Zootaxa 1785: 54–62 (2008)
www.mapress.com/zootaxa/

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

A new genus and two new species of fossil Elaterids from the Yixian Formation of Western Liaoning, China (Coleoptera: Elateridae)

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Abstract

A new genus and two new species of fossil Elateridae are described and illustrated: *Paralithomerus* **gen. nov**., *P. exquisitus* **sp. nov**, and *P. parallelus* **sp. nov**. Both species were collected from the Late Jurassic-Early Cretaceous Yixian Formation of western Liaoning, China. Fossil elaterids expressing a sutured mesoventrite have been otherwise discovered only from the Upper Jurassic strata of Karatau.

Key words: Elateridae, fossil, Yixian Formation, Late Jurassic-Early Cretaceous, China

Introduction

The superfamily Elateroidea is a large taxon of beetles that contains the familiar click beetles (Elateridae, Eucnemidae, and Throscidae), fireflies (Lampyridae), soldier beetles (Cantharidae), and their relatives. Elateridae is the largest family of the series Elateriformia and the superfamily Elateroidea, and is the ninth most diverse family of beetles, with nearly 10,000 species worldwide (Lawrence 1982). Adult elaterids are easily recognizable by their distinctive slender body shape, prothorax with extended pronotal angles on the posterior corners, and furthermore, by their ability to jump into the air while making a clicking noise. Adult elaterids are usually found on flowers or vegetation, under bark or rocks and rotten wood, and may be saprophagous, phytophagous, or predacious. Larvae occur in a variety of habitats, including soil, litter, and rotten wood. Phytophagous soil-dwelling larvae are commonly known as wireworms, which have harmful impact to crops and forests (Lawrence *et al.* 2000; Johnson 2007).

A diversity of fossil Elateridae are known from the Late Jurassic (Dolin 1975, 1976, 1980). Various Cretaceous and Tertiary deposits (including ambers) also contain adult elaterids, although most of these have not been studied. Up to date, the family includes approximately 168 fossil species (Dunstan 1923; Martynov 1926; Ping 1928; Gardiner 1961; Dolin 1975, 1976, 1980; Hong 1982, 1984; Lin 1986; Zhang 1989; Tröster 1991, 1993, 1994a, 1994b; Zhang 1994; Hörnschemeyer *et al.* 1995; Zhang 1997; Nel *et al.* 1999; Tröster 1999; Dolin & Nel 2002; Chang *et al.* 2007; Chang & Ren 2008) and 25 amber species (Handlirsch 1906–1908; Yablokov-Khzorjan 1961; Becker 1963) that are attributed to some 74 genera reported from all over the world. Among these records, only 21 species in eight genera are known from China (Ping 1928; Hong 1982, 1984; Lin 1986; Zhang 1989, 1994; Zhang 1997; Dolin & Nel 2002; Chang *et al.* 2007; Chang & Ren 2008). Based on these published records elaterids probably originated no later than the Early to Mid-Jurassic and flourished by the Late Jurassic, with many recent genera established by the Early Palaeogene. Therefore, the Late Jurassic-Early Cretaceous may be a vital period for elaterid evolution.

 Accepted by P. Johnson: 14 May 2008; published: 6 Jun. 2008

Recently, we collected two fossil elaterids from the 2nd Bed of the Yixian Formation in Huangbanjigou, near Chaomidian Village, Shangyuan County, Beipiao City, Liaoning Province. The strata of the Yixian Formation are mainly of lacustrine sediments intercalated with volcanoclastics (Ren *et al.* 1995). Paleobotanical data from fossil spores, pollen and plants indicates a climate that was both warm and moist at that time (Ding *et al.* 2001). The exact age of this formation is still contentious as three different opinions about the age (Late Jurassic, Late Jurassic-Early Cretaceous and Early Cretaceous) have been proposed based on both biostratigraphic and radiometric geochronology (Chen *et al.* 1998; Swisher *et al.* 1999; Wang *et al.* 2005). At present, we regard the age of the strata as the Late Jurassic-Early Cretaceous.

Material and methods

The specimens were examined using a Leica MZ12.5 dissecting microscope, illustrated with the aid of a drawing tube attachment, and photographed with a Nikon Digital Camera DXM1200C. Morphological terminology and the taxonomic system used here follow that of Lawrence and Newton (1995) and Calder (1996). Body length was measured along the midline from the anterior margin of the frons to apex of the abdomen, and width was measured across the broadest part of elytra. The length of the pronotum was measured along the midline; the width was measured across the broadest part.

Systematic paleontology

Genus *Paralithomerus* gen. nov.

Etymology. Generic name derived from the combination of Latin prefix "*para-*" and "*Lithomerus*", for the new genus has great similarities to *Lithomerus* Dolin (1980).

Type species: *Paralithomerus exquisitus* **sp. nov**.

Species included. *Paralithomerus exquisitus* sp. nov. and *Paralithomerus parallelus* sp. nov.

Diagnosis. The new genus differs from all other closely related genera within the same family by the following features: Metaventrite with transverse sutures, but prosternum without longitudinal furrows.

Remarks. The new genus can be assigned to the family Elateridae based on the following characters: (1) head with an exposed labrum; (2) prothorax with extended angles on the posterior corners; (3) with prosternal process and mesoventral cavity; (4) metacoxal plates well developed; and (5) abdomen with five ventrites.

