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New extinct taxa of Pelecinidae sensu lato (Hymenoptera: Proctotrupoidea) in the Laiyang Formation, Shandong, China

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Abstract

Three new species and a new genus of pelecinid wasps from the Laiyang Formation in Laiyang, Shandong, China are described: *Sinopelecinus hierus* sp. nov., *S. daspletis* sp. nov. and *Allopelecinus terpnus* gen. et sp. nov. The stratigraphic correlation of insect-bearing beds in the Laiyang, Yixian and Zaza formations is reassessed; these lacustrine sedimentary rocks are likely to be contemporaneous.

Keywords: Paleoentomology; Hymenoptera; Pelecinidae; New taxa; Laiyang Formation; Late Mesozoic; China

1. Introduction

The family Pelecinidae contains two subfamilies: the extant Pelecininae and the extinct, probably paraphyletic, Iscopininae (Kozlov, 1974; Rasnitsyn, 1980). The former includes four species within two genera: *Pelecinopteron tubuliforme* Brues, 1933 from the Eocene Baltic and Paleocene Sakhalin amber (Kozlov, 1974; Johnson, 1998; Engel, 2002), and the extant *Pelecinus polyturator* (Drury, 1773), *P. thoracicus* (Klug, 1841) and *P. dichrous* (Perty, 1833) (Johnson and Musetti, 1999). The latter subfamily consists of nine species referable to four genera from the Zaza Formation of Transbaikal, Russia (*Iscopinus baissicus* Kozlov, 1974), and Yixan Formation of Liaoning, China (*Sinopelecinus delicatus*, *S. epigaeus*, *S. magicus*, *S. viriosus*, *Eopelecinus vicinus*, *E. shanyuanensis*, *E. similaris*, and *Scorpiopelecinus versatilis*, all Zhang, Rasnitsyn and Zhang, 2002).

Recently, JZ collected many specimens of pelecinid wasps from the Laiyang Formation at the villages of Nanligezhuang and Tuanwan, Laiyang City, Shandong Province, China. Of these, eight new species have recently been assigned to *Eopelecinus* Zhang, Rasnitsyn and Zhang, 2002 (Zhang, 2005). Here we assign the remaining three to two genera: *Sinopelecinus* Zhang, Rasnitsyn and Zhang, 2002 and *Allopelecinus* gen. nov., respectively; these are as *Sinopelecinus hierus* sp. nov., *S. daspletis* sp. nov. and *Allopelecinus terpnus* gen. et sp. nov.

The fossil locality and stratigraphic section of the Laiyang Formation were described by Zhang (1992). The age of the formation is debatable. Various palaeoentomologists have suggested that it is Late Jurassic (Ren and Hong, 1998), latest Jurassic–earliest Cretaceous (Zhang, 2003), Early Cretaceous (Lin, 1995), Hauterivian–Barremian (Hong, 1998), and Barremian (Grimaldi and Engel, 2005). We consider it to be currently unresolved but see no reason for regarding the lacustrine sediments of the Laiyang, Yixian and Zaza formations of Shandong, Liaoning, and Transbaikal as differing appreciably in age.

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2. Systematic palaeontology

Order: Hymenoptera Linnaeus, 1758
Suborder: Apocrita Gerstäcker, 1867
Superfamily: Proctotrupoidea Latreille, 1802
Family: Pelecinidae Haliday, 1840
Subfamily: Iscopininae Rasnitsyn, 1980
Genus *Sinopelecinus* Zhang, Rasnitsyn and Zhang, 2002

Sinopelecinus hierus sp. nov.
Figs. 1A, B, 2A–C

Derivation of name. Greek *hierus*, sacred, alluding to the impression given by the habitus of this wasp.

Material. Holotype, NIGP, no. L91444, L91445, part and counterpart; a compression fossil pelecinid from the Laiyang Formation in the vicinity of Nanligezhuang, Tuanwan Town, Laiyang City, Shandong Province, China; deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences.

