

# New ommatids of Ommatinae ( Coleoptera : Archostemata : Ommatidae ) from the Yixian Formation of western Liaoning , China \*

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**Abstract** Four new fossil species of the family Ommatidae from the Yixian Formation of western Liaoning , China are described. Two of them belong to tribe Brochocoleini : *Brochocoleus sulcatus* sp. nov. and *Brochocoleus angustus* sp. nov. The other two refer to tribe Ommatini : *Cionocoleus planiusculus* sp. nov. and *Cionocoleus cervicalis* sp. nov. The diagnosis of *Brochocoleus* and *Cionocoleus* , respectively , are revised. A preliminary analysis of geographical distribution suggests a possible migration pathway of the genus *Brochocoleus*. The relationship between the genus *Cionocoleus* and the extant family Crowsoniellidae is briefly discussed.

**Keywords :** Ommatidae , *Brochocoleus* , *Cionocoleus* , new species , Yixian Formation.

Exceptionally well-preserved fossils have been known from the basal part of the Yixian Formation for over thirty years. The sediments of the Yixian Formation are mainly of lacustrine origin intercalated with volcanic rocks<sup>[1]</sup>, which reflects the impact of increasingly active west Pacific tectonics on northeast China during the Late Mesozoic. The preservation of the insect remains is exceptional , delicate and three-dimensional morphological structures such as hairs and setae are well preserved<sup>[2]</sup>. The composition of this insect fauna is rather abundant and includes representatives of most orders. The beetle assemblage is one of the most diverse groups of insects in the Yixian Formation , based on a study of about two hundred known specimens<sup>[3]</sup>. Among them about 30% are archostematan beetle fossils , yielding 56 described species<sup>[3,4]</sup>, mainly belonging to Cupedidae and Ommatidae.

Now , the archostematan beetles found from the Late Mesozoic northeast China are divided into two assemblages : the *Ovatocupes-Priacma* cupedid assemblage and *Amblomma-Sinocupes* ommatid assemblage<sup>[5]</sup>. At present , Ommatidae is a small family with only two extant genera and six extant species and restricted to tropical belt in the Southern Hemisphere<sup>[6,7]</sup>. However , the representatives of this

family are widely distributed in the Mesozoic of the Northern Hemisphere<sup>[4,8-14]</sup>. Therefore , it is valuable to investigate fossil species of the now relict family Ommatidae from the Yixian Formation.

Recently , we have collected several complete fossil ommatids from the ' Jianshangou Bed ' in the lower part of the Yixian Formation at Chaomidian Village near the town of Shangyuan , 28 km southeast of Beipiao , and Dawangzhangzi Village near Lingyuan City , both in western Liaoning Province , China , the area considered as a part of the Jehol Biota. From these well-preserved specimens , four new species assigned to the extinct genera , *Brochocoleus* and *Cionocoleus* of Ommatidae , are discovered , which add considerably to our knowledge of the group in the Yixian Formation.

The age of the Yixian Formation remains contentious. Older reports claimed that the Yixian Formation containing middle " Jehol " fauna might be as old as Tithonian in age. However , more recent isotopic and paleomagnetic interpretation indicates a younger age for the Yixian Formation ( 124—123 Ma ) , suggesting a late Neocomian ( Hauterivian-Barremian ) age. Some Chinese biostratigraphic researchers still believe that the Jurassic-Cretaceous boundary might be within the Yixian Formation<sup>[15]</sup>.

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Here, we tentatively follow Wang et al.<sup>[16,17]</sup> in considering the Yixian Formation as Late Jurassic to Early Cretaceous (Late Tithonian to Berriasian).

## 1 Material and methods

The specimens were examined using a Leica MZ12.5 dissecting microscope and illustrated with the aid of a drawing tube attachment. Morphological terminology and the system used here follow that of Lawrence<sup>[18]</sup>.

The body length was measured from the apex of the mandible to the apex of the abdomen. The body width was measured at base of the elytra. The length of elytra was measured from the base of the elytra to the apex of the elytra.

This study used four specimens housed in the Key Laboratory of Insect Evolution & Environmental Changes, the College of Life Science, Capital Normal University, Beijing, China.

