



Research article

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The family Cretapsychidae (Insecta, Trichoptera) from mid-Cretaceous Burmese amber, with descriptions of two new species

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Abstract. The Cretaceous family Cretapsychidae Wichard, 2021 belongs to the superfamily Sericostomatoidea Stephens, 1836 and is characterized by the five-segmented maxillary palps, with the second segment being the longest and the following three segments becoming successively smaller, and the tibial spur formula 2/2/4. In addition, the wing venation is characterized by apical forks II, III, and V in the forewings and forks I, III, and V in the hindwings. The two newly described species (*C. kachini* sp. nov. and *C. myanmari* sp. nov.) extend the genus *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018 to six extinct species, all of which were found in mid-Cretaceous Burmese amber from Kachin State, Myanmar.

Keywords. Aquatic insects, maxillary palps, wing venation, Burmapsychidae, Helicophidae.

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Introduction

The Cretaceous trichopteran genus *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018 was initially assigned to the Jurassic family Dysoneuridae Sukatsheva, 1968 (Wichard *et al.* 2018). The family Dysoneuridae includes extinct genera from the Jurassic period (Sukatsheva 1968; Sukatsheva & Vassilenko 2013) whose fossilized forewings are represented in Jurassic rock impressions, but without other morphological characters of the adults. This family has been used as a ‘waste basket’ for extinct caddisflies with similar venation, that did not necessarily belong together taxonomically, e.g., *Liadotaulius* Handlirsch, 1939, *Burmapsyche* Wichard, Neumann, Müller & Wang, 2018, and *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018.

Based on the genus *Cretapsyche* and its morphological characteristics, the family Cretapsychidae Wichard, 2021 was established and assigned to the superfamily Sericostomatoidea Stephens, 1836,

and four species were included (Wichard *et al.* 2018; Wichard & Neumann 2019; Wichard 2021). The extinct sericostomatoid family, so far found only in Burmese amber, is characterized by the ‘dysoneurid’ forewing venation with the absence of forks I and IV in the forewings and absence of forks II and IV in the hindwings, as well as several characters on the body such as the spur formula 2/2/4 and the shape of the terminal segments of the palpi. Two new species are described here: *Cretapsyche kachini* sp. nov. and *C. myanmari* sp. nov.

Material and methods

The specimens are from an amber mine likely located near Noiye Bum Village, Tanaing Township, Myanmar (Kania *et al.* 2015), but the exact locality is unknown. The age given by U-Pb dating of zircons from the volcanoclastic matrix of the amber is early Cenomanian (98.8 ± 0.6 Ma) (Shi *et al.* 2012), but the geological age of Burmese amber can be expected to be slightly older than the zircon date.

The two fossil specimens are embedded in two small ambers cut from larger pieces of Burmese amber. They are almost completely intact and visible in ventral and dorsal views. The male genitalia are distinctly flattened and distorted, covered dorsally and laterally by the wings and therefore visible only in ventral or ventral-lateral view. Significant characters are often limited to the ventrally located inferior appendages. Hindwings are partially covered by forewings. Head, thorax, abdomen, and antennae are often complete or partially complete. The general wing pattern of *Cretapsyche* can be found in Fig. 1.