The species of this new genus greatly resemble species of the genus *Lithomerus* (Dolin, 1980), but differ from the latter by the following characters: (1) head subtriangular, convex, with an exposed labrum; (2) antennae short, filiform; (3) basal margin of pronotum bisinuate, with basal pleural furrows; (4) hind angles of pronotum with distinct short carina; (5) prosternum without longitudinal furrows; and (6) metacoxal plates obtusely long triangular, slender, narrowed laterally.

Paralithomerus exquisitus sp. nov.

(Figs. 1–10)

Type specimen: Holotype. CNU-C-LB2006874-1, CNU-C-LB2006874-2 (part and counterpart of one specimen), almost complete impression of elaterid, housed in Key Lab of Insect Evolution & Environmental Changes, Capital Normal University, Beijing, China.

Locality and horizon. Collected from 2nd Bed of the Yixian Formation in Huangbanjigou, near Chaomidian Village, Shangyuan County, Beipiao City, Liaoning Province, China; Upper Jurassic-Lower Cretaceous.

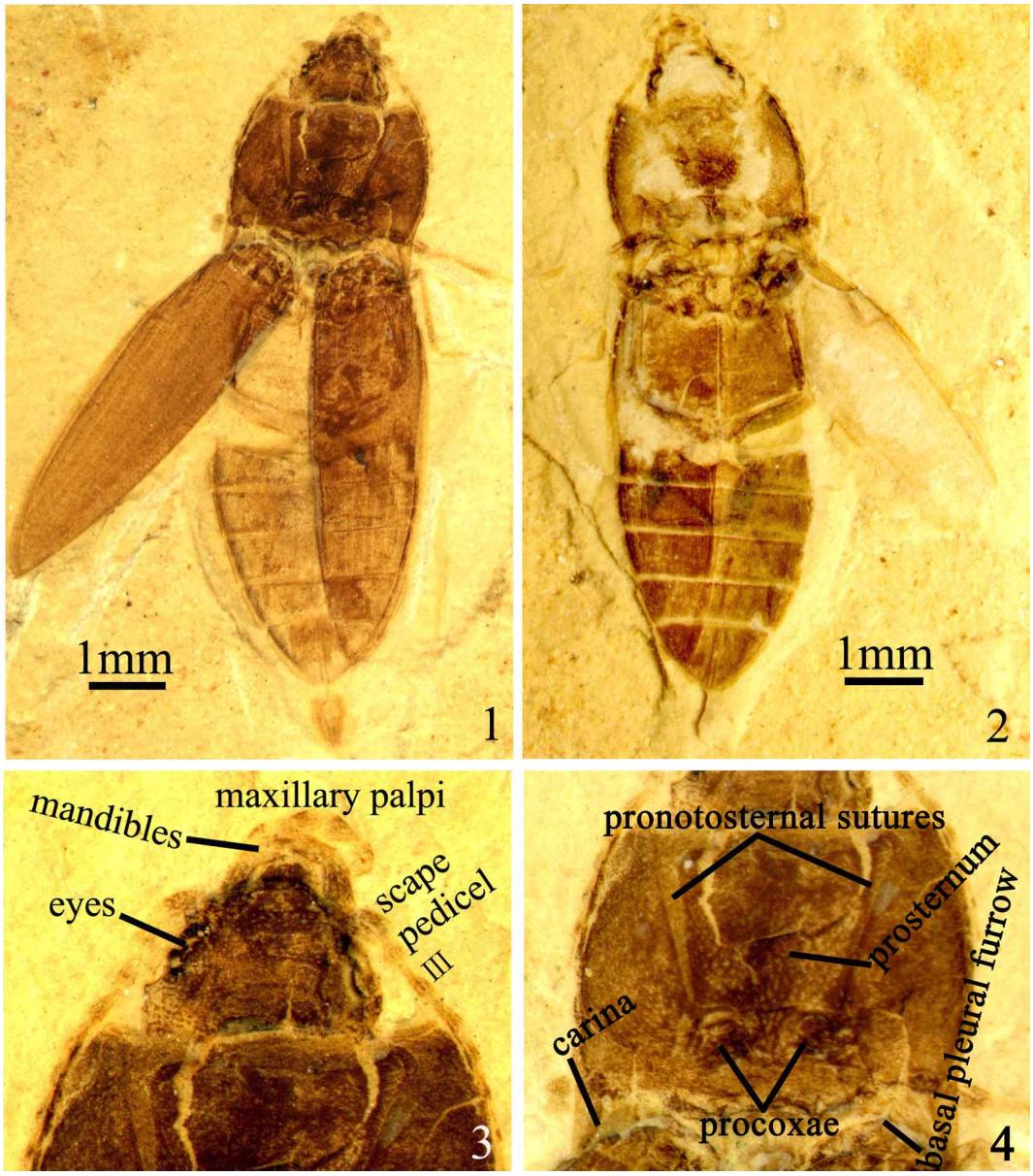
Etymology. Specific name derived from Latin "*exquisitus*", (meaning "exquisite"), for the striae of elytra are exquisitely preserved and elegantly lined.

