Contributions to the Study of Fossil Snipe-Flies (Diptera: Rhagionidae). The Genus *Palaeobolbomyia*

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**Abstract**—Five new species assigned to the genus *Palaeobolbomyia* are described from the Upper Mesozoic of Asia. The age of the deposits and the phylogeny of the genus *Palaeobolbomyia* are discussed. A key is provided to all known species of the genus *Palaeobolbomyia*.

**INTRODUCTION**

The genus *Palaeobolbomyia* was described by Kovalev (1982) for the single species *P. sibirica* included, based on two excellently preserved specimens from the Jurassic of northern Buryatiya. In the course of studying collections of Brachycera it was revealed that the genus *Palaeobolbomyia* was widely distributed in Asia and included at least six species. The type species is now recorded in both the Uda Formation of Transbaikalia and the Karabastau Formation of Kazakhstan. To date, this is the third instance when a rhagionid species has been found in deposits of different strata (Kovalev and Mostovski, 1997; Mostovski et al., 2000). Additionally, new species of *Palaeobolbomyia* are found in the Ortsag Sequence, Bahar Group, in Mongolia and in the Upper Mesozoic of Yakutiya.

The genus *Palaeobolbomyia* is most diverse in the Karabastau Formation (Karatau-Mikhailovka locality) dated as Callovian–Kimmeridgian (Polyansky and Doludenko, 1978; Kirichkova and Doludenko, 1996). The snipe-flies appear to have flourished during the Middle and Late Jurassic. In the fauna of the Karatau-Mikhailovka locality rhagionids are represented by approximately a dozen genera comprising at least 20 species and forming 53 per cent of determinable brachycerans. Besides the Rhagionidae, the brachycerans assigned to 16 more families have been found here, making this the most complete fauna and maybe of all Jurassic faunas. The genus *Palaeobolbomyia* is represented in this locality by three species, one of them was found in Transbaikalian deposits.

The Ortsag Sequence of the Bahar Group in the Central Mongolia may be considered as contemporary to the Karabastau Formation or nearly so (Sinitska, 1993, 1996). The brachyceran fauna is notably more poor here. Besides the only specimen of *P. mongolica* sp. nov., a representative of the family Empididae (Protanidae) (Mostovski, 1999b) and two specimens of asilomorph flies have been found. Ten individuals of Brachycera have been found in total in the underlying Togo-Huduk Sequence of the Bahar Group. Three of them are more distinct and can most probably be assigned to the typical Jurassic family Archisargidae (Mostovski, 1997). Additionally, two rhagionids and two asilomorph flies are found in the Togo-Huduk Sequence.

The Upper Mesozoic deposits of Yakutia exposed in the upper part of the Vilyui River Basin on the right bank of the Kempendyai River in the slope of the Ulakhan-Magan-Khaya Mountain are of particular interest. More than a thousand insect remains have been found here in the siltstone lenses that occurred among the poorly cemented obliquely laminated fine- and middle-grained sandstones. The deposits of the Ulakhan-Magan-Khaya Mountain were briefly described by Martinsson (1961), and Mesozoic deposits of the Kempendyai Depression were reviewed by Korchagin (1972). The insect remains are fragmentary due to the alluvial genesis of the sediments. Rare brachycerans are represented by the families Rhagionidae (four specimens) and Xylophagidae s.l. (a single specimen). The age of the Kempendyai insect assemblage is debatable (Sinitshenkova, 1992; Sukacheva, 1994). Its similarity to Jurassic (Rasnitsyn, 1969; Ponomarenko, pers. commun.) or Early Cretaceous (Rasnitsyn, 1980) faunas has been observed. The genus *Crenoptychoptera* Kalugina, 1985 (Eoptychopteridae) previously found in the Jurassic of Siberia (Kalugina and Kovalev, 1985) and the Kempendyai locality (Kalugina, 1989) is now recorded in Early Neocomian locality of Zhigansk (Lukashevich, 1996). The presence of the genus *Palaeobolbomyia* and the absence of true empidids in the Kempendyai suggest that the beds in question are of Jurassic age. It should be emphasized that Empididae in a broad sense (excluding, however, Protanidae) are the most characteristic element of Cretaceous faunas and are recorded in the earliest Cretaceous of Mongolia (Ulaan-Tolgoi, Hotont, Har-Hutul (Hutel-Hara auct.), and Tsagaan-Tsav localities) and England. Of great interest is distribution of true empidids in the Purbeck Beds in southern England. The only wing assigned to the subfamily Atelestinae, which is extremely rare in...
the fossil record, is from the Lower Purbeck. Representatives of other subfamilies are diverse and not rare in the Middle Purbeck and Wealden (Mostovski, 1999a). This pattern of stratigraphical distribution may be explained by hot and dry conditions in early Purbeck times. Thus, the absence of Empididae in Kempendyai may reflect either sampling bias or climatic peculiarities of this area if Early Cretaceous age is proved. On the other hand, representatives of the genus *Palaeobolbomyia* are recorded neither in the geographically near localities in Transbaikalia and Mongolia where hundreds of brachycerans are found, nor in the Lower Cretaceous of Europe and China.

