



# A new anaxyelid wood wasp (Hymenoptera: ‘Symphyta’) from the mid-Cretaceous Burmese amber

Corentin Jouault, Gi-Soo Nam, Alexandr Rasnitsyn

## ► To cite this version:

Corentin Jouault, Gi-Soo Nam, Alexandr Rasnitsyn. A new anaxyelid wood wasp (Hymenoptera: ‘Symphyta’) from the mid-Cretaceous Burmese amber. *Annales de Paléontologie*, 2022, 108 (3), pp.102568. 10.1016/j.annpal.2022.102568 . insu-03857426

**HAL Id: insu-03857426**

**<https://insu.hal.science/insu-03857426>**

Submitted on 21 Nov 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# A new anaxyelid wood wasp (Hymenoptera: ‘Symphyta’) from the mid-Cretaceous Burmese amber

*Une nouvelle guêpe anaxyelide (Hymenoptera : ‘Symphyta’) de l’ambre du Crétacé moyen du Myanmar*

Corentin Jouault<sup>a,b,c,\*</sup>, Gi-Soo Nam<sup>d</sup>, Alexandr P. Rasnitsyn<sup>e,f</sup>

<sup>a</sup>*Institut de Systématique, Évolution, Biodiversité (ISYEB), Muséum national d’Histoire naturelle, CNRS, Sorbonne Université, EPHE, Université des Antilles, CP50, 57 rue Cuvier, F-75005 Paris, France.*

<sup>b</sup>*Univ. Rennes, CNRS, Géosciences Rennes, UMR 6118, F-35000, Rennes, France.*

<sup>c</sup>*CNRS, UMR 5554 Institut des Sciences de l’Évolution de Montpellier (Université de Montpellier), Place Eugène Bataillon, F-34095, Montpellier, France.*

<sup>d</sup>*Gongju National University of Education, Gongju, Chungcheongnam-do 32553, Republic of Korea.*

<sup>e</sup>*Palaeontological Institute, Russian Academy of Sciences, Moscow, 117647, Russia*

<sup>f</sup>*Natural History Museum, London SW7 5BD, UK*

\*corresponding author ([jouaultc0@gmail.com](mailto:jouaultc0@gmail.com))

## Abstract

A new genus and species of anaxyelid wasp is described and figured from the mid-Cretaceous Burmese amber as *Curvitexis kopylovi* gen. et sp. nov. The placement of this new genus within the Anaxyelidae is corroborated by its wing venation and the configuration of its mesosoma. This new genus differs from all other Syntexinae from the mid-Cretaceous Burmese amber biota, inter alia, owing to its forewing with the vein 1Rs curved and longer than 1M, the crossvein 1r-rs absent, the vein 2Rs + M present; the hind wing with the abscissa 2M + Cu present, the vein m-cu absent, and the cell r closed. The recently described *Paraxiphydria resinata* Gao et al., 2022 is transferred to Anaxyelidae: Syntexinae, and the subfamily Paraxiphydriinae Gao et al., 2022 is synonymized under Syntexinae.

## Résumé

Un nouveau genre et espèce de guêpe anaxyelide est décrit et illustré de l'ambre du Crétacé moyen du Myanmar : *Curvitexis kopylovi* gen. et sp. nov. Le placement de ce nouveau genre dans les Anaxyelidae est corroboré par sa nervation alaire et la configuration de son mesosoma. Ce nouveau genre diffère de tous les autres Syntexinae du biote de l'ambre du Crétacé moyen du Myanmar, en raison de son aile antérieure avec la nervure 1Rs courbe et plus longue que 1M, la nervure transversale 1r-rs absente, la nervure 2Rs + M présente; l'aile postérieure avec l'abscisse 2M + Cu présente, m-cu absente et la cellule r fermée. L'espèce récemment décrite *Paraxiphydria resinata* Gao et al., 2022 est transférée dans les Anaxyelidae : Syntexinae, et la sous-famille Paraxiphydriinae Gao et al., 2022 synonymisée sous Syntexinae.

**Keywords:** Anaxyelidae, Xphydriidae, fossil record, new species, sawfly

Mots clés: Anaxyelidae, Xiphydriidae, registre fossile, nouvelle espèce, sawfly

## Introduction

The family Anaxyelidae has a particular evolutionary history because it flourished during the Jurassic and Cretaceous periods and strongly declined after or during the Late Cretaceous. Today, the family is known by only one species *Syntexis libocedrii* Rohwer, 1915 — commonly called the incense cedar wood wasp — which occurs in western North America (Rohwer, 1915; Wickman, 1967). The monophyly of the family Anaxyelidae and its placement as the sister family to the Siricidae is corroborated by molecular and morphological data, and its origin is dated back to the Early Jurassic-Late Triassic (e.g., Ronquist et al., 2012; Malm and Nyman, 2014; Nyman et al., 2019). This dating is in agreement with the oldest occurrences of the family known from the Middle Jurassic (Kopylov et al., 2020a). To date, the fossil record of the Anaxyelidae encompasses 18 genera and 44 species (Gao et al., 2021). It is mainly composed of imprint or compression fossils (= rock fossils) while only four species are formally described from amber deposits: *Eosyntexis parva* Ortega-Blanco et al., 2008, *Sclerosyntexis hirsuta* Wang et al., 2020, *Orthosyntexis elegans* Gao et al., 2021, and *Orthosyntexis thanti* Gao et al., 2021 (Ortega-Blanco et al., 2008; Wang et al., 2020; Gao et al., 2021). Recently, a new species of ‘Symphyta’, namely *Paraxiphydria resinata* Gao et al., 2022, was described from the mid-Cretaceous Burmese amber and assigned to the family Xiphydriidae (Gao et al., 2022). This placement makes it the oldest known Xiphydriidae but we rather argue that it’s a new anaxyelid wasp belonging to the subfamily Syntexinae.

