

New Beetles (Coleoptera) from the Terminal Middle Permian of China

A. G. Ponomarenko^a, E. V. Yan^{a, b}, and Huang Di-ying^b

^a*Borissiak Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya ul. 123, Moscow, 117997 Russia*

^b*State Laboratory of Paleobiology and Stratigraphics, Nanjing Institute of Geology and Paleontology,
Chinese Academy of Sciences, East Beijing Road 39, Nanjing, 210008 China*

e-mail: aponom@paleo.ru

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Abstract—New beetles are described from the Middle Permian (Upper Capitanian) locality Yinping (Anhui Province, China): *Linicupes yinpinensis* gen. et sp. nov. (Permocupedidae), *Taldycupes pingi* sp. nov. (Taldycupedidae), *Archosyne permiana* gen. et sp. nov., *Chaocoleus limnebius* gen. et sp. nov. (Ademosynidae) and *Asiocolopsis hongji* sp. nov. (Asiocolidae); the type material of *Dikerocoleus divisus* Lin, 1982 from the same type locality is redescribed. Comparison with beetles from the Permian of European Russia shows that Yinping beetles are similar to Late Severodvinian beetles rather than to Early Severodvinian and Urzhumian ones.

Keywords: new beetles, Coleoptera, Terminal Middle Permian, China

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INTRODUCTION

The Permian is one of the most important periods in the evolution of life on Earth. At the end of this period, the biota of Earth suffered the largest ecological crisis in history. Studies of beetle fossils from numerous Permian localities of Siberia (Rohdendorf, 1961) and European Russia (Ponomarenko, 2004, 2013) have shown that fossil beetles are a useful tool for studying ecological and evolutionary changes that took place in the Permian and Triassic, and for determining correlations, including intercontinental ones.

Until recently, there were almost no records of Permian beetles in China, with the exception of a single specimen described as *Dikerocoleus divisus* Lin, 1982 from Wuchiapingian deposits (now they are considered terminal Capitanian: see below) of the Anhui Province, South China (Lin, 1982). Hence, the discovery of an entire collection of Permian beetle fossils in the Yinping locality proved important and interesting, the more so for the fact that the majority of these fossils are represented by almost complete insects. Complete fossils are rare even in those localities in which numerous beetles have been collected. Importantly, in the Permian South China was in the tropical zone, while all other localities were in the temperate zone.

In addition to descriptions of new materials, a redescription of *Dikerocoleus* based on a reexamination of the holotype is provided below. In the original description, *Dikerocoleus* is considered a cupedid close to *Kaltanicupes* Rohdendorf, 1961. Our observa-

tions show that *Dikerocoleus* should be placed in the family Schizophoridae (see below).

YINPING LOCALITY

The age of the deposits from which *Dikerocoleus* was described has recently been reconsidered several times. Following Huang et al. (2007) and Lin et al. (2010), we accept that *Dikerocoleus* and the beetle fossils described below originate from the Yinping Formation, whereas before 1981, when the Yinping Formation was established (*Regional Geology...*, 1987), these deposits were termed “underlying shales of the Longtan Formation,” the basal part of the Upper Permian in the Anhui Province. Therefore, in the original description of *Dikeroñoleus* (Lin, 1982) it was indicated that it originates from the Wuchiapingian Longtan Formation. The specimens of bivalves *Myalina*, an ammonite *Kufengoceras*, foraminifers *Celebetes* and others collected at the base of the section allowed us to correlate the Yingping formation with the Yanquiao Formation in the south of the Jiangsu Province, the coal-bearing Shimei sequence of the Dingjia Formation in the western Zhejiang Province, and the Tungzi sequence in the Fujian Province, considering them as coeval deposits from different sedimentation conditions, and, if the Middle Permian is recognized, to consider the age of the deposits assigned to the Yinping Formation, to be Upper Capitanian. The indication of the Gufeng (traditionally rendered as Kufeng) Formation as the locality of *Dikeroñoleus* (*Regional Geology...*, 1987), is probably erroneous. The Yinping

Formation consists mainly of gray and dark gray siltstones and shales; the formation was deposited under conditions varying from coastal marine to wetland (Song et al., 2007); these rocks contain a lot of terrestrial detritus, including rather numerous insect fossils. The presence of the marine fauna in them and the relatively reliable correlation with other marine deposits make it possible to get precise notions about the age of these fossils and to specify the positions of Permian beetle localities of Europe, Siberia, and South Africa.

MATERIALS AND METHODS

The fossils described here originate from the Yinping locality, Yinpinghoudong section, Yinping Mountains near the southern part of Lake Chaohu southwest of Chaohu town, Anhui Province, China. The fossils were studied under Leica M165C, Nikon SMZ1000, and Zeiss Discovery V20 microscopes and photographed with digital cameras Leica DFC 425 (for Leica), DXM1200 (for Nikon), and AxioCam HRc (for Zeiss Discovery). The line drawings were produced by tracing the outlines on photographs in CorelDRAW 12 and X4 software; the photographs were processed in Adobe Photoshop CS and CorelDRAW X4. Solid lines in the drawings show distinct boundaries of sclerites; dashed lines show indistinct boundaries; dash-and-dot lines show folds. Dorsal and ventral structures are shown in different drawings, even if they are drawn from the same photograph. In some cases, in which different authors produced different interpretations of morphology, all such interpretations are shown. The scale bar in all figures is 1 mm. The morphological nomenclature is standard.

The material is stored in the Nanjing Institute of Geology and Paleontology, Chinese Academy of Sciences (NIGP).

SYSTEMATIC PALEONTOLOGY

Order Coleoptera

Suborder Archostemata

Family Permocupedidae Martynov, 1933

This family is represented in the collection by a single isolated elytron, placed in this family because of the presence of pronounced cells divided by veins, with main and intermediate veins clearly different in width. The elytral base has a short area in which the neighboring main veins are separated by six rows of cells. The fossil is described in a new genus.

