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The second species of *Sorellevania* Engel, 2006 (Evanioidea: Evaniidae) from the mid-Cretaceous Burmese amber

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The representatives of the superfamily Evanioidea, also called hatchet wasps, are easily distinguishable from all other extant and extinct Hymenoptera because of their metasoma (sometimes rounded) articulated high on the propodeum and well above the metacoxae (*e.g.*, Goulet & Huber, 1993). Recent phylogenetic studies on the superfamily Evanioidea have shown strong support for its monophyly and for the monophyly of the Evaniidae even when fossil taxa are included (*e.g.*, Li *et al.*, 2018; Parslow *et al.*, 2020; Jouault *et al.*, 2022). According to the most recent analysis, the superfamily arose during either the Upper Triassic or the Lower Jurassic. Still, its earliest species are recorded in the younger Middle Jurassic, and its crown-group representatives during the Lower Cretaceous (Jouault *et al.*, 2022: fig. 8). The stem Evaniidae are estimated to arise during the Upper Jurassic while their crown

group has a more recent origin, likely around the Cretaceous-Paleogene boundary. Extant evaniid wasps are common, nearly cosmopolitan, and moderately diversified (about 580 extant species in 21 genera) even if this diversity is underestimated (Deans, 2005; Mullins *et al.*, 2012). Little is known about the biology of extant evaniids, but their larvae are considered predators of cockroach eggs in oothecae (Huben, 1995). The Evaniidae have a good fossil record with the oldest species known from the late Hauterivian, numerous species documented up to the Miocene, and an important diversity in Burmese amber (*e.g.*, Rasnitsyn *et al.*, 1998; Nel *et al.*, 2002; Deans *et al.*, 2004; Jennings *et al.*, 2012; Shih *et al.*, 2020). Nevertheless, their past diversity is still underestimated.

Herein, a new species of evaniid wasp is described from the mid-Cretaceous Burmese amber.

Material and methods

The amber piece containing the specimen comes from the deposits of Noiye Bum in the Hukawng Valley (26° 29' N, 96° 35' E), Kachin State, northern Myanmar (see detailed map in Grimaldi & Ross, 2017: fig. 2). Radiometric data established an early Cenomanian age (98.79 ± 0.62 Ma) for Kachin amber, based on zircons from volcanic clasts found within the amber-bearing sediments (Shi *et al.*, 2012). Some ammonites found in the amber-bearing bed and within amber corroborate a late Albian–early Cenomanian age (Cruickshank & Ko, 2003; Yu *et al.*, 2019).

The holotype of *Sorellevania guillami* **sp. nov.** is a well-preserved female. The specimen was examined and photographed with a Nikon SMZ 25 with an attached Nikon

Z7II camera. All images are digitally stacked photomicrographic composites of several individual focal planes, which were obtained using Helicon Focus 6.7. The figures were composed with Adobe Illustrator CC2019 and Photoshop CC2019 software. The amber piece is housed in the Geological Department and Museum of the University of Rennes, France (IGR) under collection number IGR.BU-065.

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Systematic palaeontology

Order Hymenoptera Linnaeus, 1758

Suborder Apocrita Gerstaecker, 1867

Superfamily Evanioidea Latreille, 1802

Family Evaniidae Latreille, 1802

Genus *Sorellevania* Engel, 2006

Type species. *Sorellevania deansi* Engel, 2006, by original monotypy.

***Sorellevania guillami* sp. nov.**

(Figs 1, 2)

urn:lsid:zoobank.org:act:E1F43A04-572A-4529-88DA-9D56A1F817BA

Material. Holotype, IGR.BU-065 (a nearly complete specimen preserved in a squared piece of amber measuring $6 \times 6 \times 1$ mm), deposited in the amber collection of the Geological Department and Museum of the University of Rennes, France (IGR).

Etymology. The specific epithet honors my friend Elvis Guillam, and is treated as a noun in a genitive case.

