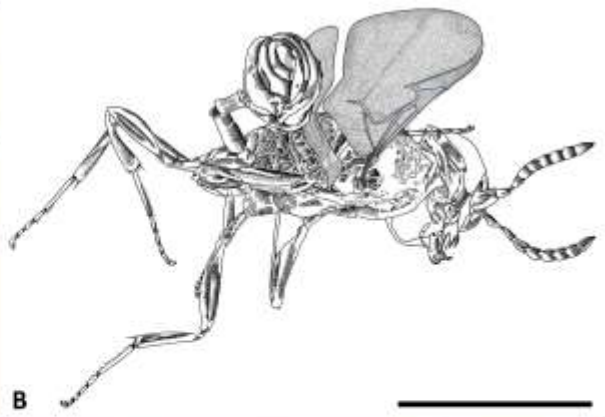
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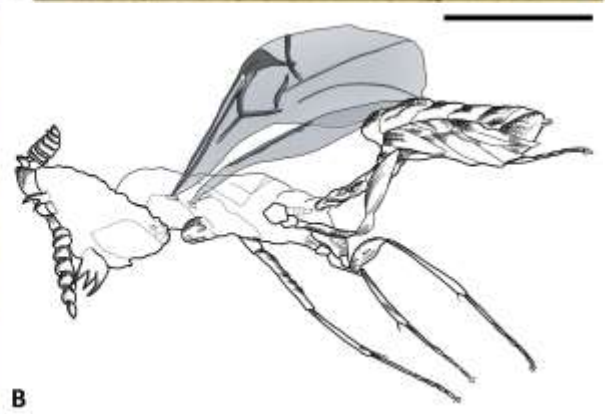
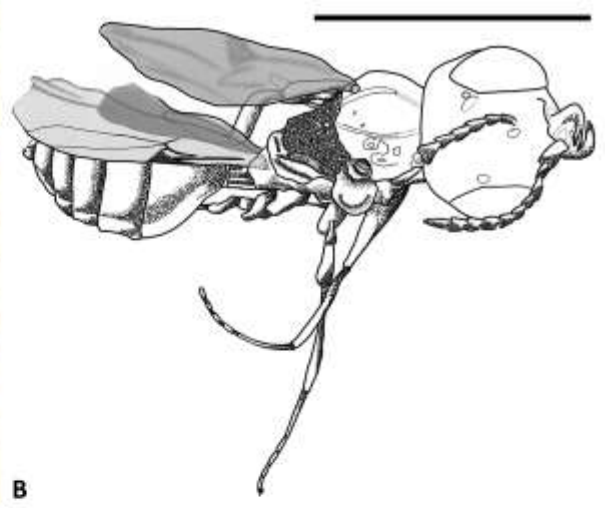
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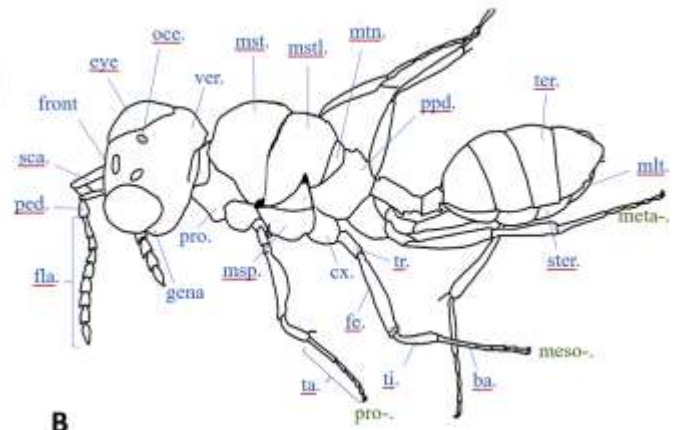
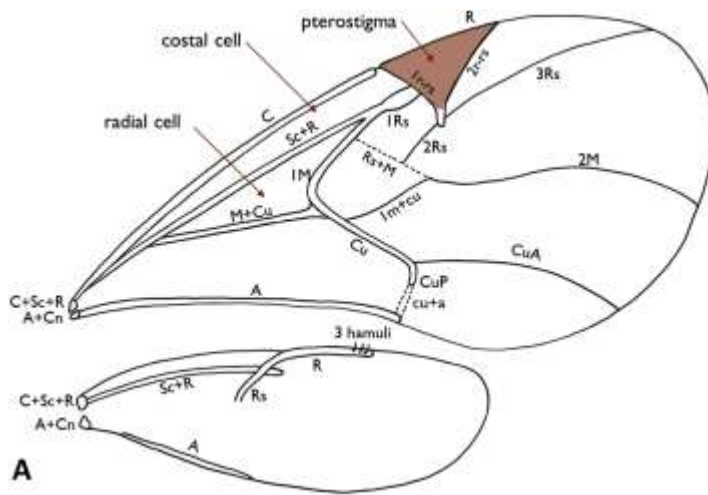


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**Declaration of interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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