

MIDDLE JURASSIC PRAEULACIDAE (INSECTA: HYMENOPTERA: EVANIOIDEA) OF INNER MONGOLIA AND KAZAKHSTAN

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SYNOPSIS Sixteen new and one undetermined species within six genera, of which two are recognised as new, referable to Praeaulacidae are described from the Middle Jurassic Daohugou deposits of Ningcheng, Inner Mongolia, China. They are *Praeaulacus orientalis* sp. nov., *Praeaulacus daohugouensis* sp. nov., *Praeaulacus exquisitus* sp. nov., *Praeaulacus scabratus* sp. nov., *Praeaulacus sculptus* sp. nov., *Praeaulacus robustus* sp. nov., *Praeaulacus afflatus* sp. nov., *Praeaulacon ningchengensis* sp. nov., *Praeaulacon elegantulus* sp. nov., *Aulacogastrinus insculptus* sp. nov., *Aulacogastrinus longaciculatus* sp. nov., *Aulacogastrinus hebeiensis* sp. nov., *Aulacogastrinus* sp., *Sinaulacogastrinus eucallus* gen. et sp. nov., *Eosaulacus giganteus* gen. et sp. nov. and *Eosaulacus granulatus* gen. et sp. nov. within Praeaulacinae, and *Anomopterella huangi* sp. nov. within Anomopterellinae. In addition, a new species, *Nevania karatau* sp. nov., assigned to Nevaniinae is reported from the Late Jurassic Karabastau Formation of Karatau, southern Kazakhstan. A key to known taxa within Praeaulacinae and Anomopterellinae, respectively, is presented. The presence of five common genera between the Daohugou and Karatau faunas indicates a close relationship between the two regions. Both a high attachment of metasoma on propodeum and a quite high diversity in the Praeaulacidae in the Middle Jurassic indicate that the Evanioidea probably emerged as early as in the Early Jurassic. The Anomopterellinae were parasitic on xylophages like Praeaulacinae.

KEY WORDS Insecta, Praeaulacidae, new taxa, Middle Jurassic, Daohugou, China, Karatau

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INTRODUCTION

The Evanioidea comprises two extant families, Gasteruptiidae and Evaniidae (Townes 1950; Rasnitsyn 1988, 2002). Although some hymenopterists (e.g. Hanson & Gauld 1995; Gauld & Bolton 1996) treat Aulacidae as a third family of Evanioidea, we consider it a subfamily of Gasteruptiidae. As well as them, two extinct families, Praeaulacidae and Andreneliidae, have also been placed in this superfamily (Rasnitsyn 1972, 2002; Rasnitsyn & Martínez-Delclòs 2000). The Cretevaniidae, from the Cretaceous of Eurasia, which was previously considered as a family within the Evanioidea (Rasnitsyn 1975, 1991; Jarzembowski 1984; Rasnitsyn *et al.* 1998; Zhang & Zhang 2000), is now included in the Evaniidae (Basibuyuk *et al.* 2002; Zhang *et al.* 2007).

The Gasteruptiidae *s.l.* is composed of four subfamilies, the extant Gasteruptiinae and Aulacinae, and the extinct Baissinae (abundant and diverse in the Early Cretaceous of Eurasia; Rasnitsyn *et al.* 1998) and Kotujellitinae (from the Lower Cretaceous of East Asia; Rasnitsyn 1975, 1991). A cladistic analysis based on morphological characters shows that Gasteruptiidae *s.l.* is monophyletic, with the Baissinae being the most basal subfamily (Basibuyuk *et al.* 2002). Baissinae was given a full family rank (Engel 2006), which, however, has little support and is not adopted herein. The Evaniidae includes 20 extant genera with over 450 species (Deans & Huben 2003) and not more than 10 extinct genera in the Cretaceous of Eurasia and North America and in the lowermost Eocene of France (Rasnitsyn 1975, 1991; Basibuyuk *et al.* 2000a, b, 2002; Zhang & Zhang 2000; Nel *et al.* 2002; Deans *et al.* 2004; Engel 2006; Zhang *et al.* 2007). The Praeaulacidae comprises four subfamilies, Cretocleistogastrinae from the Lower Cretaceous of East Asia and Australia (Rasnitsyn 1972, 1990a, b), Praeaulacinae and Anomopterellinae from the Upper Jurassic of South Kazakhstan (Rasnitsyn 1972, 1975) and Nevaniinae from the Middle Jurassic of North China (Zhang & Rasnitsyn 2007), and has been proposed as representing the ancestral group of the whole Evanioidea (Rasnitsyn

1988). The Andreneliidae, represented by a single specimen from the Lower Cretaceous of Spain (Rasnitsyn & Martínez-Delclòs 2000), is generally considered as holding an intermediate position between Praeaulacidae and other families (Rasnitsyn & Martínez-Delclòs 2000; Rasnitsyn 2002) although its type genus, *Andrenelia* Rasnitsyn, is considered to be a probable evaniid taxon (Deans *et al.* 2004; Engel 2006) or to be unplaced within the Evanioidea (Basibuyuk *et al.* 2002).

Although the monophyly of the Evanioidea has been questioned by some hymenopterists (Gibson 1985, 1986; Johnson 1988; Whitfield *et al.* 1989; Gauld & Bolton 1996; Dowton & Austin 2001: figs 2–4, 6, 8, 10), it may yet prove to be a natural grouping (Deans *et al.* 2004).

Here, we describe some wasps referable to the subfamilies Praeaulacinae and Anomopterellinae from the Daohugou deposits in Inner Mongolia, China. In addition, a nevaniine wasp is reported herein based on a forewing from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan.

MATERIALS AND METHODS

Specimens assigned to both Praeaulacinae and Anomopterellinae are described here from Daohugou in Ningcheng, Inner Mongolia, China. The Daohugou deposits have yielded abundant and diverse insects as well as other fossils, and their age is generally considered to be Middle Jurassic (for details, see Wang *et al.* 2006). All the specimens described here except the nevaniine from Karatau, which is kept in the Palaeontological Institute, Russian Academy of Sciences, are housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Observations of these specimens were made under a light microscope (NIKON SMZ1000) and photographs were prepared using a digital camera (DXM1200) connected to this microscope at the State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing. Line drawings were made using

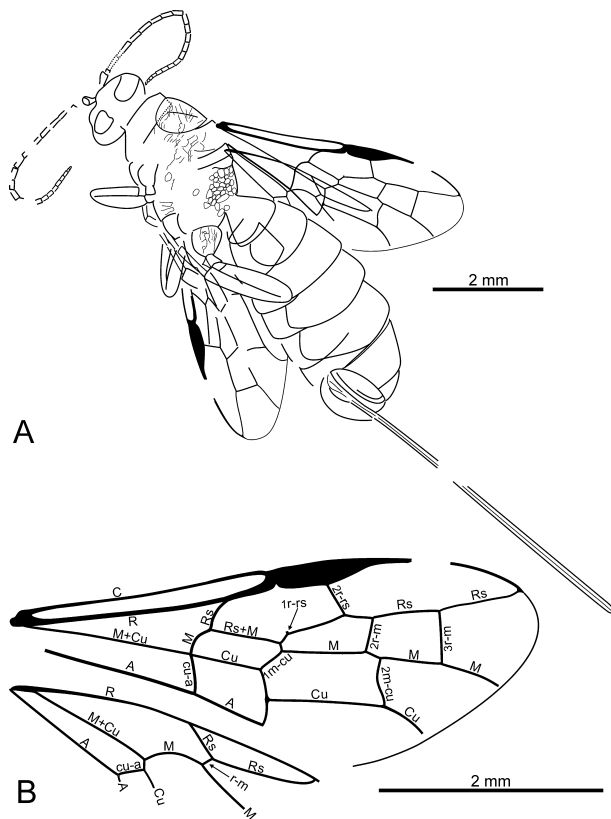


Figure 1 *Praeaulacus orientalis* sp. nov., holotype, NND0758/NIGP148216a (part). **A**, line drawing of body; **B**, line drawing of its wings to show venal symbols.

the software CorelDRAW 9. Wing venation terminology is basically adapted from Rasnitsyn (1969) and is shown in Figs 1 and 2.

SYSTEMATIC DESCRIPTIONS

Order **HYMENOPTERA** Linnaeus, 1758

Suborder **APOCRITA** Gerstaecker, 1867

Superfamily **EVANIOIDEA** Latreille, 1802

Family **PRAEULACIDAE** Rasnitsyn, 1972

Subfamily **PRAEULACINAE** Rasnitsyn, 1972

DIAGNOSIS. Antennae polymerous with scape shorter than some basal flagellomeres. Mesonotum transversely ridged. Forewing with M+Cu fork much closer to pterostigma than to wing base; 1r-rs rudimentary or absent; 2–3r-m and 2m-cu always present; 1m-cu meeting 2rm; cu-a meeting M+Cu just at its fork into M and Cu (interstitial) or meeting Cu slightly beyond fork of M+Cu (postfurcal); 2A absent. Hindwing with C absent, R strong, reaching apex of Rs and forming a distinct vein; cells rm and cua always closed. Ovipositor long with sheaths more than half length of metasoma.

REMARKS. Almost all specimens from Daohugou possess a transversely ridged mesonotum but only a few from Karatau display this character (Rasnitsyn 1972). Re-observation of the Karatau specimens shows this character is present in some specimens in various genera but is not detected in the majority, probably reflecting poorer preservation in Karatau.

KEY TO GENERA AND SPECIES WITHIN PRAEULACINAE.

1. Metasoma rounded basally ... *Praeaulacinus* Rasnitsyn, 1972 2
Metasoma not rounded basally 4
2. Antennae 14-segmented *P. crassipes* Rasnitsyn, 1972
Antennae 15-segmented 3
3. Ovipositor sheaths bent upwards for basal half *P. parvus* Rasnitsyn, 1973
Ovipositor sheaths bent downwards *P. minor* Rasnitsyn, 1972
4. First metasomal segment conical at least for anterior part 5
First metasomal segment tubular at least for anterior part 34
5. First metasomal segment conical for anterior part and rectangular for posterior part *Sinaulacogastrinus* gen. nov. (one species, *S. eucallus* sp. nov.)
First metasomal segment conical on the whole 6
6. Body longer than 16 mm excluding ovipositor; Rs origin very close to pterostigma ... *Eosaulacus* gen. nov. ... 7
Body shorter than 10 mm excluding ovipositor; Rs origin far from pterostigma 8
7. First metasomal segment transversely ridged dorsally for basal half and ventrally for the whole; hindwing with cu-a meeting M+Cu just before its fork *E. giganteus* gen. et sp. nov.
First metasomal segment transversely ridged for distal half and finely granulated for basal half; hindwing with cu-a meeting M+Cu far basad of its fork *E. granulatus* gen. et sp. nov.
8. Forewing with first abscissa of Rs not longer than its distance to pterostigma 9
Forewing with first abscissa of Rs longer than its distance to pterostigma 29
9. Forewing with 2r-rs shorter (unusually slightly longer) than maximal width of 2rm; hindwing with cu-a meeting Cu distad of M+Cu fork ... *Praeaulacus* Rasnitsyn, 1972 10
Forewing with 2r-rs usually greatly (over 1.5 times) longer than maximal width of 2rm; hindwing with cu-a meeting M+Cu basad of M+Cu fork ... *Praeaulacon* Rasnitsyn, 1972 24
10. Forewing with 1r-rs rudimentary like a short stub on Rs, where Rs is geniculate 11
Forewing with 1r-rs absent (2Rs slightly arched or straight) 14
11. Hindwing with a redundant branch of M present basally *P. ramosus* Rasnitsyn, 1972
Hindwing without redundant branch of M 12
12. First metasomal segment elongate basally *P. exquisitus* sp. nov.
First metasomal segment not elongate basally 13
13. Propodeal foramen very close to metapostnotum; forewing with cell 2rm 1.2 times as broad distally as basally *P. sculptus* sp. nov.
Propodeal foramen midway between metapostnotum and hind coxae; forewing with 2rm greatly broader distally than basally *P. orientalis* sp. nov.
14. Hindwing with M basad of r-m bent inwards cell rm 15
Hindwing with M basad of r-m straight 20

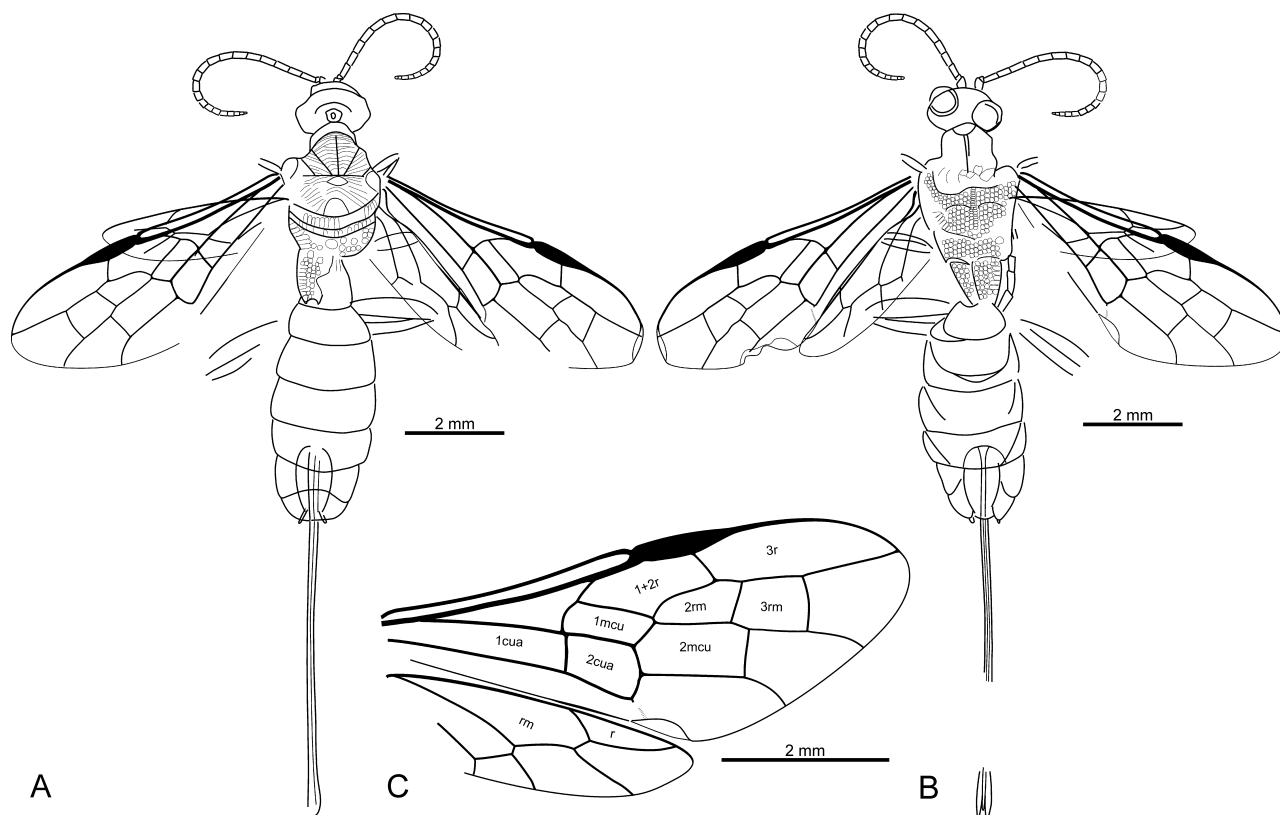


Figure 2 *Praeaulacus daohugouensis* sp. nov., holotype, NND0261/NIGP148217a/NIGP148217b (counterpart). **A**, line drawing of part; **B**, line drawing of counterpart; **C**, line drawing of wings to show wing cell symbols.

