

Short communication

New fossil elaterids (Insect: Coleoptera: Polyphaga: Elateridae) from the Middle Jurassic of Inner Mongolia, China

Huali Chang, Yunyun Zhao*, Dong Ren*

College of Life Science, Capital Normal University, Beijing 100048, China

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Abstract

A new genus with a new species of fossil elaterid, *Paraprotagrypnus superbus* gen. et sp. nov., from the Middle Jurassic Jiulongshan Formation in Daohugou Village (N41°18.979', E119°14.318'), Shantou Township, Ningcheng County, Inner Mongolia, China is described and illustrated. The genus *Paraprotagrypnus* belongs to the family of Elateridae, subfamily of Protagrypninae and tribe of Protagrypnini. Some primitive characters of the new genus and new species shed light on the ages between the Jiulongshan Formation in Inner Mongolia and the Yixian Formation in the western Liaoning Province of China. The habitat of the new species is briefly discussed.

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Keywords: Elateridae; New genus; *Paraprotagrypnus superbus* sp. nov.; Middle Jurassic; Jiulongshan Formation; China

1. Introduction

Coleopteran insects originated from the Early Permian, about 265 million years ago [1], and most primitive fossil records of elaterids were from the Lower Jurassic deposits of the Issykkul Lake basin (Kirghyzstan, Central Asia) [2]. To date, more than 100 fossil Mesozoic species of elaterids have been reported from all over the world [3]. Based on the records, elaterids probably originated no later than the Early Jurassic. Therefore, the Middle Jurassic fossil elaterids of the Jiulongshan Formation from Inner Mongolia, China would shed some light on the origin and evolution of this group.

2. Materials and methods

Three fossil specimens were collected from the Middle Jurassic Daohugou Village, Shantou Township, Jiulong-

shan Formation, Ningcheng County, Inner Mongolia in China, about 165 Ma [4–6].

The specimens were examined using a Leica MZ12.5 dissecting microscope, illustrated with the aid of a drawing tube attachment, and photographs were acquired by the Nikon Digital Camera DXM1200C. The morphological terminology used followed Lawrence and Newton [7] and Beutel and Haas [8], and the taxonomic system was taken from Dolin [9].

Body length was measured along the midline from the anterior margin of the frons to the apex of the abdomen, and the width was measured across the broadest part of elytra. The length of pronotum was measured along the midline; the width was measured across the broadest part at its posterior angles.

3. Systematic paleontology

Order Coleoptera Linnaeus, 1758
Family Elateridae Leach, 1815
Subfamily Protagrypninae Dolin, 1973
Tribe Protagrypnini Dolin, 1975
Genus *Paraprotagrypnus* gen. nov.

* Corresponding authors. Tel.: +86 10 68901757; fax: +86 10 68980851.
E-mail addresses: yunyunzhao@hotmail.com (Y. Zhao), rendong@mail.cnu.edu.cn (D. Ren).

Etymology: A combination of the Greek prefix “*Para*” (near, besides, at) and “*protagrypnus*” (a fossil genus, which is also characterized by the distinct median plate of prosternum).

Type species: *Paraprotagrypnus superbus* sp. nov.

Diagnosis: Metacoxal femoral plates short, sharply narrowed laterally; legs very slender.

Comparison: The new genus differs from *Protagrypnus* Dolin, 1973 [2] in the following characters: (1) Metacoxal femoral plates much shorter; (2) legs more slender; and (3) body much larger.

Paraprotagrypnus superbus sp. nov. (Figs. 1–4)

Etymology: Specific name derived from Latin “*superbus*”, for the well-preserved type specimens and the elegant shape of the body.

Materials: Holotype, CNU-COL-NN2006878 (gender uncertain); Paratype, CNU-COL-NN2006879 (PC, male); Additional specimen, CNU-COL-NN2007876 (female). All the specimens were collected from the Daohugou Village (N41°18.979', E119°14.318'), Shantou Township, Ningcheng County, Inner Mongolia, China by Prof. Dong Ren from the College of Life Science, Capital Normal University, China on July 2, 2006, housed in the Key Lab of Insect Evolution and Environmental Changes, Capital Normal University, Beijing, China.

