



<https://doi.org/10.11646/palaeoentomology.3.4.7>

<http://zoobank.org/urn:lsid:zoobank.org:pub:27C2E87B-9CAD-406D-BA12-75BAC508C7EB>

## *Sinomorphoptila incompleta* gen. et sp. nov., a new dysmorphoptilid from the Middle Permian of China (Hemiptera, Cicadomorpha, Prosbolomorpha)

YANZHE FU<sup>1,2</sup> & DIYING HUANG<sup>2,\*</sup>

<sup>1</sup>University of Chinese Academy of Science, Beijing 100049, China

<sup>2</sup>State Key Laboratory of Palaeobiology and Stratigraphy, Center for Excellence in Life and Palaeoenvironment, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China

✉ [yzfu@nigpas.ac.cn](mailto:yzfu@nigpas.ac.cn); <https://orcid.org/0000-0002-7819-1703>

✉ [dyhuang@nigpas.ac.cn](mailto:dyhuang@nigpas.ac.cn); <https://orcid.org/0000-0002-5637-4867>

\*Corresponding author

With 18 genera and 29 species described, the extinct family Dymorphoptilidae Handlirsch, 1906 is one of the most diverse members of the early cicadomorphan insects, widespread from the Middle Permian to the Upper Jurassic of Europe, Siberia, Central Asia, South China, South Africa, South America, and Australia (Shcherbakov, 1984, 2000; Martins-Neto *et al.*, 2003; Lambkin, 2015, 2016; Lara & Wang, 2016; Szwedo & Huang, 2019).

The classification of this morphologically diversified family is still controversial, and its phylogeny needs to be further substantiated (Lambkin, 2015; Szwedo & Huang, 2020). Shcherbakov (1984), Nicholson *et al.* (2015), and Szwedo & Huang (2019) considered the poorly known extinct family Eoscarterellidae Evans, 1956 (containing Permian *Belmontocarta*, Evans, 1958 and *Dysmorphoscartella* Riek, 1973, and Triassic *Mesonirvana* Evans, 1956 and *Eoscarterella* Evans, 1956) as a junior synonym of Dymorphoptilidae, but other authors restored it as separate family belonging to Dymorphoptiloidea (*incl.*, Carpenter, 1992; Hamilton, 1992; Szwedo *et al.*, 2004; Jell, 2004; Lara & Wang, 2016; Szwedo, 2018). Lambkin (2016) suggested that the dysmorphoptilids from the Triassic of Queensland can be separated in two subgroups (*i.e.*, eoscarterellid and dysmorphoptilid). Szwedo & Huang (2019) summarized the confused classification history of the Dymorphoptilidae, established a new subfamily, and proposed to divide the Dymorphoptilidae into five subfamilies: Dymorphoptilinae Handlirsch, 1906, Eoscarterellinae Evans, 1956, Fulgoringruinae Pinto, 1990, Gallegomorphoptilinae Martins-Neto & Gallego, 2006, and Permocixiellinae Szwedo & Huang, 2019.

The Middle Permian Yinping Formation is a localized stratum distributed only at Anhui Province, South China, which has yielded abundant fossil insects, primarily Coleoptera, Hemiptera, and Orthoptera, (Huang *et al.*, 2007; Lin *et al.*, 2010; Ponomarenko *et al.*, 2014). Until recently, only six genera and six species have been described

from the Yinping Formation: *Dikerocoleus divisus* Lin, 1982 (Coleoptera), *Sinojurina permiana* Huang, Nel, Lin & Dong, 2007 (Glosselytrodea), *Sinoagetopanorpa permiana* Lin, Nel & Huang, 2010 (Mecoptera), *Linicupes yinpinensis* Ponomarenko, Yan & Huang, 2014 (Coleoptera), *Linglunxiellus chaohuensis* Szwedo & Huang, 2019 (Hemiptera), and *Legendreia magnifica* Huang, Schubnel & Nel, 2020 (Orthoptera) (Lin, 1982; Huang *et al.*, 2007; Lin *et al.*, 2010; Ponomarenko *et al.*, 2014; Szwedo & Huang, 2019; Huang *et al.*, 2020). Here we erect another taxon, *Sinomorphoptila incompleta* gen. et sp. nov., from the same locality of the Yinping Formation in Chaohu City, Anhui Province, China.