15. Hindwing with first section of M (1M) arched *P. scabratus* sp. nov.
Hindwing with 1M straight or slightly bent 16
16. Head large, rounded, about 3/4 length of mesosoma *P. cephalotus* Rasnitsyn, 1972
Head normal in size, less than half length of mesosoma 17
17. Antennae 22-segmented; first metasomal segment slightly convex laterally *P. daohugouensis* sp. nov.
Antennae less than 22-segmented; first metasomal segment not convex laterally 18
18. Antennae 21-segmented; metasoma subcylindrical beyond first segment *P. leptogaster* Rasnitsyn, 1972
Antennae filiform, 17–19-segmented; metasoma elongate-ovoid 19
19. Antennae 19-segmented *P. elegans* Rasnitsyn, 1972
Antennae 17-segmented *P. obscurus* Rasnitsyn, 1972
20. Hindwing with free A absent *P. ventricosus* Rasnitsyn, 1972
Hindwing with free A present 21
21. Antennae 15-segmented; forewing length 2 mm *P. cubocephalus* Rasnitsyn, 1972
Antennae over 15-segmented; forewing longer than 4 mm 22
22. Antennae 19-segmented; forewing about 5 mm in length *P. afflatus* sp. nov.
23. Antennae 23- or 24-segmented; body stout; first metasomal segment as long as wide 23
Antennae 27-segmented; body slender; first metasomal segment greatly longer than wide *P. robustus* sp. nov.
Antennae 27-segmented; body slender; first metasomal segment greatly longer than wide *P. magnus* Rasnitsyn, 1972
24. Forewing with 2r-rs 1.1 times as long as maximal width of 2rm *P. elegantulus* sp. nov.
Forewing with 2r-rs more than 1.5 times as long as maximal width of 2rm 25
25. Forewing with free M long; first metasomal segment transversely ridged dorsally *P. ningchengensis* sp. nov.
Forewing with free M very short or absent; first metasomal segment smooth surfacely 26
26. Antennae setaceous; body not shorter than 4 mm ... 27
Antennae filiform; body shorter than 3.5 mm 28
27. Metasoma slender *P. elongatus* Rasnitsyn, 1972
Metasoma broad *P. caudatus* Rasnitsyn, 1972
28. Metasoma swollen beyond its mid-length *P. coniventer* Rasnitsyn, 1972
Metasoma slender and shapely *P. tenuis* Rasnitsyn, 1972
29. Forewing with 3r-m strongly oblique *Praeaulacops* Rasnitsyn, 1972 (one species, *P. lucidus* Rasnitsyn, 1972)
Forewing with 3r-m not oblique ... *Praeaulacites* Rasnitsyn, 1972 31

30. Forewing with 2r-rs meeting 2r-m; forewing not shorter than 4 mm 32
Forewing with 2r-rs basad of 2r-m; forewing shorter than 3.5 mm 33
31. Forewing more than 6 mm in length; ovipositor sheaths not longer than forewing *P. pachygaster* Rasnitsyn, 1972
Forewing 4–4.5 mm in length; ovipositor sheaths longer than forewing *P. medius* Rasnitsyn, 1972
32. Ovipositor sheaths obviously shorter than forewing ...
..... *P. nigripes* Rasnitsyn, 1972
Ovipositor sheaths nearly as long as forewing 33
33. Forewing 2rm shorter than 3rm
..... *P. subniger* Rasnitsyn, 1972
Forewing 2rm longer than 3rm
..... *P. minimus* Rasnitsyn, 1972
34. First metasomal segment tubular for anterior part and bell-mouthed for remaining part ... *Aulacogastrinus* Rasnitsyn, 1983 35
First metasomal segment tubular on the whole 38
35. Antennae 17-segmented; forewing with 2r-rs meeting Rs just at the point where 2r-m meets and distinctly longer than maximal width of 2rm
..... *A. ater* Rasnitsyn, 1983
Antennae over 17-segmented; forewing with 2r-rs quite basad of 2r-m and at most slightly longer than maximal width of 2rm 36
36. Antennae 22-segmented *A. hebeiensis* sp. nov.
Antennae greatly over 22-segmented 37
37. Antennae at least 27-segmented; forewing with 1r-rs obscure; ovipositor sheaths slightly longer than forewings
..... *A. insculptus* sp. nov.
Antennae at least 32-segmented; forewing with 1r-rs rudimentary like a short stub on Rs; ovipositor sheaths greatly longer than forewing
..... *A. longaciculatus* sp. nov.
38. Second metasomal segment rectangular (in lateral view); forewing with 2r-rs meeting Rs much basad of 2r-m ...
..... *Evanigaster* Rasnitsyn, 1972 (one species, *E. petiolatus* Rasnitsyn, 1972)
Second metasomal segment triangular (in lateral view); forewing with 2r-rs meeting Rs where 2r-m meets
..... *Evanips* Rasnitsyn, 1972 (one species, *E. rostratus* Rasnitsyn, 1972)

Genus **PRAEULACUS** Rasnitsyn, 1972

1972 *Praeaulacus* Rasnitsyn: 72.

TYPE SPECIES. *Praeaulacus ramosus* Rasnitsyn, 1972 (by original designation).

REVISED DIAGNOSIS. Head not elongate downwards. Forewing with first abscissa of Rs not longer than its distance to pterostigma; 2r-rs meeting Rs basad of 2r-m (or, unusually, at the point where 2r-m meets Rs, and on such a condition 3rm longer than 2rm); 2r-rs shorter or, unusually, slightly longer than maximal width of 2rm; 3rm slightly shorter than 2rm, with outer margin (3r-m) not strongly oblique; 2rm in contact with 1mcu by a short section of M (2M). Hindwing with M and Cu possessing free ends; cu-a meeting Cu distad of M+Cu fork, and oblique. First metasomal segment conical or slightly elongate basally. Ovipositor long with sheaths at least two-thirds length of forewing.

REMARKS. The generic diagnosis has been slightly revised based on new material from Daohugou.

OCCURRENCE. Eight species from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan and seven from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

Praeaulacus orientalis sp. nov. (Fig. 1; Pl. 1, fig. 1)

TYPE MATERIAL. Holotype: NND0758/NIGP148216a (part) and NND0711/NIGP148216b (counterpart), in lateral aspect. A slightly damaged female wasp.

ETYMOLOGY. From the Latin *orientalis*, oriental.

DIAGNOSIS. See the key listed above.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Head medium-sized, transversely broad. Eyes medium-sized. Antenna 22-segmented with scape thin basally, swollen distally, and slightly longer than wide; pedicel small, distinctly narrower than scape distally; flagellum gradually increasing in thickness for basal three-quarters length, but decreasing for remaining part; first and second flagellomeres subequal in length and about 3 times as long as wide, third through twelfth becoming successively shorter but always distinctly longer than wide, remaining ones slightly longer than wide. Mesosoma comparatively short, slightly longer than high. Pronotum comparatively long. Mesonotum transversely ridged; notaulus visible; mesoscutellum half length of mesoscutum. Metanotum and metapostnotum short. Propodeum coarsely areolate; propodeal foramen slightly closer to hind coxa than to metapostnotum. Fore- and midleg thin and short. Hindleg with coxa thick basally, swollen subbasally and about as long as wide; trochanter small; tibia as long as femur (including trochantellus); tarsus incomplete, thin with basitarsomere 0.4 times length of tibia. Forewing with first abscissa of Rs as long as that of M and 0.7 times as long as its distance to pterostigma; pterostigmal base slightly closer to Rs origin than to 2r-rs; 1r-rs rudimentary like a stub on Rs where Rs is anteriorly geniculate; 2r-rs arising from pterostigma slightly beyond its mid-length, as long as maximal width of 2rm and meeting Rs far basad of 2r-m; 2r-m slightly oblique and 3r-m vertical; 1mcu nearly parallelogrammic, about 2.5 times as long as wide; 2m-cu meeting M slightly distad of 2r-m, distinctly sinuate; cu-a interstitial and slightly longer than first abscissa of M; 2mcu as broad as 2cua distally and 1.7 times as long as 1mcu. Hindwing with r-m oblique and 0.3 length of first abscissa of Rs; first abscissa of M strongly arched, five times as long as r-m; cu-a strongly oblique, meeting Cu slightly beyond fork of M+Cu into M and Cu. Metasoma long-ovoid, broadest at fifth tergo-sternal segment; first segment thin basally, conical, slightly shorter than wide, and 1.5 times as long as hind coxa; second to sixth about as long as first. Ovipositor with sheaths slightly longer than forewing.

Measurements in mm: antennal length 3.6; head length 0.8, width 1.3; mesosomal length 2.3; forewing length 4.7, width 1.9; hindwing (as preserved) length 2.8, width 0.7; metasomal length 4.7; ovipositor length 6.7, sheath length 5.6.

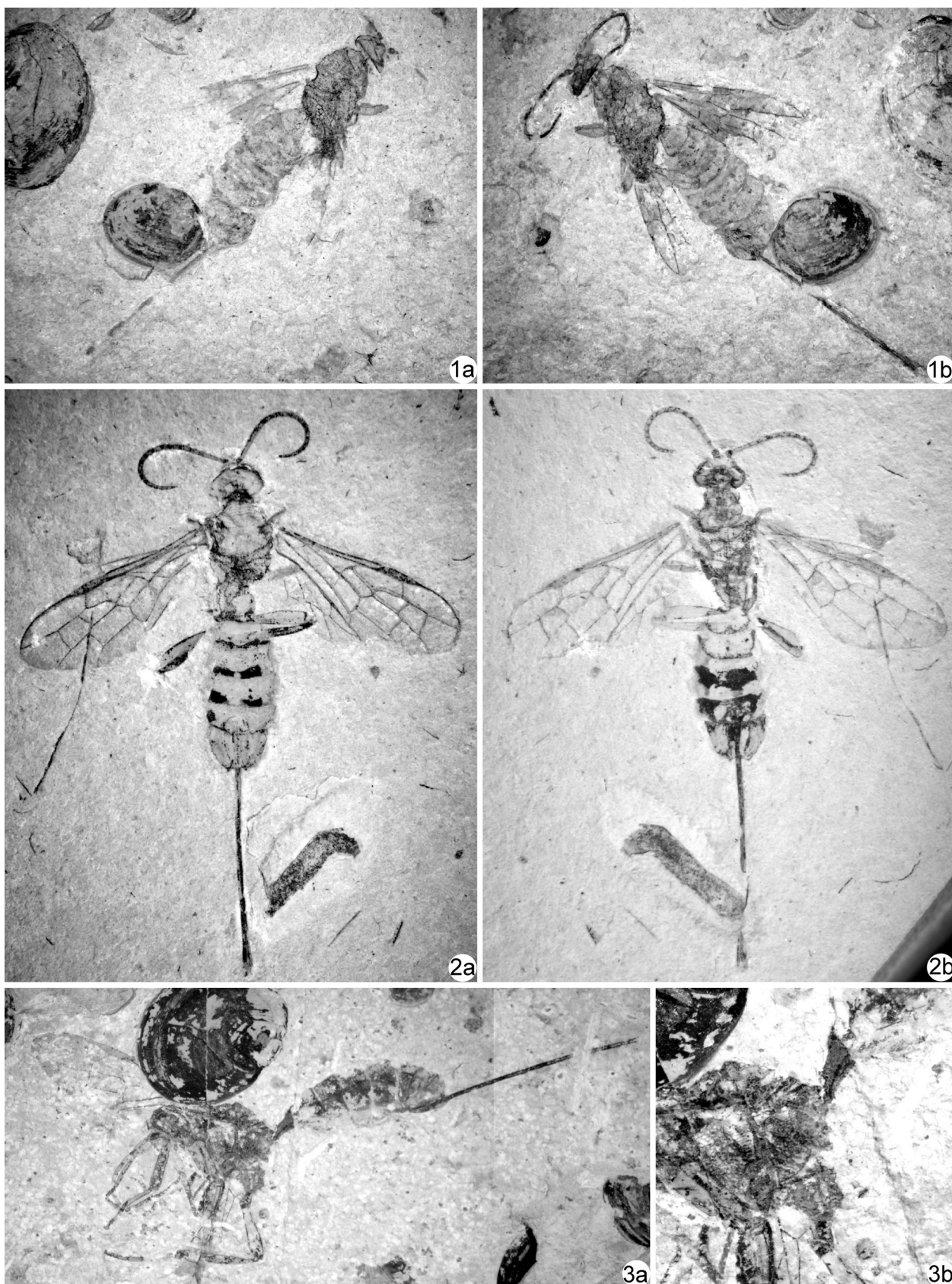


Plate 1 **Fig. 1** *Praeaulacus orientalis* sp. nov., holotype, NND0758/NIGP148216a (part) and NND0711/NIGP148216b (counterpart). **1a**, NND0711, in lateral aspect, $\times 6.4$; **1b**, NND0758, in lateral aspect, $\times 6.4$. **Fig. 2** *Praeaulacus daohugouensis* sp. nov., holotype, NND0261/NIGP148217a (part) and NND0262/NIGP148217b (counterpart). **2a**, NND0261, in dorsal aspect, $\times 6.3$; **2b**, NND0262, in ventral aspect, $\times 6.3$. **Fig. 3** *Aulacogastrinus insculptus* sp. nov., holotype, NND0260/NIGP148227, in dorsal aspect. **3a**, overall view, $\times 5.6$; **3b**, mesosoma and basal metasoma, $\times 11.4$.

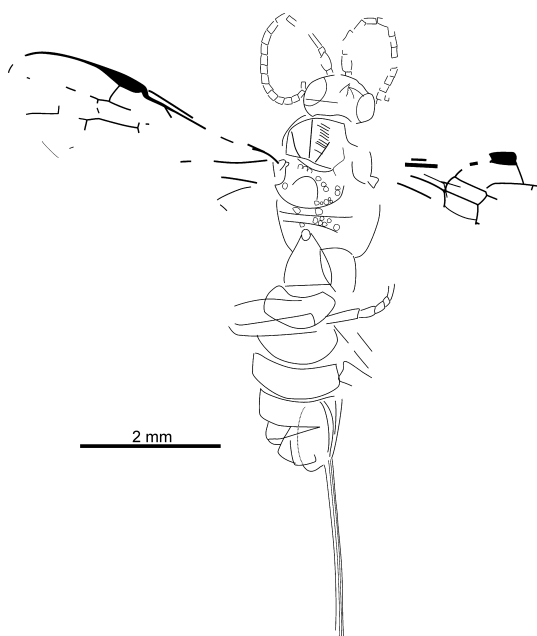


Figure 3 *Praeaulacus daohugouensis* sp. nov., paratype 1, NND0259/NIGP148218, line drawing.

***Praeaulacus daohugouensis* sp. nov** (Figs 2, 3; Pl. 1, fig. 2; Pl. 2, figs 1, 2)

TYPE MATERIAL. Holotype: NND0261/NIGP148217a (part) and NND0262/NIGP148217b (counterpart), in dorsal and ventral aspect, respectively. A rather well preserved female wasp with legs slightly damaged and a forewing slightly deformed. Paratype 1: NND0259/NIGP148218, in dorsal aspect. A poorly preserved female wasp with antennae slightly damaged, wings and legs seriously damaged and ovipositor missing distally. Paratype 2: NND0812/NIGP148219, in dorsal aspect. A poorly preserved female wasp with antennae, legs and first metasomal segment damaged and forewings folded for the left and damaged for the right.

ETYMOLOGY. From the locality Daohugou yielding the holotype.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Head medium-sized, transversely broad. Eyes medium-sized, circular. Antenna 22-segmented with scape thin basally, gradually increasing in width apically and slightly longer than wide; pedicel small, distinctly narrower than scape distally and about as long as wide; flagellum slightly and gradually increasing in thickness apically for basal two-thirds length but decreasing for remaining part; first flagellomere as broad basally as pedicel and 2.5 times as long as wide; remaining ones gradually becoming shorter in succession but at least as long as wide. Mesosoma nearly ovoid dorsally and slightly longer than wide. Pronotum comparatively short (probably covered in part with mesonotum). Mesonotum with transscutal suture straight; notauli and parapsidal sutures distinct, oblique; mesoscutellum as long as mesoscutum. Metanotum and metapostnotum short. Propodeum short dorsally; propodeal foramen small, rounded and very close to metapostnotum. Mesonotum transversely

ridged; metanotum, metapostnotum and propodeum coarsely areolate. Fore- and midleg thin and short. Hindleg with coxa thick basally, gradually decreasing in width distally, 1.5 times as long as wide and about as long as first metasomal segment; femur distinctly thicker and longer than mid femur; tibia thin; tarsus thin with basitarsomere longest, fourth tarsomere shortest. Forewing with first abscissa of Rs slightly shorter than that of M and than its distance to pterostigma; 2r-rs arising from pterostigma at about its basal two-thirds length, about as long as maximal width of 2rm and meeting Rs considerably basad of 2r-m; 2r-m slightly oblique and 3r-m subvertical; 1mcu nearly parallelogrammic, about 2.5 times as long as wide; 2m-cu meeting 3rm at basal one-quarter of its posterior margin; cu-a interstitial or very slightly postfurcal and slightly longer than first abscissa of M; 2mcu as broad as 2cua distally and 1.3 times as long as 1mcu. Hindwing with r-m strongly oblique and about 0.4 times length of first abscissa of Rs; first abscissa of M slightly arched or nearly straight, 3.5–4 times as long as r-m and ending in wing margin; cu-a strongly oblique, meeting Cu slightly beyond fork of M+Cu into M and Cu; Cu vertical for first section and long for free section; A ending in wing margin. Metasoma long-ovoid; fourth broadest; first segment thin basally, conical and slightly arched laterally and about as long as wide; second slightly shorter than first, trapezoid; cerci short. Ovipositor with sheaths slightly shorter than forewing.