Genus *Linicupes* Ponomarenko, Yan et Huang, gen. nov.

E t y m o l o g y. In honor of one of the founders of Chinese paleoentomology, Professor Lin Qi-bin.

Type species. *Linicupes yinpinensis* sp. nov., by monotypy.

D i a g n o s i s. Small, flattened, wide beetle. Elytron wide and flat, widest medially, with apex asymmetrical. Epipleural border wide, with row of large oval cells. Intermediate veins zigzagging. Cells polygonal, surrounded by small tubercles on veins. External and median areas of elytron with three rows of cells. Dilated part of medial (cubital) area at base of elytron with six rows of small cells.

S p e c i e s c o m p o s i t i o n. Type species.

C o m p a r i s o n. The new genus has a rather rare character: six rows of cells at the base of the cubital area; such structure of this area is known only in the genera *Cytocupes* Rohdendorf, 1961 and *Cytocuoides* Rohdendorf, 1961 from the Middle Permian of the Kuznetsk Basin, but both genera have elongate narrow elytra without wide epipleural borders and with only two rows of cells in the median area. The genus *Uralocupes* Ponomarenko, 1969 from the Middle Permian of European Russia has three rows of cells in the median area, but it has a narrower epipleural border and indistinct row of cells on it.

Linicupes yinpinensis Ponomarenko, Yan et Huang, sp. nov.

Plate 13, fig. 1

E t y m o l o g y. From the Yinping locality.

H o l o t y p e. NIGP, no. 158303, direct impression of right elytron; Yinping locality; terminal Middle Permian.

D e s c r i p t i o n (Fig. 1). The elytron is less than three times as long as wide. The epipleural border barely narrows posteriad. The main elytral veins are clearly wider than intermediate veins, not fused in the apical part of the elytron; intermediate veins are zigzagging. Each row contains about 40 cells. All veins bear small tubercles.

M e a s u r e m e n t s, mm. Elytron length, 2.6; elytral width, 1.5.

M a t e r i a l. Holotype. The piece of rock contains an abdomen lying near the elytron, of fitting size and having large tubercles typical of cupedoids. It is probably part of the same beetle. The abdomen has five sternites; the basal sternite is the shortest; the terminal sternite is 1.5 times as long as the previous sternite, triangular, 1.5 times as wide basally as long. The posterior two thirds of sternites 2–4 are raised and bear larger tubercles than on the anterior thirds or on the basal sternite.

Family Taldycupedidae Rohdendorf, 1961

Rohdendorf (1961) proposed this family for isolated elytra, and records of complete beetles remain very rare. The family was revised in the 1960s (Ponomarenko, 1969) and has not been reconsidered since then. The studied specimens are placed in this family, because the main and intermediate elytral veins do not differ in width and because at the base of the elytron there is a dilated part of the median area containing

numerous small cells. All specimens placed in this family belong to one new species placed in the genus *Taldycupes* Rohdendorf, 1961, because their main veins are not fused near the apex, the vein closest to the suture almost reaches the elytral apex, external area of the elytron contains three rows of cells, and the dilated part of the median area contains four rows of cells.

Genus *Taldycupes* Rohdendorf, 1961

Taldycupes pingi Ponomarenko, Yan et Huang, sp. nov.

Plate 13, figs. 2–4

Etymology. In honor of Ping Chzhi, the founder of Chinese paleoentomology.

Holotype. NIGP, no. 158304, beetle without most of its antennae and legs; Yinping locality; terminal Middle Permian.

Description (Fig. 2). Rather small, flattened, wide beetle. The head without mandibles is somewhat longer than wide, slightly narrowed. The gena is shorter than the eye; the temple is longer than the eye. The eyes are lateral, small. The antenna reaches somewhat beyond the base of the prothorax; the pedicel is shorter than the scape; antennomere 3 is longer than the scape. The pronotum is transverse, 2.5 times as wide as long, weakly narrowed from the base, with anterior angles not protruding. The pronotum is no longer than the procoxae; the pleural sutures are not fused near the anterior margin of the prosternum. The procoxa is rounded; the prosternal process is long and wide. The apical abdominal sternite is twice as long as the preapical sternite. All body is covered with small dense tubercles.

The elytron is three times as long as wide, widest in the apical third, with the apex almost symmetrical. The epipleural border is narrow. The principal veins of the elytra are somewhat wider than the intermediate veins and not fused near the apex. The intermediate veins are straight. The elytral cells are longitudinal subrectangular, paired, situated in rows of about 30 cells per row; cells in the dilated basal part of the cubital area and at the base of the anal area are smaller than cells in other parts of the elytron. The scutellar row of cells is longer than the shortened rows at the base of the cubital area. Two sutural rows of cells almost reach the elytral apex.

Measurements, mm. Body length; about 5.5; body width, about 2; head length, 1; antenna length, 1; prothorax length, 0.6; abdomen length, 1.6; elytron length, 3.3.

Comparison. The new species belongs to a group of species with straight intermediate veins and paired subrectangular cells. It is especially similar to *T. reticulatus* Ponomarenko, 1969 from the Middle Permian of the East Kazakhstan in the long scutellar vein and differs from it in the small cells in the dilated part of the cubital area and long scutellar rows of cells almost reaching the elytral apex.

