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# Cephidae (Hymenoptera) of the Mesozoic

# Цефиды (Hymenoptera) мезозоя

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***Key words*:** Cephidae, stem sawflies, Cretaceous, Eocene, *Mesocephus*, *Cuspilongus*, fossil insects.

***Ключевые слова*:** цефиды, стеблевые пилильщики, мел, эоцен, *Mesocephus*, *Cuspilongus*, ископаемые насекомые.

***Abstract.*** The morphology of the Early Cretaceous *Mesocephus ghilarovi* Rasnitsyn, 1988 is analyzed. By the structure of its ovipositor this species is closed to the Eocene *Cuspilongus cachecreekensis* Archibald et Rasnitsyn, 2015, and it is transferred to the genus *Cuspilongus* Archibald et Rasnitsyn, 2015 as *Cuspilongus ghilarovi* (Rasnitsyn, 1988), **comb.n**. Based on this distinctive ovipositor morphology we propose for the genus *Cuspilongus* the new subfamily Cuspilonginae **subfam.n.** Two new cephid species are described from the Late Cretaceous: *Mesocephus leleji* **sp.n.** and *M. brachycerus* **sp.n.** We propose that the genus *Mesocephus* Rasnitsyn, 1988 be used as a collective taxon for Mesozoic cephids not assignable to a genus-level orthotaxon. A checklist of fossil cephids is provided.

***Резюме.*** Изучена морфология раннемелового *Mesocephus ghilarovi* Rasnitsyn, 1988. По строению яйцеклада этот вид сближается с эоценовым *Cuspilongus cachecreekensis* Archibald et Rasnitsyn, 2015, и он перенесен в род *Cuspilongus* Archibald et Rasnitsyn, 2015 как *Cuspilongus ghilarovi* (Rasnitsyn, 1988), **comb.n**. На основании уникального строения яйцеклада для рода *Cuspilongus* выделяется особое подсемейство Cuspilonginae **subfam.n.** Из верхнего мела описано 2 новых вида цефид: *Mesocephus leleji* **sp.n.** и *M. brachycerus* **sp.n.** Род *Mesocephus* Rasnitsyn, 1988 предлагается использовать как сборный таксон для точно неопределимых мезозойских цефид. Составлен список ископаемых цефид.

## Introduction

Cephidae is a small family of sawflies containing three extant subfamilies, which include about 20 genera and about 200 species, all of which feed exclusively on angiosperms. The family is the best represented in the Holarctic, and to a minor degree in the Oriental, Australian and Madagascar Regions, each of the latter two regions with one of two rare endemic subfamilies [Goulet, 1993; Taeger et al., 2010]. It is the only living representative of the Cephoidea, other family Sepulcidae is restricted to the Mesozoic [Rasnitsyn, 1988, 1993]. The fossil record of Cephidae is extremely small. There are only four species from the Mesozoic (including the two described here) and three from the Eocene (see checklist below). Two species described by Heer [1849] as cephids from the Miocene of Germany (Oeningen), *Cephites oeningensis* Heer, 1849 and *C. fragilis* Heer, 1849, are ants actually [Archibald, Rasnitsyn, 2015]. We revise here the Mesozoic Cephidae.

Table 1. Checklist of fossil Cephidae
Таблица 1. Список ископаемых Cephidae

| Species | Locality | Age | Reference |
|---|---|---|---|
| *Janus disperditus* Cockerell, 1913 | Florissant | $₽_2^3$ | [Cockerell, 1913] |
| *Electrocephus stralendorffi* Konow, 1897 | Baltic amber | $₽_2^3$ | [Konow, 1897] |
| *Cuspilongus cachecreekensis* Archibald et Rasnitsyn, 2015 | Okanagan Highlands | $₽_2^1$ | [Archibald, Rasnitsyn, 2015] |
| Cephinae *species A* | Okanagan Highlands | $₽_2^1$ | [Archibald, Rasnitsyn, 2015] |
| *Mesocephus brachycerus* **sp.n.** | Obeshchayushchiy | $K_2$ | This paper |
| *Mesocephus leleji* **sp.n.** | Obeshchayushchiy | $K_2$ | This paper |
| *Cuspilongus ghilarovi* (Rasnitsyn, 1988) (= *Mesocephus ghilarovi* Rasnitsyn, 1988), **comb.n.** | Bon-Tsagan | $K_1$ | [Rasnitsyn, 1988] |
| *Mesocephus sibiricus* Rasnitsyn, 1968 | Baissa | $K_1$ | [Rasnitsyn, 1968] |

Comment. $K_1$ — Early Cretaceous; $K_2$ — Late Cretaceous; $₽_2^1$ — Early Eocene.; $₽_2^3$ — Late Eocene.
Примечание. $K_1$ — ранний мел, $K_2$ — поздний мел, $₽_2^1$ —ранний эоцен; $₽_2^3$ — поздний эоцен.