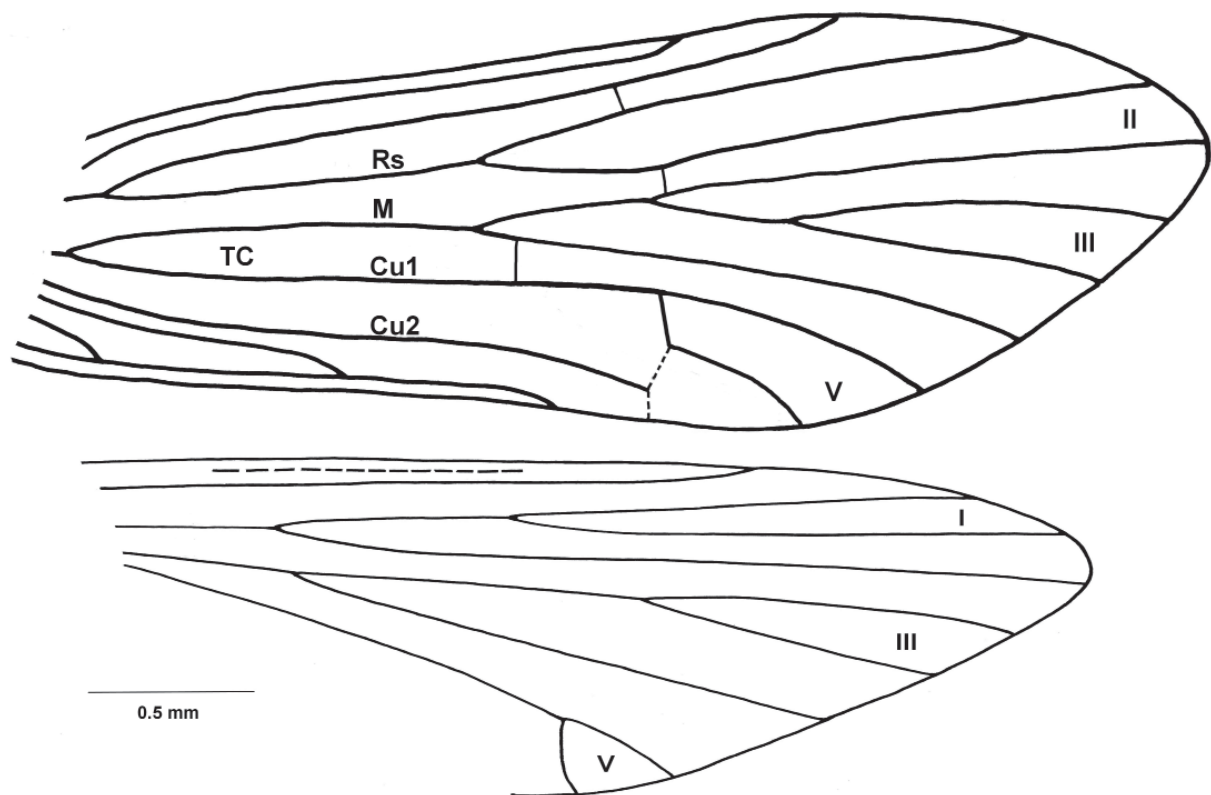


Fig. 1. *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018, wing venation in forewing with forks II, III, and V present, discoidal and thyridial cells open or closed, nygmata absent, in hindwing with forks I, III, and V usually present.

Photos were taken using a Leica M 420 Apozoom stereo microscope in combination with a Canon EOS 80D, EOS utility software and the Zerene Stacker software. All images and figures were prepared with CorelDraw X4 and Adobe Photoshop CS4.

Abbreviations

The wing venation terminology in general follows Holzenthal *et al.* (2007):

I	=	apical fork I
II	=	apical fork II
III	=	apical fork III
IV	=	apical fork IV
V	=	apical fork V
Cu1	=	cubitus anterior
Cu2	=	cubitus posterior
TC	=	thyridial cell

Abbreviations for male genitalia

coxo	=	coxopodite
harp	=	harpago
inf ap	=	inferior appendages
pre ap	=	preanal appendage (cercus)
X ap	=	mesodorsal processes of tergum X

The amber inclusions were kindly provided by Patrick Müller. The holotypes are deposited in the Zoological Research Museum Alexander Koenig, Bonn, Germany (ZFMK).

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Trichoptera Kirby, 1813
Suborder Integripalpia Martynov, 1924
Family **Cretapsychidae** Wichard, 2021

Type species

Cretapsyche Wichard, Neumann, Müller & Wang, 2018.

Revised description

HEAD. Male adult embedded in amber, light brown coloration. Large complex eyes on sides of head, slightly longer in diameter than head length. Ocelli absent. Antennae as long as, or slightly longer than forewings, each with scapus about as long as head, often bearing brush of dark setae; flagellomeres uniformly bar-shaped. Maxillary palps five-segmented; second segment longest, following three segments successively smaller and shorter; fifth segment shortest (Figs 2–4).

THORAX. Pronotum with one pair of oval setal warts. Mesonotum without setal warts on mesoscutum.

MESOSCUTELLUM. With one domed setal wart or pair of domed setal warts fused medially.

TIBIAL SPURS. 2/2/4.