Measurements in mm: specimen NND0261–2: antennal length 4.3; head length 0.9, width 1.4; mesosomal length 2.6, width 1.9; forewing length 6.4, width 2.4; hindwing length 3.9, width 1.1; metasomal length 5.3; ovipositor length 7.5, sheath 6.0. Specimen NND0259: antennal length (as preserved) 2.9; head length 0.5, width 1.0; mesosomal length 1.6; forewing length 4.1, width (as preserved) 1.5; metasomal length 3.4; ovipositor (as preserved) length 3.4, sheath 2.4. Specimen NND0812: antennal length (as preserved) 3.5; head length 1.0, width 1.5; mesosomal length 2.3, width 1.7; forewing length 6.3; hindwing length 3.8; metasomal length 5.5; ovipositor length 7.6, sheath 6.1.

***Praeaulacus exquisitus* sp. nov.** (Fig. 4; Pl. 2, fig. 3)

TYPE MATERIAL. Holotype: NND2088/NIGP148220a (part) and NND2089/NIGP148220b (counterpart), in ventral and dorsal aspect, respectively. A well-preserved female wasp with hindlegs damaged and forewings partly folded.

ETYMOLOGY. From the Latin *exquisitus*, exquisite.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Head medium-sized, ovoid. Eyes large, elongate-ovoid; ocelli comparatively large with posterior two slightly closer to anterior one than to each other. Antenna 28-segmented with scape preserved distally; pedicel small, distinctly thinner than scape distally; flagellum slightly and gradually increasing in thickness distally for basal three-quarters of length, but decreasing for remaining quarter; first flagellomere as thick as pedicel and 2.5 times as long as wide, second through sixth becoming shorter in succession but at least as long as wide, and remaining ones slightly longer than wide. Mesosoma comparatively short, slightly longer than wide. Pronotum long and finely ridged transversely. Mesonotum with mesoscutum transversely

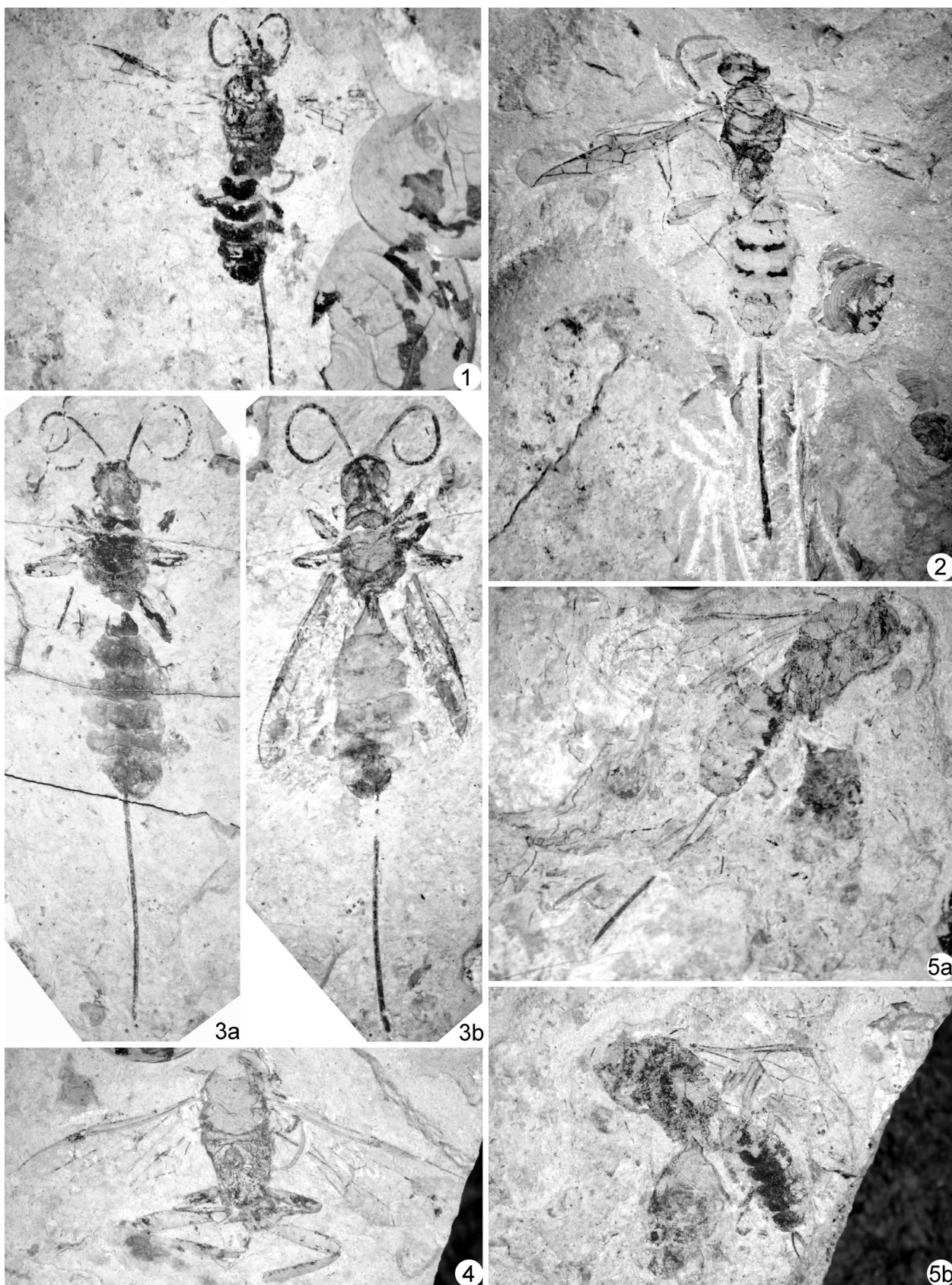


Plate 2 **Fig. 1** *Praeaulacus daohugouensis* sp. nov., paratype 1, NND0259/NIGP148218, in dorsal aspect, $\times 7.6$. **Fig. 2** *Praeaulacus daohugouensis* sp. nov., paratype 2, NND0812/NIGP148219, in dorsal aspect, $\times 6.1$. **Fig. 3** *Praeaulacus exquisitus* sp. nov., holotype, NND2088/NGIP148220a (part) and NND2089/NGIP148220b (counterpart). **3a**, NND2088, in ventral aspect, $\times 6.2$; **3b**, NND2089, in dorsal aspect, $\times 6.2$. **Fig. 4** *Praeaulacus sculptus* sp. nov., holotype, NND0542/NIGP148222, in dorsal aspect, $\times 6.4$. **Fig. 5** *Praeaulacus scabratus* sp. nov., holotype, NND2015/NIGP148221a (part) and NND2016/NIGP148221b (counterpart). **5a**, NND2015, in lateral aspect, $\times 7.3$; **5b**, NND2016, in lateral aspect, $\times 7.3$.

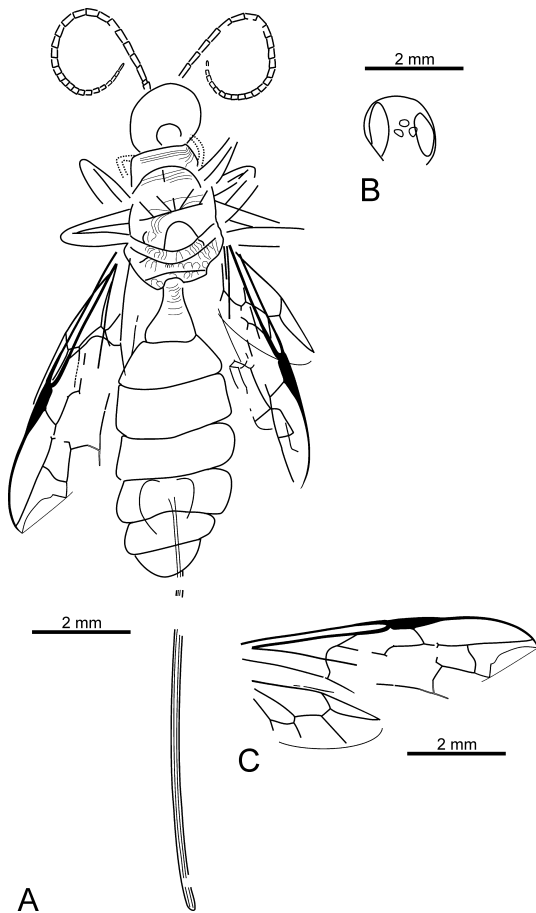


Figure 4 *Praeaulacus exquisitus* sp. nov., holotype, NND2088/NGIP148220a (part) and NND2089/NGIP148220b (counterpart). **A**, line drawing of counter part; **B**, line drawing of head from part; **C**, combined drawing of wings from counterpart.

ridged; median, parapsidal sutures and notauli distinct; mesoscutellum slightly shorter than mesoscutum. Metanotum and metapostnotum medially short. Propodeum coarsely areolate. Fore- and midleg thin, hindleg badly preserved. Forewing with first abscissa of Rs 0.6 times as long as its distance to pterostigma; pterostigmal base slightly closer to 2r-rs than to Rs origin; 1r-rs rudimentary like a stub on Rs where Rs is strongly bent; 2r-rs arising from pterostigma medially and meeting Rs far basad of 2r-m; 3r-m sinuate probably owing to wing deformation; 2m-cu meeting M slightly distad of 2r-m; cu-a interstitial. Hindwing with r-m oblique and 0.7 length of first abscissa of Rs; first abscissa of M nearly straight and about 2.5 times as long as r-m; cu-a oblique and meeting Cu slightly beyond fork of M+Cu into M and Cu; free M, Cu and A long. Metasoma long-ovoid, broadest at about its mid-length; first segment thin and slightly elongate basally, gradually thickened apically and slightly longer than broad; second to fifth slightly shorter than first; remaining short. Ovipositor with sheaths slightly longer than forewing.

Measurements in mm: antennal length 5.6; head length 1.3, width 1.4; mesosomal length 2.6; forewing (as preserved) length 6.0, width 1.7; hindwing length (as preserved) 3.0, width 1.2; metasomal length 5.8; ovipositor length 8.7, sheath length 6.8.

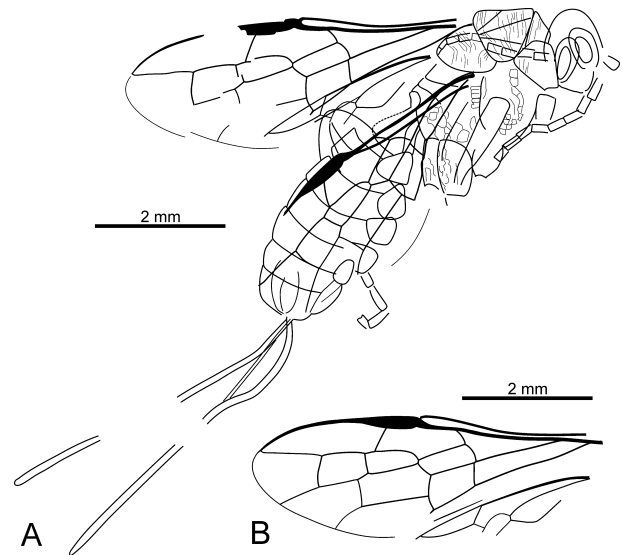


Figure 5 *Praeaulacus scabratus* sp. nov., holotype, NND2015/NGIP148221a (part). **A**, line drawing of body; **B**, combined drawing of wings.

***Praeaulacus scabratus* sp. nov.** (Fig. 5; Pl. 2, fig. 5)

TYPE MATERIAL. Holotype: NND2015/NGIP148221a (part) and 2016/NGIP148221b (counterpart), in lateral aspect. A rather well preserved female wasp with antennae, legs, wings and ovipositor somewhat damaged.

ETYMOLOGY. From the Latin *scabratus*, after the scabrate aspect of the mesosoma.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Head medium-sized. Eyes medium-sized and circular. Antennae incomplete with basal nine segments preserved; scape broadened apically and slightly longer than wide; flagellomeres subcylindrical and 1.5–2.5 times as long as wide. Mesosoma stout, slightly longer than high; pronotum long; mesonotum with notauli greatly slanted; mesoscutellum 0.7 times length of mesoscutum. Metanotum short; metapostnotum about half as long as metanotum. Propodeum short; propodeal foramen very close to metapostnotum. Pronotum and mesonotum transversely ridged; propodeum coarsely areolate. Midcoxa touching hindcoxa. Hindleg with coxa slightly longer than first metasomal segment; tarsus thin. Forewing with first abscissa of Rs slightly shorter than that of M and 0.7 times as long as its distance to pterostigma; pterostigmal base about midway between 2r-rs and Rs origin; 2r-rs slightly longer than maximal width of 2rm and meeting Rs quite basad of 2r-m; 2r-m slightly oblique and 3r-m slightly arched outwards; 1m-cu nearly parallelogrammic, about 2.4 times as long as wide; 2m-cu meeting 3rm at about basal 0.25 length of its posterior margin; cu-a slightly postfurcal and slightly longer than first abscissa of M; 2m-cu as broad as 2cua distally and 1.5 times as long as 1m-cu. Hindwing incomplete with r-m oblique; M basad of r-m strongly arched inwards in cell rm; free M very basally preserved. Metasoma with first segment conical and about as long as wide; remaining subequal in length and slightly shorter than first; fourth broadest. Ovipositor with sheaths slightly shorter than forewing.

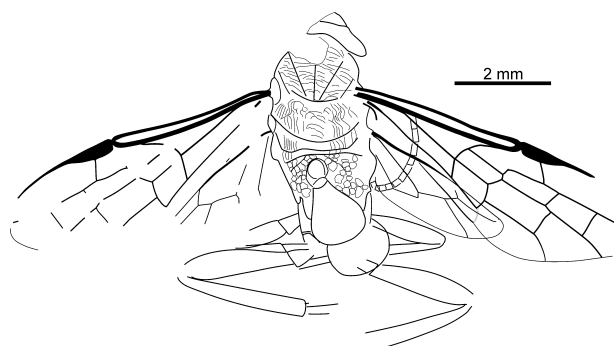


Figure 6 *Praeaulacus sculptus* sp. nov., holotype, NND0542/NIGP148222, line drawing.

Measurements in mm: antennal length (as preserved) 2.3; head length 0.9; mesosomal length 2.2; forewing length 5.2, width 2.0; hindwing (as preserved) length 2.8, width 0.5; metasomal length 3.8; ovipositor sheath length 4.9

***Praeaulacus sculptus* sp. nov.** (Fig. 6; Pl. 2, fig. 4)

TYPE MATERIAL. Holotype: NND0542/NIGP148222, in dorsal aspect. An incomplete wasp of unknown sex with head and metasoma beyond second segment missing, antennae, pronotum, mesonotum anteriorly, legs and wings damaged.

ETYMOLOGY. From the Latin *sculptus*, after the sculptural aspect of the dorsal face of mesosoma.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Antenna with 11 (subapical?) flagellomeres preserved, gradually becoming shorter in succession distally (from twice as long as to slightly longer than wide). Mesosoma elongate ovoid; pronotum comparatively long; mesonotum transversely ridged; notauli greatly slanted; parapsidal sutures distinct; mesoscutellum 0.6 times length of mesoscutum. Metanotum short; metapostnotum about half length of metanotum. Propodeum coarsely areolate; propodeal foramen small, very close to metapostnotum. Midleg short. Hindleg with coxa distinctly shorter than first metasomal segment; trochanter thin basally, gradually broadened apically and slightly longer than wide; femur distinctly longer than mid femur; tibia slightly longer than femur and possessing an apical spur. Forewing with first abscissa of Rs slightly longer than that of M, but slightly shorter than its distance to pterostigma; pterostigmal base slightly closer to 2r-rs than to Rs origin; 1r-rs rudimentary like a short stub on Rs where Rs is distinctly geniculate; 2r-rs arising from pterostigma at its basal 0.6 length, slightly longer than maximal width of 2rm and meeting Rs far basad of 2r-m; 2r-m slightly oblique and 3r-m subvertical; 1mcu nearly parallelogrammic, about 2.8 times as long as wide; 2m-cu meeting M slightly distad of 2r-m and slightly sinuate; cu-a interstitial and slightly longer than first abscissa of M; 2mcu slightly broader than 2cua distally and 1.4 times as long as 1mcu. Hindwing with r-m slightly shorter than first abscissa of Rs; first abscissa of M nearly straight, not forming a distinct angle with r-m and 2.2 times length of r-m; cu-a meeting M slightly beyond M+Cu fork. Metasoma with first tergum thin basally, becoming gradually broad distally and rounded posteriorly

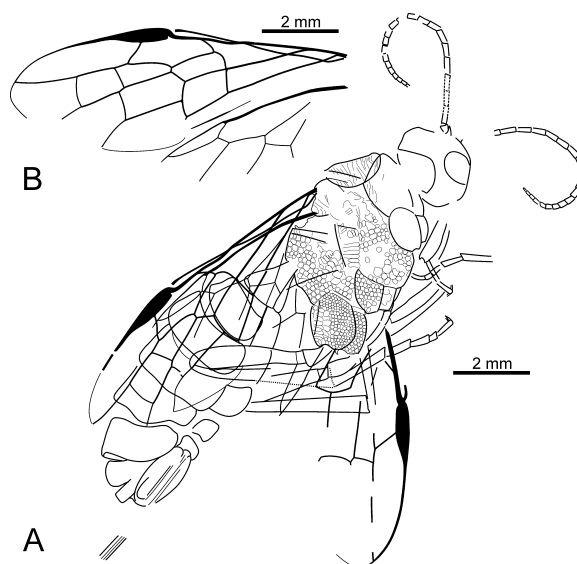


Figure 7 *Praeaulacus robustus* sp. nov., holotype, NND0620/NIGP148223. **A**, line drawing of body; **B**, combined drawing of wings.

and slightly longer than wide; second 0.6 times length of first, rounded laterally and posteriorly, and slightly shorter than wide.

