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## First fossil tooth-necked fungus beetle (Coleoptera: Derodontidae): *Juropeltastica sinica* gen. n. sp. n. from the Middle Jurassic of China

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**Key words.** Coleoptera, Derodontidae, *Juropeltastica* gen. n., fossil, Daohugou beds, Middle Jurassic, China

**Abstract.** The first fossil tooth-necked fungus beetle, *Juropeltastica sinica* gen. n. sp. n., is described and illustrated based on a single impression fossil from the Middle Jurassic Daohugou beds (ca. 165 Ma) of northeastern China. It represents the first definitive fossil belonging to the extant family Derodontidae. *Juropeltastica* is placed in Derodontidae based on its overall body shape and size, head with complex systems of tubercles and grooves, pronotum with dentate lateral carinae, open mesocoxal cavities bordered by mesepimeron and metanepisternum, excavate metacoxae, and 5-segmented abdomen. The occurrence of a reliable derodontid fossil from 165 million years ago places Derodontidae among the small but growing number of beetle families of known Middle Jurassic age, which is important in the dating of phylogenetic trees.

### INTRODUCTION

With only 23 species placed in four genera (Leschen & Beutel, 2010), the beetle family Derodontidae (or tooth-necked fungus beetles) is an isolated and primitive group in Polyphaga (Crowson, 1959) placed in their own superfamily Derodontoidea in the series Bostrichiformia by Lawrence & Newton (1995). The family was considered to be a sister taxon to Nosodendridae by Beutel (1996) and formed a clade with Nosodendridae and Scirtidae in the morphological analysis of Lawrence et al. (2011). In recent molecular studies by Hunt et al. (2007) and Bocak et al. (2014), however, Derodontidae and Nosodendridae formed two clades attached to different sections of the Polyphaga. Derodontidae consists of three subfamilies: Peltasticinae LeConte contains the single genus *Peltastica* Mannerheim, Derodontinae LeConte contains *Derodontus* LeConte, and Laricobiinae Mulsant & Rey contains *Laricobius* Rosenhauer and *Nothoderodontus* Crowson. This arrangement has been confirmed by a recent cladistic analysis (Ge et al., 2007). The extant genera *Derodontus*, *Laricobius* and *Peltastica* are holarctic in distribution, whereas *Nothoderodontus* occurs in Chile, Australia and New Zealand (Lawrence & Hlavac, 1979; Lawrence, 1985; Leschen, 2002; Háva, 2006; Yu & Montgomery, 2007). Larvae and adults typically occur together in the same habitats in the temperate regions in the northern and southern hemispheres (Lawrence & Hlavac, 1979; Crowson, 1980; Lawrence, 1982). *Peltastica* is present at sap flows where it feeds on fungi and other suspended nutrients

while *Laricobius* are predators on Adelgidae (Hemiptera) (Franz, 1958; Leschen, 2011). *Derodontus* are found exclusively on homobasidiomycete fungi and are abundant mainly in cooler seasons (Lawrence & Hlavac, 1979; Leschen, 1994, 2002). *Nothoderodontus* is associated with sooty molds (Lawrence, 1985), although some specimens have been collected in other habitats, including one new species from the flowers in tussock areas of New Zealand (Leschen & Beutel, 2010). Adults of derodontids are characterized by the presence of paired ocelli, prothorax mostly with dentate lateral carinae, open mesocoxal cavities bordered by both mesepimeron and metanepisternum, excavate metacoxae, and rugose body form in most adults (Leschen, 2002).

Unfortunately, no definitive fossil derodontids have been reported to date, and little about the origin and early evolutionary history of the superfamily Derodontoidea is known. Here we report a new genus and species of Derodontidae from the Mesozoic of China.

### MATERIAL AND METHODS

The sole specimen described here was collected from a fossil locality near Daohugou Village, Inner Mongolia, China, from which plants, diverse insects, conchostracans, anostracans, spiders, salamanders, pterosaurs, and mammals have also been discovered (Huang et al., 2006). The specimen is housed in the Nanjing Institute of Geology and Palaeontology, CAS, Nanjing, China. The specimen was observed and photographed using a Zeiss Discovery V20 stereo microscope. It was examined both dry (under low-angled light) and under 70% alcohol.

