

Pelecinid wasps (Insecta: Hymenoptera: Proctotrupoidea) from the Yixian Formation of western Liaoning, China



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Eight new species referable to three new genera from the uppermost Jurassic or Lower Cretaceous Yixian Formation in Beipiao (western Liaoning Province, China) are established herein and assigned to the subfamily Iscopinae in the family Pelecinidae (Insecta: Hymenoptera: Proctotrupoidea). They are *Sinopelecinus* gen. nov., which includes *S. delicatus* sp. nov., *S. epigaeus* sp. nov., *S. magicus* sp. nov., and *S. virosus* sp. nov.; *Eopelecinus* gen. nov., which includes *E. vicinus* sp. nov., *E. shangyuanensis* sp. nov., and *E. similis* sp. nov.; and *Scorpiopelcinus versatilis* gen. et sp. nov. A diagnosis of the subfamily Iscopinae is given on the basis of the new material. Many characters within this subfamily show that *Iscopinus* Kozlov, 1974 is more primitive than the other genera, among which *Scorpiopelcinus* is the most primitive, *Sinopelecinus* more advanced and *Eopelecinus* the most advanced.

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1. Introduction

The Pelecinidae is an extremely small family, with only one extant species, *Pelecinus polyturator* (Drury) (Muesebeck, 1979; Masner, 1993), although two species have previously been reported in this genus (Schletterer, 1889; Patton, 1894; Brues, 1928), belonging to the superfamily Proctotrupoidea (Rasnitsyn, 1980, 1988). Its history is little known and only two fossil genera from this family have been documented (Brues, 1933; Kozlov, 1974; Johnson, 1998). The first of these, *Pelecinopteron* Brues, 1933, with a single species, *Pelecinopteron tubuliforme* Brues, 1933, from Late Eocene Baltic amber and Palaeocene Sakhalin amber, was originally placed in a new family, the Pelecinopteridae (Brues, 1933). This genus was later considered to be a member of the Pelecinidae based on its forewing venation and metasomal structure (Kozlov, 1974). The other genus, *Iscopinus* Kozlov, 1974, with *Iscopinus baissicus* Kozlov, 1974 as its type species, is monotypical from the Lower Cretaceous of Transbaikalia (Kozlov, 1974). Now the family is divided into two subfamilies: Pelecininae Haliday (comprising *Pelecinus* Latreille and *Pelecinopteron* Brues) and Iscopinae Rasnitsyn

(containing only the genus *Iscopinus* Kozlov) (Rasnitsyn, 1980).

Recently, one of us (ZH) recovered eight pelecinid wasps from the uppermost Jurassic or Lower Cretaceous Jianshangou Bed of the Yixian Formation at Huangbanjigou Village, Beipiao, western Liaoning Province, China. These specimens are now deposited in the Nanjing Institute of Geology and Palaeontology, the Chinese Academy of Sciences.

2. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758

Suborder: Apocrita Gerstaecker, 1867

Superfamily: Proctotrupoidea Latreille, 1802

Family: Pelecinidae Haliday, 1840

Subfamily: Iscopinae Rasnitsyn, 1980

Remarks. The Iscopinae are little known with only one species, *Iscopinus baissicus* Kozlov, 1974, known from a single male specimen (Kozlov, 1974; Rasnitsyn, 1980). Based on material from the Yixian Formation in western Liaoning, eight new species and three new genera are established herein and assigned

to this subfamily. On these grounds, the subfamily can be diagnosed as follows: Forewing venation comparatively complete or ordinarily reduced. Hindwing with only C present. Antennae consisting of 14–18(?) segments. Female metasoma with at least one basal segment minimally modified (of usual width). Male metasoma stick-like.

Although different from known peleciniids in many ways, the wasps described are undoubtedly related to the Peleciniidae based on their metasoma, which is slender and bears specialized articulation at least between segments 3 through 6. Their forewing venation is of proctotrupoid type and very similar to that of the Mesozoic proctotrupids except for the open or absent cell r. The hindwing lacking distinct veins is also characteristic of Peleciniidae and Proctotrupidae (Rasnitsyn, 1980, 1988). Their metasoma is very similar to that of the Peleciniinae but keeps an obviously primitive character in that at least one normal (wide) segment remains in the female metasoma (first segment in *Eopelecinus* gen. nov., first and second in *Sinopelecinus* gen. nov. and first through third in *Scorpiopolecinus* gen. nov.).

Within the subfamily Iscopiniinae, *Iscopinus* Kozlov shows more primitive characters than the new material in that the forewing bears a vein 'Rs₂' and a closed cell r, the antenna possesses many more antennomeres, and the male metasoma is distinctly wider than that of *Sinopelecinus* (*Eopelecinus* and *Scorpiopolecinus* are only known from females). Among the new material, *Scorpiopolecinus* is the most primitive based on its forewings and metasoma. The venation in the forewing is much richer than that of the other two genera with some important veins still present (anal and brachial veins present as compared with *Sinopelecinus*; 2r-rs, Rs, (M+)Cu, anal and brachial veins present as compared with *Eopelecinus*). The metasoma also shows some plesiomorphic characters, especially in the three basal segments: they are wide, not particularly elongate, and most probably overlap each other in a plesiomorphic way (no specialized joint present between them unlike those between third through sixth segments). *Sinopelecinus* is more advanced in that (1) anal and brachial veins are lost in the forewing; (2) only metasomal segments 1 and 2 are comparatively wide (albeit much less so than in *Scorpiopolecinus* and *Eopelecinus*), and (3) all segments are movably connected though the joint between the first two of them is much wider than between the rearward segments. *Eopelecinus* is undoubtedly the most advanced genus owing to its forewing venation being extremely reduced (only veins C and Sc left) and its metasoma with only one wide segment (the first), which is very long (nearly as long as the mesosoma).