## 2 Taxonomy

### Order Coleoptera Linnaeus, 1758

### Family Ommatidae Sharp and Muir, 1912

### Subfamily Ommatinae Sharp and Muir, 1912

### Tribe Brochocoleini Hong, 1982

### Genus *Brochocoleus* Hong, 1982

*Brochocoleus* Hong, 1982, Geo. Pub. H. pp 100; Ponomarenko, 1994, Paleontol. Jour. No. 3: 83; Ponomarenko, 2000, Paleontol. Jour. 34(3): 317; Sorinao and Delclòs, 2006, Acta Palaeontol. Pol. 51(1): 185.

**Type species:** *Brochocoleus punctatus* Hong, 1982.

**Included species:** With the exception of the new species described below, seven species were known before. They are *Brochocoleus punctatus* Hong, 1982 from the Upper Jurassic northwest China<sup>[19]</sup>, *B. cossyphus* Ponomarenko, 1994, *B. alatus* Ponomarenko, 1994 and *B. planus* Ponomarenko, 1994<sup>[20]</sup> from the Lower Cretaceous Mongolia, *B. minor* Ponomarenko, 2000 from the Lower Cretaceous Transbaykalia<sup>[13]</sup> and *B. indibili* Sorinao and Delclòs, 2006 from the Lower Cretaceous Spain<sup>[14]</sup>.

The last one is *B. aphaleratus* (Ponomarenko, 1969) which was transferred from genus *Tetraphalerites* to *Brochocoleus* by Ponomarenko in 1997<sup>[12]</sup>.

**Diagnosis:** (based on the original description of the type species and on the study of two new species). Body flattened beetle and quite evenly covered with tubercles; head slight longer than wide, not narrowed forwards, epicraneal suture expressed; mandibles comparatively short; antennae slightly moniliform, short, not reaching posterior margin of prothorax, 11-segmented, third segment longer than other antennomeres. Prothorax transverse, wider than head, with elevation in the middle. Elytral epipleural space wide with four rows of cells in the basal half, all principal longitudinal veins parallel to elytral margin; or without distinct punctuation. Abdomen with five visible ventrites, all ventrites in one plane, last ventrite about 1.5–2 times as long as former one.

**Remarks:** The new species can be assigned to the family Ommatidae because its two procoxal cavities are contiguous and the articulations of abdominal ventrites are abutting one another not overlapping<sup>[18]</sup>. The new fossil beetles have been associated with the tribe Brochocoleini based on the following shared characteristics: (1) antennae short, not reaching posterior margin of prothorax; (2) mandibles comparatively short; (3) prothorax without distinct side margins; and (4) elytral epipleural space wide in the basal half<sup>[20]</sup>.

At present, this tribe includes two genera: *Brochocoleus* Hong, 1982 and *Odontomma* Ren and Tan, 2006<sup>[19,21]</sup>. The new species is easily distinct from *Odontomma* in lateral sides prothorax and elytral margin without serrulate and the third antennomere longer than other antennomeres. So the new fossils can be placed in *Brochocoleus* by elytral epipleural space wide in the basal half part.

### *Brochocoleus sulcatus* sp. nov. (Fig. 1)

**Etymology:** Name derived from Latin “sulcatus”, referring to the new ommatid with a groove in the middle of prothorax.

**Diagnosis:** The new species is only similar to *B. minor* Ponomarenko, 2000 and *B. indibili* Sorinao and Delclòs, 2006 by the elytron almost lacking veins and cell. It is different from *B. minor* in larger size

and the shorter last abdominal ventrite ; from *B. indibili* in larger body size , smaller eyes and head without two oval flat prominences in the vertex.

**Description** : Body length 13.5 mm , body width 3.5 mm , elytron length 9.5 mm. Medium-sized and flattened beetles , densely covered with tubercles ( Fig. 1( a ),( b )).