Locality and horizon: Daohugou Village, Shantou Township, Jiulongshan Formation, Ningcheng County, Inner Mongolia in China, the Middle Jurassic.

Diagnosis: Antennae short; Femur apical with a spur; and elytra with nine distinctly longitudinal striae, the third and fourth merging approximately at the apical 1/5.

Description of holotype and paratype: Body medium sized, slender; integument of elytra with punctures.

Head: Subtriangular, convex, eyes oval, labrum semicircular.

Antennae: Short, fail to reach the posterior angle of pronotum, 11-segmented, serrate from antennomere 4, scape robust, oblong, pedicel much shorter than scape and antennomere 3, antennomere 3 subcylindrical, distinctly elongated, approximately 2.5 times as long as wide, antennomeres 4–10 subtriangular, and antennomeres 8–11 progressively broader, antennomere 11 oval (Fig. 4(b)).

Pronotum: Subtrapezoid, width 1.36 times as long as length, anterior margin nearly straight, lateral sides slightly arcuate, with distinct sublateral carinas, basal margin bisinuate, without basal pleural furrow; hind angle acute (Fig. 2(a and b)).

Elytron: Wider than prothorax, 4.1 times as long as wide, disc slightly convex, with nine longitudinal striae, each striae nearly parallel to the sutural margin, the third and fourth merging approximately at the apical 1/5, apex of elytra slightly acute (Fig. 2(a and b)).

Hind wing: Radial cell elongated, approximately more than four times as long as wide (Fig. 2(a and b)).

Ventral surface: Chin piece normally arcuate; prosternum with distinct median plate, pronotosternal sutures apparently associated with sulciform grooves, procoxal cavities quite small, rounded and separated. Metaventricle small, with transverse sutures, mesoventral cavity suboval, mesepimeron subtriangular, mesocoxae open to mesepimeron, mesotrochantin oval. Metaventricle and mesoventricle separated by suture, metaventricle with longitudinal median suture, metacoxal femoral plates short, sharply narrowed laterally (Figs. 1(a and b) and 3(a, c, and d)).

Legs: Slender, with protibiae more or less straight, normally swollen apically, with one short spur at the tip; with procoxa small and rounded, mesocoxa circular, much bigger than procoxa, mesotrochanter subtriangular, metacoxa transverse, tarsi slender, tarsi with five tarsomeres, tarsomere 1 much longer than the others, tarsomeres 1–4 pro-

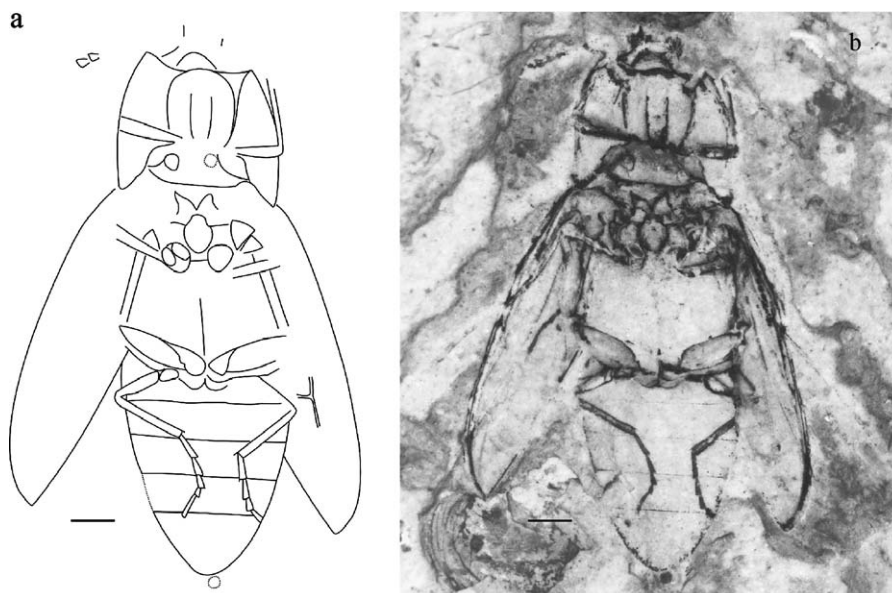


Fig. 1. *Paraprotagrypnus superbus* gen. et sp. nov. Holotype, No. CNU-COL-NN2006878 (the scale bar is 1.0 mm). (a) Line drawing; (b) photograph.

