

Peleciniid wasps (Insecta, Hymenoptera, Proctotrupoidea) from the Cretaceous of Russia and Mongolia

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Abstract

Thirteen new species referable to four genera, of which one is new, from the Cretaceous of Russia and Mongolia are established herein and assigned to the family Pelecinidae. Among the four genera, *Protopelecinus* gen. nov., including four new species, is referred to the subfamily Peleciniinae, while *Iscopinus* Kozlov, including three new species, *Eopelecinus* Zhang, Rasnitsyn and Zhang, including five new species, and *Scorpiopelecinus laetus* sp. nov. are assigned to the subfamily Iscopiniinae. Of these new taxa, eight, namely *Protopelecinus regularis*, *P. furtivus*, *Iscopinus simplex*, *?I. suspectus*, *Eopelecinus exquisitus*, *E. scorpioideus*, *E. rudis* and *Scorpiopelecinus laetus*, are from the Lower Cretaceous Zaza Formation of Baissa, Transbaikalia, Russia; two, *E. minutus* and *E. fragilis*, are from the basal Lower Cretaceous Tsagan-Tsab Formation of Khutel-Khara, Mongolia; two, *P. dubius* and *P. deformis*, are from the Lower Cretaceous (Aptian?) of Bon Tsagan, Mongolia; and one, *I. separatus*, is from the Upper Cretaceous (Cenomanian) Ola Formation of Obeshchayushchiy, Russia. A key to fossil peleciniid wasps is provided and a morphological analysis shows that the Pelecinidae might be paraphyletic with respect to the Proctotrupidae. The Chinese insect fauna from both the Yixian and Laiyang formations is dominated by *Eopelecinus* and *Sinopelecinus* whereas the Siberian + Mongolian fauna from the Zaza and Tsagan-Tsab formations is dominated by *Eopelecinus* and *Iscopinus*. Hence, *Eopelecinus* is common to both. The differences between the two faunas are likely to be the result of geographical variation in populations.

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1. Introduction

The extant Pelecinidae is a very small family of wasps consisting of only one genus, *Pelecinus* Latreille (Muesebeck, 1979; Masner, 1993). Its history is poorly known and only five fossil genera from this family have

been documented (Brues, 1933; Kozlov, 1974; Johnson, 1998; Engel, 2002; Zhang et al., 2002). The monotypic *Pelecinopterion* Brues, 1933 (Late Eocene Baltic amber and Palaeocene Sakhalin amber) was originally placed in a new family, the Pelecinopteridae (Brues, 1933), and later considered to be a member of the Pelecinidae (Kozlov, 1974). *Iscopinus* Kozlov, 1974 was treated as a family of uncertain position within the Apocrita by Johnson (1998), but has generally been assigned to the Pelecinidae (Kozlov, 1974; Rasnitsyn, 1980; Zhang et al., 2002). *Eopelecinus* Zhang, Rasnitsyn and Zhang,

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2002 and *Scorpiopelecinus* Zhang, Rasnitsyn and Zhang, 2002 were described from the Yixian Formation in China (Zhang et al., 2002). *Sinopelecinus* Zhang, Rasnitsyn and Zhang, 2002 includes four species from the Yixian Formation (Zhang et al., 2002). The family is currently divided into two subfamilies: the Peleciniinae Haliday (comprising *Pelecinius* and *Pelecinopteron*) and the Iscopiniinae Rasnitsyn (containing *Iscopinus*, *Sinopelecinus*, *Eopelecinus* and *Scorpiopelecinus*) (Rasnitsyn, 1980; Zhang et al., 2002) (see Table 1).

Here some wasps collected from the Cretaceous of Russia and Mongolia and housed in the Paleontological Institute, the Russian Academy of Sciences, are described and assigned to the Peleciniidae (see Table 1).

2. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758

Suborder: Apocrita Gerstaecker, 1867

Superfamily: Proctotrupoidea Latreille, 1802

Family: Peleciniidae Haliday, 1840

Subfamily: Peleciniinae Haliday, 1840

Diagnosis. Forewing venation comparatively complete with Rs reaching or nearly reaching margin of wing, cell r closed or nearly closed, 'Rs₂' long. Female metasoma tubular. Male metasoma slender and varying in shape.

Remarks. The Peleciniinae are represented by only three living species, namely *Pelecinius polyturator* (Drury), *P. thoracicus* Klug and *P. dichrous* Perty, and one extinct species, *Pelecinopteron tubuliforme* Brues, 1933 (Brues, 1933; Kozlov, 1974; Johnson and Musetti, 1999; Engel, 2002). Based on a nearly complete specimen of a wasp and three forewings from the Lower Cretaceous of Transbaikalia and Mongolia, four new species referred to one new genus are erected and assigned to this subfamily.

Table 1
Geographical distribution of Peleciniidae

Taxa	Locality and horizon
Peleciniinae Haliday	
<i>Pelecinius</i> Latreille	
<i>P. polyturator</i> (Drury) Schletterer, 1890	southeast Canada, eastern USA, Mexico, northern Argentina; extant
<i>P. thoracicus</i> Klug, 1841	Western Mexico; extant
<i>P. dichrous</i> Perty, 1833	Northern Argentina, Uruguay, Paraguay, southeastern Brazil; extant
<i>Pelecinopteron</i> Brues	
<i>P. tubuliforme</i> Brues, 1933	Baltic amber; Upper Eocene/Sakhalin amber, Russia; Palaeocene
<i>Protopelecinus</i> gen. nov.	
<i>P. regularis</i> gen. et sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>P. furtivus</i> gen. et sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>P. dubius</i> gen. et sp. nov.	Bon Tsagan, Mongolia; Lower Cretaceous (Aptian?)
<i>P. deformis</i> gen. et sp. nov.	Bon Tsagan, Mongolia; Lower Cretaceous (Aptian?)
Iscopininae Rasnitsyn	
<i>Iscopinus</i> Kozlov	
<i>I. baissicus</i> Kozlov, 1974	Baissa, Transbaikalia, Russia; Zaza Formation
<i>I. simplex</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>I. separatus</i> sp. nov.	Obeshchayushchiy, Russia; Ola Formation
? <i>I. suspectus</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>Eopelecinus</i> Zhang, Rasnitsyn and Zhang, 2002	
<i>E. vicinus</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>E. shangyuanensis</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>E. similis</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>E. minutus</i> sp. nov.	Khutel-Khara, Mongolia; Tsagan-Tsab Formation
<i>E. fragilis</i> sp. nov.	Khutel-Khara, Mongolia; Tsagan-Tsab Formation
<i>E. exquisitus</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>E. scorpioideus</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>E. rudis</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation
<i>Sinopelecinus</i> Zhang, Rasnitsyn and Zhang, 2002	
<i>S. viriosus</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>S. delicatus</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>S. epigaeus</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>S. magicus</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>Scorpiopelecinus</i> Zhang, Rasnitsyn and Zhang, 2002	
<i>S. versatilis</i> Zhang, Rasnitsyn and Zhang, 2002	Beipiao, Liaoning, China; Yixian Formation
<i>S. laetus</i> sp. nov.	Baissa, Transbaikalia, Russia; Zaza Formation

Genus *Protopelecinus* gen. nov.

Derivation of name. Greek, *proto*, primitive, and the generic name *Pelecinius*; gender masculine.

Type species. *Protopelecinus regularis* sp. nov.; lower Lower Cretaceous, Zaza Formation, Baissa, Transbaikalia, Russia.

Species included. The type and three new species described below.

Diagnosis. Male (female unknown). Antennae comparatively thick. Forewing with Rs reaching margin of wing; cell r closed; 'Rs₂' long, reaching margin of wing; (M+)Cu distinct; pterostigma much longer than wide. Mesosoma with notauli areolate; propodeum reticulate; metasoma with basalmost four segments of usual width and remaining tubular.

Remarks. This new genus is undoubtedly assigned to the Peleciniinae based on its comparatively complete forewing venation with Rs reaching the margin of the wing and a long 'Rs₂', and its slender metasoma (male) with three tubular distal metasomal segments. *Protopelecinus* differs from *Pelecinius* and *Pelecinopteron* in that the male has a much thicker antenna, a mesosoma with strongly punctate notauli and scutellar suture, a coarsely reticulate propodeum, a forewing with cell r closed, and a metasoma with four slightly narrowed basalmost segments. It can also be distinguished from *Pelecinopteron* by its relatively broad pterostigma in the forewing.

Within the subfamily Peleciniinae, *Protopelecinus* shows more primitive characters than *Pelecinius* and *Pelecinopteron* in that, for the male, the notauli and scutellar sutures are strongly punctate, the propodeum is coarsely reticulate, cell r is closed in the forewing, and the four basal metasomal segments are only slightly narrowed.

Protopelecinus regularis sp. nov.

Figs. 1A–C, 2

Derivation of name. Latin, *regularis*, common, regular.

Material. Holotype 3064/2003 (male), part and counterpart; antennae, hindwings and legs damaged, otherwise nearly complete. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Male; female unknown. Body brown. Head medium-sized (relative to mesosoma in width). Antennae with only seven basal segments preserved; scape thin basally and widened apically, nearly as long as wide; pedicel distinctly thinner than scape apically, with

apex seen; first flagellomere as broad as pedicel apically, subcylindrical, twice as long as wide; second flagellomere similar to first but a little longer, third as large as second, fourth and fifth incomplete. Mesosoma elongate-oval; notauli and scutellar suture very wide, punctate; mesoscutellum posteriorly and metanotum with transverse row of elongate areolae; propodeum coarsely and regularly reticulate. Fore and mid femora small; hindleg with trochanter small; femur larger than fore and mid ones; tibia longer than femur. Forewing with 2r-rs three times as long as pterostigmal width; Rs distinctly bent anteriorly, reaching apex of wing; 'Rs₂' reaching outer margin of wing, with basal half distinct and distal half spectral; (M+)Cu distinguishable, bearing rudiments of M, cu-a, 1 m-cu; 1 m-cu far basad of apex of 2cua; cu-a postfurcal; M distinguishable on distal half of wing and reaching outer margin of wing. Hindwing with anterior margin distinct basally. First metasomal segment thin basally and gradually widened apically, slightly longer than wide, with short, well-spaced, longitudinal, basal ridges; second as wide basally as first distally, and slightly narrowed distally; third subcylindrical, slightly narrower than second; fourth as wide as third; fifth much narrower than fourth distally, and gradually decreasing in width apically; sixth narrow basally and gradually widened distally; apex as wide basally as sixth distally, rounded apically. Length ratio of metasomal segments 1.0:1.3:1.3:0.9:1.3:1.3:1.0. Head length 0.6 mm, mesosoma 2.2 mm, metasoma 5.3 mm; forewing length, as preserved, 2.5 mm, width 1.0 mm.

