

New Stoneflies of the Family Palaeonemouridae from the Upper Permian of Udmurtiya and the Orenburg Region (Insecta: Perlida = Plecoptera)

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Abstract—A new genus, *Palaeonemourisca*, and 13 new species of stoneflies of the family Palaeonemouridae are described on the basis of wings from Tatarian deposits, Upper Permian. From Udmurtiya, *Palaeonemoura proximalis* sp. nov. (Chepanikha locality), *P. furcata* sp. nov. and *P. abdita* sp. nov. (Galevo locality), and *Palaeonemourisca novojilovi* sp. nov. (Prokoshevo locality) are described. From the Orenburg region (Novo-Aleksandrovka locality), *Palaeotaeniopteryx perlonga* sp. nov., *P. distalis* sp. nov., *Palaeonemoura lepida* sp. nov., *P. petaloidea* sp. nov., *P. duplicata* sp. nov., *P. riparia* sp. nov., *P. apicalis* sp. nov., *P. remota* sp. nov., and *Palaeonemourisca subita* sp. nov. are described.

Key words: Stoneflies, Plecoptera, Upper Permian, Tatarian, Eurasia, new taxa, wings, identification key.

INTRODUCTION

In the Late Permian, the diversity of aquatic insects increased considerably owing both to groups known from earlier deposits and to newly appeared groups (Sinitshenkova, 2002). Stoneflies are one of the most ancient groups of aquatic insects; their earliest fossils are from the Early Permian, where they are represented by nymphal (Tshekardoperlidae, Palaeonemouridae) and imaginal stages (Perloperidae, Palaeonemouridae). The family Palaeonemouridae survived into the Late Permian, where it became more diverse and widely distributed. Endemic Palaeoperlidae have been found from the Upper Permian of Eurasia, and Euxenoperlidae and Eustheniidae have been recorded from the Upper Permian of Gondwana.

The family Palaeonemouridae is represented in the Upper Permian of Eurasia by the following taxa: Two groups of species have been described from the Mitino Formation of the Kuznetsk Basin—*Palaeonemoura clara* Sharov, *P. altaica* Sharov, and *Palaeotaeniopteryx elegans* Sharov on the basis of isolated wings (Sharov, 1961) and *P. elegans*, *Kaltanemoura kaltanica* (Sharov), and *K. depravata* Sinitsh. on the basis of nymphal stages (Sinitshenkova, 1987). Wing remains of *Palaeonemoura zwicki* Sinitsh. and nymph remains of *K. sharovi* Sinitsh. are known from the Akkolka Formation (eastern Kazakhstan). The only fossil wing of *Palaeonemoura finitima* Sinitsh. was discovered in Mongolia (Sinitshenkova, 1992). In the Vorkuta Group of the Vorkuta Basin (*K. derosa* Sinitsh. and *Uralonymph vorkutica* Sinitsh.) and in the Leninsk Formation of

the Kuznetsk Basin (*K. repentina* Sinitsh.) (Sinitshenkova, 1987), only nymphs were discovered.

Material collected by paleontologist Novojilov from Lower Tatarian deposits of Udmurtiya (localities of Galevo, Chepanikha, and Prokoshevo) and by a paleontological expedition of the Paleontological Institute in 2002 in the Orenburg region (Novo-Aleksandrovka locality) yielded only remains of Palaeonemouridae imagoes. Two new species from the locality of Novo-Aleksandrovka belong to the genus *Palaeotaeniopteryx* (*P. perlonga* sp. nov. and *P. distalis* sp. nov.); nine new species of the genus *Palaeonemoura* have been collected from Chepanikha (*P. proximalis* sp. nov.), Galevo (*P. furcata* sp. nov. and *P. abdita* sp. nov.), and Novo-Aleksandrovka (*P. lepida* sp. nov., *P. petaloidea* sp. nov., *P. duplicata* sp. nov., *P. riparia* sp. nov., *P. apicalis* sp. nov., and *P. remota* sp. nov.). Two new species belong to a new genus, *Palaeonemourisca* gen. nov., i.e., *P. novojilovi* sp. nov. from Udmurtiya (Prokoshevo) and *P. subita* sp. nov. from Novo-Aleksandrovka. Earlier, only Palaeoperlidae, including *Palaeoperla perfracta* Sinitsh. from Novo-Aleksandrovka, were known from Tatarian deposits of the Orenburg region.

A large diversity of stoneflies in one locality is a very rare but not unique phenomenon. Ten species of four genera have been recorded in the locality of Novo-Aleksandrovka (Orenburg region, 6 km north of the village of Troitskoe, on the left bank of the Kuplya River in the village of Novo-Aleksandrovka, 100 m downstream of the bridge), which was assigned to the upper part of the Severnaya Dvina Horizon on the basis of

macroflora (Gomankov and Meyen, 1986; Gomankov, 2002). It may be compared with the locality of Dzhaichaucho (Kyrgyzstan, Madygen Formation, Middle or Upper Triassic), where 13 species in 5 genera of the family Perlariopseidae also have been recognized on the basis of wings (Sinitshenkova, 1987). These facts seem to reflect a real increase in the diversity of stoneflies and other aquatic insects in the second half of the Late Permian and during the transition from the Permian to the Triassic.