The material studied including types are housed in the collection of Paleontological Institute, Russian Academy of Sciences (PIN).

**SYSTEMATIC PALEONTOLOGY**

**Family Rhagionidae Latreille, 1802**

**Genus Palaeobolbomyia** Kovalev, 1982  
*Palaeobolbomyia*: Grimaldi and Cumming, 1999, p. 17. (Incorrect subsequent spelling.)

**Type species.** *P. sibirica* Kovalev, 1982; Upper Jurassic; Transbaikalia.


**Composition.** Besides the type species, *P. kazakhstanica* sp. nov., *P. devia* sp. nov., *P. yakutenensis* sp. nov., *P. angustalata* sp. nov., and *P. mongolica* sp. nov. from the Middle–Upper Jurassic of Asia (Fig. 1).

**Comparison.** The genus differs from *Jurabrachyceron* Kovalev, 1981 in less number of flagellomeres, more strongly curved R2+3 and the costal section R1–R2+3 being longer. It differs from *Ussatchovia* Kovalev, 1982 in S-shaped R2+3 and R4+5 fork being longer, from *Probolbomyia* Ussatchov, 1968, *Austroleptis* Hardy, 1915, and *Bolbomyia* Loew, 1850 in proximal position of M4, additionally from in greater number of the flagellomeres and in S-shaped R2+3.

**Remarks.** The opinion expressed by Kovalev (1982) regarding the close position of *Palaeobolbomyia* to ancestral forms of *Austroleptis* and *Bolbomyia* is now being confirmed. Firstly, re-examination of the *P. sibirica* type resulted in the discovery of two spurs on the hind tibiae of this species as well as in *P. kazakhstanica* sp. nov. Secondly, the hind margin of the discoidal cell is angled at the point of the M5 origin in *P. kazakhstanica* sp. nov. and the discoidal cell is narrowing distally in *P. devia* sp. nov. similarly to that of representatives of *Bolbomyia* (Hennig, 1967; Webb, 1987). Both facts argue in favor of shifting M5 towards the wing tip after M4 reduction. This is expressed in the contemporary *Probolbomyia modesta* Ussatchov, 1968 (Karabastau Formation). The anal cell is clearly petiolate in *Austroleptis*, and the beginning of this process is fixed in *P. yakutenensis* sp. nov. having the anal cell with short petiole.