Diagnosis. Antenna with 12 flagellomeres. Forewing with distal abscissa of R not fully tubular, tubular part ending before marginal cell apex; 2r-rs located near mid-length of second submarginal cell (= 3-Rs long); 1-Cu and 1-Rs of similar length; first medial cell wide; 1m-cu short and tubular (= Rs+M and Cu clearly separated); 1rs-m crossvein spectral; 4-M long reaching apex of marginal cell. Hind wing with three hamuli.

Type locality and horizon. Noiye Bum Hill, Hukawng Valley, Kachin State, Myanmar; upper Albian to lower Cenomanian, mid-Cretaceous.

Description. Female fully winged and of small body size (total body length, from apex of mandibles to apex of the metasoma but without ovipositor approximately 1.42 mm).

Head slightly wider than long (*ca.* 0.43 mm long); vertex broad, concave beyond ocelli; ocelli present; compound eyes relatively small, length less than one-half head length, well separated from vertex and ocelli; malar space slightly longer than basal mandibular width; left mandibles with a small, sharp basal tooth, a larger triangular first marginal tooth, a deep incision between first marginal and apical teeth, a broad apical tooth basally convex than

acute; clypeus swollen medially and distinctly elevated above plane of face; gena narrower than maximum width of compound eye; antenna elbowed, articulated slightly above level of head midlength, not inserted on swelling or shelf; scape elongate, *ca.* 0.28 mm long and maximal width *ca.* 0.06 mm; pedicel slightly longer (*ca.* 0.08 mm long) than wide (*ca.* 0.05 mm wide), subequal to first flagellomere article; flagellomeres each longer than wide, thickening toward apex; distalmost flagellomere tapered, *ca.* 0.18 mm long; occipital carina present and complete.

Mesosoma strongly sclerotized, compact and relatively high, *ca.* 0.47 mm high (measured above procoxa), shorter than head length; pronotum without distinct dorsal surface, collar distinct; mesoscutum slightly arching above level of head in lateral aspect giving species a slightly “hunchbacked” appearance; mesoscutellum strongly arched; propodeum posteriorly sculptured (sculpture hardly describable), laterally with relatively regular areolae; propodeum not rising toward articulation with petiole. Legs elongate; tarsi pentamerous; pretarsal claws short, slender, simple; arolium present; foreleg and midleg hardly measurable; hindleg the longest (all lengths in mm) with femur *ca.* 0.59 mm, tibia *ca.* 0.53 mm, first tarsomere *ca.* 0.20 mm, second *ca.* 0.17 mm, third *ca.* 0.13 mm, fourth *ca.* 0.11 mm, fifth *ca.* 0.11 mm.

Forewing *ca.* 1.20 mm long and *ca.* 0.38 mm wide, venation relatively complete, with seven cells enclosed by tubular or spectral veins; pterostigma elongate and narrow, narrower than distal width of costal space; M+Cu fork anteriorad 1cu-a; 1-M longer than 1-Rs; 1-Cu shorter than 1cu-a; first medial cell pentagonal longer than wide, fully enclosed by tubular veins; Rs+M shorter than 1-M; 2-Rs basally not sclerotized, subequal to 1-M; crossvein 2r-rs long, straight and vertical, longer than 1-Rs; first submarginal cell quadrate, longer than wide; marginal cell triangular, about 2.5× longer than wide; 3-Rs slightly longer than 1-Rs; 4-Rs

long slightly curved distad its mid-length; second submarginal cell longer than wide, not fully enclosed by tubular vein; 1rs-m crossvein spectral, apparently longer than 1m-cu; 4-M nearly straight, long (reaching apex of marginal cell), and ending freely in wing membrane; A tubular, not touching straight 1cu-a; 3-Cu spectral; 4-Cu less sclerotized than other vein, straight, ending freely in wing membrane distad 1rs-m.

Hind wing *ca.* 0.58 mm long, with three distal hamuli; without venation except Sc+R; with long, sparse, well-separated setae along posterior wing margin; without jugal lobe.