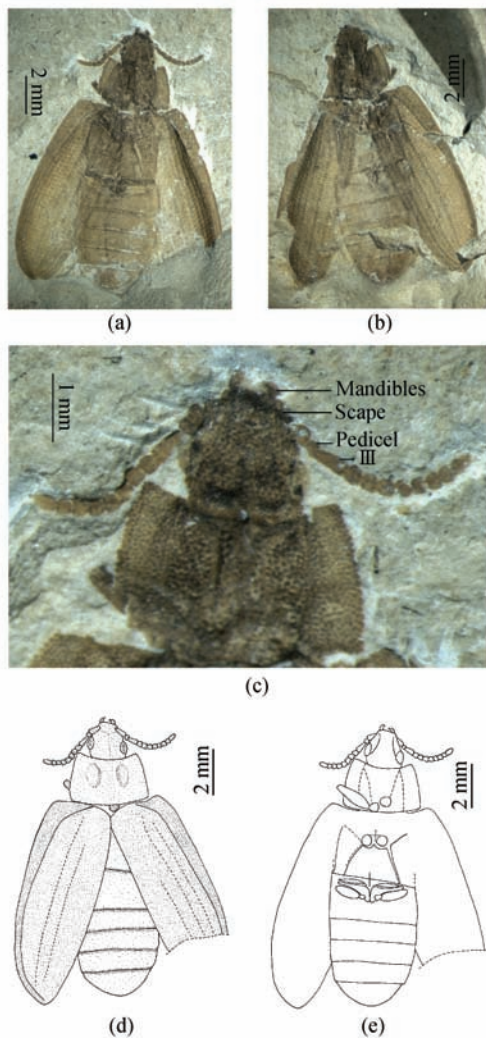


Fig. 1. *Brochocoelus sulcatus* sp. nov. , holotype. ( a ) Photograph , CNU-C-LB2006011-1 ; ( b ) photograph , CNU-C-LB2006011-2 ; ( c ) photograph of head , CNU-C-LB2006011-1 ; ( d ) line drawing of dorsal view , CNU-C-LB2006011-1 ; ( e ) line drawing of ventral view , CNU-C-LB 2006011-1.

**Head** ( Fig. 1( c ),( d ) ) : somewhat elongate , about 1.1 times as long as wide ( not including mandibles ) , abruptly narrowed before eyes , slightly broadened towards antennal bases , genae and temples shorter than eyes , not projecting laterally ; eyes medium , slightly convex ; mandibles comparatively short ; cervical constriction indistinctly.

**Antennae** : somewhat moniliform , short , 11 seg-

ments , extending beyond anterior pronotal margin , scape 3.5 times longer than pedicel , not thicker than other antennomeres , slightly wider apically than basally , pedicel small , third antennomere as long as scape , both of them much longer than others , 4—10 antennomeres nearly as long as wide , somewhat wider at posterior , last antennomere elongated and rounded at apex ( Fig. 1( c ),( d )).

**Pronotum** ( Fig. 1( e ) ) : transverse , 1.7 times as wide as long at posterior edge , weakly narrowing forwards , about 1.7 times as wide as base of head , anterior angles drawn out , posterior angles obtuse , disc of pronotum with two oblong elevations divided by longitudinal groove ; scutellum semicircular.

**Elytron** : about 1.4 times as wide as prothorax , longitudinal ridges with large tubercles , 3 times as long as wide , epipleural rim rather widened in anterior half and narrowing to apex , main veins of elytron barely distinct from intermediary ones , elytral cells indistinct ( Fig. 1( b ),( d )).

**Ventral surface** ( Fig. 1( e ) ) : gula rectangular , reaching base of eyes , widening posteriorly , gena widely separated along entire distance ventrally. Procoxal cavities contiguous , not separated by prosternal process. Mesosternum with cross sutures. Metaventricle trapezoidal , transverse , 1.7 times as wide ( at posterior margin ) as long , expressed longitudinal and transverse sutures. Abdomen with 5 visible ventrites abutted each others , narrowed from the base of fourth visible ventrite , first visible abdominal ventrite longest , last visible ventrite 1.1 times as long as the previous one , its apex rounded.

**Legs** ( Fig. 1( e ) ) : procoxae circular , medium , profemora thicker and longer than metafemora ; mesocoxae circular , separated each other ; metacoxae subtriangular , narrowing laterally , without extended over mid-length of first ventrite , metatrochanter slightly triangular , metafemora not extending well beyond side margins of body.

**Type material** : Holotype , No. CNU-C-LB2006011 ( part and counterpart ). Nearly complete ommatid.

**Horizon and locality** : Collected from the basal part of Yixian Formation ( Late Jurassic-Early Cretaceous ) , at Huangbanjigou , Chaomidian Village near the town of Shangyuan , Beipiao City , Liaoning Province , China.