Key to Iscopiniinae

1. Forewing with 'Rs₂' present, r closed; antenna 18(?) segmented. *Iscopinus* Kozlov, 1974
.....*Iscopinus baissicus* Kozlov, 1974
- Forewing with 'Rs₂' not present, r open; antenna 14–16(?) segmented. 2
2. Forewing with only C and R present, pterostigma shorter, widest beyond midlength; female metasoma with one basal segment wide. Pronotum short medially. *Eopelecinus* gen. nov. 3
- Forewing with 2r-rs, vestigial Rs and (M+)Cu present, pterostigma longer, not widened beyond midlength; female metasoma with two or three basal segments wide. Pronotum probably longer. 5
- 3(2). Hind femur clavate; first metasomal segment shorter than mesosoma, as wide basally as apically.
.....*Eopelecinus similis* gen. et sp. nov.
- Hind femur not clavate; first metasomal segment not shorter than mesosoma, much wider basally than apically. 4
- 4(3). Antenna thin, with first flagellomere longer than second; forewing pterostigma with base weakly sclerotized; first metasomal segment longer than second.
.....*Eopelecinus vicinus* gen. et sp. nov.
- Antenna thicker, with first flagellomere shorter than second; lower pterostigmal margin weakly sclerotized; first and second metasomal segments of equal length.
.....*Eopelecinus shangyuanensis* gen. et sp. nov.
- 5(2). Forewing with no anal and brachial veins; female metasoma with two basal segments wide. *Sinopelecinus* gen. nov. 6
- Forewing with anal and brachial veins; female metasoma with three basal segments wide. *Scorpiopolecinus* gen. nov.*Scorpiopolecinus versatilis* gen. et sp. nov.
- 6(5). Male (with metasoma stick-like) with antenna 16(?) segmented (female unknown).
.....*Sinopelecinus viriosus* gen. et sp. nov.
- Female (with two basal metasomal segments wide and others narrow) with antenna 14–15 segmented. 7
- 7(6). Antenna 15 segmented; mesosoma slender; hind coxa larger; metasomal segments 3–6 wider, with longitudinal ridges and with lower contour convex.
.....*Sinopelecinus delicatus* gen. et sp. nov.
- Antenna 14 segmented; mesosoma stout; hind coxa smaller; metasomal segments 3–6 thin, not sculptured, segments 4–5 with lower contour concave. 8
- 8(7). Antenna thick with first flagellomere about as long as apical one; legs elongate; first metasomal segment much longer than second, fourth longer than fifth.
.....*Sinopelecinus epigaeus* gen. et sp. nov.
- Antenna thin with first flagellomere about as long as two apical ones; legs thin and short; first and second metasomal segments subequal in length, fourth longer than fifth and sixth combined.
.....*Sinopelecinus magicus* gen. et sp. nov.

Genus *Sinopelecinus* gen. nov.

Etymology. Greek, *Sine*, China, and the generic name *Pelecinius*, gender masculine.

Type species. *Sinopelecinus delicatus* sp. nov.; uppermost Jurassic or Lower Cretaceous, Yixian Formation, Liaoning, China.

Species included. Four monotypical species described herein.

Diagnosis. Antenna 16(?)-segmented in male and 14–15-segmented in female. Forewing with pterostigma narrow, acute apically, not widened beyond midlength; 2r-rs distinct, vestigial Rs present distad of 2r-rs, (M+)Cu present, 3r open. Pronotum long medially. Metanotum and propodeum reticulate. Female metasoma with first and second segments wide and remaining tubular.

Comparison. See the key above and the following genera and species.

Sinopelecinus delicatus sp. nov.
Figures 1B, 2

Etymology. Latin, *delicatus*, delicate.

Material. Holotype LBSH98047/NIGP134157 (female). Antennae and legs incomplete, hindwings not preserved, otherwise nearly complete.

Description. Female; male unknown. Body brown, antennae and legs (tibiae and tarsi) pale. Head large, transversely broad; eyes small, subtriangular. Antennae 15-segmented and slightly longer than head and mesosoma combined; scape incomplete; pedicel as long as wide with base slightly thinner than, and apex as thick as, apex of scape; first flagellomere cylindrical, four times as long as wide and slightly thinner than pedicel; second and third as long as first, slightly thinner than that basally and thicker apically; following gradually decreasing in length and increasing in thickness; terminal flagellomere slightly longer than eleventh and rounded apically. Mesosoma narrow with collar narrow; pronotum comparatively long; mesopleura, metanotum, metapleura and propodeum densely reticulate. Foreleg and midleg thin; hindleg with coxa large and oval, trochanter small and inversely trapezoid, femur short, tibia incomplete, tarsus long with length ratio of tarsomeres 2.0:0.8:0.5:0.3:0.5. Forewing with 2r-rs oblique apicad, 2.5 times as long as pterostigmal width; Rs rudiment short, directed toward wing fore margin; (M+)Cu straight, long, not reaching margin of wing, bearing only short rudiments of free M, cu-a, 1m-cu and brachial vein. First metasomal segment nearly trapezoid in side view, about half as long as mesosoma

and about half as wide basally as apically; second nearly parallel-sided, about 0.8 times as wide as first apically and 1.2 times as wide as third; third through sixth comparatively wide in side view (third 0.8 times as wide as second, sixth as wide as second), third, fourth and fifth gradually, sixth more abruptly narrowed basad, with convex ventral and convex (third and sixth) or concave dorsal contours, with one or two longitudinal ridges. Length ratio of metasomal segments 1.0:0.8:1.2:1.6:1.5:1.4. Head length 0.8 mm, mesosoma 2.1 mm, metasoma 8.5 mm; antennal length 3.1 mm; forewing length 3.4 mm, width 1.3 mm.

Sinopelecinus epigaeus sp. nov.
Figures 1A, 3

Etymology. Latin, *epigaeus*, terrestrial.

Material. Holotype LBSH98043/NIGP134158 (female). Complete insect except wings not preserved.

Description. Female; male unknown. Body brown, antennae, legs (femora, tibiae and tarsi) and metasomal segments 4–6 pale. Head medium-sized, transversely oval in side view; eyes large and oval. Antennae 14-segmented and slightly longer than head and mesosoma combined; scape thin basally, gradually increasing in thickness apicad and twice as long as wide; pedicel slightly shorter than wide, slightly thinner than scape basally and as wide as it apically; first flagellomere distinctly thinner than pedicel basally, gradually increasing in thickness apically and three times as long as wide; second to sixth similar to first, slightly shorter and thicker; following similar to sixth, slightly shorter, apical one as long as first and rounded apically. Mesosoma oval in lateral aspect; pronotum comparatively long; mesoscutum long and about twice as long as scutellum; metanotum short; mesoscutellum, metanotum, metapleura and propodeum densely reticulate. Foreleg and midleg thin and elongate; hindleg with coxa distinctly larger than mid coxa and oval, trochanter trapezoid, femur similar to mid femur, tibia slightly longer than femur, tarsus thin and elongate. First metasomal segment as wide basally as apically, slightly broadened medially, broadest at two-thirds of its length, 0.6 times as long as mesosoma; second similar to first in shape but broadest at about one-third of its length, 0.8 times as wide as first and 1.5 times as wide as third; third through fifth slender (third 0.7 times as wide as second), gradually narrowed basad, with slightly concave ventral and convex dorsal contours; sixth straight and as wide as fifth for basal two-thirds of length, slightly convex dorsally for

