

# New Taxa of Hypoperlids (Insecta: Hypoperlida) from the Upper Permian of the Arkhangelsk Region

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**Abstract**—Four new hypoperlid species of the genus *Tshekardobia*, *Tsh. magnifica* sp. nov., *Tsh. lurida* sp. nov., *Tsh. panorpitincta* sp. nov., and *Tsh. maculitincta* sp. nov. (suborder Hypoperlina), are described from the Soyana locality, Arkhangelsk Region, Kazanian Stage. Additionally, four hypoperlids of the suborder Strephocladina, *Strephoneura tenebrosa* sp. nov., *S. vasta* sp. nov., *S. pallida* sp. nov., and *Graticladus severus* gen. et sp. nov., are described from the same locality.

## INTRODUCTION

Currently, the order Hypoperlida includes three suborders, Hypoperlina, Strephocladina, and Protelytrina (Rasnitsyn, 2002).

The genus *Tshekardobia* (suborder Hypoperlina) was established for a relatively large insect resembling habitually neuropterans of the family Osmylidae (Rasnitsyn, 1977). It included a single species, *Tsh. osmylina* A. Rasn., 1977, from the Chekarda locality in the Perm Region (Lower Permian, Kungurian Stage). Originally, this genus was placed in the family Hypoperlidae (Rasnitsyn, 1977), but recently, it has been transferred to the family Ampelipteridae (Shcherbakov, 1994). The system of the suborder Hypoperlina is rather well developed (Shcherbakov, 1994). The collection of the Paleontological Institute of the Russian Academy of Sciences (PIN) contains new representatives of the genus *Tshekardobia* from the north of European Russia (Arkhangelsk Region, Mezen District, outcrops along the Soyana and Letopala rivers, the Soyana locality; Upper Permian, Kazanian Stage, Ivagorskies Beds). These new species are described below. Additionally, some new data on the wing structure in *Tsh. osmylina* (Chekarda locality, collected by V.G. Novokshonov in 1989–2000, collection of Perm State University (PGU)) are given.

The system of the suborder Strephocladina is rather poorly developed and needs revision; however, this is impossible now, since type material is housed in various museums in different states. Therefore, descriptions of new representatives of this suborder are nominal to some extent in the present paper. In descriptions, standard abbreviations for the wing veins are used.

<sup>†</sup>Deceased.

## SYSTEMATIC PALEONTOLOGY

Suborder Hypoperlina

Family Ampelipteridae Haupt, 1941

Genus *Tshekardobia* A. Rasnitsyn, 1977

*Tshekardobia magnifica* Novokshonov, sp. nov.

