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Beetles of the Family Cupedidae from the Lower Cretaceous Locality of Semen, Transbaykalia

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Abstract—Six new species of cupedid beetles are described from the Lower Cretaceous locality of Semen in Central Transbaykalia. Based on peculiarities of morphology of newly described beetles and the distribution of the Lower Cretaceous cupedids, the Semen locality is postulated to originate during the warm episode in the beginning of the Neocomian.

INTRODUCTION

The Semen locality (Central Transbaykalia, Elizavetino Depression) is of great interest for many reasons. Approximately 2. 5 thousand insect remains are known from this locality. The composition of this insect fauna is rather perplexing. The insect assemblage appears Lower Cretaceous in general. However, species characteristic of both the lower and upper parts of the series are present, so the exact position of the sequence within the Lower Cretaceous is uncertain. The beetle assemblage also shows this inconsistency. 408 beetle fossils in total have been collected. The presence of *Coptoclava longipoda* Ping confirms the Early Cretaceous age, since Chinese deposits containing *C. longipoda,* previously considered as the Jurassic have now been independently proved to be the Early Cretaceous (Smith *et al.,* 1995; Swisher *et al,* 1999). Buprestid remains occur in the same locality, and are allocated to a genus that is known from the Upper Jurassic locality of Karatau (Alexeev, 1996) but not represented among the numerous buprestids from other Lower Cretaceous localities.

It may be valuable to investigate remains of the now relict family Cupedidae from the Semen locality. This family was widely distributed in the Mesozoic, and has been studied more comprehensively than any other family of Mesozoic beetles. Cupedids formed up to one third of all beetles in the late Triassic, but their abundance decreased to less than 10 percent by the Early Cretaceous. Two cupedid assemblages may be distinguished in the Lower Cretaceous of Transbaykalia and Mongolia, viz., mid-later Neocomian and terminal Neocomian-Aptian. No one species is common to both assemblages, but the former has species also recorded in localities in northern Transbaykalia and southern Mongolia. Localities with species common to the second assemblage are restricted to the Central Mongolia. Recent cupedids occur not only in tropics, but in North America and the southern part of the Russian Far East, i. e., territories with a temperate climate and rather severe winters. The distribution of these beetles was quite different in the Mesozoic. In spite of the poorly expressed climatic zonation in the Mesozoic, they occurred only in regions with the warmest climate. Thus, cupedids are absent from the Lower and Middle Jurassic of Siberia and are extremely rare in the Upper Jurassic. Cupedids are common in the Jurassic of the Middle Asia and China, especially in localities containing abundant conifers. There are no cupedids in the Early Jurassic of Mongolia, but they are frequently found in the Late Jurassic, although the phytooryctocenoses are still dominated by ginkgoaceous and chekanovskiales. Unlike in Recent faunas, the buprestids mentioned above were also restricted to the warmest areas in the Mesozoic.

All cupedid remains found in the Semen locality are described herein, with the exception of a fragment of a large cupedid leg that cannot be identified further. Two incomplete remains nearly undoubtedly belong to the cupedine tribe Priacmini. However, the genus can be identified only provisionally due to the absence of the head and pronotum. Some of the newly described species may be synonyms of those previously described from the Lower Cretaceous of China. Unfortunately, the descriptions of the latter species are insufficient for accurate comparison.

The material studied came from the Semen locality (Transbaykalia, Chita Region, Karym District, creek valley Semen near the settlement of Elizavetino, collected by S. M. Sinitza) and is housed in the Paleontological Institute, Russian Academy of Sciences (PIN).