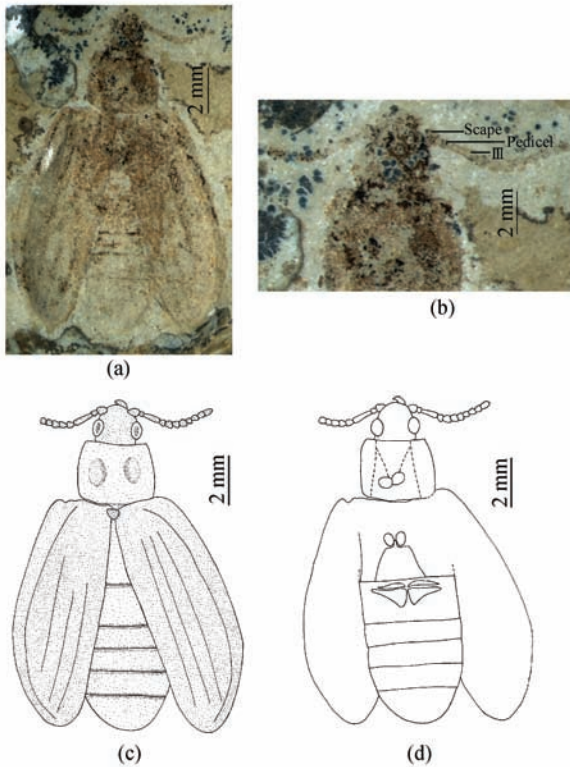


Fig. 2. *Brochocoleus angustus* sp. nov., holotype, No. CNU-C-LB2006009. (a) Photograph; (b) photograph of head; (c) line drawing of dorsal view; (d) line drawing of ventral view.

***Brochocoleus angustus* sp. nov.** (Fig. 2)

**Etymology:** Name derived from Latin “angustus”, referring to prothorax of new ommatid correspondingly narrower than other species in this genus.

**Diagnosis:** The new species is only similar to *B. minor* Ponomarenko, 2000 and *B. indibili* Sorinao and Delclòs, 2006 by the elytron almost lacking veins and cells. It is different from *B. minor* in larger size and the shorter last abdominal ventrite; from *B. indibili* in larger body size and head without two oval flat prominences in the vertex; from *B. sulcatus* sp. nov. in narrower prothroax, shorter and thicker scape, longer third antennomere and mesosternum without cross sutures.

**Description.** Body length 14.0 mm, body width 3.0 mm, elytron length 10.0 mm. Medium-sized and flattened beetles, densely covered with medium-size tubercles (Fig. 2(a)).

**Head** (Fig. 2(b), (c)): somewhat elongate, nearly as long as wide (not including mandibles), weakly narrowed before eyes, temples shorter than eyes, not projecting laterally; eyes large, convex;

mandibles comparatively short, cervical constriction indistinctly.

**Antennae:** somewhat moniliform, short, 11 segments, extending beyond anterior pronotal margin, scape 2.6 times longer than pedicel, thicker than other antennomeres, wider apically than basally, pedicel small, third antennomere longest, 4–10 antennomeres nearly as long as wide, somewhat wider at posterior, more or less homonomous, last antennomere elongated and rounded at apex (Fig. 2(b), (c)).

**Pronotum** (Fig. 2(c)): transverse, quadrate, about 1.5 times as wide as base of head, 1.2 times as wide as long at posterior edge, anterior angles without drawn out, posterior angles obtuse, disc of pronotum with two oblong elevations; scutellum subtriangular.

**Elytron:** about 1.7 times as wide as prothorax, longitudinal ridges with tubercles, 2.8 times as long as wide, epipleural rim widened in anterior half and narrowing to apex, main veins of elytron barely distinct from intermediary ones, elytral cells indistinct (Fig. 2(c)).

**Ventral surface** (Fig. 2(d)): Procoxal cavities contiguous, not separated by prosternal process. Metaventricle trapezoidal, transverse, 1.5 times as wide (at posterior margin) as long, without longitudinal suture developed on metaventricle. Abdomen with 5 visible ventrites abutted each other, narrowed from the base of fourth visible ventrite, first visible abdominal ventrite longest, last visible ventrite 1.6 times as long as the previous one, its apex rounded.

**Legs** (Fig. 2(d)): procoxae circular, medium; mesocoxae circular, nearly touched each others; metacoxae subtriangular, narrowing laterally, extended over midlength of first ventrite.

**Type material:** Holotype No. CNU-C-LB2006009. Nearly complete ommatid. From the same locality, the paratype No. CNU-C-LB2006055, a well preserved specimen without legs.

**Horizon and locality:** Collected from the Yixian Formation (Late Jurassic-Early Cretaceous), at Huangbanjigou, Chaomidian Village near the town of Shangyuan, Beipiao City, Liaoning Province, China.