Diagnosis. Similar to female *Sinopelecinus* described from Yixan in having narrow, filiform antenna; long, reticulate

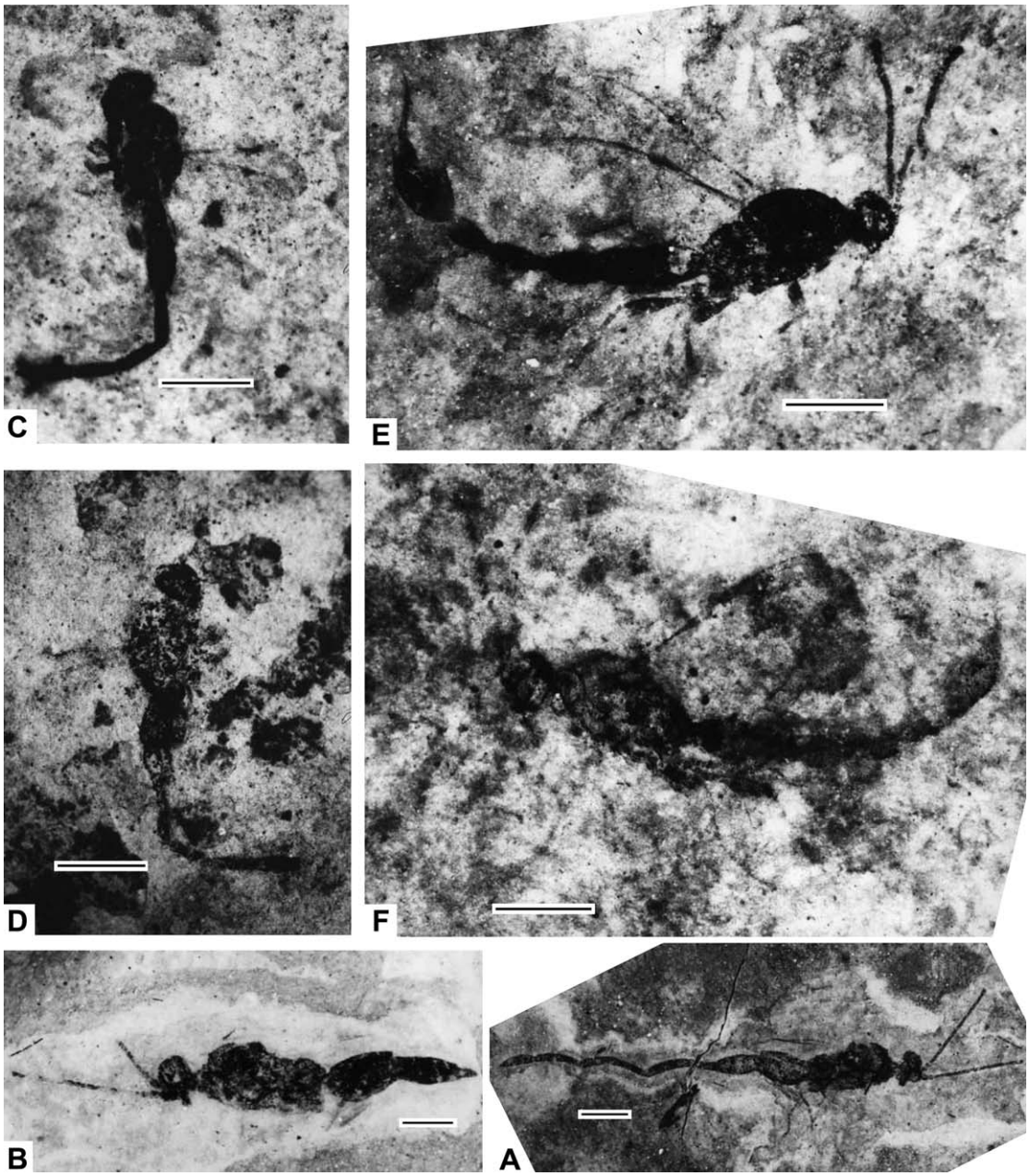

Fig. 1. A, B, *Sinopelecinus hierus* sp. nov., holotype, part, L91444, and counterpart, L91445, respectively. C, D, *Sinopelecinus daspletis* sp. nov., holotype, part, L91448, and counterpart, L91449, respectively. E, F, *Allopelecinus terpnus* gen. et sp. nov., holotype, part, L91446, and counterpart, L91447, respectively. Scale bars represent 1 mm.