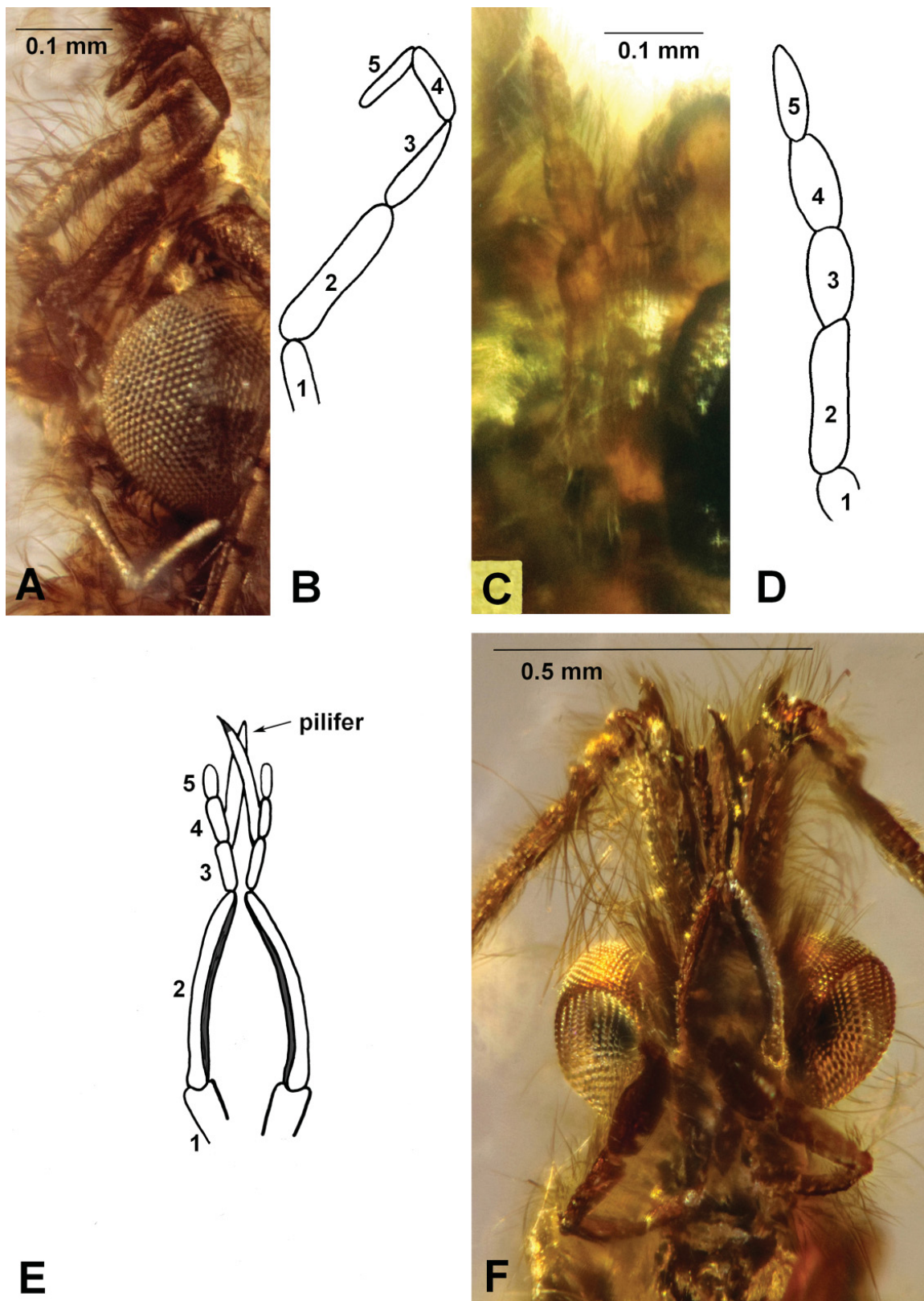


Fig. 2. The 5-segmented maxillary palps of species of *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018. **A–B.** *C. elegans* Wichard, Neumann, Müller & Wang, 2018. **C–D.** *C. circula* Wichard, Neumann, Müller & Wang, 2018. **E–F.** *C. palpinova* Wichard & Neumann, 2019.

