

# The Oldest Known Record of an Imago of Nemouridae (Insecta: Perlida = Plecoptera) in the Late Mesozoic of Eastern Transbaikalia

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**Abstract**—A new stonefly genus and species, *Dimoula dimi* (Nemouridae), is described based on a single specimen from the Glushkovo Formation (Lower Cretaceous) of Eastern Transbaikalia. This is the oldest record of an imago of the family Nemouridae.

**Key words:** Perlida, Plecoptera, Nemouridae, Lower Cretaceous, eastern Siberia, new taxa.

## INTRODUCTION

During field work in Eastern Transbaikalia in 2002, the paleontological team of the Paleontological Institute of the Russian Academy of Sciences (PIN) gathered a large collection of fossil insects from the Glushkovo Formation of the Daya locality. Three out of the four stonefly specimens collected there are nymphs, and one is an excellently preserved imago.

Nymphs (specimens PIN, nos. 3063/1423, 1424, and 3015/2013) belong to the endemic genus and species *Nemourisca diligens* of the family Nemouridae (Sinitshenkova, 1987), which was previously described from the Daya locality. The imago also belongs to the family Nemouridae, but represents a new genus and species, *Dimoula dimi* gen. et sp. nov. Three main criteria have been proposed to support conspecificity of nymphs and imagoes of fossil stoneflies: the co-occurrence of the remains, their assignment to the same higher taxon, and their corresponding body sizes (Sinitshenkova, 1987). In the present case, the first two criteria are met; however, the body size differs considerably. The body length of all nymphs of *N. diligens* does not exceed 4.5 mm, whereas the body length of the imago of *D. dimi* gen. et sp. nov. is 8 mm. Thus, there are no grounds to assign this new stonefly to the species *N. diligens*, or even to the genus *Nemourisca*, since the nymphal characters on which this genus was established do not allow one to extrapolate about the structure of the imago.

The age of insect-bearing deposits of the Glushkovo Formation (sediments of the Unda, Daya, Savino, and Volch'ya localities were earlier assigned to the Balei Formation, which was used for the description of stoneflies from there: Sinitshenkova, 1987) is still debatable. Some arthropod groups (mainly terrestrial) suggest a

Late Jurassic age, because they contain mostly Jurassic elements (Sinitza, 1993); other groups, including stoneflies, suggest an Early Cretaceous age (Sinitshenkova, 1990). Several modern stonefly families, which are not recorded in confirmed Jurassic sediments, appear in the Glushkovo Formation; this is a significant difference between the fauna from the Glushkovo Formation and earlier faunas (Sinitshenkova, 1987). The fact that the new stonefly belongs to the modern family Nemouridae supports the Cretaceous hypothesis rather than the Jurassic.

## SYSTEMATIC PALEONTOLOGY

### Family Nemouridae Newmann, 1853

#### Genus *Dimoula* Sinitshenkova, gen. nov.

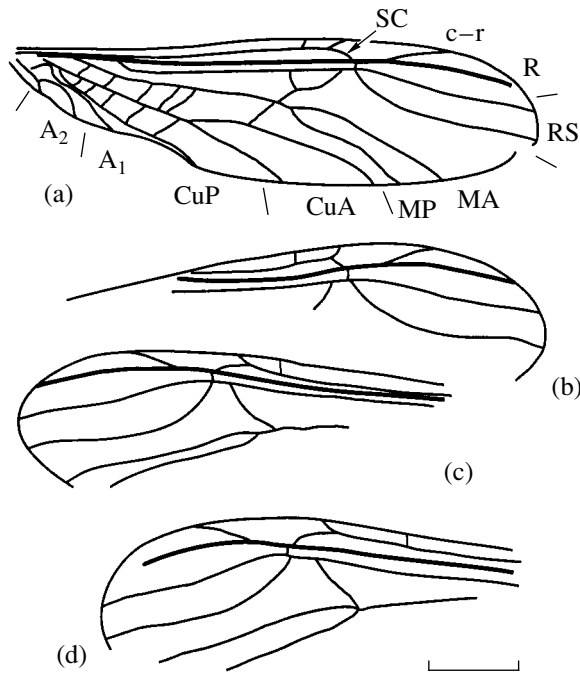
**Etymology.** In honor of the paleontologist Dmitrii Evgen'evich Shcherbakov (diminutive of the first name).