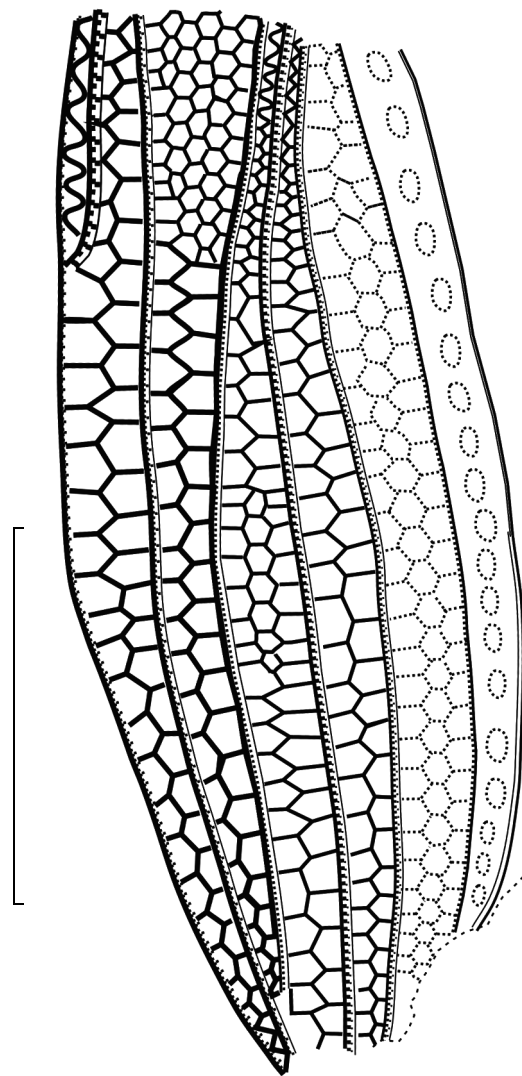


Fig. 1. *Linicupes yinpinensis* sp. nov., holotype NIGP, no. 158303. Scale bar in Figs. 1–6, 1 mm.

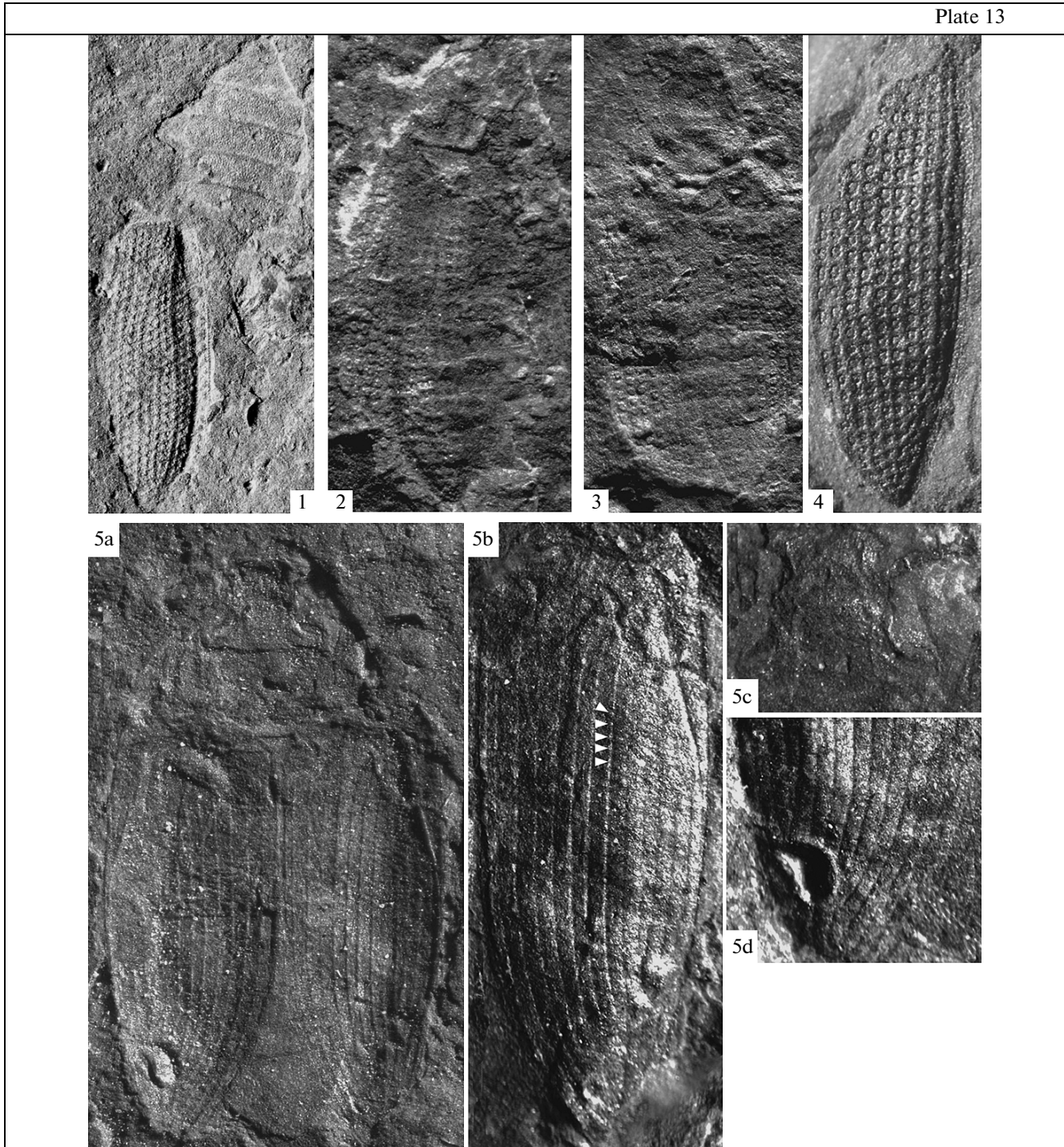
Material. Holotype and paratypes NIGP, no. 158305CHP-3, beetle without most of its antennae and legs, and NIGP, no. 158306, incomplete right elytron.

Family Ademosynidae Ponomarenko, 1969

The beetles described below are placed in this family because of the presence of prosternal sutures independently reaching into the anterior margin of the prosternum, metepisternum reaching the mesocoxal cavity, trochantinal suture of metaventrite, and elytra without schiza and with puncture grooves.

Genus *Archosyne* Ponomarenko, Yan et Huang, gen. nov.

Etymology. From the Greek *archaios* (ancient) and generic name *Ademosyne* Handlirsch, 1906.