**Tribe Ommatini Sharp and Muir, 1912**

## Genus *Cionocoleus* Ren , 1995

*Cionocoleus* Ren , 1995 , Seism. Pub. H. pp73 ;  
Ponomarenko , 1997 , Paleontol. Jour. 31( 4 ) : 389 ;  
Ponomarenko , 2000 , Paleontol. Jour. 34 ( 3 ) : 317 ;  
Sorinao and Delclòs , 2006 , Acta Palaeontol. Pol. 51  
( 1 ) : 185.

**Type species :** *Cionocoleus magicus* Ren , 1995.

**Included species :** With the exception of the new species described below , four species were known before. All of them were found in the Lower Cretaceous localities : *C. magicus* Ren , 1995 from northeast China<sup>[11]</sup> , *C. ommamimus* Ponomarenko , 1997 from Mongolia<sup>[12]</sup> , *C. sibirica* Ponomarenko , 2000 from Transbaykalia<sup>[13]</sup> and *C. longicapitis* Sorinao and Delclòs , 2006 from Spain<sup>[14]</sup>.

**Diagnosis :** ( based on the original description of the type species and on the study of two new species ). Quite large , flattened beetle. Head transverse , antennae filiform or somewhat moniliform , as long as or shorter than head and prothorax taken together , third antennomere longest ; mandibles prominent , incurved , temples shorter than eyes. Pronotum nearly transverse , without distinct side edges , procoxal cavities contiguous. Elytra flattened on disc , without trace of cells. Abdomen with 5 visible ventrites , all ventrites in one plane.

**Remarks :** The new species can be assigned to the genus *Cionocoleus* of the tribe Ommatini in family Ommatidae because the new beetles are similar to the members of genus *Omma* in almost all characteristics , except for smooth elytra. *Cionocoleus* was first described by Ren only based on one isolated elytra<sup>[11]</sup> , but it was assigned to the family Schizocoleidae Rohdendorf , 1961. In 1997 , Ponomarenko found some beetles with elytra conforming to the above diagnosis from many localities in Mongolia. After Ponomarenko studied these beetles , he considered that this genus referred to as Schizocoleidae seems unjustified due to absence of the most typical character of the family , a coupling lobe on the underside of elytra , usually seen on fossil as a short longitudinal groove<sup>[12]</sup>. So Ponomarenko<sup>[12]</sup> placed *Cionocoleus* into Cupedormorph , which includes the Cupedidae and Ommatidae. Due to lack of well preserved fore coxae , it was not possible to assign it to Cupedidae or Ommatidae. Fortunately , the materials from the fossil sites of Spain al-

lowed placing this genus in the family Ommatidae , subfamily Ommatinae , tribe Ommatini , by the presence of contiguous procoxae<sup>[14]</sup>. Now , the complete preservation of our new fossil beetles also provided enough evidence to support that this genus is one of members of the family Ommatidae.