Plate 8, fig. 1

**E t y m o l o g y.** From the Latin *magnifica* (magnificent).

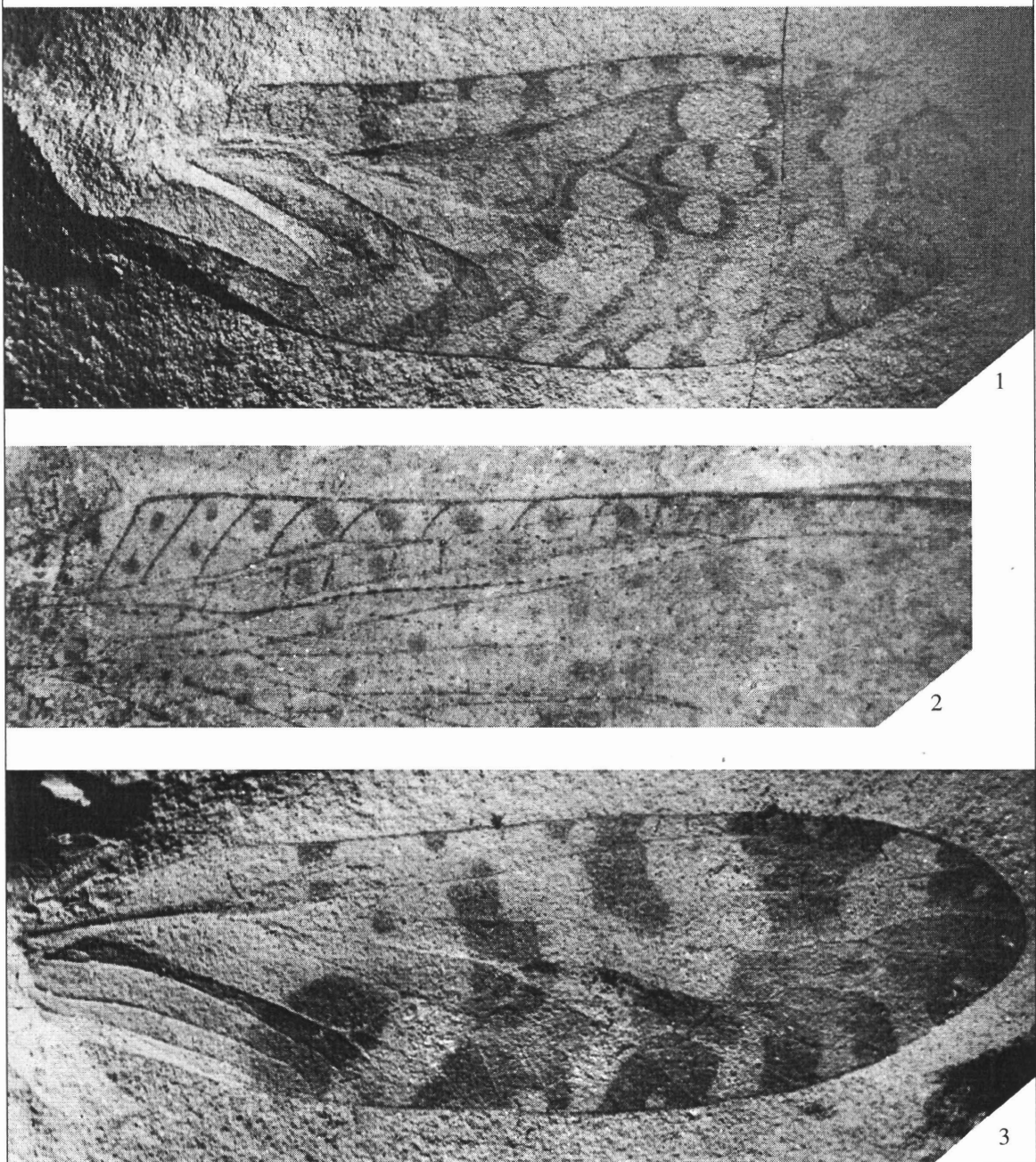
**H o l o t y p e.** PIN, no. 3353/48, part and counterpart of a well-preserved forewing; Soyana locality; Upper Permian, Kazanian Stage.

**Description** (Fig. 1a). The forewing is rather broad and possesses distinctly concave anterior and convex posterior margins. The triple fork of CuA connects to M by two transverse veins, whose insertions are demarcated by sharp breaks on the CuA ends. The color pattern on the forewing is specific and consists of rounded pale spots that fuse with each other and interrupted transverse bands, the boundaries between pale and darkened areas are accentuated with darker bordering. The anterior margin from its base to the end of the SC is intersected by several vertical, narrow, dark stripes. Up to a dozen small, rounded, dark spots are scattered over the basal half of the wing.

**M e a s u r e m e n t s,** mm: forewing length, 27.

**C o m p a r i s o n.** The new species differs from the type species in larger size (length of the forewing is 19 mm in the holotype) and in a different color pattern of the forewing.