K1 – ранний мел, K2 – поздний мел

## Material and Methods

There are only five specimens of Mesozoic cephids known to date and all were recovered from three Asian localities. They are housed in the collection of the Paleontological Institute, Russian Academy of Sciences (PIN RAS).

**Baissa** — Russia, Buryatia, Yeravninsky District, left bank of Vitim River below Baissa stream mouth. Early Cretaceous, Barremian?, Zaza Formation. Collection PIN, № 1989 [Zherikhin et al., 1998; Rasnitsyn, Zherikhin, 2002]. One specimen: *Mesocephus sibiricus* [Rasnitsyn, 1968].

**Bon-Tsagan** (Bon-Tsagaan) — Mongolia, Bayankhongor Province, 5–8 km to the South of Böön Tsagaan Lake. Early Cretaceous, Aptian, Bontsagaan Series, Khurilt Member. Collection PIN, № 3559 [Sinitsa, 1993; Rasnitsyn, Zherikhin, 2002]. One specimen: *Cuspilongus ghilarovi* (= *Mesocephus ghilarovi*, **comb.n.**) [Rasnitsyn, 1988].

**Obeshchayushchiy** — Russia, Magadan Area, Tenkinskii District, middle section of Obeshchayushchiy Creek (a right tributary of the Nil River, in the upper basin of the Arman' River). Upper Cretaceous, Santonian-lower Campanian, Ola Formation. Collection PIN, № 3901 [Rasnitsyn, Zherikhin, 2002; Herman, 2011]. Three specimens, described below.

The specimens were collected, prepared and studied using standard palaeoentomological methods. Photographs were taken with a Leica MZ 9.5 microscope and Leica DFC 420 camera. Line drawings were made using CorelDraw X6 software.

## Systematic part

Hymenoptera
Cephoidea
**Cephidae**
Cuspilonginae Kopylov et Rasnitsyn, **subfam.n.**

***Type genus.*** *Cuspilongus* Archibald et Rasnitsyn, 2015.

***Genera included.*** Only type genus.

***Diagnosis.*** Fore wing with intercostal area less transparent than rest of wing membrane, stigma narrow, 1r-rs distant from 2r-rs, emerges from R (R goes deeply into stigma, in poorly preserved specimens appearing that 1r-rs emerged from stigma distant from its base: Fig. 3), crossvein 3r-m present. Ovipositor strong, saber-shaped, curved downward, nearly as long as fore wing.

***Comparison.*** The subfamily differs from all other cephids by its long, saber-shaped ovipositor. It further differs from the Athetocephinae by infuscated fore wing costal space and downcurved ovipositor; from Australcephinae by narrow pterostigma, 1r-rs distant from 2r-rs, and presence of 3r-m.

***Description.*** As in description of its only genus, below.

### ***Cuspilongus*** Archibald et Rasnitsyn, 2015

*Cuspilongus* Archibald et Rasnitsyn, 2015: 11–12, Figs 6, 7.

***Type species:*** *Cuspilongus cachecreekensis* Archibald et Rasnitsyn, 2015.

***Species included.*** *C. cachecreekensis* Archibald et Rasnitsyn, 2015, *C. ghilarovi* (Rasnitsyn, 1988) (= *Mesocephus ghilarovi* Rasnitsyn, 1988), **comb.n.**

***Description.*** Female (male unknown). Medium-sized cephids with fore wing length 10–12 mm. Head, thorax and ovipositor very dark. Fore wing: 1-M straight or slightly arched; 1r-rs complete; 2r-rs joined stigma near or slightly distad mid-point; cell 3r 4–5 times as long as wide; 3r-m straight; 1m-cu almost interstitial to Rs+M furcation (displaced forwards or backwards less than vein width). Hind wing: 3r-m, m-cu and cu-a present.

