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Redescription of the only known Korean specimen of *Turbidapsyche dobrokhotovae* (Novokshonov, 1997) from the Amisan Formation

CORENTIN JOUAULT^{1, *}, XIN-NENG LIAN^{2, 3, 4} & GI-SOO NAM⁵

¹*Oxford University Museum of Natural History, University of Oxford, Parks Road, Oxford OX1 3PW, UK*

²*Institute of Palaeontology, Yunnan Key Laboratory of Earth System Science, Yunnan Key Laboratory for Palaeobiology, MEC International Joint Laboratory for Palaeobiology and Palaeoenvironment, Yunnan University, Kunming 650500, China*

³*Southwest United Graduate School, Kunming 650092, China*

⁴*State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China*

⁵*Gongju National University of Education, Gongju, Chungcheongnam-do 32553, Republic of Korea*
jouaultc0@gmail.com; <https://orcid.org/0000-0002-3680-5172>

2690766936@qq.com; <https://orcid.org/0000-0001-6680-1781>

nks33@naver.com; <https://orcid.org/0000-0003-0570-8270>

**Corresponding author*

The mecopteran family Mesopsychidae is characterized primarily by an elongated siphonate proboscis, which likely enabled its members to feed on and pollinate Mesozoic gymnosperms (*e.g.*, Labandeira *et al.*, 2007; Ren *et al.*, 2009). However, many species and fossil specimens from this family are known only from isolated wings, making it difficult to generalize their paleoecology (Lian *et al.*, 2024).

Compared to some other extinct mecopteran families (*e.g.*, Sinoagetopanorpidae or Englathaumatidae), Mesopsychidae is relatively diverse, with over 30 described species. The earliest representatives are found in Permian strata of Australia and Russia, while the most recent fossils are from Cretaceous deposits in China, Mongolia, and Russia (*e.g.*, Riek, 1953; Bashkuev, 2011; Novokshonov & Sukacheva, 2001).

The reasons for their decline and eventual extinction remain unclear, but their disappearance coincides with the Angiosperm Terrestrial Revolution, during which gymnosperms were progressively replaced by angiosperms (Benton *et al.*, 2022). Given their likely close ecological association with gymnosperms, the decline of these plants—presumably their primary food source—may have been a key driver of their extinction.

The systematics of the family Mesopsychidae and the delimitation of its genera remain poorly understood. Although recent studies have aimed to clarify these issues, many taxa were described decades ago, and their original material has never been reassessed (*e.g.*, Bashkuev, 2011; Lian *et al.*, 2024). A recent revision concerns the genus *Mesopsyche* Tillyard, 1917, which was restricted to only one species: *Mesopsyche triareolata* Tillyard, 1917 (Lian *et al.*, 2024). *Mesopsyche* species were recombined within the genus *Turbidapsyche* Lian & Huang, 2024, along with newly described species, and the species *Mesopsyche dobrokhotovae* Tillyard, 1917 was designated the type species of the genus (Lian *et al.*, 2024). Interestingly, the species *Turbidapsyche dobrokhotovae*

(Novokshonov, 1997) has been recorded from two geographically distant Triassic localities: the Protopivka Formation in Ukraine and the Amisan Formation in the Republic of Korea (Novokshonov, 1997; Nam & Kim, 2014). While the specimens from both localities share similar wing venation patterns, the interpretation of the venation in the Korean specimen exhibits minor discrepancies compared to its original description. Leveraging a newly available photograph, we propose a revised interpretation of the wing venation pattern, aligning it more closely with that of the type specimen.

Material and methods. A single wing was reported by Nam & Kim (2014) from the middle shale unit of the Amisan Formation exposed in the Boryeong region, South Chungcheong Province, Myeongam region. The Amisan Formation is considered to be of Late Triassic age (see detailed discussions in Park *et al.*, 2022; Jouault *et al.*, 2023). The sample was photographed using a Canon EOS 6D camera with an attached Canon EF 100 mm f/2.8 USM macro lens. Images were cropped and enhanced using Adobe Illustrator and Adobe Photoshop CC2019. The specimen is housed in the Gongju National University of Education (Gongju, Chungcheongnam-do, Republic of Korea) under collection number GNUE112007. Wing venation nomenclature follows (Lian *et al.*, 2024).