Herein, a new genus and species of anaxyelid 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 and Ross, 2017: fig. 2). Radiometric data established an early Cenomanian age ( $98.79 \pm 0.62$  Ma) for Kachin amber, based on zircons from volcanic clastes 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 amber piece was polished to facilitate the observation of the specimen using a grinder polisher (Buehler EcoMet 30), and a silicon carbide sanding paper (grit size 1/4 7000). The specimen was examined and photographed with a Nikon SMZ 25 with an attached Sony  $\alpha$  7 IV 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. Wing venation nomenclature follows Gao *et al.* (2021). The amber piece is housed in the Geological Department and Museum of the University of Rennes, France (IGR) under collection number IGR.BU-064.

Published work and nomenclatural acts are registered in ZooBank (<http://zoobank.org/>, last access: 05/10/2022), with the following LSID (reference): [urn:lsid:zoobank.org:pub:6833124B-C7C7-4D0E-9B63-C6FCD1BB41DA](http://zoobank.org/pub:6833124B-C7C7-4D0E-9B63-C6FCD1BB41DA).

### **Systematic paleontology**

Order Hymenoptera Linnaeus, 1758

Family Anaxyelidae Martynov, 1925

Subfamily Syntexinae Benson, 1935

(= Paraxiphydrinae J. Gao, Engel, & T. Gao, 2022, syn. nov.)

Genus *Curvitexis* gen. nov.

LsidXXXX

**Type species.** *Curvitexis kopylovi* sp. nov.

**Etymology.** The genus name is a combination of the word “curve” referring to the curved vein 1Rs and the genus *Syntexis* (itself from Ancient Greek *súntēxis* (σύντηξις, meaning, “colliquescence”, “emaciating”, or “wasting away”)), type genus of the subfamily Syntexinae. Gender feminine.

**Diagnosis.** Distance between notauli and mesoscuto-mesoscutellar sulcus equal to mesoprescutum length (or nearly equal). Forewing with pterostigma normal-sized, uniformly sclerotized; 1Rs curved and longer than 1M (1.14×); 1r-rs absent; 2Rs reclival; 2Rs+M present; 2r-rs extremely short, slightly inclined toward wing apex; cell 1mcu with parallel sides (1Rs+M and 2Cu), length to width ratio slightly more than 2; 1Cu shorter than 2Cu;

2m-cu slightly longer than 1m-cu; 3Cu shorter than 4Cu; 2m-cu separated from 3rs-m by a long 4M (longer than 1Rs); cell 2mcu longer than cell 1mcu. Hind wing with abscissa 2M+Cu longer than 1M; 1M slightly bend before meeting point with 1rs-m; m-cu absent, cell r closed at wing anterior margin.

*Curvitexis kopylovi* sp. nov.

urn:lsid:zoobank.org:act:CA463F91-8569-44DE-9029-1669D841AC22

Fig. 1-2

**Holotype.** IGR.BU-064, housed in the Geological Department and Museum (IGR) of the University of Rennes (France).

**Etymology.** The specific epithet honors Dr. Dmitry S. Kopylov for his contribution to the knowledge of fossil Anaxyelidae; and is to be treated as a noun in a genitive case.

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

**Diagnosis.** As for the genus (*vide supra*).

**Description.**

Thorax wide, width across tegulae *ca.* 1.40 mm; pronotum short *ca.* 0.50 mm long, having prominent anterior notch, dorsally with median longitudinal furrow. Mesoscutum with median longitudinal sulcus and notauli strongly impressed, lateral lobes posteriorly finely and transversely striate or rugose anteriorly, medially with well spaced rugae, and laterally tuberculate; mesoscutellum tapering to acute apex; mesoprescutum *ca.* 0.35 mm long, median

longitudinal sulcus between notauli and mesoscuto-mesoscutellar sulcus well impressed; mesoscutellum *ca.* 0.56 mm long, notauli terminating close to mesoscutellum; ratio of lengths of prescutum, median longitudinal sulcus between notauli and mesoscuto-mesoscutellar sulcus, and mesoscutellum about 1/1/1.6. Mesoscutellum covered with coarse punctuations. Legs elongate (only one mid- and two hind legs are preserved), metafemora shorter than associated tibia. Metatibia thickening toward apex, *ca.* 0.87 mm long, with only one apical spur visible; all tarsomeres with stiff apical setae; basitarsi long (*ca.* 0.64 mm long) but slightly shorter than remaining tarsomeres combined (length of remaining tarsomeres from base to apex: 0.31, 0.21, 0.06, 0.20 mm long); tarsomere V shorter than basitarsomere, attached to tarsomere IV extremely basally; pretarsal claws long and simple, with curved apices.