**Key to species of the genus Palaeobolbomyia**

1. Discoidal cell narrow, lanceolate, basal section of M2 absent (Fig. 3b)………………………………………devia sp. nov.  
—Discoidal cell broader, basal section of M2 present……………2

2. Wing narrow, 2.8 times as long as wide; posterior margin of discoidal cell weakly S-shaped curved, smooth (Fig. 3d)………………….angustalata sp. nov.  
—Wing broader, at most 2.4 times as long as wide……………3

3. R4+5 stem at least twice longer RS1, transverse rm shifted towards d midlength……………………………………3

4. R4+5 stem at most 1.3 times longer RS1, transverse rm shifted towards d base……………………………………….5

5. Posterior margin of discoidal cell markedly angled, R4 longer, M1 and M2 less arched forwards and backwards respectively (Fig. 3a)…………………………………….kazakhstanica sp. nov.  
—Posterior margin of discoidal cell evenly curved, R4 shorter, M1 and M2 stronger arched forwards and backwards respectively (Fig. 2)……………………………………..sibirica Kovalev  
5. Anal cell with short petiole, d narrowed distally (Fig. 3c)…….yakutenensis sp. nov.  
—Anal cell closed at point, anterior and posterior margins of d more or less parallel (Fig. 3e)………………………..mongolica sp. nov.

*Palaeobolbomyia sibirica* Kovalev, 1982  
**Holotype.** PIN, no. 3053/1081, female impression; Buryatiya, upper reaches of the Uda River.
between camps Ulai-Mailo and Ashei, the Uda locality; Middle–Upper Jurassic, Uda Formation.

Diagnosis (Fig. 2). Flagellum at least 5-segmented, first flagellomere somewhat wider than pedicel and slightly asymmetrical. Wing twice as long as broad. R\textsubscript{1} bears fine setae. R\textsubscript{4+5} stem 2.3 times as long as RS\textsubscript{1}. Vein R\textsubscript{5} 1.5 times as long as R\textsubscript{4+5} stem. Transverse rm divides anterior margin of discoidal cell as 1 : 2. M\textsubscript{1} arched anteriorly immediately after the fork, M\textsubscript{2} arched backwards. Costal sections M\textsubscript{1}–M\textsubscript{3} and M\textsubscript{3}–M\textsubscript{4} sub-equal. Posterior margin of discoidal cell between M\textsubscript{3} and M\textsubscript{4} evenly curved. Pterostigma very pale. Hind tibia slightly more than 2.5 times as long as first tarsomere.

Measurements (mm): body length, 4–4.5, wing length, 2.8, wing width, 1.3.

Occurrence. Transbaikalia, Uda Formation; Kazakhstan, Karabastau Formation.

Material. Besides the holotype and paratype PIN, no. 2022/8(61), specimen no. 2239/2214, moderately preserved fly from the Karatau-Mikhailovka locality. This specimen differs from the holotype in rm shifted somewhat distally and shorter costal section M\textsubscript{1}–M\textsubscript{2}.

**Palaeobolbomyia kazakhstanica** Mostovski, sp. nov.

Plate 11, fig. 1

Holotype. PIN, no. 2239/2178(2204), part and counterpart of fairly well preserved female; Southern Kazakhstan, Chinkent Region, Chayan District, Karatau-Mikhailovka locality; Middle–Upper Jurassic, Karabastau Formation.