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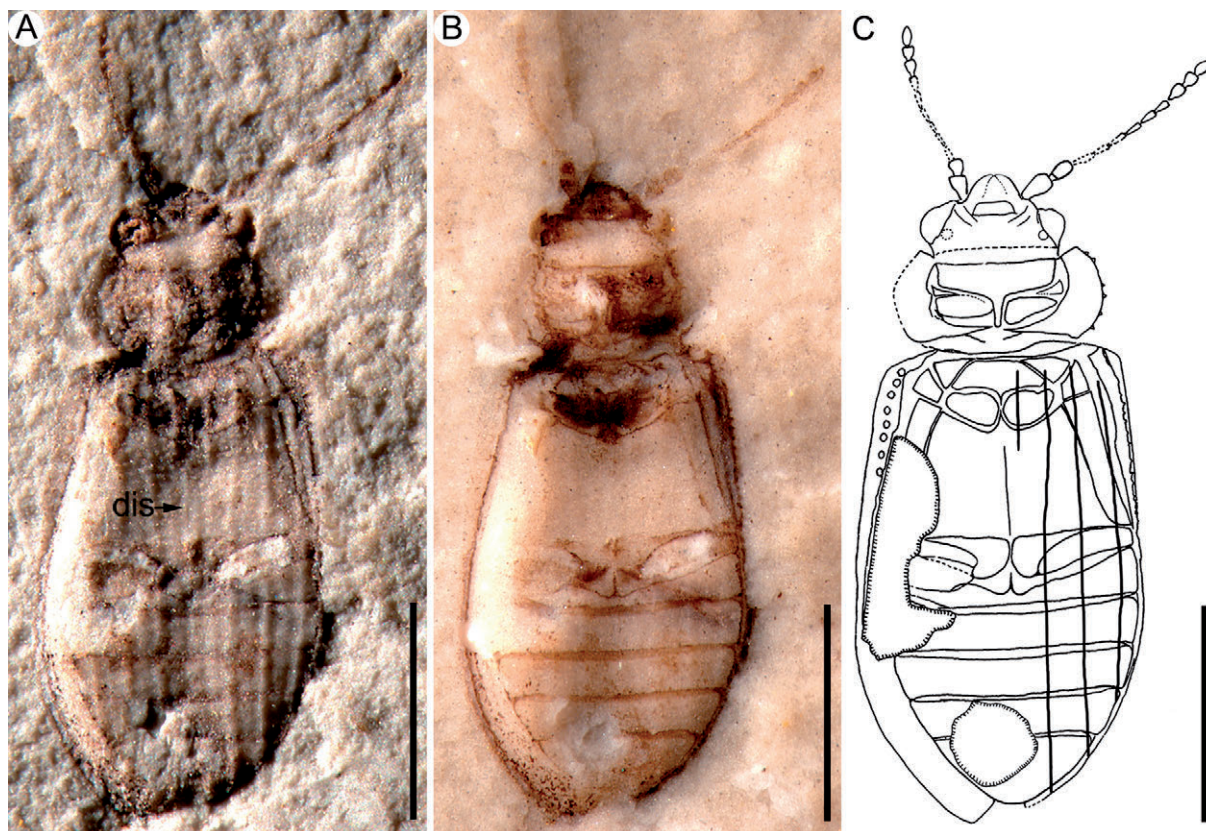


Fig. 1. *Juropeltastica sinica* gen. n. sp. n., holotype, habitus. A – under low-angled light; B – moistened with 70% alcohol; C – line drawing. Abbreviation: dis – discrimen. Scale bars 1 mm.

#### SYSTEMATIC PALEONTOLOGY

**Order:** Coleoptera Linnaeus, 1758

**Family:** Derodontidae LeConte 1861

**Subfamily:** Peltasticinae LeConte, 1861

**Genus:** *Juropeltastica* gen. n.

**Type species.** *Juropeltastica sinica* sp. n., here designated.

**Diagnosis.** Body small. Head with frontal raised area delimited laterally and posteriorly by grooves. Antenna 11-segmented, with a loose 3-segmented club. Pronotum weakly explanate; lateral margins toothed/crenulate. Procoxae distinctly separated, transverse; protrochantins exposed. Procoxal cavities externally closed. Elytron with one short mesobasal and three complete longitudinal carinae. Epipleural rim with a row of relatively large round window punctures. Mesocoxal cavities transverse, broadly open laterally, closed by mesepimeron and metanepisternum. Metaventral discrimen present. Metacoxae contiguous, excavate, extending laterally to rim of elytra. Abdominal ventrite 1 very short, without parallel ridges. Ventrites 2–5 each with a pair of small curved basolateral ridges.

**Etymology.** The name of the genus is a combination of *Juro-*, meaning “Jurassic”, and the genus *Peltastica*; it is feminine in gender.

#### *Juropeltastica sinica* sp. n. (Figs 1–3)

**Diagnosis.** As for the genus (see above).

**Description.** Body 2.91 mm long, densely and coarsely punctate.

Head (Fig. 2A) prognathous, transverse, 0.39 mm long and 0.67 mm wide; not abruptly constricted to form a neck region; temples and transverse occipital ridge absent. Frontoclypeal suture not visible. Frontal region elevated, anteriorly concave or emarginate, posteriorly delimited by deep, converging lateral grooves (Fig. 2A) joining broader transverse channel extending laterally behind the tubercles adjacent to compound eyes. Antennal grooves not visible. Eyes relatively large, laterally protruding. Ocelli (Fig. 2A) present, adjacent to the inner margins of eye. Antennal scape and pedicel (Fig. 2D) broad and subequal in length; antennomere 3 apparently elongate; antennomeres 4–8 longer than wide and decreasing in length; antennomeres 9 and 10 subquadrate; antennomere 11 conical. Antennal insertions apparently concealed. Mandible curved. Postgena covered with relatively large round punctures.