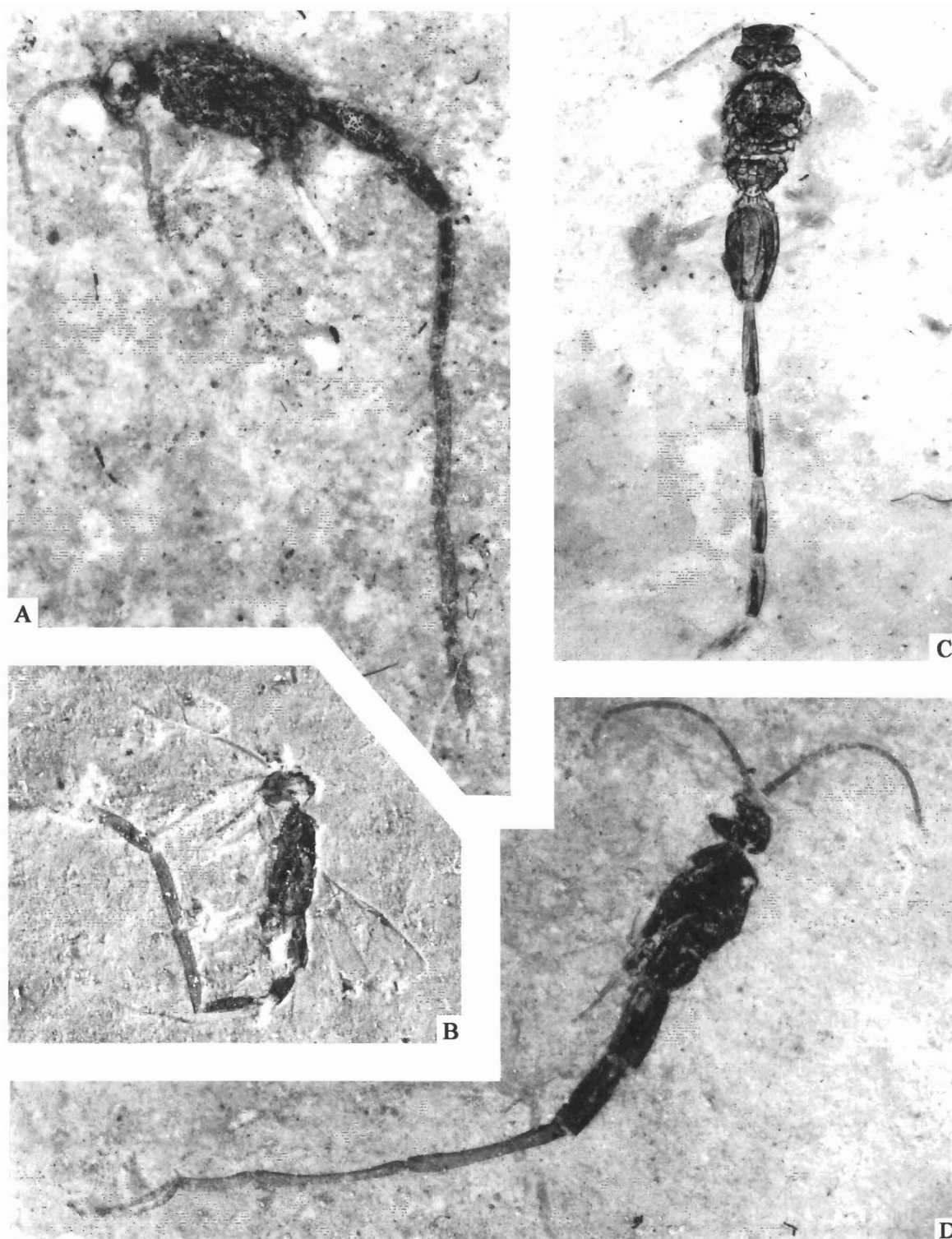


Figure 1. A, *Sinopelecinus epigaeus* sp. nov., holotype, NIGP134158; $\times 12$. B, *Sinopelecinus delicatus* sp. nov., holotype, NIGP134157; $\times 8$. C, *Eopelecinus similis* sp. nov., holotype, NIGP134163; $\times 13$. D, *Sinopelecinus magicus* sp. nov., holotype, NIGP134159; $\times 10$.

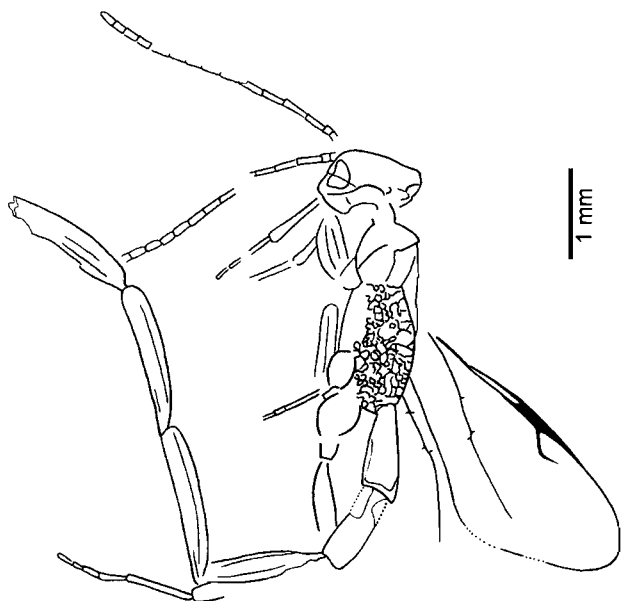


Figure 2. *Sinopelecinus delicatus* sp. nov., female, lateral aspect, camera lucida drawing of holotype, NIGP134157.

distal one-third of length. Length ratio of metasomal segments 1.0:0.8:1.6:1.4:1.3:1.0. Ovipositor thin and sharpened. Head length 0.6 mm, mesosoma 2.2 mm, metasoma 9.2 mm; antennal length 3.1 mm.

Sinopelecinus magicus sp. nov.

Figures 1D, 4

Etymology. Latin, *magicus*, magic.

Material. Holotype LBSH98044/NIGP134159 (female). Wings not preserved, otherwise nearly complete.