Measurements in mm: antennal length (as preserved) 2.0; mesosomal length 4.1, width 2.1; forewing length (as preserved) 6.3, width 2.2; hindwing length 3.4, width 1.0; first metasomal tergum length 1.3, second 0.8.

***Praeaulacus robustus* sp. nov.** (Fig. 7; Pl. 3, fig. 4)

TYPE MATERIAL. Holotype: NND0620/NIGP148223, in lateral aspect. A well preserved female wasp with antennae subbasally, wings and legs slightly damaged and ovipositor seriously damaged.

ETYMOLOGY. From the Latin *robustus*, in reference to the robust and stout body of the type specimen.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Head medium-sized, transversely ovoid. Antennae incomplete with 22 segments preserved (probably 23 or 24 segments in total); scape preserved only distally; pedicel small, becoming thick distally and as long as wide; flagellum gradually increasing in thickness distally for basal three-quarters of length and decreasing for remaining quarter; several basal flagellomeres about 3 times as long as wide, remaining ones becoming gradually shorter in succession apically but at least slightly longer than wide. Mesosoma stout, slightly longer than high. Pronotum comparatively long. Mesonotum transversely ridged; notaulus and parapsidal suture distinct; mesoscutellum 0.6 times length of mesoscutum. Metanotum damaged, comparatively long; metapostnotum very short, transversely band-like. Propodeum, mesopleura and coxae coarsely areolate. Propodeal foramen slightly closer to metapostnotum than to hind coxae. Fore- and midleg thin and short. Hindleg with coxa stout, nearly as long as wide and as first metasomal segment; trochanter 0.5 length of coxa; tibia as long as trochanter and femur combined; tarsus thin and possessing two short claws apically with basitarsomere

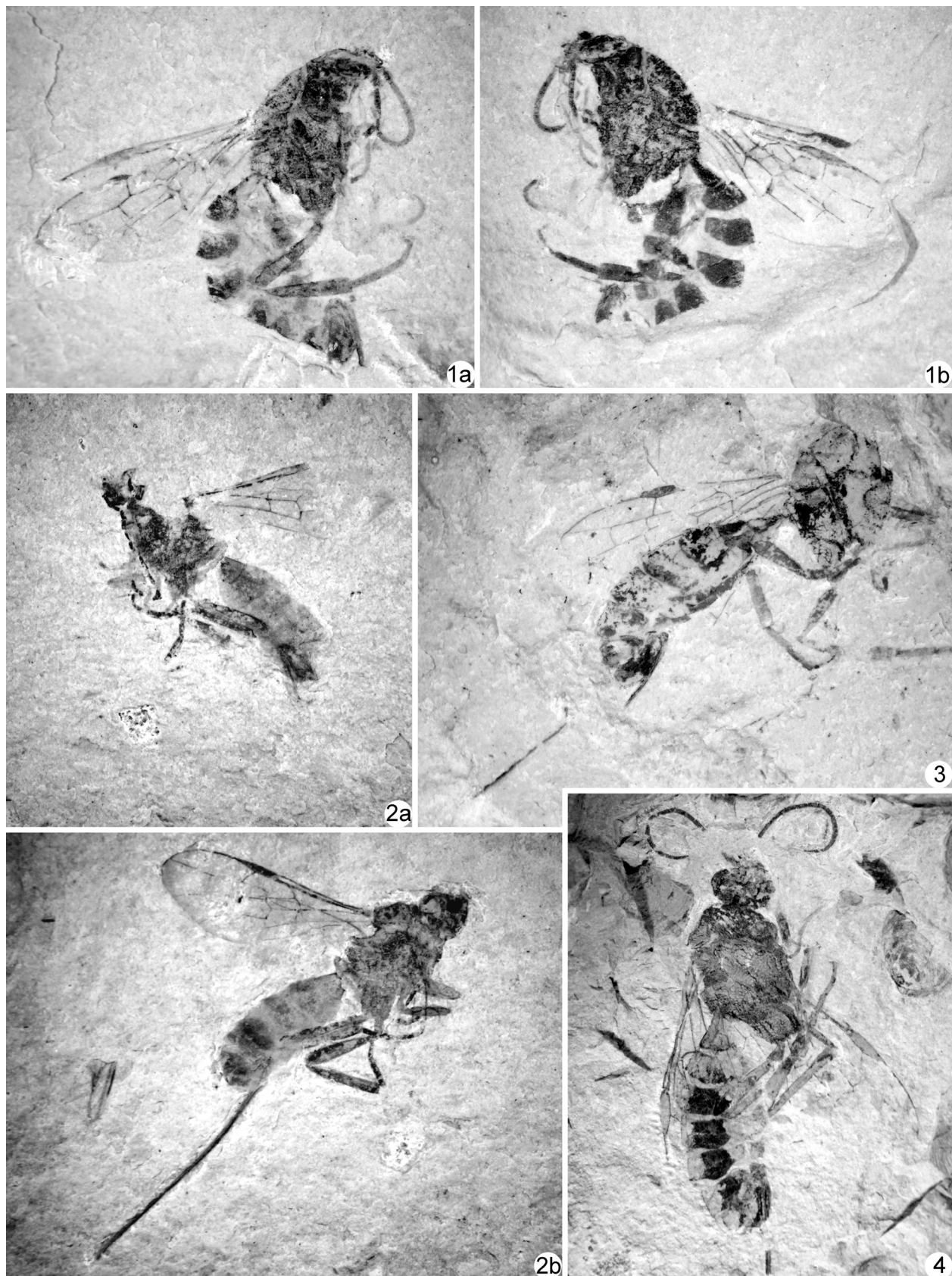


Plate 3 **Fig. 1** *Praeaulacus afflatus* sp. nov., holotype, NND0759/NGIP148224a (part) and NND0760/NGIP148224b (counterpart). **1a**, NND0759, in lateral aspect, $\times 11.1$; **1b**, NND0760, in lateral aspect, $\times 11.1$. **Fig. 2** *Praeaulacon elegantulus* sp. nov., holotype, NND0621/NGIP148226a (part) and NND0622/NGIP148226b (counterpart). **2a**, NND0621, in ventrolateral aspect, $\times 8.3$; **2b**, NND0622, in dorsolateral aspect, $\times 8.0$. **Fig. 3** *Praeaulacon ningchengensis* sp. nov., holotype, NND2034/NGIP148225, in lateral aspect, $\times 9.8$. **Fig. 4** *Praeaulacus robustus* sp. nov., holotype, NND0620/NGIP148223, in lateral aspect, $\times 5.2$.

half length of tibia, and segmental length ratios from basitarsomere to terminal tarsomere = 1.00 : 0.56 : 0.39 : 0.22 : 0.28. Forewing with first abscissa of Rs slightly shorter than that of M and 0.6 times as long as its distance to pterostigma; pterostigmal base equidistant to 2r-rs and to Rs origin; 2r-rs arising from pterostigma slightly beyond its mid-length, slightly longer than maximal width of 2rm and meeting Rs quite basad of 2r-m; 2r-m slightly oblique and 3r-m slightly bent outwards; 1mcu 2.3 times as long as wide; 2m-cu meeting M slightly distad of 2r-m; cu-a interstitial, and slightly longer than first abscissa of M. Hindwing with r-m oblique and slightly shorter than first abscissa of Rs; first abscissa of M straight and 3 times as long as r-m; cu-a strongly oblique, meeting Cu slightly beyond fork of M+Cu into M and Cu; free M, Cu and A long. Metasoma long-ovoid, broadest at about its mid-length; first segment thin basally, conical and about as long as wide; second to sixth subequal in length and slightly shorter than first; remaining ones short. Ovipositor damaged seriously with sheaths preserved subbasally.

Measurements in mm: antennal length 5.9; head length 1.7; mesosomal length 3.8; forewing (as preserved) length 8.3, width 2.7; hindwing (as preserved) length 5.2, width 1.5; metasomal length 7.8; ovipositor (as preserved) length 3.6, sheath (as preserved) length 1.7.

***Praeaulacus afflatus* sp. nov.** (Fig. 8; Pl. 3, fig. 1)

TYPE MATERIAL. Holotype: NND0759/NIGP148224a (part) and NND0760/NIGP148224b (counterpart), in lateral aspect. A female wasp with head and metasoma strongly deformed, antennae, legs, wings slightly damaged and ovipositor sheaths almost missing.

ETYMOLOGY. From the Latin *afflatus*, in reference to the swollen hind coxae.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. orientalis*, above.

DESCRIPTION. Antenna 19-segmented; scape slightly broadened distally and 1.5 times as long as wide; pedicel small; first flagellomere slightly thinner than pedicel distally, subcylindrical and 3 times as long as wide; remaining ones becoming gradually shorter in succession but remaining

longer than wide. Mesosoma stout, and slightly longer than high. Pronotum comparatively long but partly covered by head. Mesonotum transversely ridged; notauli and parapsidal suture distinct; mesoscutellum about half length of mesoscutum. Metanotum short; metapostnotum medially slightly shorter than metanotum. Propodeum, metanotum, metapostnotum, mesopleura and coxae coarsely areolate; propodeal foramen much closer to metapostnotum than to hind coxa. Midleg with coxa broad basally, twice as broad as long and just touching hind coxa; trochanter small. Hind leg with coxa thick basally, gradually becoming thin distally, as long as wide and slightly longer than first metasomal segment; trochanter small; tibia about as long as femur (including trochantellus); tarsi thin and slightly shorter than tibia, with one apical claw preserved; segmental length ratios from basitarsomere to terminal tarsomere = 1.00 : 0.80 : 0.20 : 0.10 : 0.35. Forewing with first abscissa of Rs slightly shorter than that of M and 0.6 times length of its distance to pterostigma; 2r-rs arising from pterostigma slightly beyond its mid-length, as long as maximal width of 2rm and meeting Rs far basad of 2r-m; 2r-m slightly oblique; 3r-m deformed; 1mcu nearly parallelogrammic, about 2.4 times as long as wide; 2m-cu meeting M slightly distad of 2r-m; cu-a interstitial and slightly shorter than first abscissa of M; 2mcu as broad as 2cua distally. Hindwing with r-m slightly longer than first abscissa of Rs; first abscissa of M subparallel to R and twice as long as r-m; cu-a meeting Cu slightly distad of fork of M+Cu into M and Cu; free M long; free Cu and A section badly preserved, short. Metasoma broadest medially with first segment thin basally, conical and 1.5 times as broad as long; second through third terga equal in length and slightly shorter than first; remaining ones shorter. Ovipositor with sheaths preserved very basally.

Measurements in mm: antennal length (as preserved) 3.0; head height 1.2, length 0.4; mesosomal length 2.5; forewing length (as preserved) 4.5, width 1.7; hindwing (as preserved) length 2.4, width 0.7; metasomal length 5.0; ovipositor (as preserved) length 1.2, sheath length 0.3.

REMARKS. The type specimen is deformed in the regions of its head, distal half of metasoma and forewings posterioapically. However, the rest is almost normal in shape.

Genus *PRAEULAICON* Rasnitsyn, 1972

1972 *Praeaulacon* Rasnitsyn: 79.

TYPE SPECIES. *Praeaulacon elongatus* Rasnitsyn, 1972 (by original designation).

REVISED DIAGNOSIS. Head not elongate downwards. Forewing with first abscissa of Rs shorter than its distance to pterostigma; 2r-rs meeting Rs quite basad of 2r-m and usually considerably longer than maximal width of 2rm; 3r-m not oblique; 2rm in contact with 1mcu by short 2M. Hindwing with M straight basad of r-m and not forming an obvious angle with r-m, sometimes losing its free end; cu-a meeting M+Cu quite basad of its bifurcating into M and Cu. First metasomal segment conical. Ovipositor long with sheaths at least as long as forewing.

REMARKS. The generic diagnosis has been slightly revised based on new material from Daohugou.

OCCURRENCE. Four species from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan

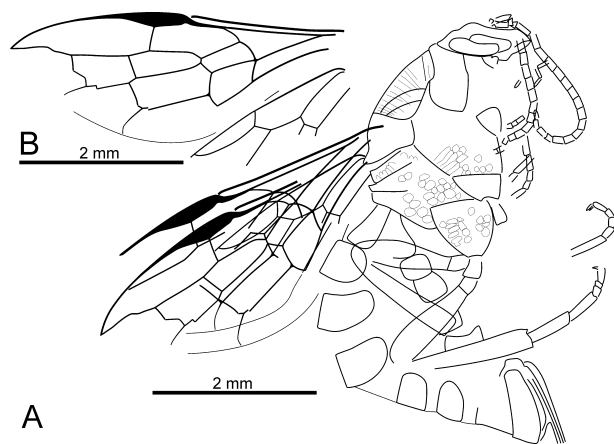


Figure 8 *Praeaulacus afflatus* sp. nov., holotype, NND0759/NIGP148224a (part). **A**, line drawing of body; **B**, combined drawing of wings.

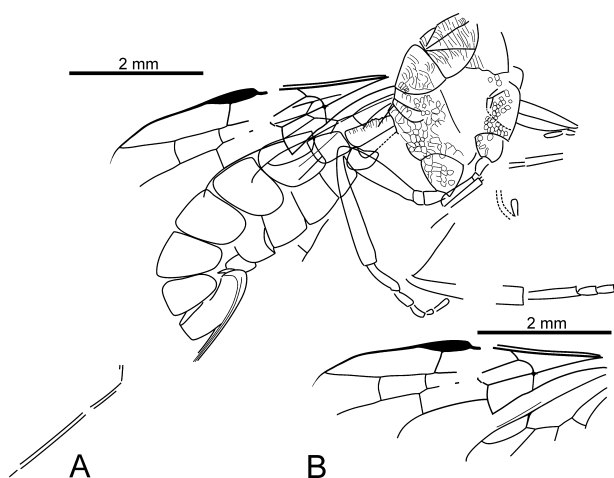


Figure 9 *Praeaulacon ningchengensis* sp. nov., holotype, NND2034/NIGP148225. **A**, line drawing of body; **B**, line drawing of wings.

and two from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

Praeaulacon ningchengensis sp. nov. (Fig. 9; Pl. 3, fig. 3)

TYPE MATERIAL. Holotype: NND2034/NIGP148225, in lateral aspect. An incomplete female wasp with head and pronotum missing, legs, wings and ovipositor partly damaged.

ETYMOLOGY. From Ningcheng County in which the type locality Daohugou is located.

DIAGNOSIS. See the key listed above.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Mesosoma short and high. Mesonotum transversely ridged; notauli nearly V-shaped; mesoscutellum slightly shorter than mesoscutum. Metanotum short; metapostnotum slightly shorter than metanotum. Mesopleuron finely areolate for upper part and coarsely for lower part; metanotum and propodeum coarsely areolate. Propodeal foramen much closer to metapostnotum than to hind coxae. Fore- and midleg thin and short. Midcoxa not touching hindcoxa when projecting posteriorly. Hindleg with coxa thick basally, inversely conical, about as long as wide and slightly shorter than first metasomal segment; trochanter small; femur thick and short; tibia slightly longer than femur (including trochantellus); tarsus slightly shorter than tibia with basitarsomere one-third length of tibia, segmental length ratios from basitarsomere to terminal tarsomere = 1.00 : 0.56 : 0.44 : 0.19 : 0.44. Forewing with first abscissa of Rs about half the length of that of M and one-quarter of its distance to pterostigma; 2r-rs arising from pterostigma slightly beyond its mid-length, 1.7 times as long as maximal width of 2rm and meeting Rs quite basad of 2r-m; 2r-m and 3r-m slightly curved outwards; 2rm slightly longer than 3rm; 1mcu nearly parallelogrammic, about 3 times as long as wide; 2m-cu vertical, meeting M quite distad of 2r-m; cu-a interstitial and slightly shorter than first abscissa of M; 2mcu slightly narrower than 2cua distally. Hindwing with r-m oblique and

two-thirds length of first abscissa of Rs; first abscissa of M straight, 3 times as long as r-m; cu-a nearly vertical, meeting Cu far basad of M+Cu fork and as long as section M+Cu basad of its fork; free M, Cu and A distinct. Metasoma long, spindle-like, broadest at about its mid-length; first segment conical, 1.5 times as long as broad distally and transversely ridged dorsally; second tergum two-thirds length of first; third slightly longer than first; fourth through sixth as long as first; remaining terga short. Ovipositor sheaths damaged subbasally, with preserved part about two-thirds length of forewing.