WINGS (Fig. 1). Forewings broader than hindwings, each with rounded apex. In forewings, forks II, III, and V present; cubitus vein Cu2 ending in Cu1b or connected to Cu1b by crossvein. Discoidal, median, and thyridial cells present or absent. Nygmata absent. Anal vein reaching wing margin before fork V or before crossvein reaching wing margin. Hindwings with forks I, III, and V present.

MALE GENITALIA. Inferior appendages two-segmented, consisting of basal coxopodite and harpago simply attached to apex of coxopodite. Coxopodite arcuate, sub-triangular or scaly, broad, long and curved; harpago finger- or needle-shaped, often straight at base and curved mesad at apex. Two parallel appendages located centrally in genitalia interpreted as probable mesodorsal pair of lobes of tergum X. Preanal appendages small, elongate or finger-like curved.

Genus *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018

Type species

Cretapsyche circula Wichard, Neumann, Müller & Wang, 2018.

Description

See family description.

So far, four species have been described and two new species are described here:

Cretapsyche circula Wichard, Neumann, Müller & Wang, 2018

Cretapsyche elegans Wichard, Neumann, Müller & Wang, 2018

Cretapsyche insueta Wichard, Neumann, Müller & Wang, 2018

Cretapsyche palpinova Wichard & Neumann, 2019

Cretapsyche kachini Wichard & Espeland sp. nov.

Cretapsyche myanmari Wichard & Espeland sp. nov.

Cretapsyche kachini sp. nov.

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Fig. 3

Diagnosis

Cretapsyche kachini sp. nov. can be distinguished from all other species in the genus by having Rs branching before M in the forewing. In all other species, Rs and M branch at about the same level, or M branches before Rs. Additionally, in the male genitalia the harpago is two-thirds the length of the coxopodite.

Etymology

Cretapsyche kachini sp. nov. is named after Kachin State in Myanmar, where the amber inclusion was found.

Material examined

Holotype

MYANMAR – **Kachin State** • ♂; exact locality unknown; Mid-Cretaceous Burmese amber inclusion; deposited in the amber collection of the ZFMK; former Patrick Müller Collection, BUB 540; ZFMK-TRI000829.

Body well preserved; forewing in dorsal view, hindwing covered dorsally by forewing. Antennae and legs present. Male genitalia visible in ventral view.