Diagnosis. Head medium sized; maxillary palpi three segmented, last segment enlarged; eyes oval. Pronotum with width 1.07 times wider than long; prosternal process short. Elytra with 9 longitudinal striae, the 2nd and 3rd, 6th and 7th are united at the apical 1/4.

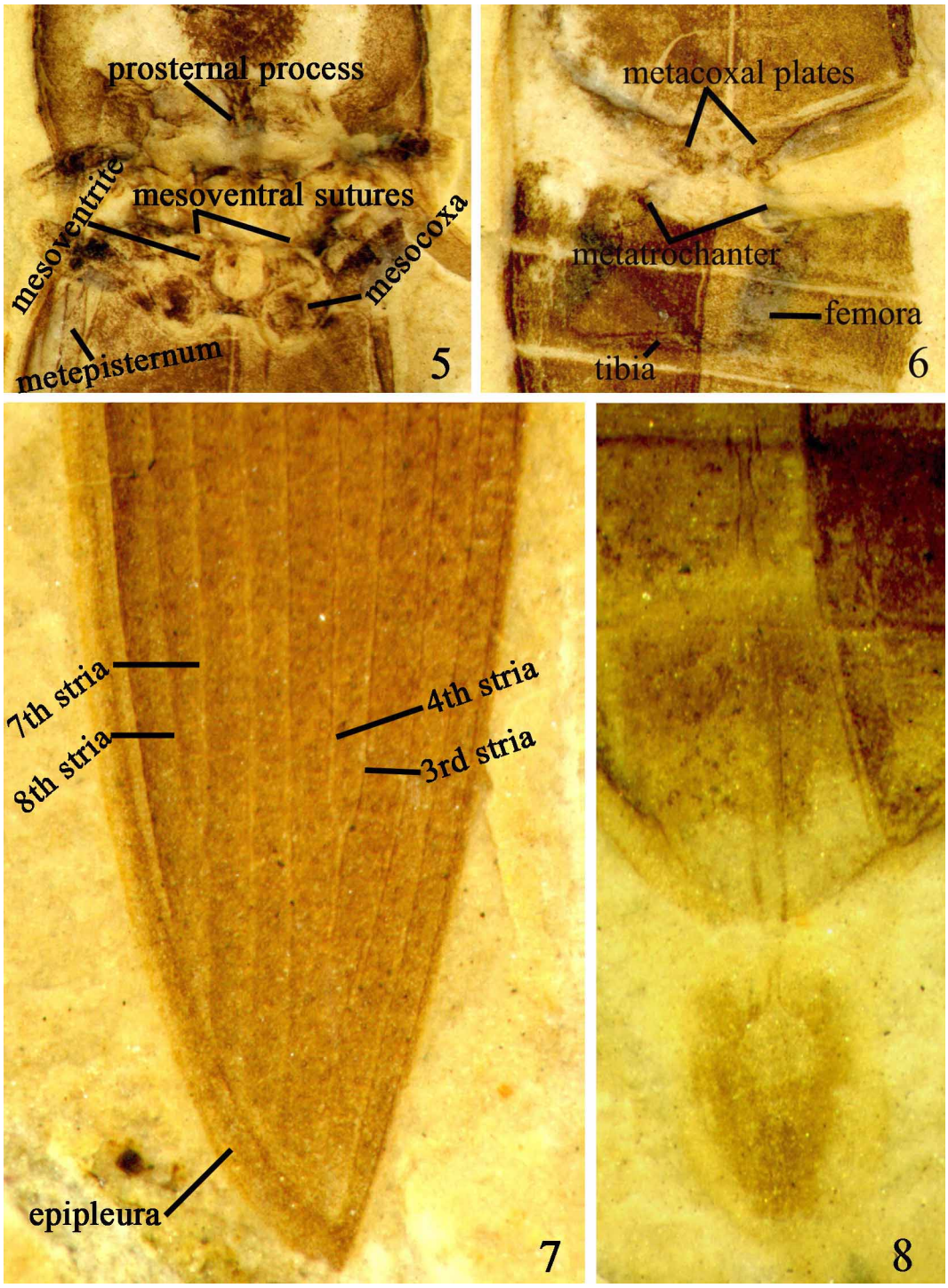
Description. Body subcylindrical, small sized, with length 8.5 mm, width 2.5 mm, elytron length 5.3mm; Maxillary palpi with terminal segment enlarged; Elytra with 9 distinctly longitudinal striae, the 3rd and 4th, 7th and 8th are united approximately at the apical 1/4 (Figs. 1, 2).

Head sub-triangular, convex; maxillary palpi three segmented, with terminal segment enlarged; mandibles incurved, bidentate at apex; labrum small, transverse; eyes oval, medium sized (Fig. 3).

Antennae filiform, incomplete with 8 preserved segments; scape robust, pedicel slightly shorter than scape and antennomere 3 together, antennomeres 4–8 progressively narrower (Figs. 3, 9).



FIGURES 1–4. *Paralithomerus exquisitus* **gen. et sp. nov.**, holotype. 1—CNU-C-LB2006874-1, 2—CNU-C-LB2006874-2, 3—head, 4—prothorax.