Description. Female; male unknown. Body brown, antennae, legs (femora, tibiae and tarsi) and metasomal segments 3–6 pale. Head medium-sized, transversely trapezoid; eyes large and semioval. Antennae 14-segmented and slightly longer than head and mesosoma combined; scape thick and twice as long as wide; pedicel as long as wide with base greatly, and apex slightly thinner than apex of scape; first flagellomere slightly thinner than pedicel basally, as wide as it apically, and four times as long as wide; second to fifth similar to first but slightly shorter, three times as long as wide; following similar to fifth but slightly shorter; terminal 1.5 times as long as eleventh and rounded apically. Pronotum comparatively long; mesoscutellum with anterior and posterior margins reticulate; metanotum short, densely areolate; propodeum

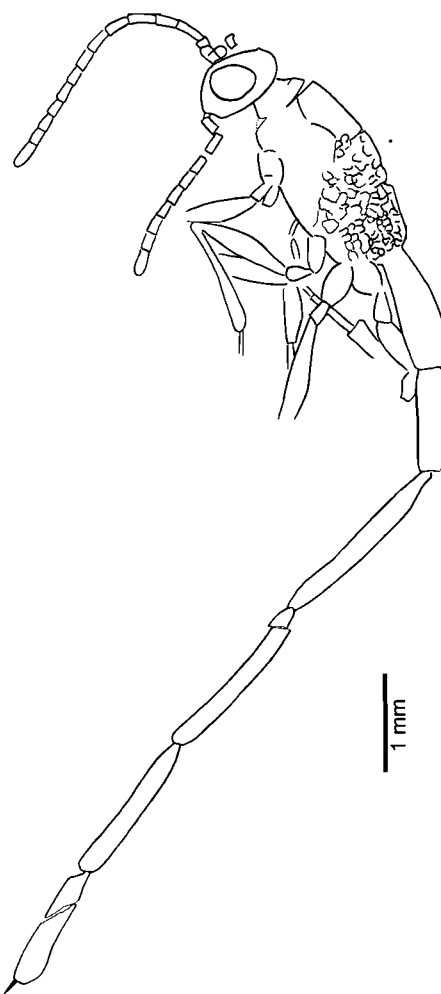


Figure 3. *Sinopelecinus epigaeus* sp. nov., female, lateral aspect, camera lucida drawing of holotype, NIGP134158.

coarsely reticulate. Foreleg and midleg short and thin; hindleg with coxa distinctly larger than mid coxa, oval, femur slightly larger than mid femur, tibia longer than femur, tarsus thin with basitarsus distinctly longer than second tarsomere, third and fourth short. First metasomal segment nearly trapezoid in basal half and parallel-sided in distal half, about 0.6 times as long as mesosoma and about 0.6 times as wide basally as apically; second nearly trapezoid and 0.8 times as wide basally as apically, about 0.8 times as wide as first apically and twice as wide as third; third through fifth slender in lateral view (third half as wide as second; fourth and fifth 0.4 times as wide as second), with concave ventral and convex dorsal contours (third ventrally convex near its base); sixth elongate-oval, 1.2 times as wide as fifth. Length ratio of metasomal segments 1.0:1.0:1.9:1.8:0.9:0.6. Ovipositor with protruded part half as long as sixth metasomal

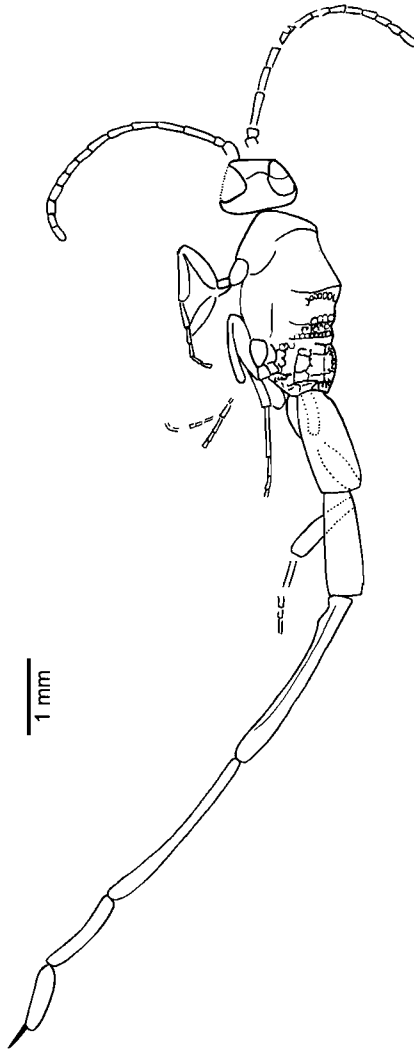


Figure 4. *Sinopelecinus magicus* sp. nov., female, lateral aspect, camera lucida drawing of holotype, NIGP134159.

segment. Head length 0.7 mm, mesosoma 2.5 mm, metasoma 9.8 mm; antennal length 3.8 mm.

Sinopelecinus viriosus sp. nov.

Figures 5A, 6

Etymology. Latin, *viriosus*, strong, robust.

Material. Holotype LBSH98048/NIGP134160 (male). Antennae and legs incomplete, hindwings not preserved.

Description. Male; female unknown. Body brown, legs and metasomal apex pale, flagellum with narrow sub-apical pale ring. Head medium-sized, oval-triangular; eyes medium-sized, oval. Antennae slightly longer

than head and mesosoma combined, probably consisting of 16 segments; scape short and distinctly enlarged apicad; pedicel subcylindrical, 1.5 times as long as wide and distinctly thinner than scape apically; first and second flagellomeres similar to pedicel, slightly longer; third as long as second, slightly thinner than second basally and gradually increasing in thickness apicad; fourth and fifth similar to third, slightly shorter; sixth to eighth slightly shorter and thinner than fifth, subcylindrical; following slightly thinner (twelfth and thirteenth pale, indistinguishable), terminal small and subtriangular. Mesosoma narrow with mesonotum, metanotum and propodeum coarsely areolate. Fore femur thin; mid femur longer than fore femur; hindleg with coxa comparatively small, oval, femur slightly longer than mid femur, tibia nearly as long as femur, thin basally and gradually increasing in thickness apicad; tarsus thin with basitarsus about twice as long as second tarsomere. Forewing with R thick and slightly bent posteriad; 2r-rs oblique apicad and forming a short arc with Rs rudiment; (M+)Cu straight, reaching level of pterostigmal base. Metasoma stick-like with segments subequal in length; first segment nearly trapezoid, twice as long as wide; second through sixth near parallel-sided. Second, third and fourth as wide as first apically; fifth slightly narrower than fourth; sixth slightly narrower than fifth; terminal as wide as sixth basally and gradually tapering apicad. Head length 0.9 mm, mesosoma 2.7 mm, metasoma 6.3 mm; antennal length 4.1 mm; forewing length, as preserved, 3.6 mm.

Genus *Eopelecinus* gen. nov.

Etymology. Greek, *eos*, dawn, morning, early, and the generic name *Pelecinus*, gender masculine.

Type species. *Eopelecinus vicinus* sp. nov.; uppermost Jurassic or Lower Cretaceous, Yixian Formation, Liaoning, China.

Species included. Three monotypical species described herein.

Diagnosis. Female (male unknown). Antenna 14-segmented. Forewing with only C and R present; pterostigma shorter, widest beyond midlength. Pronotum short medially. Mesonotum with notauli areolate. Propodeum reticulate. Metasoma with one basal segment wide and remaining tubular.