***Remarks.*** The body was interpreted incorrectly in the original description of *Cuspilongus ghilarovi* [Rasnitsyn, 1988] because of the holotype specimen was not completely prepared at that time and the abdomen and ovipositor were not visible. Preparation was subsequently done on the specimen in 2015 revealing that it bears the same long ovipositor as does the newly described *C. cachecreekensis*. This distinctive ovipositor morphology is clearly taxonomically informative showing these species to be closely related. Based on this, combined with its similar wing venation, we transfer *Mesocephus ghilarovi* Rasnitsyn, 1988 to the genus *Cuspilongus*, which we separate from other cephids in the new subfamily Cuspilonginae.

### *Cuspilongus ghilarovi* (Rasnitsyn, 1988), **comb.n.**

Figs 1–7.

*Mesocephus ghilarovi* Rasnitsyn, 1988: 70–71, Fig. 1.2.

***Type material.*** Holotype: PIN, 3559/652 (Figs 1–7), part and counterpart. Imago, female. Well preserved fore wings; hind wings almost lost; body and legs seriously damaged, head and antennae not preserved; ovipositor well preserved, complete. Bon-Tsagan, Mongolia, Aptian.

***Redescription.*** Body and legs entirely dark. Fore wing with 1-M slightly arched; 1r-rs emerging from R slightly distant from pterostigma base, arched forwards; 2r-rs joining pterostigma slightly distad mid-point, nearly straight; 2r-m straight, twice as long as 4-M; 2m-cu slightly double S-curved. Ovipositor very massive, almost as long as fore wing, vertical cross-section anywhere mid-length 1.5 times fore wing 2rm cell height.

Fore wing length 10.2 mm, width 3.3 mm, ovipositor length 9.7 mm, width (at midlength) 0.87 mm.

***Comparison.*** This species differs from *C. cachecreekensis* by fore wing with 1r-rs, 2r-rs slightly displaced forward, 2r-m straight, ovipositor higher than fore wing cell 2rm, abdomen dark, and size smaller.

Cephidae (subfamily not assigned)

### ***Mesocephus*** Rasnitsyn, 1968

*Mesocephus* Rasnitsyn, 1968: 196–197, Fig. 5.

***Type species:*** *Mesocephus sibiricus* Rasnitsyn, 1968.

***Species included.*** *M. sibiricus* Rasnitsyn, 1968, *M. leleji* **sp.n.**, *M. brachycerus* **sp.n.**

***Description.*** Medium-sized cephids with fore wing 6.3–8.6 mm long. Mesonotum with strong notauli, longitudinal and V-shaped sutures. Fore wing with intercostal area narrow and dark, rest of membrane transparent; 1-M arched; stigma narrow; 1r-rs emerging from R, displaced distal from stigmal base (Figs 10, 11, 14); 2r-rs joins stigma at mid-point; cell 3r 3.2–4.0 times as long as wide; a1-a2 distad cell 1mcu base.

***Remarks.*** The fore wing venation of a number modern and Mesozoic cephid genera is very conservative. Unfortunate-

ly, sufficient detail of the minute body characters used in cephid systematics (e.g., the structures of the mandibles, palps and claws, details of the head capsule, etc.) is not discernible in known impression fossils. As results, determination of the genera renders practically impossible except to females of *Cuspilongus* where their distinctively enormous ovipositor is preserved. Therefore we propose to use the genus *Mesocephus* as a collective taxon for such Mesozoic cephids. The dark costal space and arched 1-M in the fore wing of known *Mesocephus* species is comparable with fore wing character states of *Pachycephus* Stein, 1876, but we do not assume that this indicates that they are closely related.

### *Mesocephus sibiricus* Rasnitsyn, 1968

Figs 8–12.

*Mesocephus sibiricus* Rasnitsyn, 1968: 196–197, Fig. 5.

***Type material.*** Holotype: PIN, № 1989/2602 (Figs 8–12), part and counterpart. Imago, sex unknown. An isolated fore wing, very well preserved. Baissa, Transbaikalia, Barremian?

***Redescription.*** Fore wing with veins dark; R curved downward before 1-Rs base, R+C as wide as stigma at this point; 1-M strongly curved right before Rs+M; 1r-rs slightly arched forwards, 1.4 times as long as 2r-rs; 3-Rs 1.5 times as long as 2-Rs; 4-Rs 2.0 times as long as 3-Rs, not parallel to 3-Rs, 3-M; cell 2rm 2.5 times as long as wide; 2r-m slightly s-curved, reclival; 3r-m straight, forming acute angle with 5-Rs; 1m-cu joins M at Rs+M furcation; a1-a2 as long as 2-1A. Fore wing length 8.6 mm, width 3.6 mm.