Explanation of Plate 13

Families Permocupedidae, Taldycupedidae, Ademosynidae; Yinping, South China; terminal Middle Permian.

Fig. 1. *Linicupes yinpinensis* sp. nov., holotype NIGP, no. 158303, $\times 21.5$.

Figs. 2–4. *Taldycupes pingi* sp. nov.: (2) holotype NIGP, no. 158304, $\times 17.9$; (3) paratype NIGP; no. 158305, $\times 19.7$; (4) paratype NIGP, no. 158306, $\times 26.7$.

Fig. 5. *Archosyne permiana* sp. nov., holotype NIGP, no. 158302: (5a) habitus, $\times 24.4$; (5b) right elytron, $\times 34.4$, arrows indicate punctures in grooves; (5c) head, $\times 35.4$; (5d) apex of left elytron, $\times 35.4$.

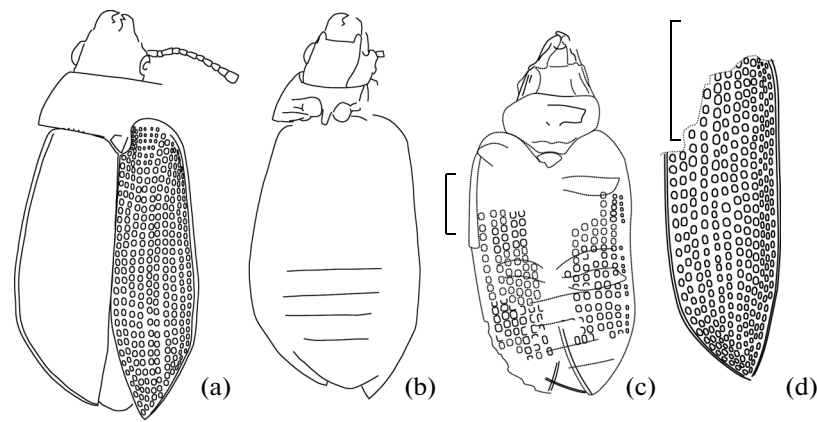


Fig. 2. *Taldycupes pingi* sp. nov.: (a, b) holotype NIGP, no. 158304: (a) in dorsal view, (b) in ventral view; (c) paratype NIGP, no. 158305, in dorsal view; (d) paratype NIGP, no. 158306.

Type species. *Archosyne permiana* sp. nov.

Diagnosis. Small, flat, wide beetle. Head prognathous, rather large. Mandibles large, visibly protruding from below labrum. Eyes lateral, large. Pronotum strongly transverse, wider than head, and narrower than elytra. Propleural sutures independently reaching into anterior margin of prosternum. Procoxa large, transverse; prosternal process narrow and short. Metaventricle trapezoid, with lateral sides almost not rounded; longitudinal metaventral suture weak; paracoxal and trochantinal sutures distinct. Elytron with wide epipleural border. Elytral disc with 12 puncture grooves. Grooves of anterior half of elytron fused near elytral apex. Sutural groove reaching middle of elytron.

Species composition. Type species.

Comparison. The new genus differs from the other genera of the family in the prognathous head, paired tubercles on the prosternum, large transverse procoxa, very small prosternal process, almost straight lateral margins of prosternum, and elytra with 12 puncture grooves, the anterior grooves fused near the elytral apex.

Archosyne permiana Ponomarenko, Yan et Huang, sp. nov.

Plate 13, fig. 5

Etymology. From the Permian period.

Holotype. NIGP, no. 158302, part and counterpart of beetle without some of its legs; Yinping locality; terminal Middle Permian.

Description (Fig. 3). The beetle is only 1.8 times as long as wide. The head makes up around 1/6 of the body length; it is almost square, very weakly narrowing anteriorly from the base, with a longitudinal elevation medially. The attachment site of the antenna is oblique, situated on a strongly sclerotized rectangular protrusion of the frons running from the anterior margin to the middle of the eye. The eye is lateral,

oval, 0.4 times as long as the head, weakly protruding to the side, with the internal margin outlined with a carina. The labrum is free, trapezoid. The mandibles protrude to half their length from under the labrum; the mandible is half as long as the head capsule, thick, with the apex pointed and a small tooth in the middle of the cutting edge. The antenna is rather short, filiform; the scape is elongate oval, three times as long as the pedicel, twice as long as each of antennomeres 3–7; antennomeres 3 and 4 are slightly longer than antennomeres 5 and 6.

The pronotum is transverse, more than twice as wide as the head, approximately twice as wide as long, weakly narrowed anteriorly, with the anterior angles protruding to the level of the middle of the eye. The flattened sides of the pronotum are tuberculate. The prosternum is longer than the procoxae. The propleu-

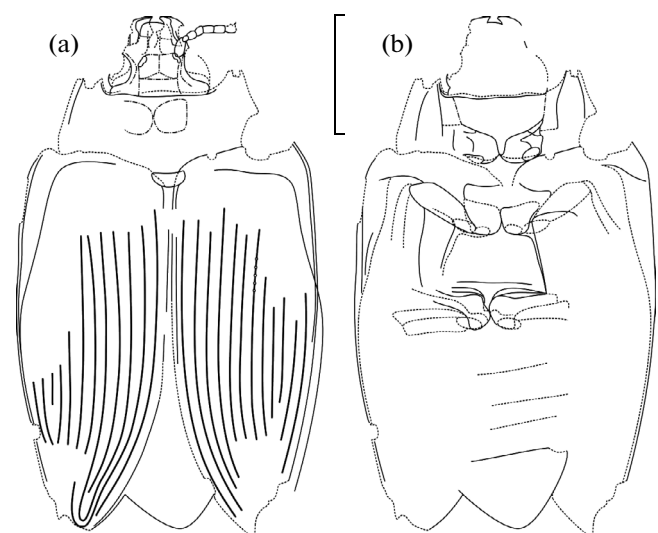


Fig. 3. *Archosyne permiana* sp. nov.: (a, b) holotype NIGP, no. 158302: (a) in dorsal view, (b) in ventral view.