Eopelecinus vicinus sp. nov.

Figures 5B, 7

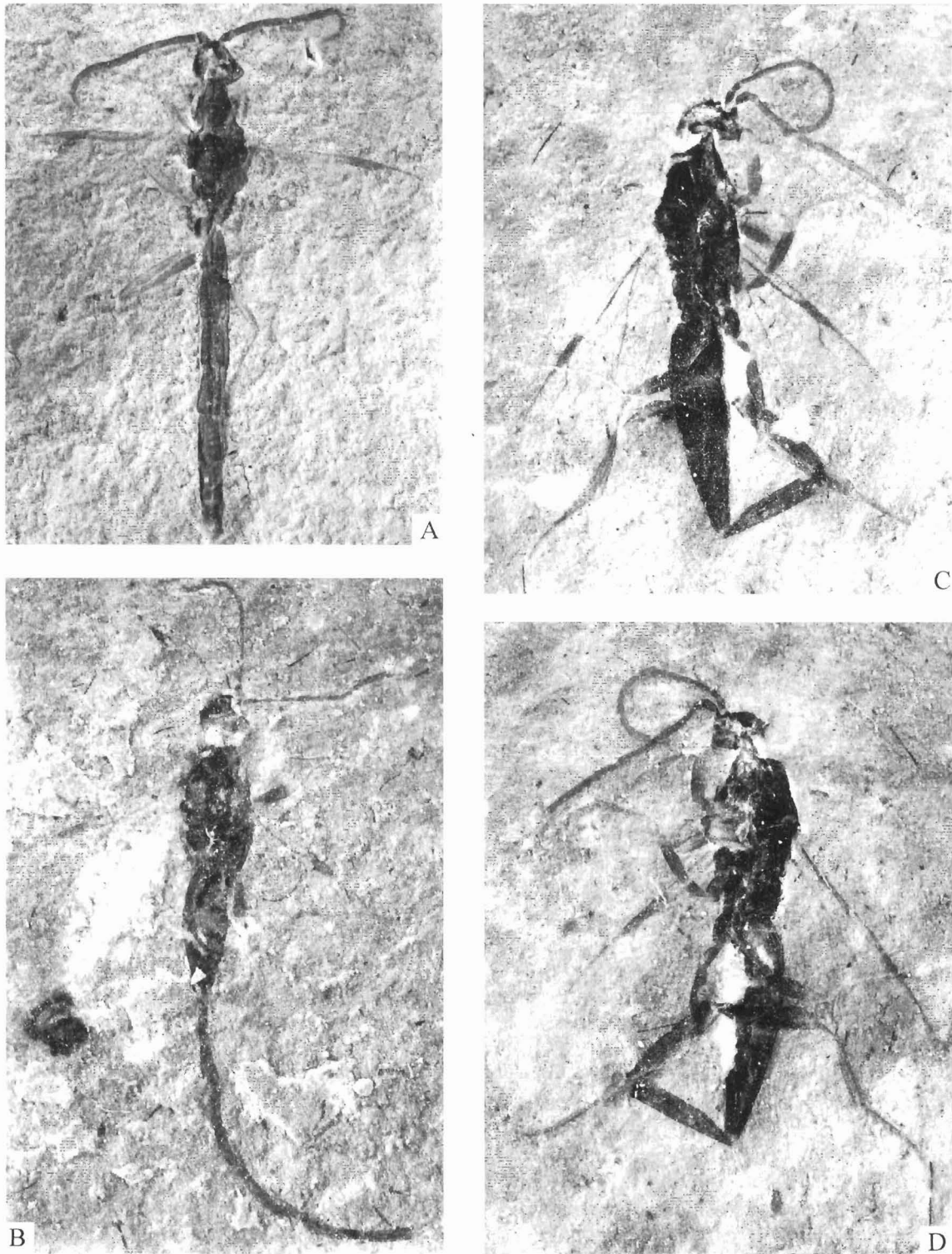


Figure 5. A, *Sinopelecinus viriosus* sp. nov., holotype, NIGP134160; $\times 8$. B, *Eopelecinus vicinus* sp. nov., holotype, NIGP134161; $\times 8$. C, *Scorpiopelcinus versatilis* sp. nov., holotype, NIGP134164a; $\times 8$. D, *Scorpiopelcinus versatilis* sp. nov., holotype, NIGP134164b; $\times 8$.

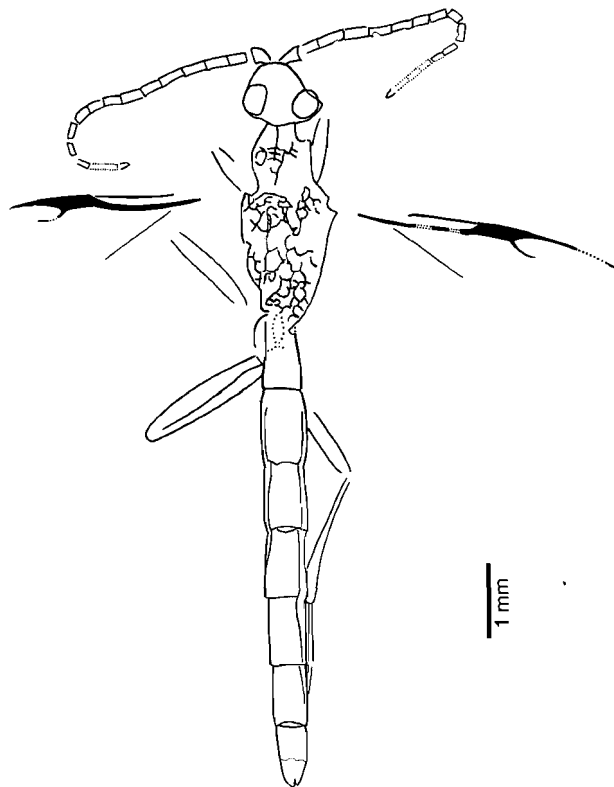


Figure 6. *Sinopelecinus viriosus* sp. nov., male, dorsal aspect, camera lucida drawing of holotype, NIGP134160.

Etymology. Latin, *vicinus*, adjacent.

Material. Holotype LBSH98042/NIGP134161 (female). Antennae and legs incomplete, hindwings not preserved.