Forewing *ca.* 5.3 mm long and *ca.* 1.6 mm wide, covered with dense microtrichia, without coloration pattern. C and R thick, costal area narrower than C and R widths. Sc absent; 2r-rs issuing from pterostigma near its midlength; 1Rs basally subvertical to R then oblique, longer than 1M, meeting 1M at acute angle. 2Rs+M distinct but short (*ca.* 0.1 mm long), shorter than 2r-rs (*ca.* 0.15 mm long). 2r-rs slightly proclival. 2+3M about 1.7× as long as 4M. Cell 1mcu pentagonal, more than twice longer than wide; cell 2mcu hexagonal, widest in its proximal part, longer than wide. 2Cu about 2.15× as long as 1Cu (respective length *ca.* 0.54 mm and *ca.* 0.24 mm long). 1cu-a (*ca.* 0.27 mm long) strongly reclival, slightly longer than 1Cu. 1m-cu (*ca.* 0.35 mm long) slightly shorter than 3Cu (*ca.* 0.39 mm long), 3Cu shorter than 4Cu (*ca.* 0.78 mm long). 2m-cu (*ca.* 0.40 mm long) shorter than 4M (*ca.* 0.50 mm long) and slightly longer than 1m-cu. 1A nearly straight, curved after 1cu-a toward wing posterior



margin. Interanal crossvein short, moderately oblique. 2A+3A sinuate and in part far from posterior margin of wing. Anal cells ordinary (not narrow).

Hind wing *ca.* 3.5 mm long. Cell r closed at wing anterior margin. 1Rs longer than 1M and equal to 2M+Cu. 1rs-m subvertical, not aligned with 1M and shorter than 1Rs (0.74×). 1M straight except bend slightly before meeting point with 1rs-m; 2M+Cu (*ca.* 0.36 mm long) present, nearly equal to length of cu-a; 1Cu well developed, nearly straight, reaching wing margin; cu-a slightly curved, *ca.* 0.33 mm long; 1A and 2A meeting before cu-a at distance slightly superior to length of 2M+Cu. Nine hamuli distad 1Rs originating point, at least five before.

Abdomen partially preserved, only slightly narrower than mesothorax; abdominal tergum I split medially, abdominal tergum II *ca.* 0.47 mm long and 1.37 mm wide.

Remark. Currently, the delineation of several syntexine genera is mainly based on differences in the 1Rs/1M ratio. Although this ratio clearly indicates three different clusters of genera (see discussion), its value is difficult to establish and it is not impossible that additional specimens will blur the limits of each genera leading to their ulterior synonymization. Nevertheless, in the current state of knowledge, the description of a new genus appears to be the only viable solution.

Identification key for genera of Syntexinae (updated from Kopylov, 2019):

- 1. Forewing with 1r-rs completely lost .....2
- Forewing with 1r-rs at least partly developed ..... 7

2. Forewing with 2r-rs originating from the distal quarter of pterostigma; Rs+M as long as 2M ..... *Cretosyntexis* Rasnitsyn et Martinez-Delclos, 2000
- Forewing with 2r-rs originating from the middle of pterostigma; Rs+M much longer than 2M, sometimes bifurcating at or beyond 1m-cu when 2M is lost ..... 3
3. 1Rs longer than 1M (at least 1.1×) .....4
- 1Rs shorter than 1M .....5
4. 1Rs straight or nearly so, and conspicuously longer than 1M (at least 1.68×) ..... *Eosyntexis* Rasnitsyn, 1990
- 1Rs strongly curved and slightly longer than 1M (1.14×) ..... *Curvitexis* Jouault et al., gen. nov.
5. Pterostigma wide. Anal cell narrow, with crossvein long and slanting, reaching midlength of cell 2a. Hind wing with Rs meeting posterior wing margin ..... *Sclerosyntexis* Wang et al. 2020
- Pterostigma narrow. Anal cell wide, with crossvein much shorter. Hind wing with Rs reaching or at least directed toward anterior wing margin ..... 6
6. 2m-cu closer to 3rs-m than to 1m-cu. Hind wing with cell 3r closed. .... *Orthosyntexis* J. Gao, Engel, Shih, & T. Gao, 2021
- 2m-cu closer to 1m-cu than to 3rs-m. Hind wing cell with 3r open ..... *Paraxiphydria* J. Gao, Engel, & T. Gao, 2022
7. Forewing with 1r-rs incomplete and not reaching R; tubular veins not developed in the apical third of the wing ..... *Curiosyntexis* Kopylov, 2019

- Forewing with 1r-rs complete; tubular veins developed in the apical third of the wing .....8
- 8. Forewing with pterostigma reaching the middle 3r cell; 2r-rs originating from the basal third of pterostigma ..... *Dolichosyntexis* Kopylov, 2019
- Forewing with pterostigma not reaching the middle 3r cell; 2r-rs originating from the middle of pterostigma ..... 9
- 9. 1M half as long as 1Cu; 2M half as long as 1m-cu .....  
*Daosyntexis* Kopylov, Rasnitsyn, Zhang & Zhang, 2020
- 1M much longer; 2M absent or much shorter .....10
- 10. Hind wing with m-cu present; distal parts of Rs, M, Cu and A tubular ..... *Parasyntexis* Kopylov, 2019
- Hind wing with m-cu absent; distal parts of Rs, M, Cu and A nebulous ..... *Syntexis* Benson, 1935