Protopelecinus furtivus sp. nov.

Figs. 1D, 3

Derivation of name. Latin, *furtivus*, secret.

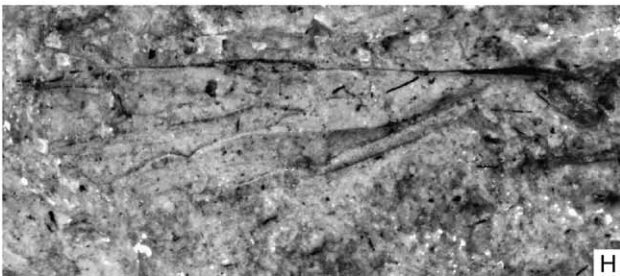
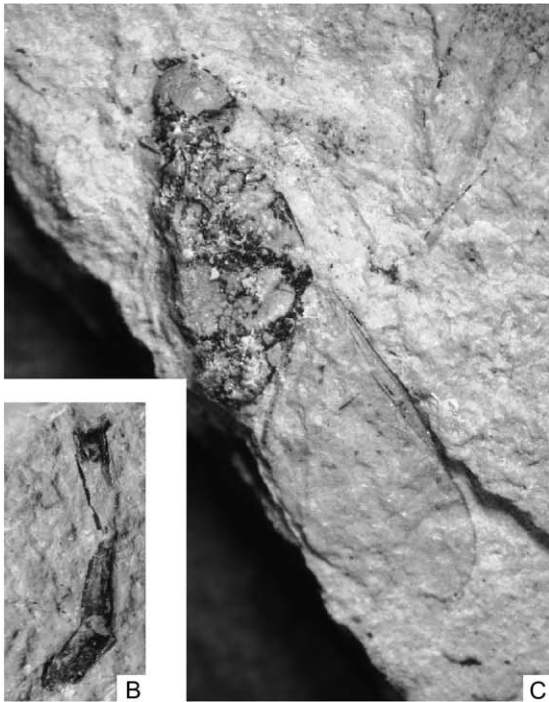
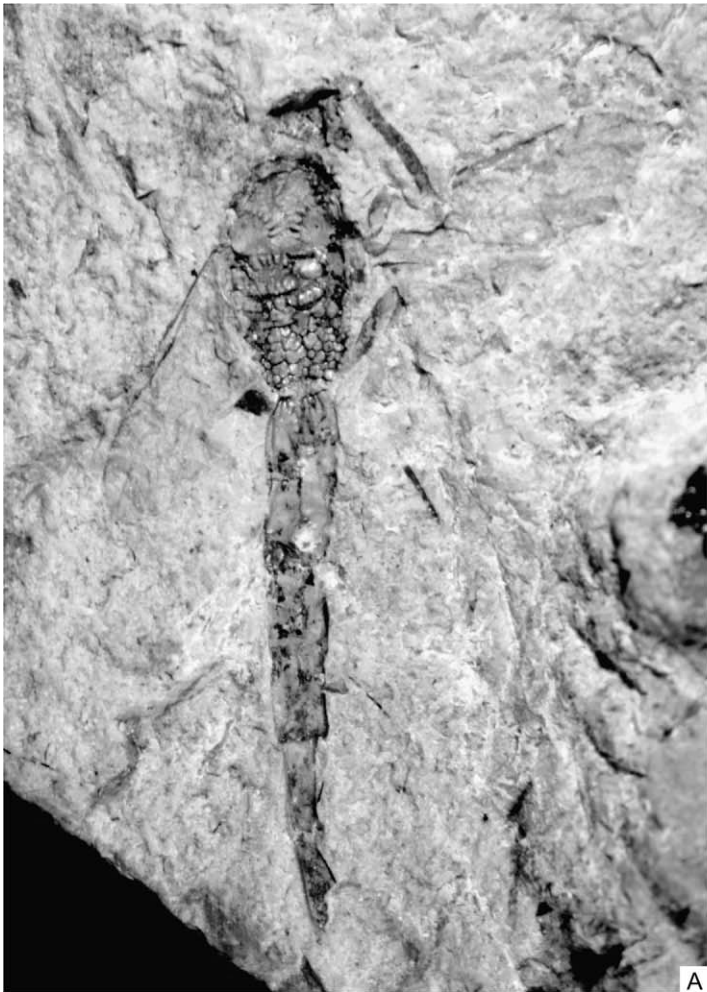
Material. Holotype 4210/7069, a forewing with base damaged. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Forewing with 2r-rs 2.5 times as long as pterostigmal width; Rs distinctly bent anteriorly, reaching margin of wing just before apex of wing; 'Rs₂' distinct for basal half and spectral for distal half; first abscissae of Rs and M, Rs + M, Rs, and M more or less weakened; first abscissa of Rs twice as long as that of M; m-cu narrow, nearly a parallelogram and twice as long as wide; 1m-cu far basad apex of 2cua; A distinguishable; cu-a interstitial, remnant. Wing length, as preserved, 5.8 mm, width 2.5 mm.

Comparison. See Section 3.

Protopelecinus dubius sp. nov.

Figs. 1E, F, 4



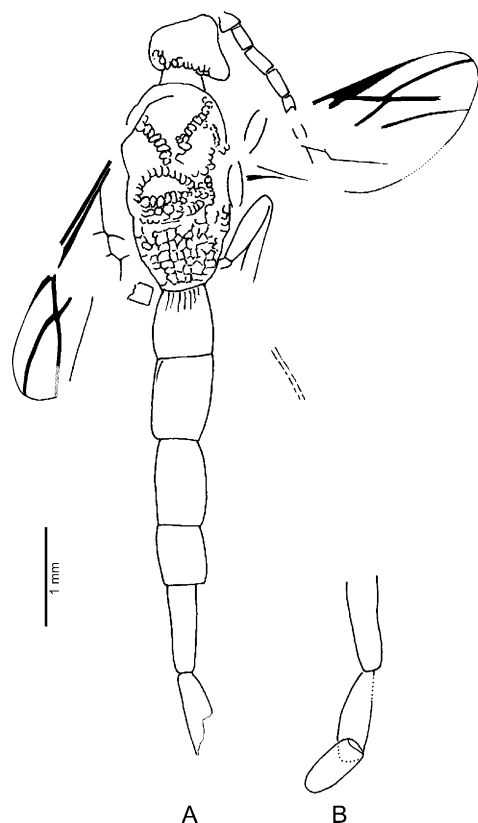


Fig. 2. *Protopelecinus regularis* sp. nov., male, dorsal aspect. A, body, camera lucida drawing of holotype, 3064/2003a. B, three distal metasomal segments, camera lucida drawing of holotype, 3064/2003b.

Derivation of name. Latin, *dubius*, doubtful.

Material. Holotype 3559/724, part and counterpart, a forewing damaged basally, apically and posteriorly. Collected from the Lower Cretaceous (Aptian?), Bon Tsagan, Mongolia.

Description. Forewing with 2r-rs slightly shorter than pterostigmal width; Rs straight, reaching anterior margin of wing much before apex of wing; r narrow and elongate; 'Rs₂' distinct and reaching outer margin of wing (?); stem Rs distinct; M indistinguishable beyond Rs + M; Cu broad, subparallel to 'Rs₂'. Wing length, as preserved, 4.2 mm, width 2.2 mm.

Remarks and comparison. Although the forewing is incomplete with some characters unknown, it is almost certain that 'Rs₂' reaches the outer margin of the wing. This character together with some other preserved features, such as the closed cell r, and the distinctly

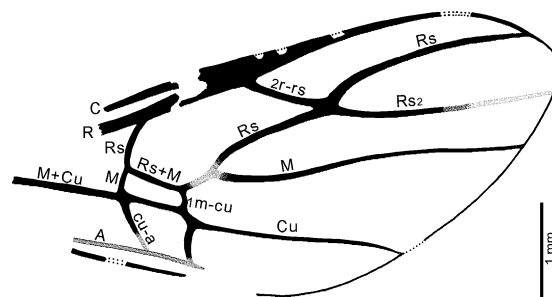


Fig. 3. *Protopelecinus furtivus* sp. nov., forewing, camera lucida drawing of holotype, 4210/7069.

long pterostigma, places this specimen in *Protopelecinus*. Comparisons with other species are given in Section 3.

Protopelecinus deformis sp. nov.

Figs. 1G, H, 5

Derivation of name. Latin, *deformis*, distorted in form.

Material. Holotype 3559/681, part and counterpart; a forewing damaged marginally and deformed in preservation. Collected from the Lower Cretaceous (Aptian?), Bon Tsagan, Mongolia.

Description. Forewing with 2r-rs about as long as pterostigmal width; Rs slightly bent anteriorly, and probably reaching margin of wing; r narrow and elongate; 'Rs₂' distinct and probably reaching margin of wing; Rs distinct basad 2r-rs; first abscissa Rs slightly shorter than that of M; Rs + M weak but distinguishable; M weak and indistinguishable basally, obviously deformed, preserved together with Cu; 1m-cu trapezoid, twice as long as wide; (M +)Cu thick and bent anteriorly basally; cu-a remnant, interstitial; 1m-cu at apex of 2cua; A distinct. Wing, as preserved, length 8.5 mm, width 2.1 mm.

Remarks and comparison. The relative position of some veins in the deformed forewing is far from its original state. However, the length of most veins has hardly changed. The preserved characters do not place this forewing in any other genus apart from *Protopelecinus*. Comparisons with other species are given in Section 3.

