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A New Species of Comb-Clawed Beetle (Coleoptera: Tenebrionidae: Alleculinae) from the Lower Cretaceous of Yixian (China, Liaoning Province)

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Abstract—A new genus and species of comb-clawed beetles, *Calcarocistela kirejtshuki* gen. et sp. nov., from the Lower Cretaceous of Yixian (China) is described. The new genus is assigned to the tribe Gonoderini of the subfamily Alleculinae (family Tenebrionidae) based on the following characters: five visible abdominal ventrites, nonwidened tarsomeres without a membranous ventral lobes, and serrate antennae. The new genus differs from other members of the tribe Gonoderini in the long spurs of metatibia reaching a half of the first metatarsomere and the lamellate prosternal process. *Calcarocistela kirejtshuki* is the first member of Alleculinae from the Lower Cretaceous.

Keywords: Alleculinae, Gonoderini, new taxa, Lower Cretaceous, Yixian Formation, China

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INTRODUCTION

Alleculid beetles (subfamily Alleculinae, family Tenebrionidae) are a widespread and diverse tenebrionid group common in the fossil record. According to Kirejtshuk et al (2008; Ponomarenko and Kirejtshuk, 2014), 32 taxa of Alleculinae, four of which are known from the Mesozoic, have been described. The earliest alleculid beetle *Cistelites insignis* has been described from the Lower Jurassic of Switzerland (Insektenmergel, Schambelen, Aargau) (Heer, 1865). It should be noted that both the original description of the genus *Cistelites* Heer, 1865 and subsequent redescription with figures (Scudder, 1885, text-fig. 1016) are doubtful in regard to the assignment of this genus to tenebrionids. *Wuhua jurassica,* a presumable member of Alleculinae, is known from the Middle Jurassic of Daohugou (Wang and Zhang, 2011). The authors of this taxon did not refer it to a particular family, only indicating that it belongs to the superfamily Tenebrionoidea. However, judging from a number of characters, including pectinate tarsal claws, this species apparently belongs to alleculid beetles. *Jurallecula grossa*, the earliest comb-clawed beetle displaying a set of reliable characteristics of this subfamily was described by Medvedev (1969) from the Upper Jurassic of the Kara-Tau (Kazakhstan). Another Mesozoic species of Alleculinae, *Cistelites sachalinensis* Heer, 1878 comes from the Upper Cretaceous (Santonian Stage of Sakhalin: Heer, 1878), although, as in the case of other descriptions provided by Heer, it remains doubtful whether or not it belongs to Alleculinae. Thus, the data on Mesozoic Alleculinae are rather scarce and descriptions are often poorly informative.

In the present study, a new species and genus of Alleculinae from the Lower Cretaceous of Yixian (China) is described, expanding considerably our knowledge of Mesozoic tenebrionids.

The Yixian locality (Yixian Formation, Laoning, China) is known for a rich fossil fauna of dinosaurs, mammals, birds, and insects, which contribute considerably to a better understanding of the evolution of these groups (Chang, 2003).

The age of the Yixian beds is widely debated and determined by many researchers as the Lower Cretaceous (Swisher III et al., 1999), that is, 125 Ma. Some data suggest that it may be Upper Jurassic (Lo et al., 1999). A number of authors, based on the radiological methods (Wang et al. 2005) and biostratigraphic comparisons of entomofaunas, are inclined to assign the Yixian locality to the Jurassic–Cretaceous boundary (Kirejtshuk et al., 2010, 2011).

The coleopteran fauna of the burial is diverse and intensely studied. In a review of the Mesozoic Coleoptera of China, 60 beetle species of 12 families have been recorded in Yixian (Kirejtshuk et al., 2010). The Tenebrionidae are represented by many members of the subfamilies Alleculinae and Diaperinae. Subsequently, *Alphitopsis initialis* Kirejtshuk, Nabozhenko

et Nel, 2011 (Kirejtshuk et al., 2011) from this burial has been described; this is the only presently known and earliest representative of the tenebrioid darkling beetles assemblage, which has much in common with native members of the tribe Alphitobiini (subfamily Tenebrioninae).

The member of the subfamily Alleculinae described in this work is the first alleculid beetle known from the Jurassic–Cretaceous boundary and the fifth described Mesozoic species. The assignment of this new genus and species to the subfamily Alleculinae is supported by its large convex eyes, the genal margin covering the scapus base, the serrate antennae with elongated antennomeres; narrow, lamellate prosternal process, as also typical for many Alleculinae; the mesocoxae not contiguous, well-pronounced process of the mesoventrite between them; externally open mesocoxal cavities; five abdominal ventrites, the fifth of which is rounded at the apex; a distinctive structure of male inner sternite VIII with a deep emargination in the middle.

MATERIAL AND METHODS

The material is housed in the Henan Geological Museum, Zhengzhou (China), with registration no. 41HII0138. The imprints were studied using a MOTIC SMZ-168 microscope. Photographs were taken using a Nikon D90 camera in ethanol and without it, with a Nikkor 105 mm photolens.