## Discussion

The new specimen can be attributed to the Anaxyelidae because of its typical fore- and hind wings each with a single rs-m, a configuration rarely find in ‘Symphyta’. The new specimen cannot be attributed to the Xiphydriidae because the mesonotum of the new specimen is not divided by a nearly straight, transverse groove between the bases of forewings and because it possesses a pronotum with a longitudinal medial groove or articulation typical of extant Anaxyelidae (Goulet & Hubert, 1993). Following the key to the subfamily of Anaxyelidae proposed by Kopylov (2019: 342) our specimen keys out in the subfamily Syntexinae

because of the couplets: forewing with pterostigma usually not reaching the midlength of cell 3r; cell 2r less than  $3\times$  as long as wide and usually significantly shorter than cell 1r; Rs+M present; forewing with Sc absent or present as a crossvein; forewing with cell 2r short and wide (less than  $1.5\times$  as long as wide), widened basally, or united with 1r (1r-rs completely or partly reduced); Rs+M usually longer than 2-M, sometimes bifurcating beyond 1m-cu. Gao *et al.* (2021) also proposed the following characters, also present on the new specimen, to support an attribution to the Syntexinae: forewing with the maximum width of pterostigma not shorter than 2r-rs, 1r-rs absent and hind wing m-cu absent. Following the key to genera of Syntexinae proposed by Kopylov (2019: 346) the new specimen keys out close to *Eosyntexis* Rasnitsyn, 1990 because of the following couplets: forewing with 1r-rs completely lost; forewing with 2r-rs issuing from the middle of pterostigma; Rs+M much longer than 2-M, sometimes bifurcating beyond 1m-cu. However, some wing venation characters preclude a confident placement within this genus (*vide infra*).

Gao *et al.* (2021) discussed the delineation of the four subfamilies of Anaxyelidae, as treated by Zhang & Rasnitsyn (2006) and Kopylov (2019) (*viz.*, Anaxyelinae, Dolichostigmatinae, Kempendajinae, and Syntexinae), and provide a phylogenetic analysis of the family (Gao *et al.*, 2021: fig. 8). Their results suggest that only the subfamilies Syntexinae and Anaxyelinae are monophyletic while the characters used to delineate the Dolichostigmatinae and Kempendajinae may have to be revised, but the poor support of the tree hampers their conclusions. Nevertheless, the wing venation of the new specimen precludes affinities with the genera *Dolichostigma* Rasnitsyn, 1968 and *Sclerostigma* Kopylov & Rasnitsyn, 2020 (Dolichostigmatinae) and *Kempendaja* Rasnitsyn, 1968 and *Mangus* Kopylov, 2019 (Kempendajinae) because its vein 1Rs is comparatively short (*vs.*

long), and the presence of only one r-rs vein (*vs.* two) (Rasnitsyn, 1968; Kopylov, 2019; Kopylov *et al.*, 2020b).

To date, the Syntexinae encompasses 13 species (12 fossils and one extant) (Gao *et al.*, 2021: supp. mat. 1). Recently, three anaxyelid species were described from Burmese amber, namely *Sclerosyntexis hirsuta* Wang *et al.* 2020, *Orthosyntexis elegans* Gao *et al.* 2021, and *Orthosyntexis thanti* Gao *et al.* 2021 (Wang *et al.*, 2020; Gao *et al.*, 2021). All these species were placed in the Syntexinae and this placement was corroborated by the phylogeny of Gao *et al.* (2021).

Recently, *Paraxiphydria resinata* was described from Burmese amber and placed within the family Xiphydriidae (Gao *et al.*, 2022). However, this species possesses several wing venation and body characters precluding its placement in the previously known xiphydriid subfamilies, which resulted in the creation of the Paraxiphydriinae to accommodate *P. resinata* (Gao *et al.*, 2022: fig. 1). At the same time, this fossil wasp lacks the most important diagnostic character of Xiphydriidae, that is, the transverse mesonotal suture, a putative synapomorphy of Xiphydriidae, Siricidae, Orussomorpha, and Apocrita. Additionally, the wing venation of this species resembles that of other Syntexinae and is, *inter alia*, similar to *Orthosyntexis* (Gao *et al.*, 2021, 2022). *P. resinata* differs from the other known Anaxyelidae, *inter alia*, by its elongate neck, a common adaptation found in numerous lineages of xylobiotic Hymenoptera (Cephidae, Stephanidae, Gasteruptiidae s.l.).

Our specimen strongly differs from *S. hirsuta* because of its forewing venation with 1Rs curved and longer than 1M (*vs.* straight), 2m-cu longer than 1m-cu (ca. 1.4× *vs.* 1.2× in the new specimen), 2r-rs extremely short (compared to the long 2r-rs of *S. hirsuta*), the wide anal region (*vs.* arrow); its hind wing with a developed 2M+Cu (*vs.* absent). The wing