**R e m a r k s.** We have no complete isolated wings of *Tsh. osmylina*, available specimens consist of either four wings and the body superimposing each other or wing fragments (Figs. 1c, 1d), which we have to assign to this species (there are no other options, although several closely related species of *Tshekardobia* might exist in Chekarda). Therefore, the full color pattern is unknown, and only the coloring of the costal area of the



## Explanation of Plate 8

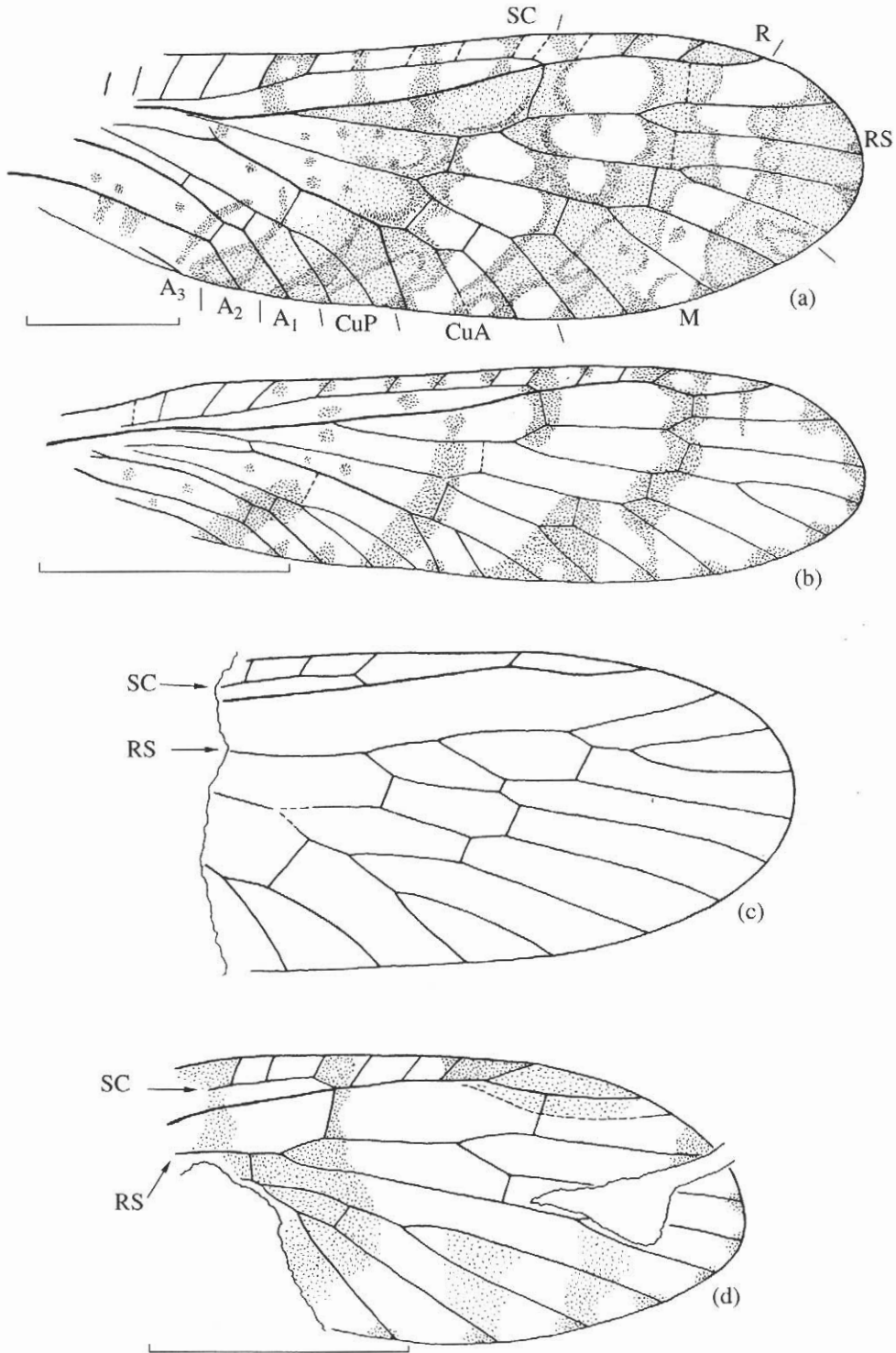
**Fig. 1.** *Tshekardobia magnifica* Novokshonov, sp. nov., holotype PIN, no. 3353/48, forewing; Soyana locality; Upper Permian,  $\times 5$ .