Subfamily: Iscopininae Rasnitsyn, 1980

Genus *Iscopinus* Kozlov, 1974

Fig. 1. A, *Protopelecinus regularis* sp. nov., holotype, 3064/2003a; $\times 15.1$. B, *Protopelecinus regularis* sp. nov., three distal metasomal segments of holotype, 3064/2003b; $\times 15.1$. C, *Protopelecinus regularis* sp. nov., holotype, 3064/2003b; $\times 19.0$. D, *Protopelecinus furtivus* sp. nov., holotype, 4210/7069; $\times 14.0$. E, *Protopelecinus dubius* sp. nov., holotype, 3559/724a; $\times 15.2$. F, *Protopelecinus dubius* sp. nov., holotype, 3559/724b; $\times 15.2$. G, *Protopelecinus deformis* sp. nov., holotype, 3559/681a; $\times 8.4$. H, *Protopelecinus deformis* sp. nov., holotype, 3559/681b; $\times 8.4$.

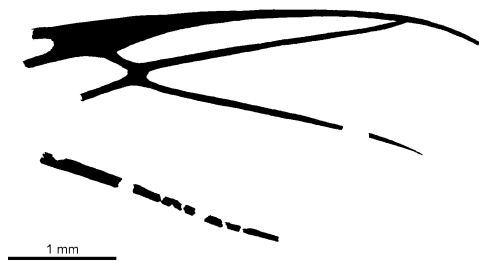


Fig. 4. *Protopelecinus dubius* sp. nov., forewing, camera lucida drawing of holotype, 3559/724b.

Type species. *Iscopinus baissicus* Kozlov, 1974; lower Lower Cretaceous, Zaza Formation, Baissa, Transbaikalia, Russia.

Species included. The type and four new species described below.

Diagnosis. Male (female unknown). Forewing venation complete or slightly reduced; cell r closed; 'Rs₂' short or absent. Metasoma of normal width or slightly narrowed.

Remarks. The genus *Iscopinus* consists of only one previously known species, the type *I. baissicus* represented by a male from the Zaza Formation of Baissa. It is assigned to the Peleciniidae on the basis of its slightly elongate metasoma and vestigial 'Rs₂'. Based on three specimens collected from the Zaza Formation and the Upper Cretaceous Ola Formation of Obeshchayushchiy, Russia, three new species are erected and assigned to this genus. Of these specimens, two are considered to be male judging from the fact that *I. simplex* has a slightly elongate and seven-segmented metasoma and *?I. suspectus* has an usually shaped metasoma (except for two distal segments, segmentation is not clear owing to poor preservation) with the ovipositor unseen; the third specimen is of unknown gender due to its poorly preserved metasoma with several distal segments lost. Their venation in the forewing is comparatively complete and similar to that of the type species except for the vestigial vein 'Rs₂', which disappears in *I. simplex* and is unknown in *I. separatus* and *?I. suspectus* due to poor preservation.

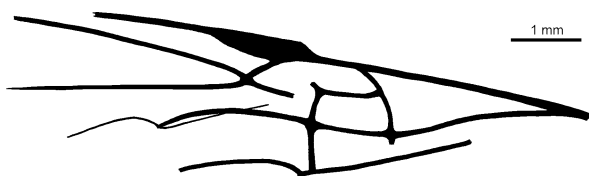


Fig. 5. *Protopelecinus deformis* sp. nov., forewing, camera lucida drawing of holotype, 3559/681b.

Iscopinus simplex sp. nov.

Figs. 6A, B, 7

Derivation of name. Latin, simplex, simple.

Material. Holotype 4210/5239 (male), part and counterpart; antennae, legs and wings incomplete. Collected from the lower Lower Cretaceous Zaza Formation, Baissa, Transbaikalia, Russia.

Description. Male; female unknown. Body dark brown with brown legs. Head large, transversely oval. Antennae with ten distal flagellomeres preserved, each as long as or slightly longer than wide. Mesosoma nearly elongate-oval; mesonotum with notauli areolate, and widely separated from each other anteriorly; propodeum coarsely areolate. Fore- and midlegs narrow; hindleg distinctly longer than midleg. Forewing with pterostigma narrow basally, gradually increasing in width distally, acute apically, broadest at basal two-thirds length; 2r-rs slightly shorter than pterostigmal width; r narrow and elongate; first abscissa Rs distinguishable; M distinguishable distad level of pterostigmal apex; Cu partly distinguishable. Metasoma elongate-oval; first metasomal segment contracted basally, gradually increasing in width, trapezoid, slightly wider than long; second as wide basally as first distally, trapezoid, as long as first; third broadest, transversely rectangular, slightly shorter than second; remainder gradually decreasing in width. Head length 0.9 mm, mesosoma 2.4 mm, metasoma 4.4 mm; forewing, as preserved, length 3.7 mm, width 1.5 mm.

Comparison. Although some veins are reduced, including 'Rs₂' in the forewing, the narrow and closed cell r and slightly narrowed metasoma favour placing the species in the genus *Iscopinus*. Comparisons of this species with others are given in Section 3

Iscopinus separatus sp. nov.

Figs. 6C, D, 8

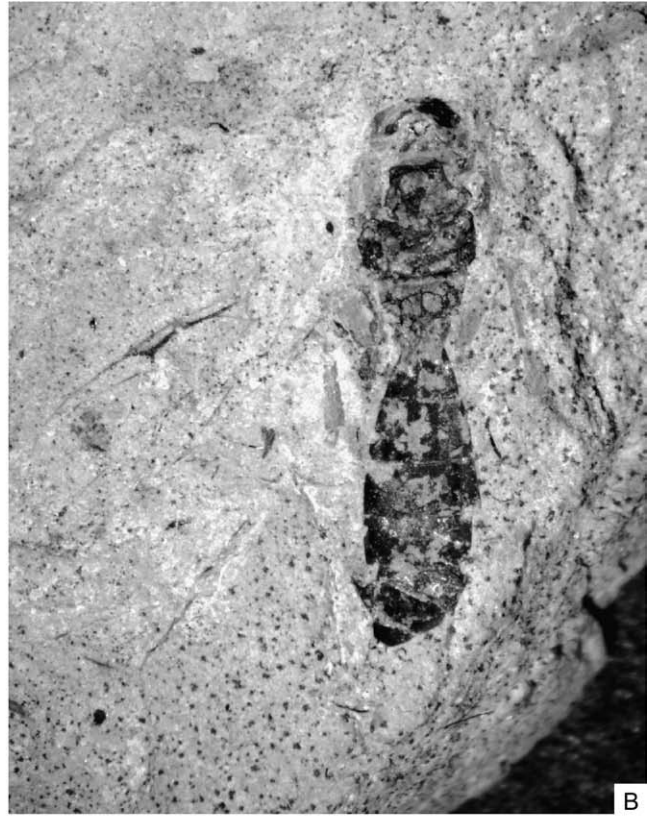
Derivation of name. Latin, separatus, separate.

Material. Holotype 3901/82 (female), part and counterpart; antennae and hindwings missing; legs, forewings, and metasoma incomplete. Collected from the Upper Cretaceous (Cenomanian) Ola Formation, Obeshchayushchiy, Russia.

Description. Sex unknown. Body dark brown. Head medium-sized, transversely oval in lateral view; eyes large, transversely oval. Mesosoma short, broad, and nearly rhombic in lateral view; pronotum narrow midway; mesonotum strongly convex with notauli slightly arched inward; propodeum broad, coarsely



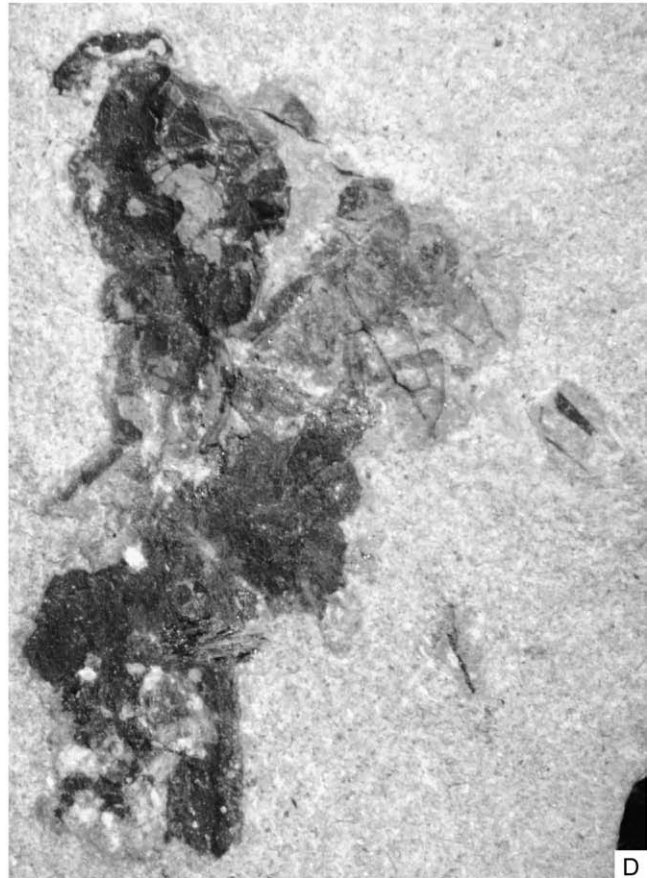
A



B



C



D

Fig. 6. A, *Iscopinus simplex* sp. nov., holotype, 4210/5239a; $\times 10.0$. B, *Iscopinus simplex* sp. nov., holotype, 4210/5239b; $\times 10.0$. C, *Iscopinus separatus* sp. nov., holotype, 3901/82a; $\times 7.9$. D, *Iscopinus separatus* sp. nov., holotype, 3901/82b; $\times 7.9$.