Metasoma rounded, narrower close to petiole; petiole *ca.* 0.20 mm, tubular, and curved distally; length of other segments combined *ca.* 0.45 mm; ovipositor long (at least 0.53 mm long) and thin, acute distally.

Discussion

The specimen can be readily attributed to the family Evaniidae because of its rounded metasoma articulated high on the propodeum and well above the metacoxae (*e.g.*, Goulet & Huber, 1993). Using the key to the fossil genera of Evaniidae of Shih *et al.* (2020), the specimen keys out in *Sorellevania* because of the following: forewing venation with more than three closed cells; forewing with 2rs-m, 3rs-m and 2m-cu alternatively present or all of them absent; forewing with marginal cell wide triangular, antenna elbowed, scape elongate, about as long as head.

The genus *Sorellevania* is monotypic and only known from the mid-Cretaceous Burmese amber (Engel, 2006). The new specimen differs from the type species *Sorellevania*

deansi Engel, 2006, at least because of its antennae with 12 flagellomeres but also because of its forewing venation with the crossvein 2r-rs located at midlength of 2-Rs & 3-Rs (*vs.* closer to 2rs-m, because 3-Rs is short), the vein 4-M long reaching apex of the cell 3r (*vs.* short ending in the middle of the cell 3r), and the cell 1mcu $\approx 1.5\times$ as long as high (*vs.* about twice as long as high).

This new species of *Sorellevania* possesses an unusual number of flagellomeres for an evaniid wasp. In fact, the number of flagellomeres in Cretaceous Evaniidae is often 10, as in *Cretevania s.l.*, or 11 in other Evaniidae (including the type species of *Sorellevania*). However, *Sorellevania guillami* **sp. nov.** is not the only Cretaceous evaniid with 12 flagellomeres as *Burmaevania brevis* Shih, Li & Ren, 2020 also possesses a similar configuration of the antennae (Shih *et al.*, 2020). From a broad evolutionary perspective, this high number of flagellomeres likely represents the plesiomorphic condition of the family Evaniidae.

Note that the genus *Mesevania* Basibuyuk & Rasnitsyn, 2000 (in Basibuyuk *et al.*, 2000) has a forewing venation well-developed with numerous crossveins, and antennae with more than 15 antennomeres. These characters question its putative affinities with the Evaniidae and rather suggest proximity with the Praeaulacidae.

Rasnitsyn (1969, 1980) proposed a general trend in Hymenoptera evolution consisting of the miniaturization, venational reduction, enlargement of pterostigma, and reduction of the number of the antennal flagellomeres from the plesiomorphic conditions found in Symphyta to more derived conditions found in recently diverged families. This trend is seen in the evanioids (Li *et al.*, 2015) with a reduction of the wing venation and the flagellomere number. In fact, the Protoevanioides (Praeaulacidae + Othniodellithidae) possess antennae

with more than 20 antennomeres (*e.g.*, Jouault *et al.*, 2020, 2022) while the Neoevanioides often have less than 20 antennomeres (except the Anomopterellidae; Li *et al.*, 2014). Therefore, the number of antennomeres decreases within the Evanioidea with the Protoevanioides possessing the highest number of antennomeres recorded in the Evanioidea, and then a decrease within the Neoevanioides from *ca.* 20 antennomeres in the Anomopterellidae (Li *et al.*, 2014), to maximum 13–14 antennomeres in the Aulaciformes with the highest number of antennomeres (*e.g.*, Zhang & Rasnitsyn, 2004; Shih *et al.*, 2020).

The fossil diversity of the family Evaniidae was recently summarized (Shih *et al.*, 2020: table 1; Jouault *et al.*, 2022: table 1) but additional material is expected to be described in a near future. Among these future taxonomic additions, a new species of *Cretevania* Rasnitsyn, 1975 is expected from the Aptian deposit of Congo-Brazzaville and will extend the distribution of the genus in Gondwana (Rasnitsyn & Öhm-Kühnle, 2021).