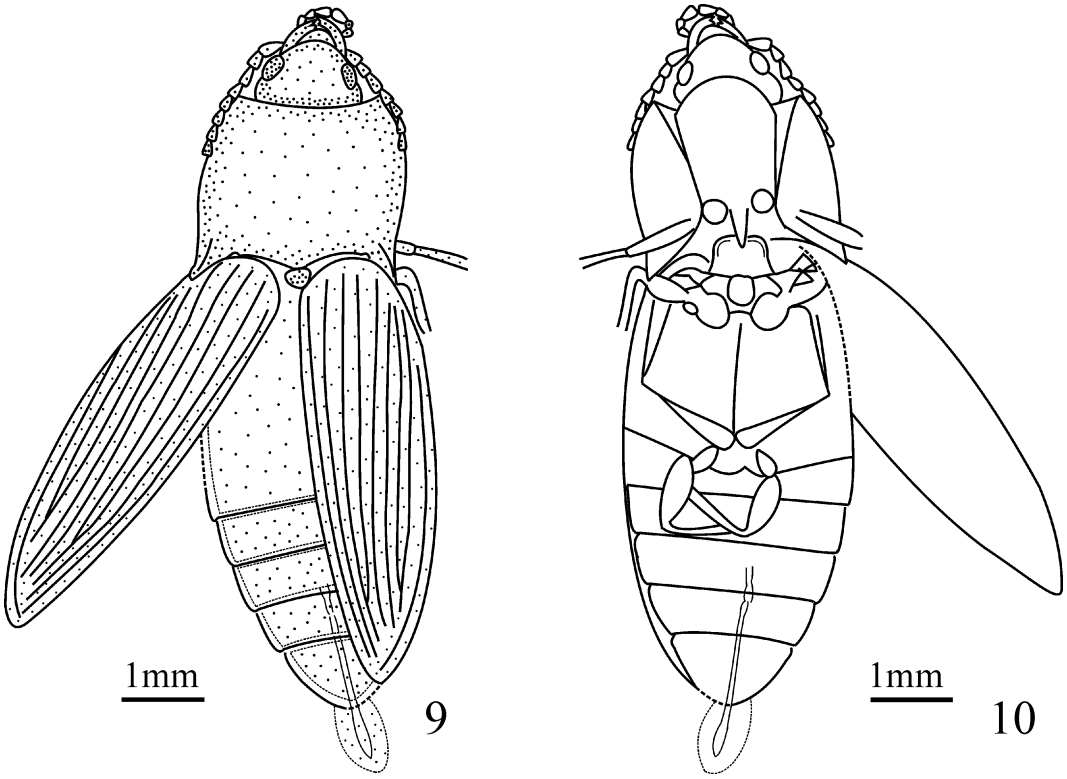
FIGURES 5–8. *Paralithomerus exquisitus* **gen. et sp. nov.** holotype, 5—mesoventrite, 6—hind legs, 7—apical half of elytron, 8—oviposotor.

Pronotum 1.92 times as long as head; with width 1.07 times wider than long; anterior margin arched inside, with short angles, lateral margins arcuate in front of hind angles, basal margin bisinuate, with basal pleural furrow; disc slightly convex; hind angles acute, with distinct short carina, produced laterally and posteriorly while embracing elytra bases (Figs. 1, 4, 9).

Elytra wider than prothorax, 3.62 times as long as wide; disc slightly convex, with 9 distinct longitudinal striae, the 3rd and 4th, 7th and 8th are united approximately at the apical 1/4; apex of elytra slightly obtuse (Figs. 1, 7, 9).

Ventral surface with chin piece normally arcuate; pronotosternal suture double, widely opened anteriorly; procoxal cavities small, rounded and separated, open behind; prosternal process quite short, wedge-shaped. Mesoventrite small, with transverse sutures, mesoventral cavity circular, mesepimeron triangular, mesocoxae open to mesepimeron. Metaventrite and mesoventrite separated by distinct suture, metaventrite relatively long and flat, with longitudinal suture; metepisternum normal; metacoxal plates slender, obtusely long triangular, evenly narrowed laterally. Abdomen with 5 visible ventrites, narrowed from the base of fifth visible ventrite, apical ventrite extending beyond elytra; ovipositor slightly extended (Figs. 2, 4–6, 8, 10).

Legs with procoxa rounded, profemur slender, mesocoxa circular, much bigger than procoxa, mesotrochanter quite small, oval, metacoxa plates slender, obtusely long triangular, metatrochanter oval (Figs. 6, 10).



FIGURES 9–10. *Paralithomerus exquisitus* **gen. et sp. nov.**, holotype, 9—dorsal view, 10—ventral view.

***Paralithomerus parallelus* sp. nov.**
(Figs. 11–15)

Type specimen: Holotype. CNU-C-LB2006872, an impression of elaterid with almost complete body, but most antennal segments absent, housed in Key Lab of Insect Evolution & Environmental Change, Capital Normal University, Beijing, China.