Description (Fig. 3a). The body and legs are dark. The forehead is as wide as the third antennal segment or slightly wider, parallel sided from above, somewhat broadened downwards, sparsely covered with short hairs. The eyes are transverse oval, ca. 1.3 times as high as long. The antennae are equal to the head in length, the flagellum is 6-segmented, the first flagellomere is slightly wider than the pedicel, the second flagellomere is as long as wide, the third flagellomere is slightly longer than wide, the fourth and fifth flagellomeres are elongate and the sixth flagellomere is the longest. The ocellar triangle is wide, occupying almost the whole forehead at the top, slightly raised, the ocellar bristles are very short. The mesonotum has sparse short bristles probably arranged in rows. The scutellum is rounded trapeziform, twice as wide as long, with short bristles in its apical half. The wing is twice as long as broad, obtusely rounded apically. The wing membrane is evenly microtrichose. The hair fringe is present at the hind edge of the wing. The pterostigma is developed as pale brown spot mainly under R\textsubscript{1}. The vein R\textsubscript{5} has no setae. The R\textsubscript{4+5} stem is twice as long as RS\textsubscript{1}, R\textsubscript{5} is 1.9–2 times as long as R\textsubscript{4+5}. The transverse rm divides the anterior margin of the discoidal cell as 1 : 1.8. The basal section of M\textsubscript{2} is equal to rm. The posterior margin of the discoidal cell between M\textsubscript{3} and M\textsubscript{4} is angled. M\textsubscript{1} is nearly straight or very weakly arched anteriorly, M\textsubscript{2} is weakly arched backwards. The costal section M\textsubscript{1}–M\textsubscript{3} is slightly shorter than the section M\textsubscript{3}–M\textsubscript{4}. The apical portion of CuA is gently arched. CuP is straight. The anal cell has short or point petiole. The haltere is dark, its stem paler. The legs are evenly covered with short adjacent hairs. The hind tibia is slightly more than twice as long as the first tarsomere. The claws are small, weakly curved. The 8th abdominal segment is slightly shorter when compared with the 7th one, and somewhat more heavy sclerotized than the previous segments.

Measurements (mm): holotype: body length, 4.8, wing length, 2.8, wing width, 1.1; paratype: body length, 3.8, wing length, 2.7, wing width, 1.3.

Remark. The holotype body length should be less since the abdomen is obviously elongated postmortem.
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Material. Besides the holotype, paratype PIN, no. 2904/1576, fairly well preserved female from the same locality.

**Palaeobolbomyia devia** Mostovski, sp. nov.

Plate 11, fig. 2

Etymology. From Latin *devia* (deviated).

Holotype. PIN, no. 2239/2196, fairly well preserved male; Southern Kazakhstan, Chimkent Region, Chayan District, Karatau-Mikhailovka locality; Middle–Upper Jurassic, Karabastau Formation.

Description (Fig. 3a). The head and thorax are dark, the abdomen and legs slightly paler. The head is hemispherical in profile, the occiput is convex. The ocellar triangle is raised. The scutellum has short bristles apically. The wing membrane is evenly microtrichose. There is a hair fringe at the hind edge of the wing. The pterostigma is very pale, more visible under

Explanation of Plate 11

Fig. 1. *Palaeobolbomyia kazakhstanica* sp. nov., holotype PIN, no. 2239/2178.
Fig. 2. *Palaeobolbomyia devia* sp. nov., holotype PIN, no. 2239/2196.
Fig. 3. *Palaeobolbomyia mongolica* sp. nov., holotype PIN, no. 3791/2858.
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R2 + 3. The vein R1 bears sparse and short setae at least in its distal part. R4 + 5 stem is 2.3 times as long as RS, R5 is 1.9 times as long as R4 + 5. The transverse rm divides the anterior margin of the discoidal cell as 1 : 2. The transverse rm is connected with M1 + 2 immediately before M1 and M2 bifurcation. The discoidal cell is narrow, lanceolate. M1 and M3 are symmetrically diverged, M2 and M3 are parallel. The costal section M1–M2 is half as long as the section M2–M4. The apical portion of CuA is weakly arched. CuA and CuP meet at the wing margin. The legs are evenly covered with short adjacent hairs. The hind tibia is 1.8 times as long as the first tarsomere. Abdominal tergites are covered with sparse hairs that are somewhat longer at the hind edge of each tergite. The gonocoxae are weakly swollen, covered with very short hairs.

Measurements (mm): body length, 3, wing length, 1.9, wing width, 0.8.

Material. Holotype.

Palaeobolbomyia yakutensis Mostovski, sp. nov.