Description. Female; male unknown. Body brown, mesosoma and metasoma partly dark-brown. Head medium-sized, nearly trapezoid; eyes medium-sized, oval. Antennae thin, with 12 segments preserved, as long as head and mesosoma combined; scape short as seen (probably covered by head for most part); pedicel small, as long as wide, with base distinctly, and apex slightly thinner than apex of scape; first flagellomere six times as long as wide, slightly thinner than pedicel basally and about as wide as it apically; second and third similar to first in shape, slightly shorter; following similar to third in shape, gradually shortened and maintaining proportions. Mesosoma suboval; pronotum short; mesonotum with notauli oblique and finely areolate, scutellum with anterior margin arched and bearing short radial lines; metanotum and propodeum irregularly and coarsely reticulate. Fore and mid coxa small; hindleg with coxa small; trochanter trapezoid; femur similar to mid femur. Forewing with R bent

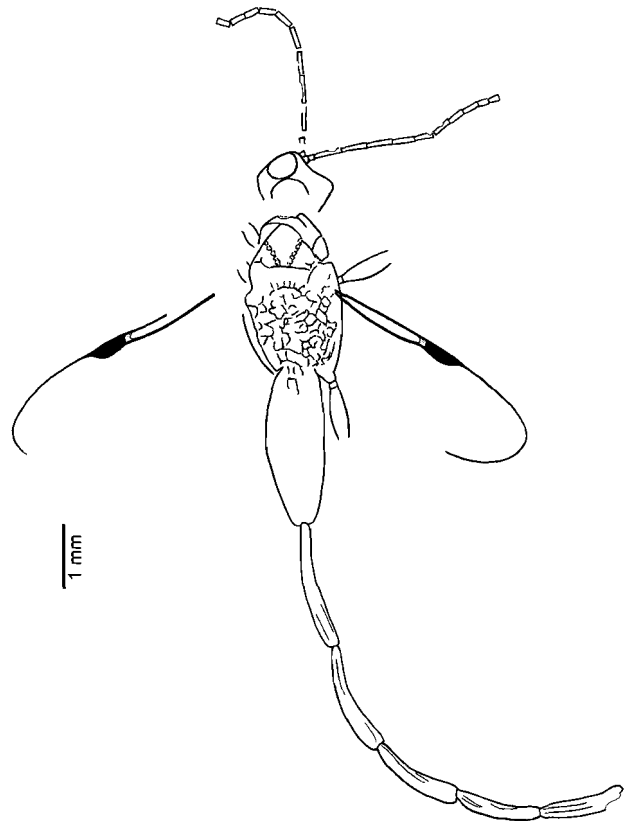


Figure 7. *Eopelecinus vicinus* sp. nov., female, dorsal aspect, camera lucida drawing of holotype, NIGP134161.

posteriad; costal area broad; pterostigma with base weakly sclerotized. First metasomal segment elongate-oval, broadest at its midlength, slightly longer than mesosoma and about twice as wide basally as apically; second through sixth slender and gradually narrowed basad, with concave ventral and convex dorsal contours, and with one or two longitudinal ridges. Length ratio of metasomal segments 1.0:0.8:0.7:0.6:0.5:0.5. Head length 1.0 mm, mesosoma 2.4 mm, metasoma 10.4 mm; antennal length, as preserved, 3.3 mm; forewing length 4.0 mm, width, as preserved, 1.3 mm.

Eopelecinus shangyuanensis sp. nov.

Figures 8A, B, 9A, B

Etymology. Shangyuan is the location of the section that yielded the specimen.

Material. Holotype LBSH98045/NIGP134162 (female), part and counterpart. Incomplete insect with distal half of metasoma, most of fore- and midlegs and hindwings not preserved.

Description. Female; male unknown. Body brown, anterior half of head, pronotum and sides of first

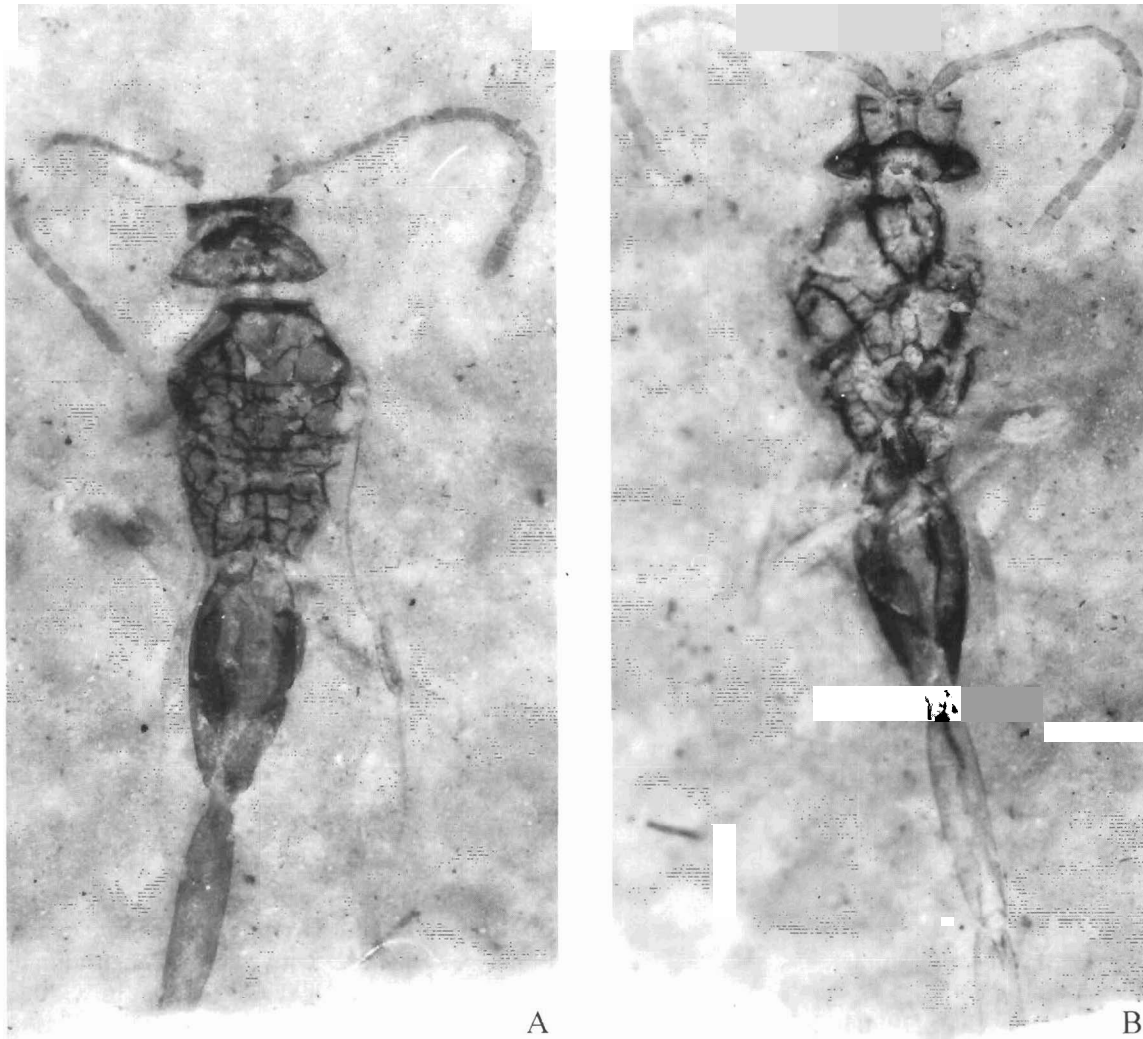


Figure 8. *Eopelecinus shangyuanensis* sp. nov., holotype. A, part, NIGP134162a; $\times 23$. B, counterpart, NIGP134162b; $\times 23$.