**Type species.** *D. dimi* sp. nov.

**Diagnosis.** Imago. Female. Forewings slightly longer than hindwings, venation of both pairs of wings similar, anal region of hindwing not broadened. Additional crossvein c–sc present in costal area basad of SC tip, apical crossvein in costal area c–r long and gently sloping. RS bifurcating at r–rs level, its branches gently arched. When folded, wings much longer than body. Hind femora and tibiae long and narrow. Cerci short, three-segmented.

**Species composition.** Type species.

**Comparison.** The new genus differs markedly from all known modern genera in having three-segmented cerci, in the anal region of the hindwing being not broadened, and in the long and gently sloping c–r.



**Fig. 1.** Female *Dimoula dimi* gen. et sp. nov., imago, holotype PIN, no. 3063/1422: (a) right forewing, (b) right hindwing, (c) left forewing, and (d) left hindwing. Scale bar, 2 mm.

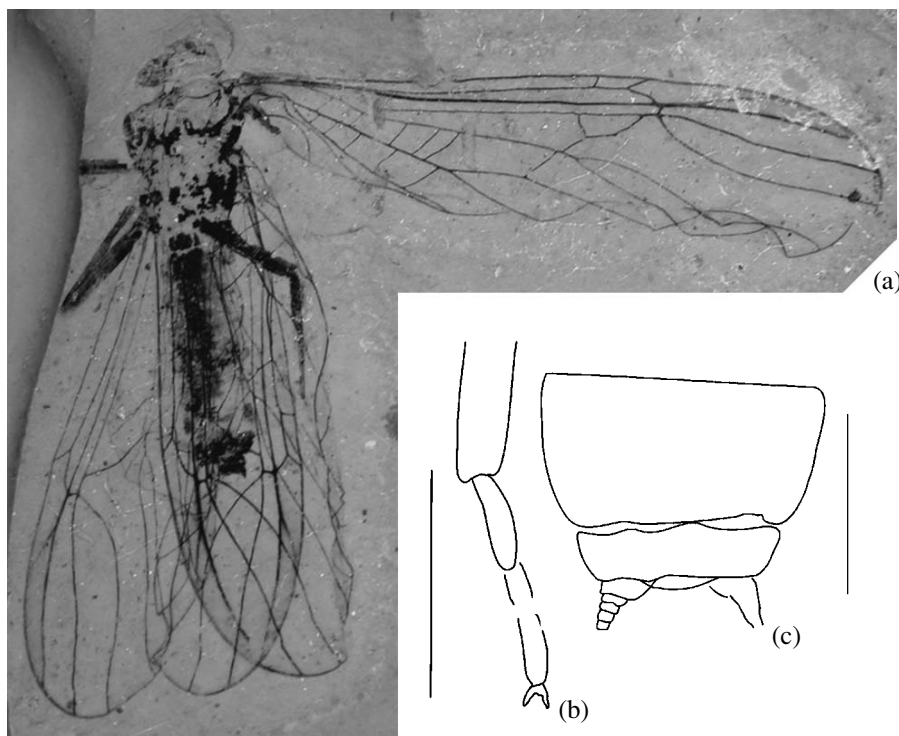
**Remarks.** The presence of the additional crossvein *c-sc* in the costal area near the tip of *SC* is also atypical in modern nemourids, but occurs occasionally. In such cases (*Shipsa rotunda* (Claassen) and *Protonemoura meyeri* (Pictet): Baumann, 1975), *SC* is strongly arched near its tip, so that the costal area becomes very narrow, and the base of the posterior branch of *RS* is strongly curved, a situation very different from the genus under description. An additional *c-sc* near the tip of *SC* is also present in the wings of *Zapada cordillera* (Baumann et Gaufin); however, the wing venation of the latter species differs strikingly from all nemourids in the dichotomizing branches of *RS* and in the presence of two rows of crossveins between *M* and *CuA*.