ron is narrowing anteriorly. The prosternal process narrows towards its rounded apex and does not reach the posterior margins of the procoxae. The scutellum is large, semicircular; the base of the elytron is 3.5 times as wide as the scutellum. The mesocoxae are contiguous. The metaventrite is 1.8 times as wide (at posterior margin) as long; the posterior process of the metaventrite reaches the middle of the metacoxae; the paracoxal suture angulately protrudes posteriad. The metepisternum is dilated anteriorly, with an oblique anterior margin. The metacoxae are strongly shortened laterally, 2.5 times as wide as long. The abdomen is longer than the meso- and metathorax together. The apical abdominal sternite is triangular, 2.5 times as long as the preceding sternite. The legs are rather short; femora do not reach beyond the body outline; mesofemur and mesotibia are subequal in length; femora are thickened; tibiae are dilated towards the apex; meso- and metatrochanter are one third as long as the meso- and metafemur, respectively.

The elytron is 2.5 times as long as wide medially, with the apex symmetrical. The epipleural border is widest at the base of the elytron, narrowing towards the middle of the elytron. The fourth groove from the sutural margin ends blindly; the third and fifth grooves are closed around it; the second and sixth grooves are roundedly closed around the third and fifth groove. The distance between two adjacent punctures in the grooves is subequal to the puncture diameter. The epipleuron has two grooves, which probably participated in forming the lock between the elytron and abdomen.

Measurements, mm. Body length, 4.3; body width, about 2.4; head length, 0.6; prothorax length, 0.7; abdomen length, 1.8; elytron length, 3.2; elytron width, 1.3.

Material. Holotype.

Genus *Chaocoleus* Ponomarenko, Yan et Huang, gen.nov.

Etymology. From Lake Chaohu.

Type species. *Chaocoleus limnebius* sp. nov.

Diagnosis. Rather small convex beetle. Head is large, prognathous, longer than wide. Mandibles not protruding. Antennae 11-segmented, rather short, thickened apically. Pronotum not curved downward, flattened laterally, considerably wider than head, roundedly narrowed anteriorly; pleural sutures apically directed towards each other, but nevertheless reaching into anterior margin of prosternum independently. Procoxae transverse; prosternal process long and wide. Elytron with poorly visible puncture grooves.

Species composition. Type species.

Comparison. The new genus differs from all other genera in the pronotum strongly narrowed anteriorly, with flattened sides.

Chaocoleus limnebius Ponomarenko, Yan et Huang, sp. nov.

Plate 14, fig. 1–2

Etymology. From the Greek *limnos* (lake).

Holotype. NIGP, no. 158308ab, part and counterpart of beetle without most of its legs; Yinping locality; terminal Middle Permian.

Description (Fig. 4). The body is 2.2 times as long as wide. The head is 1.2 times as long as wide, narrowing anteriorly from its base. The gena is short; the temple is longer than the eye. The eyes are lateral, small. The antenna reaches the middle of prothorax. The scape and apical antennomere are the longest antennomeres; antennomere 3 is shorter than the scape; antennomeres 5 and 6 are larger than each of antennomeres 4 and 7–9; distal antennomeres thickened; apical antennomere egg-shaped, almost twice as thick as the scape.

The pronotum is transverse, 1.9 times as wide as long, twice as wide as the head, narrowed anteriorly from the base, with the posterior margin almost twice as wide as the anterior margin and anterior angles protruding. The prosternum is shorter than the procoxae. The procoxa is three times as wide as the prosternal process. The scutellum is semicircular. The mesocoxae are rounded, almost contiguous. The metaventrite is roundedly narrowing in the anterior third, 1.5 times as wide basally as long. The longitudinal, paracoxal, and trochantal sutures are clearly pronounced. The metepisternum is twice at the anterior margin as wide as at the posterior margin. The metacoxa is short, twice as wide as long. The abdomen is longer than the meso- and metathorax together. Abdominal sternites 1 and 2 are longer than ventrites 3 and 4; apical sternite is twice as long as the preceding one. The body is covered with small dense tubercles; flattened lateral parts of the pronotum bear large rounded tubercles.

The elytron is three times as long as wide, narrowing in the anterior half, with the apex almost symmetrical. The epipleural border is narrow.

Measurements, mm. Body length, about 5.8; body width, 2.7; head length, 1.0; pronotum length, 0.7; abdomen length, 1.8; elytron length, 4.4; elytron width, 1.6.

Material. Holotype and paratype NIGP, no. 158309, part and counterpart of beetle without most of its legs, from the same locality.

Family Asiocoleidae Rohdendorf, 1961

This family was proposed by Rohdendorf (1961) for a single isolated elytron from the Middle Permian of the Kuznetsk Basin. The elytron had only three main veins; the two closest to the suture were branching. One of the beetles represented by an elytron in the studied collection also had three main veins, but only one of them, the middle one, is branching. We place this beetle in a new genus of the family Asiocoleidae.