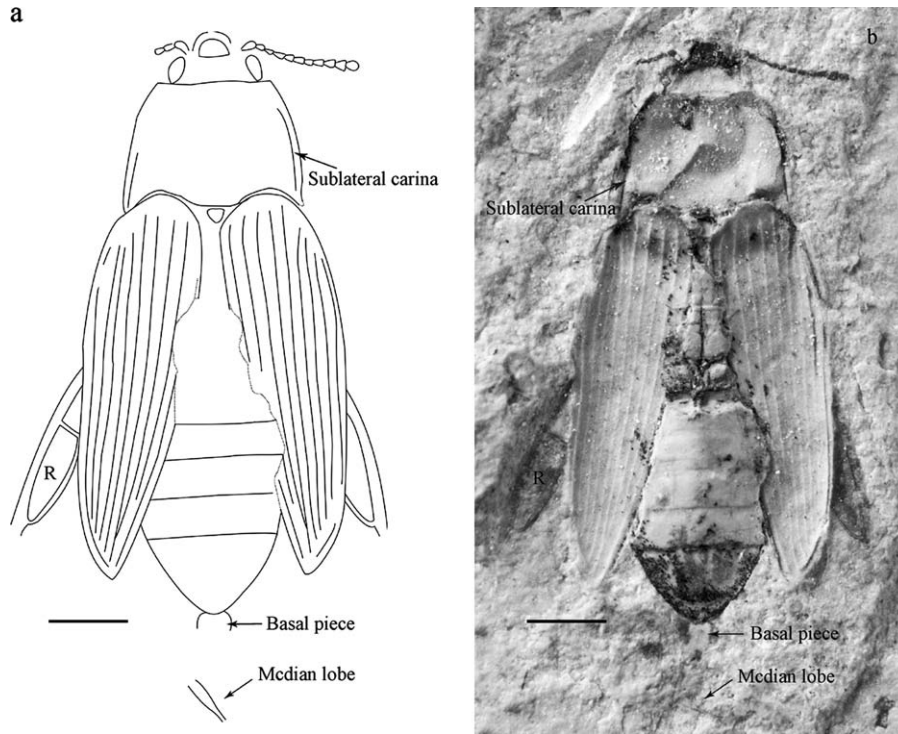


Fig. 2. *Paraprotagrypnus superbus* gen. et sp. nov. Paratype, No. CNU-COL-NN2006879-1 (the scale bar is 1.0 mm). (a) Line drawing; (b) photograph.