***Remarks.*** In the holotype of *M. sibiricus*, R has a space just proximad the base of 1r-rs. Originally it was interpreted as a bulla, but closer observation raised doubts about this determination. Upon re-examination, the ends of the veins are very sharp and do not appear to be a true vein border, the ruptured edges have exactly the same shape on both sides, and the hairs on the membrane just below the rupture are distorted (Figs 10, 11). All of this evidence leads us to the conclusion that this is not a bulla, but rather a post-mortem break in the vein.

### *Mesocephus leleji* Kopylov et Rasnitsyn, **sp.n.**

Figs 13–16.

***Type material.*** ***Holotype:*** PIN, № 3901/1023 (Figs 13–16), part without a counterpart. Imago, sex unknown. Fore wing, part of hind wing, head with basal antennomeres, and part of the thorax preserved; legs incomplete, abdomen lost. Head overlays propleuron. Obeshchayushchiy, Magadan region, Santonian to lower Campanian.

***Description.*** Head and thorax very dark, legs and antennae pale, veins dark. Head large, eyes elongated. Antennae filiform, basal flagellomeres 3.0–4.0 times as long as wide. Fore wing with R slightly angled at 1-Rs base, R+C 0.7 times as wide as stigma at this point; 1-M arched; 1r-rs slightly arched forwards, 1.5 times as long as 2r-rs; 3-Rs as long as 2-Rs; 4-Rs 2.3 times as long as 3-Rs, not parallel to 3-Rs, parallel to 3-M; cell 2rm 2.6 times as long as wide; 2r-m straight, vertical; 3r-m straight, forming obtuse angle with 5-Rs; 1m-cu joining M after Rs+M furcation; a1-a2 0.8 times as long as 2-1A. Head length 2.0 mm, width 1.6 mm; fore wing length 6.3 mm, width 2.7 mm.

***Etymology.*** In honor of Professor Arkadiy S. Lelej, a famous Russian hymenopterologist.

***Comparison.*** *Mesocephus leleji* **sp.n.** differs from other species (including *M. brachycerus* **sp.n.** described below) by head large, fore wing with 3-Rs short (as long as 2-Rs) and body size small. It further differs from *M. sibiricus* by shape of 1-M (arched, but not strongly curved before Rs+M), 4-Rs parallel to 3M, 3r-m forms an obtuse angle with 5-Rs, and 1m-cu joins M after Rs+M furcation.

### *Mesocephus brachycerus* Kopylov et Rasnitsyn, **sp.n.**

Figs 17–22.

***Type material.*** ***Holotype:*** PIN, № 3901/1028 (Figs 17–20), part, without a counterpart. Imago, sex unknown. One fore wing and antennae complete, head and thorax well preserved, abdomen and legs incomplete. ***Paratype.*** PIN, № 3901/21 (Figs 21, 22), part, without a counterpart. Imago, female. Head, thorax and abdomen complete; antennae, legs and ovipositor behind abdominal apex lost; two fore wings present, but venation poorly preserved. Obeshchayushchiy, Magadan region, Santonian-lower Campanian.

***Description.*** Body very dark; legs, antennae and wing veins dark. Head medium-sized. Antennae with 24 flagellomeres, fusiform, short (0.5 times as long as fore wing); central, distal flagellomeres twice as wide as basal ones; flagellomeres 1–3 3.0 times as long as wide, flagellomere 4 as long as wide, posterior flagellomeres gradually decreasing in length, subapical ones twice as wide as long, apical one almost twice as long as wide, acuminate. Fore wing: R straight at 1-Rs base, R+C 0.7 times as wide as stigma at this point; 1-M arched, gently curved before Rs+M; 1r-rs almost straight, as long as 2r-rs; 3-Rs 2.0 times as long as 2-Rs; 4-Rs 1.3 times as long as 3-Rs, parallel to 3-Rs and 3-M; cell 2rm 4.0 times as long as wide; 2r-m straight, vertical; 1m-cu joins M after Rs+M furcation; a1-a2 1.4–2.0 times as long as 2-1A.