Measurements in mm: mesosomal length 2.1; forewing (as preserved) length 4.4, width 1.3; hindwing (as preserved) length 1.8, width 0.6; metasomal length 4.5; ovipositor (as preserved) length 4.0, sheath length 3.2.

Praeaulacon elegantulus sp. nov. (Fig. 10; Pl. 3, fig. 2)

TYPE MATERIAL. Holotype: NND0621/NIGP148226a (part) and NND0622/NIGP148226b (counterpart), in ventrolateral and dorsolateral aspect, respectively. A well preserved female wasp with antennae slightly damaged and one forewing unclear venationally for distal half.

ETYMOLOGY. From the Latin *elegantulus*, slightly elegant.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *P. ningchengensis*, above.

DESCRIPTION. Head medium-sized. Eyes medium-sized and ovoid. Antennae with 19 segments preserved; scape incomplete, thick apically; pedicel small, slightly shorter than wide; first flagellomere as broad as pedicel, subcylindrical and nearly twice as long as wide; second through ninth subequal to first in length; remaining ones becoming gradually shorter in succession but at least as long as wide. Mesosoma short, slightly longer than high. Pronotum partly covered with

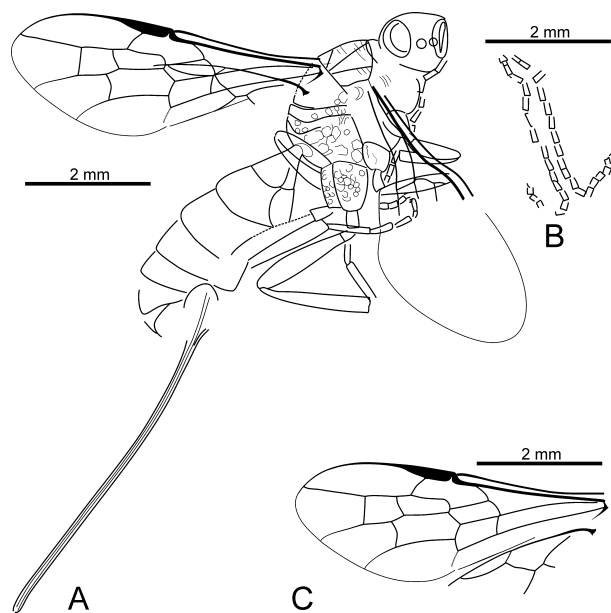


Figure 10 *Praeaulacon elegantulus* sp. nov., holotype, NND0621/NIGP148226a (part) and NND0622/NIGP148226b (counterpart). **A**, line drawing of counterpart; **B**, line drawing of antennae from part; **C**, line drawing of wings from counterpart.

head. Mesonotum transversely ridged; notauli strongly oblique; mesoscutellum about as long as mesoscutum. Metanotum short; metapostnotum about as long as metanotum. Propodeum coarsely areolate; propodeal foramen much closer to metapostnotum than to hind coxae. Fore- and midleg thin and short. Hind leg with coxa thick basally, becoming gradually thin distally, 1.4 times as long as wide and as long as first metasomal segment; trochanter small and 1.5 times as long as wide; tibia as long as femur (including trochantellus); tarsus thin and slightly shorter than tibia, with two short apical claws; basitarsomere 0.4 times tibial length; segmental length ratios from basitarsomere to terminal tarsomere = 1.00 : 0.60 : 0.40 : 0.15 : 0.30. Forewing with first abscissa of Rs as long as that of M and slightly shorter than its distance to pterostigma; pterostigmal base equidistant to 2r-rs and to Rs origin; 2r-rs arising from pterostigma medially, slightly longer than maximal width of 2rm and meeting Rs quite basad of 2r-m; Rs strongly arched soon after its branching from Rs+M; 2r-m slightly bent outwards; 3r-m vertical; 2rm slightly longer than 3rm; 1mcu nearly parallelogrammic, about 2.4 times as long as wide; 2m-cu meeting M quite distad of 2r-m, slightly bent inwards; cu-a slightly postfurcal and as long as first abscissa of M; 2mcu as broad as 2cua distally and 1.5 times as long as 1mcu. Hindwing with r-m slightly shorter than first abscissa of Rs; first abscissa of M 2.3 times as long as r-m; cu-a meeting M+Cu far basad of its fork; free M absent; free Cu long. Metasoma long-ovoid; first segment thin basally, conical, and about as long as maximal height; second and third about as long as first; remaining ones short. Ovipositor with sheaths as long as forewing.

Measurements in mm: antennal length (as preserved) 3.1; head height 1.0, width 1.1; mesosomal length 2.2; forewing length 5.0, width 1.9; hindwing (as preserved) length 2.5, width 0.7; metasomal length 3.8; ovipositor length 6.1, sheath length 5.0.

REMARKS. The character 'crossvein 2r-rs is slightly longer than the maximal width of 2rm' differentiates this new species from all other congeners, but other characters known from the specimen cannot assign it to any other genus within Praeaulacinae but *Praeaulacon*.

Genus **AULACOGASTRINUS** Rasnitsyn, 1983

1972 *Aulacogaster* Rasnitsyn: 85.

1983 *Aulacogastrinus* Rasnitsyn: 103.

TYPE SPECIES. *Aulacogastrinus ater* Rasnitsyn, 1983 (by original designation).

REVISED DIAGNOSIS. Head transverse, not elongate. Forewing with Rs origin far from pterostigma; 2r-rs longer than maximal width of 2rm, meeting Rs just at 2r-m or basad of that; 3rm not distinctly oblique; 2rm in contact with 1mcu by short 2M. Hindwing with cu-a meeting M(+Cu) near fork of M+Cu into M and Cu. Metasoma thick with first segment elongate, contracted and tubular basally, and bell-mouthed distally. Ovipositor sheaths at least nearly as long as forewing.

REMARKS. The generic diagnosis has been revised and supplemented based on new material from Daohugou.

OCCURRENCE. One species, the type, from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan and four from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

Aulacogastrinus insculptus sp. nov. (Fig. 11; Pl. 1, fig. 3)

TYPE MATERIAL. Holotype: NND0260/NIGP148227, in lateral aspect. A well preserved female wasp with wings, legs and ovipositor subapically slightly damaged.

ETYMOLOGY. From the Latin *insculptus*, in allusion to the laterally carved mesosoma.

DIAGNOSIS. See the key listed above.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Head medium-sized. Eyes large, slightly kidney-shaped. Antennae at least 27-segmented; scape about twice as long as wide; pedicel small; first flagellomeres subcylindrical, about 3 times as long as wide; remaining ones gradually becoming shorter in succession but remaining at least as long as wide. Mesosoma comparatively short and high. Mesonotum with mesoscutum nearly twice as long as mesoscutellum. Metanotum short and slightly longer than metapostnotum. Mesopleuron and propodeum finely areolate. Propodeal foramen much closer to metapostnotum than to hindcoxae. Fore- and midleg thin and short. Hindleg with coxa thick basally, inversely conical, as long as broad,

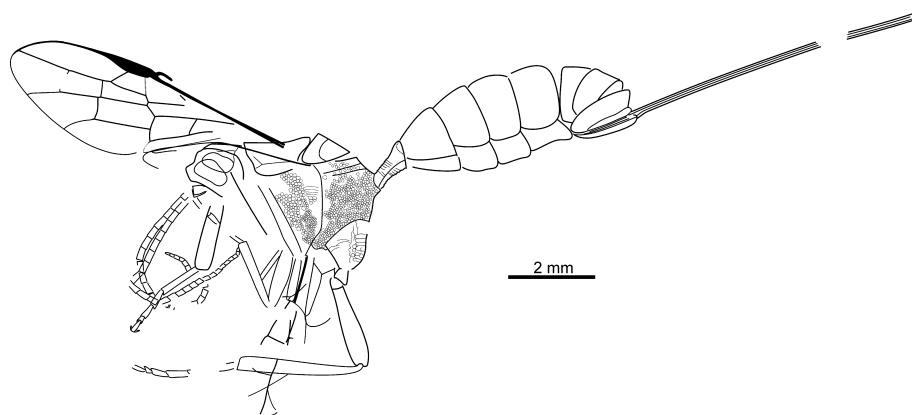


Figure 11 *Aulacogastrinus insculptus* sp. nov., holotype, NND0260/NIGP148227, line drawing.

and slightly longer than first metasomal segment; trochanter small; femur distinctly thicker and longer than mid leg; tibia 1.4 times as long as femur (including trochantellus); tarsus slightly shorter than tibia with basitarsomere 0.4 times length of tibia, segmental length ratios from basitarsomere to terminal tarsomere = 1.00 : 0.44 : 0.31 : 0.13 : 0.28. Forewing with 1r-rs obscure; 2r-rs originating from pterostigma slightly beyond its mid-length, meeting Rs quite basad of 2-rm and slightly longer than maximal width of 2rm; 2rm slightly longer than 3rm; 2m-cu slightly distad of 2r-m, and slightly bent inwards. Hindwing with r-m as long as first abscissa of Rs; free M present. Metasoma elongate, spindle-like, broadest at about its mid-length; first segment transversely ridged for basal two-thirds of length, thin and tubular for basal half, and becoming gradually thick apically for distal half; second slightly longer than first; third through fifth about as long as first; remaining ones shorter. Ovipositor long with sheaths slightly longer than forewing.

Measurements in mm: antennal length 5.7; head (as preserved) height 1.2, width 1.0; mesosomal length 3.2; forewing length 6.6, width 2.2; hindwing length 3.8, width (as preserved) 0.6; metasomal length 6.2; ovipositor length 8.5, sheath length 6.9.

***Aulacogastrinus longaciculatus* sp. nov.** (Fig. 12; Pl. 4, fig. 1)

TYPE MATERIAL. Holotype: NND0691/NIGP148229a (part) and NND0692/NIGP148229b (counterpart), in laterodorsal and lateroventral aspect, respectively. A well preserved female wasp with antennae, legs and hindwings slightly damaged, and forewings folded.

ETYMOLOGY. From the Latin *long-*, long, and *aciculatus*, needle-like, implying that the new species has a very long ovipositor.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *A. insculptus*, above.

DESCRIPTION. Head medium-sized. Eyes large, ovoid; ocelli equidistant with anterior one slightly larger. Antennae with 32 segments preserved; scape long, about 3 times as long as wide; pedicel small, as long as wide; first flagellomere about as long as scape; remaining ones comparatively short but at least longer than wide; distal one-third of flagellum becoming gradually narrow apically. Mesosoma comparatively short, ovoid. Pronotum completely covered; propleuron and mesonotum transversely ridged. Notauli, parapsidal sutures distinct, oblique; mesoscutellum slightly shorter than mesoscutum. Metapostnotum half length of metanotum. Propodeum coarsely areolate; propodeal foramen very close to metapostnotum. Fore- and midleg small. Hind leg with coxa thick basally, gradually becoming thin distally and much shorter than first metasomal segment; femur and tibia long; tarsus thin, incomplete. Forewings folded; first abscissa of Rs distinctly shorter than that of M and about one-third as long as its distance to pterostigma; pterostigmal base much closer to 2r-rs than to Rs origin; 1r-rs rudimentary like a short stub on Rs; 2r-rs slightly longer than width of 2rm and meeting Rs far basad of 2r-m; 2rm slightly longer than 3rm; cu-a interstitial. Hindwing venation complete with first section of M slightly longer than r-m; cu-a meeting M+Cu just basad of its fork into M and Cu; free M, Cu and A long. Metasoma

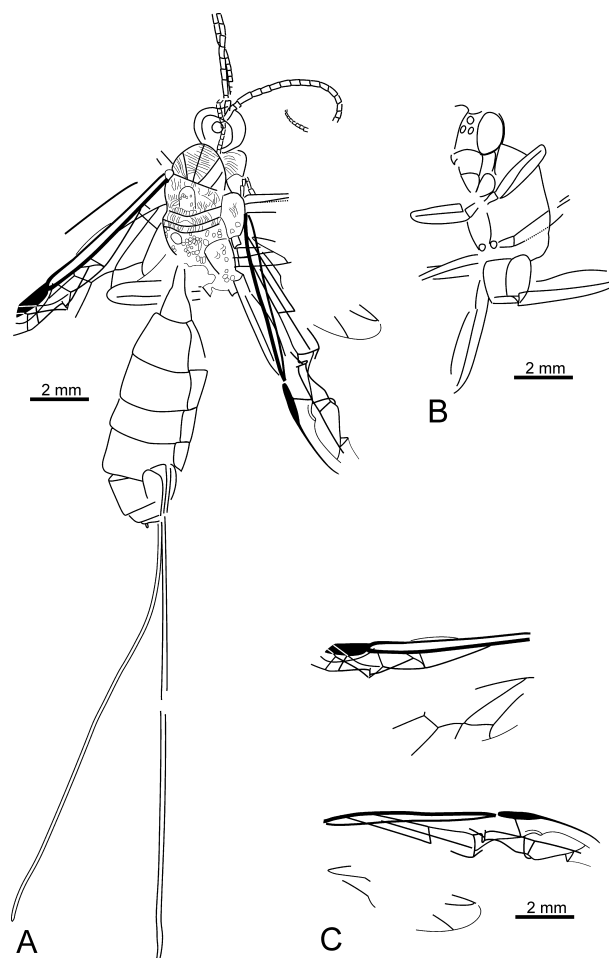


Figure 12 *Aulacogastrinus longaciculatus* sp. nov., holotype, NND0691/NIGP148229a (part) and NND0692/NIGP148229b (counterpart). **A**, line drawing of part; **B**, line drawing of head and mesosoma from counterpart; **C**, line drawing of wings from part.

elongate-ovoid with first segment thin and nearly tubular for basal two-fifths of length and becoming gradually thicker apically for distal three-fifths of length; second slightly shorter than first, trapezoid; third through fifth as thick as second distally. Ovipositor very long with sheaths slightly longer than body and about 1.5 times as long as forewing.

Measurements in mm: antennal length (as preserved) 8.0; head height 1.5, width 1.8; mesosomal length 3.2; forewing (as preserved) length 9.4, width 1.5; hindwing length (as preserved) 5.6, width 1.8; metasomal length 8.8; ovipositor length 17.0, sheath length 15.0.

***Aulacogastrinus hebeiensis* sp. nov.** (Fig. 13; Pl. 5, fig. 3)

TYPE MATERIAL. Holotype: NND0959/NIGP148230a (part) and NND0960/NIGP148230b (counterpart), in lateral aspect. A female wasp with legs damaged and one forewing and both hindwings missing.

ETYMOLOGY. From Hebei Province in which the type locality Daohugou is located.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *A. insculptus*, above.