### Material and methods

The studied specimen (NIGP173214), preserved in black shale, was collected from the lower section of the Yinping Formation, at Yinping Mountain near the Houdong Village, Sanbing Township, Chaohu City, Anhui Province, China (The location of fossil site see Szwedo & Huang, 2019: figure 2). The geological age of the fossil layer close to the latest Middle Permian (Yao *et al.*, 2015).

The specimen was carefully prepared using a sharp knife under a stereo microscope. Photograph was taken with a digital camera attached to a Zeiss Discovery V16 microscope; the raw digital image was processed with Helicon Focus 7.0.2 to increase the depth of field; line drawing was drafted with Adobe Illustrator CC 2018 graphic software. The material studied here is deposited in the Nanjing Institute of Geology and Palaeontology (NIGPAS), Chinese Academy of Sciences (CAS), Nanjing, China.

Wing venation terminology and cell nomenclature follow Nel *et al.* (2012) and Bourgoin *et al.* (2015). All measurements are presented in millimeters.

## Systematic palaeontology

### Order Hemiptera Linnaeus, 1758

### Suborder Cicadomorpha Evans, 1946

### Infraorder Prosbolomorpha Popov, 1980

### Superfamily Dymorphoptiloidea Handlirsch, 1906

### Family Dymorphoptilidae Handlirsch, 1906

### Subfamily Dymorphoptilinae Handlirsch, 1906

### Genus *Sinomorphoptila* Fu & Huang, gen. nov.

**Type species.** *Sinomorphoptila incompleta* gen. et sp. nov.; by present designation.

**Etymology.** Generic name is derived from a combination of *Sina*, Latin for China, and from *~morphoptila*, alluding to *Dymorphoptila*, the type genus of the family. Gender feminine.

**Diagnosis.** Tegmen length over 13 mm, punctate only on basal-median portion (corium) and around veins; precostal carina and marginal membrane distinct; strigil not detected in basal costal space; apical lobe well-developed, with acute protuberance, strongly truncate apically, emarginate at apex of RA<sub>2b</sub>; stems ScP+R, MP and CuA leaving basal cell at same point; stem ScP+R without prenodal veinlets; ScP+RA about 1.3 times as long as ScP+R; primary branch of RA<sub>1</sub> dichotomous; stems MP and CuA deeply forked, stem MP forked slightly apicad of CuA forking, with at least three terminal branches; crossvein *imp* present, making cell C3 closed.

### *Sinomorphoptila incompleta* sp. nov.

(Fig. 1)

**Material.** Holotype, NIGP173214, a forewing without counterpart. Tegmen with clavus and mainly apical area missing.

**Etymology.** The species name is from the Latin *incompletus*, meaning incomplete.

**Type locality and horizon.** Near the Houdong Village, Sanbing Township, Chaohu City, Anhui Province, China; Middle Permian Yinping Formation (Capitanian).