**Fig. 2.** *Tshekardobia osmylina* A. Rasn., 1977, specimen PGU, no. 2/130, anterior margin of the forewing, without apical part; Chakarda locality, Lower Permian,  $\times 7$ .

**Fig. 3.** *Tshekardobia panorpitincta* Novokshonov, sp. nov., paratype PIN, no. 3353/30, forewing; Soyana locality; Upper Permian,  $\times 8$ .

forewing, which is not hidden by other fragments, may be used for comparison. In the species from Chakarda, there are distinct, rounded, dark spots between the veins of the costal area (Pl. 8, fig. 2); the spots are smaller and paired in the basal part and larger and single in the distal part; this feature was originally noted for *Tsh. osmylina* by Rasnitsyn (1977).

The study of *Tsh. osmylina* impressions from the collections of PGU and PIN revealed that the original description of this species was inexact (Rasnitsyn, 1977, p. 68, text-fig. 3); i.e., SC was shown as a short vein terminating short of reaching even the midlength of the wing. The same error was repeated in later reconstructions of this insect (Rasnitsyn, 1980a, p. 26, text-



**Fig. 1.** Forewings of hypoperlids of the genus *Tsherkardobia*: (a) *Tsh. magnifica* sp. nov., holotype PIN, no. 3353/48; (b) *Tsh. lurida* sp. nov., holotype PIN, no. 3353/51; and (c, d) forewing apices of the *Tsh. osmylina* A. Rasn., 1977: (c) specimen PGU, no. 1/95 and (d) specimen PGU, no. 2/450. Scale bar, 5 mm.

fig. 16; 1980b, p. 42, text-fig. 12). In actual fact, this vein is of the same length as in *Tsh. magnifica* sp. nov. and other species described below.

**Material.** In addition to the holotype, paratype PIN, no 3353/22, part and counterpart of an incomplete forewing from the same locality.

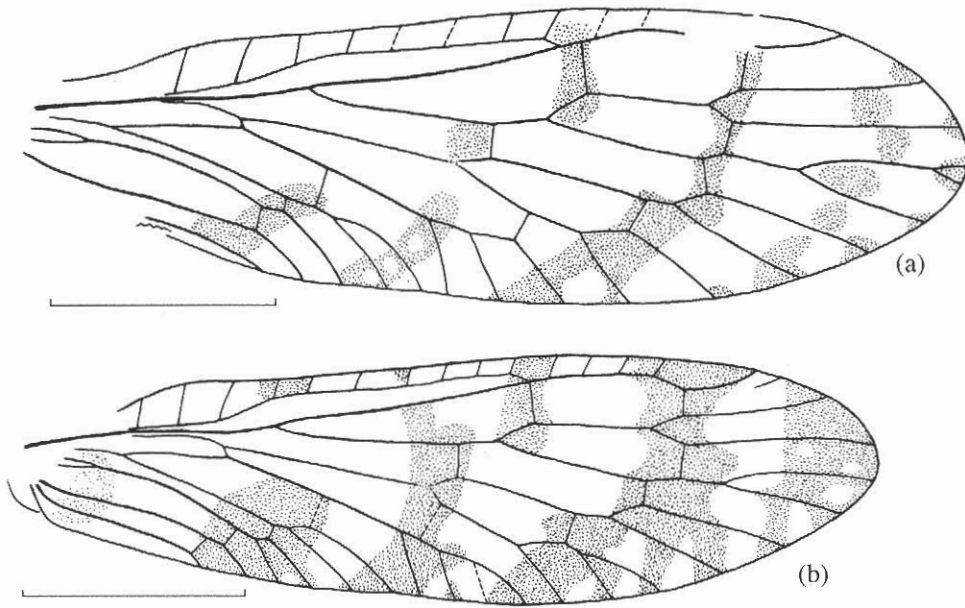


Fig. 2. Forewings of hypoperlids of the genus *Tshekardobia*: (a) *Tsh. maculitincta* sp. nov., holotype PIN, no. 117/2285; and (b) *Tsh. panorpitincta* sp. nov., holotype PIN, no. 3353/35. Scale bar, 5 mm.