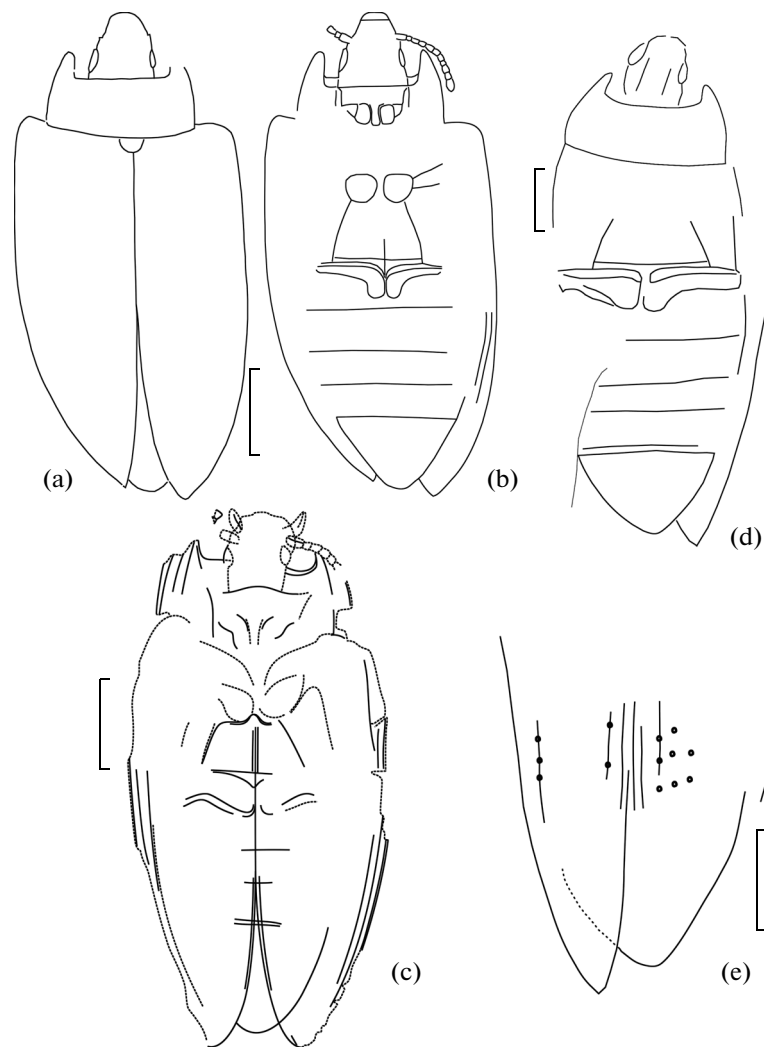


Fig. 4. *Chaocoleus limnebius* sp. nov.: (a, b, c) holotype NIGP, no. 158308ab: (a) in dorsal view, (b, c) in ventral view, alternative interpretations; (d, e) paratype NIGP, no. 158309: (d) in ventral view, (e) in dorsal view.

Genus *Asiicoleopsis* Ponomarenko, Yan et Huang gen. nov.

E t y m o l o g y. From the generic name *Asiicoleus* Rohdendorf, 1961.

T y p e s p e c i e s. *Asiicoleopsis hongii* sp. nov.

D i a g n o s i s. Elytron with three main veins; middle main vein branching. Epipleural border very wide, with row of large cells. Main vein closest to suture reaching elytral apex. Elytral cells strongly differing in size, some of them very large.

S p e c i e s c o m p o s i t i o n. Type species.

C o m p a r i s o n. The new genus is distinguished by the branching of the middle vein only, very wide epipleural border, and elytral cells strongly differing in size.

Asiicoleopsis hongii Ponomarenko, Yan et Huang, sp. nov.