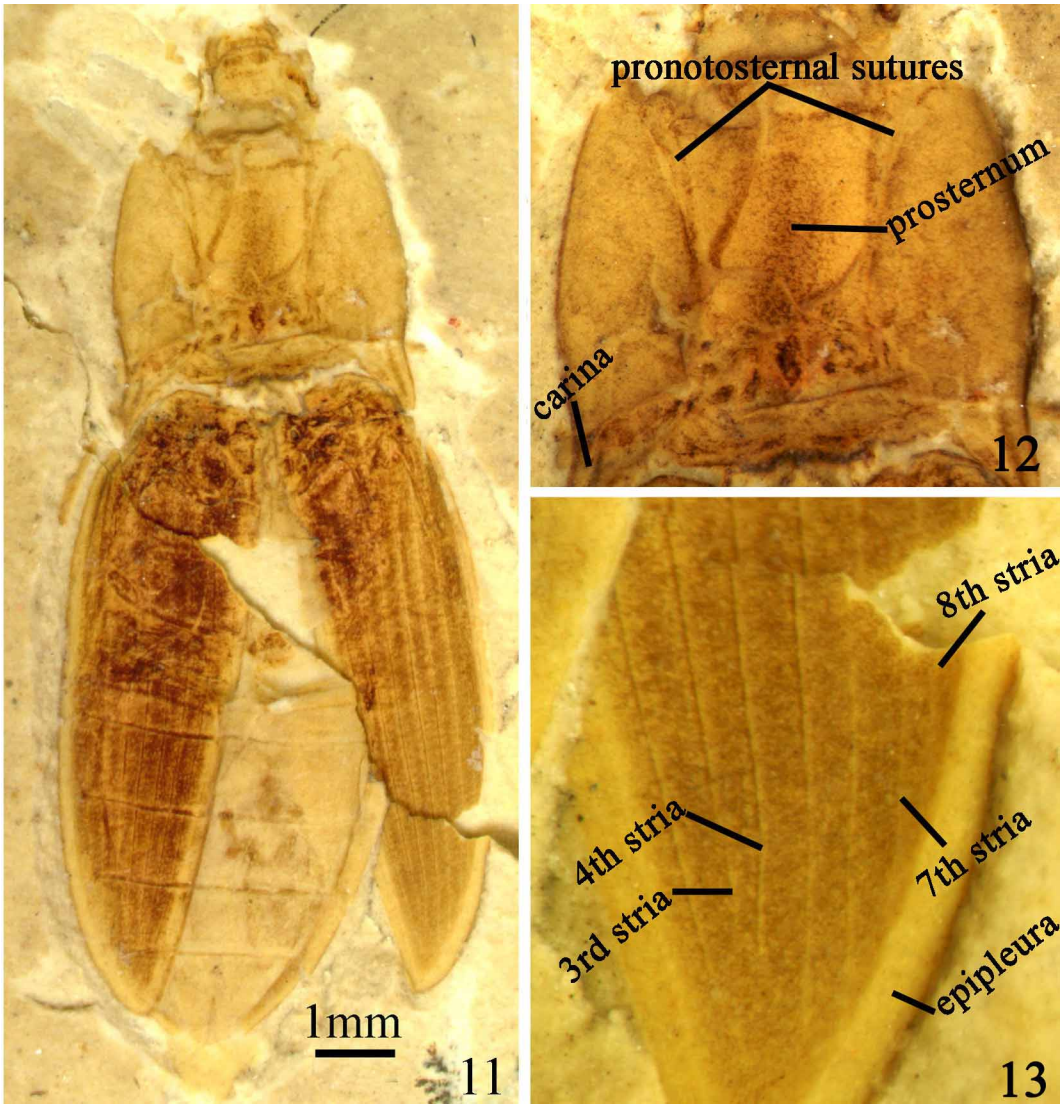
Locality and horizon. Collected from 2nd Bed of Yixian Formation in Huangbanjigou, near Chaomidian Village, Shangyuan County, Beipiao City, Liaoning Province, China; Upper Jurassic-Lower Cretaceous.

Etymology. Specific name derived from Latin "*parallelus*", (meaning "parallel"), for the striae of the elytra that are parallel to each other.

Diagnosis. This new species is distinguished from *P. exquisitus* by the following characters: (1) pronotum width shorter than length if the length is measured at the median line; (2) prosternal process quite short; (3) metepisternum narrow; (4) elytra with 9 distinct longitudinal striae, each stria nearly parallel to the sutural margin, the 3rd and 4th, 7th and 8th not united; and (5) apical ventrite 1.33 times longer than the previous one and broadly rounded apically.

Description. Body subcylindrical, medium sized, with length 12.5 mm, width 4.5 mm, elytron length 7.8 mm; Elytra with nine nearly parallel longitudinal striae (Figs. 11, 13, 14).

Head sub-triangular, convex; eyes oval, medium sized; mandibles incurved, bidentate at apex; labrum small, transverse (Fig. 11).



FIGURES 11–13. *Paralithomerus parallelus* **sp. nov.**, 11—dorsal view, 12—prothorax, 13—apical half of elytron.