**Diagnosis.** As for genus (vide supra).

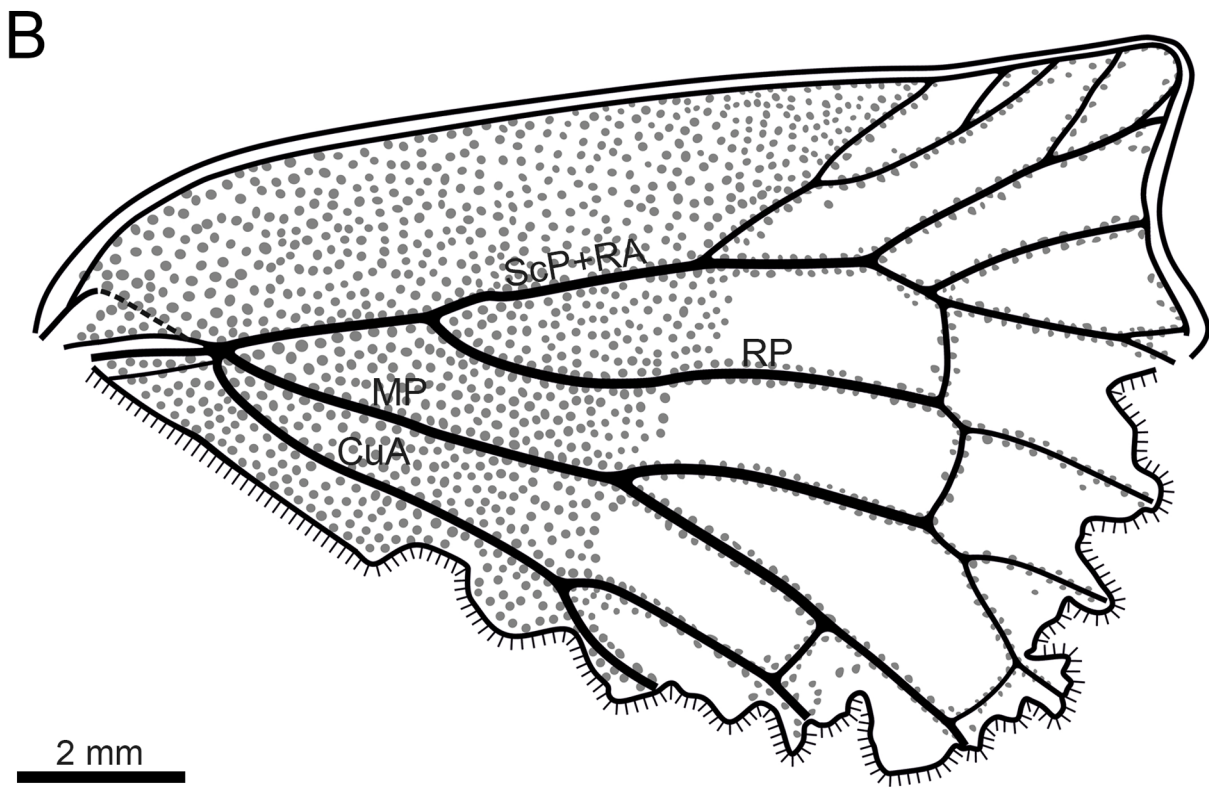
**Description.** Tegmen preserved length 13.4 mm, with macrosculpture punctate on basal-median portion (corium) and around veins (longitudinal and transverse veins), surface without contrasting colour pattern and protuberances; costal margin curved at base then almost straight, deflected acutely distally, forming tapered projection; apical lobe long and strongly truncate; apical margin, clavus, posterior margin and tornus not preserved; CP relatively short, apical portion directed to ScP weakened; basal portion of ScP appressed to lower margin of costal cell; basal cell short, tapering apicad; stems ScP+R, MP and CuA leaving basal cell at same point; stem ScP+R straight, without prenodal veinlets,

forking into RA and RP apparently antieriad of stems MP and CuA branchings; ScP+RA forked slightly apicad of stem MP forking; 9 postnodal terminals of RA in total, primary branch of RA<sub>1</sub> dichotomous, RA<sub>2</sub> area subtriangular, with 6 terminals; RP sinuous, not forked before apex, connected to MP<sub>1+2</sub> by crossvein *rp-mp*; stem MP almost straight, nearly as long as stem CuA and twice as long as ScP+R, forked basad of the midpoint of tegmen length; MP<sub>1+2</sub> with 2 terminals, MP<sub>3+4</sub> connected to CuA<sub>1</sub> by crossvein *mp-cua*; stem CuA curved at base, forking into CuA<sub>1</sub> and CuA<sub>2</sub> slightly basad of MP forking. Single row of four crossveins (*ir*, *rp-mp*, *im* and *mp-cua*) perpendicular to longitudinal veins; *rp-mp* slightly apicad of *ir* and *mp-cua*.

## Discussion

There are rare records of Permian cicadomorphan insects in China. Recently, a single specimen from the Middle Permian Yinping Formation (Chaohu City, Anhui Province, South China) was described as *Linglunxiellus chaohuensis* Szweo & Huang, 2019 and attributed to the family Dymorphoptilidae. This fossil increased the documented palaeodiversity of the Permian dymorphoptilids to five genera, three of which are known from the Southern hemisphere: *Belmontocarta* Evans, 1958 (Eoscarterellinae) from Australia, *Dymorphoscarterella* Riek, 1973 (Eoscarterellinae) from South Africa, and *Fulgoringruo* Pinto, 1990 (Fulgoringruinae) from Brazil; while two others from the Northern hemisphere are attributed to the recently established subfamily Permocixiellinae, having several plesiomorphic characters, and is supposed to be the most 'basal' group within Dymorphoptilidae: *Permocixiella* Becker-Migdisova, 1961 from Russia, and *Linglunxiellus* Szweo & Huang, 2019 from China (Evans, 1958; Becker-Migdisova, 1961; Riek, 1973; Pinto, 1990; Shcherbakov, 2000; Szweo & Huang, 2019).