Body length 8.0–10.5 mm, head length 1.6–2.0 mm, width 1.3–1.8 mm; antenna length 3.7 mm; fore wing length 7.2–8.1 mm, width 2.9–3.0 mm.

***Etymology.*** From the Greek «brachys» for short, and «keras» for horn.

***Comparison.*** *Mesocephus brachycerus* **sp.n.** differs from other species by 1r-rs and 2-1A short, cell 2rm long, 3-Rs long, and 4-Rs parallel to 3-Rs and 3-M.

***Remarks.*** The paratype of *M. brachycerus* has the basal part of its ovipositor preserved, but in dorsal view, so its shape, length and the size of its vertical cross-section cannot be determined.

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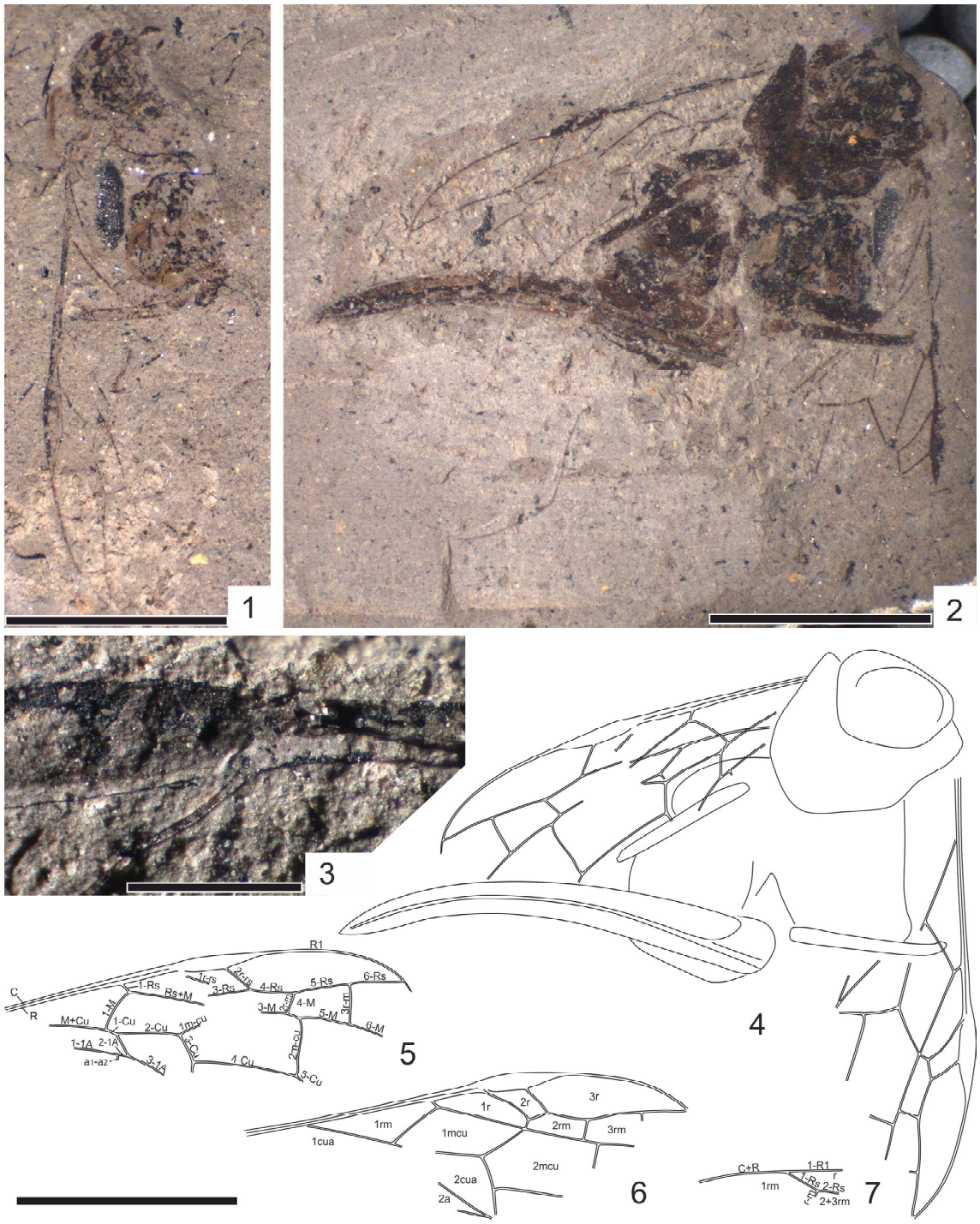
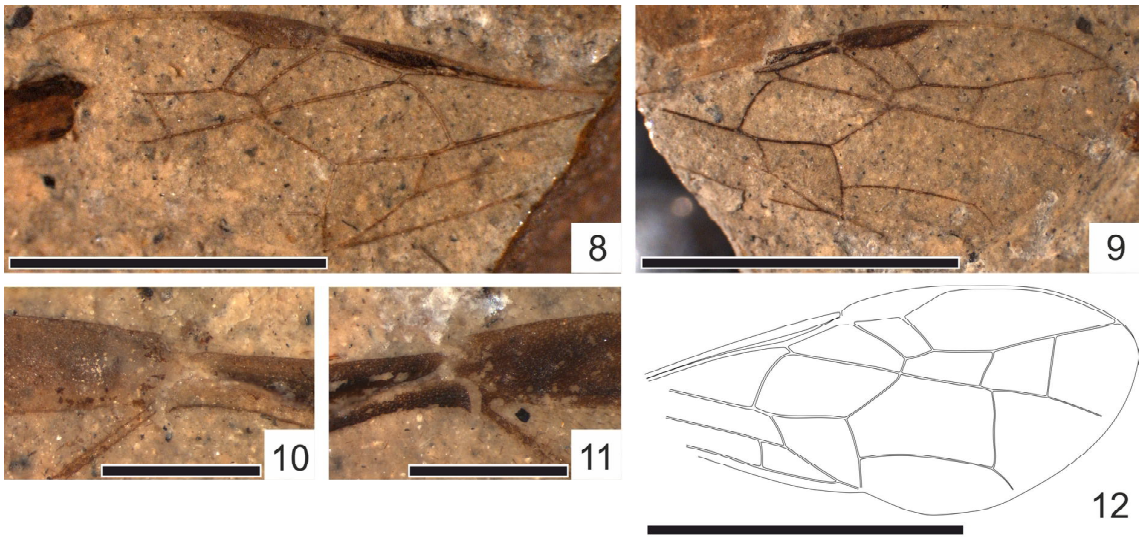