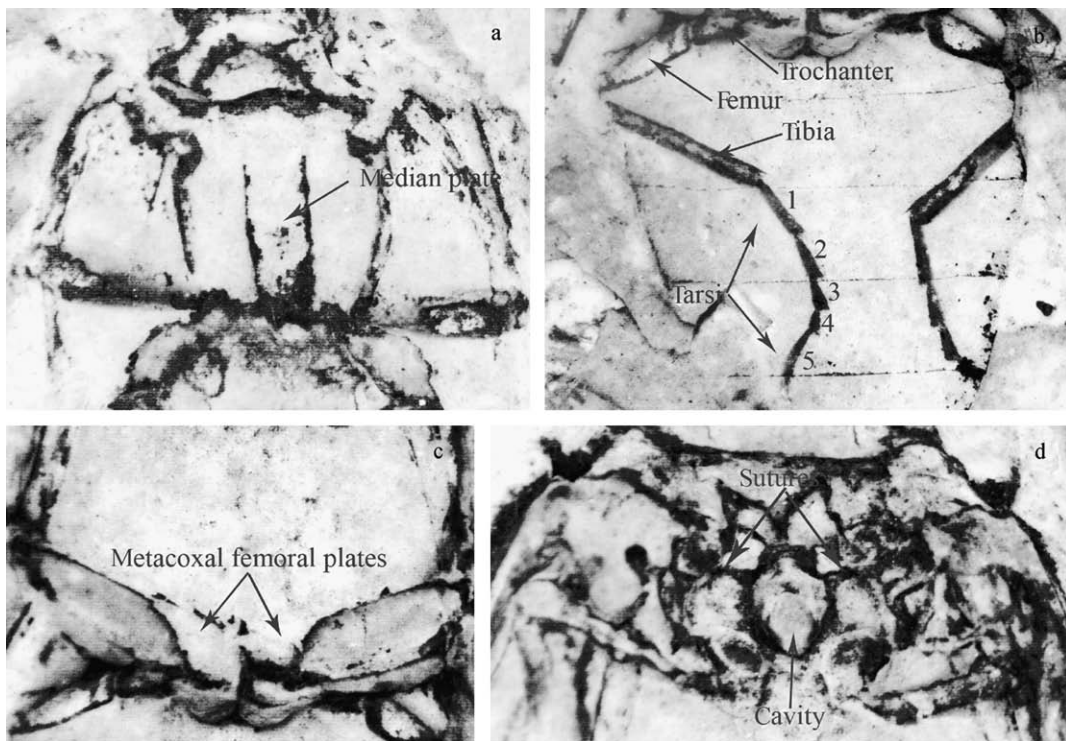


Fig. 3. *Paraprotagrypnus superbus* gen. et sp. nov. Holotype, No. CNU-COL-NN2006878. Photographs of (a) prothorax; (b) hind legs; (c) metacoxal plates; and (d) mesoventrite.

gressively shorter, the fourth one is the shortest, claws fal-ciform (Figs. 3(b) and 4(a)).

Aedeagus: Trilobate type, basal piece partly visible, median lobe gradually tapering apically (Fig. 2(a and b)).

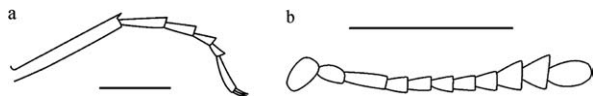


Fig. 4. (a) *Paraprotagrypnus superbus* gen. et sp. nov. Holotype, No. CNU-COL-NN2006878, line drawing of hind legs (the scale bar is 1.0 mm); (b) *Paraprotagrypnus superbus* gen. et sp. nov. Paratype, No. CNU-COL-NN2006879-1, line drawing of antennae (the scale bar is 1.0 mm).

Description of additional specimen: Anterior part of the pronotum with two distinct longitudinal ridges, lateral sides slightly arcuate, with distinct sublateral carinas. Hind wing with radial cell elongated, approximately four times as long as wide, r_3 partly visible (Fig. 5).

Dimensions (mm): CNU-COL-NN2006878: Body length, 12.5; body width, 4.5; elytron length, 7.8. CNU-COL-NN2007876: Body length, 9.4; body width, 3.0; elytron length, 6.0. CNU-COL-NN2006879: Body length, 7.2; body width, 2.0; elytron length, 4.6.

4. Discussion

Paraprotagrypnus superbus sp. nov. sheds light on the ages of the Jiulongshan Formation in eastern Inner Mongolia of China and the Yixian Formation in the western Liaoning Province of China. Compared with the fossil elaterids from the Yixian Formation, the new genus *Paraprotagrypnus* has many primitive characters, such as (1) prosternum with distinct median plate; (2) pronotum without basal furrow at the posterior margin; (3) sublateral carinas distinct; and (4) much shorter antennae [3,10–12]. These specimens with the primitive characters from the Jiulongshan Formation suggest that the age of the Yixian Formation is later than that of the Jiulongshan Formation.

Well-developed metacoxal femoral plates of elaterids are an indication of adaptation to underground life, because when the adult elaterids move in the soil, their hind legs can be retracted into the well-developed metacoxal femoral

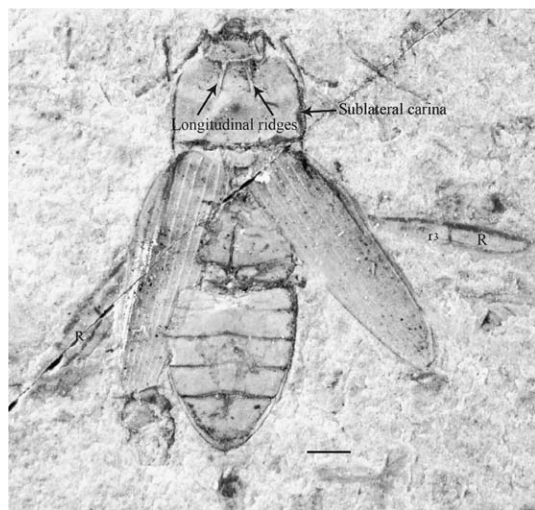


Fig. 5. *Paraprotagrypnus superbus* gen. et sp. nov. Photograph of additional specimen, No. CNU-COL-NN2007876 (the scale bar is 1.0 mm).

plates to avoid damage [13]. The adults of the new genus with small metacoxal femoral plates and very slender legs suggest that they might have lived on trees or plants rather than underground or terrestrial.