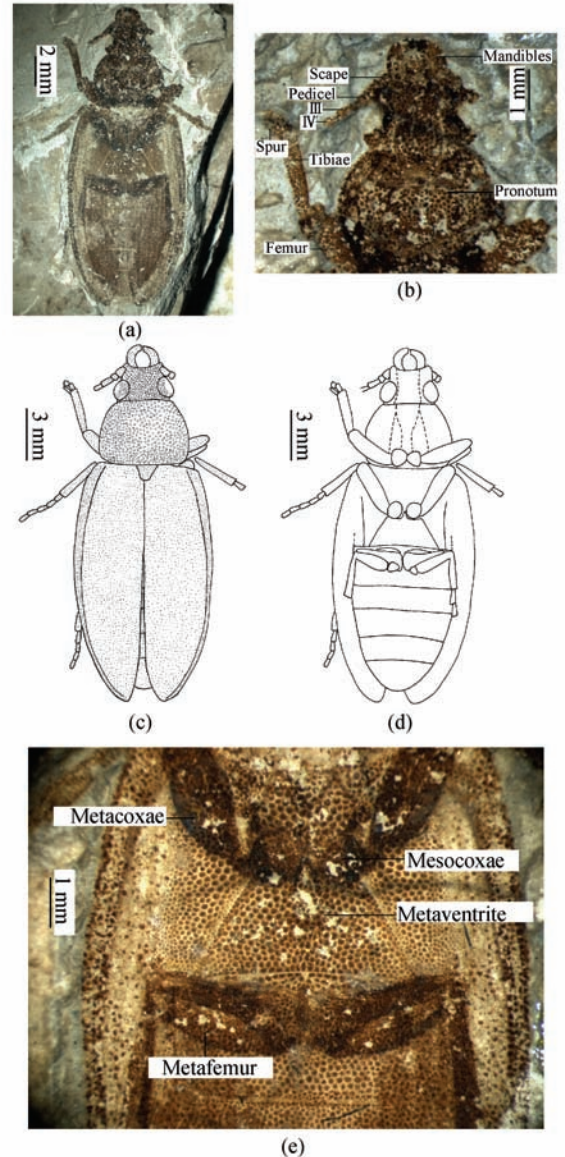


Fig. 3. *Cionocoleus planiusculus* sp. nov. , holotype , No. CNU-C-LB2006008. ( a ) Photograph ; ( b ) photograph of head ; ( c ) line drawing of dorsal view ; ( d ) line drawing of ventral view ; ( e ) photograph of metaventricle.

### *Cionocoleus planiusculus* sp. nov. ( Fig. 3 )

**Etymology :** Name derived from Latin “ planiusculus ” , referring to body of the new ommatid very flattened.

**Diagnosis :** The new species is distinct from

*Cionocoleus magicus* Ren, 1995 in elongate elytra, but without acuminate apex like in *C. sibirica* Ponomarenko, 2000. From *C. ommamimus* Ponomarenko, 1997 differs in the ratio between abdominal ventrites, cervical constriction indistinctly and genae longer than eyes, and from *C. longicapitis* Sorinao and Delclòs, 2006 in the third antennomere longer than other antennomeres.

**Description** : Body length 21.5 mm, body width 5.0 mm, elytron length 14.5 mm. Large and flattened beetles, densely covered with tubercles, larger on head and pronotum, quite smaller in abdomen (Fig. 3(a)).

Head (Fig. 3(b)): transverse, about 1.6 times as wide as long (not including mandibles), feebly narrowed before eyes, temples very short, not projecting laterally; eyes large, slightly convex; mandibles prominent, cervical constriction indistinctly.

Antennae: filiform, with four visible segments, scape thicker than other antennomeres, slightly wider apically than basally, pedicel small, third antennomere nearly as long as pedicel and fourth antennomere together in length (Fig. 3(b)(c)).

Pronotum: elongate, weakly narrowing forwards, base slightly wider than base of head, 1.3 times as wide as long at posterior edge, anterior and posterior angles obtuse, scutellum subtriangular (Fig. 3(c)).

Elytron (Fig. 3(c)): about 1.2 times as wide as prothorax, 3.6 times as long as wide, almost parallel-sided, epipleural rim comparatively wide, elytral cells not visible.

Ventral surface (Fig. 3(d),(e)): gula rectangular, reaching posterior ridge of the head, widening posteriorly. Procoxal cavities contiguous, not separated by prosternal process. Metaventrite trapezoidal, transverse, 2.6 times as wide (at posterior margin) as long, without longitudinal suture developed on metaventrite. Abdomen with 5 visible ventrites abutted each other, narrowed from the base of fourth visible ventrite, first visible abdominal ventrite longer than others, last visible ventrite 1.3 times as long as the previous one, its apex rounded.

Legs (Fig. 3(d)): procoxae subtriangular, medium, profemora thicker than protibiae, both of

them subequal in length, apex of protibiae with a spur, protarsi with two visible segments; mesocoxae rounded, slightly separated each other, mesofemora thick, longer than mesotibiae, mesotarsi with five tarsomeres, more or less homonomous; metacoxae subtriangular, narrowing laterally, without extended over midlength of first ventrite, metatrochanter slightly triangular, metafemora short, not extending well beyond side margin of body, metatibiae slightly longer than metafemora, metatarsi with five segments, first tarsomere longer than other tarsomeres.

**Type material** : Holotype No. CNU-C-LB2006008, nearly complete ommatid.

**Horizon and locality** : Collected from the basal part of Yixian Formation (Late Jurassic-Early Cretaceous), at Jianshangou, Chaomidian Village near the town of Shangyuan, Beipiao City, Liaoning Province, China.

***Cionocoleus cervicalis* sp. nov.** (Fig. 4)

**Etymology** : Name derived from Latin "*cervicalis*", referring to the new ommatid with distinct cervical constriction.