Pronotum (Fig. 2A) transverse, with dense round punctures, wider than head, 0.44 mm long and 0.97 mm wide; weakly explanate. Prosternum (Fig. 2C) in front of coxae about as long as longitudinal coxal diameter; prosternal process (Fig. 2C), narrow, parallel-sided with rounded apex. Procoxae transverse; protrochantins exposed; procoxal cavities strongly transverse, externally closed by relatively narrow notal projections. Elytra (Fig. 2E) complete, length 2.10 mm, combined width 1.32 mm. Each elytron with three complete longitudinal carinae on intervals 3, 5 and 7 and a short additional carina on interval 1, which does not extend beyond anterior fifth (Fig. 2E). Epipleural rim well developed, gradually narrowing

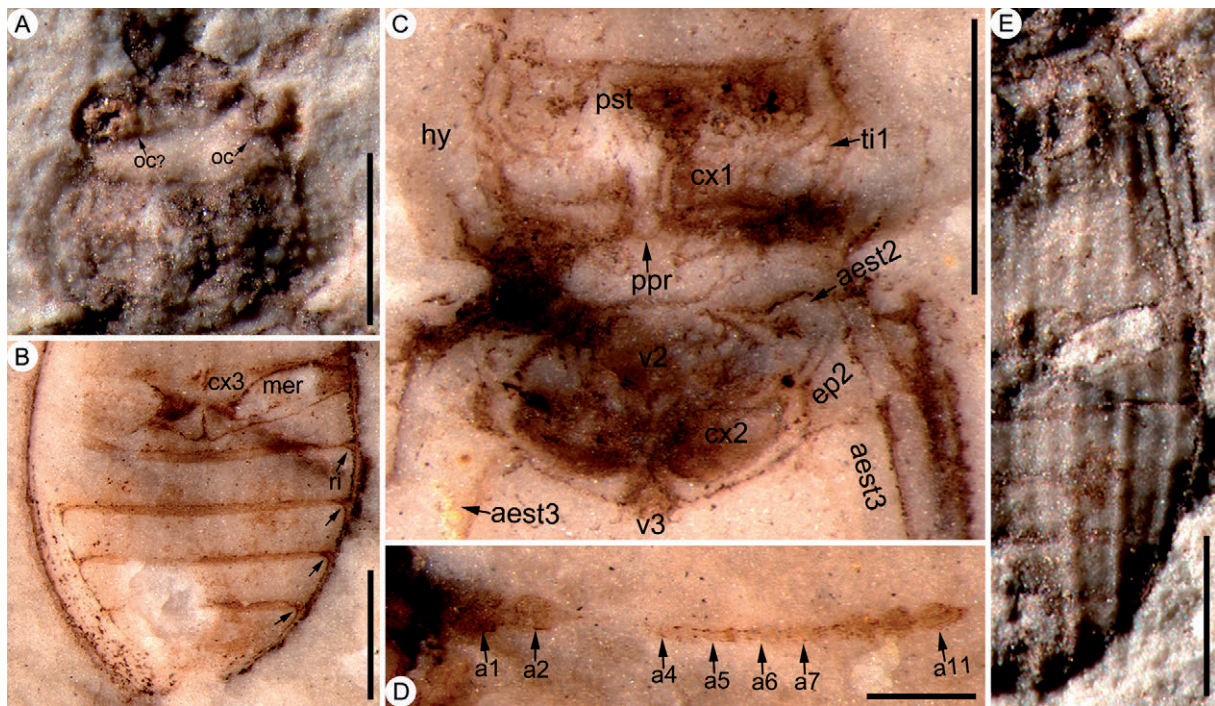


Fig. 2. *Juropeltastica sinica* gen. n. sp. n., holotype, details. A – head and prothorax, with ocelli indicated; B – metacoxae and abdomen; C – prothorax and mesothorax; D – right antenna; E – right eytron. A and E under low-angled light; others moistened with 70% alcohol. Abbreviations: a – antennomere; aest2/3 – mes-/metanepisternum; cx1/2/3 – pro-/meso-/metacoxa; ep2 – mesepimeron; hy – hypomeron; mer – metacoxal meron; oc – ocellus; ppr – prosternal process; pst – prosternum; ri – ridge; ti1 – protochantin; v2/3 – meso-/metaventricle. Scale bars 200  $\mu$ m in D, 500  $\mu$ m in others.

from base to half of elytron. Mesocoxae (Fig. 2C) almost contiguous; mesocoxal cavities transverse and oblique, broadly open laterally (Fig. 2C). Mesoventrite very short, punctate, separated by complete sutures from mesanepisterna; procoxal rests absent. Metaventricle very large, with dense round punctures, wider than long; discrimen present. Metanepisternum elongate, slightly narrowing posteriorly, inner posterior angle broadly rounded. Metacoxae (Fig. 2B) strongly transverse and probably excavate near base, contiguous, extending laterally to meet elytra.