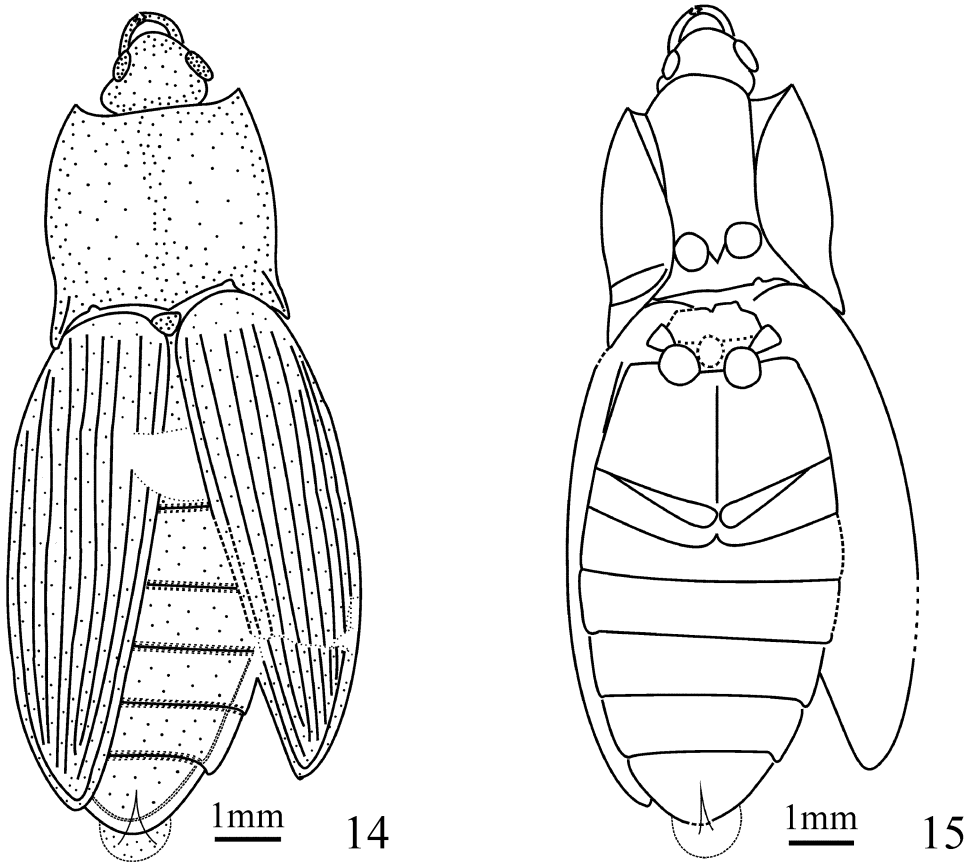
Pronotum subtrapezoidal, 2.17 times as long as head, width 1.23 times wider than long; anterior margin arched inside, with short angles, lateral sides slightly arcuate in front of hind angles, basal margin bisinuate, with basal pleural furrow; disc slightly convex, with a mild median longitudinal depression; hind angles acute, produced posteriorly, with distinct short carina (Figs. 11, 12).

Elytra wider than prothorax, 3.45 times as long as wide, with 9 distinct longitudinal striae, each stria nearly parallel to the sutural margin, apex of elytra slightly obtuse; epipleural rim normal (Figs. 13, 14).

Ventral surface with chin piece normally arcuate; pronotosternal suture double, widely opened anteriorly; procoxal cavities quite small, rounded and separated, open behind; prosternal process short, wedge-shaped; Mesoventrite small, mesoventral cavity circular, mesepimeron subtriangular, mesocoxae open to mesepimeron. Metaventrite and mesoventrite separated by distinct suture, metaventrite relatively long and flat, with longitudinal suture; metepisternum narrow; metacoxal plates slender, obtusely long triangular, evenly narrowed laterally. Abdomen with 5 visible ventrites, narrowed from the base of fifth visible ventrite, apical ventrite 1.33 times longer than ventrite 4 and broadly rounded apically (Figs. 12, 15).

Legs with procoxa rounded; mesocoxa circular, larger than procoxa, metacoxa transverse (Fig. 11).

Remarks. Although most of the antennal segments are absent, the new species can be assigned to the new genus *Paralithomerus* based on the following characters: (1) head subtriangular, convex; (2) pronotosternal sutures double, open anteriorly; (3) mesocoxae open to mesepimeron; mesoventrite and metaventrite separated by distinct suture; and (4) metacoxal plates slender, obtusely long triangular, evenly narrowed laterally.



FIGURES 14–15. *Paralithomerus parallelus* **sp. nov.**, holotype. 14—dorsal view, 15—ventral view.

Discussion

The classification of recent Elateridae is currently in a state of flux, the latest classification is that of Calder (1996) which recognises eight subfamilies: Agrypninae, Cardiophorinae, Denticollinae, Elaterinae, Lissominae, Negastriinae, Pityobiinae, and Thylacosterninae. Based on the form of the pronotosternal suture, the new genus appears to have a close relationship with the recent subfamily Agrypninae, but due to its unique sutured mesoventrite, it is not suitable to assign it into the subfamily Agrypninae.

Dolin (1975, 1976, 1980) established 32 genera based on 108 fossil species from the Upper Jurassic strata of Karatau in Kazakhstan. Among these genera eight were assigned to the extant subfamilies Agrypninae, Negastriinae and Cardiophorinae. The other 24 genera with unique furrowed prosternum and sutured mesoventrite were assigned to a specially-erected extinct subfamily Protagrypninae and three tribes: Protagrypnini (*Acheonus*, *Lithocoelus*, *Lithomerus*, *Micragrypnites*, *Protagrypnites*, *Paragrypnus*), Hypnomorphini (*Abrotus*, *Adiagnostus*, *Codemus*, *Graciolacon*, *Hypnomorphoides*, *Hyponomorphus*, *Idiomerus*, *Idiomorphus*, *Lapidiconides*, *Lapidostenus*, *Lithoptychus*, *Lithosomus*, *Necrocoelus*, *Negastrioides*, *Parahypnomorphus*, *Platyelater*) and Desmatini (*Desmatus*, *Plesiorhaphes*). Based on the sutured mesoventrite, the new genus should also have close relationship with Protagrypninae, but as it does not have the longitudinal furrows

on the prosternum, it is not suitable to assign it to this subfamily. We feel that it is inadvisable to set up a new subfamily for a single genus, so we regrettably but necessarily regard its subfamily and tribe assignments as uncertain.