SYSTEMATIC PALEONTOLOGY

Family Cupedidae Lacordaire, 1857

Subfamily Ommatinae Sharp et Muir, 1912

Tribe Notocupedini Ponomarenko, 1966 Genus *Zygadenia* Handlirsch, 1906

Notocupes: **Ponomarenko, 1964, p. 61. (syn. nov.)**

Explanation of Plate 8

Fig. 1. *Zygadenia sinitzae sp.* nov.. holotype PIN, no. 2385/1040, x 4. 5.
Figs. 2 and 3. *Zygadenia semen* sp. nov.: (2) holotype PIN, no. 2385/1042. (3) paratype PIN, no. 2385/157,. x7. 5.
Figs. 4 and 5. Zygadenia *sibirica* sp. nov.: (4) holotype PIN. no. 2385/1046. (5) paratype PIN, no. 2385/192, x11.
Fig. 6. Brochocoleus *minor* sp. nov., holotype PIN, no. 2385/1047, x l5.
Fig. 7. *Cionocoleus sibiricus* sp. nov., holotype PIN. no. 2385/175. x4. 6.
Figs. 8 and 9. *Priacma striata* sp. nov.: (8) holotype PIN, no. 2385/1222, (9) paratype PIN, no. 2385/912, x7.

Zygadenia sinitzae* Ponomarenko, sp. *nov.

Plate 8, fig. 1

Etymology. After Dr S. M. Sinitza, geologist and palaeontologist.

Holotype. PIN, no. 2385/1040, part and counterpart of beetle lacking legs and antennae; Semen locality; *Lower* Cretaceous.

Description (Fig. 1). The beetle is subcylindrical and rather large. The head is little longer than wider, weakly narrowed frontally. The cheeks and temples are shorter than the eyes, the occiput is sloping, the cervical constriction is weak. The pronotum is transverse, 0. 6 times as long as wide, strongly narrowed anteriorly, its front corners are produced, its front margin is incised. The disc of the pronotum bears a large rectangular elevation divided by a longitudinal furrow. The metathorax is short, twice as wide as long. The relief of the middle abdominal sternites is weak. The last sternite is 2. 5 times as long as the previous one. The elytron is 3. 5 times as long as wide, its apex is not tapered. The epipleural border is narrow, broadened in its front third, which bears a row of indistinct cells. The main veins of the elytron are sharply distinct from the intercalaries, the two veins nearest to the suture are fused before the apex. The cells are rounded, elongated in the distal part of the elytron, approximately 25 cells form a row. The body is rather evenly covered with tubercles that are only slightly larger in the fore part of each abdominal sternite.

Measurements (mm): body length, 18-19, body width, 10, head and pronotum length, 4. 5, abdomen length, 7, elytron length, 13. 7-14. 5.

Comparison. Differs from other species with similar abdominal sternites in the narrow epipleural border broadened and bearing cells only in its front third. In some features and dimensions the new species is similar to Z *lentus* (Ren, 1995) comb. nov. (erroneously described in the genus *Tetraphalerus)* from the Yixian Formation, China, and may fall in synonymy later. However, the situation cannot be clarified due to the inadequate description of Z. *lentus.*

Material. Holotype and specimens PIN, no. 2385/158, elytron, nos. 2385/913, 1210, incomplete elytra.

***Zygadenia semen* Ponomarenko, sp. nov.**

Plate 8. figs, 2 and 3

Etymology. From the Semen locality.

Holotype. PIN, no. 2385/1042, part and counterpart of a beetle without head and prothorax; Semen locality; Lower Cretaceous.

Description (Fig. 2). The beetle is subcylindrical, medium-sized. The metathorax is rather short, 0. 6 times as long as broad. The relief of the middle abdominal sternites is weak. The last abdominal sternite is 2. 5 times longer than the previous one. The elytron is 3. 5 times as long as wide, its apex is not