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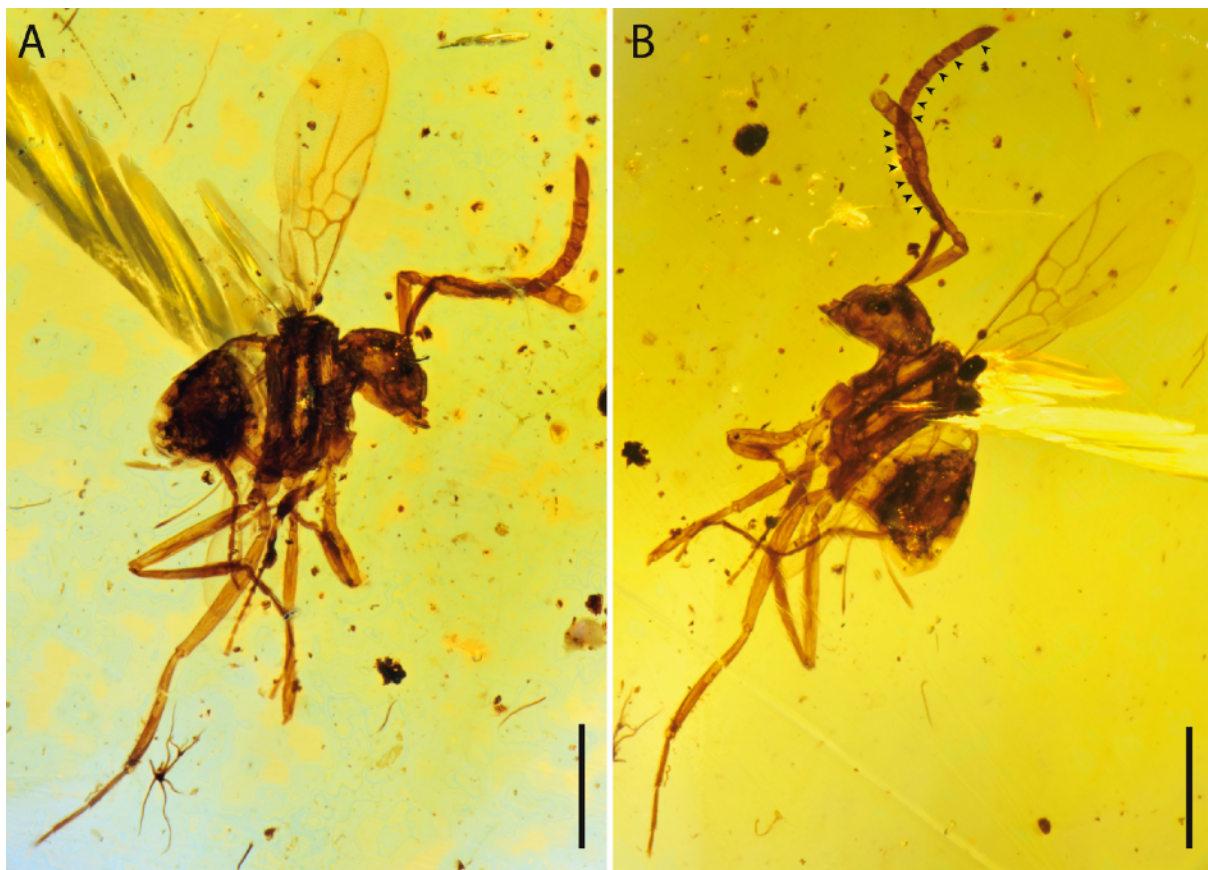


FIGURE 1. *Sorellevania guillami* sp. nov., holotype IGR.BU-065. **A**, Habitus in right lateral view. **B**, Habitus in left lateral view (arrows pointing each flagellomere). Scale bars = 0.5 mm.