Even if its incomplete tegmen is lacking a largely apical area and clavus, the combined characters of the costal area, truncated apical lobe and preserved anterior apical margin indicate that the tegmen shape of *Sinomorphoptila incompleta* gen. et sp. nov. was probably similar to that of *Bandelnielsenia* Martins-Neto & Gallego, 2003 from the Upper Triassic of Argentina. *Sinomorphoptila* gen. nov. exhibits specialized characters supporting an attribution to the subfamily Dymorphoptilinae, viz., the punctate, oddly shaped tegmen with apical lobes developed, veins RA and RP not fused distally, RP simple, crossvein *ir* present (Szweo & Huang, 2019). However, it differs from all known members of Dymorphoptilinae as follows: 1) tegmen punctate only in basal-median portion and around veins (generally finely punctate in other representatives); 2) stems ScP+R, MP and CuA leaving basal cell at same point (not at same



**FIGURE 1.** Holotype (NIGP173214) of *Sinomorphoptila incompleta* gen. et sp. nov., from the Yinping Formation in Chaohu City, Anhui Province, China. **A**, photograph of forewing. **B**, line drawing of forewing. (Scale bars = 2 mm).

point, in others); 3) stem ScP+R without prenodal veinlets (prenodal veinlets present except in *Dysmorphoptiloides* Evans, 1956); 4) stems MP deeply forked, bifurcation not

exceeding midpoint of tegmen length (MP forked near apex in others); 5) crossvein *imp* making cell C3 closed (*imp* absent in others). The new taxon represents the oldest record

of the subfamily Dymorphoptilinae, and the first record of this subfamily from China, confirming that the Permian Dymorphoptilidae were more diversified than previously supposed and began to show ecological diversification. It also provides some novel information on the morphological diversity of shapes, venations and ornamentation patterns of the tegmina of this ancient family.

## Acknowledgments

We thank two anonymous reviewers for their valuable comments. This work was supported by the Strategic Priority Research Program of the Chinese Academy of Sciences (XDB26000000 and XDB18000000), and the National Natural Science Foundation of China (41925008 and 41688103).