<http://zoobank.org/urn:lsid:zoobank.org:pub:54871CC7-54B0-4E46-9E2B-5575F05D99D4>

Order Mecoptera Packard, 1886

Superfamily Mesopsuchoidea Tillyard, 1917

Family Mesopsychidae Tillyard, 1917

Genus *Turbidapsyche* Lian & Huang, 2024 (in Lian *et al.*, 2024)

Type species. *Turbidapsyche dobrokhotovae* (Novokshonov, 1997)

Other species. *Turbidapsyche gentica* (Novokshonov & Sukatsheva, 2001), *T. hongii* Lian & Huang, 2024 (in Lian *et al.*, 2024), *T. incompleta* (Bashkuev, 2011), *T. jinsuoguanensis* (Lian, Cai & Huang, 2021), *T. justa* (Novokshonov & Sukatsheva, 2001), *T. liaoi* (Lian, Cai & Huang, 2021), *T. ordinata* (Novokshonov & Sukatsheva, 2001), *T. orientalis* Lian & Huang, 2024 (in Lian *et al.*, 2024), *T. shcherbakovi* (Novokshonov, 1997), *T. sparsanota* Lian & Huang, 2024 (in Lian *et al.*, 2024), *T. tongchuanensis* (Hong, 2007), and *T. tortiva* (Novokshonov & Sukatsheva, 2001).

Turbidapsyche dobrokhotovae (Novokshonov, 1997)

(Fig. 1)

Material. Specimen GNUE112007 (KNU-2009023), housed in the Gongju National University of Education (Gongju, Chungcheongnam-do, Republic of Korea).

Locality and horizon. Amisan Formation, possibly Upper Triassic, Seongju-myeon, Boryeong City, Chungcheongnam-do, Republic of Korea (128°37'33.40"E, 36°20'20.24"N).

Description. Forewing about 24.2 mm long (as preserved) and about 9.4 mm wide, with distinct coloration pattern; three incomplete, non-colored stripes crossing membrane antero-posteriorly at M+CuA fork, Rs fork, and Rs₁₊₂ and Rs₃₊₄ fork; additional non-colored areas between M₂ and M₃, and Rs₂ and Rs₃; costal space relatively broad, maximal width about 0.95 mm, broader than subcostal space; Sc with three anterior veinlets, terminating anteriorly at Rs₁₊₂ fork, Sc₁ long (about 7.45 mm), Sc₂ and Sc₃ short, Sc₂ oblique, Sc₃ transverse; humeral veinlet present; distance between end of Sc₁ and origin point of Sc₂ (L1), about 3.72× distance between origin points of Sc₂ and Sc₃

(L2, about 2 mm), distance from origin of Sc₃ to humeral vein (L3, about 4.4 mm) about 0.59× L1; R₁ slightly sigmoidal after r-rs crossvein; r-rs distinctly sigmoidal; pterostigma if present not discernible; Rs with four branches, Rs fork about 5.3 mm distad R+Rs fork, Rs₁₊₂ fork slightly distad Rs₃₊₄ fork, distance between Rs₁₊₂ fork and first Rs fork about 6.2 mm, distance between Rs₃₊₄ fork and first Rs fork about 5.7 mm, one crossvein present between Rs₂ and Rs₃; one nygma on each side of first rs-m crossvein, second rs-m crossvein distad Rs₃₊₄ fork; M with four branches, M₁ strongly arched basally, originating about 5.2 mm distad M fork, M₁₊₂ stem 2.76× as long as M₃₊₄ stem (about 1.9 mm long), M₁₊₂ fork slightly anterior to Rs₃₊₄ fork and distinctly distad M₃₊₄ fork, one crossvein between M₂ and M₃ located distad M₁₊₂ fork; m-cua located immediately distad M₃₊₄ fork; CuA nearly straight, slightly angled at level of m-cua; one cua-cup crossveins located distad M+CuA fork; CuP almost entirely straight, except apical part arched; claval fold distinct; three sub-straight anal veins present; one crossvein present basally between A₁ and A₂; anal fold faint.

Remark. The apex of the wing in specimen GNUE112007 is deformed, resulting in a wing shape that differs from that of the type specimen.

Discussion. Our description clarifies and refines the wing venation patterns of the only known Korean specimen of *Turbidapsyche dobrokhotovae*. Specifically, we correct and specify the number of subcostal veinlets, the position, shape, and number of crossveins, and the branching patterns of Rs, M, CuA, CuP, and the anal veins. We agree with Nam & Kim (2014) that cracks and deformation in the shale matrix complicate the interpretation of the wing venation pattern. Our study provides an updated reconstruction of the wing venation of the Korean *T. dobrokhotovae*, which may serve as a valuable reference for future research on the evolution of wing venation patterns in Mesopsychidae or, more broadly, in Mecoptera.

Acknowledgements

We thank Dr. Agnieszka Soszyńska and an anonymous reviewer for their constructive comments and suggestions, and Dr. Dmitry S. Kopylov for managing our article during the editorial process.

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Figure caption:

FIGURE 1. *Turbidapsyche dobrokhotovae* (Novokshonov, 1997), specimen GNUE112007. **A**, Photograph captured under vertical reflected light. **B**, Interpretative line drawing of wing venation with names of veins labelled (coloration pattern omitted). Scale bars = 2 mm.