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New Mecoptera from the end-Permian intertrappean deposits of the Tunguska Basin

Новые Mecoptera из позднепермских межтрапповых отложений Тунгусского бассейна

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KEY WORDS: Mecoptera, Nedubroviidae, Mesopsychidae, intertrappean beds, Permian–Triassic, Tunguska, new species.

КЛЮЧЕВЫЕ СЛОВА: Mecoptera, Nedubroviidae, Mesopsychidae, межтрапповые отложения, пермо-триасовый переход, Тунгуска, новый вид.

ABSTRACT. Four mecopteran specimens are collected from the transitional Permian–Triassic intertrappean deposits of the Tunguska Basin, two of which are described as *Nedubrovia evenkiana* **sp.n.** and Mesopsychidae gen. et sp. This is the first report of Mecoptera from these deposits and of Nedubroviidae outside the Russian Platform. The age of the intertrappean insect localities is discussed.

РЕЗЮМЕ. В переходных от перми к триасу межтрапповых отложениях Тунгусского бассейна собраны четыре экземпляра мекоптер, два из которых описаны как *Nedubrovia evenkiana* **sp.n.** и Mesopsychidae gen. et sp. Это первое описание ископаемых скорпионниц из межтрапповых отложений, а также первая находка семейства Nedubroviidae за пределами Русской платформы. Кратко обсуждается возраст и стратиграфия местонахождений насекомых в межтрапповых отложениях.

Introduction

Contrary to the current opinion, insect remains in the intertrappean (non-coal-bearing) sedimentary deposits of the Tunguska Basin are quite abundant: they occur in a number of outcrops along the Nizhnyaya Tunguska River and its tributaries. The small number of specimens collected there so far reflects the difficulty in accessing these remote localities rather than their richness. At the same time, most of the insect assemblages at these localities — including the particularly representative Anakit-3 and Khungtukun-2 (reported by Aristov [2011], and Sinitshenkova [2013], with even more material remaining unpublished), which yielded hundreds of specimens — are not taxonomically diverse, being dominated by beetles [Ponomarenko, 2006 and unpublished data], followed by grylloblattodeans (mainly Chaulioditidae) [Aristov, 2011], Auchenorrhyncha [Shcherbakov, 2000], or mayfly nymphs [Sinitshenkova, 2013]. Among other insects, some Blattodea: Phyloblattidae [Vrsansky, 2010], Neuroptera: Permithonidae [Ponomarenko & Shcherbakov, 2004], and Orthoptera: Locustavidae [Sharov, 1968] have been described from there.

Representatives of Mecoptera in the Tunguska Basin intertrappean beds are extremely rare and have not been closely studied so far. Vrsansky [2010] mentioned two wings of unidentified Mecoptera from the Bugarikta-1 locality (Bugarikta Formation), collected as early as 1960. In fact, only one of these (a nearly complete insect rather than just a wing) can be placed in Mecoptera; it is attributed by the present author to Permotanyderidae — which represents the first record of permotanyderids outside the type locality at Belmont, Australia — and will be described elsewhere.

In the summer of 2010, an expedition by the Arthropoda Lab of the Borissiak Paleontological Institute of RAS (PIN) to the Nizhnyaya Tunguska River collected numerous new specimens of fossil insects, including three mecopteran wings, representing Nedubroviidae, Mesopsychidae, and an additional specimen of Permotanyderidae. The first two are described herein as *Nedubrovia evenkiana* **sp.n.** and Mesopsychidae incertae sedis.

The new data confirm and broaden the known composition of Mecoptera during the Permian–Triassic transition. The family Nedubroviidae was recently erected based on material from several Upper Permian and Permian–Triassic localities in European Russia [Bashkuev, 2011a]. The new species is closely related to *Nedubrovia mostovskii* (Novokshonov, Sukacheva óå Aristov 2004), described from the Nedubrovo beds (see below). The mainly Mesozoic family Mesopsychidae was recently reported also from the Upper Permian, including the Permian–Triassic sequence of Babiy Kamen' (Maltsevo Formation of Kuzbass) [Bashkuev, 2011b].