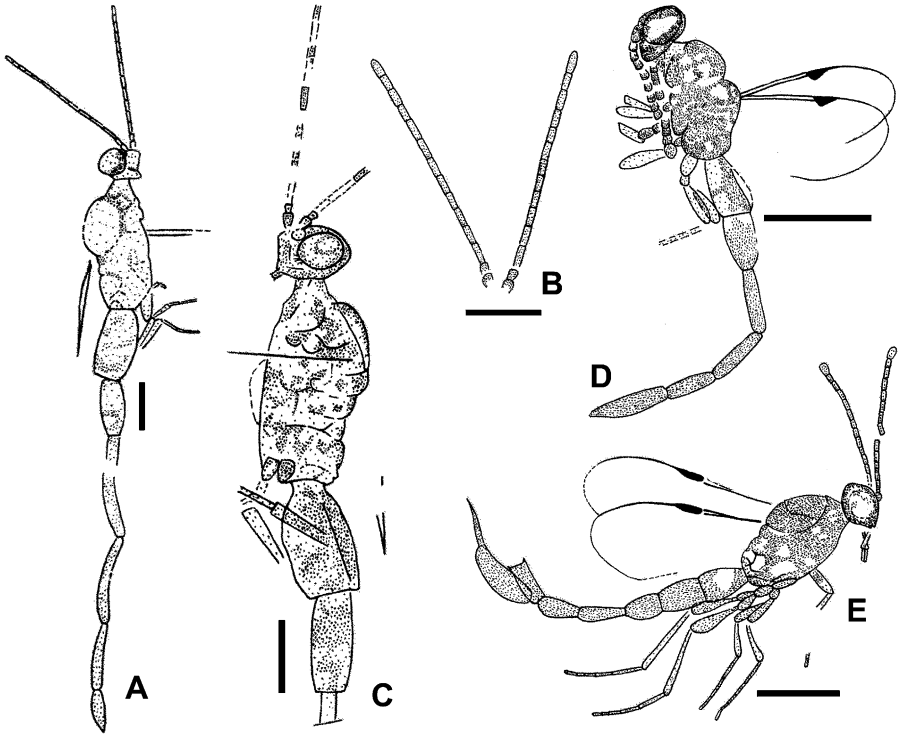

Fig. 2. A–C, *Sinopelecinus hierus* sp. nov. A, female, lateral aspect. B, antennae, camera lucida drawing of specimen L91444. C, female, lateral aspect, camera lucida drawing of specimen L91445. D, *Sinopelecinus daspletis* sp. nov., female, lateral aspect, camera lucida drawing of specimen L91448. E, *Allopelecinus terpnus* gen. et sp. nov., lateral aspect, camera lucida drawing of specimen L91446.

propodeum; and elongate metasoma. Differs in having mesothorax highly elevated above propodeum; third and fourth metasomal segments arched dorsally.

Description. Female (male unknown): Body dark-brown, legs paler. Head relatively small, wider than long; eyes relatively small, suboval, not reaching posterior margin of head. Antenna thin, filiform, hardly swollen towards apex, 14-segmented, nearly as long as head and mesosoma combined; scape relatively short, slightly thicker than remaining segments, clearly shorter than first flagellomere; pedicel relatively small, longer than wide, shorter and thinner than scape; flagellomeres oblong, first flagellomere slightly longer than second, second to eleventh nearly equal in length and width, terminal flagellomere rounded apically. Mesosoma relatively thin, elongate-oval; pronotum poorly preserved, rather short; mesonotum convex, high compared to propodeum, with oblique, long notauli; metanotum and metapostnotum relatively large; propodeum long, possibly coarsely reticulate. Legs short, thin, poorly preserved. Metasoma about 2.6 times as long as head and mesosoma combined, segment length ratio 1.0:0.8:1.4:1.2:0.9:0.6. First metasomal segment wider than propodeum, narrowed at both ends, with dorsal contour weakly, evenly convex; sternal contour more strongly convex, particularly basally. Second metasomal segment narrower, distinctly narrowed at both ends, with sternal contour more even. Following three segments tubular (narrow, near parallel-sided), arching dorsally (fourth strongly, sixth weakly), seventh segment short, fusiform.