*Tshekardobia lurida* Novokshonov, sp. nov.

**E t y m o l o g y.** From the Latin *lurida* (pale).

**H o l o t y p e.** PIN, no. 3353/51, part and counterpart of a well-preserved forewing; Soyana locality; Upper Permian, Kazanian Stage.

**D e s c r i p t i o n** (Fig. 1b). The forewing is relatively narrow and its anterior and posterior margins are almost parallel; the concavity of the anterior margin is virtually absent. The venation is typical for the genus (there is a sporadic terminal fork on one of the RS branches in the holotype). The color pattern of the forewing consists of isolated spots fusing in more or less complete, narrow, obliquely vertical bands. Most of the membrane is pale. The costal area is devoid of distinct coloration.

**M e a s u r e m e n t s,** mm: forewing length, 18–21.

**C o m p a r i s o n.** The new species is distinguished from other species primarily by the shape of the forewing and a different coloration; thus, it differs from *Tsh. osmylina*, in a different pattern on the costal area, and from *Tsh. magnifica* sp. nov. in its small size, different pattern, narrow forewings, and in the paler wing membrane.

**M a t e r i a l.** In addition to the holotype, paratype PIN, no. 117/2416, forewing from the outcrop on the Letopala River.

*Tshekardobia maculitincta* Novokshonov, sp. nov.

**E t y m o l o g y.** From the Latin *macula* (spot) and *tincta* (colored).

**H o l o t y p e.** PIN, no. 117/2285, counterpart of a well-preserved forewing; Soyana locality, outcrop on the Letopala River; Upper Permian, Kazanian Stage.

**D e s c r i p t i o n** (Fig. 2a). The forewing is narrow, its anterior and posterior margins are subparallel. The venation is typical of the genus. The pattern on the forewing consists of numerous scattered small spots and larger spots, which fuse into more or less full, broad, obliquely vertical bands. Pigmented fields on the membrane occupy a smaller area than nonpigmented fields.

**M e a s u r e m e n t s,** mm: forewing length, 15.5.

**C o m p a r i s o n.** This species differs from the previously described species in a different color pattern and in a smaller size.

**R e m a r k s.** This wing was earlier figured and identified as *Hypoperla elegans* Mart. (Rasnitsyn, 1980, p. 26, text-fig. 12); however, this error has already been pointed out (Novokshonov, 2001).