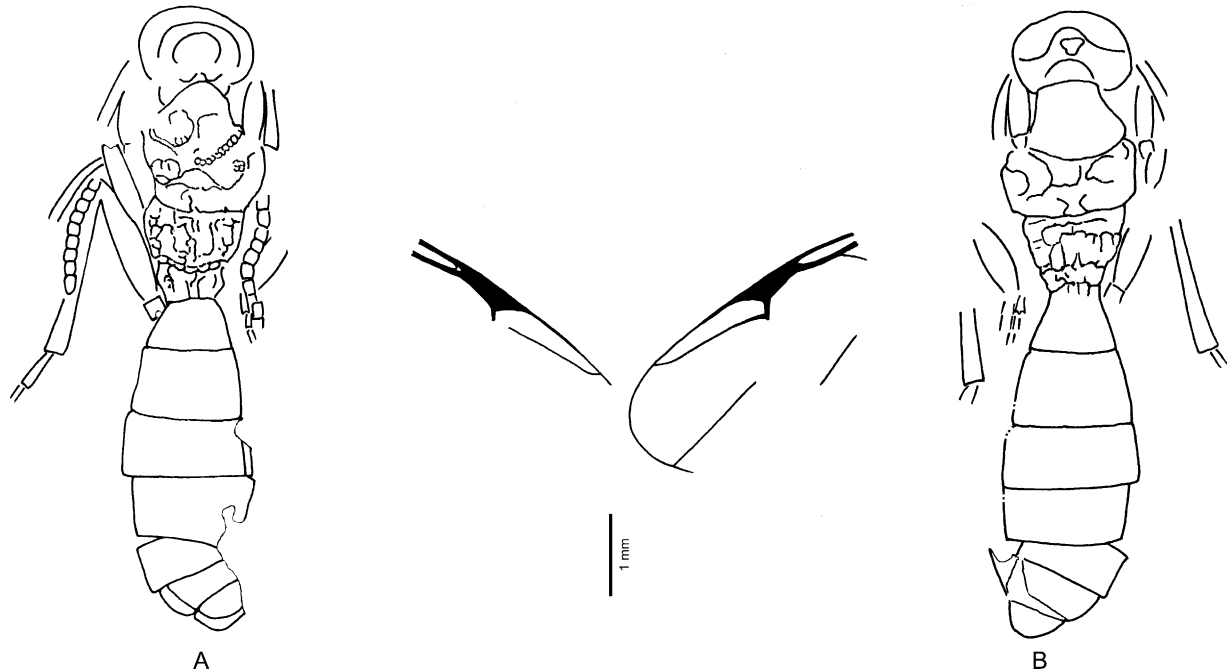


Fig. 7. *Iscopinus simplex* sp. nov., male. A, dorsal aspect, camera lucida drawing of holotype, 4210/5239a. B, ventral aspect, camera lucida drawing of holotype, 4210/5239b.

reticulate. Foreleg with comparatively small coxa; trochanter small, trapezoid. Midleg with coxa slightly larger than fore coxa, suboval; tibia long, with two short spurs distally; tarsus long, with basitarsus 1.4 times as long as second tarsomere, second slightly longer than third, twice as long as fourth, terminal incomplete. Hindleg with large, suboval coxa. Forewing with broad costal area; pterostigma damaged basally, gradually

narrowed distally; first abscissa of Rs as long as that of M; Rs + M weak; 2r-rs damaged but probably slightly longer than pterostigmal width; Rs distinct distad 2r-rs but damaged where it meets 2r-rs; m-cu half as long as first abscissa of M; mcu nearly trapezoid, twice as long as wide; 1m-cu far distad apex of 2cu-a; cu-a interstitial. Metasoma distinctly narrow, elongate; first metasomal segment narrow basally and distally, slightly swollen at mid-length; second and third poorly preserved; fourth as broad as first, subcylindrical. Head length 1.1 mm, mesosoma 4.8 mm, metasoma, as preserved, 9.0 mm; forewing, as preserved, length 6.6 mm, width, 2.1 mm.

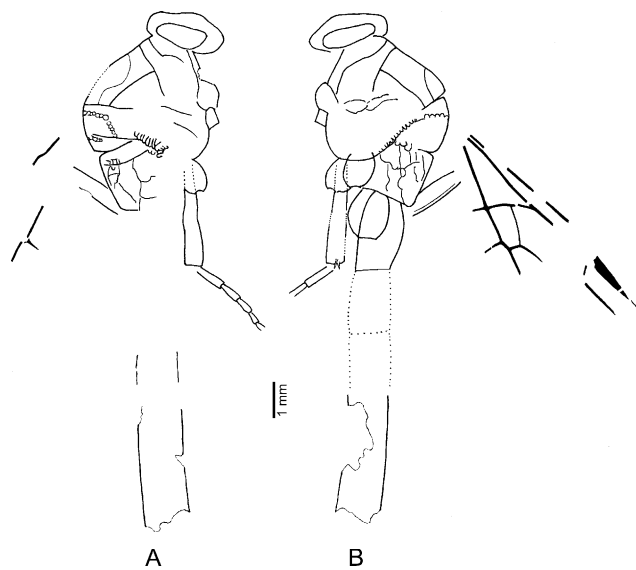


Fig. 8. *Iscopinus separatus* sp. nov., female, lateral aspect. A, camera lucida drawing of holotype, 3901/82a. B, camera lucida drawing of holotype, 3901/82b.

Remarks and comparison. Although the type specimen is incomplete with some important characters unknown, its comparatively complete forewing venation and slender metasoma place this species in the Iscopininae. Since the forewing is incomplete with its apex missing and middle part damaged, it is not known whether Rs reaches the margin of the wing. However, other veins and crossveins, such as the first abscissae of Rs and M, Rs + M, m-cu, (M+Cu), cu-a, are less weakened, judging from which vein Rs probably runs to the margin of the wing. The condition of Rs₂ is unknown since the area is damaged around the connection of 2r-rs to Rs, but to judge from the preserved part in the forewing, Rs₂ would be very short if present. Based on the above analysis, this species can be placed in *Iscopinus*. Although its metasoma is thin and elongate for at least the four basal segments, the

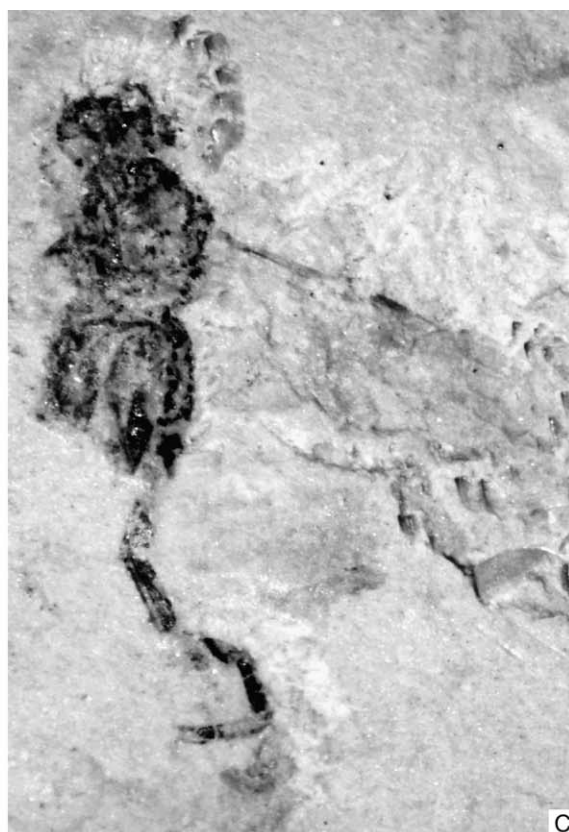
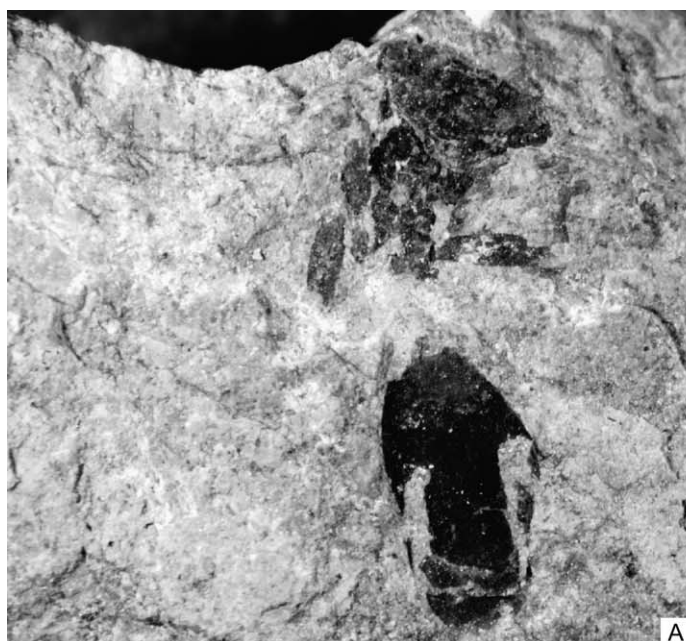


Fig. 9. A, *?Iscopinus suspectus* sp. nov., holotype, 4210/5240a; $\times 10.1$. B, *?Iscopinus suspectus* sp. nov., holotype, 4210/5240b; $\times 8.8$. C, *Eopelecinus minutus* sp. nov., holotype, 3965/424; $\times 28.7$. D, *Eopelecinus fragilis* sp. nov., holotype, 3965/428b; $\times 23.0$. E, *Eopelecinus fragilis* sp. nov., holotype, 3965/428a; $\times 14.3$.

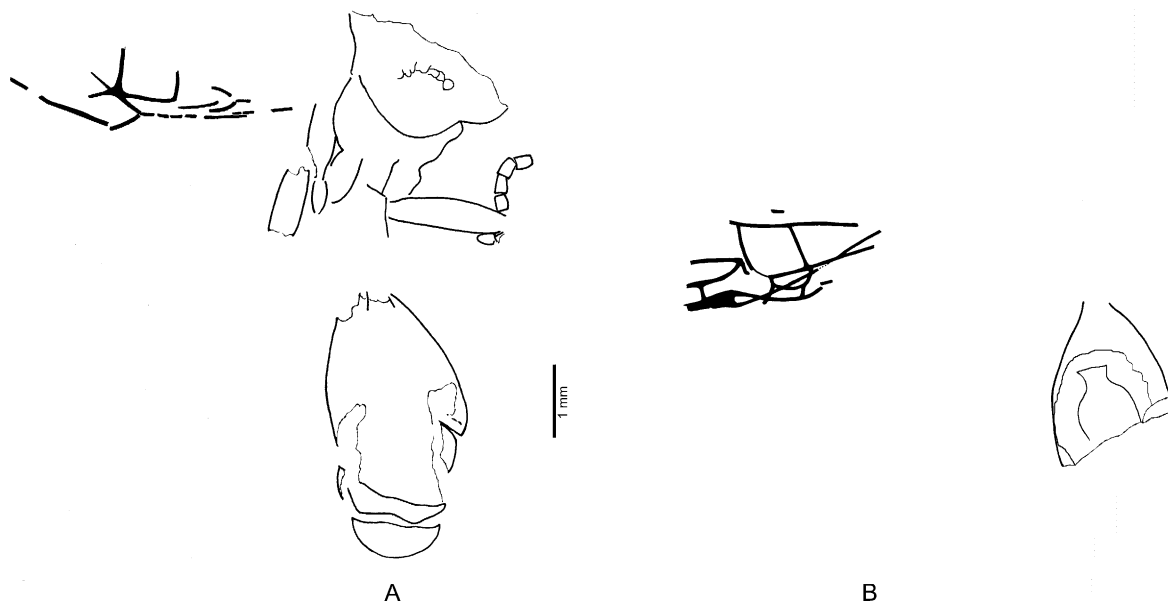


Fig. 10. *Iscopinus suspectus* sp. nov., male, dorsal aspect. A, camera lucida drawing of holotype, 4210/5240a. B, camera lucida drawing of holotype, 4210/5240b.

articulation between segments does not differ from that of other *Iscopinus* males; hence, until the remaining segments are recovered its sex remains unknown.