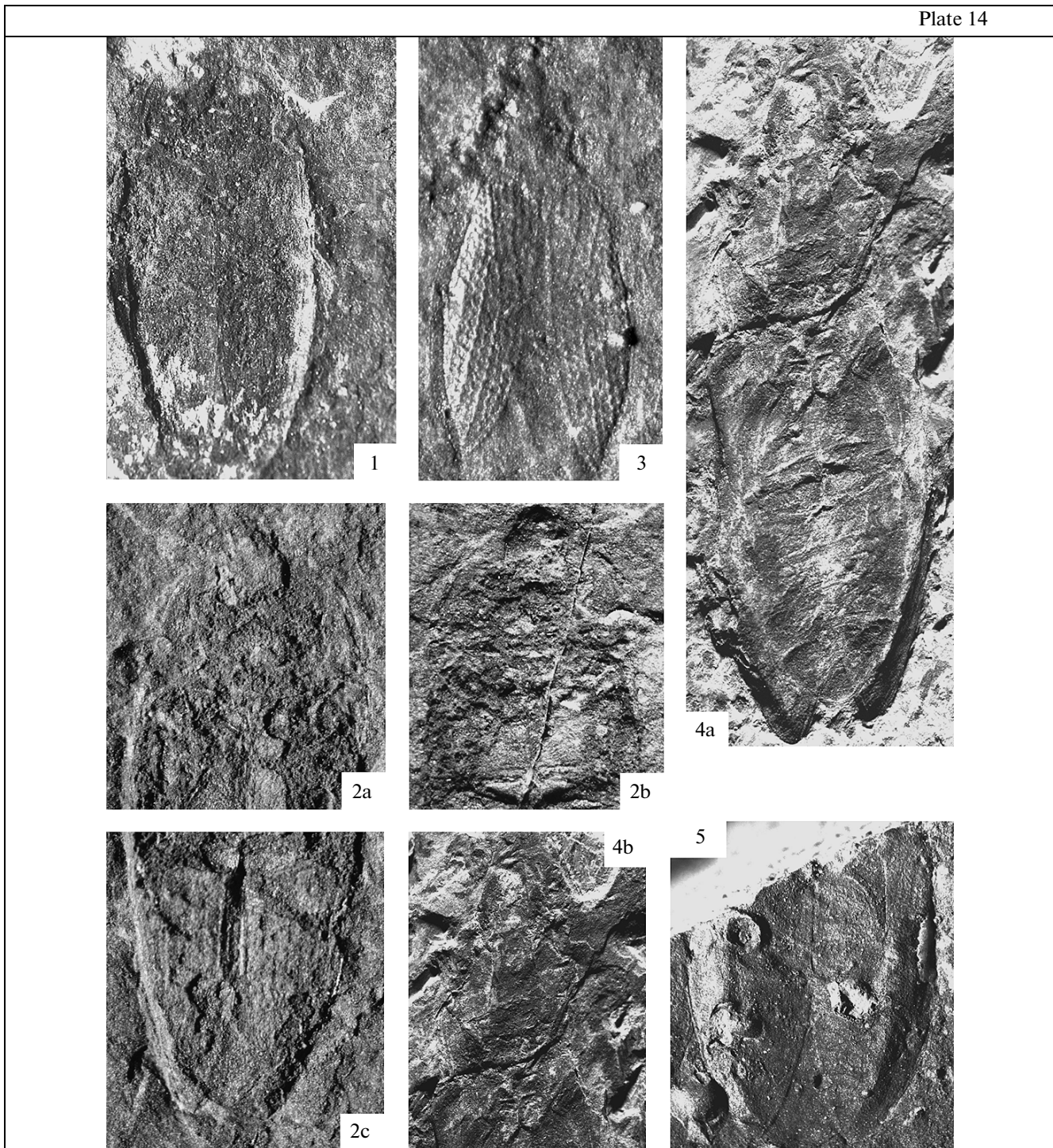
Plate 14, fig. 3

E t y m o l o g y. In honor of Hong Yu-chong, one of the founders of Chinese paleoentomology.

H o l o t y p e. NIGP, no. 158307, direct impression of beetle without legs and antennae; Yinping locality; terminal Middle Permian.

D e s c r i p t i o n (Fig. 5). A rather small narrow beetle. The head is slightly longer than wide and slightly narrowed anteriorly from the base. The gena and temple are shorter than the eye. The eyes are lateral, small. The pronotum is transverse, approximately twice as wide as long, not narrowed anteriorly, with the anterior margins not protruding. The apical abdominal sternite is twice as long as the preceding sternite. The entire body is covered with small dense tubercles.

The elytron is 2.7 times as long as wide, dilated from the base, widest in front of the middle, narrowed more distally, with the apex asymmetrical. The epipleural border is very wide, with two or three rows of cells. The main elytral veins are markedly wider than the intermediate veins, not fused near the elytral apex; the middle main vein and the main vein closest to the suture are wider than the main vein closest to the external margin. The middle main vein branches in the basal third. The intermediate



Explanation of Plate 14

Families Ademosynidae, Asiocoleidae, Schizophoridae; Yinping, South China; terminal Middle Permian.

Figs. 1 and 2. *Chaocoleus limnebius* sp. nov.: (1) holotype NIGP, no. 158308, $\times 16.6$; (2) paratype NIGP, no. 158309: (2a, 2b) anterior half of body, (2c) elytra, $\times 20$.

Fig. 3. *Asiocoleopsis hongii* sp. nov., holotype NIGP, no. 158307, $\times 29.5$.

Figs. 4 and 5. *Dikerocoleus divisus* Lin, 1982, holotype NIGP, no. 70704: (4a) habitus, $\times 12.4$, (4b) anterior half of body, $\times 12.6$; (5) specimen NIGP, no. 1583107, $\times 8$.

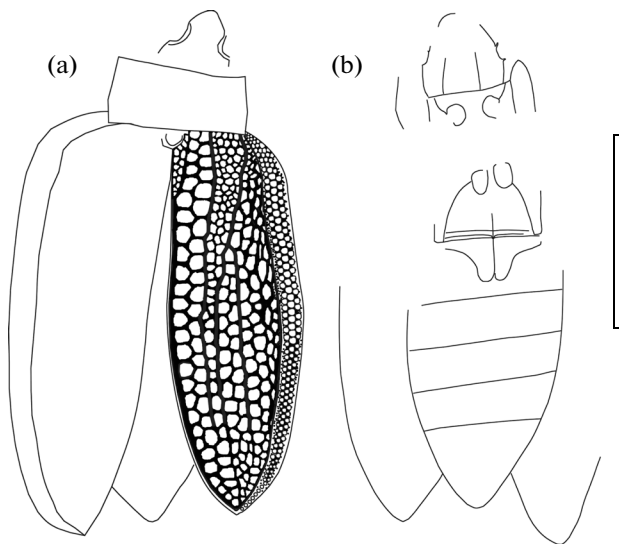


Fig. 5. *Asiocoleopsis hongii* sp. nov., holotype NIGP, no. 158307: (a) dorsal view, (b) ventral view.

veins are zigzagging. The elytral cells strongly differ in size; the larger ones are pentagonal; the smaller ones are rounded; each row contains about 25 cells. The area behind the middle vein is dilated. The small multiple-row cells in this area reach one third of the elytron. The cells are surrounded with tubercles; the tubercles running along the main veins are larger.

M e a s u r e m e n t s, mm. Body length, about 1.5; head length, 0.5; prothorax length, 0.3; abdomen length, 1.5; elytron length, 2.2.

M a t e r i a l. Holotype.

Family Schizophoridae Ponomarenko, 1968

This family was described for Triassic and Jurassic beetles based on the presence of the archostematan type of the metathorax and dorsally smooth elytra bearing the “schiza,” a protrusion on the internal surface of the elytron, seen in fossils as a small longitudinal groove. Isolated elytra of such structure are very abundant in the Middle Permian and, especially, in the Upper Permian and Triassic. Since this structure of elytra occurs not only in schizophoroids, but also in other groups of beetles, it was proposed to describe isolated elytra of this structure in the formal family Schizocoleidae. Complete fossils of Permian schizophorids have never been described before.

Dikerocoleus divisus Lin, 1982 was described in the family Cupedidae (called “Cupidae” by the author of this species), but it has smooth elytra and has to be placed in the family Schizophoridae. The genus *Dikerocoleus* is redescribed below based on our reexamination of the holotype.

Genus *Dikerocoleus* Lin, 1982

Dikerocoleus: Lin Qi-bin, 1982, p. 332.

Type species. *Dikerocoleus divisus* Lin, 1982.