Holotype. PIN, no. 923/1083, well preserved wing impression; Yakutiya, Suntar District, right bank of the Kempendyai River, 2.5 km downstream of Ulakan-Magan-Khaya Mountain, Kempendyai locality, outcrop 1, bed 16; Upper Jurassic.

Description (Fig. 3c). The apex of the wing is obtusely rounded. The pterostigma is pale, developed as an elongate spot mainly under R1. The vein R1 is bare. The costal section Sc–R1 is greater than the R1–R2 + 3 section. The stem R4 + 5 is 1.3 times as long as RS1, R5 is twice as long as R4 + 5. The transverse rm divides the anterior margin of the discoidal cell as 1 : 3. A convex fold is developed from the wing base, it crosses rm and disappears at the level of R4 + 5 fork. The basal section of M2 is equal to rm. The discoidal cell is narrowed distally, its posterior margin between M2 and M3 is gently S-shaped. M1 is nearly straight or just weakly arched anteriorly, M2 is nearly straight, these veins seem to be parallel. The costal section M1–M2 is nearly half as long as the M2–M4 section. The apical portion of CuA is more or less straight and somewhat bent just before its fusion with straight CuP. The anal vein has short petiole.

Measurements (mm): wing length, 2.4, wing width, 1.1.

Material. Holotype.

Palaeobolbomyia angustalata Mostovski, sp. nov.

Etymology. From Latin angustus (narrow) and ala (wing).

Holotype. PIN, no. 923/1125, well preserved wing impression and body fragments; Yakutiya, Suntar District, right bank of the Kempendyai River, 2.5 km downstream of Ulakan-Magan-Khaya Mountain, Kempendyai locality, outcrop 1, bed 16; Upper Jurassic.

Description (Fig. 3d). The body is brown, the legs are somewhat paler. The head is nearly hemispherical. The mesonotum bears sparse short hairs. The apex of the wing is obtusely rounded. The pterostigma is very pale, placed under R1. The vein R1 is bare. The costal section Sc–R1 is equal to the R1–R2 + 3 section. The stem R4 + 5 is 2.3 times as long as RS1, R5 is 1.3 times as long as R4 + 5. The transverse rm is placed.
in the basal third of the discoidal cell. The convex fold is developed from the wing base, it crosses \( rm \) and disappears at the level of \( R_{1+5} \) fork. The basal section of \( M_2 \) is equal to \( rm \). The discoidal cell is narrow, its posterior margin between \( M_2 \) and \( M_4 \) is gently S-shaped. \( M_1 \) is slightly arched anteriorly, \( M_2 \) is nearly straight and subparallel to \( M_4 \). The \( M_2-M_4 \) section is 1.5 times as long as the costal section \( M_1-M_2 \). The transverse \( mcu \) divides \( M_4 \) into very short basal and long distal sections. The apical portion of \( CuA \) is very weakly arched. The wing membrane is densely microtrichose, and seems to be unfuscated.

**Measurements** (mm): body length, ca. 3, wing length, 2.5, wing width, 0.9.

**Material.** Holotype.

*Palaeobolbomyia mongolica* Mostovski, sp. nov.

Plate 11, fig. 3

**Holotype.** PIN, no. 3791/2858, moderately well-preserved fly, preserved in profile; Central Mongolia, Bayanhongor Aymag, northeastern outlying areas of Gobi-Altai depression, Bahar locality, outcrop 208/4; Middle–Upper Jurassic, Bahar Group, Ortsag Sequence.

**Description** (Fig. 3e). The body and legs are dark. The head is nearly hemispherical. The apex of the wing is obtusely rounded. The pterostigma is pale, dark. The head is nearly hemispherical. The apex of the wing is obtusely rounded. The pterostigma is pale, dark. The head is nearly hemispherical. The apex of the wing is obtusely rounded. The pterostigma is pale, dark.

**Measurements** (mm): body length, ca. 3, wing length, 2.5, wing width, 0.9.

**Material.** Holotype.

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