Comparisons with other species are given in Section 3.

?Iscopinus suspectus sp. nov.

Figs. 9A, B, 10

Derivation of name. Latin, *suspectus*, dubious.

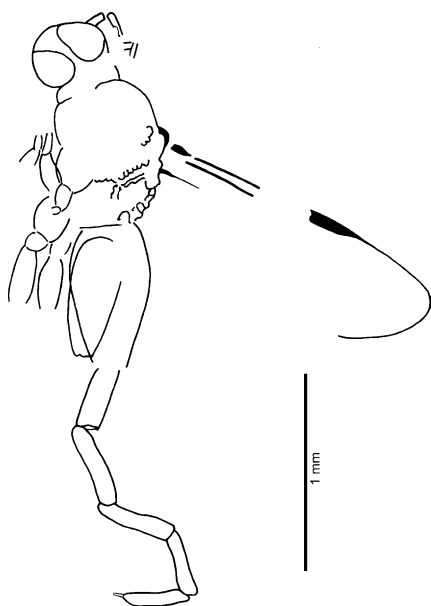


Fig. 11. *Eopelecinus minutus* sp. nov., female, lateral aspect, camera lucida drawing of holotype, 3965/424.

Material. Holotype 4210/5240 (male), part and counterpart; body very incomplete, with head, mesosomal basal half and hindwings missing; forewings incomplete and deformed; metasomal base damaged.

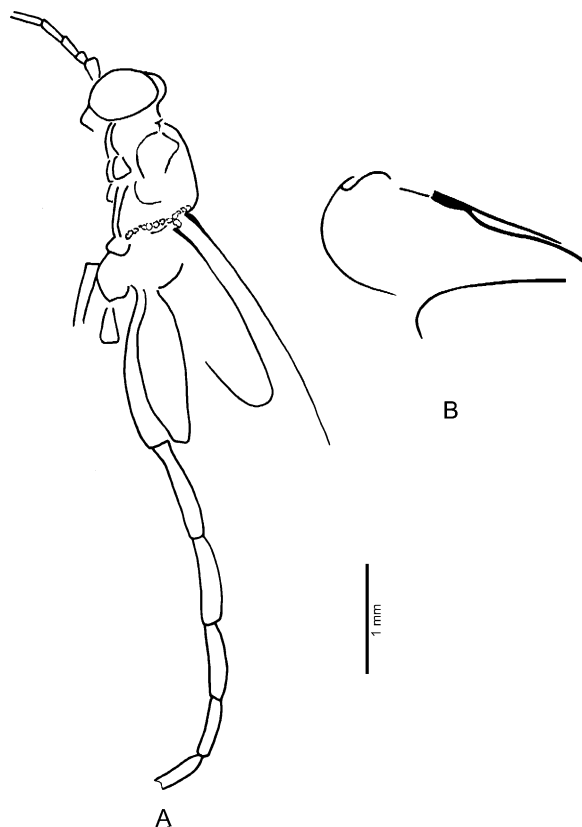


Fig. 12. *Eopelecinus fragilis* sp. nov., female, lateral aspect. A, camera lucida drawing of holotype, 3965/428a. B, wings, camera lucida drawing of holotype, 3965/428b.

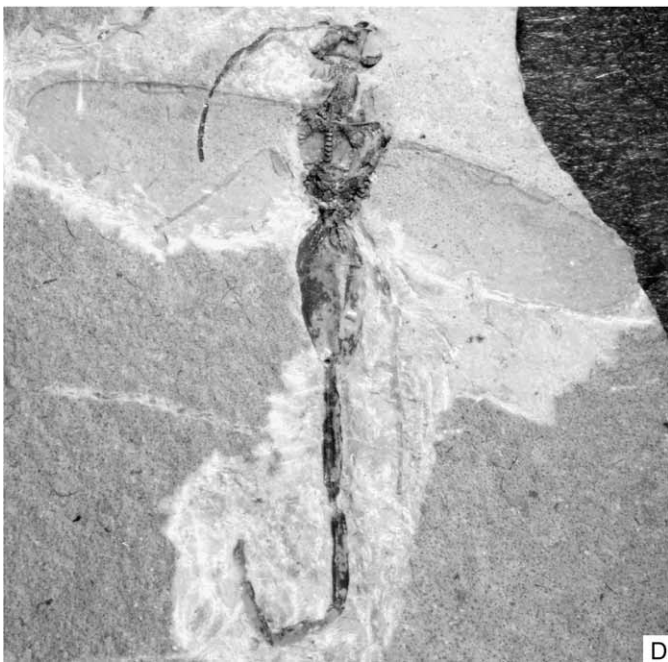
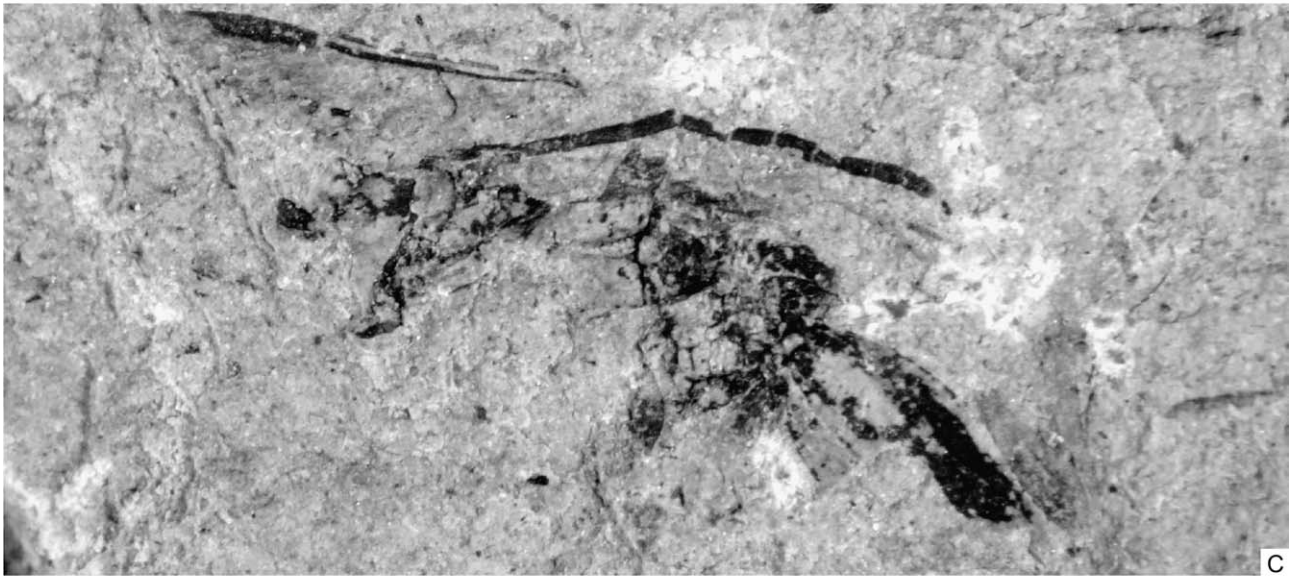
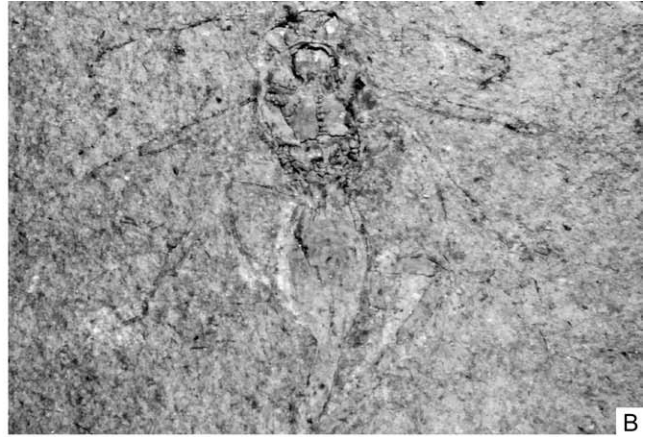


Fig. 13. A, *Eopelecinus exquisitus* sp. nov., holotype, 4210/1171a; $\times 6.7$. B, *Eopelecinus exquisitus* sp. nov., holotype, 4210/1171b; $\times 6.7$. C, *Eopelecinus rudis* sp. nov., holotype, 4210/1173; $\times 16.9$. D, *Eopelecinus scorpioideus* sp. nov., holotype, 4210/5242; $\times 6.4$. E, *Scorpiopolecinus laetus* sp. nov., holotype, 4210/6938; $\times 9.7$.