**Diagnosis** : The new species is distinct from *Cionocoleus magicus* Ren, 1995 in elongate elytra, but without acuminate apex like in *C. sibirica* Ponomarenko, 2000. From *C. ommamimus* Ponomarenko, 1997 differs in the ratio between abdominal ventrites, shorter temple and longer genae, and from *C. longicapitis* Sorinao and Delclòs, 2006 in the third antennomere longer than other antennomeres. *C. cervicalis* sp. nov. is different from *C. planiusculus* sp. nov. in distinct cervical, shorter mesofemora and developed longitudinal suture on the metaventrite.

**Description** : Body length 24 mm, body width 4.0 mm, elytron length 16.0 mm. Large and flattened beetles, densely covered with medium-tubercles (Fig. 4(a),(b)).

Head (Fig. 4(c)): transverse, trapezoidal, about 1.3 times as wide as long (not including mandibles), feebly narrowed before eyes, temples very short, projecting laterally; eyes large, convex; mandibles prominent, with two teeth in horizontal plane, cervical constriction distinctly.

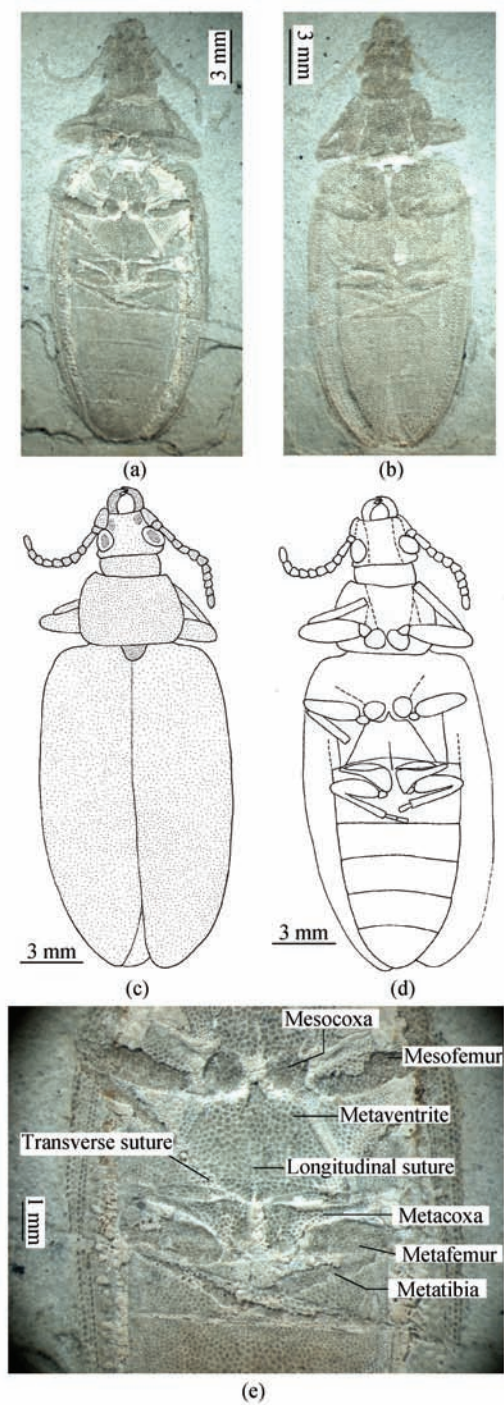


Fig. 4. *Cionocoleus cervicalis* sp. nov., holotype. (a) Photograph, CNU-C-LB2006007-1; (b) photograph, CNU-C-LB2006007-2; (c) line drawing of dorsal view, CNU-C-LB2006007-1; (d) line drawing of ventral view, CNU-C-LB2006007-1; (e) photograph of metaventrite, CNU-C-LB2006007-1.

Antennae : filiform , 11 segments , scape thicker than other antennomeres , slightly wider apically than basally , pedicel small , third antennomere nearly as long as pedicel and fourth antennomere together in length , 4—10 antennomeres nearly as long as wide ,

somewhat wider at posterior , more or less homonomous , last antennomere elongated and rounded at apex ( Fig. 4( c ) ).

Pronotum : elongate , narrowed towards base and apex , base slightly wider than base of head , 1.2 times as wide as long at posterior edge , anterior margin nearly straight , lateral ones rounded , anterior and posterior angles obtuse , scutellum subtriangular.