venation of our specimen resembles that of the genera *Orthosyntexis* and *Paraxiphydria* but differs in having a forewing with 1Rs distinctly curved and conspicuously longer than 1M (vs. 1Rs straight and shorter than 1M in *Orthosyntexis* and *Paraxiphydria*). The ratio of 1Rs/1M in the new specimen is equal to 1.14 while respectively 0.6 and 0.78 in *O. elegans* and *O. thanti*. Similarly, it strongly differs from *P. resinata* that possesses a 1Rs/1M ratio equal to 0.64. Note that Gao *et al.* (2021) indicate in the diagnosis of the genus *Orthosyntexis* that the forewing is *inter alia* characterized by a vein 3rs-m twice shorter than 4M but this character is only found in the species *O. thanti* and not in *O. elegans* in which the vein 3rs-m is ca.  $0.74\times$  the length of 4M. Nevertheless, the forewing ratio of 1Rs/1M clearly indicates three clusters of morphological similarities for the genera *Orthosyntexis*, *Eosyntexis*, *Curvitexis* gen. nov., and *Paraxiphydria*. The first one with a short 1Rs (shorter than 1M) and is composed of *Paraxiphydria* and *Orthosyntexis* (ratio between 0.60 and 0.78). A second cluster with all the *Eosyntexis* species (ratio between 1.68 and 2.20), and between these two clusters *Curvitexis* gen. nov (ratio equal 1.14).

As aforementioned, the major difference between the new specimen and the genera *Orthosyntexis* and *Paraxiphydria* is the configuration of the 1Rs and 1M veins (comparative length and shape). Because the diagnoses of the above genera will be altered with the addition of the new specimen in any of them, we create a new genus. Note that the relative length of these veins is a key character used to delineate numerous fossil and extant families, subfamilies and genera belonging to early diverged families of Hymenoptera (*e.g.*, Gao *et al.*, 2013; Dai *et al.*, 2022). Therefore, the differences recorded for this character combined with the other characters listed in the diagnosis are sufficient to erect a new genus of Syntexinae.

The new specimen strongly differs from the genus *Cretosyntexis* at least because of its vein 1Rs comparatively short (vs. long in *Cretosyntexis*), the presence of a 2Rs+M (vs. absent), the vein 2Rs subvertical (vs. strongly oblique), the cell 1m-cu with parallel 1Rs+M and 2Cu (vs. not parallel) (Rasnitsyn & Martínez-Delclòs, 2000). It also differs from the genus *Curiosyntexis* because its forewing lacks a vein 1r-rs (vs. present in *Curiosyntexis*), the vein 1Rs is curved (vs. straight), and the vein 2r-rs is slightly inclined toward the apex of the wing (vs. vertical) (Kopylov, 2019). Similarly, the presence of the vein 1r-rs in *Daosyntexis* precludes affinities with our specimen (Kopylov *et al.*, 2020a). Additionally, the lack of a vein 2Rs+M (vs. present in the new fossil), the presence of a very long 1Rs *i.e.*, more than twice as long as 1M (vs. not twice as long as 1M), and the crossvein 2m-cu located close to 3rs-m (vs. separated from 3rs-m by a length longer than 1Rs) are sufficient characters to refute any affinities of the new fossil with the genus *Daosyntexis*. The genus *Dolichosyntexis* has a forewing with 1r-rs present (vs. absent in the new specimen), the vein 1Rs straight and strongly inclined toward wing apex (vs. curved and subvertical), the vein 2r-rs located slightly before pterostigma mid-length (vs. at or slightly distad) (Kopylov, 2019). The genus *Eosyntexis* is *inter alia* characterized by a long vein 1Rs *i.e.*, at least 1.5× as long as 1M (vs. comparatively shorter in the new specimen, only 1.1× as long as 1M), the vein 1Rs is also straight or feebly curved (vs. abruptly curved) (Rasnitsyn, 1990; Rasnitsyn & Martínez-Delclòs, 2000; Ortega-Blanco *et al.*, 2008). Note that the curvature of 1Rs as figured in Ortega-Blanco *et al.* (2008: fig. 1f) for in *Eosyntexis senilis* is exaggerated when compared to the original drawing of Rasnitsyn (1990: fig. 148). The new specimen also differs from all the *Eosyntexis*, except *Eosyntexis parva*, in possessing a vein 2M+Cu (Rasnitsyn, 1990; Rasnitsyn *et al.*, 1998; Rasnitsyn & Martínez-Delclòs, 2000; Ortega-Blanco *et al.*, 2008). The genus *Parasyntexis* has a wing venation with 1r-rs present (vs. absent in the new specimen),

1Rs long and strongly inclined toward wing apex (*vs.* comparatively short and not strongly inclined), and a hind wing with a completely different configuration of the veins (Kopylov, 2019: fig. 2A). Finally, our specimen differs from the only extant genus of the family (*viz.*, *Syntexis*) because of its forewing with only one r-rs crossvein (*vs.* two), the vein 1Rs comparatively shorter and curved (*vs.* longer and straight), the vein 2Rs+M present (*vs.* absent), and the vein 2r-rs slightly inclined (*vs.* vertical) (Goulet & Huber, 1993: fig. 33). The hind wing of *Syntexis* strongly differs from that of our specimen, *inter alia*, because of the absence of the abscissa 2M+Cu (*vs.* present the new specimen), the crossvein m-cu present (*vs.* absent), and the cell r opened (*vs.* closed).

## **Conclusion**

The diversity of ‘Symphyta’ from the mid-Cretaceous Burmese amber is still underestimated and the description of *Curvitexis kopylovi* gen. et sp. nov. serves to increase the diversity of anaxyelid documented from the Burmese amber biota during the mid-Cretaceous. It also adds to the morphological diversity of the clade and suggests that the decline of the Anaxyelidae likely happened after the Cenomanian.

