

Another new species of Iotacyphinae (Lophioneuridae, Thysanoptera s.l.) from mid-Cretaceous Burmese amber

Еще один новый вид Iotacyphinae (Lophioneuridae, Thysanoptera s.l.) из средне мелового бирманского янтаря

D.E. Shcherbakov*, A.S. Shmakov
Д.Е. Щербаков*, А.С. Шмаков

Borissiak Palaeontological Institute, Russian Academy of Sciences, Profsoyuznaya Str. 123, Moscow 117647 Russia.

Палеонтологический институт им. А.А. Борисяка РАН, Профсоюзная 123, Москва 117647 Россия.

Dmitry Shcherbakov dshh@narod.ru ORCID 0000-0003-4508-9259

Alexey Shmakov shmakov@paleo.ru ORCID 0000-0002-9033-384X

* Corresponding author

KEY WORDS: thrips, Paraneoptera, miniaturization, palynophagy.

КЛЮЧЕВЫЕ СЛОВА: трипсы, Паранеоптера, миниатюризация, палинофагия.

ABSTRACT. A fourth species of minute lophioneurids with elytrized forewings of the subfamily Iotacyphinae, *Iotacypha vishniakovae* **sp.n.**, is described from mid-Cretaceous Burmese amber.

РЕЗЮМЕ. Четвертый вид миниатюрных лопхионеурид с элитризованными передними крыльями из подсемейства Iotacyphinae, *Iotacypha vishniakovae* **sp.n.**, описан из средне мелового бирманского янтаря.

Lophioneurids, originally described in Homoptera, were later assigned to Psocoptera [Tillyard, 1935]. Sharov [1972] demonstrated that lophioneurids are ancestral to the thrips. Zherikhin [1980] and Vishniakova [1981] included Lophioneuridae in Thysanoptera s.l. as a primitive suborder Lophioneurina. Zherikhin [2000] described a peculiar lophioneurid with elytrized forewings, and Shcherbakov *et al.* [2024] discovered a related genus, also from Burmese amber, and erected a separate subfamily for these two genera, the smallest known lophioneurids. A third genus was added to this subfamily by Cumming *et al.* [2024]. Lophioneurids were among the smallest insects since the Early Permian. The Thysanoptera s.l. is considered an ancient group of gymnosperm pollen feeders [Zherikhin, 2002; Wang *et al.*, 2009]. Palynophagy is also hypothesized for iotacyphines, whose beetle-like habit implies that they may have dwell inside male strobiles [Shcherbakov *et al.*, 2024].

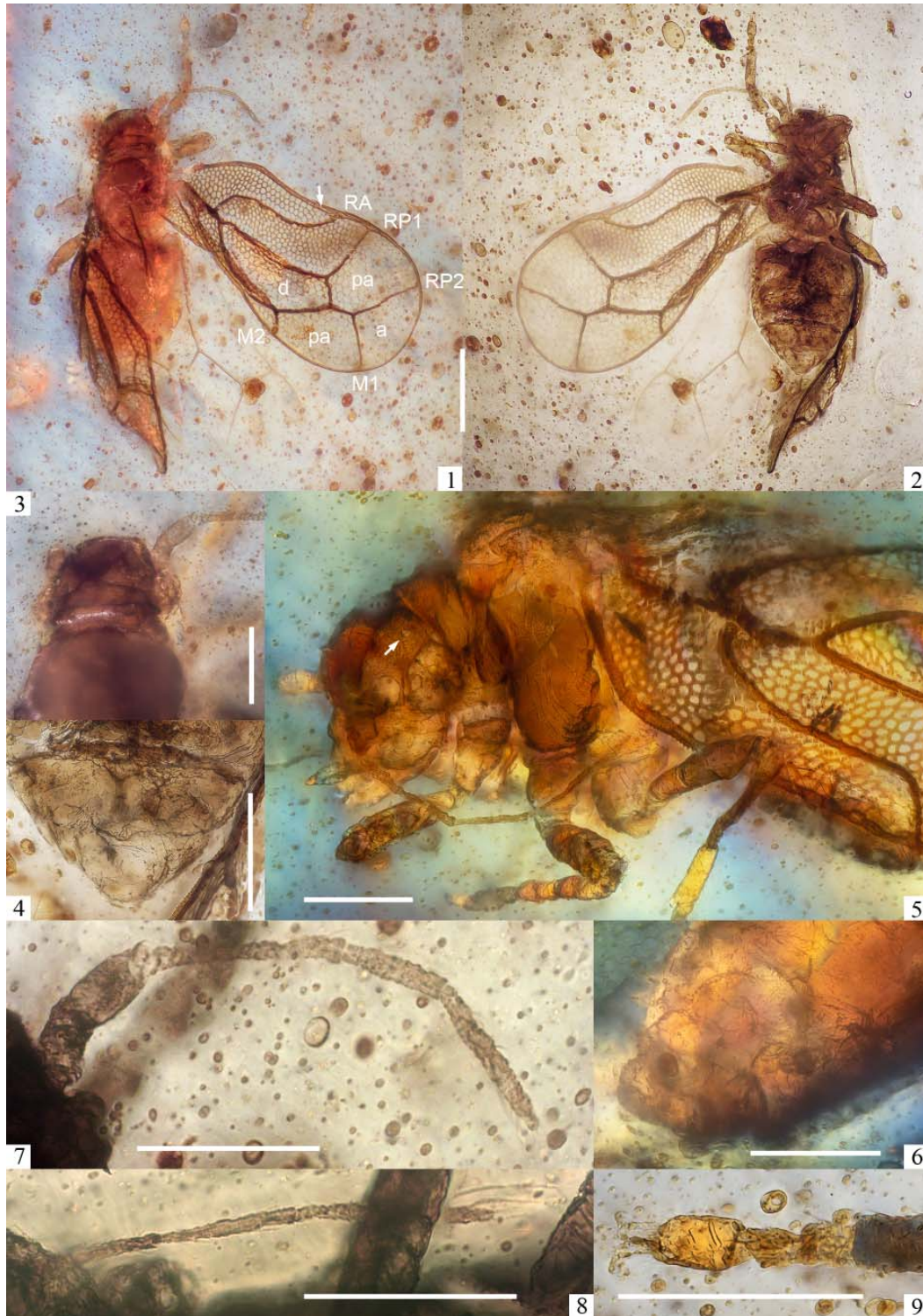
The type specimen is deposited at Borissiak Paleontological Institute, Russian Academy of Sciences, Moscow (PIN). The vein homology is after Shcherbakov *et al.* [2024]. Imaging was done using a Nikon E-800 compound microscope equipped