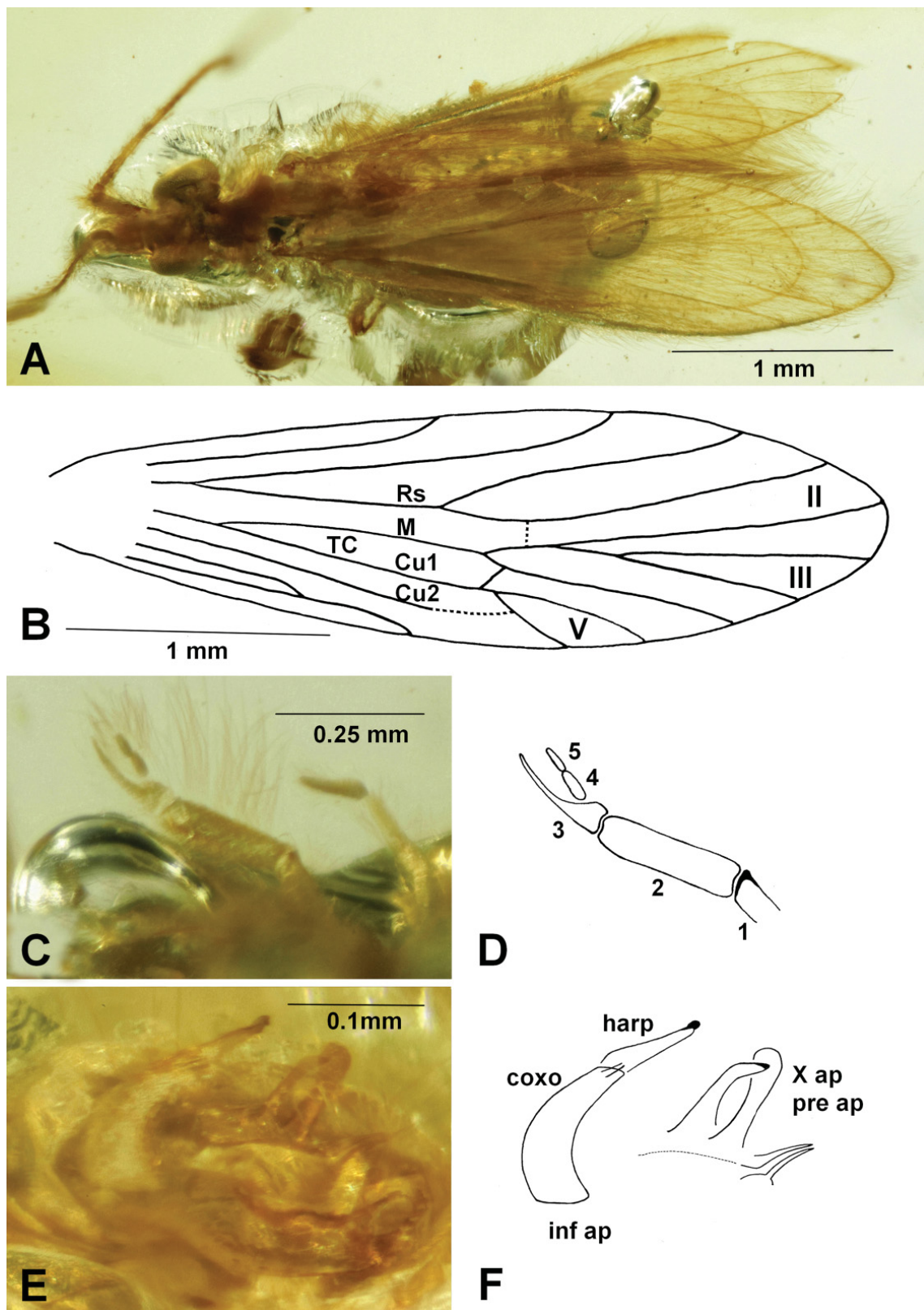


Fig. 3. *Cretapsyche kachini* sp. nov., holotype, ♂ (ZFMK-TRI000829). **A.** Dorsal view. **B.** Drawing of a forewing. **C.** Maxillary and labial palps. **D.** Drawing of the maxillary palp. **E.** Male genitalia in ventrolateral view, distinctly flattened and partially distorted. **F.** Drawing of male genitalia, left half.

Description

Male

Ocelli absent. Antennae probably about as long as forewings (holotype antennae incomplete). Scapus about as long as head. Maxillary palps 5-segmented, 2nd segment longest, following segments decreasing in length, 3rd segment basally barrel-shaped and extended laterad to form pointed spur corresponding in length to 4th and 5th segments. Body and wings light brown. Forewing with length 2.8 mm longer than small hindwing. In forewings, apical forks II, III and V present, discoidal cell absent, thyridial cell present, Cu2 running continuously to Cu1b. In hindwings, apical forks I, III and V present (difficult to see, holotype forewing hides hindwings in dorsal view). Tibial spur formula 2/2/4. In male genitalia, two-segmented inferior appendages characterized by basally broad coxopodite, tapering and curving mesad. Harpago elongate and tapering continuously towards apex, two-thirds of coxopodite length.

Cretapsyche myanmari sp. nov.

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Fig. 4

Diagnosis

Cretapsyche myanmari sp. nov. can be distinguished from all other species in the genus by having M branching before Rs in the forewing and an open thyridial cell. *Cretapsyche myanmari* sp. nov. can also be distinguished in the male genitalia by the mesodorsal processes of tergum X, scale-shaped, each with two black spines.

Etymology

Cretapsyche myanmari sp. nov. is named after Myanmar, where the amber inclusion was found in Kachin State.

Material examined

Holotype

MYANMAR – **Kachin State** • ♂; exact locality unknown; Mid-Cretaceous Burmese amber inclusion; deposited in the amber collection of the ZFMK; former Patrick Müller Collection, BUB 3597; ZFMK-TRI000830.

Body well preserved; forewing in dorsal view, hindwing covered dorsally by forewing. Antennae and legs present. Male genitalia visible in ventral view.