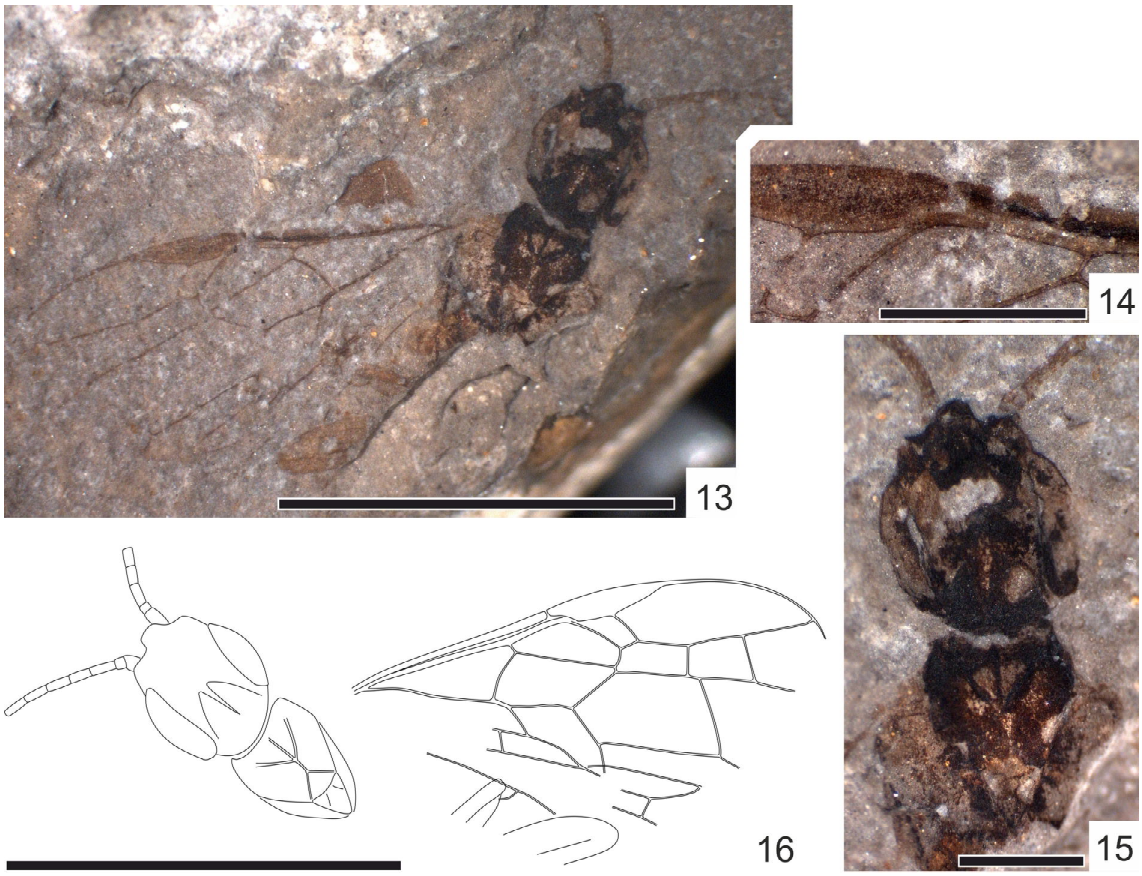

Figs 1–7. *Cuspilongus ghilarovi*, **comb.n.,** holotype PIN, № 3559/652, Bon-Tsagan, Mongolia, Aptian: 1 — photograph of counterpart; 2 — photograph of part; 3 — base of pterostigma, oblique light; 4 — habitus drawing; 5 — right wing with veins labeled; 6 –left wing with cells labeled; 7 — remains of hind wing with veins and cells labeled. Scale bars: 3 — 1.0 mm; others — 5.0 mm (4–7 — scale bar is common).

Рис. 1–7. *Cuspilongus ghilarovi*, **comb.n.,** голотип ПИН, № 3559/652, Бон-Цаган, Монголия, апт: 1 — фотографии противоотпечатка; 2 — фотографии отпечатка; 3 — основание птеростигмы, косой свет; 4 — общий вид, рисунок; 5 — правое крыло с обозначением жилок; 6 — левое крыло с обозначением ячеек; 7 — остатки заднего крыла с обозначением жилок и ячеек. Масштабная линейка: 3 — 1,0 мм; остальные — 5,0 мм (4–7 — линейка общая).