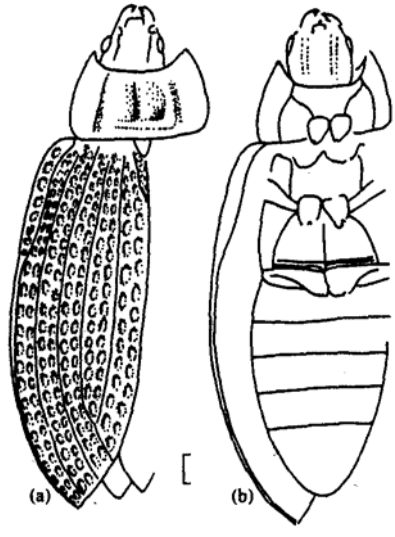

Fig. 1. *Zygadenia sinitzae* sp. nov., holotype PIN, no. 2385/1040: (a) dorsal view, (b) ventral view. Scale bars in all ligures I mm.

tapered. The epipleural border is narrow, broadened and with a row of indistinct cells in its front third. The main veins of the elytron are sharply distinct from the intercalaries, two veins nearest to the suture are fused before the apex. The cells are rounded, elongated in the distal part of the elytron, approximately 25 cells form a row. The elytra are mainly dark, with three light bands separated into spots.

Measurements (mm): body length, 15, abdomen length, 7, elytron length, 10. 5-10. 8, elytron width, 3. 2-3. 4.

Comparison. Differs from other species with similar abdominal sternites in the narrow epipleural border broadened only in its front third and bearing cells only there. It differs from Z. *sinitzae* sp. nov. in smaller size and the metathorax being longer.

Material. Holotype and specimens PIN, nos. 2385/157, 911, 1043, 1045, 1227, elytra.

***Zygadenia sibirica* Ponomarenko, sp. nov.**

Plate 8, figs. 4 and 5

Holotype. PIN, no. 2385/1046, part and counterpart of a beetle without head and prothorax; Semen locality; Lower Cretaceous.

Description (Fig. 3). The beetle is subcylindrical, small. The metathorax is short, 0. 5 times as long as broad. The relief of the middle abdominal sternites is weak. The last abdominal sternite is 2. 5 times longer

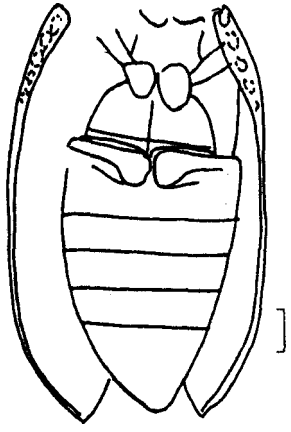

Fig. 2. *Zygadenia semen* sp. nov., holotype PIN. no. 2385/1042, ventral view.

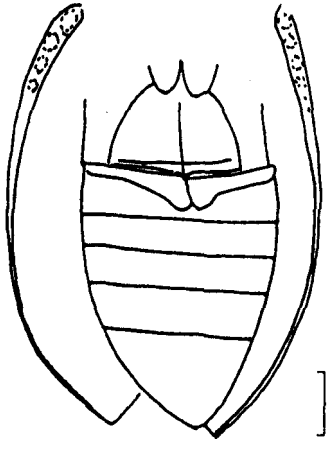

Fig. 3. Zygadenia sibirica IP. nov, holotype PIN. no. 2385/1046, ventral view.

than the previous one. The elytron is 3. 5 times as long as wide, its apex is not tapered. The elytron bears four broad irregular dark bands. The epipleural border is narrow, broadened in its fore third and bears a row of indistinct cells there. The main veins of the elytron are sharply distinct from the intercalaries, two veins nearest to the suture are fused before the apex. The cells are rounded, elongated in the distal part of the elytron, approximately 25 cells form a row.

Measurements (mm): beetle length, approximately 10, beetle width, 5, abdomen length, 5. 5, elytron length, 6. 8-7. 3, elytron width, 2. 5-2. 7.