Notes on stratigraphy

The fossils examined were collected at two localities of nearly the same age: Khungtukun-2 (right bank of the Nizhnyaya Tunguska River between mouths of the Anakit and Khungtukun Rivers, 64°10'25.80"N 101°42'26.46"E), and Lower Lyulyuikta-1 (left bank of the Nizhnyaya Tunguska River about 3.1 km downstream of the mouth of the Lower Lyulyuikta River, 64° 7'46.50"N 101°15'26.88"E). The Khungtukun-2 section is the stratotype of the Khungtukun Horizon [Sadovnikov & Orlova, 1995]; insects occur here in calcareous concretions within tuff siltstones of the bed 6 belonging to the Pirda Formation.

The precise age of insects from the Lower Lyulyuikta-1 is less clear. Aristov [2011] referred Lyulyuikta to the Kholokit Formation of the terminal Dvurogino Horizon [= terminal Khungtukun: Sadovnikov, 2010] or basal Putorana Horizon, but this is obviously a misinterpretation. The Lyulyuikta section is represented by: 1) tuff siltstones (12 m thick) with plant megafossils, charophytes, ostracods (mainly *Gerdalia*), and conchostracans; 2) overlying basalts (3 m); 3) tuffs (15 m), containing clasts of tuff siltstones, originating most probably from beds 1. According to G. N. Sadovnikov (pers. comm.), the tuff siltstones belong to the Lebedeva Horizon, but in the uppermost part may refer to the Khungtukun Horizon. The basalts and tuffs belong definitely to the Khungtukun Horizon. Insects come from the nodules and rounded clasts collected from talus and coming apparently from the eroded upper tuff bed, i.e. from the upper Lebedeva or (most probably) lower Khungtukun Horizon.

The age of the Siberian intertrappean deposits is still disputable: some authors refer them to the terminal Permian [Sadovnikov, 2008 and earlier], particularly to the so-called "Taimyrian Stage" [Sadovnikov & Orlova, 1994], while others date them as earliest Triassic, or late Early Triassic [the point of view adopted in the regional stratigraphic scale: Mogutcheva & Krugovykh 2009]. Recently, Kozur & Weems [2010, 2011] provided a detailed correlation of the uppermost Changhsingian to lowermost Triassic conchostracan zones of the Germanic and Tunguska + Taimyr Basins with the marine conodont scale, which strongly supports the terminal-Permian age of the Siberian Trap flood basalts and intertrappean beds. Although this correlation contains several misinterpretations and needs further adjustments (for example, contrary to that study, the Khungtukun Horizon is not subdivided into the lower and the upper parts: Sadovnikov, pers. comm.), it seems to be better substantiated than correlations treating the intertrappean beds as Triassic. Here I accept the opinion of both Kozur & Weems and Sadovnikov that all the intertrappean deposits (Lebedeva, Khungtukun and Putorana Horizons) are dated below the adopted P/T boundary (PTB) and correspond to the terminal Changhsingian (Vyatkian of the Russian Platform), at least not lower than the *Clarkina bachmani* conodont Zone.

In this respect, it is necessary to discuss the age of another important near-PTB insect locality, Nedubrovo (Kichmenga River, Vologda Province). The Nedubrovo beds are treated by some authors as earliest Triassic [e.g. Lozovsky et al, 2001, and later], and this point of view was accepted by the present author [Bashkuev, 2011a]. According to Kozur & Weems [2011], the Nedubrovo beds correspond to the *Falcisca turaica – F. zavjalovi* conchostracan Zone (which occurs in the Tunguska Basin within the Khungtukun Horizon) and can be correlated to the upper half of the *Clarkina changxingensis – C. deflecta* conodont Zone and the lower part of the *C. zhangi* Zone of the Upper Changhsingian. According to Sadovnikov (pers. comm.), the Nedubrovo beds may correspond rather to the Putorana Horizon of the Tunguska Basin and lie below the PTB as well.