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

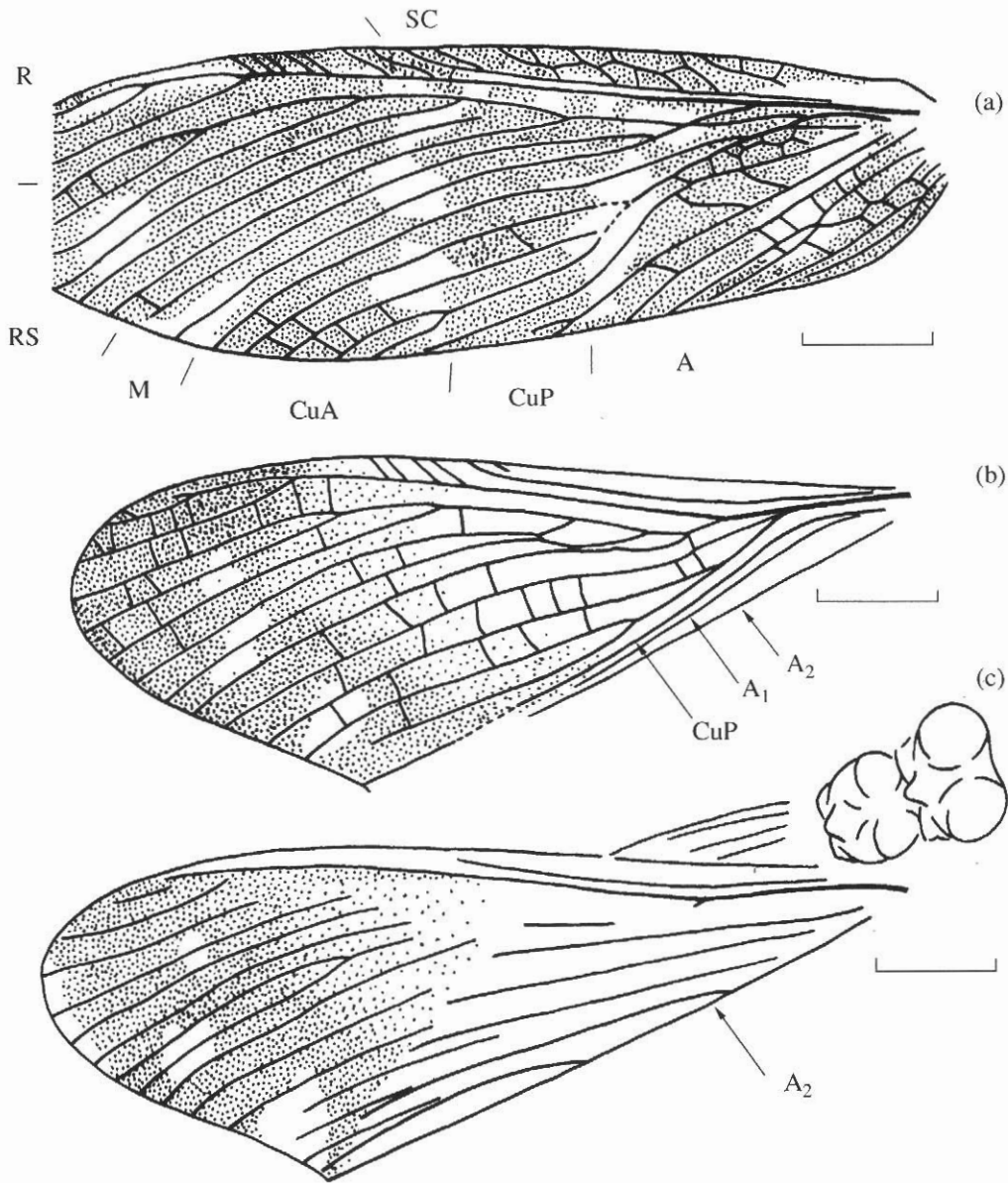
*Tshekardobia panorpitincta* Novokshonov, sp. nov.

Plate 8, fig. 3

**E t y m o l o g y.** From the generic name *Panorpa* and the Latin *tincta* (dyed).

**H o l o t y p e.** PIN, no. 3353/35, part and counterpart of a well-preserved forewing; Soyana locality; Upper Permian, Kazanian Stage.

**D e s c r i p t i o n** (Fig. 2b). The forewing is comparatively narrow, its apex is slightly acuminate. The venation is typical of the genus: in the holotype, additional forks are present on M and A<sub>1</sub>; in the paratype (no. 3353/30), the fork on the anterior branch of RS is



**Fig. 3.** *Strephoneura tenebrosa* sp. nov.: (a) holotype PIN, no. 2455/339, forewing; and (b, c) specimen PIN, no. 2455/340, hind wings with pterothorax fragments. Scale bar, 5 mm.

lost (Pl. 8, fig. 3). The color pattern of the forewing strongly resembles that of some species of the scorpion-flies *Panorpa* and consists of isolated spots fusing into more or less complete, broad, obliquely vertical bands. Pigmented and pale regions of the membrane occupy approximately equal areas. The costal area has isolated small spots.