Comparison. Differs from other species with similar abdominal sternites in the narrow epipleural border broadened only in its fore third and bearing cells only there. It differs from Z. *sinitzae* sp. nov. and *Z. semen* sp. nov. in smaller size. Additionally, differs from Z. *semen* sp. nov. in the metathorax being shorter. Based on size and some features Z. *sibirica* sp. nov. resembles Z. *tuanwangensis* (Hong, 1990) comb. nov. (described in the genus *Picticupes)* from the Laiyang Formation, China, and may fall in synonymy later. However, the situation cannot now be clarified due to the inadequate description of *Z. tuanwangensis.*

Material. Holotype and specimens PIN, nos. 2385/192, 920, 1044, 1049, 1207, isolated elytra.

Tribe Brochocoleini Hong, 1982

Genus *Brochocoleus* Hong, 1982

***Brochocoleus minor* Ponomarenko, sp. nov.**

Plate 8. fig. 6

Etymology. From Latin *minor* (smaller).

Holotype. PIN, no. 2385/1047, part and counterpart of the beetle without head and prothorax; Semen locality; Lower Cretaceous.

Description (Fig. 4). The beetle is small and flattened. The metathorax is transverse, 2 limes as broad as long. The abdomen is rather long, narrowed from the base of third sternite, the last sternite is twice as long as the previous one. The elytron is 3. 5 limes as long as broad, with a rounded apex. The epipleural borer is not wide compared to other representatives of the genus, evenly narrowed beyond the mid length. The main veins of the elytron weakly differ from the intercalaries, the cells are poorly defined. The body is densely covered with medium-sized tubercles.

Measurements (mm): body length, approximately 7, body width, 2. 6, abdomen length, 3. 5, elytron length, 4. 7.

Comparison. Differs from other species in much smaller size, the last abdominal sternite being longer, and the narrower epipleural border.

Material. Holotype.

Cupedidae incertae *sedis propria* Ommatini

Genus *Cionocoleus* Ren, 1995

Cionocoleus sibirica Ponomarenko, sp. nov.

Plate 8. fig. 7

Holotype. PIN, no. 2385/175, isolated elytron; Semen locality; Lower Cretaceous.

Description. The beetle is rather large. The elytron is 3. 5 times as long as broad, with an acuminate apex. The epipleural border is not wide, regular rows of

large tubercles are absent. The disc of the elytron is densely covered with medium-sized tubercles.

Measurements (mm): body length, approximately 23, elytron length, 17. 5, elytron width, 4. 8.

Comparison. Differs from the type species in the elytron being elongate and having an acuminate apex, and large tubercles, differs from *C. ommamimus* Ponomarenko, 1997 in larger size[1] and tubercles being smaller.

Material. Holotype.

Subfamily Cupedinae Lacordaire, 1857

Tribe Priacmini Crowson, 1962

Genus *Priacma* LeConte, 1874

***Priacma striata* Ponomarenko, sp. nov**

Plate 8. figs. 8 and 9

Etymology. From Latin *stria* (furrow).

Holotype. PIN, no. 2385/1222, part and counterpart of the beetle without head and prothorax; Semen locality; Lower Cretaceous.

Description (Fig. 5). The beetle is medium-sized. The metathorax is rather long, 0. 7 times as long as broad, strongly narrowed anteriorly. The abdomen is rather long, narrowed from the base of the third sternite, the last sternite is 2. 5 times longer than the previous one. The elytron is about 4 times as long as broad, with a rounded apex. The epipleural border is narrow. The disc of the elytron bears a lot of small nearly rectangle cells (up to 40). The main veins are poorly distinct from the intercalarles, fused in pairs preapically. The elytron is dark, with several longitudinal pale flecks.

Measurements (mm): body length, approximately 15, elytron length, 9. 5-10, elytron width, 2. 7-2. 9.

Comparison. Differs from the type species in the absence of small spines on the lateral margin of the elytron, from *P. corrugata* Ponomarenko, 1986 and *P. oculata* Ponomarenko, 1997 in the metathorax being elongate and strongly narrowed anteriorly, from *P. longicapitis* Ponomarenko, 1997 in the dark elytra with paler flecks.