## **Acknowledgement**

We thank Dr. Dmitry S Kopylov and one anonymous reviewer for their meaningful comments. This work was contributed by CJ during its Ph.D. project.

## **References**



- Cruikshank, R.D., Ko, K., 2003. Geology of an amber locality in the Hukawng Valley, northern Myanmar. *Journal of Asian Earth Sciences* 21, 441–455. [https://doi.org/10.1016/S1367-9120\(02\)00044-5](https://doi.org/10.1016/S1367-9120(02)00044-5).
- Dai, L., Rasnitsyn, A.P., Shih, C., Wang, M., Ren, D., 2022. New Fossil Xyelidae (Hymenoptera: Symphyta) from the Mesozoic of Northeastern China. *Insects* 13, 383. <https://doi.org/10.3390/insects13040383>
- Gao, J., Engel, M.S., Grímsson, F., Gu, L., Ren, D., Gao, T.-P., 2022. The first xiphydriid wood wasp in Cretaceous amber (Hymenoptera: Xiphydriidae) and a potential association with *Cycadales*. *Fossil Record* 24, 445–453. <https://doi.org/10.5194/fr-24-445-2022>
- Gao, J., Engel, M.S., Shih, C., Ren, D., Gao, T., 2021. A new genus of anaxyelid wood wasps from the mid-Cretaceous and the phylogeny of Anaxyelidae (Hymenoptera). *Journal of Hymenoptera Research* 86, 151–169. <https://doi.org/10.3897/jhr.86.73161>
- Gao, T., Shih, C., Rasnitsyn, A.P., Ren, D., 2013. *Hoplitolyda duolunica* gen. et sp. nov. (Insecta, Hymenoptera, Praesiricidae), the Hitherto Largest Sawfly from the Mesozoic of China. *PlosOne* 8, e62420. <https://doi.org/10.1371/journal.pone.0062420>
- Goulet, H., Huber, J.T., 1993. *Hymenoptera of the world: an identification guide to families*. Ottawa: Agriculture Canada, pp. 680.
- Grimaldi, D.A., Ross, A.J., 2017. Extraordinary Lagerstätten in amber, with particular reference to the Cretaceous of Burma. In: Fraser, N.C. & Sues, H.D. (Eds.), *Terrestrial Conservation Lagerstätten: Windows into the Evolution of Life on Land*. Dunedin Academic Press, Edinburgh, pp. 287–342.

- Kopylov, D.S., 2019. New anaxyelids (Hymenoptera: Anaxyelidae) from the Cretaceous of Asia. *Zootaxa* 4603, 341–353. <https://doi.org/10.11646/zootaxa.4603.2.7>
- Kopylov, D.S., Rasnitsyn, A.P., Aristov, D.S., Bashkuev, A.S., Bazhenova, N.V., Dmitriev, V.Yu., Gorochoy, A.V., Ignatov, M.S., Ivanov, V.D., Khramov, A.V., Legalov, A.A., Lukashevich, E.D., Mamontov, Yu.S., Melnitsky, S.I., Ogłaza, B., Ponomarenko, A.G., Prokin, A.A., Ryzhkova, O.V., Shmakov, A.S., Sinitshenkova, N.D., Solodovnikov, A.Yu., Strelnikova, O.D., Sukacheva, I.D., Uliakhin, A.V., Vasilenko, D.V., Wegierek, P., Yan, E.V., & Zmarzły, M. 2020b. The Khasurty Fossil Insect Lagerstätte. *Paleontological Journal* 54, 1221–1394. <https://doi.org/10.1134/S0031030120110027>
- Kopylov, D.S., Rasnitsyn, A.P., Zhang, H.C., Zhang, Q., 2020a. Anaxyelidae of Daohugou: oldest occurrences of the relict family in the fossil record. Part1: *Daosyntexis* and *Brachysyntexis*. *Alcheringa: An Australasian Journal of Palaeontology* 44, 104–114. <https://doi.org/10.1080/03115518.2019.1697753>
- Malm, T., Nyman, T., 2014. Phylogeny of the symphytan grade of Hymenoptera: new pieces into the old jigsaw(fly) puzzle. *Cladistics* 31, 1–17. <https://doi.org/10.1111/cla.12069>
- Nyman, T., Onstein, R.E., Silvestro, D., Wutke, S., Taeger, A., Wahlberg, N., Blank, S.M., Malm, T., 2019. The early wasp plucks the flower: disparate extant diversity of sawfly superfamilies (Hymenoptera: ‘Symphyta’) may reflect asynchronous switching to angiosperm hosts. *Biological Journal of the Linnean Society* 128, 1–19. <https://doi.org/10.1093/biolinnean/blz071>