with Olympus OM-D E-M10-II digital camera. Stacks of images, comprising multiple focal planes, were treated for color, digital noise and sharpness with Adobe Lightroom. Focus stacking was performed with Helicon Focus 7.6.2. Some photographs were taken using a Leica M165C stereomicroscope with a Leica DFC425 digital camera and a Zeiss Axioplan 2 microscope with a Zeiss Axiocam 105 digital camera. We are grateful to Dmitry Vorontsov (Koltzov Institute of Developmental Biology RAS) for superb images, Alexey Bashkuev for drawing our attention to the fossil, and Eugeny Karasev and Roman Rakitov (all PIN) for their help with photography.

Order Thysanoptera Haliday, 1836, s.l.
Suborder Lophioneurina Zherikhin, 1980
Family Lophioneuridae Tillyard, 1921
Subfamily Iotacyphinae Shcherbakov,
Bashkuev et Shmakov, 2024

COMPOSITION. *Iotacypha* Shcherbakov, Bashkuev et Shmakov, 2024; *Burmacypha* Zherikhin, 2000; *Retiptera* Cumming, Engel, Lian et Ulitzka, 2024; all from mid-Cretaceous Burmese amber.

REMARKS. Tillyard [1935] assigned Lophioneuridae Tillyard, 1921 (= Cyphoneuridae Carpenter, 1932) along with Zoropsocidae to Psocoptera. Becker-Migdisova [1961] united these two families. Vishniakova [1981] retained Lophioneurinae and Zoropsocinae as subfamilies of Lophioneuridae, but our data confirm that there is no reason to keep this distinction even at the subfamily level [Shcherbakov *et al.*, 2024]. The three currently known iotacyphine genera have the same very distinctive habitus, but differ strikingly in their forewing venation.



Figs 1–9. *Iotacypha vishniakovae* Shcherbakov et Shmakov, **sp.n.**, female holotype PIN 5608/174 (photographs by Dmitry Vorontsov, except 7–8; 5–6 in polarized light): 1 — habitus, dorsal (a — apical cell; d — discal cell; pa — preapical cell; arrow — precostal carina); 2 — habitus, ventral; 3 — head and thorax, dorsal; 4 — apex of abdomen, ventral; 5 — anterior part of body, left lateral (arrow, left ocellus); 6 — distal part of abdomen, right lateral; 7 — right antenna, dorsal; 8 — left antenna, ventral; 9 — right fore tarsus, ventral. Scale bars: 1–2 — 0.2 mm; 3–9 — 0.1 mm.