Elytron : about 1.7 times as wide as prothorax , 3.5 times as long as wide , almost parallel-sided , epipleural rim nearly indistinct , elytral cells not visible ( Fig. 4( c ) ).

Ventral surface ( Fig. 4( d ) , ( e ) ) : gula rectangular , reaching posterior ridge of head , widening posteriorly . Procoxal cavities contiguous , not separated by prosternal process . Metaventrite trapezoidal , transverse , 2.5 times as wide ( at posterior margin ) as long , longitudinal and transverse sutures developed on metaventrite . Abdomen with 5 visible ventrites abutted each other , narrowed from the base of third visible ventrite , first visible abdominal ventrite longest , last visible ventrite 1.2 times as long as the previous one , its apex tapered .

Legs ( Fig. 4( d ) ) : procoxae rounded , medium , profemora thicker than protibiae , both of them nearly subequal in length , apex of protibiae without a spur ; mesocoxae rounded , slightly separated each other , mesofemora thick , as long as mesotibiae ; metacoxae subtriangular , narrowing laterally , without extended over midlength of first ventrite , metatrochanter small , slightly triangular , metafemora short , not extending well beyond side margin of body , metatibiae slightly longer than metafemora , metatarsi with two visible segments , first tarsomere as long as second tarsomere .

**Type material :** Holotype No. CNU-C-LB2006007 ( part and counterpart ) . Nearly complete ommatid .

**Horizon and locality :** Collected from the basal part of Yixian Formation ( Late Jurassic-Early Cretaceous ) , at Dawangzhangzi Village near Lingyuan City , Liaoning Province , China .

### 3 Discussion

The elytra of representatives of *Brochocoleus* appeared to consist of two different types . Therefore ,

we propose that the species in genus *Brochocoleus* can be divided into two series: *Brochocoleus punctatus* series and *B. minor* series, based on elytra with or without rows of large, rectangular cells. The new beetles described in this paper belong to *B. minor* series because their elytra do not have distinct cells.

The genus *Brochocoleus* existed from the Early Jurassic to the Early Cretaceous and the distribution of these extinct ommatids seemed to be restricted to Palearctic. Now, the earliest known species of this genus was found from the Lower Liassic locality in Kirghizia<sup>[11]</sup>. In the Late Jurassic, another species appeared in northwest China<sup>[19]</sup>. During the Early Cretaceous, the species of *Brochocoleus* were spread to the most part of Eurasia, which were found in the fossil sites of East Transbaikalia, Mongolia, Northeast China and Spain. According to this distribution pattern, the most parsimonious hypothesis is that the basal species of this genus initially radiated in central Asia, and subsequently spread into northwest China during the Late Jurassic and finally reached the marginal region of Eurasia in the Early Cretaceous. Later, these beetles probably became extinct due to climatic and environmental alterations during the Late Cretaceous. However, information about the genus is still too limited to verify this assumption.

In addition, the beetles of genus *Cionocoleus* in almost all characteristics, except for smooth elytra, are similar to species of the genus *Omma*. The presence of cells in cupedid or ommatid elytra and retention of a primary wing membrane in these cells were regarded as characters of high taxonomical value<sup>[12]</sup>, and Machatschke<sup>[22]</sup> even suggested excluding the group from all the other beetles. However, a recent beetle *Crowsoniella relictata* Pace, 1976<sup>[23]</sup> is now known as the fourth extant family in the suborder Archostemata, likewise combining all other ommatidid characteristics with a smooth elytra<sup>[23]</sup>. Based on the phylogenetic analysis, Beutel and Hörschemeyer considered that Ommatidae and Crowsoniellidae have some relationship and may be the sister group<sup>[24]</sup>. Moreover, a phylogeny of the major living and extinct lineages of Coleoptera indicated that the primitive species of family Crowsoniellidae might appear firstly in the Late Jurassic<sup>[25]</sup>. So the species of genus *Cionocoleus* and the extant family Crowsoniellidae might have certain relationship in evolution. Furthermore, the species of genus *Cionocoleus* were also

found from the main Late Jurassic fossil localities in Eurasia, such as Northeast China, Mongolia, Transbaikalia and Spain<sup>[1,12–14]</sup>. Thus *Crowsoniella relictata* from Italy might be the relict of genus *Cionocoleus* in Europe. However, it is a preliminary view because we need more fossil specimens to provide more evidence.

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