metasomal tergum dark-brown. Head large, transversely broad and hat-like with anterior margin distinctly shorter than posterior; eyes medium-sized, oval and distant from posterior margin of head. Antennae slightly longer than head and mesosoma combined; scape thin basally and widened apically, 2.5 times as long as wide; pedicel small and slightly longer than wide, with base greatly, and apex slightly thinner than apex of scape; first flagellomere three times as long as wide, distinctly thinner than pedicel basally and slightly so apically; second similar to first, slightly longer; third and fourth similar to first, a little thicker; following gradually decreasing in length and increasing in width; terminal slightly longer than eleventh and rounded apically. Mesosoma subhexagonal; collar short; pronotum very short; notauli arched inwards and coarsely areolate; mesoscutellum with anterior margin bearing dense and short radial lines; metano-

tum short with anterior and posterior margins consisting of fine areolae; propodeum regularly and coarsely reticulate. Fore femur short and thin; midleg with coxa small, femur larger than fore femur; hindleg with coxa slightly larger than mid coxa and inversely trapezoid, trochanter small and trapezoid, femur short, tibia thin basally, gradually increasing in thickness distad and distinctly longer than femur, tarsus thin. Forewing with R greatly bent posteriad; pterostigma with lower margin weakly sclerotized. First metasomal segment elongate-oval, broadest slightly before its midlength, as long as mesosoma and twice as wide basally as apically; second as long as and 0.4 times as wide as first; third incompletely preserved, probably as wide as second. Head length 0.5 mm, mesosoma 1.5 mm, metasoma 3.4 mm as preserved; antennal length 2.5 mm; forewing length 2.8 mm.

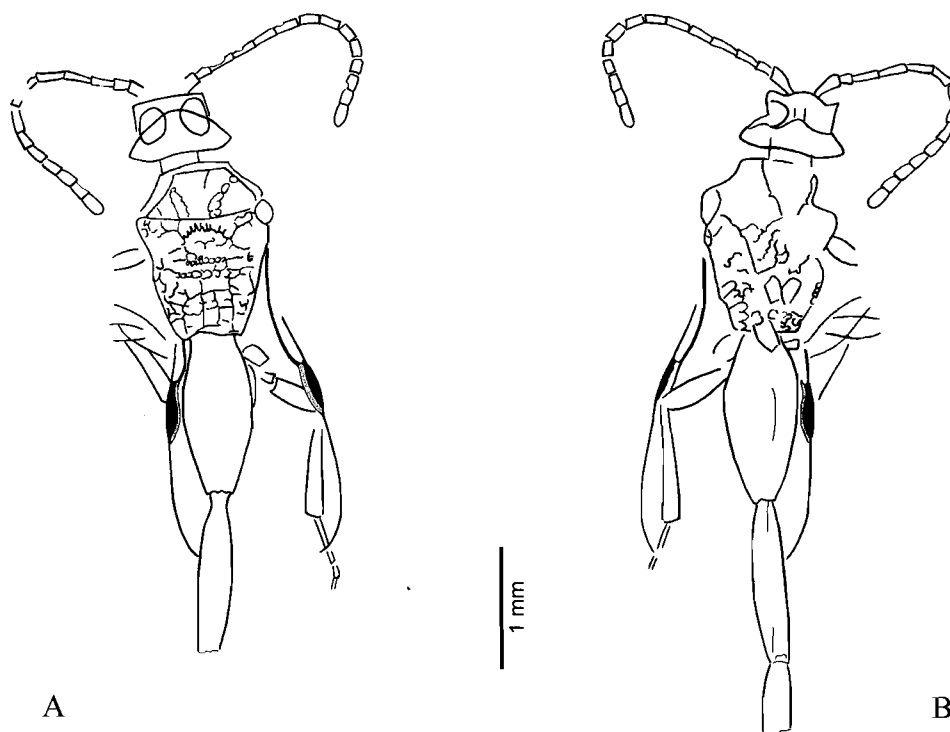


Figure 9. *Eopelecinus shangyuanensis* sp. nov., holotype. A, female, dorsal aspect, camera lucida drawing of NIGP134162a. B, female, ventral aspect, camera lucida drawing of NIGP134162b.

Eopelecinus similis sp. nov.

Figures 1C, 10

Etymology. Latin, *similis*, similar.

Material. Holotype LBSH98046/NIGP134163 (female). Incomplete insect with distal parts of antennae, most of fore- and midlegs, hind tarsi and wings not preserved.

Description. Female; male unknown. Body brown, antennae and legs pale. Head large, nearly transversely trapezoid; eyes medium-sized, semioval. Antennae with eight segments preserved; scape incomplete; pedicel thin basally, gradually increasing in thickness apicad, 1.5 times longer than wide; first flagellomere slightly thinner than pedicel basally, as wide as that apically, 2.5 times as long as wide; second similar to first, slightly longer; third and fourth similar to first; fifth and sixth slightly shorter than fourth. Mesosoma suboval; collar short; pronotum extremely short; notauli arched inwards and coarsely areolate, mesoscutellum and metanotum with anterior and posterior margins consisting of fine areolae; propodeum coarsely and regularly reticulate. Fore and mid femora short and thin; hindleg with femur clavate, slightly thicker than mid femur, tibia thin

basally and gradually broadened apicad. First metasomal segment elongate-oval, broadest at about its midlength, 0.8 times as long as mesosoma and as wide basally as apically, with several longitudinal ridges; second through sixth slender, equal in width, gradually narrowed basad, with 1–3 longitudinal ridges. Length ratio of metasomal segments 1.0:0.8:0.7:0.7:0.6:0.6. Head length 0.5 mm, mesosoma 1.6 mm, metasoma 6.1 mm; antennal length 1.5 mm as preserved.

Genus *Scorpiopelecinus* gen. nov.

Etymology. Greek, *scorpios*, scorpion, and the generic name *Pelecinus*, gender masculine.