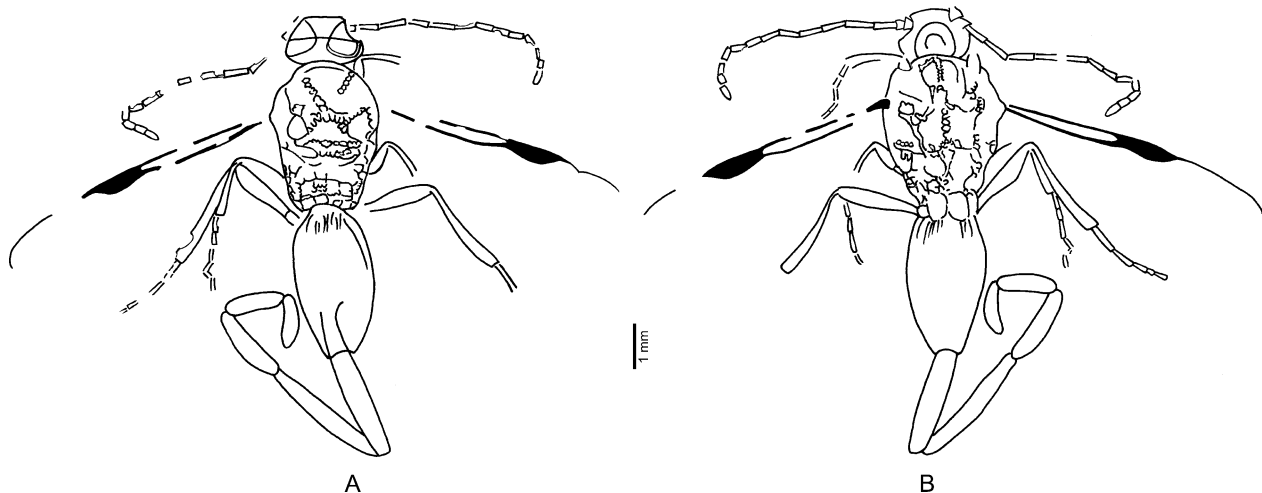


Fig. 14. *Eopelecinus exquisitus* sp. nov., female. A, dorsal aspect, camera lucida drawing of holotype, 4210/1171a. B, ventral aspect, camera lucida drawing of holotype, 4210/1171b.

Collected from the lower Lower Cretaceous Zaza Formation, Baissa, Transbaikalia, Russia.

Description. Male; female unknown. Body dark brown. Antennae incomplete with six distal flagellomeres preserved, each slightly longer than wide. Legs incomplete. Forewing with distal part missing; first abscissa of Rs shorter than that of M; m-cu one-third of first abscissa of M in length; 2r-rs shorter than pterostigmal width; cu-a slightly postfurcal, distinctly longer than basal vein (both basal sections of Rs and M). Metasoma elongate-oval, poorly preserved; two distal segments short. Mesosoma length, as preserved,

2.9 mm, metasoma, as preserved, 3.6 mm; forewing, as preserved, length 3.0 mm, width 1.3 mm.

Remarks and comparison. Unlike other male pelecids, this species has a metasoma of normal shape (not elongate and narrow) with segmentation little known owing to poor preservation. In the forewing, although the distal part is missing, it is almost certain that Rs reaches the margin of the wing, judging from other complete veins and crossveins in the preserved part. As a result, its forewing is similar to those of other species within *Iscopinus*. On these grounds, this species is tentatively placed in the genus *Iscopinus*. Comparisons with other species are given in Section 3.

Genus *Eopelecinus* Zhang, Rasnitsyn and Zhang, 2002

Type species. *Eopelecinus vicinus* Zhang, Rasnitsyn and Zhang, 2002; Yixian Formation, Liaoning, China.

Species included. Three previously published species, namely *Eopelecinus vicinus* Zhang, Rasnitsyn and Zhang,

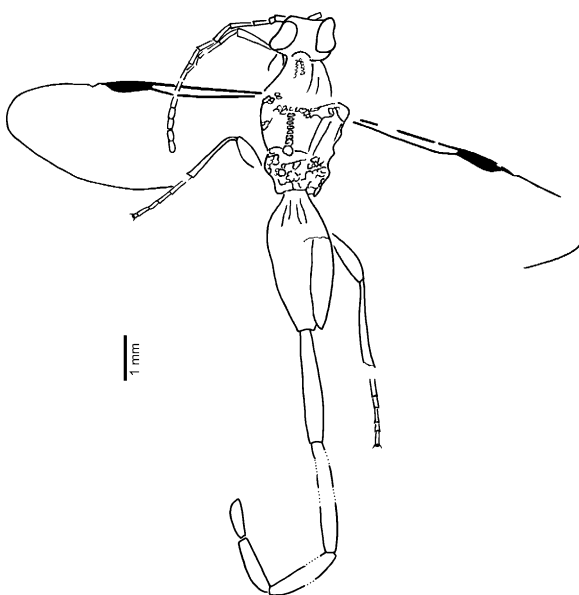


Fig. 15. *Eopelecinus scorpioideus* sp. nov., female, dorsal-ventral aspect, camera lucida drawing of holotype, 4210/5242.

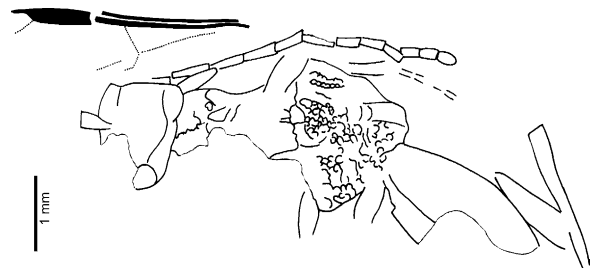


Fig. 16. *Eopelecinus rudis* sp. nov., female?, dorsal aspect, camera lucida drawing of holotype, 4210/1173.

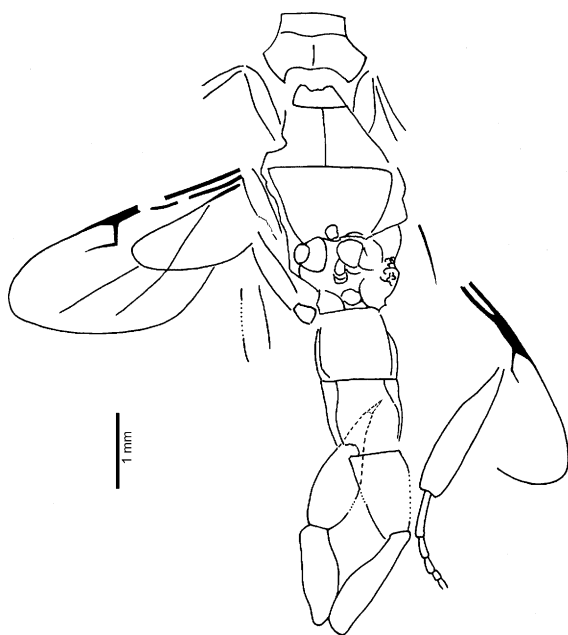


Fig. 17. *Scorpiolecinus laetus* sp. nov., female, ventral aspect, camera lucida drawing of holotype, 4210/6938.

2002, *E. shangyuanensis* Zhang, Rasnitsyn and Zhang, 2002 and *E. similis* Zhang, Rasnitsyn and Zhang, 2002, and the five new species described below.

Diagnosis. Antenna 14- or 15-segmented. Forewing with C and R present; other veins or crossveins spectral, if present; pterostigma comparatively short. Pronotum short medially. Mesonotum with notauli areolate. Propodeum reticulate. Metasoma with one broad basal segment remaining tubular.

Eopelecinus minutus sp. nov.

Figs. 9C, 11

Derivation of name. Latin, *minutus*, tiny.

Material. Holotype 3965/424 (female), antennae, legs and wings incomplete. Collected from the Tsagan-Tsab Formation (basal Lower Cretaceous), Khutel-Khara, Mongolia.

Description. Female; male unknown. Body brown. Head medium-sized (relative to mesosoma in width), transversely broad; eyes large, oval. Antennae narrow, with only four basal segments preserved. Pronotum short; metanotum short, with anterior margin areolate; propodeum coarsely reticulate. Foreleg with narrow trochanter, femur short; mid coxa small; hindleg with large, oval coxa, trochanter small, femur broad. Forewing with pterostigma of constant width for basal two-thirds. Hindwing with anterior margin preserved

basally. First metasomal segment slightly narrowed basally, gradually increasing in width for basal one-third, decreasing in width for distal two-thirds, nearly as long as mesosoma and about 1.5 times as wide basally as apically. Second through sixth metasomal segments slender, straight or slightly curved ventrally. Ovipositor protruding from metasomal apex and damaged apically. Length ratio of metasomal segments 1.0:0.4:0.6:0.5:0.5:0.4. Head length 0.3 mm, mesosoma 0.8 mm, metasoma 2.7 mm; forewing length 1.6 mm, width, as preserved, 0.5 mm.

Comparison. See Section 3.

Eopelecinus fragilis sp. nov.

Figs. 9D, E, 12

Derivation of name. Latin, *fragilis*, frail, fragile.

Material. Holotype 3965/428 (female), part and counterpart; antennae, legs and wings incomplete; wings deformed. Collected from the Tsagan-Tsab Formation (basal Lower Cretaceous), Khutel-Khara, Mongolia.

Description. Female; male unknown. Body brown. Head large; eyes large, transversely oval. Antennae with only five basal segments preserved; scape narrow basally and widened apically, 1.5 times as long as wide; pedicel small, slightly longer than wide, with base narrow and apex slightly swollen; first flagellomere 2.5 times as long as wide, distinctly narrower than pedicel basally and slightly narrower apically; second similar to first, slightly longer; third as broad as second, subcylindrical. Mesosoma slender; mesonotum long with posterior margin areolate. Fore and mid coxae small; hindleg with large coxa, trochanter elongate, trapezoid. Forewing with R very bent posteriorly; pterostigma narrowed basally, slightly widened at midpoint (?). Hindwing with anterior margin distinct. First metasomal segment elongate-oval, broadest approximately at midpoint, as long as mesosoma and as wide basally as apically; others slender with concave ventral and convex dorsal contours; last one incomplete. Length ratio of metasomal segments 1.0:0.6:0.6:0.5:0.4:0.3. Head length 0.5 mm, mesosoma 1.6 mm, metasoma 4.8 mm; forewing, as preserved, length 2.6 mm, width 1.0 mm; hindwing length 1.8 mm, width, as preserved, 0.5 mm.

Comparison. See Section 3.

Eopelecinus exquisitus sp. nov.

Figs. 13A, B, 14

Derivation of name. Latin, *exquisitus*, exquisite, fine.