Рис. 1–9. *Iotacypha vishniakovae* Shcherbakov et Shmakov, **sp.n.**, голотип ПИН 5608/174, самка (фото Дмитрия Воронцова, кроме 7–8; 5–6 в поляризованном свете): 1 — общий вид сверху (a — апикальная, d — дискальная, pa — преапикальные ячейки; стрелка — прекостальный киль); 2 — общий вид снизу; 3 — голова и грудь сверху; 4 — вершина брюшка снизу; 5 — передняя часть тела слева (стрелка — левый глазок); 6 — дистальная часть брюшка справа; 7 — правый усик сверху; 8 — левый усик снизу; 9 — правая передняя лапка снизу. Длина масштабных линеек: 1–2 — 0,2 мм; 3–9 — 0,1 мм.

Genus *Iotacypha* Shcherbakov, Bashkuev et Shmakov, 2024

TYPE SPECIES. *Iotacypha zherikhini* Shcherbakov, Bashkuev et Shmakov, 2024

REVISED DIAGNOSIS. Minute subbrachypterous lophioneurids. Forewings weakly elongated, strongly sclerotized, deeply convex; veins carinate, beset with strong curved setae; membrane finely areolate; Sc absent; RA long sigmoidal, leaving short R+M stem before separation of M (short RP+M stem developed); arculus (basal *m-cu* crossvein) between R+M and CuA; veins at wing apex Y-shaped (apical cell petiolate); discal cell bordered by 4 cells; clavus short and broad. Hind wing about half as wide as forewing, with long R+M+CuA stem, R and M separating distally; R, M and CuA subtransverse; anal area areolate. Antennae 7-segmented, at most 1/2 as long as forewing, scape and pedicel stout, flagellum moderately slender, with simple seta-like sense cones. Ocelli far apart, lateral ocelli close to eyes, median ocellus near clypeus. Pronotum short, saddle-shaped. Hind coxae enlarged. Tibiae with rows of setae. Tarsi 2-segmented; two slender curved claws. Genitalia very small.

COMPOSITION. Type species and *Iotacypha vishniakovae* **sp.n.**

REMARKS. Similar to *Burmacypha* Zherikhin, 2000 and *Retiptera* Cumming, Engel, Lian et Ulitzka, 2024 in convex areolate forewings and very simple hindwing venation, but in these two genera the veins at the forewing apex are H-shaped (the apical cell is not petiolate), the discal cell is bordered by 7 cells, and the antennae are at least 2/3 forewing length with a filiform flagellum. Additionally, *Retiptera* differs from *Iotacypha* in the forewing discal cell constricted about midlength and the hind wing 1/6 as wide as the forewing, and *Burmacypha* differs from *Iotacypha* in the forewing RA short transverse (rather than long sigmoidal) and the clavus much reduced.

Iotacypha vishniakovae Shcherbakov et Shmakov, **sp.n.**
Figs 1–9.

MATERIAL. Holotype PIN 5608/174, female — Burmese amber, Hukawng Valley, Kachin State, Myanmar; mid-Cretaceous (Albian–Cenomanian).

DESCRIPTION. Very small, robust lophioneurids; female body length 0.65 mm (as preserved). Subbrachypterous. Forewings 0.7 mm long, rather broad (1.9:1), widest beyond 2/3 wing length, broadly rounded apically, steeply tectiform in repose (their apical margins held vertically and meeting along midline), deeply convex, strongly sclerotized (especially proximally); wing base pale; membrane translucent, covered with stub-like microtrichia and fine dark hexagonal areolation, areoles increase and somewhat fade towards apex; veins dark, raised, beset with strong curved setae (including distal C). Costal margin sinuate about midlength (at least in anterior view); costal vein submarginal, with well-developed areolate precostal carina reaching RP2. Sc absent. RA strongly sigmoidal, almost as long as wing width, distant from C distally, leaving short R+M stem about its midlength (short RP+M stem developed). Arculus (basal *m-cu* crossvein) between R+M and CuA closing broad basal cell. RP and M both forked before 2/3 wing length, RP1 and M2 transverse, oblique RP2 and M1 fused

for a short distance, forming petiole of apical cell enclosing wing apex. RP1 apex not far from RA; discal cell longer than each of two preapical cells; apical and anterior preapical cells transverse, posterior preapical cell elongated. Clavus short and broad, with two anal veins. Hind wings narrow, broadly rounded at apex; veins dark; R+M+CuA stem dividing distal to 1/2 wing length, R and M separating distal to 1/3 wing length; R, M and CuA subtransverse; claval furrow distinct; clavus with areolation near base.