Because Dolin's (1975) Protagrypninae distinguished from the recent Agrypninae and all the other recent subfamilies mainly by having a furrowed prosternum and a sutured mesoventrite. We suggest that the furrowed prosternum and sutured mesoventrite might be primitive characters of elaterids. Thus, we conclude that the new genus with normal prosternum and sutured mesoventrite might represent a transitional evolutionary stage between Protagrypninae and recent Agrypninae.

Fossil elaterids with a furrowed prosternum and a sutured mesoventrite have been discovered from the Upper Jurassic strata of Karatau and the Middle Jurassic Jiulongshan Formation of China. The new genus with sutured mesoventrite and without furrowed prosternum is the first report from the Late Jurassic-Early Cretaceous Yixian Formation of China. These new findings may have some new indications about the origination and radiation of elaterids, and extend the geographical distribution of ancient elaterids.

Acknowledgements

We are grateful to Prof. Paul J. Johnson from the Insect Research Collection, South Dakota State University of USA, Dr. Shih ChungKun from College of Life Sciences, Capital Normal University of China, for their improvement of our manuscript. This research is supported by the National Natural Science Foundation of China (No. 30430100), the Nature Science Foundation of Beijing (No. 5082002), the Funding Project for Academic Human Resources Under the Jurisdiction of Beijing Municipality, and the National Basic Research Program of China (973 Program, Grant No. 2006CB102005).

References

Becker, E.C. (1963) Three new fossil elaterids from the amber of Chiapas, Mexico, including a new genus (Coleoptera). *Journal of Paleontology*, 37(1), 125–128.

Calder, A.A. (1996) Click Beetles: Genera of Australian Elateridae (Coleoptera). *Monographs on Invertebrate Taxonomy*, 2, 1–401.

Chang, H.L. & Ren, D. (2008) New Fossil Beetles of the Family Elateridae from the Jehol Biota of China (Coleoptera: Polyphaga). *Acta Geologica Sinica* (English edition), 82(2), 236–243.

Chang, H.L., Ren, D. & Shih, C.K. (2007) New fossil elaterid (Coleoptera: Polyphaga: Elateridae) from Yixian Formation of western Liaoning, China. *Progress in Natural Science* (English edition), 17(10), 1244–1249.

Chen, P.J., Dong, Z.M. & Zhen, S.N. (1998) An exceptionally well-preserved theropod dinosaur from the Yixian Formation of China. *Nature*, 391, 147–152.

Ding, Q.H., Zhang, L.D., Guo, S.Z., Zhang, C.J., Peng, Y.D., Jia, B., Chen, S.W. & Xing, D.H. (2001) The stratigraphic sequence and fossil bearing horizon of the Yixian Formation in western Liaoning, China. *Geology and Resources*, 10(4), 193–198 (In Chinese, English abstract).

Dolin, V.G. (1975) To the systematics of the Mesozoic click-beetles (Coleoptera, Elateridae). *Paleontolgicheskii Zhurnal*, 4, 51–62 (In Russian).

Dolin, V.G. (1976) Fossil click-beetles (Coleoptera, Elateridae) of the sub-families Negastriinae and Cardiophorinae from Upper Jurassic of Karatau. *Vestnik Zoologii*, 2, 67–75 (In Russian).

Dolin, V.G. (1980) Click-beetles (Coleoptera, Elateridae) from Upper Jurrasic of Karatau. *In*: Dolin, V.G., Panfilov, D.V., Ponomarenko, A.G. & Pritykina L.N. (Eds.), *Mesozoic Fossil insects*. Naukova Dumka Publ House, Kiev, 17–81 (In Russian).

Dolin, V.G. & Nel, A. (2002) Three new fossil Elateridae from Superior Mesozoic in China (Coleoptera). *Bulletin de la Société entomologique de France*, 107(4), 341–346 (In French).

Dunstan, B. (1923) Introduction and Coleoptera. *In*: Tillyard R. J. (Ed.) *Mesozoic Insects of Queensland*. Queensland Geological Survey press, Brisbane, pp. 44–47.

Gardiner B.G. (1961) New Rhaetic and Liassic beetles. *Palaeontology*, 1(4), 87–88.

Handlirsch, A. (1906–1908) *Die fossilen Insekten und die Phylogenie der rezenten Formen*. Wilhelm Engelmann, Leipzig, 1430 pp (In German).

Hong Y.C. (1982) *Mesozoic Fossil Insects of Jiuquan Basin in Gansu Province*. Geological Publishing House, Beijing, 129 pp (In Chinese).

Hong Y.C. (1984) Mesozoic Division. *In*: Geological Institute of Tianjin (Ed.), *Atlas of Palaeontology from North Region of China*. Geological Publishing House, Beijing, pp. 167–168 (In Chinese).