Material and methods

All specimens are deposited in the Borissiak Paleontological Institute of RAS, Moscow, Russia (PIN). The fossils were extensively prepared using a steel needle and entomological pins to remove the covering matrix, and examined with a Leica M165C stereomicroscope. Scanning electron micrographs were taken from uncoated specimens using a Tescan Vega XMU electron microscope. Line drawings were made using Inkscape v.0.48 vector graphics editor. The wing venation terminology follows Novokshonov [2002].

Systematic paleontology

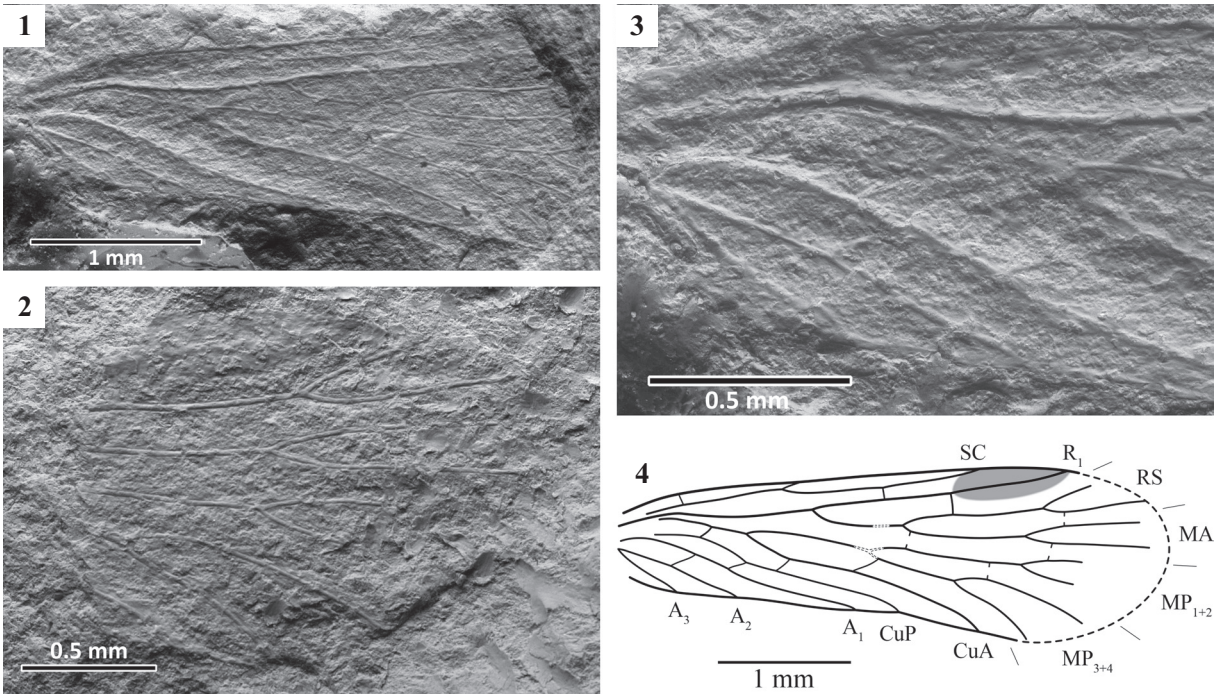
Family Nedubroviidae Bashkuev, 2011
Genus *Nedubrovia* Bashkuev, 2011
Nedubrovia evenkiana **sp.n.**
Figs 1–4

HOLOTYPE. PIN 2402/2; forewing: well-preserved negative impression, showing about 3/4 of wing, and partly preserved positive one, showing distal wing quarter with apex destroyed.