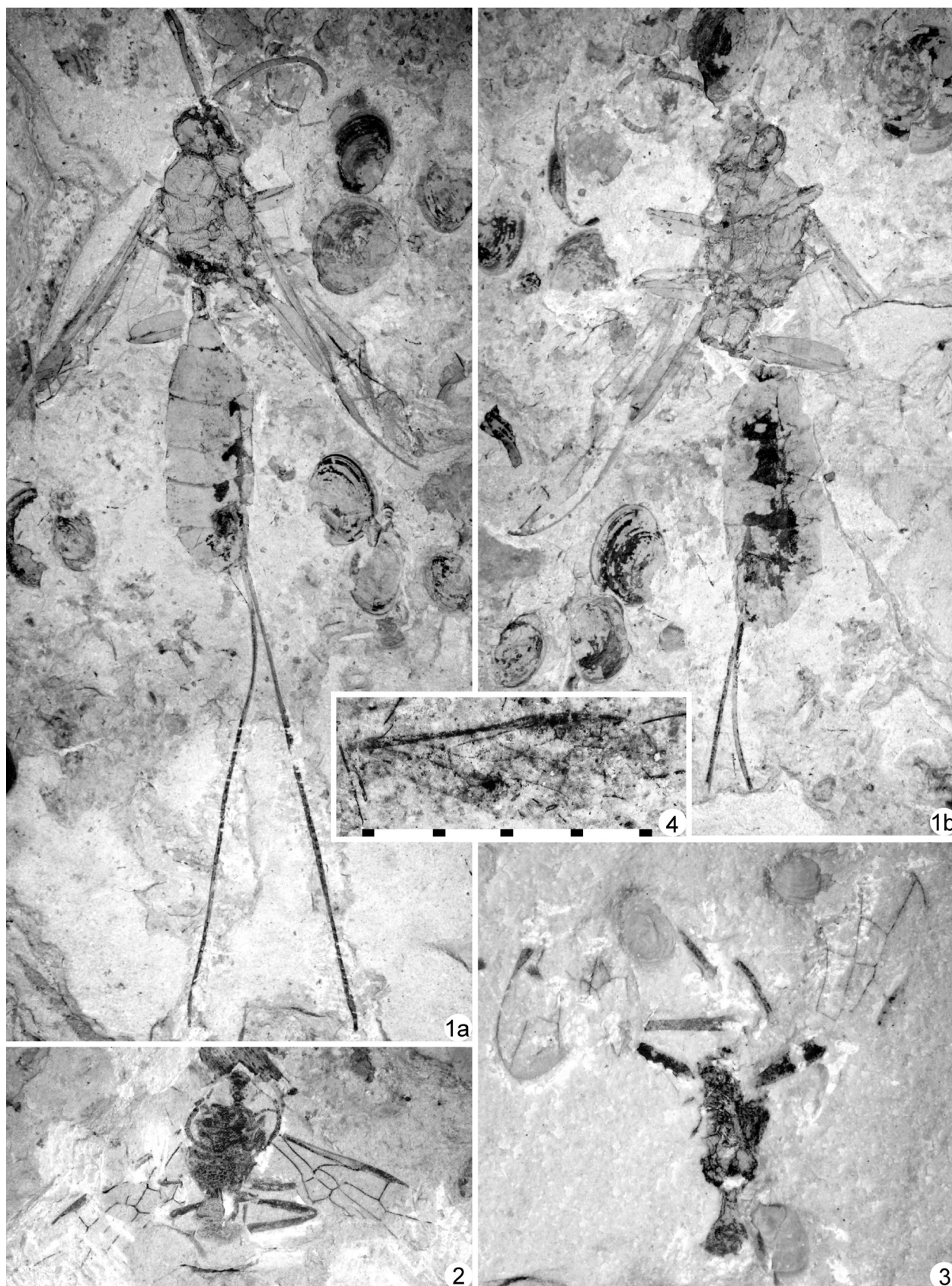


Plate 4 **Fig. 1** *Aulacogastrinus longaciculatus* sp. nov., holotype, NND0691/NIGP148229a (part) and NND0692/NIGP148229b (counterpart). **1a**, NND0691, in laterodorsal aspect, $\times 5.9$; **1b**, NND0692, in lateroventral aspect, $\times 6.4$. **Fig. 2** *Anomopterella huangi* sp. nov., holotype, NND2066/NIGP148228, in dorsal aspect, $\times 7.4$. **Fig. 3** *Aulacogastrinus* sp., NND2223/NIGP148231, in dorsal aspect, $\times 9.8$. **Fig. 4** *Nevania karatau* sp. nov., holotype, PIN2997–4157, a forewing, $\times 12.5$.

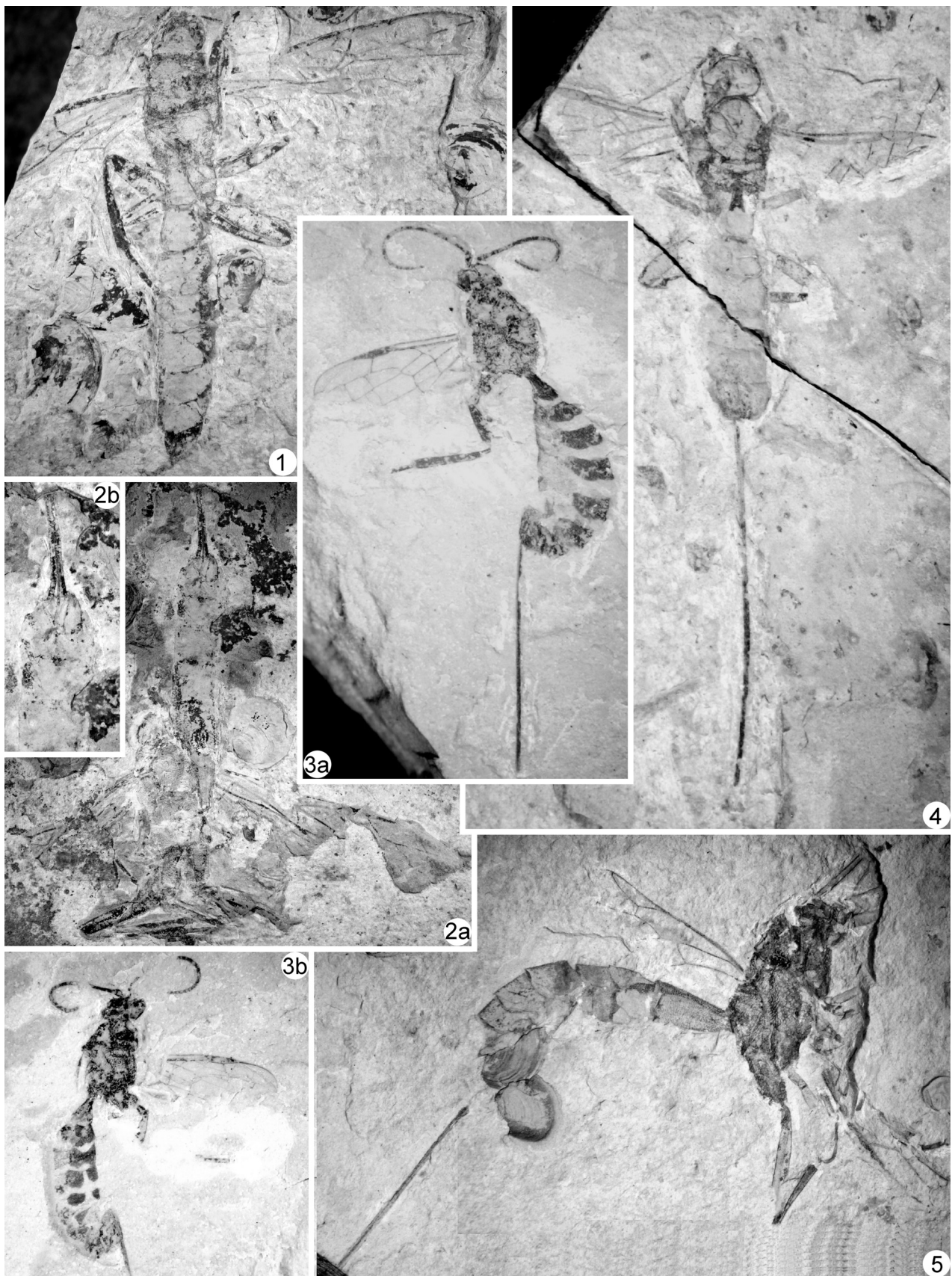


Plate 5 **Fig. 1** *Eosaulacus giganteus* gen. et sp. nov., holotype, NND0913/NIGP148233, in dorsal aspect, $\times 4.4$. **Fig. 2** *Eosaulacus giganteus* gen. et sp. nov., paratype, NND0715/NIGP148234, in dorsal aspect for head and mesosoma and in ventral aspect for metasoma. **2a**, overall view, $\times 3.0$; **2b**, distal metasoma to show ovipositor, $\times 4.7$. **Fig. 3** *Aulacogastrinus hebeiensis* sp. nov., holotype, NND0959/NIGP148230a (part) and NND0960/NIGP148230b (counterpart). **3a**, NND0959, in lateral aspect, $\times 6.6$; **3b**, NND0960, in lateral aspect, $\times 5.6$. **Fig. 4** *Sinaulacogastrinus eucallus* gen. et sp. nov., holotype, NND0772/NIGP148232, in dorsal aspect, $\times 11.1$. **Fig. 5** *Eosaulacus granulatus* gen. et sp. nov., holotype, NND0192/NIGP148235, in lateral aspect, $\times 5.3$.

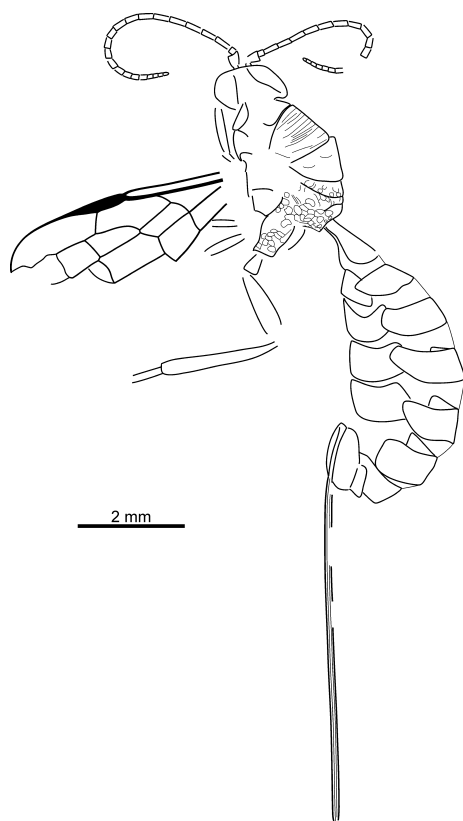


Figure 13 *Aulacogastrinus hebeiensis* sp. nov., holotype, NND0959/NIGP148230a (part), line drawing.

DESCRIPTION. Head medium-sized. Eyes large. Antenna 22-segmented with scape thin basally, gradually thickened distally and slightly longer than wide; pedicel cylindrical, distinctly narrower than scape distally and about as long as wide; first flagellomere slightly narrower than pedicel, subcylindrical and about 3 times as long as broad; second through fifth subequal to first in length; remaining ones gradually becoming shorter but at least longer than wide. Mesosoma short, slightly longer than high with mesoscutellum about as long as mesoscutum. Metanotum short; metapostnotum about half as long as metanotum. Mesonotum transversely ridged; metanotum and propodeum coarsely areolate. Fore- and midleg thin. Hindleg with coxa thick basally, becoming gradually thin distally and quite shorter than first metasomal segment; trochanter small; femur short; tibia 1.6 times as long as femur; tarsus thin with only basitarsomere preserved basally. Forewing with first abscissa of Rs slightly shorter than that of M and far shorter than its distance to pterostigma; pterostigmal base equidistant to 2r-rs and to Rs origin; 2r-rs arising from pterostigma slightly beyond its mid-length, as long as maximal width of 2rm and meeting Rs quite basad of 2r-m; 2r-m slightly oblique; 3r-m subvertical (also slightly sinuate, which, however, obviously resulted from deformation of the forewing); 2rm slightly longer than 3rm; 1mcu nearly parallelogrammic, about 2.4 times as long as wide; 2m-cu meeting M slightly distad of 2r-m; cu-a interstitial and slightly longer than first abscissa of M; 2mcu as broad as 2cua distally and 1.5 times as long as 1mcu. Metasoma broadest at about its mid-length; first segment thin basally, nearly tubular for basal one-third of length and conical for

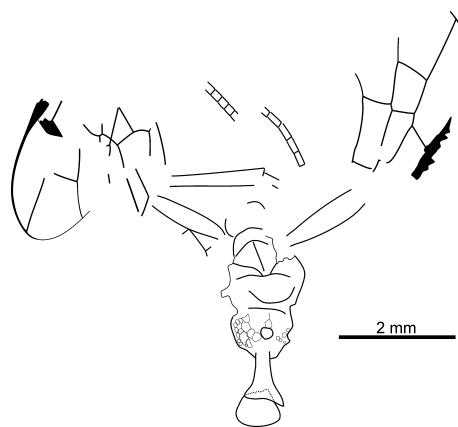


Figure 14 *Aulacogastrinus* sp., NND2223/NIGP148231, line drawing.

distal two-thirds, about 1.7 times as long as wide; second through fifth terga subequal in length and distinctly shorter than first. Ovipositor with sheaths longer than forewing.

Measurements in mm: antennal length 4.4; head height 0.8, width 1.4; mesosomal length 2.5; forewing (as preserved) length 4.3, width 1.6; metasomal length 5.4; ovipositor length 7.5, sheath length 6.5.

***Aulacogastrinus* sp.** (Fig. 14; Pl. 4, fig. 3)

MATERIAL. NND2223/NIGP148231, in dorsal aspect. A badly preserved wasp of unknown sex with head, antennae, mesosoma, hindlegs and forewings damaged, and hindwings, fore- and midlegs and metasoma beyond second segment missing.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for *A. insculptus*, above.

DESCRIPTION. Antennae with only a few flagellomeres preserved, thin and longer than wide for each. Pronotum comparatively long. Mesonotum with median suture clear, notauli strongly close to each other backwards; mesoscutellum slightly shorter than mesonotum. Metanotum short. Propodeum coarsely areolate; propodeal foramen small, rounded. Hindleg (?) with femur comparatively thick and long, tibia thin. Forewing somewhat deformed but the following characters distinguishable: 2r-rs slightly longer than maximal width of 2rm, meeting Rs quite basad of 2r-m; 3r-m slightly oblique; 2rm slightly longer than 3rm; 2m-cu slightly distad of 2r-m. First metasomal segment thin and nearly tubular for basal three-fifths of length and bell-mouthed for remaining part; second small and somewhat trapezoid.

Measurements in mm: antennal length (as preserved) 1.2; head length 0.4; mesosomal length 2.3 mm; first metasomal segment length 0.8; forewing (as preserved) length 4.4, width 1.8.

REMARKS. Although greatly incomplete, the specimen can be assigned to *Aulacogastrinus* on the basis of the first metasomal segment which is tubular for the basal three-fifths of its length and bell-mouthed for the remaining part and the forewing venation which is not in contradiction with *Aulacogastrinus*.

Genus **SINULACOGASTRINUS** nov.

TYPE SPECIES. *Sinulacogastrinus eucallus* sp. nov.

ETYMOLOGY. From the Greek *sin-*, China, and generic name *Aulacogastrinus*.

DIAGNOSIS. Head transversely broad. Forewing with Rs origin far from pterostigma; 2r-rs meeting Rs quite basad of 2r-m and about as long as maximal width of 2r-m; 3r-m subvertical; 2rm about as long as 3rm; 2rm in contact with 1mcu by a point. Hindwing with M straight, not forming an obvious angle; free M and Cu distinct; cu-a meeting M+Cu basad of its fork into M and Cu. First metasomal segment conical for basal half and rectangular for distal half. Ovipositor with sheaths longer than forewing.

OCCURRENCE. One species, the type, from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

REMARKS. Although the wing venation and long ovipositor as seen in the new taxon are widely observed in other genera within Praeaulacinae, the shape of the first metasomal segment, i.e. conical for the basal half and rectangular for the distal half, distinctly differentiates this genus from other praeaulacines.

Sinulacogastrinus eucallus sp. nov. (Fig. 15; Pl. 5, fig. 4)

TYPE MATERIAL. Holotype: NND0772/NIGP148232, in dorsal aspect. An incomplete female wasp with antennae, legs and left hindwing slightly damaged, right forewing folded and left one missing for distal half, and right hindwing almost missing.

ETYMOLOGY. From the Latin *eucallus*, beautiful.