Remarks. This species is definitely assigned to the tribe Priacmini, but has been allocated to the genus *Priacma* tentatively based on the long metathorax and the last abdominal sternite, and the elytra having characteristic colour pattern with longitudinal flecks.

Material. Holotype and specimen PIN, no. 2385/912, isolated elytron.

DISCUSSION

The composition of the cupedid assemblage in the Semen locality is rather peculiar. It includes either endemic species or species previously known from China. No cupedids described from Transbaykalia or Mongolia are recorded here. In the Lower Cretaceous of Mongolia cupedids are found predominantly in two upper insect assemblages, i. e., Shin-Huduk and Bon-Tsagaan assemblages. As for more ancient deposits, only the Gurvan-Eren assemblage in western Mongolia yields rare cupedids. These beetles are absent from the assemblages of Tsagaan-Tsav type in the East and Cen-

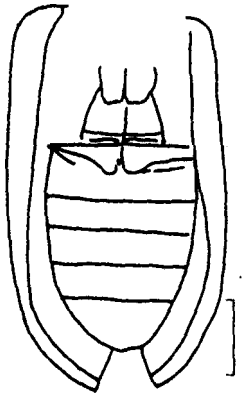

Fig. 4. *Brochocoleus minor* sp. nov,. holotype PIN. no. 2. 185/1047, ventral view.

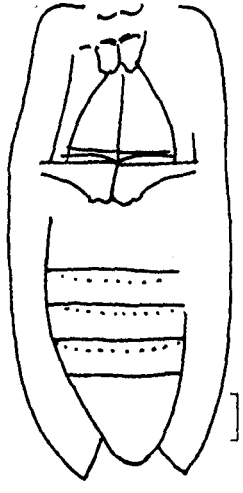

Fig. 5. *Priacma striata* sp. nov., holotype PIN. no. 2385/1222, ventral view.

[1] It was erroneously indicated in the original description of C. *ommamimus* Ponomarenko, 1997 that it differs from the type species in its larger size. In fact, it differs in its smaller size.

tral Mongolia. In Transbaykalia, cupedids are most abundant in the famous locality of Baissa that seems to be contemporaneous to the Mongolian localities of the Shin-Huduk type. There is a single cupedid fossil known from the Turga deposits, Pavlovka locality. It belongs to the genus *Zygadenia (=Notocupes).* The absence of cupedid remains in Tsagaan-Tsav and Turga deposits may almost certainly be explained by a cool episode caused by volcanic activity during that time.

The majority of cupedid remains found in the Semen locality belong to three species of the genus *Zygadenia.* This genus includes more than SO known species and existed from the Late Triassic until the Paleocene. Typically, the species became larger and the last abdominal sternite became longer over the course of time. In the Jurassic the ratio of the length of the last to the penultimate abdominal sternites is on average 2. 5, and never reaches 3. In the Cretaceous the average is 2. 9 and often exceeds 3. This ratio is 2. 5 in all three newly described species, so they resemble Jurassic beetles in this feature. A few *Zygadenia* species known from the beginning of the Neocomian, viz., Pavlovka locality and Chinese localities, also have a relatively short last sternite, and this ratio is rarely exceeds 2. 5. Thus, based on this feature the Semen locality should be Jurassic or Lower Neocomian.

Judging from the relatively narrow epipleural border and rather long last abdominal sternite, the new species of the genus *Brochocoleus* is less derived than other species of the genus. This might be explained by its more ancient age compared to species that are recorded in the Middle Neocomian of China or the Late Neocomian of Mongolia. In the Early Neocomian of Europe (the Purbeck Beds of England) representatives of the genus also have a narrow epipleural border.

On balance, it seems reasonable to assume that the position of the Semen locality is Lower Neocomian, and the occurrence of thermophilic elements in the entomofauna may be connected with a warm temperature shift.

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