Material. Holotype 4210/1171 (female), part and counterpart; hindwings missing, otherwise nearly complete. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Female; male unknown. Body brown, legs and distal half of metasoma pale. Head medium-sized, nearly transversely trapezoid; eyes large, nearly oval. Antennae 14-segmented; scape narrow basally, widened apically, nearly as long as wide; pedicel distinctly narrower than scape distally, swollen apically, about as long as wide; first flagellomere narrower basally than pedicel distally, gradually increasing in width apically, three times as long as wide; second through fourth similar to first; fifth through eighth similar to first but a little shorter; ninth through eleventh as wide as eighth apically, cylindrical, about twice as long as wide; terminal a little longer than eleventh, rounded apically. Mesosoma suboval; pronotum extremely short; notauli coarsely areolate, mesoscutellum and metanotum with anterior and posterior margins consisting of fine areolae; propodeum coarsely and regularly reticulate. Fore and mid legs short and thin. Hindleg with medium-sized coxa, trochanter small, femur swollen at midpoint, tibia narrow basally, gradually broadened apically and slightly longer than femur; basitarsus about one-third as long as tibia, second tarsomere slightly shorter than basal, third half as long as basal, fourth shortest and half as long as third, fifth clavate and as long as third. Forewing with broad costal area; pterostigma broadest in its apical third, with posterior margin arched. First metasomal segment elongate-oval, broadest slightly before its mid-length, about as long as mesosoma and slightly broader basally than apically, with several longitudinal ridges near its base; second through sixth slender, with apical four slightly narrower than second. Length ratio of metasomal segments 1.0:1.0:0.9:0.6:0.4:0.4. Head length 1.0 mm, mesosoma 3.2 mm, metasoma 14.1 mm; antennal length, as preserved, 5.4 mm; forewing length, as preserved, 6.5 mm.

Comparison. See Section 3.

Eopelecinus scorpioideus sp. nov.

Figs. 13D, 15

Derivation of name. Latin, *scorpioideus*, similar to a scorpion tail.

Material. Holotype 4210/5242 (female), hindwings and an antenna missing, legs incomplete. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Female; male unknown. Body brown, legs pale. Head medium-sized, transversely trapezoid; eyes large, kidney-like. Antennae 14-segmented; scape incomplete; pedicel slightly narrower basally than scape distally, slightly broadened distally, as long as wide; first flagellomere distinctly narrower basally than pedicel distally, gradually becoming wider apically, three times as long as wide; second and third similar to first, but a little longer; fourth through six similar to first; seventh incomplete; remaining flagellomeres slightly shorter and broader, about twice as long as wide; terminal rounded apically. Mesosoma nearly elongate-hexagonal; propodeum coarsely and irregularly reticulate. Foreleg short and narrow; midleg slightly longer than foreleg. Hindleg with femur swollen near its end, tibia narrow basally and gradually widened apically; second tarsomere shorter than basitarsus, slightly shorter than third; fourth shortest; fifth as long as third. Forewing with R bent posteriorly; costal area broad; pterostigma broadest in its apical fourth, with posterior margin arched. First metasomal segment elongate-oval, broadest at about its basal third, about as long as mesosoma and slightly broader basally than apically, with several longitudinal ridges near its base; second through sixth slender. Length ratio of metasomal segments 1.0:0.8:0.8:0.5:0.4:0.3. Head length 0.9 mm, mesosoma 2.8 mm, metasoma 12.0 mm; antennal length 4.6 mm; forewing length 5.7 mm, width 2.4 mm.

Comparison. See Section 3.

Eopelecinus rudis sp. nov.

Figs. 13C, 16

Derivation of name. Latin, *rudis*, wild, rude.

Material. Holotype 4210/1173 (female?), body incomplete. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Female. Body brown, legs pale. Head large, nearly trapezoid. Antennae with scape narrow basally, greatly swollen distally, 2.5 times as long as wide; several basal flagellomeres slightly wider distally than basally, three to four times as long as wide, remainder slightly shorter; terminal rounded apically. Mesosoma incomplete, areolate dorsally. Hindleg with long femur and tibia. Forewing with R slightly bent posteriorly; costal area narrow; pterostigma slightly widened at midpoint; basal vein (both of first abscissae of Rs and M), 2r-rs, (M+)(Cu and cu-a spectral; cu-a interstitial. First metasomal segment incomplete, distinctly narrower basally than mesosoma apically, oval in shape as presumed from preserved part. Head length 1.1 mm, mesosoma

3.0 mm, metasoma, as preserved, 2.3 mm; antennal length, as preserved, 4.4 mm; forewing length, as preserved, 3.3 mm.

Remarks and comparison. Although the metasoma is incomplete, its first segment, which is narrow basally and distally and swollen midway, favours placing this species in *Eopelecinus*, and, moreover, its interpretation as a female. Comparisons with other species are given in Section 3.

Genus *Scorpiopolecinus* Zhang, Rasnitsyn and Zhang, 2002

Type species. *Scorpiopolecinus versatilis* Zhang, Rasnitsyn and Zhang, 2002; Yixian Formation, Liaoning, China.

Species included. The type species and *S. laetus* described below.

Diagnosis. Female (male unknown). Antenna 14-segmented. Forewing with pterostigma narrow, acute apically, not widened beyond mid-length; 2r-rs distinct, vestigial Rs present distad 2r-rs, r open; (M+Cu) distinct. Hindwing with only C present. Pronotum comparatively long. Propodeum reticulate. Metasoma with three basal segments wide and remainder tubular.

Scorpiopolecinus laetus sp. nov.

Figs. 13E, 17

Derivation of name. Latin, *laetus*, vivid.

Material. Holotype 4210/6938, antennae missing, otherwise nearly complete. Collected from the Zaza Formation (lower Lower Cretaceous), Baissa, Transbaikalia, Russia.

Description. Female; male unknown. Body brown, legs pale. Head large, slightly convex anteriorly and widened posteriorly. Mesosoma elongate-hexagonal. Fore- and midlegs narrow. Hindlegs distinctly long; tibia clavate; tarsus shorter than tibia, with fourth tarsomere shortest. Forewing with R slightly bent posteriorly; 2r-rs 2.5 times as long as pterostigmal width, Rs short; M distinguishable on distal half of wing; (M)+Cu distinguishable. Hindwing short, without distinguishable veins. First metasomal segment nearly trapezoid, about one-third as long as mesosoma and 0.8 times as wide basally as apically; second inversely trapezoid; third slightly narrower basally than second distally, gradually tapering apically; fourth narrow basally and wider for distal two-thirds of length; fifth slightly wider than fourth; sixth swollen in basal half, gradually decreasing in width apically. Length ratio

of metasomal segments 1.0:1.1:1.2:1.8:1.4:1.8. Ovipositor short, extruded from metasomal apex and sharpened apically. Head length 0.9 mm, mesosoma 3.1 mm, metasoma 7.7 mm; forewing length, as preserved, 3.6 mm, width 1.6 mm; hindwing length, as preserved, 1.7 mm, width 0.8 mm.

Comparison. See Section 3.

3. Key to fossil peleciniid wasps

Based on the known extinct peleciniids (Brues, 1933; Kozlov, 1974; Rasnitsyn, 1980; Johnson, 1998; Engel, 2002; Zhang et al., 2002) and the new material described above, a key to the fossil peleciniid wasps is given as follows.

- 1 Forewing venation comparatively complete with 'Rs₂' long. Female metasoma tubular. Male metasoma varying in shape. Peleciniinae Haliday, 1840 2
- Forewing venation comparatively complete and usually reduced, 'Rs₂' short or absent. Female metasoma with at least one basal segment minimally modified (of usual width). Male metasoma slightly narrowed or stick-like. Iscopiniinae Rasnitsyn, 1980. 7
- 2 Forewing with pterostigma very narrow. Male metasoma tubular. *Pelecinopteran* Brues, 1933 *tubuliforme* Brues, 1933
- Forewing with pterostigma comparatively broad. Male metasoma not tubular. 3
- 3(2) Male metasoma clavate. *Pelecinus* Latreille; for species diagnostics, see Johnson and Musetti, 1999

- Male metasoma with four basal segments minimally modified (of usual width). *Protopelecinus* gen. nov. 4
- 4(3) Forewing with M indistinguishable beyond Rs + M, 2r-rs shorter than pterostigmal width. *Protopelecinus dubius* gen. et sp. nov. (Figs. 1E, F, 4)
- Forewing with M distinguishable, 2r-rs not shorter than pterostigmal width. 5
- 5(4) Forewing with M very weak, 2r-rs as long as pterostigmal width. *Protopelecinus deformis* gen. et sp. nov. (Figs. 1G, H, 5)
- Forewing with M distinct, 2r-rs greatly longer than pterostigmal width. 6
- 6(5) Forewing with Rs reaching apex of wing, cu-a postfurcal. *Protopelecinus regularis* gen. et sp. nov. (Figs. 1A–C, 2)
- Forewing with Rs reaching anterior margin of wing, cu-a interstitial. *Protopelecinus furtivus* gen. et sp. nov. (Figs. 1D, 3)
- 7(1) Forewing venation complete or slightly reduced, r closed; antenna 18(?)–segmented. *Iscopinus* Kozlov, 1974. 8
- Forewing venation greatly reduced, r open or absent; antenna 13(?)–16(?)–segmented. 11
- 8(7) Forewing with Rs + M, Rs between Rs + M and 2r-rs, and m-cu lost. *Iscopinus simplex* sp. nov. (Figs. 6A, B, 7)
- Forewing venation complete or nearly complete. 9
- 9(8) Metasoma of usual width. *?Iscopinus suspectus* sp. nov. (Figs. 9A, B, 10)
- Metasoma more or less elongate and narrowed. 10
- 10(9) Forewing with m-cu basad of 2cu. *Iscopinus baissicus* Kozlov, 1974
- Forewing with m-cu distad of 2cu. *Iscopinus separatus* sp. nov. (Figs. 6C, D, 8)
- 11(7) Female metasoma with one basal segment wide. *Eopelecinus* Zhang, Rasnitsyn and Zhang, 2002. 12
- Female metasoma with two or three wide basal segments. 19
- 12(11) Forewing with pterostigma incompletely sclerotized. 13
- Forewing with pterostigma completely sclerotized. 14
- 13(12) Antenna thin, with first flagellomere longer than second; forewing with basal pterostigma weakly sclerotized; first metasomal segment longer than second. *Eopelecinus vicinus* Zhang, Rasnitsyn and Zhang, 2002
- Antenna thicker, with first flagellomere shorter than second; lower pterostigmal margin weakly sclerotized; first and second metasomal segments of equal length. *Eopelecinus shangyuanensis* Zhang, Rasnitsyn and Zhang, 2002
- 14(12) Forewing shorter than 2 mm. *Eopelecinus minutus* sp. nov. (Figs. 9C, 11)
- Forewing longer than 2 mm (forewing, statistically, about as long as mesosoma and first metasomal segment combined for *Eopelecinus* based on all species with forewing(s) preserved; so for *E. similis*, its forewing may be 3 mm long as estimated). 15
- 15(14) Body feeble; first metasomal segment slender. *Eopelecinus fragilis* sp. nov. (Figs. 9D, E, 12)