MATERIAL

The material being studied (including type material) is housed at the Paleontological Institute of the Russian Academy of Sciences (PIN).

SYSTEMATIC PALEONTOLOGY

Family Palaeonemouridae Sinitshenkova, 1987

Genus *Palaeotaeniopteryx* Sharov, 1961

Palaeotaeniopteryx perlonga Sinitshenkova, sp. nov.

Plate 9, fig. 1

E t y m o l o g y. From Latin *perlonga* (very long).

H o l o t y p e. PIN, no. 3700/78, part and counterpart of forewing fragment; Novo-Aleksandrovka locality; Upper Permian, Upper Tatarian.

D e s c r i p t i o n (Fig. 1a). Imago. The apex of the forewing is broadly rounded. In the forewing, SC enters R noticeably proximad of r-rs. There is one long crossvein in the pterostigmal area; the costal field is devoid of crossveins. The RS stalk is long and more than twice as long as its fork. Transverse rs-m starts from R proximad of r-rs, which enters MA very distad of the M fork. M is three-branched; its posterior branch ramifies near its base.

M e a s u r e m e n t s, mm. Forewing fragment length, 4.6; full length, about 6.

C o m p a r i s o n. It differs from the type species *P. elegans* Sharov in its broadly rounded wing apex, three-branched M, and longer RS stalk.

M a t e r i a l. Holotype.

Palaeotaeniopteryx distalis Sinitshenkova, sp. nov.

E t y m o l o g y. From Latin *distalis* (distal).

H o l o t y p e. PIN, no. 3700/74, part and counterpart of small wing fragment; Novo-Aleksandrovka locality; Upper Permian, Upper Tatarian.

D e s c r i p t i o n (Fig. 1b). Imago. SC enters R distad of r-rs; c-sc is short and enters C noticeably proximad of the SC tip and r-rs.

M e a s u r e m e n t s, mm. Wing fragment length, 2.5; full length, about 7.

C o m p a r i s o n. It clearly differs from other species in that SC enters R distad of r-rs.

M a t e r i a l. Holotype.

Genus *Palaeonemoura* Sharov, 1961

Palaeonemoura proximalis Sinitshenkova, sp. nov.

E t y m o l o g y. From Latin *proximalis* (proximal).

H o l o t y p e. PIN, no. 3286/7, positive impression of very well preserved forewing fragment; Udmurtiya, right bank of the Kama River, water divide between the Rassokha and Kas'yanovka rivers, 1.5 km northeast of the village of Chepanikha, borehole 121L, depth 44–48 m; Upper Permian, Lower Tatarian.

D e s c r i p t i o n (Fig. 1c). Imago. In the forewing, c-sc is long and enters C slightly distad of the tip of SC, which enters R very proximad of r-rs. The pterostigma is darkened and has no crossveins; at least one crossvein is in the costal field. The RS stalk is short, more than five times shorter than the RS fork; the only rs-m enters RS noticeably proximad of r-rs at the level of the SC tip.

M e a s u r e m e n t s, mm. Forewing fragment length, 6; full length, about 9.

C o m p a r i s o n. In the presence of the short RS stalk, this new species is similar to *P. finitima* Sinitsh. from the Upper Permian of Mongolia (Sinitshenkova, 1992), from which it clearly differs in that SC enters R proximally.

M a t e r i a l. Holotype.

Palaeonemoura furcata Sinitshenkova, sp. nov.

Plate 9, fig. 2

E t y m o l o g y. From Latin *furcatus* (forked).

H o l o t y p e. PIN, no. 3695/4, positive impression of nearly complete well-preserved forewing that is bent at its midlength; Udmurtiya, the right bank cliff of the Kama River, 6.4 km downstream of the Galevo pier, near triangulation sign 168.6; Upper Permian, Lower Tatarian.

D e s c r i p t i o n (Fig. 1d). Imago. In the forewing, c-sc enters C slightly distad of the tip of SC, which enters R at the level of r-rs. Crossveins are absent in the pterostigmal region; there are two crossveins in the costal field. The RS stalk is short, nearly five times shorter than its fork. M forks very distad of r-rs, and the basal part of its anterior branch connects to RS by a single rs-m that enters RS slightly distad of r-rs. M forks approximately at the wing midlength and very basad of the RS fork. There are six crossveins between M and CuA; CuP is short and enters the posterior margin of the wing proximad of the M fork; there are three crossveins between CuA and CuP, one of which connects CuA to the posterior margin of the wing.

M e a s u r e m e n t s, mm. Forewing fragment length, 9; full length, about 10.

C o m p a r i s o n. It differs from known species in the long RS fork.

M a t e r i a l. Holotype.