- Ortega-Blanco, J., Rasnitsyn, A.P., Delclòs, X., 2008. First record of anaxyelid woodwasps (Hymenoptera: Anaxyelidae) in Lower Cretaceous Spanish amber. *Zootaxa* 1937, 39–50. <https://doi.org/10.11646/zootaxa.1937.1.3>
- Rasnitsyn, A.P., 1968. *Noviye Mezozoyskiye Pilil'shchiki (Hymenoptera, Symphata) [New Mesozoic Sawflies (Hymenoptera, Symphata)]*. *Yurskoy Nasekomiye Karatau [Jurassic Insects of Karatau]* 190–236.
- Rasnitsyn, A.P., 1990. Hymenopterans, Vespida, in *Pozdne-Mezozoyskie Nasekomye Vostochnogo Zabaykal'ya*. In A.P. Rasnitsyn (ed.), *Akademiya Nauk SSSR, Trudy Paleontologicheskogo Instituta*, 239, 177–205.
- Rasnitsyn, A.P., Jarzembowski, E.A., Ross, A.J., 1998. Wasps (Insecta: Vespida=Hymenoptera) from the Purbeck and Wealden (Lower Cretaceous) of southern England and their biostratigraphical and palaeoenvironmental significance. *Cretaceous Research* 19, 329–391. <https://doi.org/10.1006/cres.1997.0114>
- Rasnitsyn, A.P., Martínez-Delclòs, X., 2000. Wasps (Insecta: Vespida = Hymenoptera) from the Early Cretaceous of Spain. *Acta Geologica Hispanica* 35, 65–95.
- Rohwer, S.A., 1915. A remarkable new genus of Cephidae. *Proceedings of the Entomological Society of Washington* 17, 114–117.
- Ronquist, F., Klopstein, S., Vilhelmsen, L., Schulmeister, S., Murray, D.L., Rasnitsyn, A.P., 2012. A Total-Evidence Approach to Dating with Fossils, Applied to the Early Radiation of the Hymenoptera. *Systematic Biology* 61, 973–999. <https://doi.org/10.1093/sysbio/sys058>

- Shi, G.-H., Grimaldi, D.A., Harlow, G.E., Wang, J., Yang, M.-C., Lei, W.-Y., Li, Q.-L., Li, X.-H., 2012. Age constraint on Burmese amber based on U-Pb dating of zircons. *Cretaceous Research* 37, 155–163. <https://doi.org/10.1016/j.cretres.2012.03.014>.
- Wang, Y.M., Ren, D., Kopylov, D.S., Gao, T.P., 2020. A new anaxyelid sawfly (Insecta, Hymenoptera, Siricoidea) in mid-Cretaceous Myanmar amber. *Cretaceous Research* 109, 104372. <https://doi.org/10.1016/j.cretres.2020.104372>
- Wickman, B.E., 1967. Life history of the incense-cedar wood wasp, *Syntexis libocedrii* (Hymenoptera: Syntexidae). *Annals of the Entomological Society of America* 60, 1291–1295. <https://doi.org/10.1093/aesa/60.6.1291>
- Yu, T.-T., Kelly, R., Mu, L., Ross, A., Kennedy, J., Broly, P., Xia, F.-Y., Zhang, H.-C., Wang, B., Dilcher, D., 2019. An ammonite trapped in Burmese amber. *Proceedings of the National Academy of Sciences of the United States of America* 116, 11345–11350. <https://doi.org/10.1073/pnas.1821292116>.