LOCALITY AND HORIZON. Lower Lyulyukta-1, Nizhnyaya Tunguska River, Krasnoyarsk Prov., Middle Siberia; Upper Permian, upper Changhsingian; upper Lebedeva or lower Khungtukun Horizon.

DIAGNOSIS. General venational pattern typical of the genus. In the wing shape and proportions the new species is most similar to *N. mostovskii*, differing from this and other *Nedubrovia* species by the following: 1) RS+MA originates and bifurcates rather late, resulting in the relative position of thyridulum located proximad on the RS+MA stem (rather than at the point of MA origin); 2) MP and CuA fused for a longer distance; 3) CuA, CuP and A_1 much longer; 4) all cubital and anal crossveins strongly inclined.

DESCRIPTION. Forewing oblong, clearly narrowed in basal half. Wing length, as preserved, 4 mm, estimated about 4.15 mm; maximal width, 1.3 mm. Anterior margin slightly convex basally. SC long, reaching basal margin of pterostigma. SC branch well before level of RS+MA (due to late origin of the latter). Humeral vein well-defined. Crossvein sc–r before level of RS+MA branching. Subcostal space widened towards SC branch. Pterostigma distinct, lanceolate. R_1 nearly straight without clear distal curving. RS+MA originating from R_1 and forking rather late. RS fork quite short, MA fork somewhat deeper. Thyridium accompanied by unsclerotized section on RS+MA stem well before its fork (thyridulum). MP and CuA fused for a rather long distance, comparable (somewhat shorter) with that from MP+CuA fork to cua–cup crossvein. Free base of CuA oblique, at same angle as cua–cup crossvein. CuA,



Figs 1–4. *Nedubrovia evenkiana* **sp.n.**, Lower Lyulyuikta-1, holotype PIN 2402/2, forewing: 1–2 — part and counterpart, SEM micrographs (1 — mirrored); 3 — basal part of wing (mirrored); 4 — venation.

Рис. 1–4. *Nedubrovia evenkiana* **sp.n.**, Нижняя Люлюикта-1, голотип ПИН № 2402/2, переднее крыло: 1–2 — отпечаток и противоотпечаток, СЭМ микрофотографии (1 — отображен зеркально); 3 — базальная часть крыла (отображена зеркально); 4 — жилкование.

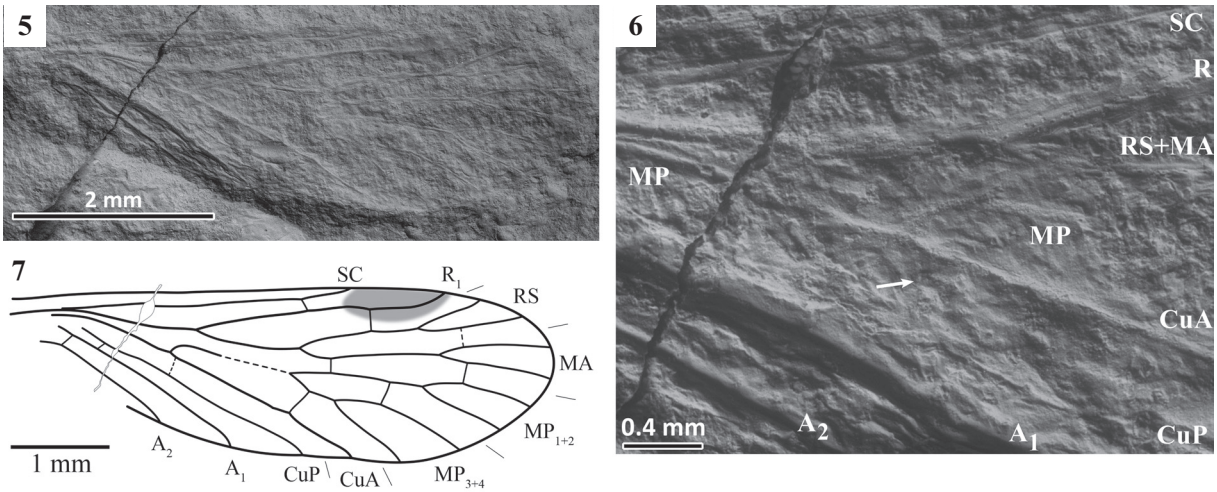
CuP and A_1 long, curving parallel in first half; CuA extending well beyond wing midlength, CuP terminating at midlength; A_1 almost reaching level of mp–cua crossvein. Crossvein pattern typical of family; crossvein between MP branches shifted posteriad and connected to MP_{1+2} stem [like in *Paranedubrovia minutissima* Bashkuev, 2011]; crossvein mp–cua strongly inclined, connected to base of MP_{3+4} at thyridial area; crossveins between anal veins distinct, strongly inclined. Coloration not preserved.