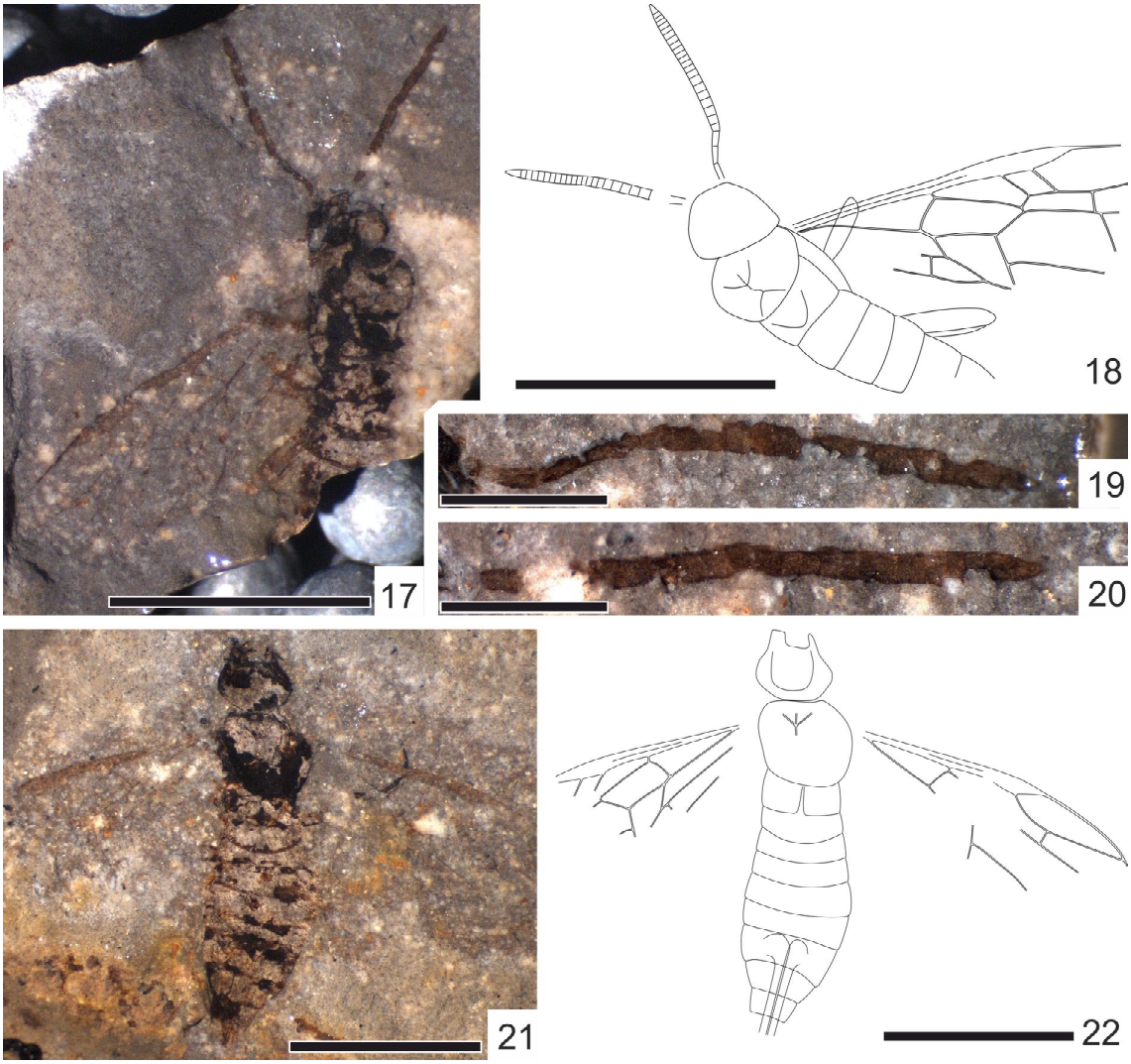

Figs 8–12. *Mesocephus sibiricus* Rasnitsyn, 1968, holotype PIN, № 1989/2602, Baissa, Transbaikalia, Barremian?: 8 — photograph of part; 9 — photograph of counterpart; 10, 11 — base of pterostigma; 12 — drawing of fore wing. Scale bars: 10, 11 — 0.5 mm; others — 5.0 mm.

Рис. 8–12. *Mesocephus sibiricus* Rasnitsyn, 1968, голотип ПИН, № 1989/2602, Байса, Забайкалье, баррем?: 8 — фотографии отпечатка; 9 — фотографии противоотпечатка; 10, 11 — основание птеростигмы; 12 — рисунок переднего крыла. Масштабная линейка: 10, 11 — 0,5 мм; остальные — 5,0 мм.




Figs 13–16. *Mesocephus leleji* **sp.n.**, holotype PIN, № 3901/1023, Obeshchayushchiy, Magadan Province, Santonian to lower Campanian: 13 — photograph of part; 14 — base of pterostigma; 15 — head and thorax; 16 — habitus drawing. Scale bars: 14, 15 — 1.0 mm; others — 5.0 mm.

Рис. 13–16. *Mesocephus leleji* **sp.n.**, голотип ПИН, № 3901/1023, Обещающий, Магаданская область, сантон — нижний кампан: 13 — фотография отпечатка; 14 — основание птеростигмы; 15 — голова и грудь; 16 — рисунок общего вида. Масштабная линейка: 14, 15 — 1,0 мм; остальные — 5,0 мм.




Figs 17–22. *Mesocephus brachycerus* **sp.n.**, holotype PIN, № 3901/1028 (17–20) and paratype PIN, № 3901/21 (21, 22), Obeshchayushchiy, Magadan Province, Santonian — lower Campanian: 17, 21 — photograph of part; 18, 22 — habitus drawing; 19, 20 — antennae. Scale bars: 19, 20 — 1.0 mm; others — 5.0 mm.

Рис. 17–22. *Mesocephus brachycerus* **sp.n.**, голотип ПИН, № 3901/1028 (17–20) и паратип ПИН, № 3901/21 (21, 22), Обещающий, Магаданская область, сантон — нижний кампан: 17, 21 — фотография отпечатка; 18, 22 — общий вид; 19, 20 — антенны. Масштабная линейка: 19, 20 — 1,0 мм; остальные — 5,0 мм.

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