- Body robust; first metasomal segment broad. 16
- 16(15) Forewing shorter than 4 mm. *Eopelecinus similis* Zhang, Rasnitsyn and Zhang, 2002
- Forewing longer than 4 mm. 17
- 17(16) Forewing with pterostigma broadest midway. *Eopelecinus rudis* sp. nov. (Figs. 13C, 16)
- Forewing with pterostigma broadest beyond mid-length. 18
- 18(17) Forewing with pterostigma broader; second metasomal segment as long as first. *Eopelecinus exquisitus* sp. nov. (Figs. 13A, B, 14)
- Forewing with pterostigma narrower; second metasomal segment shorter than first. *Eopelecinus scorioideus* sp. nov. (Figs. 13D, 15)
- 19(11) Female metasoma with two basal segments wide; male metasoma stick-like. *Sinopelecinus* Zhang, Rasnitsyn and Zhang, 2002. 20
- Female metasoma with three basal segments wide; male unknown. *Scoriopelecinus* Zhang, Rasnitsyn and Zhang, 2002. 23
- 20(19) Male (with metasoma stick-like) with antenna 16(?) segmented (female unknown). *Sinopelecinus viriosus* Zhang, Rasnitsyn and Zhang, 2002
- Female (with two basal metasomal segments wide and others narrow) with antenna 14–15 segmented. 21
- 21(20) Antenna 15-segmented; mesosoma slender; hindcoxa larger; metasomal segments 3–6 wider, with lower contour convex. *Sinopelecinus delicatus* Zhang, Rasnitsyn and Zhang, 2002
- Antenna 14-segmented; mesosoma stout; hind coxa smaller; metasomal segments 3–6 thin, segments 4–5 with lower contour concave. 22
- 22(21) Antenna thick with first flagellomere about as long as apical one; legs elongate; first metasomal segment much longer than second, fourth slightly longer than fifth. *Sinopelecinus epigaeus* Zhang, Rasnitsyn and Zhang, 2002
- 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 twice as long as fifth. *Sinopelecinus magicus* Zhang, Rasnitsyn and Zhang, 2002
- 23(19) Forewing with anal and brachial veins present, M absent; terminal metasomal segment thickest distally. *Scoriopelecinus versatilis* Zhang, Rasnitsyn and Zhang, 2002
- Forewing with anal and brachial veins absent, M present; terminal metasomal segment thickest basally. *Scoriopelecinus laetus* sp. nov. (Figs. 13E, 17)

4. Discussion

Although the history of the family Pelecinidae is not very clear, it is likely that pelecinids were diverse and abundant in the Cretaceous (perhaps from the latest Jurassic to the Cretaceous), especially in the Early Cretaceous (Kozlov, 1974; Zhang et al., 2002; herein). From then on, very few fossil and living representatives

have been recognized, with one Tertiary species and three extant congeners documented (Brues, 1933; Johnson, 1998; Johnson and Musetti, 1999; Engel, 2002).

Based on the overall aspect of the metasoma, the Peleciniidae and Monomachidae were suggested by Königsmann (1978) to be sister groups. Morphological analyses indicate that the Peleciniidae are grouped together with Proctotrupidae and Vanhorniidae (Rasnitsyn, 1980) or with Proctotrupidae (including Vanhorniidae) (Rasnitsyn, 1988). Analyses of mitochondrial 16S RNA sequence data show that, under different methods of analysis, the relationships of the Peleciniidae are highly unstable: the Peleciniidae are recovered as the sister group to Proctotrupidae + Vanhorniidae, to most Proctotrupomorpha, and to Platygastroidea (Dowton et al., 1997). Similarly, simultaneous analyses of 16S, 28S, COI and morphology indicate that the Peleciniidae are recovered as the sister group to Roproniidae, Platygastroidea, and Proctotrupidae + Vanhorniidae (Dowton and Austin, 2001). Cladistic analyses (Ronquist et al., 1999; Sharkey and Roy, 2002) suggest that the Peleciniidae are the sister group to Proctotrupidae. Most of the above analyses are based on extant Peleciniidae (Peleciniinae), with little attention having been paid to fossils.

Recently, many fossils have been described from the Mesozoic and assigned to the Peleciniidae (Zhang et al., 2002; present paper). In addition, some peleciniids from the Laiyang Formation of Shandong, China, are currently being studied, including eight species of *Eopelecinus*, two of *Sinopelecinus* and a new genus within the Iscopiniinae. The family exhibits many plesiomorphic characters when compared with the Proctotrupidae. (1) Number of antennal components. In the subfamily Peleciniinae the number of antennal segments is 13 (for *Pelecinopterion*) or 14 (for *Pelecinus*; unknown for *Protopelecinus* owing to poor preservation) (Brues, 1933; Johnson and Musetti, 1999; present paper); in the Iscopiniinae it varies from 14 to 18(?) (Kozlov, 1974; Zhang et al., 2002; herein). In the Proctotrupidae the number is stable, namely 13 (Rasnitsyn, 1980, 1988; Ronquist et al., 1999). The smaller number of antennal segments is considered to be an apomorphic character (Ronquist et al., 1999). (2) Basal metasomal segmentation. In the Peleciniidae metasomal segments are individual, even being nearly normal in length and width for all segments in male *Iscopinus* and *Sinopelecinus*, for four basal segments in male *Protopelecinus*, three in female *Scorpiopelecinus*, and two in female *Sinopelecinus* (Kozlov, 1974; Zhang et al., 2002; herein). In the Proctotrupidae, several basal metasomal segments are very modified, with sterna and terga respectively fused with them, which can be considered apomorphic. (3) Length and shape of female metasoma. In the Peleciniidae, the female metasoma is distinctly elongate

and slender, as in not only extant representatives but also extinct members. In the Proctotrupidae, the female metasoma is short but extendable in length (Rasnitsyn, 1980, 1988; Ronquist et al., 1999). The distinctly elongate and slender metasoma is considered plesiomorphic with respect to the state in the Proctotrupidae (Ronquist et al., 1999). (4) Metasomal apex and ovipositor. In the subfamily Peleciniinae, *Pelecinus* and *Pelecinopterion* have a metasoma with a closed apex at rest and an internal ovipositor (Brues, 1933; Johnson, 1998; Johnson and Musetti, 1999; Engel, 2002), whereas this character is unknown in *Protopelecinus* because the genus is known only from a male and some unattached forewings. In the subfamily Iscopiniinae, *Sinopelecinus*, *Scorpiopelecinus* and the new Laiyang genus bear a metasoma with an open apex and an external ovipositor (Zhang et al., 2002; herein). *Eopelecinus* includes 16 females, with three from the Yixian Formation (Zhang et al., 2002), three from the Zaza Formation, two from the Tsagan-Tsab Formation (herein) and eight undescribed from the Laiyang Formation. Most have a perfectly preserved metasomal apex and at least in *E. minutus* the ovipositor extends from the metasomal apex. Hence, it can be considered that the *Eopelecinus* has an external ovipositor. The metasomal apex and ovipositor of the Proctotrupidae are so greatly modified (ovipositor exerted secondarily with sheaths transformed to help penetration rather than protection; see Rasnitsyn, 1988) that it might be interpreted as apomorphic compared with some iscopinines, such as *Scorpiopelecinus* in which the metasomal apex is open and the ovipositor is normally external. Also, the character state of the closed metasomal apex and internal ovipositor is considered apomorphic compared with that of the open metasomal apex and external ovipositor (Ronquist et al., 1999).

From the above discussion, it seems that the Proctotrupidae might be derived from the Iscopiniinae; in another words, the Iscopiniinae might be ancestral to the Proctotrupidae, which are considered as the sister group to the Peleciniinae as mentioned above. Hence, cladistically the Peleciniidae as defined herein might be paraphyletic, although a more positive conclusion will require detailed cladistic analyses.

The Yixian Formation of Beipiao, the Laiyang Formation of Laiyang, the Zaza Formation of Transbaikalia and the Tsagan-Tsab Formation of Mongolia are approximately coeval because their fossil assemblages are very similar. The insect fauna from both the Yixian and Laiyang formations is dominated by *Eopelecinus* (11 of 19 at the specific level) and *Sinopelecinus* (six of 19) while the Siberian + Mongolian fauna from the Zaza and Tsagan-Tsab formations is dominated by *Eopelecinus* (five of 11) and *Iscopinus* (three of 11) (see Tables 1, 2). Of these taxa, *Eopelecinus* is common in the two faunas, whereas *Sinopelecinus* and *Iscopinus* are respectively

Table 2
Distribution of Peleciniidae in the Yixian, Laiyang, Zaza and Tsagan-Tsab formations

Genus	China			Siberia and Mongolia		
	Yixian FM	Laiyang FM	Total	Zaza FM	Tsagan-Tsab FM	Total
	Number of species					
<i>Protopelecinus</i>	0	0	0	2	0	2
<i>Eopelecinus</i>	3	8	11	3	2	5
<i>Iscopinus</i>	0	0	0	3	0	3
<i>Sinopelecinus</i>	4	2	6	0	0	0
<i>Scorpiopolecinus</i>	1	0	1	1	0	1
<i>Iscopininae</i> gen. nov.	0	1	1	0	0	0

absent from them. These differences might be for many reasons, but are probably the result of geographical variation in populations.

The fact that in the Siberian + Mongolian insect fauna, *Iscopinus* is represented only by males and *Eopelecinus* only by females suggests that they might belong to a single genus. However, this hypothesis does not tally with the Chinese record, in which *Eopelecinus* is common but *Iscopinus* is absent (Zhang et al., 2002). Male peleciniids are generally rare in the Mesozoic of China, which might be a result of geographical variation in male abundance, a phenomenon known in contemporary hymenopterans. Another problem, however, is that *Iscopinus* and *Eopelecinus* represent the opposite ends of the venational spectrum in the subfamily Iscopininae, whereas *Sinopelecinus* is venationally nearly uniform in both males and females. Because of these problems, for the time being we prefer to accept the present taxonomy in spite of its possibly artificial character.

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