Figure captions

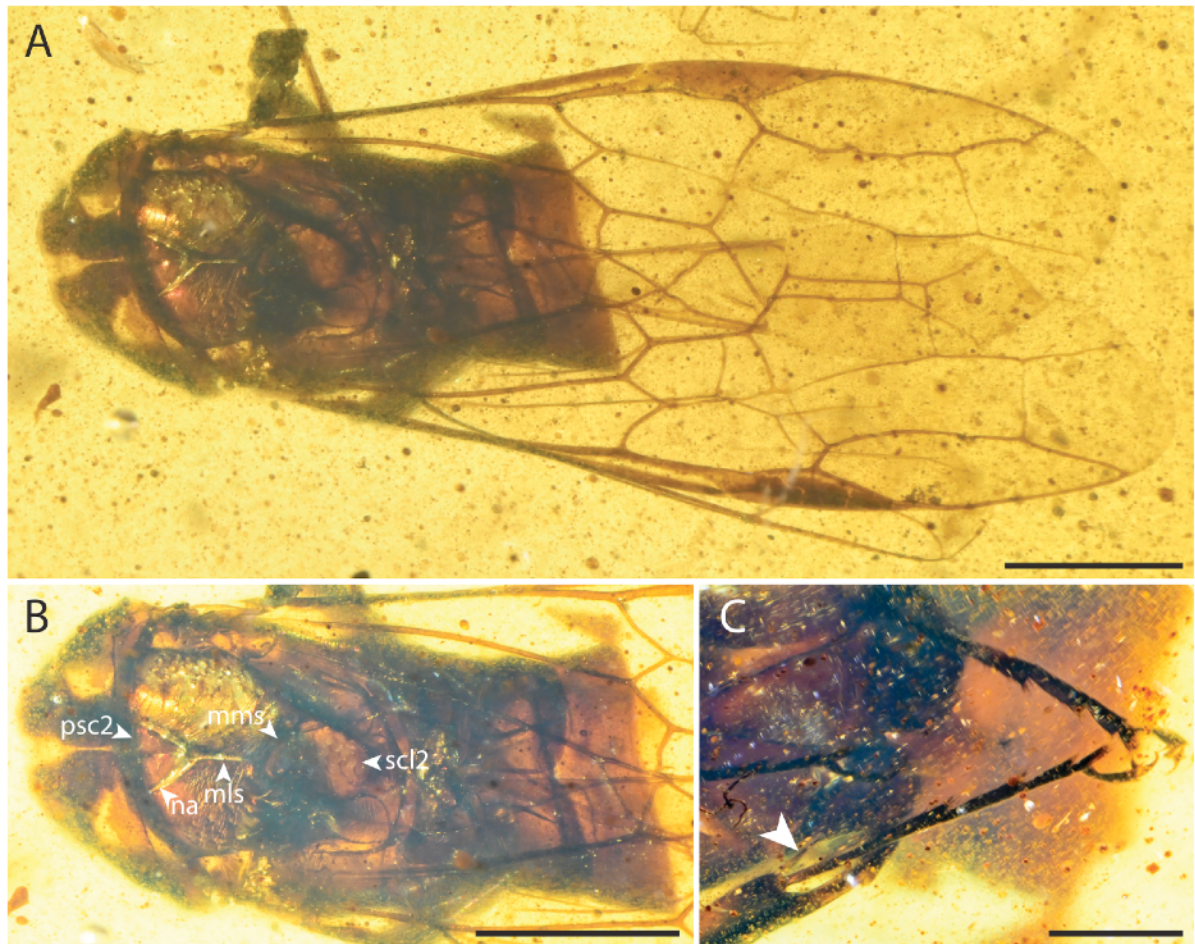


Figure 1. *Curvitexis kopylovi* gen. et sp. nov., holotype IGR.BU-064. A: Photograph of the specimen. B: Detailed view of the mesosoma. C: Detailed view of metatarsus. Abbreviations: mms, mesoscuto-mesoscutellar sulcus; mls, median longitudinal sulcus; na, notaulus; psc2, mesoprescutum; scl2, mesoscutellum. Scale bars: 1 mm (A, B); 0.5 mm (B).

*Curvitexis kopylovi* gen. et sp. nov., holotype IGR.BU-064. A : Photographie du spécimen. B : Vue détaillée du mesosoma. C : Vue détaillée du metatarsus. Abréviations : mms, sulcus mesoscuto-mesoscutellaire ; mls, sulcus longitudinal médian ; na, notaulus ; psc2, mesoprescutum ; scl2, mesoscutellum. Barres d'échelle 1 mm (A, B) ; 0.5 mm (B).

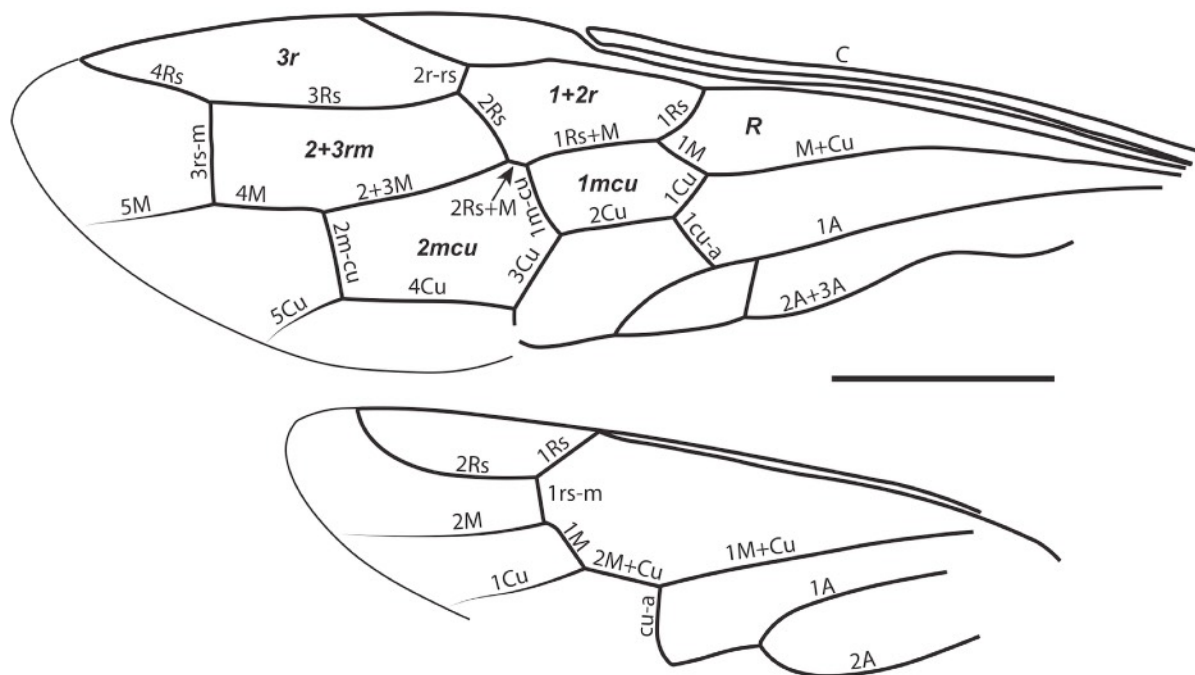


Figure 2. *Curvitexis kopylovi* gen. et sp. nov., holotype IGR.BU-064. Interpretative line drawing of the wings venation with names of veins and cells labeled. Scale bar equal 1 mm.

*Curvitexis kopylovi* gen. et sp. nov., holotype IGR.BU-064. Dessin interprétatif de la nervation des ailes avec les noms des veines et des cellules indiqués. Barre d'échelle égale à 1 mm.