DIAGNOSIS. As for genus.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Head medium-sized. Eyes medium-sized, ovoid. Antennae with 10 segments preserved; scape small, broadened distally, slightly shorter than wide; pedicel small; first flagellomere distinctly thinner than pedicel distally, subcylindrical, 3 times as long as wide; remaining ones gradually decreasing in length but remaining longer than wide. Mesosoma short, ovoid and slightly longer than broad. Pronotum short, probably covered partly with mesosoma and head. Mesonotum transversely ridged; notauli V-shaped; parapsidal sutures distinct, oblique; mesoscutellum nearly as long as mesoscutum. Metanotum short; metapostnotum medially shorter than metanotum. Metanotum, metapostnotum and propodeum coarsely areolate; propodeal foramen very close to metapostnotum. Midleg thin and short. Hind leg with coxa thick basally, gradually becoming thin distally and half length of first metasomal segment; femur distinctly thicker and longer than mid femur. Forewing with first abscissa of Rs slightly shorter than that of M but distinctly smaller than its distance to pterostigma; Rs strongly arched soon after its branching from Rs+M; 2r-rs as long as maximal width of 2rm, meeting Rs quite basad of 2r-m; 2r-m and 3r-m subvertical; 2rm as long as 3rm; 1mcu nearly parallelogrammic, about 2.2 times as long as wide; 2m-cu meeting M quite

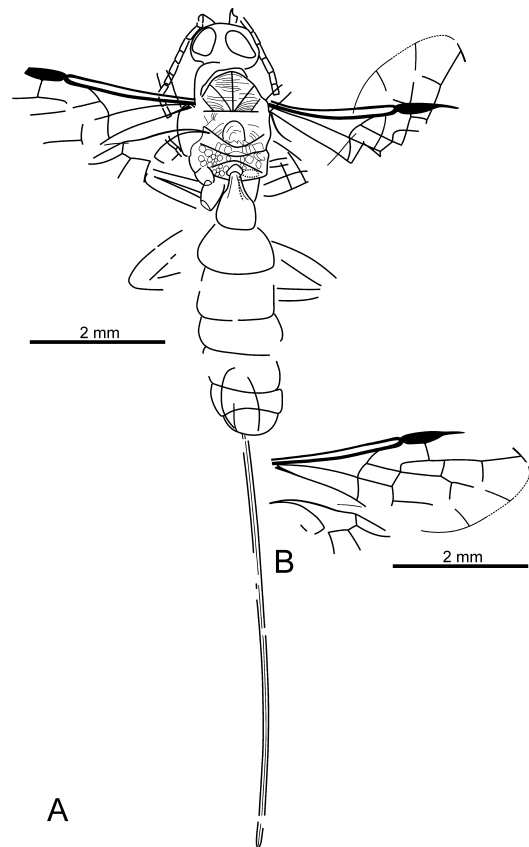


Figure 15 *Sinulacogastrinus eucallus* gen. et sp. nov., holotype, NND0772/NIGP148232. **A**, line drawing of body; **B**, combined and restored drawing of wings.

distad of 2r-m; cu-a interstitial. Hindwing with r-m as long as first abscissa of Rs; first section of M twice as long as r-m; cu-a strongly oblique, meeting M+Cu slightly basad of its forking into M and Cu; free M and Cu long. Metasoma long-ovoid, segments 2–6 almost similarly broad; first segment thin basally, conical for basal half and rectangular for distal half, 1.5 times as long as broad; second slightly shorter than first and trapezoid; third as long as second and rectangular; fourth slightly shorter than third; remaining ones at most as long as fourth. Ovipositor sheaths 1.6 times as long as forewing.

Measurements in mm: antennal length (as preserved) 2.1; head length 0.7, width 1.0; mesosomal length 1.7; forewing length 3.8, width 1.5; hindwing (as preserved) length 1.9, width 0.7; metasomal length 3.9; ovipositor length 7.1, sheath length 6.1.

Genus **EOSAULACUS** gen. nov.

TYPE SPECIES. *Eosaulacus giganteus* gen. et sp. nov.

ETYMOLOGY. From the Greek *eos-*, meaning the Orient, and generic name *Aulacus*.

DIAGNOSIS. Body large (about 20 mm in length). Antennae filiform with over 30 segments. Forewing with Rs origin at base of pterostigma; first abscissa of Rs much shorter than that of M; 2r-rs originating basad of pterostigmal mid-length, meeting Rs just at the point where 2r-m joins, and greatly

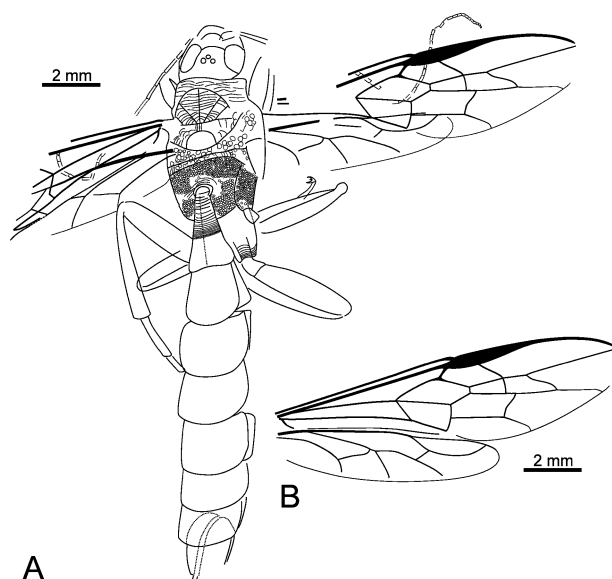


Figure 16 *Eosaulacus giganteus* gen. et sp. nov., holotype, NND0913/NIGP148233. **A**, line drawing of body; **B**, combined drawing of wings.

longer than maximal width of 2rm; 3r-m greatly oblique and sinuate; 2rm shorter than 3rm in terms of their posterior margins. Hindwing with M arched before r-m; cu-a meeting M+Cu basad of its fork into M and Cu, and obviously oblique; free M, Cu and A present. First metasomal segment long conical and transversely ridged. Ovipositor with sheaths longer than hindwing.

OCCURRENCE. Two species from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

REMARKS. The new genus differs from other praeaulacines in having a larger body (shorter than 16 mm excluding ovipositor for other genera within Praeaulacinae), and a very basal origin for Rs and much shorter first abscissa of Rs than that of M in the forewing.

***Eosaulacus giganteus* gen. et sp. nov.** (Figs 16, 17; Pl. 5, figs 1, 2)

TYPE MATERIAL. Holotype: NND0913/NIGP148233, in dorsal aspect. An incomplete female with antennae and wings slightly damaged, and ovipositor sheaths almost missing. Paratype: NND0715/NIGP148234, in dorsal aspect for head and mesosoma, and ventral for metasoma. An incomplete female with antennae missing, wings seriously damaged and ovipositor partly missing.

ETYMOLOGY. From the Latin *giganteus*, in allusion to the large size of the fossil.

DIAGNOSIS. As for genus.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Head slightly narrower than mesosoma, transversely round; eyes medium-sized, ovoid; ocelli small with posterior two much closer to anterior one than to each

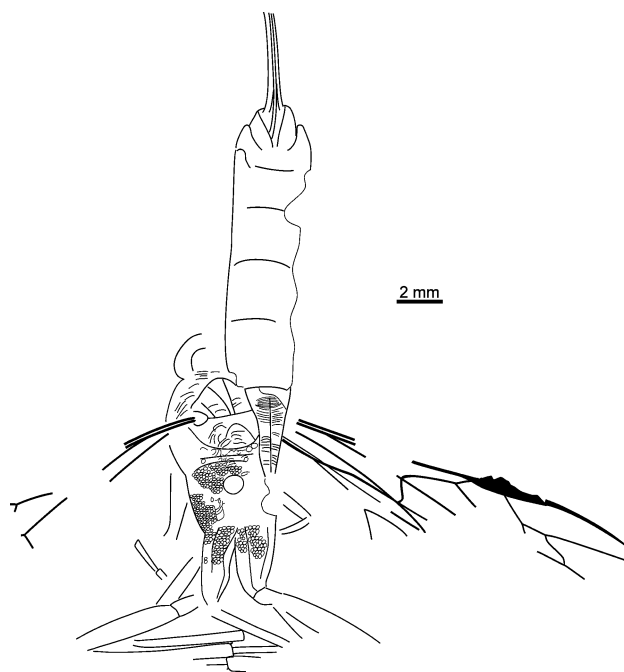


Figure 17 *Eosaulacus giganteus* gen. et sp. nov., paratype, NND0715/NIGP148234, line drawing.

other. Antenna very thin, about as long as forewing, with 30 segments preserved; scape thick, several basal flagellomeres about 5 times as long as wide, remaining ones gradually decreasing in length in succession but remaining longer than wide. Mesosoma short. Mesonotum with notauli nearly V-shaped; parapsidal sutures distinct; mesoscutellum slightly shorter than mesoscutum. Metanotum short; metapostnotum shorter than metanotum. Pronotum and mesonotum finely transversely ridged; metanotum, metapostnotum and propodeum finely areolate. Propodeal foramen small, about equidistant from metapostnotum and hindcoxae. Fore- and midleg small. Hindleg distinctly thicker than midleg; coxa large, 1.5 times as long as wide and distinctly shorter than first metasomal segment; trochanter small; femur as long as mid one; tibia slightly longer than femur; tarsus incomplete with basitarsomere 0.4 times length of tibia and twice as long as second tarsomere. Forewing with Rs originating just basad of pterostigma; first abscissa of Rs one-quarter length of that of M; 2r-rs strongly oblique, about twice as long as maximal width of 2rm; 3rm nearly 1.5 times as long as 2rm in terms of their posterior margins; 2m-cu meeting 3rm slightly distad of 2r-m, oblique and sinuate; cu-a interstitial and half length of first abscissa of M. Hindwing with r-m oblique and two-thirds length of first abscissa of Rs; first abscissa of M arched, 2.5 times as long as r-m; cu-a meeting M+Cu slightly before its fork. Metasoma long, spindle-like with first segment 1.5 times as long as wide, transversely ridged dorsally for basal half and ventrally for the whole; second through fifth subequal in length and width, slightly shorter than first; sixth and seventh slightly shorter than fifth. Ovipositor incomplete with preserved part as long as first metasomal segment.

Measurements in mm: specimen NND0913: antennal length (as preserved) 7.6; head length 1.8, width 2.3; mesosomal length 3.7; forewing length (as preserved) 11.9, width 3.1; hindwing (as preserved) length 6.0, width 1.6; metasomal length 13.3; ovipositor (as preserved) length 2.4,

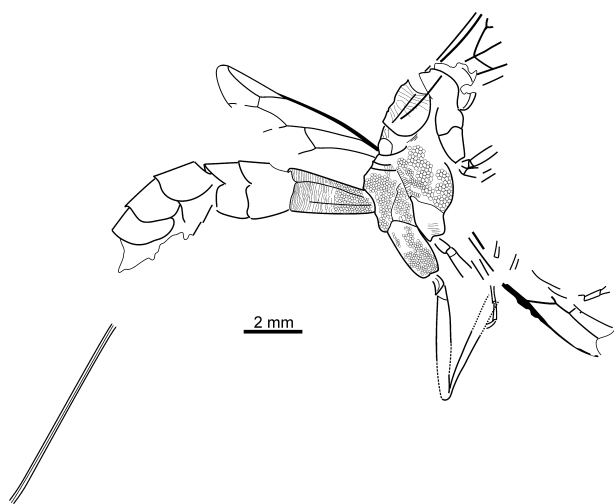


Figure 18 *Eosaulacus granulatus* gen. et sp. nov., holotype, NND0192/NIGP148235, line drawing.

sheath length 0.2. Specimen NND0715: head length 2.0; mesosomal length 4.7; forewing length (as preserved) 16.2, width 2.7; hindwing (as preserved) length 7.3, width 2.0; metasomal length 16.2; ovipositor (as preserved) length 6.0, sheath length 4.2.

***Eosaulacus granulatus* gen. et sp. nov.** (Fig. 18; Pl. 5, fig. 5)

TYPE MATERIAL. Holotype: NND0192/NIGP148235, in lateral aspect. An incomplete female with head, legs, forewings, metasoma distally and ovipositor basally and distally damaged and antennae missing.

ETYMOLOGY. From the Latin *granulatus*, in reference to the granulated basal part of the first metasomal segment.

DIAGNOSIS. See the key listed above.

OCCURRENCE. As for genus *Eosaulacus*, above.

DESCRIPTION. Pronotum long. Mesonotum with mesoscutum about twice as long as mesoscutellum. Metanotum short; metapostnotum much shorter than metanotum. Propodeal foramen just midway between metapostnotum and hind coxa. Mesoscutum transversely ridged; mesopleura, propodeum and hind coxa finely areolate. Legs thin; hindleg with coxa thick, squat, twice as long as wide and slightly shorter than first metasomal segment; trochanter small; femur about twice as long as coxa; tibia as long as femur (including trochantellus). Forewing incomplete with cu-a interstitial and two-thirds length of first abscissa of M. Hindwing with r-m slightly oblique and about one-third length of first abscissa of Rs; first abscissa of M slightly arched and about 4 times as long as r-m; cu-a meeting M+Cu far basad of its fork, slightly longer than section M+Cu beyond cu-a and about as long as first abscissa of Rs. Metasoma long with first segment slightly thinner basally than hind coxa basally, 1.8 times as wide distally as basally and finely granulated for basal half and transversely ridged for distal half; remaining ones short and, at most, half length of first. Ovipositor with preserved sheaths slightly longer than hindwing.

Measurement in mm: head (as preserved) length 0.9; mesosomal length 4.8; forewing (as preserved) length 4.5,

width 2.1; hindwing length 6.3, width (as preserved) 1.6; metasomal length (as preserved) 9.9; ovipositor sheath (as preserved) length 6.9.

Subfamily **ANOMOPTERELLINAE** Rasnitsyn, 1975

REVISED DIAGNOSIS. Mesonotum transversely ridged. Forewing with costal area broad; 2r-rs meeting pterostigma apically; only one r-m crossvein (3r-m) present; 2m-cu present; two mcu cells, particularly 1mcu, narrow; cu-a moderately postfurcal; outer margin of 2cua nearly perpendicular to posterior margin of wing; 2A and a1-a2 absent. Hindwing with C present; Rs and M fused for an interval; free terminal of Cu absent. First metasomal segment narrow basally. Ovipositor short.

REMARKS. A transversely ridged mesonotum is distinctly present in the specimen described below. Restudy of the Karatau specimens confirms that this character is also present in those species although not mentioned previously (Rasnitsyn 1975).

Genus **ANOMOPTERELLA** Rasnitsyn, 1975

1975 *Anomopterella* Rasnitsyn: 90.

TYPE SPECIES. *Anomopterella mirabilis* Rasnitsyn, 1975 (by original designation).

REVISED DIAGNOSIS. Antennae filiform with more than 15 segments. Mesosoma short, high; propodeum high, strongly convex or quite short, with posterior margin subvertical. Forewing with 3r quite broad, 2r-rs and 2m-cu basad of 3r-m. Hindwing with first abscissae of Rs and M subequal in length, short, orthogonal or at an obtuse angle. Metasoma broadest beyond its mid-length with first segment becoming gradually thick distally and longer than any other one. Ovipositor short (sheaths shorter than basal sclerite).

REMARKS. Anomopterellinae was previously classified as a family within the Evanioidea (Rasnitsyn 1975) and later lowered to a subfamily within the Praeulacidae (Rasnitsyn 1980). Based on the new material described below, the generic diagnosis has been slightly revised.

OCCURRENCE. Two species including the type from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan and one from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China.

KEY TO SPECIES WITHIN ANOMOPTERELLA.

1. Forewing with Rs origin quite away from pterostigma; 1r-rs rudimentary like a stub; 2mcu as broad as 2+3rm *A. huangi* sp. nov.
Forewing with Rs origin close to pterostigma; 1r-rs absent; 2mcu narrower than 2+3rm 2
2. Body length 4 mm; antennae shorter than forewing *A. mirabilis* Rasnitsyn, 1975
Body length 2.5 mm; antennae at least as long as forewing *A. stenocera* Rasnitsyn, 1975

***Anomopterella huangi* sp. nov.** (Fig. 19; Pl. 4, fig. 2)

TYPE MATERIAL. Holotype: NND2066/NIGP148228, in dorsal aspect. An incomplete wasp of unknown sex with antennae partly preserved, mesosoma damaged laterally,

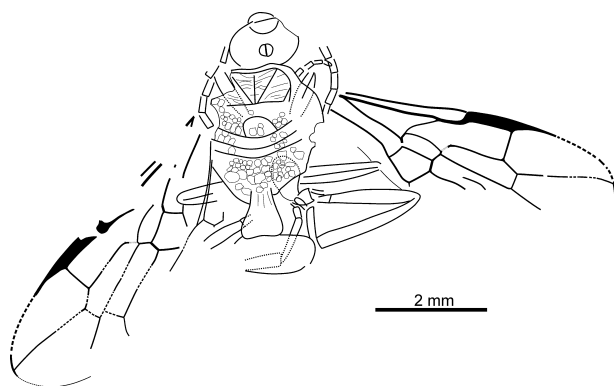


Figure 19 *Anopterella huangi* sp. nov., holotype, NND2066/NIGP148228, line drawing.

metasoma missing beyond second segment and wings damaged partly.

ETYMOLOGY. Specific name is dedicated to Dr Huang Diying, the collector of the holotype, from the Nanjing Institute of Geology and Palaeontology.

DIAGNOSIS. See the key listed above.

OCCURRENCE. Middle Jurassic, Daohugou deposits; Daohugou, Ningcheng, Inner Mongolia, China.