The reason why we chose the fossil specimen with registered number CNU-COL-NN2006878 (sex uncertain) as holotype, but not the fossil specimen which numbered CNU-COL-NN2006879 (PC, male) and CNU-COL-NN2007876 (female) with clear sex, is that it has an extremely well-preserved ventral side of the body, and the essential diagnosis characters are displayed on the ventral side, for example, the shape of mesocoxal plates, the transverse sutures on the mesoventrite, and median plate of the prosternum and so on (Figs. 1 and 3), but the paratype CNU-COL-NN2006879 and the additional specimen CNU-COL-NN2007876 with only a well-preserved dorsal side of the body.

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References

- [1] Ponomarenko AG. The geological history of beetles. In: Pakaluk J, Slipinski SA, editors. Biology, phylogeny, and classification of coleoptera, vol. 1. Warszawa: Muzeum i Instytut Zoologii OAN; 1995. p. 155–72.
- [2] Dolin VG. Fossil forms of click-beetles (Elateridae, Coleoptera) from Lower Jurassic of Middle Asia. In: Fauna and biology of insects of Moldavia. Kishinev: 'Shtiintsa'; 1973. p. 72–82, [in Russian].
- [3] Chang HL, Ren D, Zhang F. New fossil elaterids from the Yixian Formation of western Liaoning, China (Coleoptera: Polyphaga: Elateridae). Zootaxa 2008;1785:54–62.
- [4] Ren D, Gao KQ, Guo ZG, et al. Stratigraphic division of the Jurassic in the Daohugou area, Ningcheng, Inner Mongolia. Geol Bull China 2002;21(8–9):584–91, [in Chinese].
- [5] Chen W, Ji Q, Liu DY, et al. Isotope geochronology of the fossil-bearing beds in the Daohugou Area, Ningcheng, Inner Mongolia. Geol Bull China 2004;23(12):1165–9, [in Chinese].
- [6] Gao KQ, Ren D. Radiometric dating of ignimbrite from Inner Mongolia provides no indication of a Post-Middle Jurassic Age for the Daohugou Bed. Acta Geol Sin 2006;80(1):41–5.
- [7] Lawrence, JF, Newton AF. Families and subfamilies of Coleoptera (with selected genera, notes, references and data on family-group names). In: Biology, phylogeny, and classification of coleoptera. Papers celebrating the 80th birthday of Roy A. Crowson. Warsaw: Muzeum I Instytut Zoologii PAN; 1995. p. 779–1006.
- [8] Beutel R, Hass F. Phylogenetic relationships of the suborders of Coleoptera (Insecta). Cladistics 2000;16:103–41.
- [9] Dolin VG. Click-beetles (Coleoptera, Elateridae) from Upper Jurassic of Karatau. In: Mesozoic fossil insects. Kiev: Naukova Dumka Publ House; 1980. p. 17–81.

- [10] Dolin VG, Nel A. Three new fossil Elateridae from Superior Mesozoic in China (Coleoptera). *Bull Soc Entomol France* 2002;107(4):341–6.
- [11] Chang HL, Ren D, Shih CK. New fossil elaterid (Coleoptera: Polyphaga: Elateridae) from Yixian Formation of western Liaoning, China. *Prog Nat Sci* 2007;17(10):1244–9.
- [12] Chang HL, Ren D. New fossil beetles of the family Elateridae from the Jehol Biota of China (Coleoptera: Polyphaga). *Acta Geol Sin* 2008;82(2):236–43.
- [13] Jiang SH, Wang SY. Economic click beetle fauna of China (Coleoptera: Elateridae). Beijing: Agricultural Publishing Company of China; 1999, p. 1–15.