ETYMOLOGY. Derived from Evenki, an ethnic group in the Tunguska region, Middle Siberia.

Mesopsychidae Tillyard, 1917

Gen. et sp. indet.
Figs 5–7

MATERIAL. Specimen PIN 5382/81; poorly-preserved negative impression of almost complete forewing, with anal margin missing.



Figs 5–7. Mesopsychidae gen. et sp., Khungtukun-2, specimen PIN 5382/81, forewing: 5 — general view, SEM micrograph (mirrored); 6 — basal part of wing (mirrored); 7 — venation. Hypothetical position of CuA base is marked with arrow in 6 and dashed line in 7.

Рис. 5–7. Mesopsychidae gen. et sp., Хунгтукун-2, экз. ПИН № 5382/81, переднее крыло: 5 — общий вид, СЭМ микрофотография (отображена зеркально); 6 — базальная часть крыла (отображена зеркально); 7 — жилкование. Предполагаемое положение основания CuA на рис. 6 показано стрелкой, на рис. 7 пунктирной линией.

LOCALITY AND HORIZON. Khungtukun-2, Nizhnyaya Tunguska River, Krasnoyarsk Prov., Middle Siberia; Upper Permian, upper Changhsingian; Khungtukun Horizon.

DESCRIPTION. Forewing oblong-ovate, with anal area somewhat compressed due to deformation of rock matrix. Wing length, 5.5 mm; maximal width, 1.8 mm. SC ending somewhat before basal margin of pterostigma. SC lacking any visible branches, but this may be result of poor preservation, particularly of slantwise fracture cutting the wing in its basal quarter. Crossvein sc–r at level of RS+MA branching. Subcostal space distinctly wider than costal one. Pterostigma rounded. R_1 clearly curved posteriad at pterostigma. RS forking somewhat earlier than MA. Thyridium well defined as unsclerotized section on MP stem spanning from more than half of its length down to fork. Thyridulum not traceable. Connection between MP and CuA obscure, base of CuA and cua–cup crossvein not visible. Crossvein pattern standard; cup–a_1 and a_1–a_2 located quite basally.

REMARKS. Based on its general venation scheme and certain distinctive characters, such as the unsclerotized MP stem, the species can be confidently referred to Mesopsychidae, but it cannot be attributed to any particular genus since the key diagnostic characters, including the position of CuA base (the dashed line in Fig. 7 shows its hypothetical position), are not visible due to poor preservation.

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References

Aristov D.S. 2011. New and little known Grylloblattida (Insecta) from intertrappean deposits of the Tunguska Basin of Sibiria // Paleontological Journal. Vol.45. No.5. P.537–545.

Bashkuev A.S. 2011a. Nedubroviidae, a new family of Mecoptera: the first Paleozoic long-proboscid scorpionfies // Zootaxa. No.2895. P.47–57.

Bashkuev A.S. 2011b. The earliest Mesopsychidae and revision of the family Mesopanorpodidae (Mecoptera) // Shcherbakov D.E., Engel M.S. & Sharkey M.J. (Eds.). Advances in the Systematics of Fossil and Modern Insects: Honouring Alexandr Rasnitsyn. ZooKeys. No.130. P.263–279.