DESCRIPTION. Head normal in size, transversely ovoid. Antennae with 9 flagellomeres preserved; several subbasal ones comparatively thick and 2.5 times as long as wide; distal ones becoming gradually thinner apically and about twice as long as wide; terminal flagellomere rounded apically. Mesosoma broad and ovoid in dorsal aspect; pronotum very short, probably covered with mesonotum; mesonotum with transscutal, median, parapsidal sutures and notauli distinct, and notauli nearly V-shaped; mesoscutellum as long as mesoscutum; metanotum and metapostnotum short; propodeum broad. Mesoscutum transversely ridged; mesoscutellum laterally and posteriorly, metanotum, metapostnotum and propodeum coarsely areolate. Forelegs thin and short. Midlegs thin but distinctly longer than forelegs. Hindlegs distinctly thicker and longer than midlegs with coxa short and sharply narrowed distally; trochanter thin basally, becoming broad distally and slightly longer than wide; femur thin, elongate with trochantellus distinct; tibia as long as femur (including trochantellus); tarsus thin with basitarsomere 0.4 times length of tibia. Forewing with costal area beyond Rs origin slightly wider than pterostigma; first abscissa of Rs about 5 times as long as that of M and slightly longer than its distance to pterostigma; 2r-rs vertical and 1.4 times as long as maximal width of 2+3rm; 1+2rs slightly shorter than 3r; 1r-rs rudimentary like a very short stub on Rs where Rs is geniculate; second abscissa of Rs nebular slightly basad of 1r-rs; 2+3rm twice as long as and slightly wider than 1m-cu; 2m-cu as long and wide (maximum) as 2+3rm; 2cu-a 1.8 times as high as 1m-cu. Hindwing with first abscissae of Rs and M at an obtuse angle (more than 120°). First metasomal segment comparatively thin basally, gradually broadened apically and slightly longer than wide; second slightly shorter than first and about twice as wide as long.

Measurements in mm: head length 0.8, width 1.1; metasomal length 2.2; first metasomal segment length 0.7, second

0.6; forewing (as preserved) length 5.0, width 1.5; hindwing (as preserved) length 2.2.

Subfamily **NEVANIINAE** Zhang & Rasnitsyn, 2007

DIAGNOSIS. Head small to medium-sized with occipital foramen closed ventrally. Antenna filiform and polymerous with scape short. Pronotum comparatively long, not short medially. Pronotum and mesonotum transversely ridged. Mesonotum with median and transscutal sutures and notauli present. Metapostnotum present. Forewing venation complete with 2–3rm and 2m-cu tubular; basal vein (Rs&M) meeting M+Cu far basad of pterostigma; cu-a postfurcal or interstitial; 2A present. Hindwing venation complete with C, r-m and cu-a present; r closed. Metasoma attached to propodeum about halfway between metapostnotum and hind coxa, with two basal metasomal segments tube-like. Ovipositor short and slightly exsert.

Genus **NEVANIA** Zhang & Rasnitsyn, 2007

2007 *Nevania* Zhang & Rasnitsyn: 151.

TYPE SPECIES. *Nevania robusta* Zhang & Rasnitsyn, 2007 (by original designation).

DIAGNOSIS. As for subfamily.

OCCURRENCE. Six species including the type from the Middle Jurassic Daohugou deposits of Daohugou, Ningcheng, Inner Mongolia, China and one from the Late Jurassic Karabastau Formation of Aulie, Karatau, southern Kazakhstan.

Nevania karatau sp. nov. (Fig. 20; Pl. 4, fig. 4)

TYPE MATERIAL. Holotype: PIN2997-4157. An isolated and complete forewing.

ETYMOLOGY. From Karatau, South Kazakhstan, which yielded the type specimen.

DIAGNOSIS. Easily distinguished by its small size, very close origin of Rs to pterostigma and comparatively short 2r-rs.

OCCURRENCE. Late Jurassic, Karabastau Formation; Aulie, Karatau, southern Kazakhstan.

DESCRIPTION. Forewing with M+Cu fork slightly closer to wing base than to pterostigma; Rs originating very close to pterostigma; first abscissa of Rs 0.7 times length of that of M; 2r-rs subvertical, meeting pterostigma at its basal 0.4 length, about as long as pterostigmal width, and half length of maximal width of 2rm; 3r about 1.3 times as long as 1+2r; 1m-cu in contact with 2rm by a point; 2rm slightly shorter than 1+2r but slightly longer than 3rm; cu-a interstitial and subparallel to 2r-rs.

Measurements in mm: forewing length 4.2, width 1.7.

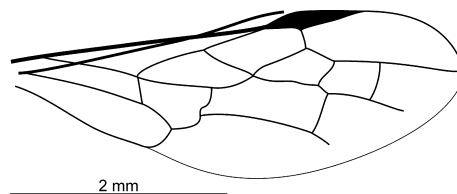


Figure 20 *Nevania karatau* sp. nov., holotype, PIN2997-4157, line drawing of wing.

Table 1 List of the Mesozoic Evanioidea excluding those with the badly preserved or missing antennae.

Taxa	N.A.S	Occurrence	References
Praeaulacidae			
Praeaulacinae			
<i>Aulacogastrinus ater</i> Rasnitsyn, 1983	17	Kazakhstan; U. Jur.	Rasnitsyn 1972, 1983
<i>Aulacogastrinus hebeiensis</i> sp. nov.	22	China; M. Jur.	This study
<i>Aulacogastrinus insculptus</i> sp. nov.	27	China; M. Jur.	This study
<i>Aulacogastrinus longaciculatus</i> sp. nov.	>32	China; M. Jur.	This study
<i>Eosaulacus giganteus</i> sp. nov.	>30	China; M. Jur.	This study
<i>Evaniops rostratus</i> Rasnitsyn, 1972	20	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacinus crassipes</i> Rasnitsyn, 1972	14	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacinus minor</i> Rasnitsyn, 1972	15	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacinus parvus</i> Rasnitsyn, 1973	15	Kazakhstan; U. Jur.	Rasnitsyn 1972, 1973
<i>Praeaulacites medius</i> Rasnitsyn, 1972	20–22	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacites minimus</i> Rasnitsyn, 1972	14	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacites nigripes</i> Rasnitsyn, 1972	19	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacites pachygaster</i> Rasnitsyn, 1972	19–20	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacites subniger</i> Rasnitsyn, 1972	20	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacon caudatus</i> Rasnitsyn, 1972	21	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacon coniventer</i> Rasnitsyn, 1972	19	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacon elongatus</i> Rasnitsyn, 1972	≥ 20	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacon tenuis</i> Rasnitsyn, 1972	18	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacops lucidus</i> Rasnitsyn, 1972	23	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus afflatus</i> sp. nov.	19	China; M. Jur.	This study
<i>Praeaulacus cubocephalus</i> Rasnitsyn, 1972	15	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus douhugouensis</i> sp. nov.	22	China; M. Jur.	This study
<i>Praeaulacus elegans</i> Rasnitsyn, 1972	19	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus exquisitus</i> sp. nov.	28	China; M. Jur.	This study
<i>Praeaulacus leptogaster</i> Rasnitsyn, 1972	21	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus magnus</i> Rasnitsyn, 1972	27	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus obscurus</i> Rasnitsyn, 1972	17	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus orientalis</i> sp. nov.	22	China; M. Jur.	This study
<i>Praeaulacus ramosus</i> Rasnitsyn, 1972	23–25	Kazakhstan; U. Jur.	Rasnitsyn 1972
<i>Praeaulacus robustus</i> sp. nov.	23 or 24	China; M. Jur.	This study
Anomopterellinae			
<i>Anomopterella mirabilis</i> Rasnitsyn, 1972	18	Kazakhstan; U. Jur.	Rasnitsyn 1972
Cretocleistogastrinae			
<i>Westratia caudata</i> Rasnitsyn, 1990	≤15	Russia; L. Cret.	Rasnitsyn 1990b
<i>Westratia curtipes</i> Rasnitsyn, 1990	14	Russia; L. Cret.	Rasnitsyn 1990a
<i>Westratia nana</i> Jell & Duncan, 1986	14	Australia; L. Cret.	Jell & Duncan 1986
<i>Westratia pentadecamera</i> Rasnitsyn, 1990	15	Mongolia; L. Cret.	Rasnitsyn 1990b
<i>Westratia striata</i> Rasnitsyn, 1990	15(?)	Russia; L. Cret.	Rasnitsyn 1990b
Nevaniinae			
<i>Nevania delicata</i> Zhang & Rasnitsyn, 2007	>31	China; M. Jur.	Zhang & Rasnitsyn 2007
<i>Nevania ferocula</i> Zhang & Rasnitsyn, 2007	≥ 29	China; M. Jur.	Zhang & Rasnitsyn 2007
<i>Nevania malleata</i> Zhang & Rasnitsyn, 2007	>28	China; M. Jur.	Zhang & Rasnitsyn 2007
<i>Nevania robusta</i> Zhang & Rasnitsyn, 2007	>28	China; M. Jur.	Zhang & Rasnitsyn 2007
Andrenelliidae			
<i>Andrenelia pinnata</i> Rasnitsyn & Martínez-Delclòs, 2000	18 or 19	Spain; L. Cret.	Rasnitsyn & Martínez-Delclòs 2000
Gasteruptionidae			
Aulacinae			
<i>Hyptiogastrites electrinus</i> Cockerell, 1917	14(?) (♀)	Myanmar; L. Cret.	Jennings <i>et al.</i> 2004
Baissinae			
<i>Manlaya lacabrua</i> Rasnitsyn & Ansoerge, 2000	14 (♀)	Spain; L. Cret.	Rasnitsyn & Ansoerge 2000
<i>Sinowestratia communicata</i> Zhang & Zhang, 2000	14 (♀)	China; L. Cret.	Zhang & Zhang 2000
Kotujellitinae			
<i>Kotujellites crucis</i> Rasnitsyn <i>in</i> Pagliano & Scaramozzino, 1990	13 (♂)	Russia; U. Cret.	Rasnitsyn 1975; Pagliano & Scaramozzino 1990
<i>Kotujisca priapulius</i> Rasnitsyn, 1991	14 (♀)	Mongolia; L. Cret.	Rasnitsyn 1991
Evaniidae			
<i>Cretevania major</i> Rasnitsyn, 1975	12	Russia; U. Cret.	Rasnitsyn 1975
<i>Eovernevania cyrtocerca</i> Deans, 2004	13(?)	Lebanon; L. Cret.	Deans <i>et al.</i> 2004
<i>Grimaldivania ackermani</i> Basibuyuk, Fitton & Rasnitsyn, 2000	13	USA; U. Cret.	Basibuyuk <i>et al.</i> 2000a
<i>Grimaldivania mckimorum</i> Engel, 2006	13	USA; U. Cret.	Engel 2006
<i>Lebanevania azari</i> Basibuyuk & Rasnitsyn, 2002	12	Lebanon; L. Cret.	Basibuyuk <i>et al.</i> 2002
<i>Mesevania swinhoei</i> Basibuyuk & Rasnitsyn, 2000	26	Myanmar; L. Cret.	Basibuyuk <i>et al.</i> 2000b
<i>Newjersevania casei</i> Basibuyuk, Quicke & Rasnitsyn, 2000	13	USA; U. Cret.	Basibuyuk <i>et al.</i> 2000a
<i>Newjersevania nascimbenei</i> Basibuyuk, Quicke & Rasnitsyn, 2000	13	USA; U. Cret.	Basibuyuk <i>et al.</i> 2000a
<i>Procretevania exquisita</i> Zhang <i>et al.</i> , 2007	13	China; L. Cret.	Zhang <i>et al.</i> 2007
<i>Procretevania vesca</i> Zhang <i>et al.</i> , 2007	13	China; L. Cret.	Zhang <i>et al.</i> 2007
<i>Protoparevania lourothi</i> Deans, 2004	13	Lebanon; L. Cret.	Deans <i>et al.</i> 2004
<i>Sorellevania deansi</i> Engel, 2006	13	Myanmar; L. Cret.	Engel 2006

Abbreviations: N.A.S., number of antennal segments; M. Jur., Middle Jurassic; U. Jur., Upper Jurassic; L. Cret., Lower Cretaceous; U. Cret., Upper Cretaceous.

DISCUSSION

Three subfamilies of Praeaulacidae, Praeaulacinae, Anomopterellinae and Nevaniinae, have been discovered from the Middle Jurassic Daohugou deposits (Zhang & Rasnitsyn 2007; this study), which are also present in the Upper Jurassic Karabastau Formation of Karatau, South Kazakhstan (Rasnitsyn 1972, 1975; this study). More specifically, there are 16 species (including an undetermined species) within five genera in Praeaulacinae, one genus and species in Anomopterellinae and six species within one genus in Nevaniinae in the Daohugou fauna, whereas there are 23 species within eight genera in Praeaulacinae, two species within one genus in Anomopterellinae and one genus and species in Nevaniinae in the Karatau fauna (Rasnitsyn 1972, 1973, 1975, 1983; this study). These data show that both Praeaulacinae and Anomopterellinae are less diverse from Daohugou than from Karatau, but that the Praeaulacidae as a whole are similarly diverse in the two faunas. There are five common genera in the two faunas, namely *Praeaulacus*, *Praeaulacon* and *Aulacogastrinus* within Praeaulacinae, *Anomopterella* within Anomopterellinae and *Nevania* within Nevaniinae, indicating a close relationship between the two regions. However, a distinct difference is implied by the fact that no common species have been detected.

Over time, the number of antenna segments tends to decrease in Evanioidea (Fig. 21, Table 1). In the Late Jurassic, evanioids had between 14 and 27 antennal segments and about 19 on an average. Later, the number became 12–26 and about 15, respectively, in the Early Cretaceous, and 12–13 and about 13 in the Late Cretaceous. Since then, the number has remained invariable through the Cenozoic (Basibuyuk *et al.* 2002; Nel *et al.* 2002, 2004) until the present, i.e. 14 in females and 13 in males of Gasteruptionidae *s. l.* (Rasnitsyn 1988) and 13 in Evaniidae (other than 10 in *Decevania*: Deans & Huben 2003). Specimens from Daohugou show from 19 to over 32 antennal segments, averaging about 26 in Praeaulacidae, being a much earlier stage in this aspect.

The high attachment of the metasoma on the propodeum, a character of the Evanioidea, is constant between the Praeaulacinae from both Daohugou and Karatau: all show a small metasomal foramen just midway between the metapostnotum and hindcoxae, or even much closer to the former

than the latter. However, the tubular first metasomal segment seen in *Evanigaster* and *Evanioops* (Rasnitsyn 1972) from Karatau, a derived character of the Evanioidea (Basibuyuk *et al.* 2002), is not yet visible in the subfamily Praeaulacinae from Daohugou.

The hindwing venation appears to be complete in Daohugou praеaulacines except *Praeaulacus scabratus* (Fig. 5; Pl. 2, figs 5a, 5b), which shows a very short free section of M and completely absent free A (possibly due to the poor preservation), and *Praeaulacon elegantulus* (Fig. 10; Pl. 3, figs 2a, 2b), in which the free M disappears. By contrast, hindwing venation tends to be reduced in this subfamily from Karatau, as exhibited by variously rudimentary free M, Cu and A (see e.g. *Praeaulacon caudatus* Rasnitsyn, 1972: fig. 12).

In Evanioidea, the attachment of the metasoma to the propodeum is thought to have evolved by the metasomal joint first narrowing down and then very rapidly moving upwards and away from the hind coxae (Rasnitsyn 1980). The Praeaulacidae from Daohugou undoubtedly display the position of the metasomal joint that is typical of Evanioidea, a high attachment of the metasoma on the propodeum (Zhang & Rasnitsyn 2007; this study). This condition, as well as the fact that this family possessed a quite high diversity in the Middle Jurassic, indicates that the Evanioidea emerged earlier than the Middle Jurassic.

Daohugou praеaulacines probably parasitised xylophages similar to their Late Jurassic relatives (Rasnitsyn 1972, 1980) and the Anomopterellinae, as suggested by the transversely ridged mesonotum (see fig. 19), would have had a similar feeding habit.

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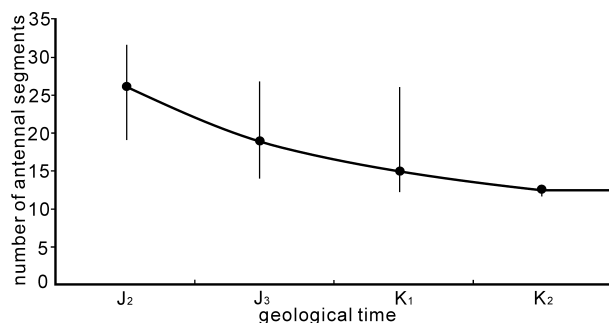


Figure 21 Graph showing how the number of antennal segments of the Evanioidea changed during the Late Mesozoic (data from Table 1). Filled circles, the average number of antennal segments. Upright lines crossing the circles dot represent the range of antennal segments. Abbreviations: J₂, Middle Jurassic; J₃, Late Jurassic; K₁, Early Cretaceous; K₂, Late Cretaceous.

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