Abdomen (Fig. 2B) with five free ventrites; intercoxal process of abdomen very narrow and acute; ventrites 2 and 3 subequal; ventrite 4 shorter than 3; ventrite 5 the longest.

**Material.** Holotype: Only one piece of impression fossil included, without counterpart, NIGP157738. The fossil beetle is an adult, with more ventral structures visible than dorsal ones. Maxillary palps, labial palps and legs not preserved.

**Locality.** Middle Jurassic Jiulongshan Formation at Daohugou, Ningcheng County, Inner Mongolia, Northeast China. The site was a relatively large lake surrounded by a forest containing, among other, conifers, ferns and Ginkgoales. The palaeoclimate of Daohugou was probably warm temperate based on the entomofauna (Ren et al., 2010).

**Etymology.** Derived from the country (China) where the type species comes from.

## DISCUSSION

Although in general habitus *Juropeltastica sinica* is superficially similar to some members of the cucujoid family Latridiidae and the subfamily Dasycerinae of the staphylinoid family Staphylinidae, it is easily separated from mem-

bers of either group by the large transverse procoxae with exposed trochantins, open mesocoxal cavities laterally closed by mesepimeron and metanepisternum, large, contiguous and excavate metacoxae and short first abdominal ventrite. Additionally, it may be distinguished from Dasycerinae by the distinctly separated procoxae, posteriorly closed procoxal cavities and the abdomen with five ventrites (six in Dasycerinae).

*Juropeltastica* is placed in the Recent small family Derodontidae based on the overall body shape and size, dorsal surfaces of head with canals and elevations, toothed/crenulate pronotal lateral margins, open mesocoxal cavities bordered by mesepimeron and metanepisternum, and excavate metacoxae (Leschen, 2002). In addition, the combination of 11-segmented antennae with 3-segmented club, distinctly separated procoxae, exposed protochantins, developed metaventral discrimen, contiguous and strongly transverse metacoxae extending laterally to rim of elytra, and 5-segmented abdomen also supports this assignment. Most modern adults of Derodontidae are also characterized by the presence of a pair of ocelli, which are more or less close to compound eyes (e.g., Lawrence & Hlavac, 1979; Lawrence, 1985; Leschen & Beutel, 2004; see exceptions in Leschen, 2011). Due to the insufficient preservation of the holotype, ocelli are not clearly shown from the mainly ventral-aspect impression fossil. However, a relatively large round tubercle is present and adjacent to the inner margin of the left eye, which is morphologically similar to the ocellus found in extant members of *Peltastica*. The presence of paired curved basolateral ridges (although

small) on ventrites 2–5, clearly shown in at least *Derodontus* and *Peltastica*, also supports the placement. Another interesting character of extant derodontids is that the inner posterior angle of metanepisternum is broadly rounded, a feature also found in the new genus *Juropeltastica*.

Derodontidae currently comprises three subfamilies: Peltasticinae (*Peltastica*), Derodontinae (*Derodontus*) and Laricobiinae (*Laricobius* and *Nothoderodontus*) (e.g., Háva 2006; Lawrence & Hlavac, 1979). The new genus *Juropeltastica* can be attributed to the extant subfamily Peltasticinae as evidenced by the more or less explanate pronotum, carinate elytra, and simple first visible abdominal ventrite lacking ridges near midline (Lawrence & Hlavac, 1979). *Juropeltastica* appears to combine features belonging to the genera *Peltastica* and *Derodontus*. It shares with *Peltastica* the explanate pronotum and elytra, subcontiguous mesocoxae, relatively short first abdominal ventrite lacking ridges, and elytra bearing carinae (the latter tuberculate in *Peltastica*); and shares with *Derodontus* the relatively narrow pronotum and densely punctate postgena, prosternum, and meso- and metaventrite.

Since no definitive fossil derodontids are known to date, the new discovery of a definite derodontid of the Mesozoic age is undoubtedly of great significance for understanding the origin and early evolutionary history of the family Derodontidae, and even for the superfamily Derodontoidae. The find of a new derodontid genus from the Middle Jurassic (ca. 165 Ma) of China suggests that the Derodontidae may have originated sometime in the early Jurassic.

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