The ocular index considered as an important diagnostic character of Alleculinae (Campbell and Marshall, 1964) was not calculated, because the imprint displays the ventral head part alone (this index is measured on the dorsal side) and the head is slightly distorted.

SYSTEMATIC PALEONTOLOGY

Order Coleoptera Linnaeus, 1758

Superfamily Tenebrionoidea Latreille, 1802

Family Tenebrionidae Latreille, 1802

Subfamily Alleculinae Laporte de Castelnau, 1840

Tribe Gonoderini Seidlitz, 1896

Genus *Calcarocistela* Nabozhenko, gen. nov.

Etymology. From the Latin *calcar* (spur) and the Latin name *Cistela* Fabricius, 1775 (nom. praeocc. non *Cistela* Geoffroy, 1762); feminine gender.

Type species. *Calcarocistela kirejtshuki* Nabozhenko, sp. nov.

Diagnosis. Body moderately large (13.5 mm long), elongate. Head slightly elongate. Eyes ventrally large, transverse, emarginated in basal canthus. Antennae serrate, antennomeres (only five first preserved) longitudinally elongated. Pronotum trapezoid, not narrower than elytral base. Posterior angles indistinct, rounded widely apically. Elytra almost parallel, narrowing apically. Prosternum (proventrite) very narrow between procoxal cavities. Process of mesoventrite between mesocoxal cavities slightly rounded at apex. Intercoxal process of abdomen broadly triangular. Fifth abdominal ventrite with rounded margin. Inner sternite VIII of male longitudinally elongated, with narrow deep emargination in middle. Fore and middle legs not long; profemora not projecting beyond pronotum; mesofemora slightly projecting beyond elytra. Hind legs longer, distinctly projecting beyond elytra. Metatibiae with at least one long spur half as long as first long metatarsomere. Tarsi narrow, filiform, their penultimate tarsomere without membranous lobe. First tarsomere of all legs twice as long as second tarsomere. First metatarsomere very long, twice as long as second and third. Metatrochanters large, one-fourth of metafemoral length.

Comparison. The new genus is assigned to the tribe Gonoderini, which has five visible abdominal ventrites, nonwidened tarsomeres without membranous ventral lobes (characteristic of the tribe Alleculini) or serrate antennae. The same characters are also characteristic of the tribe Xystropodini, but it differs from other alleculine groups in the unusual pronotum and body shape. The new genus differs from known genera of Gonoderini in the long spurs of metatibia reaching half of the first metatarsomere. In addition, *Calcarocistela* gen. nov. has a narrow lamellate prosternal process, whereas other genera of the tribe Gonoderini have a wide prosternal process.

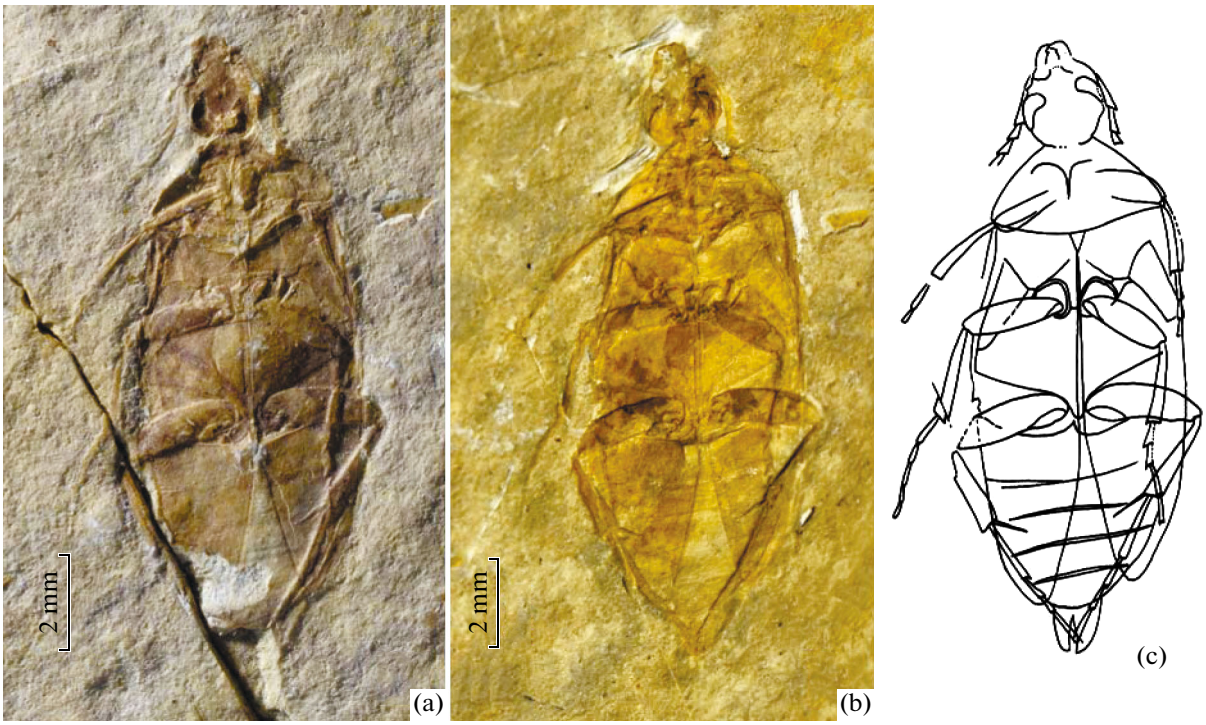
Additional differences from the Palearctic genera *Copistethus* Seidlitz, 1890, *Cornucistela* Campbell, 1980, *Gonodera* Mulsant, 1856, and *Isomira* Mulsant 1856 are antennomeres 4 (minimum)–7 longer than wide; they are widest at the apex and distinctly serrate; the pronotum is the widest at the base and gradually narrows towards the anterior margin. These diagnostic characters also distinguish the genus *Pseudocistela* Crotch, 1873 from other genera.