*Dimoula dimi* Sinitshenkova, sp. nov.

**Etymology.** In honor of Dmitrii Vasilenko, who collected the holotype.

**Holotype.** PIN, no. 3063/1422, well-preserved part and counterpart of adult female; Chita Region, Shelopuginskii District, left bank of the Daya River upstream of the Shiviya gully mouth; Lower Cretaceous, Glushkovo Formation.

**Description** (Figs. 1, 2). The abdomen is 1.5 times as long as the thorax, cylindrical, with all segments of equal width except the last, which is half as wide as the others, and has short three-segmented cerci,



**Fig. 2.** Female *Dimoula dimi* gen. et sp. nov., imago, holotype PIN, no. 3063/1422: (a) general appearance,  $\times 10.6$ , (b) hind tarsus, and (c) tip of abdomen. Scale bar, 1 mm.

with the segments poorly separated from each other. The forewing is 1.5 times as long as the body and 1.2 times as long as the hindwing; the hindwings are shorter than the body. SC is slightly longer than two-thirds of the total wing length, the costal area expands evenly towards the apex, the apical c–sc is oblique and enters C noticeably basad of the SC tip; an additional crossvein c–sc is situated basad of the apical crossvein, almost vertical, very clear in the right pair of wings, and poorly visible in the left pair. Crossvein c–r deviates from R considerably distad of the SC tip, is weakly arched, and enters C approximately at the midlength of the RS branches; the pterostigma is slightly darkened. R is the thickest vein, RS deviates from R in the basal quarter of the wing, bifurcates in the apical third at the level of r–rs, its anterior branch is very slightly curved medially in the middle and is slightly arched near the wing margin, its posterior branch is nearly parallel to the anterior one. Crossvein rs–m enters RS a little basad of the RS fork; it is long and curved, sometimes strengthened by an additional crossvein entering RS. M ramifies distad of rs–m; m–cua originates from M slightly basad of rs–m and connects the anterior branch of CuA in its basal third, the posterior branch of CuA is straight. CuP terminates on the posterior margin of the wing almost at the level of the CuA fork; there are six crossveins between M and CuA and five crossveins between CuA and CuP. A<sub>1</sub> is strongly curved basally, A<sub>2</sub> has a long loop-like anterior branch, its posterior branch is very short. The first tarsomere of the hind leg is almost twice as long as the third tarsomere, which is noticeably longer than the second.

**M e a s u r e m e n t s**, mm: body length, 8; forewing length, 12; hindwing length, 10; hind femur length, 2.2; hind tibia length, 2.5; hind tarsus length, 1.1.

**V a r i a b i l i t y**. In *D. dimi* sp. nov., the position of the apical c–sc is very variable; it may enter C almost at the level of the SC tip, as in the right hind wing (Fig. 1b); slightly basad of it, as in the right fore wing (Fig. 1a); or noticeably basad of that level, as in the left wings (Figs. 1c, 1d). SC terminates on R slightly basad of r–rs in the right fore (Fig. 1a) and left hind (Fig. 1d) wings or at the level of r–rs in the left fore (Fig. 1c) and

right hind (Fig. 1b) wings. RS branches at the level of r–rs in the fore wings (Figs. 1a, 1c), but slightly proximal of r–rs in the right hind wing (Fig. 1b) or slightly basad of r–rs in the left hind wing (Fig. 1d). The posterior branch of RS is bent somewhat more strongly basally in the left fore wing (Fig. 1c) than in the other wings. The additional crossvein connecting rs–m with RS is developed only in the right fore wing. It should be emphasized that, along with the above variations, the position and shape of c–sc is essentially stable in all wings.

**R e m a r k s**. It is known that wing venation is often slightly variable in stoneflies; thus, the venation of the right and left wings is sometimes different in the same individual. These variations refer to the anastomosis of the main veins as well as of the crossveins. The excellent preservation of *D. dimi* sp. nov. allows examination of the main features of the venation in all four wings. Description of the variability of the wing venation is particularly important for fossil insects, since they are often represented by isolated wings that can only be identified with great difficulty.

**M a t e r i a l**. Holotype.

#### ACKNOWLEDGMENTS

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