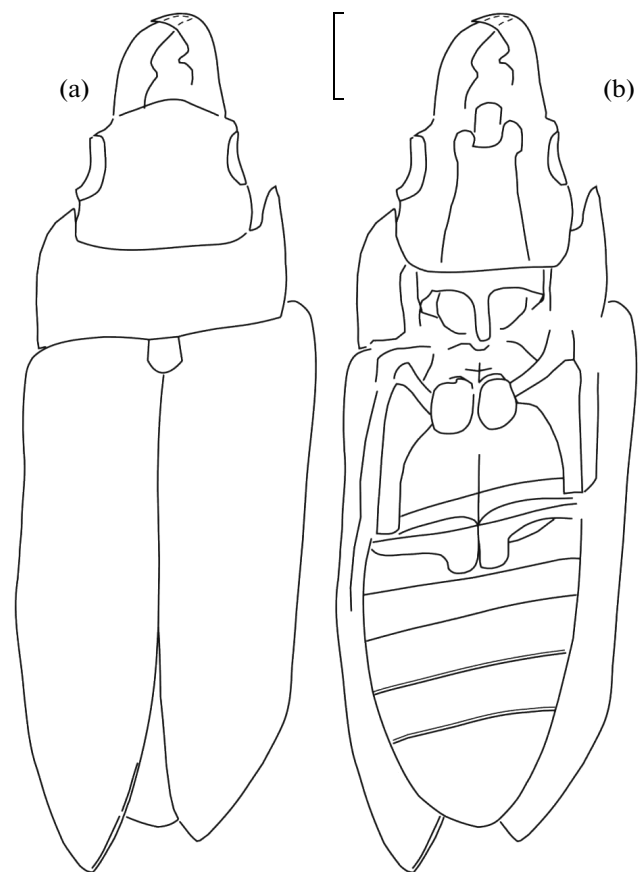


Fig. 6. *Dikerocoleus divisus* Lin, 1982, holotype NIGP, no. 70704: (a) dorsal view, (b) ventral view.

D i a g n o s i s. Medium-sized narrow beetle. Head large, antennae markedly thickened toward apex. Mandibles large, protruding anteriorly. Pronotum without flattened lateral parts. Procoxa rounded; prosternal process long and wide. Elytron without rows of punctures.

S p e c i e s c o m p o s i t i o n. In addition to the type species, another, undescribed species from the same locality.

C o m p a r i s o n. This genus differs from all genera of the family except *Catabrycus* Ponomarenko, 1969 by the very large mandibles protruding anteriorly. It differs from *Catabrycus* in the much smaller size, small mandibular teeth, and pronotum without flattened lateral parts.

Dikerocoleus divisus Lin, 1982

Plate 14, figs. 4, 5

Dikerocoleus divisus: Lin Qi-bin, 1982, p. 332, pl. 126, fig. 2.

H o l o t y p e. NIGP, no. 70704, part and counterpart of a beetle without some portion of antennae and legs; Yinping locality; terminal Middle Permian.

D e s c r i p t i o n (Fig. 6). The head without mandibles is slightly longer than wide, narrowed anteriorly from its base. The gena is very short; the temple is shorter than the eye. The eyes are lateral, rather large. The mandible is

only slightly shorter than the head capsule. The pronotum is transverse, approximately twice as wide as long, narrowed in the anterior half, with protruding anterior angles. The prosternum is longer than the procoxae; the pleural sutures are not fused near the anterior margin of the prosternum. The procoxa is twice as wide as the prosternal process. The scutellum is semicircular. The meso-coxae are almost contiguous. The metaventrite roundedly narrows anteriorly; it is 1.7 times as wide as long. The longitudinal, paracoxal, and trochantinal sutures are present. The metepisternum is twice as wide at the anterior margin as at the posterior margin. The metacoxa is short, twice as wide as long. The abdomen is longer than the meso- and metathorax together. The apical abdominal sternite is twice as long as the preceding sternite. All body is covered with small dense tubercles.

The elytron is 4.3 times as long as wide, narrowed in the apical third, with the apex almost symmetrical. The epipleural border is narrow.

Measurements, mm. Body length, about 10; body width, about 4; head length with mandibles, 3.5; prothorax length, 1.9; abdomen length, 3.6; elytron length, 6.3; elytron width, 1.7.

Material. Holotype and additional specimen NIGP, no. 158310, posterior half of body from the same locality.

DISCUSSION

The studied collection consists of 11 specimens, nine of which are described above. Only two of these specimens are represented by isolated elytra; in the others the bodies of the beetles are more or less preserved. The collection includes six species, all from different genera. Five genera and all species are new; they belong to five different families. The studied sample is insufficient for statistically significant conclusions, but nevertheless allows making some assertions. The most detailed sequence of beetle fossils is known from European Russia (ER) and the Kuznetsk Basin, Siberia (KB), where up to six levels of changing beetle fossil diversity are known, to which the studied sample can be compared. The family Permocupedidae emerges in the basal Middle Permian; it is especially diverse in the terminal Permian and rare in Severodvinian (ER) and Erunakovian (KB) deposits, as well as in Belmont (Australia); in later deposits representatives of this family disappear, but one specimen has been found in the Anisian of Germany. Taldycupedidae emerge at the end of the Middle Permian, but they are abundant only in Erunakovian deposits; they are also known in Belmont and in the Normandien formation in South Africa; in addition, one Permian genus has been found in the late Triassic of Central Asia and Australia. Complete fossils of Ademosynidae are known only from the Triassic, but isolated wings of the same structure emerge in the Upper Vyatkian (ER) and Erunakovian deposits. The remaining two families are widespread. The Upper Capitanian age of the Yinping formation has been determined from the marine fauna and can be used as the basis for correlation. According to the stratigraphic

scale accepted for ER, it corresponds to Urzhumian deposits, which contain a completely different assemblage of beetles, dominated by Permocupedidae. In ER the boundary between Capitanian and Wuchiapingian corresponds rather to the boundary between the Severodvinian and Vyatkian than to the boundary between the Severodvinian and Urzhumian.

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