## References

- Becker-Migdisova, E.E. (1961) Rhynchota. In: Rohdendorf, B.B., Becker-Migdisova, E.E., Martynova, O.M. & Sharov, A.G. (Eds), *Paleozoic insects of the Kuznetsk Basin. Trudy Paleontologicheskogo Instituta, Akademia Nauk SSSR*, 85, 286–392 [In Russian].
- Bourgoin, T., Wang, R., Asche, M., Hoch, H., Soulier-Perkins, A., Stroinski, A., Yap, S. & Szewo, J. (2015) From micropterism to hyperpterism: recognition strategy and standardized homology-driven terminology of the forewing venation patterns in planthoppers (Hemiptera: Fulgoromorpha). *Zoomorphology*, 134, 63–77.  
https://doi.org/10.1007/s00435-014-0243-6
- Evans, J.W. (1956) Paleozoic and Mesozoic Hemiptera (Insecta). *Australian Journal of Zoology*, 4, 165–268.  
https://doi.org/10.1071/ZO9560165
- Evans, J.W. (1958) New Upper Permian Homoptera from the Belmont Beds. *Records of the Australian Museum*, 24, 109–114.  
https://doi.org/10.3853/j.0067-1975.24.1958.647
- Handlirsch, B.A. (1906–1908) *Die fossilen Insekten und die Phylogenie der rezenten Formen. Ein Handbuch für Paläontologen und Zoologen*. Engelmann, Leipzig, 1430 pp.  
https://doi.org/10.5962/bhl.title.34145
- Hong, Y.C. & Chen, R. (1981) Magnaciacidae, a new family of Homoptera from the Middle Triassic of Tongchuan, Shaanxi Province. *Chinese Science Bulletin*, 26, 338–340.
- Huang, D.Y., Nel, A., Lin, Q.B. & Dong, F.B. (2007) The first Glosselytrodea (Insecta) from the latest Middle Permian of Anhui Province, China. *Bulletin de la Société Entomologique de France*, 112, 179–182.
- Huang, D.Y., Schubnel, T. & Nel, A. (2020) A new middle Permian orthopteran family questions the position of the order Titanoptera (Archaeorthoptera: Orthoptera). *Journal of Systematic Palaeontology*, 18, 1217–1222.  
https://doi.org/10.1080/14772019.2020.1733112
- Lambkin, K.J. (2015) Revision of the Dymorphoptilidae with emarginate tegmina (Hemiptera: Auchenorrhyncha: Cicadomorpha: Prosboloidea) of the Queensland Triassic. *Zootaxa*, 3936 (3), 357–374.  
https://doi.org/10.11646/zootaxa.3936.3.3
- Lambkin, K.J. (2016) Revision of the Dymorphoptilidae (Hemiptera: Cicadomorpha: Prosboloidea) of the Queensland Triassic—Part 2. *Zootaxa*, 4092 (2), 207–218.  
https://doi.org/10.11646/zootaxa.4092.2.4
- Lara, M.B. & Wang, B. (2016) New hemipteran insects (Eoscarterellidae, Scytinopteridae and Protosyllidiidae) from the Upper Triassic Potrerillos Formation of Mendoza, Argentina. *Paläontologische Zeitschrift*, 90, 49–61.  
https://doi.org/10.1007/s12542-016-0286-8
- Lin, Q.B., Nel, A. & Huang, D.Y. (2010) The first agetopanorpine mecopteroid insect from Middle Permian of China (Insecta: Mecoptera: Permochoristidae). *Annales de la Société Entomologique de France*, 46, 62–66.  
https://doi.org/10.1080/00379271.2010.10697639
- Linnaeus, C. (1758) *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. L. Salvii, Holmiae [= Stockholm], 824 pp.  
https://doi.org/10.5962/bhl.title.542
- Martins-Neto, R.G. & Gallego, O.F. (2006) Review of Dymorphoptilidae Handlirsch (Hemiptera: Cicadomorpha) from the Argentinean Triassic, with description of a new subfamily, and a new species. *Polish Journal of Entomology*, 75, 185–197.
- Martins-Neto, R.G., Gallego, O.F. & Melchor, R.N. (2003) The Triassic insect fauna from South America (Brazil, Argentina and Chile): a checklist (except Blattoptera and Coleoptera) and descriptions of new taxa. *Acta Zoologica Cracoviensia*, 46, 229–256.
- Nel, A., Prokop, J., Nel, P., Grandcolas, P., Huang, D.Y., Roques, P., Guilbert, E., Dostál, O. & Szewo, J. (2012) Traits and evolution of wing venation pattern in paraneopteran insects. *Journal of Morphology*, 273, 480–506.  
https://doi.org/10.1002/jmor.11036
- Pinto, I.D. (1990) Permian Insects from Paraná Basin, South Brazil. VI Homoptera – 3. Fulgoringruidae. *Pesquisas*, 17, 3–6.  
https://doi.org/10.22456/1807-9806.21373
- Popov, Y.A. (1980) Nadotryad Cimicidea Laicharting, 1781. Otryad Cimicina Laicharting, 1781. Poluzhestorylye, ili khobotnye [Superorder Cimicidea Laicharting, 1781. Order Cimicina Laicharting, 1781. Hemipterans, or rhynchotans]. In: Rohdendorf, B.B. & Rasnitsyn, A.P. (Eds), *Istoricheskoe razvitye klassa nasekomykh [Historical development of the class Insecta]*. Trudy Paleontologicheskogo Instituta Akademii Nauk SSSR, 175, 58–69.

- Riek, E.F. (1973) Fossil insects from the Upper Permian of Natal, South Africa. *Annals of the Natal Museum*, 21, 513–532.
- Shcherbakov, D.E. (1984) A system and the phylogeny of Permian Cicadomorpha (Cimicida, Cicadina). *Paleontological Zhurnal*, 2, 89–101.
- Shcherbakov, D.E. (2000) Permian faunas of Homoptera (Hemiptera) in relation to phytogeography and the Permo-Triassic crisis. *Paleontologicheskii Zhurnal*, 34, 251–267.
- Szwedo, J. (2018) The unity, diversity and conformity of bugs (Hemiptera) through time. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, 107, 109–128.  
<https://doi.org/10.1017/S175569101700038X>
- Szwedo, J. & Huang, D.Y. (2019) First Dysmorphoptilidae from the Permian of China (Hemiptera: Cicadomorpha: Prosbolomorpha), with notes on the fossil record of the family. *Palaeoentomology*, 2 (2), 148–170.  
<https://doi.org/10.11646/palaeoentomology.2.2.6>
- Yao, X., Zhou, Y.Q. & Hinnov, L.A. (2015) Astronomical forcing of a Middle Permian chert sequence in Chaohu, South China. *Earth and Planetary Science Letters*, 422, 206–211.  
<https://doi.org/10.1016/j.epsl.2015.04.017>