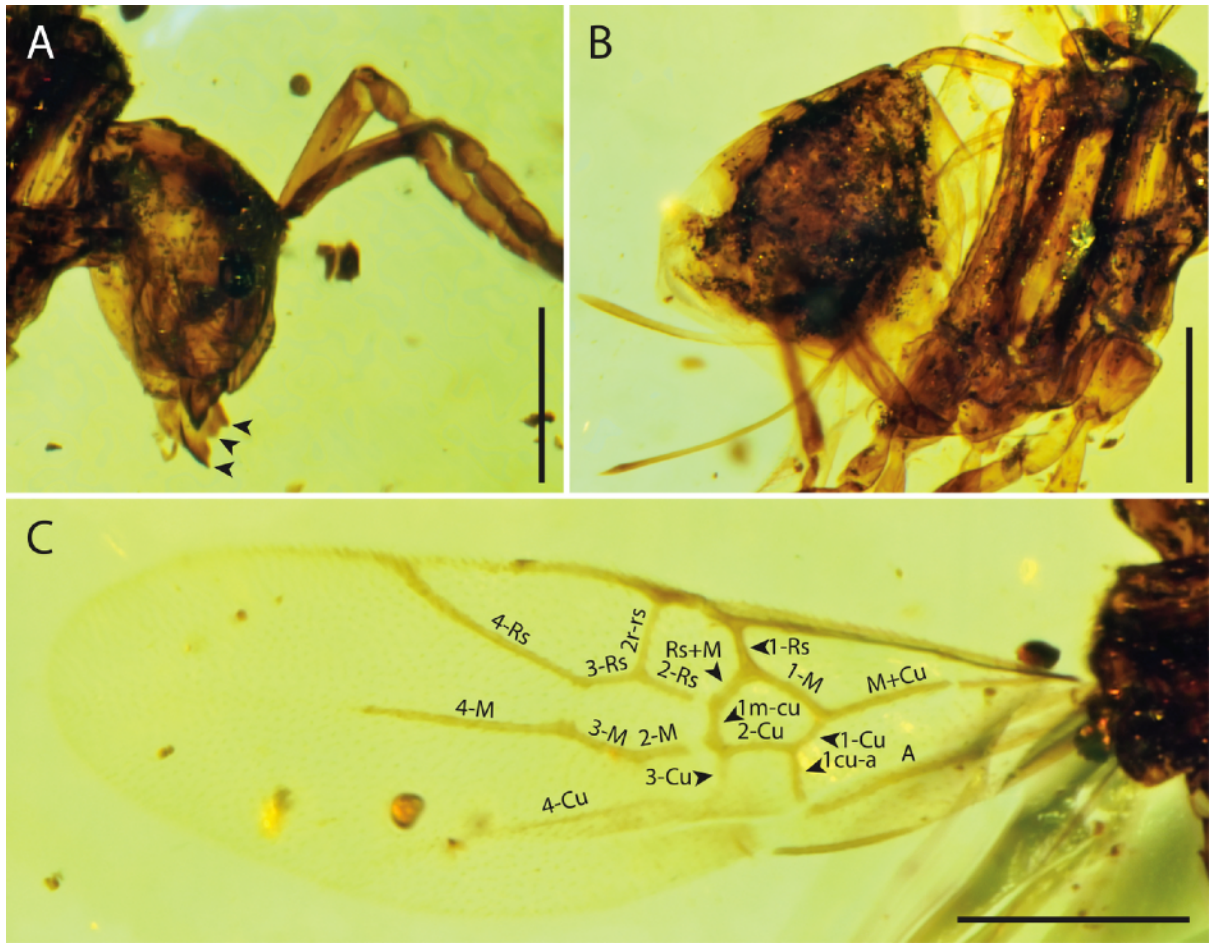


FIGURE 2. *Sorellevania guillami* **sp. nov.**, holotype IGR.BU-065. **A**, Detailed view of the head in right lateral view (arrows pointing the teeth). **B**, Detailed view of the metasoma in right lateral view. **C**, Detailed view of the forewing venation with names of veins labelled. Scale bars = 0.25 mm.