**Measurements**, mm: forewing length, 18–19.

**Comparison.** This species is distinguished from the above species primarily by a different color pattern of its forewings.

**Material.** In addition to the holotype, paratype PIN, no 3353/30, forewing, and, possibly, specimen

no. 3353/50 (forewing length, 15 mm). All come from the type locality.

Suborder Strephocladina

**Family Permarhaphidae Martynov, 1930**

**Genus *Strephoneura* Martynov, 1940**

*Strephoneura tenebrosa* Novokshonov et Aristov, sp. nov.

**Etymology.** From the Latin *tenebrosa* (dark).

**Holotype.** PIN, no. 2455/339, part and counterpart of a well-preserved forewing; Soyana locality; Upper Permian, Kazanian Stage.

**Description** (Fig. 3a). The forewing is elongated, the membrane is heavily pigmented, with only small pale areas. The SC branches are strongly inclined in the first half of the wing, there are transverse veins between them; subsequently, the SC branches become less inclined and more densely spaced toward the wing apex. R branches near the apex and terminates in three ends on the wing margin. The RS branches are not numerous, only six ends are observed. M is in point contact with RS near the wing base; then, it nearly immediately branches and terminates in two ends on the wing margin. CuA first branches relatively proximally, so that the CuA<sub>1</sub> base is much longer than the M<sub>5</sub> base. CuA has five main ends (a small additional fork is on the penultimate branch), its posterior branch is simple, smoothly S-shaped, and distinctly convex, whereas the anterior branches are neutral. There are rare simple transverse veins between CuA and CuP, the anal veins are not connected to each other by a dense net of transverse veins.

**Measurements**, mm: forewing length, 32–34.

**Comparison.** The new species differs from the type species in the anterior branches of SC, which do not form a double row of cells; the presence of anastomosis between RS and MA; two-branched mediana; S-shaped CuA<sub>2</sub>; and in the absence of dense venation in the claval area.

**Remarks.** This and other new species are assigned to the genus *Strephoneura* due to the branching R, which is not recorded in other strephocladines (Rasnitsyn, 1977, 1980; Carpenter, 1992; Novokshonov, 1998). There are two hind wings with folded anal regions and a fragment of the pterothorax (specimen PIN, no. 2455/340) which were found nearby (at a distance of 4 cm from the type specimen) on the same surface of the host rock; however, judging from their size and general resemblance with the hind wings of *S. robusta*, they might belong to the same individual of *S. tenebrosa* sp. nov. (Figs. 3b, 3c). One of these hind wings demonstrates unusual folding of the anal region for scarabaeone insects. Commonly, the anal region of scarabaeones bends along the fold located behind A<sub>2</sub>, whereas in the new species, this fold extends between A<sub>1</sub> and A<sub>2</sub>, which is characteristic of gryllones.

**Material.** Holotype.

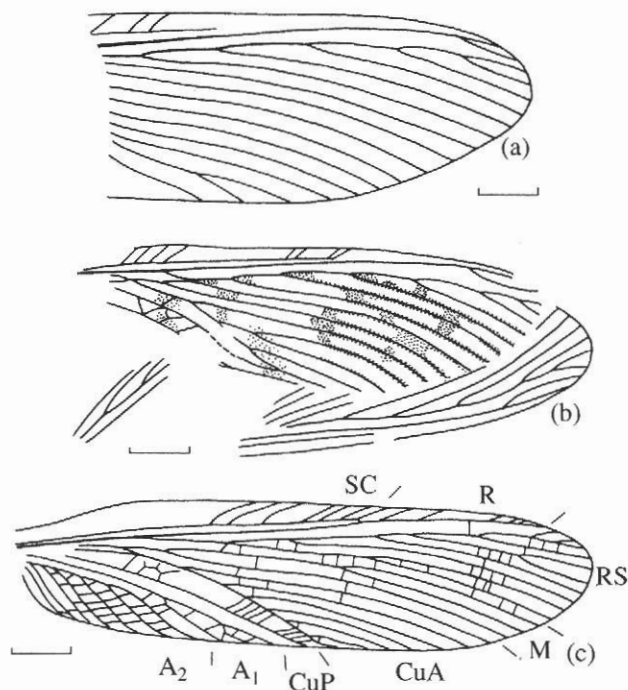
*Strephoneura vasta* Novokshonov et Aristov, sp. nov.