Description

Male

Ocelli absent. Antennae little longer than forewings. Scapus about as long as head, smaller pedicellus, followed by more than 30 cylindrical flagellomeres gradually shortening in length apically. Maxillary palps 5-segmented, 2nd segment longest, following three segments successively smaller and shorter. Body and wings light brown. Forewing with length about 2.8 mm. In forewings, apical forks II, III and V present, discoidal and thyridial cells absent, Cu2 running continuously to Cu1b. In hindwings, apical forks I, III and V present (holotype hindwings partially spread laterally and visible). Tibial spur formula 2/2/4. In male genitalia, two-segmented inferior appendages characterized by finger-shaped, curved coxopodite and by short and cone-shaped harpago. Two appendages, each with two dark spines, located centrally in genitalia interpreted as probable mesodorsal pair of lobes of tergum X (Wichard 2021).

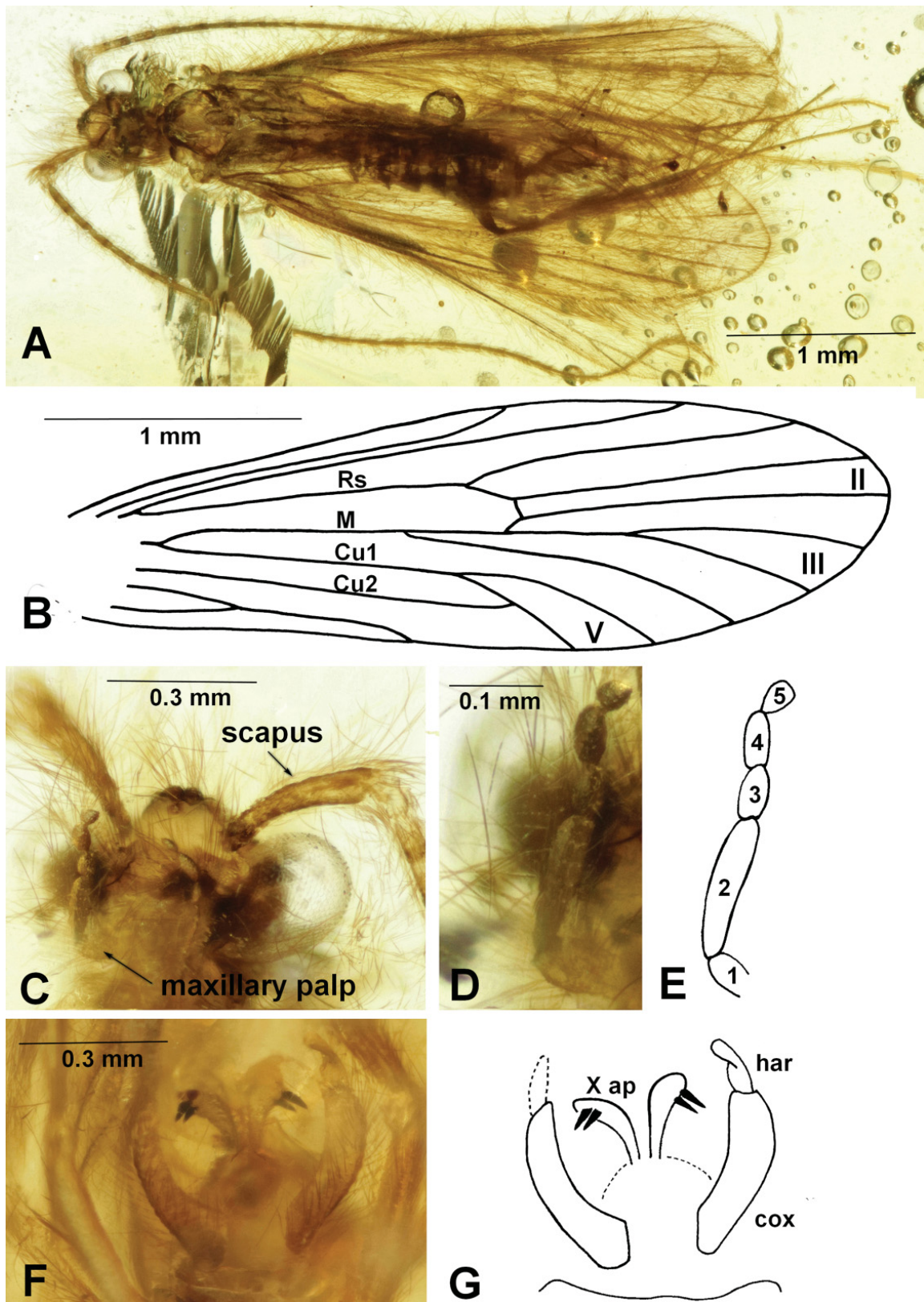


Fig. 4. *Cretapsyche myanmari* sp. nov., holotype, ♂ (ZFMK-TRI000830). **A.** Dorsal view. **B.** Drawing of a forewing. **C.** Head in dorsal view, with scapus, compound eye and maxillary palp. **D.** Left maxillary palp. **E.** Drawing of a maxillary palp. **F.** Male genitalia in ventral view. **G.** Drawing of male genitalia.

Key of males of species of *Cretapsyche* Wichard, Neumann, Müller & Wang, 2018

Family and genus characters: five-segmented maxillary palps with second segment longest; three-segmented labial palps; forewing forks II, III, and V and hindwing forks I, III, and V present; tibial spurs 2/2/4.

1. Forewing with Rs branching before M; in male genitalia, harpago shorter than coxopodite, cone-shaped *Cretapsyche kachini* sp. nov.
 - Forewing with Rs and M branching at about same level; in male genitalia, harpago about as long as coxopodite..... 2
 - Forewing with M branching before Rs; in male genitalia, harpago shorter than coxopodite, needle-shaped 3
2. Labial palps with third segment oval, flattened; maxillary palps each with pilifer arising from third segment *Cretapsyche palpinova* Wichard & Neumann, 2019
 - Labial palps with third segment simple; maxillary palps simple, without pilifers
..... *Cretapsyche circula* Wichard, Neumann, Müller & Wang, 2018
3. Forewing with thyridial cell open, fork V petiolate *Cretapsyche myanmari* sp. nov.