Hörnschemeyer, T., Tröster, G. & Wedmann, S. (1995) The Eocene beetle faunas of the Geiseltal and the Grube Messel—a comparison under systematic and paleoecological aspects. *Jahrbuch der Geowissenschaften*, 17, 107–111 (In German).

Johnson, P.J. (2007) Costa Rican Elateridae: The Click Beetles, Skipjacks, or Snappers. Available from http://nathist.sdstate.edu/SMIRCOL/Costa_Rica/crcero (accessed 8 July2007)

Lawrence, J.F. (1982) Coleoptera. *In*: Parker, S. (Ed.), *Synopsis and Classification of Living Organisims*. McGraw-Hill, New York, pp. 482–553.

Lawrence, J.F., Hastings, A.M., Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (2000) Elateriformia (Coleoptera): descriptions, illustrations, identification, and information retrieval for families and subfamilies. Available from http://delta-intkey.com (accessed 9 October 2005)

Lawrence, J.F. & Newton, A.F. (1995) Families and subfamilies of Coleoptera (with selected genera, notes, references and data on family-group names). *In*: Pakaluk, J. & Slipinski, S.A. (Eds), *Biology, Phylogeny, and Classification of Coleoptera. Papers Celebrating the 80th Birthday of Roy A. Crowson*. Muzeum I Instytut Zoologii PAN, Warsaw, pp. 779–1006.

Lin, Q.B. (1986) Early Mesozoic Insects of South China. *Palaeontologica Sinica*. Science Press, Beijing, 79 pp (In Chinese).

Martynov, A.B. (1926) To the knowledge of fossil insects from jurassic beds in Turkestan. *Annuals of the Russian Paleontological Society*, 1–38.

Nel, A., Plöeg, G., Dejax, J., Duffaud, S., Gaudant, J., Hau, S., Jossang, A., Lapparent, F., Pozzi, J.P., Paicheler, J.C., Bouchet, F. & Rage, J.G. (1999) Un gisement sparnacien exceptionnel à plants, arthropods et vertébrés. *Comptes-Rendus de l'Académie des Sciences*, 329, 65–72 (In French).

Ping, Z. (1928) Cretaceous fossil insects of China. *Palaeontologia Sinica*, 13(1), 1–35.

Ren, D., Lu, L.W., Ji, S.A. & Guo, Z.G. (1995) *Faunae and Stratigraphy of Jurassic-Cretaceous in Beijing and the adjacent areas*. Seismic Publishing House, Beijing, 223 pp (In Chinese).

Swisher, C.C., Wang, Y.Q., Wang, X.L., Xu, X. & Wang, Y. (1999) Cretaceous age for the feathered dinosaurs of Liaoning, China. *Nature*, 400, 58–61.

Tröster, G. (1991) A new genus of Elateridae (Insecta:Coleoptera) *Macropunctum* gen. n. of the Messel formation of the Middle-Eocene. *Courier Forschungsinstitut Senckenberg*, 139, 99–117 (In German).

Tröster, G. (1993) Fossil click-beetles of the genus *Lanelater* ARNETT 1952 (Coleoptera, Pyrophorinae, Agrypnnini) from the Eocene of the Messel Pit, near Darmstadt. *Senckenbergiana letheaa*, 73(1), 49–60 (In German).

Tröster, G. (1994a) Fossil Elateridae (Insecta: Coleoptera) from the middle Eocene (Lutetium) of the Grube Messel near Darmstadt. *Courier Forschungsinstitut Senckenberg*, 170, 11–64 (In German).

Tröster, G. (1994b) New species of the genus *Macropunctum* (Insect, Coleoptera, Elateridae) from the middle Eocene of the Messel pit near Darmstadt. *Paläontologische Zeitschrift*, 68, 145–162 (In German).

Tröster, G. (1999) An unusual new fossil click-beetle (Coleoptera: Elateridae) from the Middle Eocene of the Grube Messel (Germany). *Neues Jahrbuch Geologie,Paläontologische Monatshefte*, 1999(1), 11–20.

Wang, W.L., Zhang, L.J., Zheng, S.L., Ren, D., Zheng, Y. J., Ding, Q.H., Zhang, H., Li, Z.T. & Yang. F.L. (2005) The age of the Yixian stage and the boundary of Jurassic-Cretaceous_the establishment and study of stratotypes of the Yixian stages. *Geological Review*, 51(3), 234–242 (In Chinese, English abstract).

Yablokov-Khzorjan, S.M. (1961) New Coleoptera of family Elateridae from Baltic amber. *Paleontolgicheskii Zhurnal*, 3, 84–97 (In Russian).

Zhang, H.C. (1997) A new genus of Elateridae (Insecta, Coleoptera) from lower-middle Jurassic of Junggar Basin, Xinjiang, China. *Acta Micropalaeontologica Sinica*, 14, 71–77 (In Chinese).

Zhang, J.F. (1989) *Fossil Insects from Shanwang, Shandong, China*. Shandong Science Technological Press, Jinan, 122 pp (In Chinese).

Zhang, J.F. (1994) *Middle Miocene Insects and Spiders from Shanwang, Shandong, China*. Science Technological Press, Beijing, 91 pp (In Chinese).