Kozur H.W., Weems R.E. 2010. The biostratigraphic importance of conchostracans in the continental Triassic of the northern hemisphere // Lucas S.G. (Ed.). The Triassic Timescale. Geological Society, London, Special Publication. Vol.334. P.315–417.

Kozur H.W., Weems R.E. 2011. Detailed correlation and age of continental late Changhsingian and earliest Triassic beds: implications for the role of the Siberian Trap in the Permian–Triassic biotic crisis // Palaeogeography, Palaeoclimatology, Palaeoecology. No.308. P.22–40.

Lozovsky V.R., Krassilov V.A., Afonin S.A., Burov B.V., Jaroshenko O.P. 2001. Transitional Permian–Triassic deposits in European Russia, and non-marine correlations // Cassinis G. (Ed.). Permian continental deposits of Europe and other areas. Regional reports and correlations. Monografie Di ‘‘Natura Bresciana”. No.25. P.301–310.

Mogutcheva N.K., Krugovykh V.V. 2009. New data on the stratigraphic chart for Triassic deposits in the Tunguska syneclise and Kuznetsk basin // Stratigraphy and Geological Correlation. Vol.17. No.5. P.510–518.

Novokshonov V.G. 2002. Order Panorpida Latreille, 1802 // Rasnitsyn A.P. & Quicke D.L.J. (Eds). History of Insects. Kluwer Academic Press, Dordrecht. P.194–199.

Ponomarenko A.G. 2006. A new bettle species of the genus Taldycupes (Taldycupedidae, Coleoptera) from the Permian of the Tunguska River basin // Paleontological Journal. Vol.40. No.3. P.295–296.

Ponomarenko A.G., Shcherbakov D.E. 2004. New lacewings (Neuroptera) from the terminal Permian and basal Triassic of Siberia // Paleontological Journal. Vol.38. Suppl. 2. P.197–203.

Sadovnikov G.N. 2008. On the global stratotype section and point of the Triassic base // Stratigraphy and Geological Corelation. Vol.16. No.1. P.31–46.

Sadovnikov G.N. 2010. The “Dvurogino Horizon” in volcanogenic deposits of Middle Siberia. Izvestiya vysshyh uchebnyh zavedenii. Geologia i razvedka. No.1. P.3–7. [in Russian].

Sadovnikov G.N. & Orlova E.F. 1994. The Taimyrian Stage -– terminal stage of the continental Permian // Doklady Akademii Nauk. Vol.338. No.5. P.658–661. [in Russian].

Sadovnikov G.N. & Orlova E.F. 1995. New data on stratigraphy of the Permian–Triassic volcanogenic strata of the Central Part of the Tungussian syneclise // Stratigraphy and Geological Correlation. Vol.3. No.1. P.258–266.

Sharov A.G. 1968. Phylogeny of orthopteroid insects // Transactions of the Paleontological Institute, Academy of Sciences of USSR. Vol.118. P.1–216. [English translation: 1971. Jerusalem: Israel Program for Scientific Translations. 251 pp].

Shcherbakov D.E. 2000. Permian faunas of Homoptera (Hemiptera) in relation to phytogeography and the Permo-Triassic crisis // Paleontological Journal. Vol.34. Suppl. 3. P.251–267.

Sinitshenkova N.D. 2013. New mayflies (Insecta: Ephemerida= Ephemeroptera) from the intertrappean deposits of the Tunguska Basin, Siberia // Paleontological Journal. Vol.47. No.1. P.84–88.

Vrsansky P. 2010. A new genus and species of cockroach (Blattida: Phyloblattidae) from the Permian/Triassic boundary beds of Tunguska Basin in eastern Siberia, Russia // Zootaxa. No.2353. P.55–61.