Length of head, 0.7 mm; antenna, 3.3 mm; mesosoma, 3.0 mm; metasoma, 9.6 mm.

Sinopelecinus daspletis sp. nov.
Figs. 1C, D, 2D

Derivation of name. Greek, *daspletis*, fearful.

Material. NIGP, no. L91448, L91449, part and counterpart, female impression preserved in lateral aspect; locality and repository as for *Sinopelecinus hierus* sp. nov.

Diagnosis. Differs from all other female congeners as follows: antenna short, thick, probably with fewer segments; short, non-reticulate propodeum; comparatively short metasoma with third and fourth segments far less elongate. Differs from those with known venation, viz. *S. delicates*, *S. viriosus*, by its greatly reduced venation and triangular pterostigma.

Description. Female (male unknown): Body dark brown. Head relatively large, eyes large, oval, almost reaching posterior margin of head. Antenna short (about as long as head and mesosoma combined), thick, distinctly swollen apically, number of segments not precisely known but possibly small (13?). Scape relatively thick, long, slightly thinner basally than apically, clearly longer than first flagellomere; pedicel relatively small, wider than long, distinctly shorter and slightly thinner than scape; first flagellomere nearly as long

as wide, slightly longer than second; second to tenth(?) nearly equal in length and width, each wider than long; eleventh(?) thickened, suboval, rounded apically. Mesosoma relatively short, elongate-oval; pronotum quite long, less convex; mesonotum strongly convex, detail of structure on mesonotum not visible; scutellum badly preserved; propodeum very short, apparently sculptured. Midleg with femur slightly clavate; hindleg with small coxa slightly longer than wide, trochanter short, thick, slightly wider than long; femur similar in shape and size to mid femur, tibia poorly preserved, apparently thin, parallel-sided. Forewing with C, R straight; costal area relatively narrow; pterostigma rather large, triangular; no other vein present. Metasoma about 2.3 times as long as head and mesosoma combined, with segment length ratio 1.0:1.0:1.1:1.1:0.8:1.4. First and second metasomal segments thick, jointly clearly shorter than head and mesosoma combined, widely attached to each other, narrowed anteriorly and posteriorly. First segment slightly thicker than second, half as wide basally as apically, broadest near apex. Second segment broadest near its base, 2.5 times as wide basally as apically. Third to fifth segments tubular, nearly parallel-sided, with both dorsal and ventral contours weakly convex. Sixth segment lanceolate, wider than the three preceding it, widest at midlength, acuminate apically, dorsal contour much more convex than ventral.

Length of head, 0.4 mm; antenna, ca. 1.3 mm; mesosoma, 1.2 mm; metasoma, 3.4 mm; forewing 1.5 mm. Width of forewing, 0.8 mm.

Remarks. This new species differs from congeners in many respects, and might warrant generic distinction. However, as the majority of these species are insufficiently known, particularly with respect to their wing venation, erection of a new genus for this species would be premature.

Genus *Allopelecinus* gen. nov.

Type species. *Allopelecinus terpnus* gen. et sp. nov.

Derivation of name. Greek, *allos*, other or different, alluding to the relationship of its morphology to that of the genus *Pelecinus*.

Diagnosis. Female (male unknown). Antenna 15-segmented. Pronotum long dorsally. Forewing with pterostigma narrow, acute apically, not roundly widened beyond midlength, veins other than C, R lost. Propodeum reticulate. Metasoma with three basal segments wide, distinctly constricted at junctions, following two moderately narrowed, not strictly tubular, sixth about as thick as first. Ovipositor external, long (longer than shortest metasomal segment).