Additional differences from *Pseudocistela* Crotch, 1873 are the eyes not rounded ventrally, so that their basal margin is widely emarginate rather than rounded; and the posterior angles of the pronotum are rounded (not acute apically). Some species of *Pseudocistela,* for example, *Pseudocistela opaca* (LeConte, 1859), are similar to *Calcarocistela* in the ventral view of eyes, but their basal margin is straight.

In addition, *Calcarocistela* differs from *Cacoplesia* Fairmaire, 1898 and *Viriathus* Fairmaire, 1902 in the pronotum base not narrower than the elytral base. In *Cacoplesia* and *Viriathus,* the pronotum is considerably narrower than the elytral base.

Calcarocistela additionally differs from *Onychomira* Campbell, 1984 in the pronotum base not narrower than the elytral base, the triangular, strongly transverse pronotum, and the serrate antennae.

Additional differences from *Jurallecula* Medvedev, 1969 are the strongly elongated elytra, the lateral sides



Calcarocistela kirejtshuki Nabozhenko gen. et sp. nov., holotype no. 41HII0138, male; Yixian locality, Lower Cretaceous: (a) photograph of a dry print; (b) photograph under ethanol; and (c) reconstruction.

of which are almost straight (*Jurallecula* has elongated triangular elytra); the relatively short fore and middle legs, and the profemora only slightly projecting beyond the pronotum (in *Jurallecula,* the anterior legs are long).

***Calcarocistela kirejtshuki* Nabozhenko, sp. nov.**

Etymology. In honor of A.G. Kirejtshuk, a well-known Russian entomologist and paleontologist.

Holotype. Registration no. 41HII0138, male, well-preserved imprint of the ventral side. The antennae and protarsi are only represented by several segments; procoxal cavities are only partly visible.

Occurrence. Bed 2 of the Yixian Formation of China, Huangbanjigou locality near the village of Chaomidian, Shangyuan County, Beipiao City, Liaoning Province. Coordinates: 41.6148° N, 120.8341° E.

Description (Fig. 1). The body is 13.5 mm long and 2.3 mm wide, elongated, slender. The head is wider than the anterior margin of the pronotum. The epicranium is rounded, almost as wide as long. The mandibles are elongated, with distinct apical and preapical teeth. The head is widest at the eye level. Eyes are large, slightly convex, oblique, transverse; the basal eye margin is widely emarginate. The antennae are serrated, at least four antennomeres (4–7) are longer than others (antennae are only represented by seven antennomeres, 1–7). Antennomeres 4–7 are longitudinal, widest apically.

The pronotum is triangular, transverse (the width at the base is 2.03 times greater than the length), widest at the base, where it is 2.15 times as wide as the head; the head width is 1.5 times greater than the anterior margin of pronotum. The pronotum is 4 mm wide. The pronotal base is 3.25 as wide as the anterior margin. The lateral sides are slightly rounded, almost straight; the anterior margin is widely rounded, the base is slightly trisinuate. The anterior angles of the pronotum are indistinct; the posterior angles are acute, with a narrowly rounded apex. The prosternal process is narrow, lamellate. The scuttum is elongated triangular.

The elytra are elongated, with almost parallel sides, four times as long as the pronotum. The elytra are 8.5 mm long and 4.5 mm wide. Each elytron is on average 3.8 times longer than wide. The lateral sides of elytra are weakly rounded, almost straight. The elytral base is not wider than the pronotal base.

The process of the mesoventrite between the mesocoxae is wide, obtuse apically. The mesocoxal cavities are longitudinal. The metepimeres are transverse, metepisterna are elongated, positioned obliquely. The metaventrite is transverse, 1.75 times wide than long. The intercoxal process of the first abdominal ventrite is acute, triangular. The fifth abdominal ventrite is widely rounded. Male inner sternite VIII has elongated "lobes" and a deep emargination in the middle.

The pro- and mesofemora are relatively short, only slightly projecting beyond the pronotum and elytra;

the metafemora are long, thickened, with large trochanters. The tibiae are straight; the metatibiae are significantly thickened and have long spurs reaching the middle of metatarsomere 1. The tarsi are long; the metatarsi are approximately 1.6 times as long as the metatibiae. The first tarsomere of each tarsus is distinctly longer than the others.

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