**Etymology.** From the Latin *vasta* (huge).

**Holotype.** PIN, no. 117/90, satisfactorily preserved impression of the distal half of a forewing; Soyana locality; Upper Permian, Kazanian Stage.

**Description** (Fig. 4a). Large insect. R terminates in two ends. The color pattern is not preserved.

**Measurements**, mm: length of the forewing fragment, 36.



**Fig. 4.** Forewings and their fragments of hypoperlids of the suborder Strephocladina: (a) *Strephoneura vasta* sp. nov., holotype PIN, no. 117/90; (b) *S. pallida* sp. nov., holotype PIN, no. 117/376; and (c) *Graticladus severus* gen. et sp. nov., holotype PIN, no. 3353/367. Scale bar, 5 mm.

**Comparison.** The new species differs from the type species primarily in much greater size (presumably, the forewing is 70 mm long).

**Material.** Holotype.

*Strephoneura pallida* Novokshonov et Aristov, sp. nov.

**Etymology.** From the Latin *pallida* (pale).

**Holotype.** PIN, no. 117/376, part of an incomplete right forewing and counterpart of a fragment of the left hind wing, which are partly superimpose on each other; Soyana locality; Upper Permian, Kazanian Stage.

**Description** (Fig. 4b). R terminates in two ends. RS terminates in seven ends. M is in point contact with RS and terminates in two ends at the wing margin. The color pattern is faint, there are isolated dark spots, the rest of the membrane is pale. The hind wing is pale; R has two ends.

**Measurements**, mm: forewing length, ca. 40.

**Comparison.** The new species differs from *S. vasta* sp. nov., in a smaller size; it differs from *S. tenebrosa* sp. nov., in the simple and straight anterior branches of SC and in the tip of CuA<sub>2</sub> that is fused with CuA<sub>1</sub>. In addition, it differs from *S. tenebrosa* sp. nov. and the type species in that the RS is fused with the mediana before the ramification of the latter.

**Material.** Holotype.

**Genus *Graticladus* Novokshonov et Aristov, gen. nov.**

**Etymology.** From the Latin *gratia* (graceful) and the generic name *Tococladus*.

**Type species.** *G. severus* sp. nov.

**Diagnosis.** Forewing narrow, with slightly acuminate apex. M lacking contact with RS, but connected to RS by short obliquely transverse vein. Costal area broadened at its base; then, rapidly narrowing. R not branching. RS with six main stems, some of them with additional forks. M with three ends. CuA strictly pectinate, with seven ends; its posterior branch distinctly convex, other branches neutral. CuP simple. Doubled row of cells located between origins of CuA and CuP and followed distally by series of densely spaced simple transverse veins. A<sub>1</sub> having three ends. A<sub>2+3</sub> forming clear comb of seven veins, which connected to each other by series of densely spaced simple transverse veins.

**Comparison.** The new genus clearly differs from all genera of the suborder Strephocladina in the strictly pectinate structure of A<sub>2+3</sub>.

**Specific composition.** Type species.

***Graticladus severus* Novokshonov et Aristov, sp. nov.**

**Etymology.** From the Latin *severus* (strict).

**Holotype.** PIN, no. 3353/367, part and counterpart of a well-preserved forewing; Soyana locality; Upper Permian, Kazanian Stage.

**Description.** The wing membrane is entirely pale.

**Measurements, mm:** forewing length, 48; maximum width, 11.5.

**Material.** Holotype.

## ACKNOWLEDGMENTS

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