 - Forewing with thyridial cell closed, fork V nearly sessile..... 4
4. Median cell open; in male genitalia mesodorsal process of tergum X distinct, ventrally protruded...
..... *Cretapsyche insueta* Wichard, Neumann, Müller & Wang, 2018
 - Median cell closed; in male genitalia mesodorsal process of tergum X simple
..... *Cretapsyche elegans* Wichard, Neumann, Müller & Wang, 2018

Discussion

The extinct family Cretapsychidae belongs to the superfamily Sericostomatoidea following Johanson *et al.* (2017), characterized by the absence of ocelli (except for Anomalopsychidae Flint, 1981), by the terminal maxillary and labial segments both not being flexible or annulate, and by the tibial spur formula being 2/2/4, the latter stated to be a synapomorphy for the superfamily by Ross (1967). The family Cretapsychidae is distinguished from all other families of Sericostomatoidea by its wing venation (the absence of forks I and IV in the forewings and of forks II and IV in the hindwings) and by its maxillary palps (second segment longest, the following three segments successively smaller and shorter; fifth segment shortest).

In the presence of forks II, III, and V and the absence of forks I and IV in the forewings, the extinct Cretapsychidae agree with the extinct Burmapsychidae Wichard, 2021 and the extant Helicophidae Mosely, 1953. However, the Burmapsychidae differ from the Cretapsychidae in the latter's three-segmented maxillary palps in males, in the scapus being longer than the head, and in the modified flagellomeres of the antennae (Wichard 2021).

The extant Helicophidae and the extinct Cretapsychidae differ significantly in their geographic distributions and paleogeological history. The family Helicophidae is distributed in the southern hemisphere in the Neotropical (Chile, Patagonia) and Australasian (South Australia, New Zealand, New Caledonia) regions. The family Cretapsychidae is found so far only in Southeast Asia in Burmese amber from the Middle Cretaceous. Evidence of the extinct family dating back nearly 100 million years (early Cenomanian) does not suggest a shared history with the Gondwanan family Helicophidae, especially since the Australian continent did not drift into the southwest Pacific and thus into the geographic proximity of what is now Southeast Asia until the late Eocene (Hall 2011).

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