Antennae 7-segmented, about 1/2 as long as forewing; scape and pedicel stout; flagellum moderately slender; first and last flagellomeres shortest, terminal flagellomere with two very long curved sense cones (much surpassing its apex) and three unequal apical setae. Eyes protruding, rounded; ommatidia few in number, loosely arranged. Cranium rounded; lateral ocelli near eyes; median ocellus near base of clypeus. Mouth cone wide, directed ventrally and slightly anteriorly; maxillary palps moderately long, stout, probably 3-segmented, 2nd segment long and massive, 3rd segment minute; labial palps short, unsegmented. Pronotum transverse, saddle-shaped; mesoscutum subtriangular. Legs rather short, hind tibia no longer than 1/4 forewing length. Hind coxae largest. Tibiae with rows of setae. Tarsi 2-segmented, basitarsus about 1/2 distitarsus length; right fore tarsus deformed or malformed, longer than any other tarsus and appearing 3-segmented; two slender curved claws with sub-basal tooth. Female abdomen as long as head + thorax, widest and more sclerotized proximally. Last two sternites with small rounded median projection on posterior margin. Ovipositor rudimentary, concealed by last sternite.

ETYMOLOGY. After paleoentomologist Valentina N. Vishniakova for her great contribution to our knowledge of lophioneurids.

KEY TO *IOTACYPHA* SPECIES

1. Slender. Forewings more elongate (2.1–2.3:1), widest about midlength, narrowly rounded apically, shallowly tectiform in repose, their apices widely separated. Costal margin unevenly arched; costal vein marginal, without precostal carina. Body slenderer, female abdomen longer than head + thorax, widest and more sclerotized distally
.....*Iotacypha zherikhini* Shcherbakov *et al.*, 2024
- Robust. Forewings rather broad (1.9:1), widest beyond 2/3 wing length, broadly rounded apically, steeply tectiform in repose, their apical margins held vertically and meeting along midline. Costal margin sinuate about midlength (at least in anterior view); costal vein submarginal, with well-developed areolate precostal carina. Body stouter, female abdomen as long as head + thorax, widest and more sclerotized proximally*Iotacypha vishniakovae* **sp.n.**

Competing interests. The authors declare no competing interests.

References

- Becker-Midgisova E.E. 1961. [Superorder Psocopteroidea] // Paleozoiskie nasekomye Kuznetskogo basseina. Trudy Paleontologicheskogo Instituta AN SSSR. Vol.85. P.271–286 [in Russian].

- Cumming R.T., Engel M.S., Lian Z., Ullitzka M.R. 2024. Small, intricate, and beautiful; a new species of lophioneurid from the Cretaceous (Insecta: Thripida: †Lophioneurida) // *Faunitaxys*. Vol.12. No.58. P.1–10.
- Sharov A.G. 1972. The phylogenetic relations of the order Thysanoptera // *Entomological Review*. Vol.51. P.506–508.
- Shcherbakov D.E., Bashkuev A.S., Shmakov A.S. 2024. A new genus of Lophioneuridae (Thysanoptera s.l.) with elytrized forewings from mid-Cretaceous Burmese amber // *Russian Entomol. J.* Vol.33. No.3. P.272–275.
- Tillyard R.J. 1935. Upper Permian insects of New South Wales. III. The order Copeognatha // *Proceedings of the Linnean Society of New South Wales*. Vol.60. P.265–279.
- Vishniakova V.N. 1981. [New Paleozoic and Mesozoic lophioneurids (Thripida, Lophioneuridae)] // *Trudy Paleontologicheskogo Instituta AN SSSR*. Vol.183. P.43–63 [in Russian].
- Wang J., Labandeira C.C., Zhang G., Bek J., Pfefferkorn H.W. 2009. Permian *Circulipuncturites discinisporis* Labandeira, Wang, Zhang, Bek et Pfefferkorn gen. et spec. nov. (formerly *Discinispora*) from China, an ichnotaxon of a punch-and-sucking insect on Noeggerathialean spores // *Review of Palaeobotany and Palynology*. Vol.156. P.277–282.
- Zherikhin V.V. 1980 [Order Thripida] // *Istoricheskoe razvitie klassa nasekomykh*. *Trudy Paleontologicheskogo Instituta AN SSSR*. Vol.175. P.69–72 [in Russian].
- Zherikhin V.V. 2000. A new genus and species of Lophioneuridae from Burmese amber (Thripida (=Thysanoptera): Lophioneurina) // *Bulletin of the Natural History Museum, London, Geology*. Vol.56. P.39–41.
- Zherikhin V.V. 2002. Order Thripida Fallen, 1914 (=Thysanoptera Haliday, 1836). The thrips // A.P. Rasnitsyn, D.L.J. Quicke (eds.). *History of Insects*. Dordrecht: Kluwer. P.133–143.