Remarks. The new genus is unique among Pelecinidae in that it combines the most plesiomorphic metasomal morphology within the family (the third to fifth segments least modified and hardly elongate, and well-developed ovipositor) with deeply reduced wing venation, as in *Eopelecinus*. It is assigned to Iscopininae and not to Pelecininae because of its plesiomorphic metasomal construction (in Pelecininae all segments are individual and elongate), and differing wing venation (most veins simply lost instead of being nebulous and with secondarily long RS_2).

Allopelecinus terpnus sp. nov.
Figs. 1C,D, 2E

Derivation of name. Greek, *terpnus*, charming.

Material. NIGP, no. L91446, L91447, part and counterpart, female impression in lateral aspect; locality and repository as for *Sinopelecinus hierus* sp. nov.

Diagnosis. As for genus.

Description. Female (male unknown). Body and appendages dark brown, except paler maxillary palps, tibiae and tarsi. Head moderately large, suboval, apparently thicker than long; eyes poorly-preserved, apparently small, suboval, not reaching posterior margin of head. Antenna thin except for swollen apex, nearly as long as head and mesosoma combined; scape relatively thick, suboval, much thicker, but shorter than first flagellomere; pedicel quite small, subquadrate, markedly shorter and thinner than scape; first flagellomere longest, nearly three times as long as wide, obviously longer than second; second to twelfth nearly equal in length and width, each more than twice as long as wide; thirteenth thickened, elongate-oval, rounded apically. Mandibles small, subtriangular. Maxillary palps thin but relatively long. Mesosoma relatively thin, elongate-oval; pronotum relatively short; mesonotum distinctly convex, with notauli oblique, long; scutellum apparently small, convex; metanotum and propodeum flat, irregularly, coarsely reticulate. Foreleg with femur slightly widened, tibia relatively thick, only barely thinner than femur; midleg with suboval trochanter, femur slightly swollen apically, tibia very thin but slightly thickened apically, tarsus markedly longer but thinner than tibia, with basitarsus elongate, clearly shorter than remainder combined; hindleg with coxa large, suboval, trochanter relatively large, oblong, femur clavate, tibia distinctly longer, but thinner than femur, slightly thicker apically, tarsus filiform, nearly as long as tibia, with basitarsus less than twice as long as second tarsomere, fourth shortest. Forewing with C, R straight; costal area moderately wide near pterostigma; pterostigma relatively large, narrow lanceolate, tapering apically. Metasoma (excluding ovipositor) about 1.9 times as long as head and mesosoma combined, with segment length ratio 1.0:0.9:0.8:1.0:0.9:1.7. Three basal metasomal segments thick, gradually decreasing in length and width, slightly constricted between each segment, apparently shorter than head and mesosoma combined; first half as wide basally as apically, widest beyond its midlength, slightly thicker, longer than second; second widest near its base, 1.5 times as wide basally as apically, slightly thinner and shorter than first; third clearly shorter and thinner than second, widest

near its midlength; fourth and fifth subclavate, widest near apex; fourth longer and thinner than fifth; last (sixth) strongly elongate, much widened before its midlength, thicker than third, with dorsal contour weakly convex basally, weakly concave distally, ventral contour convex. Ovipositor slightly shorter than last mesosomal segment, with sheath long, wedge-like, almost straight (very slightly sinuous).

Length of head, 0.5 mm; antenna, ca. 1.9 mm; mesosoma, 1.5 mm; metasoma, 3.6 mm; hindleg, 3.1 mm; forewing, 2.3 mm. Width of forewing, 0.9 mm.

3. Discussion

Distinct differences are apparent between the pelecinid assemblages of Laiyang and Yixian (Zhang, Rasnitsyn and Zhang, 2002). They have no species in common; those present are not similar. Of the three genera known from Yixian, two are found at Laiyang (those described here and in Zhang, 2005). The ways in which these assemblages vary do not, however, indicate any significant age difference between these localities because neither shows a concentration of particularly basal versus derived genera; furthermore, these localities are too near each other for geographical separation to account for their distinctiveness. We suspect that this is a result of differing taphonomic and local environmental conditions.

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