Type species. *Scorpiopelecinus versatilis* sp. nov.; uppermost Jurassic or Lower Cretaceous, Yixian Formation, Liaoning, China.

Species included. One monotypical species described herein.

Diagnosis. Female (male unknown). Antenna 14-segmented. Forewing with pterostigma narrow, acute apically, not widened beyond midlength; 2r-rs distinct, vestigial RS present distad of 2r-rs, 3r open; (M+)Cu, anal and brachial veins distinct. Hindwing

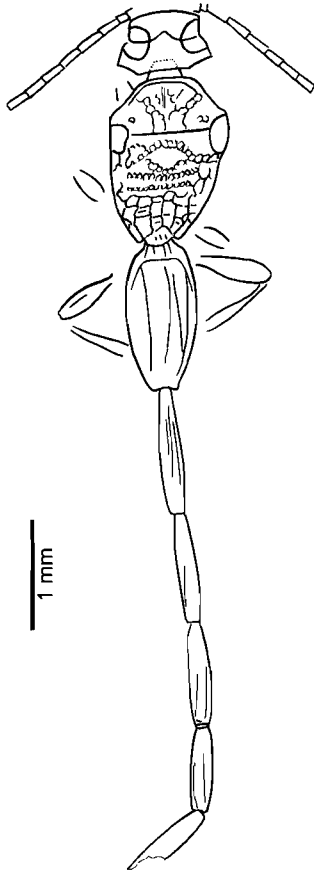


Figure 10. *Eopelecinus similis* sp. nov., female, dorsal aspect, camera lucida drawing of holotype, NIGP134163.

with only C present. Pronotum long. Propodeum reticulate. Metasoma with three basal segments wide and remaining tubular.

Scorpiopelcinus versatilis sp. nov.
Figures 5C–D, 11

Etymology. Latin, *versatilis*, versatile.

Material. Holotype LBSH98049/NIGP134164 (female), part and counterpart. Nearly complete insect.

Description. Female; male unknown. Body brown, antennae, legs and metasomal segments 4–6 pale. Head medium-sized and nearly transversely trapezoid; eyes medium-sized, semioval. Antennae thin and slightly longer than head and mesosoma combined; scape thin basally and gradually increasing in width apically, twice as long as wide; pedicel as long as wide with base thinner than, and apex as thick as, apex of scape; first flagellomere distinctly thinner basally than

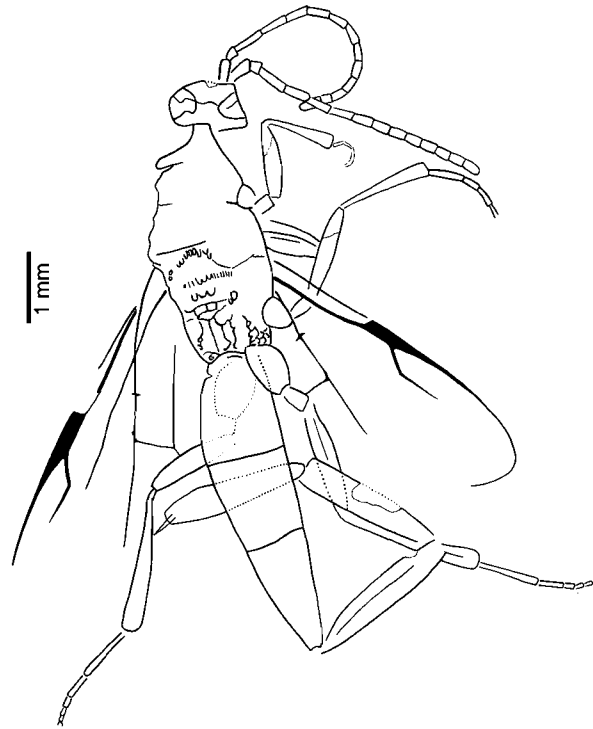


Figure 11. *Scorpiopelcinus versatilis* sp. nov., female, dorso-lateral aspect, camera lucida drawing of holotype, NIGP134164a.

pedicel, gradually increasing in thickness apically, three times as long as wide; second similar to first, slightly shorter; those following gradually decreasing in length, terminal slightly longer than eleventh, rounded apically. Pronotum comparatively long; mesoscutellum with anterior margin arched and consisting of fine cells; metanotum short with anterior and posterior margins areolate; propodeum sparsely reticulate. Foreleg short and thin; midleg slightly longer than foreleg; hindleg distinctly larger than midleg with coxa large and suboval, trochanter small and trapezoid, femur slightly longer than mid femur, tibia distinctly longer than femur, very thin basally, gradually increasing in thickness apicad, tarsus slightly shorter than tibia, with two short claws, length ratio of tarsomeres 3.0:1.3:0.5:0.4:0.3. Forewing with R slightly bent posteriad, costal area broad; 2r-rs oblique apicad, twice as long as pterostigmal width, Rs rudiment longer than 2r-rs and subparallel to wing fore margin; M+Cu straight, long, not reaching margin of wing, bearing short rudiments of free M, cu-a, 1m-cu; anal and brachial veins complete. Hindwing with C long but weak. First metasomal segment nearly trapezoid in lateral view, about half as long as mesosoma and 0.6 times as wide basally as apically; second inversely trapezoid with base as wide as, and apex 0.8

times as wide as first apically; third inversely trapezoid with base as wide as, and apex 0.2 times as wide as second apically; fourth through sixth slender, half as wide as base of third, gradually narrowed basad (sixth also narrowed toward apex). Length ratio of metasomal segments 1.0:0.9:1.2:1.6:1.5:1.5. Ovipositor slightly extruded from metasomal apex, sharpened. Head length 0.7 mm, mesosoma 3.3 mm, metasoma 11.0 mm; antennal length 4.0 mm; forewing length 4.0 mm, width, as preserved, 1.7 mm.

3. Palaeoecology

In the Beipiao area during the latest Jurassic and/or earliest Cretaceous, there was a large lake surrounded by hygrophilous plants, dominated by shoreline equisetals and filicales, under a warm and humid microclimate. By contrast arboreal gymnosperms represented by ginkgos and conifers under a temperate but arid microclimate composed forests on high mountains some distance from the lakeshore (Zhang & Zhang, 2000). These peleciniid wasps probably lived in the forests and were parasites of Scarabaeidae larvae like their only extant relative *Pelecinius polyturator* (Drury), which occurs in North America and can be found in open woodlands where the females are presumably searching for soil-inhabiting scarab grubs (e.g., *Phyllophaga anxia*, *Phyllophaga futilis*) as hosts using their extremely elongate abdomen (Muesebeck, 1979; Lim *et al.*, 1980). This inference can be confirmed by the fact that some kinds of scarabaeid beetles in our collection have been recovered from the same locality and horizon.

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